PROJECT DESCRIPTION: *VCS Version 3*

Project Title	**April Salumei REDD Project**
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Prepared By	Environmental Accounting Services (EAS) for Rainforest Project Management Limited
Contact	Mr Stephen Hooper, CEO Rainforest Project Management PO Box 3319, Boroko, NCD, Papua New Guinea Phone: +61 (0) 488 088 321 Email: shooper@p-f-a.org

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LIST OF ACRONYMS

Acronym	Definition
AFOLU	Agriculture, Forestry and Other Land Use
Baseline	The net GHG emissions or sequestration which would occur in the absence of the project.
BCEF	Biomass Conversion Expansion Factor
CAP	Corrective Action Plan
CCB	Climate, Community and Biodiversity (Standard)
CITIES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP	Conference of the Parties
DEC	Department of Environment and Conservation
DBH	Diameter at Breast Height
EAS	Environmental Accounting Services
EIA	Environmental Impact Assessment
EIR	Environmental Impact Register
EMP	Environmental Management Plan
Ex-ante	Calculations and predictions made prior the project implementation
Ex-post	Events that occur after the project has been implemented
FCP	World Bank's Forest and Conservation Project
FIMS	Forest Information Management System
FMA	Forest Management Area
FMP	Forest Management Plan
Ha	Hectare
GIS	Geographical Information Systems
GHG	Greenhouse gas
HRH	Hunstein Range Holdings Limited
ICS	Information communication systems
IFM – LtPF	Improved Forest Management – Logged to Protected Forest
ILGs	Incorporated Land Groups
IPA	Investment Promotion Authority
ITTO	International Tropical Timber Organisation
Km	Kilometres
LC	Land Class
LMAs	Leakage Management Areas
LU	Land Use
M	Million
Masl	metres above sea level
NEC	National Executive Council
NGO	Non-Governmental Organisation
PFA	Pacific Forest Alliance

PNG	Papua New Guinea
PNGFA	Papua New Guinea Forest Authority
PNGRIS	Papua New Guinea Resource Information System
PSP	Permanent Sample Plots
QA	Quality Assurance
QC	Quality Control
REDD	Reduced Emissions from Deforestation and Forest Degradation
REDD-AUD	Reduced Emissions from Deforestation and Forest Degradation – Avoided Unplanned Deforestation
RPM	Rainforest Project Management
SOP	Standard Operating Procedure
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
WMA	Wildlife Management Area

LIST OF ACCOMPANYING DOCUMENTS

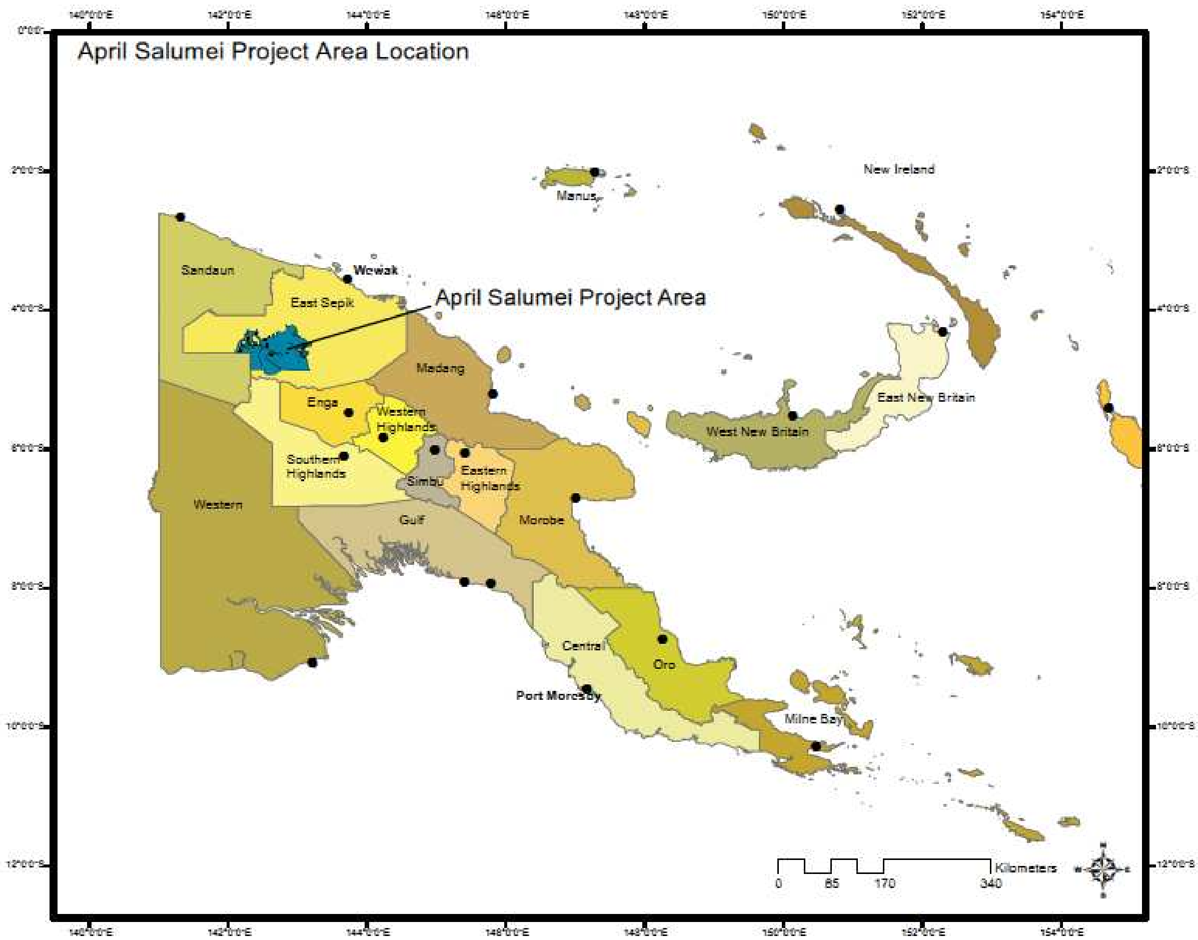
Document Type	Document Name
Spatial files – Project boundaries	April Salumei_Project Boundaries_Final (ArcGIS and KML compatible versions)
Legal	Annex 1_Official Agreement between Rainforest Project Management,Landowner companies and ILG's
Information	Annex 2_PFA Project Information Booklet
Legal	Annex 3_Decision number NG 106/2012
Legal/Technical	Annex 4_Forest Management and Development Plan_RoadTimbers
Technical	Annex 5_Historical Analysis of Deforestation
Legal	Annex 6_Development Options Study
Technical	Annex 7_Module T-Bar
Technical	Annex 8_Participatory Rural Appraisal Report
Technical	Annex 9_Carbon Stock Report
Technical	Annex 10_ April River Timber Harvest Plan
Company Procedures	Annex 12_Standard Operating Procedures
Technical	Annex 13_Peat Mapping Report
Information	Annex 14_Road Timber Forest Management & Development Proposal
Legal	Annex 15_National Gazette
Legal	Annex 16_Court Papers
Information	Annex 17_Provincial Agricultural Development Plan

1 PROJECT DETAILS

1.1 Summary description of the Project

The April Salumei REDD Project ('the Project') is a pilot project located in the Wosera Gawi and Ambunti Drekiker Districts in East Sepik Province of Papua New Guinea. The Sepik River area has been identified as one of the least developed areas within Papua New Guinea (WWF, undated). The area is rich in traditional culture and possesses extraordinary levels of biodiversity. The Project is located approximately 122 kilometres (km) from the provincial town of Wewak within north-western Papua New Guinea. The location of the Project Area is shown in Figure 1.

Figure 1: Location of the Project in relation to Papua New Guinea



Source: EAS for Rainforest Project Management, 2012.

Forests play a vital role in sustaining the traditional subsistence livelihoods of most of the local population. However, levels of income, healthcare and education are all very low. The forest and land in the Project

Area is under customary ownership, which is formalised via Incorporated Land Groups (ILGs), which are recognized under Papua New Guinea's Lands Group Incorporation Act (1974).[1]

Figure 2: Men from the Niksek village dressed in traditional tribal attire

Source: EAS for Rainforest Project Management, 2012

The Project Area is defined by the area of forested land on mineral soils within the boundaries of two Forestry Management Agreements (FMA) namely; April Salumei (530,868 ha) and April River (75,313 ha) with a combined area of 606,181 hectares (ha)[2]. An FMA is a legal agreement between the landowners and the Government (issued via the Papua New Guinea Forest Authority). Under the terms of the FMA, the landowners have authorised the issuance of a 50-year timber concession license, allowing harvesting of timber in the FMA. This normally involves the approval of a timber harvest plan for the first rotation

[1] In Papua New Guinea, land ownership is based on traditional and customary (i.e. tribal groups and clan) ownership of the land. (including the forest resource and biodiversity). Legal recognition of the corporate status of certain customary and similar groups is formalised by the Land Groups Incorporation Act 1974. Under this Act, landowners are entitled to form ILGs which have legal control and management responsibility for their land. This right is enshrined in Papua New Guinea's Constitution

[2] The variation in total area between the FMA boundaries and the Project area boundaries have resulted due to the discovery of peat soils in the FMA. Areas of peat were mapped and excluded in accordance with the selected VCS methodologies.

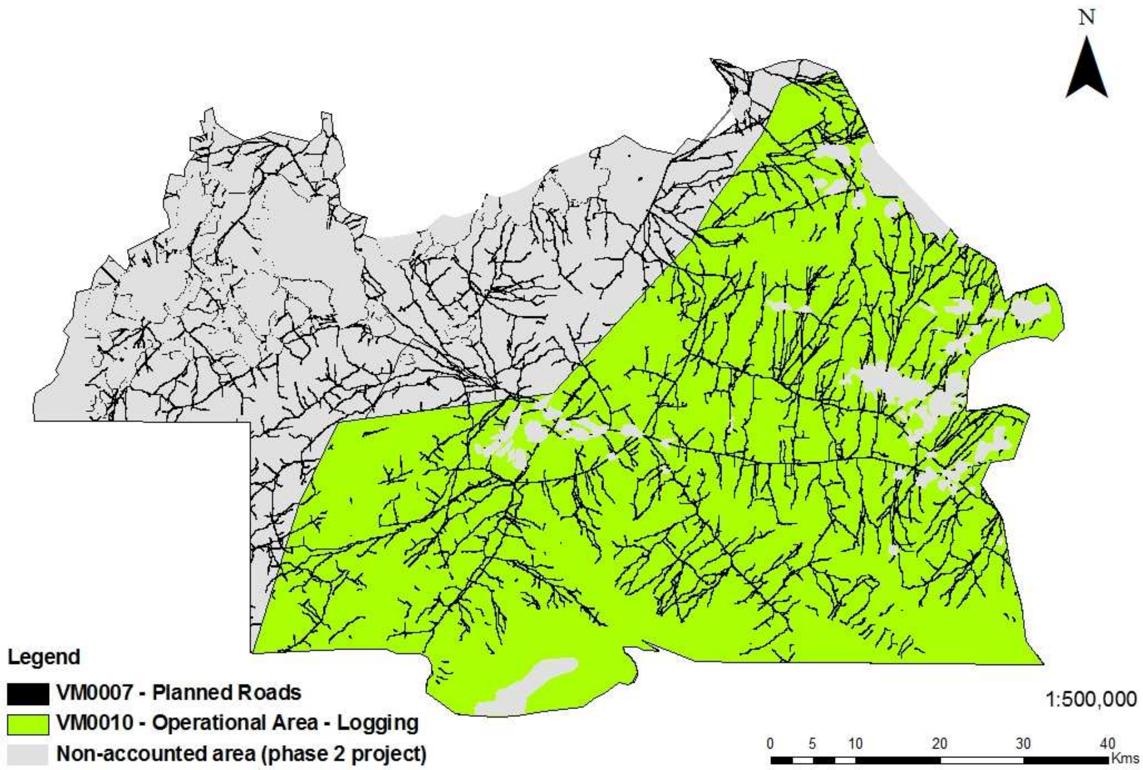
(between 30 and 40 years), and then on approval by the Forest Authority, the FMA is extended for a second rotation. The timber harvest plans describe timber extraction rates, road and other infrastructure development and regeneration plans and typically agriculture development plans for areas within the FMA that have low timber production value. Timber harvest plans for the April Salumei and April River areas were available and used to develop the baseline scenario which includes planned timber extraction (IFM-LtP) and areas to be converted to non-forest due to construction of logging roads (REDD-APD). Conversion to agriculture is conservatively ignored in the baseline scenario in this project and is not included in the carbon accounting area. The assumed baseline is conservative, as several studies suggest that logging operations in Papua New Guinea are not undertaken on a sustainable basis (Forest Trends, 2006; ODI, 2006; ITTO, 2007; Shearman, et.al., 2008). For example, Shearman, et.al., (2008) reported that 23% of Papua New Guinea's forest land that was logged between 1972 and 2002, was subsequently converted to non-forest.

The Project Area fits into two different VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Categories[3] depending on whether the forest is converted during the baseline crediting period. These categories are Reduced Emissions from Deforestation and Forest Degradation – Avoided Planned (Sanctioned) Deforestation (REDD-APD), and Improved Forest Management – Logged to Protected Forest (IFM – LtPF), as shown in Figure 3 below. For the remainder of this document, the boundaries of the two different Project categories are collectively referred to as the 'Project Area'.

There is significant support for development in this area and as soon as investment for infrastructure is made significant areas within the Project boundary would be converted to agriculture (i.e. most likely palm oil, coffee and cocoa; as well as rice). Given there is peat soils within the vicinity of the Project Area, conversion to agriculture has been conservatively excluded in this stage of the Project Development due to a lack of an approved VCS methodology. It is anticipated that Phase 2 of this multiple project will include a third methodology that will address the deforestation and agricultural development in the Project Area on peat soils when an applicable methodology becomes available. This area will be accounted on areas defined as 'excluded from accounting' in Figure 3.

[3] VCS AFOLU Guidelines V3.3, Section 3.1.8 states that "Projects may include multiple project activities where the methodology applied to the project allows more than one project activity and/or where projects apply more than one methodology, as set out in the VCS Standard. Such projects shall comply with the respective project requirements of each included AFOLU category. For each activity covered by a different methodology, the geographic extent of the area to which the methodology is applied shall be clearly delineated.

Figure 3: Project Boundaries for the two VCS Project Categories (APD & IFM)



Source: EAS for Rainforest Project Management, 2012

The key project attributes for the two categories of the Project are summarised Table 1 below.

Table 1: Summary of the key attributes of the Project

	REDD-APD	IFM - LtPF
Project Area (ha)	18,643	196,707
Geographical Position	Centroid: 4°33'31"S and 142°41'20"E	
Forest Type	Moist Tropical Rainforest - Low Altitude Forest	
Soil Type	Hydraquents and fluvaquents in wetlands and river banks. Humitropepets and dystropepts in higher elevations[4]	
Baseline sequence of activities leading to deforestation or degradation	1. Construction of roads that are sanctioned and developed to allow timber extraction. 2. Planned road development was modelled as specified in the Forest Management and Development Proposal (FMDP), however road development regularly exceeds the code requirements and leads to more extensive and rapid road development.	1. Legal timber harvesting as permitted under a Forestry Management Agreement (FMA) in accordance with a valid and verifiable Forest Management and Development Proposal (FMDP) 2. Timber extraction rates were modelled to occur in accordance with the FMDP. In reality, extraction rates often exceed those in the plan.
Legal Land Use Classification	Primary intact forest	
Selected Methodology	REDD Methodology Modules, v1.3. VM0007	Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.2 VM0010[5]

The aim of this Project is to protect the forest and biodiversity of the Project Area whilst providing important source of income for the impoverished landowners that reside within it. The Project also aims to improve wellbeing of local communities in the Project Area through the development of viable sustainable agriculture opportunities; as well as by improving access to healthcare, education and infrastructure; while preserving the local communities' rich cultural traditions and customs.

1.2 Sectoral scope and project type

The April Salumei REDD Project falls under the 'AFOLU' sectoral scope of the VCS.

[4] Source: Development Option Study for April Salumei, 1996

[5] As this methodology was on-hold at the time of writing, the updated but yet-to-approved version (v1.2) was used to prepare this PD and the associated calculations

Table 2 shows the Project scope, category, activity and grouping classification.

Table 2: Sectoral scope, project category, activity and grouping classification

Scope	Category	Activity	Grouped or Multiple Project
14 – Agriculture, Forestry and Other Land Use	Avoided (Sanctioned) Planned Deforestation	Protection without logging, fuel wood collection or charcoal production	Multiple
14 – Agriculture, Forestry and Other Land Use	Improved Forest Management	Conversion from Logged to Protected Forest	Multiple

1.3 Project Proponent

The Project Proponent is Rainforest Project Management Limited. Rainforest Project Management was granted the rights to develop and manage the project by the landowners[6] and the Papua New Guinea National Government. Contact details for the Project Proponent are summarised in Table 3 below.

Table 3: Project Proponent details

Project Proponent	Address	Contact Person	Contact Details
Rainforest Project Management Limited (Company No 1-72274)	Po Box 3319, Boroko, NCD, Papua New Guinea	Stephen Hooper	Phone: +61 (0) 488 088 321 Email: shooper@p-f-a.org

1.4 Other entities involved in the Project

Rainforest Project Management has partnered with a number of organisations to assist with the design, development and operation of the April Salumei REDD Project, as described in Table 4 below.

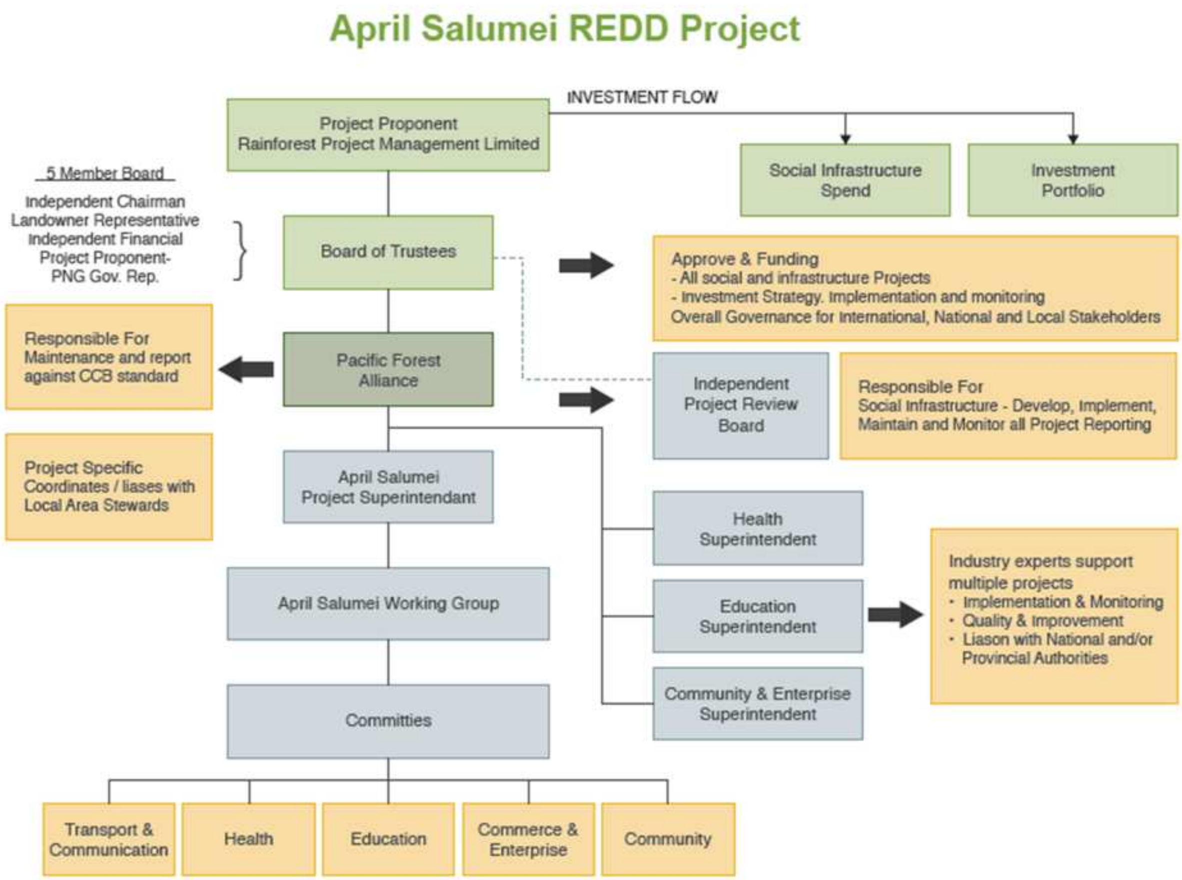
[6] A copy of the official Agreement between Rainforest Project Management and the Landowner companies was provided to the auditor in Annex 1.

Table 4: Summary of other entities involved in the Project

Name of project partner/stakeholder	Role in the project	Roles & responsibilities
Incorporated Land Groups (ILGs)	Land owners	Owners of the land. Project staff. Chairman of the ILGs has a seat on the April Salumei Group.
Pacific Forest Alliance	Implementation partner	Specifically established to manage the project. For more information see: http://www.pacificforestalliance.org
April Salumei Working Group	Implementation partner	Responsible for development of the Project Management Plan. Consists of members and representatives of the landowners within the Project Area
Environmental Accounting Services (EAS)	Lead technical & VCS consultant	Technical design and development of the carbon project elements including fieldwork, remote sensing analysis, and historical land use change analysis and technical project development. Also responsible for development of documentation and systems to achieve validation and verification against the VCS.
University of Papua New Guinea, School of Natural and Physical Sciences:	Technical support	Provision of expert advice on forestry, climate change, natural resources, geology, mining, GIS, geography, sustainable development, hydrology, biodiversity, community livelihoods, law and policy. Assisted with the collection of field inventory data
Papua New Guinea Forest Research Institute	Technical and implementation support	Provided expert advice in tropical forestry and REDD management in Papua New Guinea. Assisted with the collection of field inventory data. Conducted Government liaison for the Project.
Papua New Guinea Forest Authority	Government authorisation	Responsible for: official Government approval of the project; provision of forest inventory data and provincial land use planning; advice on REDD project implementation
Prime Minister and Office of Climate Change and Development	Policy support	Advice on REDD policy and implementation
Partners with Melanesia	Community development	Not for Profit (NGO) focused on conservation and community development programmes in Papua New Guinea

The institutional structure of the Project is summarised in Figure 4.

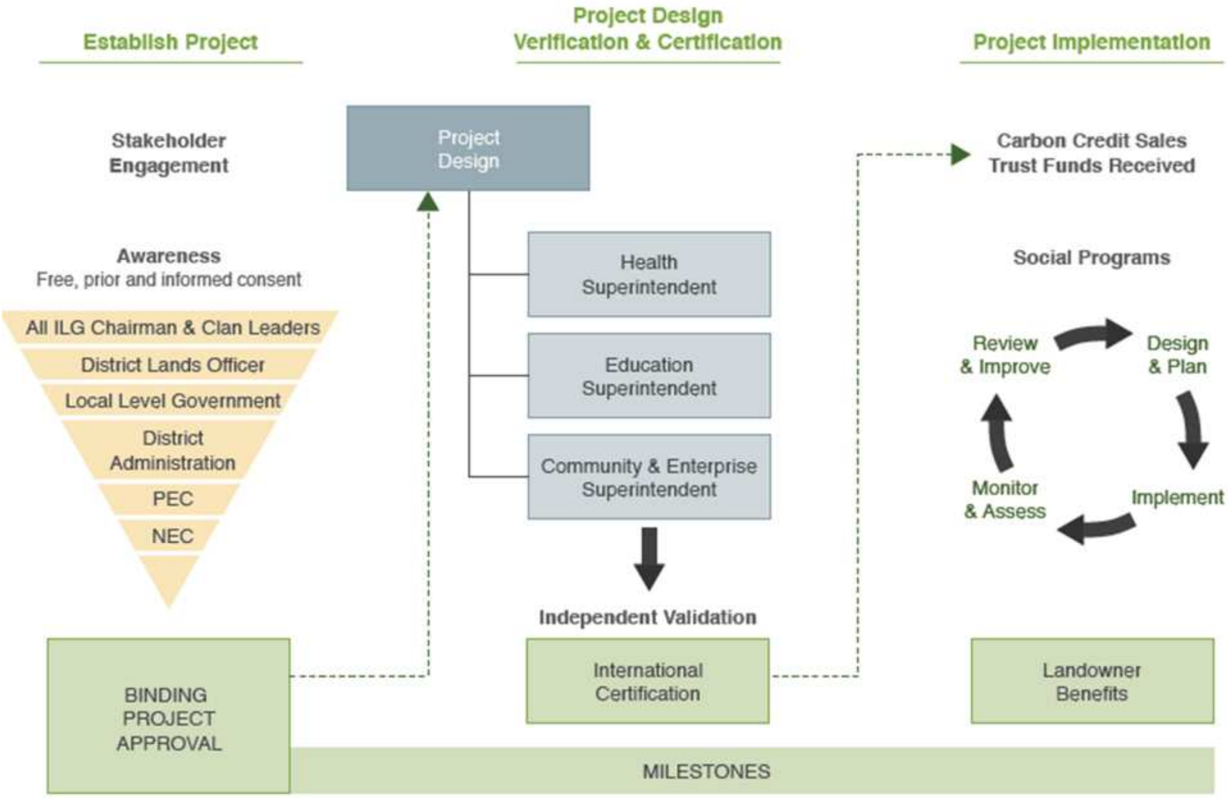
Figure 4: Project management structure



Source: EAS for Rainforest Project Management, 2012

The operational structure of the Project is summarised in Figure 5.

Figure 5: Operational structure of the Project



Source: EAS for Rainforest Project Management, 2012

More detailed information on the operational structure of the Project is outlined in the 'Pacific Forest Alliance Booklet', (Annex 2).

1.5 Project start date

The project start date is May 22, 2009. This is the date that the first agreement was signed between the Landowner Companies and a Project Developer to develop the April Salumei FMA into a Carbon Project. Under this agreement, Hunstein Range Holdings (HRH, representing the 164 ILGs at the time)[7] transferred the rights to the carbon stored within the Project Area to the Project Developer. Subsequent to this agreement, a joint venture agreement was also signed by both parties. A copy of the original agreement is available to the auditor.

The start and end dates for the historical reference period, fixed baseline period and the monitoring period are provided in Table 5 below.

Table 5: Temporal boundaries of the Project

Temporal boundary	Start Date	End Date
Fixed baseline period	22 May 2009	21 May 2019
First Monitoring period[8]	22 May 2009	21 May 2012

1.6 Project crediting period

The crediting period for the project is 40 years (i.e. approved timber harvest plan is for 40 years) as shown in Table 6 below.

Table 6: Project crediting period

Time Period	Start Date	End Date	No of years
Project crediting period	22 May 2009	21 May 2049	40

1.7 Project scale and estimated GHG emission reductions or removals

[7] Subsequently following extensive consultation with the communities HRH has been removed as the landowner representative umbrella group. The landholders have instead reverted to the landowner companies each representing their own ‘onetalk’ interests and the structure of the agreements and the project operational structure has been updated to reflect this landowner requested change.

[8] The first monitoring period covers four years. Subsequent monitoring periods are defined in the Monitoring Plan, please see 5.9.

Table 7 shows the GHG emissions reductions that are expected to be achieved by the Project over its first crediting period.

Table 7: Estimated GHG emission reductions during the first baseline period

Year ending	**Estimated GHG emission reductions REDD-APD (tCO_2e)**	**Estimated GHG emission reductions IFM-LtP (tCO_2e)**	**Total Estimated GHG emission reductions (tCO_2e)**
May 2010	393,742	220,466	614,207
May 2011	410,395	319,031	729,427
May 2012	427,049	417,597	844,646
May 2013	443,702	516,163	959,866
May 2014	460,356	614,729	1,075,085
May 2015	477,010	713,295	1,190,305
May 2016	493,663	811,861	1,305,524
May 2017	510,317	910,427	1,420,744
May 2018	526,970	1,008,993	1,535,963
May 2019	543,624	1,107,559	1,651,183
Total estimated ERs	**4,686,828**	**6,640,121**	**11,326,950**
Total number of crediting years	10	10	10
Average annual ERs	**468,683**	**664,012**	**1,132,695**

This demonstrates that the April Salumei REDD Project qualifies as a 'Large-Project' as shown in Table 8.

Table 8: Classification of Project scale

Project	
Large project	X

1.8 Description of the project activity

There are three primary aims of the Project, categorised according to climate, community or biodiversity outcomes. These aims are:

- Climate: To avoid greenhouse gas emissions related to planned deforestation and timber harvest in the Project Area
- Community: To result in a net increase in the wellbeing of communities in the Project Area, via improved health standards, education, transportation, employment opportunities, community support for conservation, and equitable distribution of project benefits
- Biodiversity: To maximise biodiversity value of the Project Area by preventing habitat and therefore species loss

In order to achieve these objectives, the project has implemented (and will continue to implement) a number of activities as described below. It should be noted that project related activities do not lead to the clearance of any native ecosystems.

1.8.1 Climate related activities

There are two main activities targeted towards reducing greenhouse gas emissions, as described below.

Reclassification of the FMA as a REDD Project Area:
The Project Area is defined by an FMA that permits the Papua New Guinea Forest Authority to award forest harvesting rights to a company for fifty (50) years. In agreements signed by the landowners with the Project Developer the landholders have agreed to terminate the FMA upon validation to the VCS[9]. This is possible under clause 16.1 (a) of the FMA agreement which states that the FMA can be terminated "by agreement at any time by all parties". The National Government is the other Party to the FMA agreement through the Papua New Guinea Forest Authority. With the National Governments approval of the FMAs being the REDD pilot project through the NEC decision clearly demonstrates that both parties are in agreement to convert this area from an FMA to a REDD conservation project. Removal of the Project Area from the Papua New Guinea land registry will ensure that commercial logging concessions cannot be awarded in the future.

Pending cancellation of the FMA and its subsequent removal from the land registry, the Project Proponent has sought to protect the Project Area by formally delineating the area as a REDD pilot project. This was achieved on the 10th May 2012, when Papua New Guinea's authority for Climate Change, the National Executive Council (NEC) formally approved the project as a national level REDD pilot project. This is formally enshrined in a legally-binding National Decision (number 106/2012), which represents the highest level of a REDD Project approval possible in Papua New Guinea. A copy of this decision is available to the auditor in Annex 3.

Monitoring of land use change within the Project Area:
During the crediting period, both on-ground monitoring and remote sensing analyses will be utilised to detect and therefore address disturbances in the Project Area.
Ground-based monitoring will be undertaken by project employees from the local area. These 'Community Rangers' will be given comprehensive training, including induction, communication skills, and computer training. In addition, 'Forest Stewards' will also be responsible for monitoring, observing and reporting of the forest at local level. They will be trained in measurement of key parameters like tree Diameter at Breast Height (DBH), tree height, tree count, classification of tree species, assessment of abnormalities (tree mortality, logging) and use of a GPS.

[9] This agreement can be made available on request to Third Party validators.

Figure 6: Local forest monitoring staff collecting litter biomass

Source: EAS for Rainforest Project Management, 2012

Forest Stewards will be required to report their observations on an immediate and/or annual basis, as outlined according to the schedule listed in Table 9 below. It is proposed that these field activities will commence the year following VCS validation.

Table 9: Field based reporting schedule

Reporting frequency	Observed activity
Immediate	Illegal logging
	Fire
	Any other loss of resource
Annual (commencing the year following validation)	Third party validation of the resource area by a qualified forester with Papua New Guinea Forest Authority
	Investigation of any irregularities identified in aerial surveys or satellite imaging as they become available
	Survey of timber used for traditional purposes (e.g. clearance for making gardens, harvesting for building canoes or homes).

1.8.2 Community related activities

Supporting sustainable projects and livelihoods for the local community is considered crucial towards the success of the project. Community development activities will be tailored towards the specific community needs as well as being consistent with Papua New Guinea's Vision 2050 Goals (Papua New Guinea Vision 2050, 2011), which aims to improve socio-economic conditions of its people.[10] Seven key community development strategies are being implemented under the Project, as described below.

Strategy 1: Improved community infrastructure

Housing, community centres and other infrastructure is generally very poor in the Project Area. Examples of activities that are planned to be implemented to improve community infrastructure include:

- Renovation of housing at Yambi and Ambunti, including the establishment of fully equipped offices in the District Headquarters in Yambi. These headquarters will serve as the base for the Project field operations, as well as a community centre for project controls, pending establishment of a community centre inside the Project Area.
- Establishment of regional resource centres in each of the jurisdictions of the land owner companies. These will be multi-purpose, and be a place for the storage, dissemination and exchange of data, knowledge, skills and technology. They will also serve as a communication hub for the landowners.

[10] Papua New Guinea Vision 2050 activities (and their respective numbers in the policy document) considered relevant to the project include: Education activities: 1.17.2.1 free education; 1.17.2.2 100% literacy for adult population over 15yrs; 1.17.2.17 establish a public-private partnership in delivery of education; 1.17.2.18 introduce environmental sustainability and climate change into the curriculum. Health activities include: 1.17.3.1 reduce HIV-AIDS to 0.1% of the population aged 15-49yrs; 1.17.3.2 Reduce tuberculosis to 10/100,000 of population; 1.17.3.3 Reduce malaria deaths to 10/100,000; 1.17.3.5 Establish one aid post per ward area; 1.17.3.6 establish two health workers per ward area; 1.17.3.7 establish one basic health service centre with two doctors and support personnel per district; 1.17.3.8 improve the terms and conditions of employment of health officers More details can be found in the Papua New Guinea Vision 2050 report (Papua New Guinea Vision 2050, 2011).

Figure 7 Housing typically observed in the Project Area

Source: EAS for Rainforest Project Management, 2012.

Strategy 2: Improve community education quality and extent

Literacy levels in the area are low. The Project aims at improving literacy and general education of children and youth in the Project Area. Examples of early implementation activities include:

- Analysis of the education needs of the respective areas and their current schools in terms of facilities, human resources, and equipment
- Provision of education materials to existing schools, as per needs assessment conducted above
- Provision of secondary and tertiary scholarships to encourage local youths to continue their education and become future leaders in the region

Figure 8: School classroom as typically observed in the Project Area

Source: EAS for Rainforest Project Management, 2012

Strategy 3: Improve healthcare quality and outreach

There is currently little or no access to health care in the area, resulting in a high mortality biased toward small children, infants and mothers. Examples of early implementation activities to address this issue include:

- Comprehensive review of the communities' needs and development of a prioritised Project health plan
- Support for the establishment of community health buildings in strategic locations to improve health care accessibility, in accordance with the Project health plan

Figure 9: Local communities in the Project Area

Source: EAS for Rainforest Project Management, 2012

Strategy 4: Improve mobility and transport

The local communities suffer from a lack of mobility along rivers within the Project Area and also isolation from the rest of the region due to a lack of access to transport. This has flow-on implications for the ability of local people to access healthcare and education. Examples of early implementation activities to address this issue include:

- The initial purchase of five large (23 foot) dinghies with 40 horsepower outboard motors to support the transport needs of the communities. The dinghies will also be used in the provision of project programs and for dissemination of information.

Figure 10: Delivery and welcoming of boats to the communities

Source: EAS for Rainforest Project Management, 2012

Figure 11: Typical long boat transportation

Source: EAS for Rainforest Project Management, 2012

Strategy 5: Improved communication networks

Communication networks in the area are not effective, being either erratic or non-existent. Examples of early implementation activities to address this issue include:

- Auditing of existing radio communication and immediately repair or replace faulty radios or components
- Set up of satellite communication for the entire Project Area

Figure 12 Typical communication systems in the Project Area

Source: EAS for Rainforest Project Management, 2012

Strategy 6: Update the land owner database

Traditional landowners change frequently due to births and deaths but the cost of updating the ILG database is often too great for landowners to bear. Examples of early implementation activities to address this issue include:

- Arranging for real-time update of all ILG's and mapping their boundaries that will be completed consistently with the new ILG Act. It is estimated that this process will take 3 to 4 years for completion. Mapping of traditional landowner boundaries will help resolve disputes, and will also assist in the fair and transparent distribution of Project benefits.

Strategy 7: Generate employment opportunities

Local employment opportunities will arise from the Project itself, as Forest Stewards and Community Rangers. The project will trial the development of community policing in the Project Area, whereby community leaders develop culturally appropriate but effective ways to promote public safety and enhance the quality of life in their neighbourhoods. In addition, the leakage management activities such as improved agricultural productivity in existing agricultural areas will not only increase food production for subsistence purposes, but it may also result in excess food production that can be sold in local markets.

Figure: 13 Local woman processing sago for her family and market

Source: EAS for Rainforest Project Management, 2012

1.8.3 Project technologies, products and services

The April Salumei REDD Project is primarily a forest conservation project. The project design is focused on supporting activities that reduce the drivers of deforestation and forest degradation, focussing on proven technologies, products or services across three main areas; 1) forest conservation; 2) sustainable agriculture development; and 3) small enterprise development, as described below.

- Forest conservation – Activities primarily focused on supervision, monitoring, conservation research and other conservation based land management activities. These activities will be supported by technical experts in forest inventory and remote sensing where required.
- Sustainable agriculture development – The Project will employ agricultural experts to test and implement agricultural regimes that are culturally appropriate, but that will also improve productivity

permitting excess production to be sold in markets. A broader range of agricultural products will also be produced, allowing the local people to generate produce across a broader range of seasons, while improving nutrition for the local communities.

- Small enterprise development – The Project aims to encourage and assist in the development of small enterprises to generate alternative sources of income and reduce the pressure on the forest resource. These enterprises will be supported by the project and external expertise will be sought if and where required.

1.9 Project location

The Project Area is located within the Wosera Gawi and Ambunti Drekiker Districts in the East Sepik province of Papua New Guinea. A map of this location in relation to Papua New Guinea can be seen in Figure 1, while Figure 3 shows a more detailed version of Project Area. The geographic coordinates of the centroid of the Project Area are 4°33'31"S and 142°41'20"E[11].

1.10 Conditions prior to Project initiation

1.10.1 Biodiversity

Papua New Guinea is one of the world's most biologically diverse regions on the planet, and is home to an estimated 5 – 7% of the world's total biodiversity, but has less than 1% of its land area (Sekharan & Miller, 1995). Papua New Guinea is home to at least 191 species of mammals (of which 80% are endemic); 750 bird species (greater than 50% are endemic); 300 species of reptiles; 197 species of amphibians; 3000 species of fish; and an estimated 200,000 to 400,000 insect species most of which are yet to be described and classified (Sekhran and Miller, 1994). Forests in Papua New Guinea are the dominant feature of the country's ecology, covering over 33 million ha (Shearman et.al, 2008), providing vital ecological services to land and coastal marine ecosystems. They also play a major role in the cycling of water and CO_2, helping to regulate climate stability (Hunt, 2006). Lowland tropical and subtropical moist forests, such as those found in the Project Area, have been ranked among the world's ten most ecologically distinctive forest regions (Penman *et al* (eds), 2003; Olsen and Dinerstein, 1998; Brooks *et al,* 2006; Bryant *et al*, 1997).

1.10.2 Elevation and terrain

Elevations range from 20 metres above sea level (masl) in the Sepik valley up to 3,000 masl in the Central Ranges (Hanson *et al*., 2001). The area is relatively flat to undulating in the lowlands but becomes hilly and rugged within the vicinity of Hunstein range and the headwaters of Ario, April, Salumei and Korosameri rivers.

1.10.3 Hydrology

The main hydrological features of the Project Area are the wetlands and many tributaries of the Sepik River. In addition to the Sepik, the main rivers include the Leonard Schultz, the April, the Salumei and

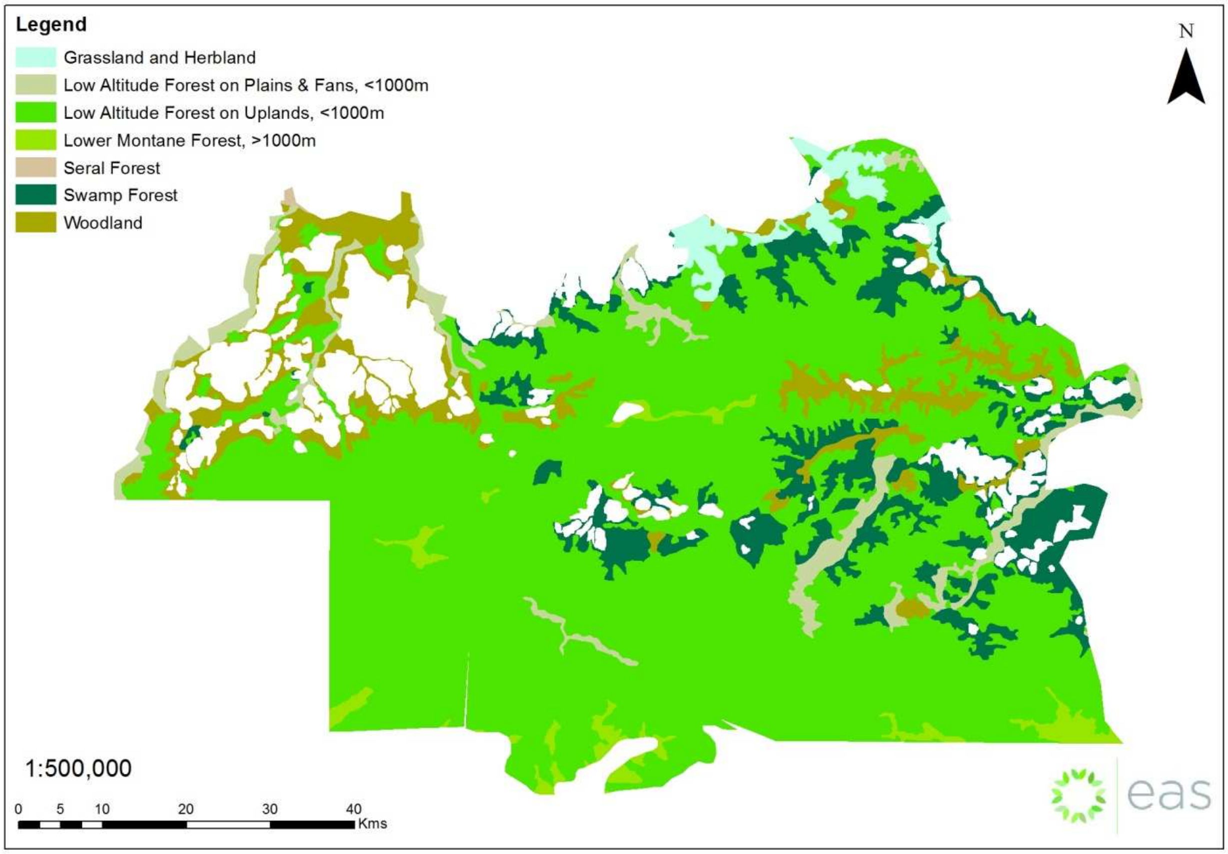
[11] A KML file of the Project boundaries is provided in the supporting documents.

Korosameri rivers. The tributaries include the April, Silipa, Salumei, Wario and Korosameri rivers, all originating within the Project Area in the mountain headwaters for the catchment area. Local hydrology plays an important role in influencing soil type, vegetation and relief. These rivers also provide the drinking water supply for local communities, with water quality improving in an upstream direction. Aside from the rivers mentioned, there are numerous known and unmapped creeks originating from the uplands within the Project Area.

1.10.4 Forest type

Forest and vegetation types in Papua New Guinea are classified according to structural and floristic features, as well as environmental factors such as topography, drainage and altitude (Paijams1975 and 1976, Saunders, 1993). According to the Papua New Guinea Resource Information System (PNGRIS) spatial database, seven forest types are found within the Project Area, as show in Figure 14 and described in Table 10.

Figure 14: Vegetation classes located in the Project Area



Source: EAS for Rainforest Project Management, using PNGRIS vegetation data

Table 10: Vegetation types found within the Project Area

Vegetation Type	Description
Low Altitude Forest on plains and fans	Located in swamp areas and around rivers where the water table remains at or near the surface, at between 500-1000 masl. All canopy crown sizes are represented but large-medium crown cover and open forest are the dominant types. Large-medium crowned forest has a 30-35m average canopy height with individuals reaching over 50m, and occurs on well to imperfectly drained alluvial plains and fans. Species composition is very mixed. Similar in species composition, the open forest reaches 30m in height, with some individuals attaining 40m, crown canopy is small to medium
Low Altitude Forest on uplands	Located between 700-1000 masl, and composed of medium crowned forest with an average canopy height of 25-30m. Species composition is very mixed, and a gradual change exists between this and the low altitude forest on plains and fans. Some *Agathis* (Kauri pine) exist, reaching up to 70m in height, and these are are a particularly valuable conservation species, most occurring in the Hunstein Range Wildlife Management Area.
Lower Montane Forest	This forest type is mainly small crowned forest located above 1000masl. Canopy height is generally between 20-30m, with a gradual decline as elevation increases. Species composition is mixed.
Grassland and Herbland	Located on low altitude plains, in permanent to intermittently dry swamps
Swamp Forest	Includes riverine mixed succession and swamp forests. Characterised by an irregularly open to open irregularly uneven, medium to small crown canopy up to 30 m in height.
Woodland	Characterized by low and open canopy cover with the ground layer usually dense, and may include shrubs, herbs or grasses, or any combination of these. Occurs on permanently dry to periodically inundated terrain, mainly in seasonally dry coastal areas.

Source: PNGRIS database

Figure 15 Example of forest in the Project Area

Source: Rainforest Project Management, 2012

1.10.5 Forest condition

Forest within the Project Area has not previously been subject to commercial or illegal logging. The only anthropogenic land use change at the Project start date was due to gradual encroachment of small scale gardens proximate to villages and camps; as well as expansion of settlements, mission stations, airstrips, aid posts and similar small scale development. As such, the majority of forest can be considered pristine. Agricultural activity in the Project area at the project start date is at a subsistence level, and is based on cultivation of small localised accessible gardens along rivers and trails.

1.10.6 Local communities

According to the 2000 census, the population within the April – Salumei FMA area was around 7,700 persons. Most of the population resides in villages located along the major tributaries of the Sepik River, along the northern boundary of the Project Area. Land in the upper reaches of the April – Salumei Rivers is sparsely inhabited with population densities of 4 persons per km^2, and moderate to high densities (242–956 persons per km^2 around the main villages of Akamau, Yerakai, Tomware and Hauna to the west of the FMA.

Almost all of the forests in Papua New Guinea (97%) are under customary ownership by local communities, either tribal groups or individuals (Government of Papua New Guinea, 2008). Following independence and the development of the Papua New Guinea Constitution (1975), the traditional system of land ownership evolved to the creation ILG's recognized under the Lands Group Incorporation Act (1974).

There are five main cultural groups in the Project Area, and they have formed the following landowner companies to represent themselves:

- Salumei Investments Ltd: consisting of 38 ILG's
- Sio Walio Investments Ltd: consisting of 54 ILG's
- Nom Investments Ltd: consisting of 28 ILG's
- Niksek Samsei Resources Ltd: consisting of 14 ILG's
- B'Nomo Investments Ltd: consisting of 30 ILG's

Forests play a vital role in sustaining the traditional subsistence livelihoods of most of the population. Levels of income, healthcare and education are all very low in the Project Area, and this is discussed in more detail in the CCB Project Design Document.[12]

Figure 16: Women in traditional tribal clothing, Niksek, April River

Source: EAS for Rainforest Project Management, 2012

12 https://s3.amazonaws.com/CCBA/Projects/April_Salumei_Sustainable_Forest_Management_Project/April+Salumei+PDD+Validated+-+June+2011.pdf

1.10.7 Threats

Deforestation poses a major threat to these important forest ecosystems. In 2002 the estimated rate of deforestation or degradation of Papua New Guinea's forests was 1.41% per annum. Based on these rates, Shearman et al, (2008) estimated that 83% of Papua New Guinea's forests would be lost or degraded by 2021. Greenpeace (2010) estimates that roughly half of Papua New Guinea's forests (i.e. approximately 16.3 million ha of primary forest) is under threat of selective logging and therefore entering the cycle of degradation leading to deforestation. A more detailed description of the nature of the threats faced by forest in the Project Area is described in Section 0.

1.10.8 Project authenticity

There is no evidence to suggest that the FMA was put in place in anticipation of markets for REDD credits. In fact, the FMA was signed in 1996, long before the Coalition of Rainforest Nations submitted its proposal to include REDD in the successor treaty to the Kyoto Protocol in 2005. As such, this project has developed from a genuine desire to mitigate climate change and protect the forest, and has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction.

1.11 Compliance with laws, statutes and other regulatory frameworks

The Project is compliant with both international and local laws, regulations and conventions. A detailed description of most relevant local laws and regulations related to Project activities and the Project's compliance with these laws and regulations is provided in Appendix 1.

1.12 Ownership and other programs

1.12.1 Legal status

The legal status of the project is defined according to several layers of authority and approvals. These include: 1) ownership of the land itself; 2) Government recognition of the Project as an official REDD pilot project; and 3) formalisation of Government approval in the form of a legally binding National Decision. These layers of legal status are described below.

Legal ownership of the land & status of the FMA

As described in Section 1.10.6, the ILGs or clans are legally in control of and responsible for the management of their land. Legal recognition of the corporate status of certain customary and similar groups is formalised by the Land Groups Incorporation Act 1974. Under this Act, landowners are entitled to form ILGs which have legal control and management responsibility for their land. This right is also enshrined in Papua New Guinea's Constitution. ILGs are now used throughout the country to prove and secure title to land. Projects in the mining, forestry and petroleum sectors typically implement their projects by formally gaining the consent of the ILGs, which are also used as the basis to distribute royalties and compensation. The ILGs from the April Salumei FMA area have been formally gazetted and are registered at the Papua New Guinea Lands Department.

On 20 December 1996, landowners of the Project Area, in their legal capacity as ILGs, entered into an FMA agreement with the Papua New Guinea Forest Authority. Under this agreement the Papua New Guinea Forest Authority have the rights to award a logging concession to a logging company for 50 years. Negotiations between the ILGs and prospective concession owners took place not long after the FMA was signed. However a concession had not yet been awarded when, on 13 September 1997, the Papua New Guinea Government declared part of the FMA to be a Wildlife Management Area (WMA) in accordance with the Fauna (Protection and Control) Act 1966. This was done without landowner consent and in direct breach of the FMA. Legal action was taken by the landowners, and in an out-of-court settlement, it was agreed the remaining area under the FMA should become a pilot project for Papua New Guinea's REDD program as an option to avoid unsustainable logging alternatives.

Figure 17: Local communities (in Igai) welcome technical team

Source: EAS for Rainforest Project Management, 2012

Government recognition as an official REDD pilot project

The Papua New Guinea Government has shown significant leadership on REDD, as the founding member of the Coalition of Rainforest Nations, which is a group of forested countries that formed a united negotiating block in discussions under the United Nations Framework Convention on Climate Change (UNFCCC). In these international negotiations, the Coalition of Rainforest Nations was a major supporter of efforts to include the REDD mechanism in the successor treaty to the Kyoto Protocol. As part of its national REDD Strategy, the Papua New Guinea Forest Authority has identified five official REDD pilot projects, one of which is this Project. This Project was formally announced at the 17th Conference of the

Parties (COP) to the UNFCCC held in Durban in 2011; and the Project was featured at a Papua New Guinea Government side event at the same meeting.

Government approval via a National Decision

On 10 May 2012 the April Salumei REDD Project was approved and endorsed by the National Executive Council, via decision number NG 106/2012[13]. Approval from the National Executive Council gives the project a clear mandate to be managed as a REDD project rather than as an FMA, as well as the right for Rainforest Project Management to sell Verified Emission Reductions (VERs) generated by the Project.

1.12.2 Right of use

The April Salumei REDD Project has been under development since May 2009, at which time an agreement was signed between the Landowner Companies and a Project Developer to develop the April Salumei FMA into a carbon project. The Project Proponent's Right of Use to emission reductions generated under the Project is evidenced by the following series of documents:

- Legal agreement between ILGs, landowner companies and RPM (example provided in Annex 1)
- Joint venture agreement between Rainforest Project Management Limited and landowner companies (provided in Annex 1)
- The FMA (specifically relevant is termination clause in Section 16.1 (a) (provided in Annex 4)
- National Executive Committee Decision NG 106/2012 (provided in Annex 3)

1.12.3 Emissions trading programs and other binding limits

Not Applicable. Papua New Guinea does not have a National emission trading program or a legally binding commitment under any international treaty.

1.12.4 Participation under other GHG programs

The Project was validated to the Climate, Community and Biodiversity (CCB) Standard with Gold status on June 11, 2011. Since the time of CCB validation, some components of the project have evolved and improvements have been made. To prevent confusion when comparing the VCS and CCB documents, a summary of these changes are outlined in

Table 11.

[13] A copy of the National Executive Council document was provided to the auditor in Annex 3.

Table 11: Changes to the Project since CCB validation

	Situation at time of CCB validation	Situation at the time of writing	Justification
Land Owner Companies	4 land owner companies	B'Nomo Investment Limited added to make a total of 5 land owner companies.	More closely reflected traditional boundaries and the removal of Hunstein Range Holdings as the umbrella representation company.
High level project management	Foundation	Replaced by in-country board	In country board gives local context to decision makers and reduces project overheads.
Hunstein Range Holding	Landowner Representation	No longer involved.	Removed holding company as requested by landowners.

The Project has not been registered nor is seeking registration under any other GHG programs that generate carbon units (note that the CCB Standard does not actually verify carbon units).

1.12.5 Other forms of environmental credit

Not applicable. No other form of environmental credit will be sought or generated under this Project.

1.12.6 Projects rejected by other GHG programs

Not applicable. The project has not been rejected by any other GHG program.

1.13 Additional information relevant to the Project

1.13.1 Eligibility criteria

Not applicable. The project is not a grouped project.

1.13.2 Commercially sensitive information

Commercially sensitive information includes:

- legal agreements between the landowner companies and the developer
- NEC decision

These documents are available to third Party auditors.

1.13.3 Further information

No further information.

2 APPLICATION OF METHODOLOGY

As described previously, the Project Area is divided into two different VCS Project Categories with stratification of the Project Area used to delineate the spatial boundaries of each VCS Project Category for accounting purposes. This section explains the procedures for selection and applicability of the two separate Methodologies while Sections 3 and 4 deal separately with the procedures used to calculate emission reductions in accordance with each Methodology.

2.1 Title and reference of Methodologies

2.1.1 Planned (Sanctioned) deforestation in the baseline

This project will follow the methodology rules and guidelines set out in VCS Approved Methodology VM0007, 'REDD Methodology Modules Version 1.3', applying the relevant listed modules for planned deforestation, from here on referred to as 'the REDD methodology'.

2.1.2 Planned degradation in the baseline

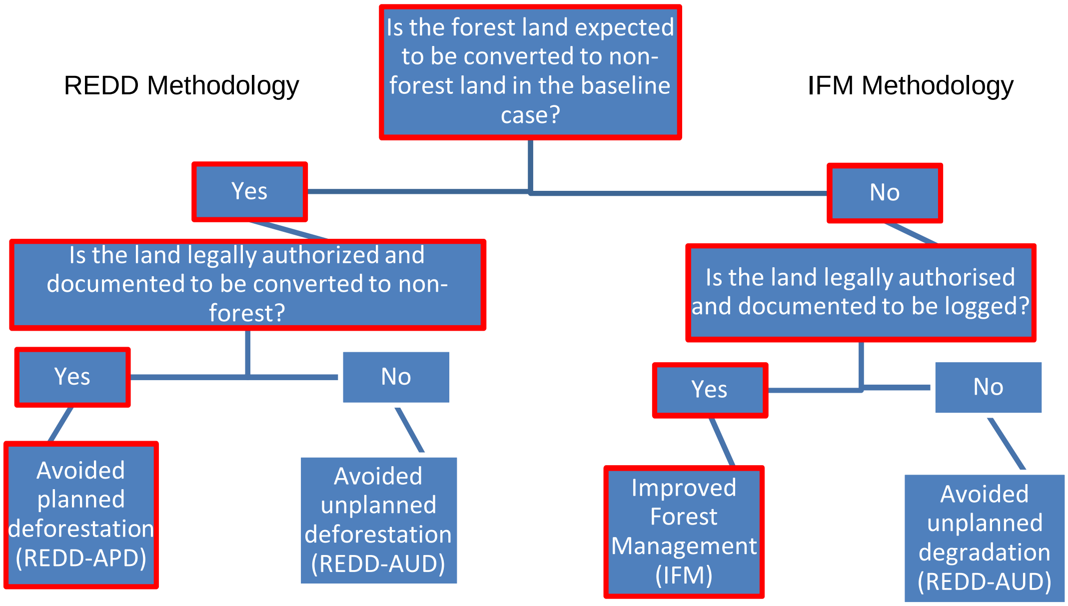
This project will follow the methodology rules and guidelines set out in VCS Approved Methodology VM0010, 'Methodology for Improved Forest Management: Conversion from Logged to Protected Forest Version 1.2'[14], (from here on referred to as 'the IFM methodology').

2.2 Applicability of Methodologies

The following decision tree was used to determine the appropriate VCS Project Category, and therefore the appropriate methodology for the Project Area. The pathways chosen for the different parts of the Project Area are indicated with red outlines.

[14] As this methodology was on-hold at the time of writing, the updated but yet-to-approved version (v1.2) was used to prepare this PD and the associated calculations

Table 12: Decision tree to select VCS project category



Adapted from: VCS Methodology VM0007[15]

The April Salumei REDD Project complies with the respective applicability conditions for the IFM and REDD methodologies. The applicability criteria that are common to both methodologies are described in.

Table 13 below.

While the criteria that are specific to each methodology are described in
Table 14 and

[15] Working through this step-wise approach demonstrates completion of VM0007 Step 0 – Identification of most plausible VCS-eligible activities.

Table 15. Note that the REDD Methodology also contains additional applicability criteria unique to each module, and the Project's compliance with these criteria are addressed in Section 3.

Table 13: Applicability criteria common to both methodologies

Applicability Criteria		Justification
1	Project activities may include one or a combination of the eligible categories defined in the description of the scope of the methodology	Baseline modelling predicts that deforestation will occur in some parts of the Project Area due to roads constructed as part of the logging operation. As a result, these areas are classified as REDD-APD. Areas that were not modelled to be deforested but are located in 'operable' timber harvesting areas were predicted to be heavily degraded but then show a slight recovery of biomass, and are therefore categorised as IFM – LtPF.
2	At project commencement, the Project Area shall include only land qualifying as "forest" for a minimum of 10 years prior to the project start date	Historical land use and land use change analysis confirms that land within the Project Area has been a forest for at least 10 years prior to the project start date (See Annex 5).
3	The Project Area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50cm. if the Project Area included a forested wetlands growing on peat (eg peat swamp forests), this methodology is not applicable.	Whilst peat soils have not officially been mapped in Papua New Guinea, peat soils were discovered in the proximity of the Project Area as part of the field survey. As a result, a peat mapping exercise was undertaken, using the SRTM satellite imagery to delineate the extent of the peat domes. The areas mapped as peat were then excised from the Project Area. A copy of the peat mapping report was provided in the supporting documentation (Annex 13).

Table 14 VM0007 applicability criteria

Applicability Criteria		Justification
General VM0007 Applicability Criteria		
4	Project proponents must be able to show control over the project area and ownership of carbon rights for the project area at the time of verification.	See landowner communication and legal agreements (Annex 1 and 3) which demonstrate the ownership of carbon rights for the Project Area. The Government NEC approval of the Project also represents National recognition of these rights.
5	Baseline deforestation and baseline forest degradation in the project area fall within one or more of the following categories: o Unplanned	The baseline deforestation falls under the category of planned deforestation as the clearing of forest for timber harvest and road

	deforestation (VCS category AUDD); • Planned deforestation (VCS category APD); • Degradation through extraction of wood for fuel (fuel wood and charcoal production) (VCS category AUDD). •	construction is sanctioned by the Government when the land was classified as a Forest Management Area and also as described in the approved Timber Harvest Plan.
6	Baselines shall be renewed every 10 years from the project start date.	The Project commits to renewing the baseline every 10 years from 21st May 2009.
7	All land areas registered under the CDM or under any other carbon trading scheme (both voluntary and compliance-orientated) must be transparently reported and excluded from the project area. The exclusion of land in the project area from any other carbon trading scheme shall be monitored over time and reported in the monitoring reports.	These are no CDM projects registered in Papua New Guinea.
8	If land is not being converted to an alternative use but will be allowed to naturally regrow (i.e. temporarily unstocked), this framework shall not be used.	The deforested land modelled using VM0007 is used as primary and secondary roads and analysis of the proxy areas suggests that these roads are not permitted to naturally regrow, presumably due to frequent traffic.
9	Leakage avoidance activities shall not include: • Agricultural lands that are flooded to increase production (e.g. paddy rice); • Intensifying livestock production through use of "feed-lots"[4] and/or manure lagoons. •	Leakage avoidance activities are not a requirement of this Project.
Planned Deforestation Applicability Criteria		
10	Conversion of forest lands to a deforested condition must be legally permitted	Deforestation for road development in the Forest Management Area is a legally permitted activity.
11	Documentation must be available to clearly demonstrate with credible evidence and documentation that indeed the land would have been converted to non-forest use if not for the REDD project.	The approved FMDP within the defined Forest Management Area is documentary proof that the land would have been harvested and forest lands subsequently converted to permanent roads if not for the REDD project.
12	Where, pre-project, unsustainable fuel wood collection is occurring within the project boundaries modules BL-DFW and LK-DFW shall be used to determine potential leakage.	The PRA, fieldwork and remote sensing analysis conducted indicated that pre-project fuel wood collection is sustainable in the Project area. Modules BL-DFW and LK-DFW were not applied.

Table 15VM00010 applicability criteria

Applicability Criteria		Justification
13	Projects must fall within the AFOLU project category "IFM Logged to Protected Forest"	The Project Area is designated for timber production by the Papua New Guinea Government. The Project activities include elimination of commercial timber harvesting. As a result, this part of the Project Area meets the VCS definition of 'IFM Logged to Protected Forest' as set out in the AFOLU Requirements, version 3.3.
14	Forest Management in the baseline scenario must be planned timber harvest.	The Project Area falls under an FMA approved by the Papua New Guinea Forest Authority and is designated to be harvested.
15	Under the project scenario, forest use is limited to activities that do not result in commercial timber harvest or forest degradation.	No timber harvest or forest degradation will be undertaken in the project scenario. Areas used by the local community for daily activities have been excluded from the Project Area. This criteria has been met.
16	Planned timber harvest must be estimated using forest inventory methods that determine allowable offtake as volume of timber (m^3 ha^{-1}).	The planned timber harvest volume is specified in the FMA document, which was provided to the auditor. The planned harvest rates in the FMA are specified in terms of m^3 ha^{-1}.
17	The boundaries of the forest land must be clearly defined and documented.	Boundaries of the Project Area are based on the boundaries of the FMA, excluding areas of peatland and non-forest. The boundaries have been clearly defined using Landsat images to determine forest type and ArcGIS to demarcate boundaries. See Section 2.3 for more details.
18	Baseline conditions cannot include conversion to managed plantations.	The allocated FMA is a sustainable timber harvesting licence which does not sanction conversion to managed plantation.
19	The legal right to harvest must be issued by a relevant government body. Legal allocation of rights to a forest timber resource must be provided with a plan for forest management.	The FMA was approved by the Papua New Guinea Forest Authority on 20/12/1996. This document (provided to the auditor as Annex 4) also describes volumes to be expected to harvest, and includes a map of the FMA. FMAs are to be harvested in accordance to the logging code.
20	Intent to harvest must be provided by the project proponent. This can be done through a valid and verifiable Government –approved timber management plan for harvesting the Project Area.	The signed FMA outlines expected volume of timber to be extracted and is a valid document. This was provided to the auditor in the supporting documentation.

2.3 Project boundary

2.3.1 Definition of the Project Boundaries

Geographical Boundaries

The geographical boundaries of the project are presented in Figure 3. This map clearly delineates the REDD and IFM geographical boundaries within the defined Project Area.

In accordance with the REDD methodology, the area delineated as the REDD activity includes only forest land that qualified as a forest 10 years prior to the project start date[16]. This statement also holds true for areas delineated for the IFM activity.

Table 16: VM0007 Geographical Boundary Requirements

Requirement	VM0007 Evidence	VM0010 Evidence
Project Area Name	Logging roads	Timber Area
Maps (digital) of the area	Figure 3	Figure 3
Geographic co-ordinates of each polygon vertex and documentation of their accuracy	Boundary of deforested area defined by series of vectors representing modelled roads occurring across the entire extent of the FMA.	Coordinates define the project area: Northern most point: 142^{o}49"30.511" E; 4^{o}13'45.195"S Easternmost point: 143^{o}12"4.441" E; 4^{o}30'29.127"S Southernmost point: 142^{o}34"35.232" E; 4^{o}55'59.609"S Easternmost point: 142^{o}5"34.077" E; 4^{o}36'27.106"S
Total land area (ha)	18,643	196,707
Forest land right and user rights	Subject to a FMA, as discussed in Section 1.12	
Project Area and Proxy Areas	A shapefile & KML of the project boundaries provided as supporting documentation. File name: April Salumei_Project Boundaries_VM0007_Roads (KML file), Project Boundaries_Roads_Dec 14_2012 (ArcGIS file).	A shapefile & KML file of the project boundaries provided in supporting documentation. File name: April Salumei_Project Boundaries_VM0010_IFM (KML file), IFM_Project Boundaries_Final (ArcGIS file).

Purposely, to comply with both selected methodologies, there are no overlaps in boundaries between areas appropriate to each of the baselines.

[16] Refer to Annex 5 for details of the land use land cover analysis conducted to demonstrate that the land included in the Project Area was a forest 10 years prior to the Project start date.

Note that calculation of leakage under both Methodologies was conducted using a 'leakage factor' approach. Therefore there was no need for spatial delineation of a leakage buffer or area for activity shifting leakage.

Table 17: Temporal boundaries

Requirements	VM0007 Evidence	VM0010 Evidence
Start and end date of the 'historical reference period'	The start date of the historical reference period is defined as 2000 and the end date 2009[17].	N/A
Start and end date of the 'project crediting period' [18]	The start date of the project crediting period is the date on which the first monitoring period commenced, which is 22nd May 2009.	The start date of the project crediting period is the date on which the first monitoring period commenced, which is 22nd May 2009.
Date of baseline revision	The date of the scheduled baseline revision is 21st May 2019[19].	N/A
Duration of monitoring periods	The first monitoring period shall be for a period of 3 years and 7 months (i.e. 22nd May 2009 – 31December 2012). The second, third and fourth monitoring period shall be one year (i.e. 1st January 2013 – 31st December 2013, 1st January 2014 - 31st December 2014 and 1st January 2015 - 31st December 2015) and subsequent monitoring periods shall be every two years thereafter. For the monitoring schedule refer to Section 5.9.	The first monitoring period shall be for a period of 3 years and 7 months (i.e. 22nd May 2009 – 31December 2012). The second, third and fourth monitoring period shall be one year (i.e. 1st January 2013 – 31st December 2013, 1st January 2014 - 31st December 2014 and 1st January 2015 - 31st December 2015) and subsequent monitoring periods shall be every two years thereafter. For the monitoring schedule refer to Section 5.9

[17] This complies with the REDD methodology requirement that the historical reference period start date shall be between 9 and 12 years in the past and end within 2 years of the project start date (REDD-MF, page 10).

[18] The definition of the project crediting period was taken from the VCS Program Definitions V3.3, page 8.

[19] In compliance with the VCS V3.3 and the VM0007 the fixed baseline period for planned deforestation is10 years.

2.3.2 Carbon Pools

Table 18: Excluded and included carbon pools

Carbon Pools	Methodology	Included / TBD / Excluded	Justification / Explanation
Above-ground	**VM0007**	**Tree: Included**	**Carbon stock change in this pool is always significant.**
		Non-tree: Included	**Included**
	VM0010	**Tree: Included**	**Carbon stock change in this pool is always significant.**
		Non-tree: Excluded	Excluded as this is conservative when forests remains as forest.
Below-ground	**VM0007**	**Included**	**Root allometric equations are available and therefore estimations based on Project Area specific forest inventory can be made. The methodology recommends the inclusion of this pool.**
	VM0010	Excluded	This pool will be excluded as it is unlikely to change significantly in forests remaining as forests.
Deadwood	VM0007	Excluded	Deadwood is excluded as it will not be greater in the baseline (i.e. cleared land for roads) compared with the project scenario (i.e. primary tropical forest)
	VM0010	**Included**	**Required under VCS Tool for AFOLU Methodological Issues**
Harvested wood products	**VM0007**	**Included**	**This will be greater in baseline than the project scenario and is therefore included.**
	VM0010	**Included**	**This will be greater in baseline than the project scenario and is therefore included.**
Litter	VM0007	Excluded	This pool is insignificant and has been excluded.
	VM0010	Excluded	This pool is insignificant and has been excluded.
Soil organic carbon	VM0007	Excluded	Soil organic carbon is a long lived pool that is unlikely to change under the project scenario. Exclusion is conservative.
	VM0010	Excluded	Soil organic carbon is a long lived pool that is unlikely to change under the project scenario. Exclusion is always conservative when forests remains as forest

2.3.3 Sources of GHG emissions

Table 19: REDD project excluded and included sources and GHG emissions

Source		Gas	Status	Justification/Explanation of choice
Baseline and Project	**Biomass Burning**	CO_2	Excluded	Counted as carbon stock change
		CH_4	**Included**	**Non-CO_2 gases emitted from woody biomass burning – included in both the Project and Baseline scenarios.**
		N_2O	**Included**	
	Combustion of fossil fuels	CO_2	Excluded	Excluded from baseline accounting
		CH_4	Excluded	Not a significant source
		N_2O	Excluded	Not a significant source
	Use of fertilisers	CO_2	Excluded	Not a significant source
		CH_4	Excluded	Not a significant source
		N_2O	Excluded	Excluded from the baseline and therefore project accounting. Fertiliser will not be used as a leakage avoidance mechanism

Table 20: IFM project excluded and included sources and GHG emissions

Source		Gas	Status	Justification/Explanation of choice
Baseline and Project	Combustion of fossil fuels	CO_2	Excluded	Emissions will be greater in the baseline scenario. Conservative to exclude.
		CH_4	Excluded	Emissions will be greater in the baseline scenario. Conservative to exclude.
		N_2O	Excluded	Potential emissions are negligible
	Burning of biomass	**CH_4**	**Included**	**Included as CO_2 equivalent emission**
		N_2O	Excluded	Negligible
	Nitrogen based fertilizer	N_2O	Excluded	Potential emissions are negligible
	Removal of herbaceous vegetation	CO_2	Excluded	Based on CDM EB decision reflected in paragraph 11 of the report of the 23rd session of the board: cdm.unfcc.int/Paneks/ar/023/ar_023_rep.pdf

2.4 Baseline Scenario

The most probable baseline scenario in forest areas allocated as Forest Management Areas in Papua New Guinea has been well documented (GoPapua New Guinea, 1989, Forest Trends, 2006, ODI, 2007, Ningal et al, 2008, Shearman et al. 2009, Shearman and Bryan, 2011). As summarised in Babon, 2011, the leading drivers of deforestation in Papua New Guinea have been identified as commercial logging (48.2%) and indigenous production systems (45.6%), with forest fires (4.4%), clearing for agricultural plantations (1.0%) and finally with mining (0.6%) as only a minor contributor. Logging has been the main driver of forest cover change in the lowland areas of the coastal and island regions, with indigenous production systems the major driver in the highland areas in the period 1970 - 2000 (Shearman and Bryan 2011). Rapid population growth, international demand for timber and weak governance are seen as indirect drivers of deforestation in Papua New Guinea.

In the absence of the Project, the forest within the April Salumei and April River FMA areas would have been logged by one of the large timber harvesting companies operating in Papua New Guinea. Based on our analysis, the most likely agents of deforestation/degradation would have either been 1) the Taiwanese logging company called ‘Road Timber Co Ltd’, which prepared the FMDP plan to log and convert the area; or 2) Rimbuan Hijau (RH), a Malaysian logging company which engaged in discussions with Landowners in the April River area to enact the timber harvest plan (per comm. Phillip Ugu, Landowner Chairman). Typical logging operations in Papua New Guinea involve the selection and felling of trees on the basis of species and diameter (legally >50cm diameter at breast height, DBH for export logs, and down to 30cm for locally processed sawn timber, plywood and veneer) (Papua New Guinea Forest Authority, 1996). The logging operation causes substantial destruction to the forest in the form of roading and collateral damage from tree felling. Each log is dragged by bulldozer along a snig track of cleared vegetation 4m wide (University of Papua New Guinea, 2006), to a cleared log dump accessible to trucks. Snig tracks can extend up to a few hundred meters away from a log dump and road (Shearman et al. 2009). Roads that can be used by logging trucks require a graded bulldozed track with a 5-6m wide roadway; and typically 30-50m of forest is damaged when obstructing trees are felled and used for road footings and bridges or bulldozed into the surrounding forest (Shearman et al, 2009).

In a publication by the University of Papua New Guinea (Shearman et al, 2008), concern was raised about the recovery of the forest after selective logging has been completed. This study highlighted that further degradation after logging is commonplace, via conversion to non-forest by burning, secondary logging via new operators, local people with walkabout sawmills or by shifting cultivators. The study also found that overall, 23% of forest lands that had been logged were subsequently converted to non-forest cover following the first extraction phase of a Forest Management Plan.

To allow access to the logging area and extraction of timber, significant areas of land are deforested for roads and infrastructure. Plans for the development of primary, secondary and tertiary roads are defined in the timber harvest plan; however these roads are typically developed more broadly than described. In particular roads up to 50m wide can be cut through the forest. Once the initial roads have been established, the improved access can later lead to frontier deforestation due to smaller scale timber extraction by local landholders and agricultural crop development (i.e. cocoa and coffee). The increase in jobs can then lead to a tertiary wave of deforestation due to increasing population pressure.

In summary the baseline scenario is legally sanctioned forest degradation and (planned) deforestation as a result of classifying the land as an FMA. This sanctioned degradation and deforestation is to be conducted in accordance with an agreed FMDP and in compliance with the Forestry Code. However due to a lack of resources and governance, non-compliance becomes the normal operating environment which ultimately compromises sustainable rotational forestry activities, leading to wider scale land use conversion following the completion of the first rotation (i.e. approximately after 30 years since timber harvesting commenced). To be conservative, however, only degradation and deforestation related to the legally permitted logging operations, as identified in the timber harvest plans for the area, have been modelled in the baseline for this Project. Planned agricultural conversion activities have not been included in this project[20].

2.5 Additionality

In accordance with the methodology the most probable baseline scenario described in Section 0, and the Project Activity is shown to be additional using the 'Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities V3.0' (VT0001).

Compliance with the VT0001 applicability conditions are demonstrated below:

1. As the project is focused solely on the protection of virgin forest areas, the proposed project activities do not lead to violation of any applicable law, even if the law is not enforced. The forest was zoned for timber harvest however the Forest Authority has formally agreed to allow the Project Area to be protected as a REDD project. This agreement was formalised through the National Executive Committee decision number NG 106/2012 dated 6th November 2002. This document can be found in Annex 3.
2. There is consistency between determination of the baseline scenario and additionality of the project activity, as can be seen by comparison of this Section to Section 0 above.

VT0001 Steps 1, 3 and 4 were considered in the additionality assessment. Barrier Analysis was performed instead of the Investment Analysis as there are relevant additional non-financial barriers in Papua New Guinea to prevent a VCS AFOLU project from proceeding.

[20] Areas where planned conversion to palm oil were predicted to occur were excised from the project boundaries. This is because the selected methodology VM0007 requires the Project to have agreements in place with agents of deforestation who plan to convert forest to agriculture plantations that can be established on peat. As it was not possible to achieve these agreements in the project development timeline, the baseline scenario of conversion to palm oil was excluded. As a result the Project Area was reduced to less than the full FMA area. The remaining low lying areas are more conducive to agriculture development (including palm oil). These areas within the FMA will be included at a later date.

2.5.1 VT0001 Step 1: Identify alternative land use scenarios, assess if they are legal and/or most plausible

The list of possible land use scenarios for the April Salumei forest (VT0001: Step 1a) are outlined below in terms of their compliance with relevant laws and legislation (VT0001: Step 1b), and their feasibility for the project site (VT0001: Step 1c).

Continuation of the pre-project land use (planned deforestation due to road construction, commercial logging)

The pre-project land use represents the planned, legally authorised commercial harvest of the area. The Development Option Study (DOS) prepared by the Forest Authority flagged the Project Area for timber production. Following approval of the DOS, a Taiwanese logging company called 'Road Timber Co. Ltd' prepared an FMDP for the April Salumei area. An additional plan was developed by the April Development Corporation Timber Resource Area Development Plan. These combined plans that cover timber harvest operations within the Project Area, outline the intention to extract 460,000 m^3 yr^{-1} of timber from the Project Area. A certificate of the company registration documents, as well as the cover page of the FMDP is provided in Figure 18. The plan also included detailed specifications on the type and extent of roads to be constructed (Figure 19). Therefore the DOS, together with the FMDP, provides substantial evidence to suggest that the pre-project land use of planned commercial logging and road construction was very likely to occur in the absence of the Project. A copy of the DOS (Annex 6), the FMDP (Annex 14) and the April River Timber Harvest Pan (Annex 10) was provided in the supporting documentation.

Figure 18: 'Road Timber' company registration certificate (left); and cover page of the FMDP (right)

PAPUA NEW GUINEA
Companies Act 1997

Form 5

Sections 14 & 442 Company Number 1-25213

CERTIFICATE OF INCORPORATION

I certify that

ROAD TIMBER CO LIMITED
(formerly ROAD TIMBER CO PTY LIMITED)
(originally GADOSISI NO.11 PTY. LIMITED)

which was on 23 February 1996 incorporated under the Companies Act (Chapter 146)

is, on and from 1 July 1998,

incorporated under the *Companies Act* 1997.

Given under my hand and seal on 1 July 1998.

REGISTRAR OF COMPANIES PAPUA NEW GUINEA

Anthony Beven
Registrar of Companies.

A 0001590

FOREST MANAGEMENT

AND

DEVELOPMENT PROPOSAL

FOR

APRIL - SALUMEI FMA

SUBMITTED BY

ROAD TIMBER CO., PTY. LTD.
P.O.BOX 2754 Boroko NCD PAPUA NEW GUINEA

Figure 19 Road construction plan from Road Timber Co. Ltd's FMDP

TABLE 8 STANDARDS AND SPECIFICATIONS

Arterial roads	Rural road class 2		
Sepik River to April River	Hilly	Mountainous	
Length (km)	60	40	total = 100
Design speed (km/hr)	40	25	
Absolute minimum radius (m)	60	20	
Desirable minimum radius (m)	75	30	
General maximum gradient (%)	10	12	
Absolute maximum gradient (%)	12	12 (14%)	
Maximum length at absolute maximum gradient (m)	250	500	
Maximum length desirable	500	500	
Overall width (m)	7	7	
Pavement width (m)	4	4	

Secondary roads	Access road class 2	
Bisorio and Inaru	Hilly	Mountainous
Length (km)	24	34 total = 54
Design speed (km/hr)	30	25
Absolute minimum radius (m)	30	20
Desirable minimum radius (m)	50	30
General maximum gradient (%)	10	12
Absolute maximum gradient (%)	12	12 (14%)
Maximum length at absolute maximum gradient(m)	250	300
Maximum length desirable	500	300
Overall width (m)	6	6
Pavement width (m)	4	4

Arterial roads Timber harvesting roads			
Timber harvesting roads	Hilly	Mountainous	
Length (km)	75	40	total = 125
Design speed (km/hr)	25	50	
Absolute minimum radius (m)		20	20
Desirable minimum radius (m)		40	15
General maximum gradient (%)		12	25
Absolute maximum gradient (%)	250	14	
Maximum length at absolute maximum gradient(m)	250	150	
Maximum length desirable	250	150	
Overall width (m)	6	6	
Pavement width (m)	3.6	3.6	

Commercial logging of the Project Area represents a legally authorised land use. An FMA was granted on the Project Area in accordance with the *Forestry Act 1991* and the Forest Authority 34 step approval process. This process has not been challenged when followed correctly.

Once logging had been conducted, it was the intention of the Road Timber logging company to develop parts of the FMA into a palm oil, cacao and coffee plantations, among other agricultural crops. This was clearly stated in various sections of the FMDP, as shown in Figure 20 and Figure 21 below. Agricultural conversion was not yet planed in the April River Development Plan with the difficult terrain being acknowledged as a barrier to larger scale agriculture expansion in this section of the Project Area. The extent of the agricultural conversion to the north of the Project Area is substantiated in maps of proposed agricultural development in West Sepik developed by the Provincial Government (Annex 17).

Figure 20: Extract from the FMDP, stating planned extent of conversion

6.4.4 Leasehold land / Subleasing

Road Timber will lease an estimated 500,000 ha. For a multiple purpose project involving agriculture, industry, some industry and commercial.
The land will then be subleased in order to implement different projects for each parcel of sub-leased land.

(1) Aim of Leased / subleased land

Makes it possible to attract investors ,willing to invest in Papua New Guinea and make development in the underdeveloped areas possible.

Plans for agricultural expansion are common in development option studies conducted by the Forest Authority. The expansion of agriculture is generally part of the larger development of areas within an FMA that have low productivity and are made financially viable with the expansion of road networks and infrastructure resulting from the timber harvest operation.

Based on these plans for the area and the extensive Provincial Agriculture Expansion Plan there is significant support for development in this area and as soon as investment for infrastructure is made significant areas within the Project boundary would be converted to agriculture (i.e. most likely palm oil, coffee and cocoa; as well as rice). Given there is peat soils within the vicinity of the Project Area, conversion to agriculture has been conservatively excluded in this stage of the Project Development due to a lack of an approved VCS methodology. It is anticipated that Phase 2 of this multiple project will include a third methodology that will address the deforestation and agricultural development in the Project Area when an applicable methodology becomes available. This area will be accounted on areas defined as 'excluded from accounting' in Figure 3.

Figure 21: Extract from the FMDP, broad agriculture conversion plan

6.4.3 Proposed Agricultural activities

The following crops have been proposed to be farmed for the local market but more directed for the export market overseas.

Items Planted Area

Item	Planted Area (ha)	Item	Planted Area (ha)
Ginger	5,000	Bananas	1,000
Onions	10,000	Pineapple	3,000
Garlic Bulbs	5,000	Citrus-Ponkans	3,000
Bamboo Shoot	3,000	Grapefruits	1,000
Asparagus	4,000	Guavas	1,000
Radishes	500	Pears	1,000
Carrots	500	Apples	1,000
Water Bamboo	500	Papayas	500
Mangoes	10,000	Sugar-Cane	200,000
Durian	5,000	Unhulled rice	160,000
Watermelon	500	Grapes	1,000
Maize (Food)	5,000	Muskmelon	1,000
Soybeans	5,000	Tomatoes	2,000
Peanuts	5,000	Palm Oil	60,000
Vanilla	15,000	Soya beans	5,000
Coffee	20,000	Potatoes	2,000
Rubber	40,000	Taros	2,000
Tea	5,000	Animal Products	20,000
Wood	20,000	Cocoa beans	10,000
Total	159,000	Total	474,500

Total estimated Planted area targeted : 643,500

This type of land use transition is common in Papua New Guinea (Hunt, 2010; Shearman, 2008), and conversion to agriculture was observed in the FMA proxy areas. Conversion to agricultural land was envisioned by the Papua New Guinea Forest Authority in its DOS, where it stated that "There is a lot of potential for other business development to be developed within the area when the Project commences. Some of those potential ones include: development of fisheries and agriculture-oriented projects." (pg.13, DOS). The conversion of forest areas within an FMA to agriculture is legally sanctioned and approved under the Timber Harvest Plan, usually on a small scale (i.e. areas less than 1000 hectares), and is seen as a potential source of additional income for the traditional land owners. This was confirmed in discussions with the Papua New Guinea Forest Authority and Forest Research Institute (personal communication Dr Martin Goldman, Papua New Guinea FRI).

Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project

On 13 September 1997, the Papua New Guinea government intervened and stopped development of the logging concession in the Project Area, by declaring some of the FMA area to be a WMA, supposedly in accordance with the *Fauna (Protection and Control) Act 1966*. However, this Government declaration was announced without any formal consultation with the land owners. Nor did the Government make any attempt to revoke or cancel the FMA. The declaration of the area as a WMA deprived the landowners of a considerable source of income in the form of timber concession payments, which was the very motivation for them seeking the establishment of the FMA in the first instance. As a result, the landowners successfully contested the WMA declaration, and, in an out-of-court settlement, it was agreed the remaining area under the FMA should become a pilot project for Papua New Guinea's REDD program. Without the possibility of revenues from carbon finance, the landowners would not have agreed to protect the area, but rather they would have pursued generation of revenues from the logging concession.

Activities similar to the proposed project activity, resulting from legal requirements

The *Fauna (Protection and Control) Act 1966* includes a provision allowing the Government of Papua New Guinea to create protected areas. There is also compulsory acquisition provision in the *Land Act 1996*. Both of these Acts have provisions to enact a legal requirement to protect the area, which would constitute similar activities to the project activity. In fact the *Fauna (Protection and Control) Act 1966* clause was tested when part of the Project Area was zoned as a WMA. This provision was contested by the landowners in court, and the finding was that the protection order had not been enacted in accordance with the Act (Annex 16). Based on the strong objection of the local people to list the area as a WMA it is not likely that protection of the area based on the legal requirements in the two aforementioned Acts would be effective. The landowner's primary objection to the WMA was not due to an unwillingness to protect the forest and natural resources, but rather directly related to the landowners needs and wants to generate income from the land, which is restricted under a WMA.

The *Fauna (Protection & Control) Act 1966* does allow for areas to be protected with the consent of the landowners and the local government. There is a clause in the Act that allows the Minister to protect the area without the consent of the local government; however the consent of the landowners is still mandatory, and as described above, this seems highly unlikely in the absence of the REDD project.

Outcome of substep 1c

It is considered that continuation of the pre-project land use (i.e. legal logging and road construction) is the most likely baseline scenario, because this is the intended purpose of an FMA. In addition, a valid, verifiable plan exists that clearly describes logging and road construction as the planned land use. It is also likely that conversion to agriculture would occur after conclusion of the logging operations, as the FMDP clearly states that this was Road Timbers' intention. However, this baseline land use conversion scenario was not considered imminent during the ten year baseline validity period, based on the rate of land use change observed in the proxy areas. The baseline will be reassessed in less than ten years, and conversion to agriculture may become a likely baseline scenario at that time. Protection in the absence of carbon finance is not considered a likely baseline scenario, as the Government has tried, and failed, to pursue this avenue via zonation of the area as a WMA.

2.5.2 VT0001 STEP 3: Barrier Analysis

There are multiple barriers that would prevent the implementation of the project activity without the revenue from the sale of the GHG credits, but do not prevent the implementation of at least one of the alternative project scenarios. These barriers are described in detail below in Table 21.

Table 21: Barrier Analysis

Barrier	Applicability to Project in the absence of carbon finance	Applicability to other land use scenarios
Access to NGO or Government funding	Implementation of a forest conservation project requires significant upfront investment. The Government of Papua New Guinea is a developing country whose budgets are already stretched. As a result, the Government is forced to seek funding for non-carbon related conservation projects from international NGOs or Government donors. The quantity of such funding is limited, and often comes with significant administrative requirements that prohibit groups of landholders from applying.	Because the logging operation or agricultural production would generate commercially valuable products for which there is strong demand, the logging or agricultural company has the ability to generate profit, and therefore the baseline logging and agriculture would have been funded with private capital. There would be no need to attract funds from an NGO or Government donor. Therefore this barrier does not apply to logging.
Poor enforcement of Government policies & laws on sustainable land management	Poor enforcement of Government conservation policies makes it difficult to implement a conservation project in the absence of carbon finance. This is evidenced by the Government's failed attempt to implement a WMA on the site.	Many publications (GoPapua New Guinea, 1989, Forest Trends, 2006, ODI, 2007, Ningal et al, 2008, Shearman et al. 2009, Shearman and Bryan, 2011) document and provide evidence of illegal logging, unregulated agricultural expansion, and noncompliance with the Government's forestry and agriculture policies. This low level of compliance implies that it is actually easier to implement an (unsustainable) logging or agricultural regime in Papua New Guinea, so poor enforcement of Government policy and legislation is not a barrier to these land uses.
Need for sustainable revenue generation	The local people need to generate an income source from their land area, resulting in an unwillingness to conserve large areas of forest in the absence of carbon finance.	Logging operations pay rent to local landholders in exchange for permission to extract the landholders' timber. In the case of Road Timber, the company planned to pay the local landholders 1,000 Kina (≈USD480) per month, for lease of their land.

2.5.3 VT0001 STEP 4: Common practice analysis

It is **not** common practice for landholder companies, such as the project proponent, to protect forest areas for financial return in Papua New Guinea, in the absence of AFOLU revenues. The Project proponent's April Salumei REDD Project is the first AFOLU Project activity of its type that will be validated under the VCS in Papua New Guinea. Activities of similar scale or geographical location have not been observed, as there are no other conservation areas of this kind in Papua New Guinea at the time of writing. The proposed VCS AFOLU project activity is not the baseline scenario and, hence, it is additional.

2.5.4 Summary of Additionality Test Using VT0001

- The most likely alternative land uses in the absence of the project is the pattern of commercial scale harvesting of the FMA in breach of the code of Forest Practice leading to degraded forest areas, as well as deforestation due to logging road construction.[21]
- Conversion to agriculture is considered possible, but this is not considered a significant threat during the current ten-year baseline applicability period.

2.6 Methodology Deviations

There are no deviations from the two methodologies applied for this Project.

[21] It should be noted that VM0010 does not permit modelling of logging operations beyond those that are legally permitted. Therefore degradation due to breaches of the Code have been conservatively excluded from the baseline.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS UNDER THE REDD METHODOLOGY FRAMEWORK (VM0007)

3.1 REDD Methodology Framework (REDD-MF)

This section describes the application of the REDD Methodology Framework module of VM0007, which sets out the basis for all subsequent calculations in associated modules.

3.1.1 Planned Deforestation Framework Modules Applied

In accordance with the VM0007 framework requirements the modules listed in Table 22 were used in the quantification of GHG emission reductions and removals.

Table 22: VM0007 Modules Applied[22]

	Module	Code	Version
Always Mandatory	REDD Methodology Framework (REDD-MF)	VM0007	1.3
	Methods for monitoring of greenhouse gas emissions and removals (M-MON)	VMD0015	2.1
	Estimation of uncertainty for REDD project activities (X-UNC)	VMD0017	2.0
	Methods for stratification of the project area (X-STR)	VMD0016	1.0
	Tool for the Demonstration and Assessment of Additionality (T-ADD)	VT0001	3.0
	AFOLU Non-Permanence Risk Tool (T-BAR)		3.2
Baseline	Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation and planned degradation (BL-PL)	VMD0006	2.0
Leakage	Estimation of emissions from activity shifting for avoided planned deforestation and planned degradation (LK-ASP)	VMD0009	1.1
	Estimation of emissions from market-effects (LK-ME)	VMD0011	1.0
Pools	Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB)	VMD001	1.0
	Estimation of carbon stocks in the litter pool (CP-L)	VMD0003	1.0
	Estimation of carbon stocks in the long-term wood products pool (CP-W)	VMD0005	1.1
Emissions	Estimation of greenhouse gas emissions from biomass burning (E-BB)	VMD0013	1.0

[22] All modules can be downloaded from the following VCS website link: http://v-c-s.org/methodologies/VM0007

3.1.2 Applicability Conditions

Applicability conditions for VM0007 are addressed in Section 2.2 and the applied modules are addressed in Section 3.5 onwards under each module.

3.1.3 Procedures

Step 0: Identification of Most Plausible VCS eligible activity
See Section 2.2

STEP 1. Definition of the project boundaries
See Section 2.3.1.

STEP 2. Demonstration of additionality
See Section 2.5.

STEP 3. Development of Monitoring Plan
See Section 5.

STEP 4. Estimation of baseline carbon stock changes and GHG emissions
The baseline was estimated *ex ante* and will be monitored in a defined proxy area which includes operational FMAs (as required for planned deforestation) for the purpose of periodically adjusting the baseline. The *ex-ante* baseline estimations were used in both the *ex-ante* and *ex-post* estimation of net carbon stock changes and greenhouse gas emission reductions. The estimation of baseline carbon stock changes and greenhouse gas emissions was conducted in accordance with VMD0006 - Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation and planned degradation (BL-PL) as described in Section 3.5. A description of the baseline scenario and how it was identified is presented in Section 0 and the calculations for the planned deforestation are presented in Section 3.5.

STEP 5. Estimation of total net GHG emissions reductions (net of project minus baseline and leakage)
The total net greenhouse gas emissions reductions achieved by the REDD project activity are presented in the accompanying spreadshseet 'April Salumei_Master Calculation Spreadsheet' (from here on referred to as the 'Master Calculation Spreadsheet' and were calculated as follows:

$$C_{REDD,t} = \Delta C_{BSL} - \Delta C_P - \Delta C_{LK} \qquad \text{Equation REDD-MF 1}$$

Where,

$C_{REDD,t}$ Total net greenhouse emission reductions at time t; t CO_2-e

ΔC_{BSL} Net greenhouse gas emissions under the baseline scenario; t CO_2-e

ΔC_P Net greenhouse gas emissions within the project area under the project scenario; t CO_2-e, (from M-MON)

ΔC_{LK} Net greenhouse gas emissions due to leakage; t CO_2-e

And where,

$$\Delta C_{BSL} = \Delta C_{BSL,planned}$$ Adapted from Equation REDD-MF 2

Where,

ΔC_{BSL} Net greenhouse gas emissions under the baseline scenario; t CO_2-e

$\Delta C_{BSL,planned}$ Net greenhouse gas emissions in the baseline from planned deforestation; t CO_2-e (from BL-PL)

And where,

$$\Delta C_{LK} = \Delta C_{LK\text{-}AS,planned} + \Delta C_{LK\text{-}ME}$$ Adapted from Equation REDD-MF 3

where,

ΔC_{LK} Net greenhouse gas emissions due to leakage; t CO_2-e

$\Delta C_{LK\text{-}AS,planned}$ Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation; t CO_2-e (from LK-ASP)

$\Delta C_{LK\text{-}ME}$ Net greenhouse gas emissions due to market-effects leakage; t CO_2-e (from LK-ME)

The calculation of the VCS buffer (to be held in the VCS permanence risk buffer) was determined as a percentage of the total carbon stock benefits as follows: [23]

$$\text{Buffer}_{\text{PLANNED}} = \left((\Delta C_{\text{BSL,planned}}) - (\Delta C_{\text{P}}) \right) \times (\text{Buffer\%})$$ Adapted from Equation REDD-MF 4

Where:

$\text{Buffer}_{PLANNED}$ Buffer withholding for planned deforestation project areas; t CO_2-e

$\Delta C_{BSL,planned}$ Net greenhouse gas emissions in the baseline from planned deforestation; t CO_2-e

[23] Note that an error was identified in the VCS Module REDD-MF, whereby the multiplication parameters in equation REDD-MF 4 was listed as (1-Buffer%), which gives the amount of VCUs, rather than the amount of the buffer. This error was reported to the VCS Association, and rectification of this error is underway at the time of writing. For the purposes of our calculations, we have used the correct parameter assuming it will be updated in the module. Copies of our correspondence with the VCS Association are available on request.

ΔC_P Net greenhouse gas emissions within the project area under the project scenario; t CO_2-e

Buffer% Buffer withholding percentage; %

i 1, 2, 3, …M strata

t 1, 2, 3, …t* years elapsed since the start of the REDD VCS project activity

And where,

$$Buffer_{TOTAL} = \Delta Buffer_{PLANNED}$$ Adapted from Equation REDD-MF 7

Where:

$Buffer_{TOTAL}$ = Total permanence risk buffer withholding; t CO_2-e

$Buffer_{PLANNED}$ = Buffer withholding for planned deforestation project areas; t CO_2-e

The buffer withholding percentage was calculated using the VCS Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination (T-BAR, see Annex 7).

Uncertainty analysis was performed in accordance with the X-UNC module to combine uncertainty information and conservative estimates. The outcome was an overall estimate of the uncertainty of total net GHG emission reductions. The estimated cumulative net anthropogenic GHG emission reductions was adjusted at each point in time to account for uncertainty as indicated in the module X-UNC.

The allowable uncertainty under this methodology is +/- 15% of $C_{REDD,t}$ at the 95% confidence level. Where this precision level is met, no deduction is required for uncertainty. Where uncertainty exceeds 15% of $C_{REDD,t}$ at the 95% confidence level then the deduction shall be equal to the amount that the uncertainty exceeds the allowable level. In this case of this project, uncertainty was below the 15% threshold, and therefore no deduction was required, as described in Section 3.12.

The total number of REDD credits was adjusted with the value of Adjusted_$C_{REDD,t}$ to account for uncertainty:

$$Adjusted\_C_{REDD,t} = C_{REDD,t} \times (100\% - C_{REDD\_ERROR,t^*} + 15\%)$$ Equation X-UNC 11

Where:

Adjusted_ $C_{REDD,t}$	Cumulative total net GHG emission reductions through time t adjusted to account for uncertainty; t CO_2-e
$C_{REDD,t}$	Cumulative total net GHG emission reductions through time t; t CO_2-e
C_{REDD_ERROR,t^*}	Cumulative uncertainty for REDD project activity through time t; %
t	1, 2, 3, …t years elapsed since the start of the REDD VCS project activity. For details see X-UNC.

Finally, the number of Verified Carbon Units (VCUs) for the monitoring period $T = t_2 - t_1$ was calculated as follows:

$$VCU_{,t} = (Adjusted\_C_{REDD,t2} - Adjusted\_C_{REDD,t1}) - Buffer_{TOTAL} \qquad \text{Equation REDD-MF 8}$$

Where,

VCU_t	Number of Verified Carbon Units at time $t = t_2 - t_1$; VCU
$Adjusted\_C_{REDD,t2}$	Cumulative total net GHG emissions reductions at time t_2 adjusted to account for uncertainty; t CO_2-e
$Adjusted\_C_{REDD,t1}$	Cumulative total net GHG emissions reductions at time t_1; t CO_2-e
$Buffer_{TOTAL}$	Total permanence risk buffer withholding; t CO_2-e

Ex-post monitoring

Ex-post monitoring was conducted in accordance with the Monitoring Plan, which is described in Section 5.

3.2 Tool for the Demonstration and Assessment of Additionality (T-ADD)

The full application of VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities is presented in Section 2.5.

3.3 AFOLU Non-Permanence Risk Tool (T-BAR)

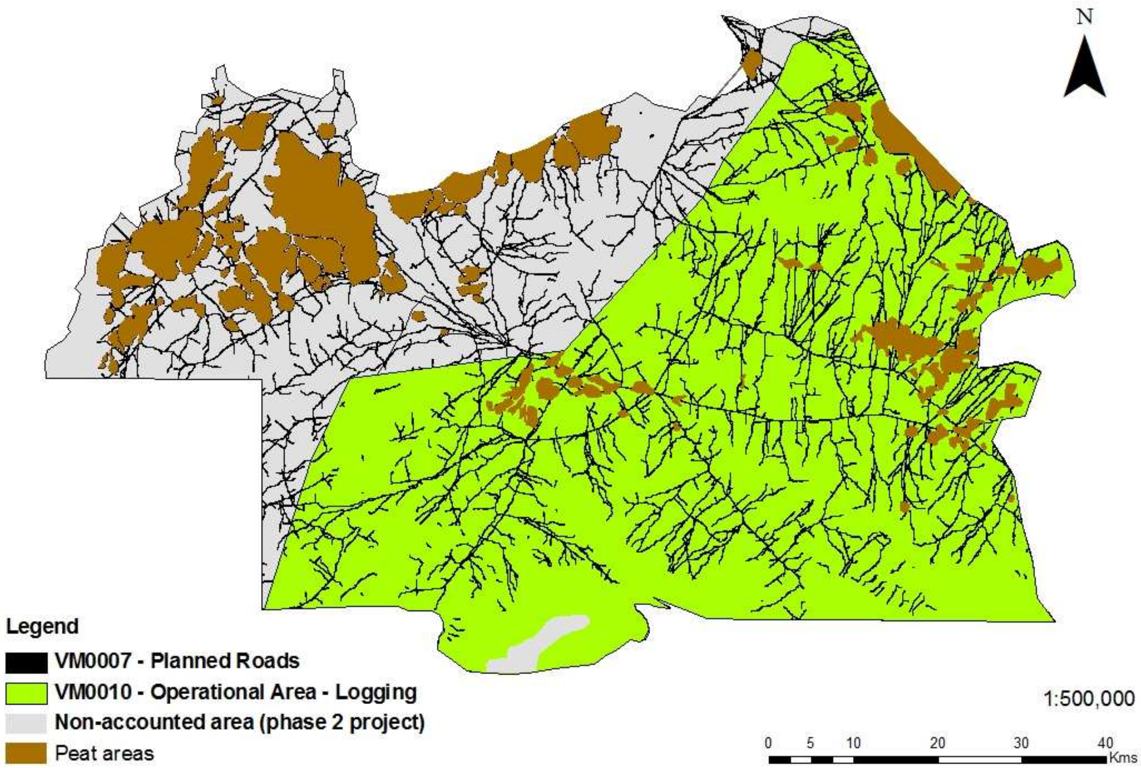
The full application of the AFOLU Non-Permanence Risk Tool is presented in Annex 7.

3.4 Methods for stratification of the project area (X-STR)

In accordance with the X-STR module, the Project Area was stratified based on ancillary data that served as a proxy for potential biomass classes. Forest classes spatially delineated in the PNGRIS dataset were used to delineate forest types within which carbon inventory plots were allocated.

No significant difference in carbon stock was detected between the productive forest strata measured in the field, therefore a single forest carbon strata was defined. The stratification map of the two project types (i.e. IFM-LTP and REDD-APD) accounting areas was developed and is presented in Figure 22, which also shows the areas of peatland which were excised from the Project boundaries.

Figure 22 Project boundaries, showing peat areas that were excised from the Project Boundaries



Source: EAS for Rainforest Project Management, 2012

The individual strata naturally sums to the total project area (i.e Sub-total listed inTable 23). The Project area combined with the remaining non-accounting areas is presented in Figure 3 make up the complete FMA area (i.e. Total FMA listed in Table 23).

Table 23: Area within identified strata

Strata Name	Area (hectares)
IFM-LtP	196,707
REDD-APD	18,643
Sub-Total Project Area	**215,350**
Peat Areas	104,672
Other Non Accounting Area	262,740
Total forested area of FMA	**582,762**

3.5 Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions from Planned Deforestation and Planned Degradation (BL-PL)

3.5.1 Applicability Conditions

The Project meets all applicability conditions specified in the BL-PL module. The land in the Project Area is privately owned by traditional landowners (Section 1.10.6) who have completed the process to define the area as an FMA, in which deforestation and degradation associated with timber harvest operations is legally authorized in accordance with the Forest Management Plan (Annex 4).

Unsustainable fuelwood collection is not occurring inside the project area. This has been confirmed through the completion of a Participatory Rural Appraisal (PRA), as provided in Annex 8.

In the project scenario:

- The land area remains a forest
- Sustainable management practices are undertaken/encouraged on these land areas to ensure that the level of carbon stocks on these lands does not systematically decrease over time
- National and regional forestry and nature conservation regulations will be complied with (See Section 9)

3.5.2 Procedures

The baseline net GHG emissions for planned deforestation were calculated according to the following equation:

$$\Delta C_{BSL,planned} = \sum_{t=1}^{t*} \sum_{i=1}^{M} (\Delta C_{BSL,i,t} + GHG_{BSL-E,i,t})^{24} \quad \text{Equation BL-PL 1}$$

Where:

$\Delta C_{BSL,planned}$ Net greenhouse gas emissions in the baseline from planned deforestation; t CO_2-e

$\Delta C_{BSL,i,t}$ Net carbon stock changes in all pools in the baseline stratum i at time t; t CO_2-e

$GHG_{BSL-E,i,t}$ Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum i during project year t; t CO_2-e $year^{-1}$

i 1, 2, 3, … M strata

t 1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

This equation required calculation of input values as described in the following steps.

Part 1 - Calculating the annual area of land deforested

3.5.3 Identify the agent of planned deforestation

The original FMDP was prepared by Road Timber Limited of Taiwan. At the time of writing, this group does not appear to be operational under this name in Papua New Guinea. While there are currently many international investors and operators in PNG's forest industry, Rimbunan Hijau PNG, a wholly owned subsidiary of Malaysian company Rimbunan Hijau, is by far the most influential forestry player. From the perspective of the level of logging activity in-country, however, RH is the most likely agent of deforestation. Rimbunan Hijau Group (RH Group) is one of Malaysia's largest multi-industry companies. Their business focus[25] is forestry and oil palm, as well as a range of other related activities such as media, hospitality, infrastructure development and mining.

RH has been operating in Papua New Guinea for more than two decades and has expanded from a small forestry operation to become one of Papua New Guinea's largest employers and Papua New Guinea's leading manufacturer and exporter of forest products. RH has also recently expanded its operations in oil palm development in East New Britain Province of Papua New Guinea. For example, the Sigite Mukus Integrated Rural Development Project is an area approved for agriculture development by the RH Group. The Project is 42,000 hectares, with 31,000 hectares allocated for oil palm development. It is expected to

[24] Note that the equation in BL-PL v1.1 is incorrectly listed as $\Delta C_{BSL,planned} = \sum_{t=1}^{t*} \sum_{i=1}^{M} (\Delta C_{BSL,i,t} * GHG_{BSL-E,i,t})$.

[25] According to their website http://www.rhg.com.my/ Last accessed 18th September 2012.

contribute royalties, premium payments, infrastructure levies and other community funding worth K834 million (US$390 million) over the project's lifespan and provide transport and social infrastructure to the local communities.

3.5.4 Area of deforestation

Information presented in Table 24 represents documentary proof of the immediate site-specific threat of deforestation.

Table 24: Documentary proof of immediate site-specific threat of deforestation

VMD0006 BL-PL Requirement	Project related documentary proof
Legal permissibility for deforestation	Area approved for construction of roads as specified in the FMDP prepared by Road Timber and approved by the Papua New Guinea Forest Authority, an extract of which is provided in Figure 23.
Suitability of project area for conversion to alternative non-forest land use	The DOS conducted by the Papua New Guinea Forest Authority recognised the value of the timber in the region as well as the importance of the river system for transport of logs to markets. Allocation of the area as an FMA consolidates its suitability for timber harvest and identifies areas for non-forest land use such as roads and timber harvest related infrastructure as well as agriculture plantations. Furthermore, the FMDP includes a plan for conversion of 643,500 ha in the region to a variety of agricultural uses as specified in the baseline assessment earlier in the document (see Section 6.4.2 of the FMDP). While only some of this development was planned for land inside the Project Area, it demonstrates its 'suitability' for conversion to non-forest land uses and the need for extensive road networks to support this scale of activity.
Evidence of likely transfer of ownership to baseline agent of deforestation or class of agent	The DOS conducted by the Papua New Guinea Forest Authority represents the first stage in the *bona fide* bidding process for the Project Area. The FMDP developed by Road Timbers and supported by the traditional land owners represents a purchase offer by an entity that is clearly dedicated to agricultural and urban development activities, following timber extraction.
Government approval and intention to deforest within the Project Area	The classification of the area as an FMA provides evidence that the Papua New Guinea Government has given permission to develop road infrastructure and agriculture plantations in accordance with the DOS, also prepared by the Government. For example, the DOS states that: "The landowner's most important wish is to allow the developer to link all villages in the FAM with all-weather condition roads." (p.9, DOS).

VMD0006 BL-PL Requirement	Project related documentary proof
Intent to deforest	The Road Timber FMDP represents a valid and verifiable land use management plan for deforesting the project area. The size, density (i.e. 10m / hectare) and class of logging roads are clearly specified in Section 7.0 of the FMDP. In addition to this, historical land use change analysis within active FMAs in neighbouring West Sepik and West New Britain by similar timber harvesting companies on similar terrain with similar population and regulatory characteristics (see Annex 5) found the plan to be typical of the level of road development by timber harvesting companies in Papua New Guinea.

3.5.5 Rate of deforestation (D%planned,i,t)

The rate of deforestation was based on the Road Timbers FMDP which outlined the proposed road construction (infrastructure) deforestation rates. We also investigated deforestation rates related to road development in proxy areas to confirm the rate at which the road density is achieved in Papua New Guinea.

Infrastructure Deforestation Rate

The FMDP states that the road density would be developed to 10m / hectare (
Figure 23)[26].

Figure 23: Extract from Road Timber's FMDP, stating the planned density of roads

As the timber harvesting progresses, the road network will be extended annually to ensure a density of 10 km/ha. in the production areas, to the tune of 12.5 km secondary road annually.

Source: Road Timber's Forest Management and Development Plan

The rate of development of the road density was specified in the Section 7.0 Road Construction of the plan, as occurring at 12.5km annually, or within three years (
Figure 23, Figure 24). However, this pace of road construction was considered unrealistic based on our observations from deforestation rates in proxy areas (See Annex 5). Therefore a conservative linear deforestation rate was modelled over the first 20 years of timber harvest using the rate of road

[26] Note that this extract from the plan states that road density would be 10km / ha. These units were considered to be listed in error as it is not possible to reach this density (i.e. 10km of roads at the specified width exceeds an area of 1 ha). Road development in proxy areas indicated that a 10m / ha road development in logging areas is typical and therefore this target density was applied to the modelling.

development in the proxy areas, as required under the Methodology where a reliable estimate cannot be derived from the plan.

Figure 24: Planned rate of road construction as specified in Road Timbers FMDP

Road construction is proposed to be completed within three years especially the road to April river. All machines will be working as a team opening up harvesting roads as well.

Source: Road Timber's Forest Management and Development Plan

Proxy Areas

More than 40 areas allocated for timber harvest (eg. FMAs) located in two different Provinces (West Sepik and West New Britain) were selected as 'proxy areas' for analysis of the road development rate (Table 25). The proxy areas were selected based on the criteria listed in the BL-PL, as specified in The full extent of all proxy areas was determined to be 566,848 ha.

Table 25: Description of Proxy Areas

Name	Area	Province
Vanimo Block 1-6 (two timber concessions)	254,552	West Sepik
	312,296	West New Britain
Total Proxy Area	**566,848**	

Table 26. The selected proxy areas were all classified as productive timber harvest areas and therefore were under the management of the same class of deforestation agent as in the Project Area. The full extent of all proxy areas was determined to be 566,848 ha.

Table 25: Description of Proxy Areas

Name	Area	Province
Vanimo Block 1-6 (two timber concessions)	254,552	West Sepik
	312,296	West New Britain
Total Proxy Area	**566,848**	

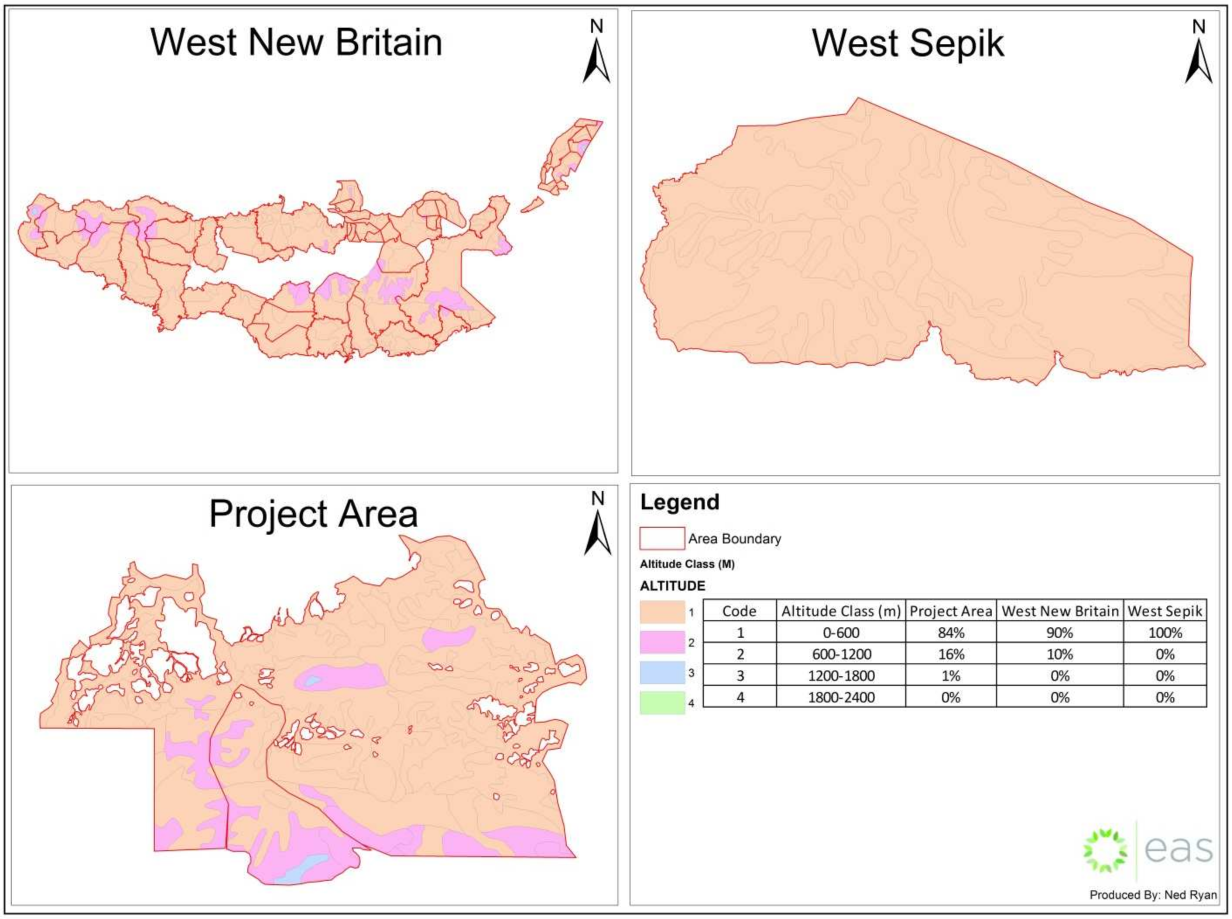
Table 26: Demonstration of Applicability of Selected Proxy Area

Applicability Criteria	Project Compliance

Land conversion practices shall be the same as those used by the baseline agent or class of agent	All of the proxy areas are areas managed as timber concessions. These areas are subject to the same requirements under the Forestry Code of Practice and therefore are subject to the same land use practices.
The post-deforestation land use shall be the same in the proxy areas as expected in the project area under business as usual	The post deforestation land use is expected to be the same (i.e. logging infrastructure such as primary, secondary and tertiary logging roads).
The proxy areas shall have the same management and land use rights types as the proposed project area under business as usual	All of the proxy areas are defined as FMAs or TRPs. These are all subject to logging practices prescribed under the Logging Code of Practice. Logging operations within all the proxy areas were overseen by the Papua New Guinea Forest Authority.
Proximity of suitable sites to the Project Area	Two active FMAs were selected in the Province of West Sepik, which is in close proximity to the Project Area. Logging concessions in West New Britain Province were also selected based on the having a similar (low) population density to that of East Sepik, where the Project is located. As population has been found to influence land use conversion rates, proxy areas were selected to eliminate population pressure artificially inflating deforestation rates in the Project Area.
Applicability Criteria	**Project Compliance**
Agents of deforestation in proxy areas must have deforested their land under the same criteria that the project lands must follow	Timber harvest operations within all proxy areas selected are subject to compliance with the Papua New Guinea Logging Code of Practice. Any logging operations in the Project Area would also have to comply with the Code.
Deforestation in the proxy areas shall have occurred within the 10 years prior to the baseline period	Deforestation within the proxy areas was identified over the period 2000 – 2009.

The four following conditions shall be met: 1. The forest types surrounding the proxy area or in the proxy area prior to deforestation shall be in the same proportion as in the project area (±20%). 2. 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 proxy area in the same proportion as the project area (±20%). 3. The ratio of slope classes "gentle" (slope <15%) to "steep" (slope ≥15%) in the proxy areas shall be (±20%) the same of the ratio in the project area. 4. Elevation classes (500m classes) in the proxy area shall be in the same proportion as in the project area (±20%).	A comparison of the project area to the proxy areas (grouped according to Province) was conducted, and the results are shown in the maps and Tables below. The forest types, soil types, slope classes and elevation classes were found to be within ±20% in all cases. The numerical comparison of these variables is available to the auditor on request.

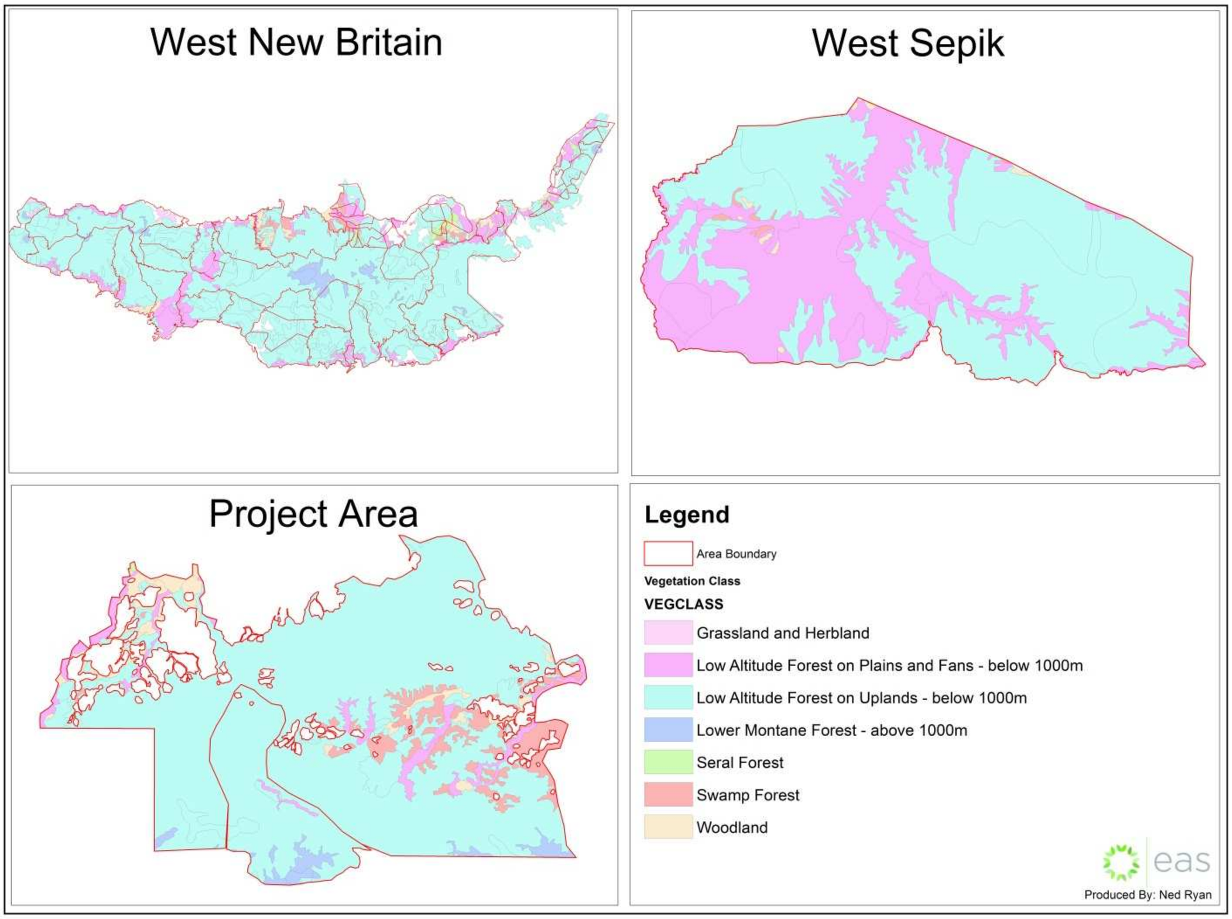
Figure 25: Comparison of altitude classes in the Project Area to those in the Proxy Areas



Code	Altitude Class (m)	Project Area	West New Britain	West Sepik
1	0-600	84%	90%	100%
2	600-1200	16%	10%	0%
3	1200-1800	1%	0%	0%
4	1800-2400	0%	0%	0%

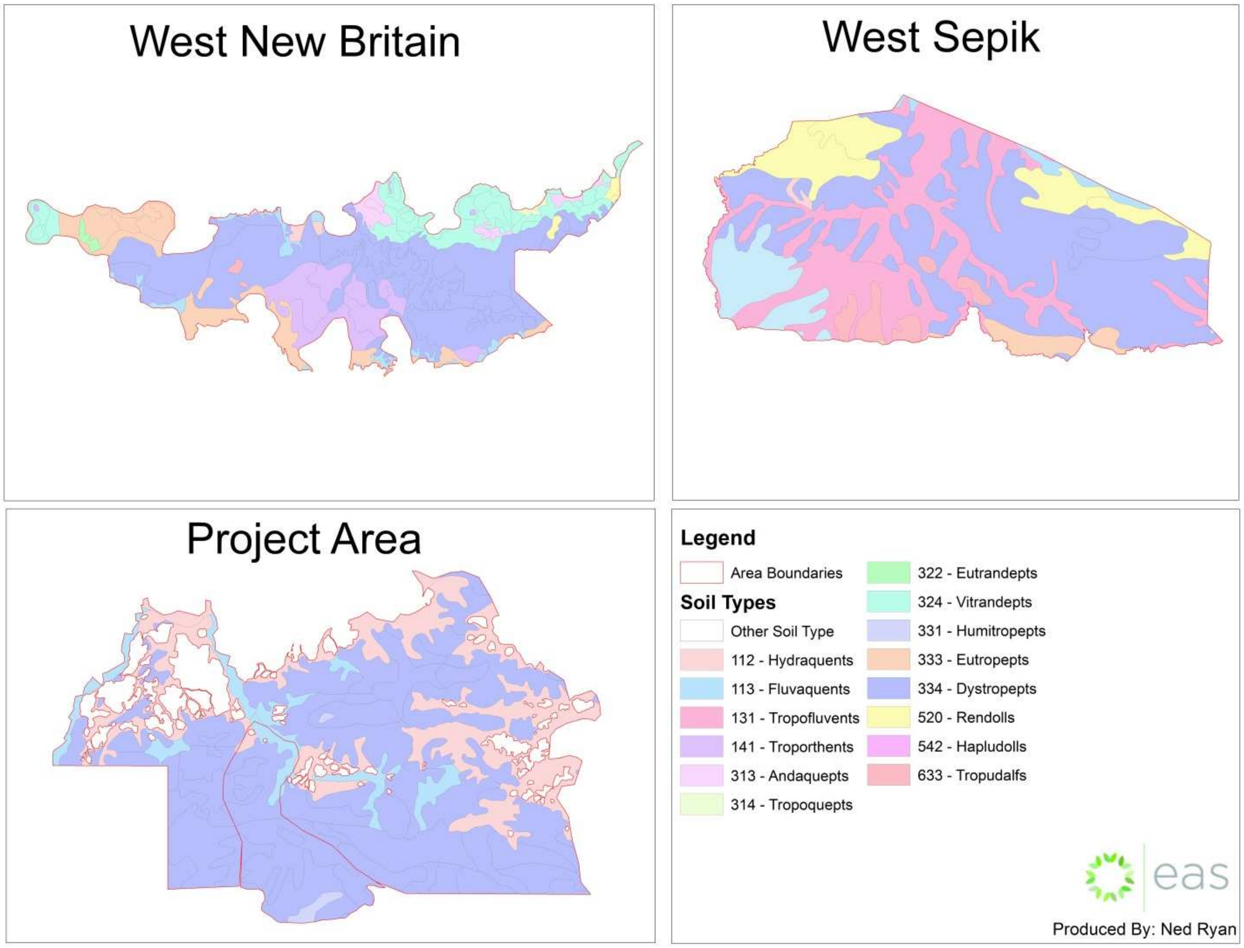
Source: EAS for Rainforest Project Management, 2012

Figure 26: Comparison of vegetation types in the Project Area to those in the Proxy Areas



Source: EAS for Rainforest Project Management, 2012

Figure 27: Comparison of soil types in the Project Area to those in the Proxy Areas



Source: EAS for Rainforest Project Management, 2012

The deforestation rate in the Proxy Areas was calculated by conducting a Land Use/Land Cover (LULC) change assessment, according to the methodology described in Annex 5. The average deforestation rate observed in the proxy areas was used to model the rate of deforestation due to road establishment, as per the equation below.

$$D\%_{planned,i,t} = \left(\sum_{pn=1}^{n*} \left(D\%_{pn} / Yrs_{pn} \right) \right) / n \qquad \text{Equation BL-PL 2}$$

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) of a proxy area 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 proxy area; years
n	Total number of land parcels examined
pn	1, 2, 3, …n* land parcels examined in proxy area
i	1, 2, 3, …M strata

The data applied in Equation BL-PL2 for each of the proxy areas is presented in Table 27.

Table 27: Proxy area infrastructure deforestation rate data

Proxy Area Name	Area (hectares)	Annual Road Develop over Phase 1^ (ha yr^{-1})	Annual Road Development over Phase 2* (ha yr^{-1})	$D\%_{pn}$	Yrs_{pn}
Vanimo Block 1-6	244,107	1801	2219	1.65	9
West New Britain	246,263	1883	1281	1.28	9

^Phase 1 is the 4 year period 2000 – 2004

* Phase 2 is the 5 year period from 2005 - 2009

As a result of this analysis it was determined that the roads are established at an annual linear rate of 0.172% of the total Project Area until the desired road density specified in the plan is achieved which was estimated to be 19 years. Based on the LULC analysis conducted in the area that were .

3.5.6 Likelihood of Deforestation (L-Di)

According to the BL-PL module, if planned deforestation in the Project is not under government control, the likelihood of deforestation is assumed to be 100%. This assumption applies for this Project, as the deforestation, once approved by the Government, is carried out on privately owned land by a privately-owned timber harvesting company on a commercial basis.

3.5.7 Risk of Abandonment

The risk of abandonment was assessed in the six proxy areas defined in Table 25. Within the 10 year observation period, deforestation continued and no FMAs were abandoned. The LULC matrices listed below, reveal that none of the areas cleared for infrastructure or non-infrastructure uses across the entire reference region reverted back to forest in the 10 year period assessed.

Table 28: Land use Change Matrix – West New Britain

RR_WNB (p1 activity)			2000-2004		
Final \ Initial	Forest	Non-forest	Infra	Rivers	*Final area*
Forest	1,379,585.3				*1,379,585.3*
Non-forest	17,649.5	105,358.4			*123,007.9*
Infra	1,366.9		9,782.6		*11,149.5*
Rivers				5,900.9	*5,900.9*
Initial area	*1,398,601.8*	*105,358.4*	*9,782.6*	*5,900.9*	*1,519,643.7*
Net change	**-19,016.5**	**17,649.5**	**1,366.9**	**0.0**	**0.0**

RR_WNB (p2 activity)			2004-2009		
Final \ Initial	Forest	Non-forest	Infra	Rivers	*Final area*
Forest	1,366,336.2				*1,366,336.2*
Non-forest	10,573.3	123,007.9			*133,581.2*
Infra	2,675.8		11,149.5		*13,825.3*
Rivers				5,900.9	*5,900.9*
Initial area	*1,379,585.3*	*123,007.9*	*11,149.5*	*5,900.9*	*1,519,643.7*
Net change	**-13,249.1**	**10,573.3**	**2,675.8**	**0.0**	**0.0**

RR_WNB area (combined activity)			2000-2009		
Final \ Initial	Forest	Non-forest	Infra	Rivers	*Final area*
Forest	1,366,336.2				*1,366,336.2*
Non-forest	28,222.8	105,358.4			*133,581.2*
Infra	4,042.7		9,782.6		*13,825.3*
Rivers				5,900.9	*5,900.9*
Initial area	*1,398,601.8*	*105,358.4*	*9,782.6*	*5,900.9*	*1,519,643.7*
Net change	**-32,265.5**	**28,222.8**	**4,042.7**	**0.0**	**0.0**

Table 29: Land use Change Matrix – West Sepik

RR_WS (p1 activity)		2000-2004		
Final \ Initial	Forest	Non-forest	Infra	Rivers	*Final area*
Forest	240,823.9				*240,823.9*
Non-forest	294.2	5,715.8			*6,010.0*
Infra	1,507.5		3,771.7		*5,279.2*
Rivers				2,502.4	*2,502.4*
Initial area	*242,625.7*	*5,715.8*	*3,771.7*	*2,502.4*	*254,615.5*
Net change	**-1,801.7**	**294.2**	**1,507.5**	**0.0**	**0.0**

RR_WS (p2 activity)		2004-2009			
Final \ Initial	Forest	Non-forest	Infra	Rivers	*Final area*
Forest	238,604.2				*238,604.2*
Non-forest	313.4	6,010.0			*6,323.4*
Infra	1,906.3		5,279.2		*7,185.6*
Rivers				2,502.4	*2,502.4*
Initial area	*240,823.9*	*6,010.0*	*5,279.2*	*2,502.4*	*254,615.5*
Net change	**-2,219.7**	**313.4**	**1,906.3**	**0.0**	**0.0**

RR_WS (combined activity)		2000-2009			
Final \ Initial	Forest	Non-forest	Infra	Rivers	*Final area*
Forest	238,604.2				*238,604.2*
Non-forest	607.6	5,715.8			*6,323.4*
Infra	3,413.9		3,771.7		*7,185.6*
Rivers				2,502.4	*2,502.4*
Initial area	*242,625.7*	*5,715.8*	*3,771.7*	*2,502.4*	*254,615.5*
Net change	**-4,021.4**	**607.6**	**3,413.9**	**0.0**	**0.0**

3.5.8 Annual Area of Deforestation (AAplanned,i,t)

The annual area of planned deforestation was calculated as follows:

$$AA_{planned,i,t} = \left(A_{planned,i} \times D\%_{planned,i,t}\right) \times L - D_i$$ Equation BL-PL 3

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 (e.g. 25% per year for 4 years), 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; %

From land use change analysis conducted in the Project area it was determined that roads are developed throughout the FMA areas, not only in the ‘productive forest areas’. This is believed to be driven by the ultimate intention of converting extensive areas within and to the north of the project area to agriculture. It was estimated based on the land use change analysis that lands on peat soils would not be deforested for road construction, therefore these areas were excluded. Based on extensive LULC change analysis of active and expired timber harvest areas in PNG (Annex ??) the plan to develop a road network to a density of 10m / ha, with width of between 30 and 40m was typical of logging operation in PNG. LandSAT images were used in the detection of roads and logging infrastructure (Annex 5), therefore only deforested areas with a width greater than 30m were detected. The detected deforestation from roads and logging infrastructure within the proxy areas over the 9 year historical period was then used as the proxy for road development rate and annual % was determined as a % of the total FMA area (minus areas that would not be deforested such as areas of significant slope and inundation class).

Based on the available area of this large FMA a total of 18,643 hectares would be expected to be deforested for roads over a 21 year period. Applying the average linear deforestation rate (%) of 0.171% detected in the proxy areas Table 27, the annual area of deforestation in the baseline case was estimated and the result is presented in Table 30. Therefore the information presented in the timber harvest plans were used for supporting evidence that primary, secondary and tertiary roads were planned but the rate of development was determined from historical land use change detected in timber harvest areas of similar traits to the Project Area including forest types, soil inundation classes and population density.

Table 30: Annual area subjected to planned deforestation in the Project Area

Year	Total Planned Deforestation (ha)
1	915
2	915
3	915
4	915
5	915
6	915
7	915
8	915
9	915
10	915
11	915
12	915
13	915
14	915
15	915
16	915
17	915
18	915
19	915
20	915
21	335
Total (in first baseline period)	**18,643**

The location of areas deforested during selective harvesting (due to road construction, logging dumps, harvesting camps and other infrastructure), was based on observations of density and rates of deforested areas for road infrastructure in proxy areas. These observations were then used to develop correlations between spatial variables such as slope, distance to nearest population centres, and other spatial factors. These correlations were used to model road construction in the Project Area using the IDRISI Land Use Change Modeller.[27] A more detailed explanation of the IDRISI modelling process is provided in Annex 5.

[27]For more information about the IDRISI Land Change Modeller, refer to: http://www.clarklabs.org/products/Land-Change-Modeling-IDRISI.cfm

Cross-reference of these deforestation rates against peer-reviewed literature suggests that these rates are likely to be conservative. The ratio of total selectively harvested area to deforested area has been estimated to be 15% in tropical operations (Pulkki, 1997), whereas our modelling produced a ratio of 3.4% deforestation for logging infrastructure. There is also a significant body of published literature that suggests wide scale non-conformance to the logging code and significant degradation and deforestation within Papua New Guinea FMAs (GoPNG, 1989, Forest Trends, 2006, CELCOR and ACF, 2006, Shearman et al, 2008) which also supports that our approach to estimating the deforestation rate is conservative.

3.5.9 Part 2 – Baseline carbon stock change

In accordance with requirements set out in REDD-MF and T-SIG, Table 18 and Table 19 present the carbon pools and greenhouse gas emissions included and excluded in the estimation of baseline (and project) carbon stock change. In accordance with the Methodology, carbon pools excluded from the project are accounted as zero. Herbaceous non-tree vegetation is considered to be *de minimus* in all instances.

In the case of the logging roads, it was assumed that all primary and secondary roads were permanently deforested and maintained for transport. As a result, a carbon stock of zero was assumed for the post deforestation land use. Additional deforestation due to construction of tertiary timber harvesting roads was conservatively excluded. These areas are known to regenerate quickly with pioneer species after completion of the logging operation. Because the rate of deforestation was based on a LULC observed in proxy areas using the Landsat imagery, only permanent deforestation was recorded. Furthermore, the resolution of the satellite images is too small to pick up the narrow tertiary logging roads, and so they were automatically excluded from our baseline modelling.

The included pools were calculated utilising the approved modules, and the following generalised equations:

$$\Delta C_{ABtree,i} = C_{ABtree,bsl,i} - C_{ABtree,post,i}$$ Equation BL-PL 4

$$\Delta C_{ABnon-tree,i} = C_{ABnon-tree,bsl,i} - C_{ABnon-tree,post,i}$$ Equation BL-PL 5

$$\Delta C_{BBtree,i} = C_{BBtree,bsl,i} - C_{BBtree,post,i}$$ Equation BL-PL 6

$$\Delta C_{BBnon-tree,i} = C_{BBnon-tree,bsl,i} - C_{BBnon-tree,post,i}$$ Equation BL-PL 7

$$\Delta C_{LI,i} = C_{LI,bsl,i} - C_{LI,post,i}$$ Equation BL-PL 9

Where:

$\Delta C_{AB\_tree,i}$ Baseline carbon stock change in aboveground tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{AB\_tree,bsl,i}$ Forest carbon stock in aboveground tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{AB\_tree,post,i}$ Post-deforestation carbon stock in aboveground tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$\Delta C_{BB\_tree,i}$ Baseline carbon stock change in belowground tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{BB\_tree,bsl,i}$ Forest carbon stock in belowground tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{BB\_tree,post,i}$ Post-deforestation carbon stock in belowground tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$\Delta C_{AB\_non-tree,i}$ Baseline carbon stock change in aboveground non-tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{AB\_non-tree,bsl,i}$ Forest carbon stock in aboveground non-tree vegetation in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{AB\_non-tree,post,i}$ Post-deforestation carbon stock in aboveground non-tree vegetation in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$\Delta C_{BB\_non-tree,i}$ Baseline carbon stock change in belowground non-tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{BB\_nontree,bsl,i}$ Forest carbon stock in belowground non-tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$C_{BB\_nontree,post,i}$ Post-deforestation carbon stock in belowground non-tree biomass in stratum i; t CO_2-e ha^{-1}. For details see CP-AB.

$\Delta C_{LI,i}$ Baseline carbon stock change in litter in stratum i; t CO_2-e ha^{-1}. For details see CP-L.

$C_{LI,bsl,i}$ Forest carbon stock in litter in stratum i; t CO_2-e ha^{-1}. For details see CP-L.

$C_{LI,post,i}$ Post-deforestation carbon stock in litter in stratum i; t CO_2-e ha^{-1}. For details see CP-L.

As harvesting of long-term wood products is the baseline scenario, carbon storage in the long term harvested wood products pool was included. Calculations were conducted in accordance with module CP-W.

Carbon stock changes in the baseline were estimated according to the following equation:

$$\Delta C_{BSL,i,t} = AA_{planned,i,t} \times (\Delta C_{ABtree,i} + \Delta C_{ABnon-tree,i} + \Delta C_{LI,i}) + \sum_{t-10}^{t} \left(AA_{planned,i,t} \times (\Delta C_{BBtree,i} + \Delta C_{BBnon-tree,i}) \times \frac{1}{10}\right) + \sum_{t-20}^{t} \left(AA_{planned,i,t} \times (C_{WP100,i}) \times \frac{1}{20}\right)$$

Adapted from Equation BL-PL 11

Where:

$\Delta C_{BSL,i,t}$	Sum of the baseline carbon stock change in all pools in stratum i at time t, t CO_2-e
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum i at time t; ha
$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i; t CO_2-e ha^{-1}
$\Delta C_{AB\_tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum i; t CO_2-e ha^{-1}
$\Delta C_{BB\_tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum i; t CO_2-e ha^{-1}
$\Delta C_{AB\_non-tree,i}$	Baseline carbon stock change in aboveground non-tree biomass in stratum i; t CO_2-e ha^{-1}
$\Delta C_{BB\_tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum i; t CO_2-e ha^{-1}
$\Delta C_{BB\_non-tree,i}$	Baseline carbon stock change in belowground non-tree biomass in stratum i; t CO_2-e ha^{-1}
$\Delta C_{LI,i}$	Baseline carbon stock change in litter in stratum i; t CO_2-e ha^{-1}
i	1, 2, 3, … M strata
t	1, 2, 3, … t years elapsed since the projected start of the REDD project activity

3.5.10 Part 3 – Greenhouse gas emissions

The GHG emissions in the baseline within the project boundary were estimated according to the following equation:

$$GHG_{BSL,E,i,t} = E_{BiomassBurn,i,t}$$

Adapted from Equation BL-PL 12

Where:

$GHG_{BSL,E}$	Greenhouse gas emissions as a result deforestation activities within the project boundary in the stratum i in year t; t CO_2-e
$E_{BiomassBurn,i,t}$	Non-CO_2 emissions due to biomass burning in stratum i in year t; t CO_2-e. For details see E-BB.

Emissions due to fossil fuel combustion and application of nitrogen fertilizer in the baseline scenario were conservatively assumed to be zero.

3.5.11 Part 4 – Frequency of baseline renewal

The baseline will be revised every ten years in accordance with the Methodology, as this project is subject to ongoing planned deforestation. The series of tables below summarise the data and parameters that will not be monitored over time. The tables also summarise the source of the data and justification for the choice of default value where applicable.

Table 31: BL-PL Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	$A_{planned,i}$
Data Unit:	Ha
Used in equations:	BL-PL 3
Description:	Total area of planned deforestation over the fixed baseline period for stratum i
Source of data:	The nature of deforestation activities were based on the FMDP for the April Salumei Forest Management Area, in addition to an analysis of typical deforestation rates within six proxy areas. The location of the deforestation activity within the Project Area was predicted and spatially modelled using the IDRISI model.
Value applied:	Over the fixed baseline period 22nd May 2009 – 21st May 2019 Infrastructure related deforestation – 915 hectares per year OR 18,643 hectares over the first 21 years of the project.
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	

Data / Parameter:	$D\%_{planned,i,t}$
Data Unit:	$\%year^{-1}$
Used in equations:	BL-PL 2,3
Description:	Projected annual proportion of land that will be deforested in stratum i at year t
Source of data:	Analysis of land use land change remote sensing data within six proxy areas over a period of nine years.
Value applied:	Over the fixed baseline period 22nd May 2009 – 21st May 2019 Infrastructure related deforestation – 0.181% as a percentage of the entire Project Area.
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	These figures will be revisited at the time of the baseline revision.

Data / Parameter:	L-D
Data Unit:	%
Used in equations:	BL-PL 3
Description:	Likelihood of deforestation in stratum i
Source of data:	N/A
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied:	Areas subject to deforestation are not under Government control and are zoned for deforestation.
Any comment:	

3.6 Estimation of emissions from activity shifting for avoided planned deforestation and planned degradation (LK-ASP)

3.6.1 Applicability

The LK-ASP module must be applied for quantification of leakage emissions due to activity shifting, where forest lands are legally authorized and documented to be converted to non-forest land. Under this module, there are two options for quantification of activity-shifting leakage, where either: 1) the baseline agent of deforestation has been identified; or 2) where only a class of deforestation agents can be identified. While a specific agent of deforestation has been identified (i.e. Road Timber Co. Ltd), option 1 could not be applied, as it requires access to official records of historical deforestation by the baseline agent of deforestation. A search for the requisite data was conducted, and no records of deforestation by the Road Timbers company could be found, either in its current name, or its former name (Gadossi No. 11 Pty Ltd). As a result, option 2 was applied, for circumstances where only a class of deforestation agents can be identified.

3.6.2 Procedures: Part 2: Where only a class of deforestation agents can be identified

Calculation of emissions from activity-shifting leakage involved the following steps as summarised in Table 32 below.

Table 32: Activity shifting leakage calculation steps

Step	Response
Step 1: Identify commodity produced by the baseline class of agent	Timber is the primary product produced by the baseline class of agents. Other agricultural commodities may also be produced; however these were not included in the baseline modelling due to lack of clarity around establishment of these crops.
Step 2: Assess proportion of available areas that are forested	Although the land upon which the deforestation occurs is used for productive timber harvest, the timber removed in the deforestation for logging infrastructure (i.e. roads) does not enter the market (i.e. is it used for road footings or bridges) and therefore cannot contribute to activity shifting leakage. Activity shifting leakage related to the baseline activities is fully accounted in the IFM-LtP component of this Project.
Step 3: Evaluate project area relative to other forested areas for commodity production in the country	The productivity of the Project Area relative to other forested areas was expressed in terms of the ratio of merchantable biomass (annual allowable cut) relative to the total FMA area, from a sample of 26 different FMAs across Papua New Guinea. The data was derived from an analysis conducted by Forest Trends (2006).
Step 4: Assess proportional leakage factor.	The leakage factor of 0 was applied. See Step 2 above for justification.
Step 5: Calculate estimated leakage	Total market leakage was calculated using equation 7 of the methodology.

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t*} \sum_{i=1}^{M} \sum_{c=1}^{C} \left(\left(\Delta C_{BSL,planned} \right) * PF_c * LK_{CP-ME,c,i} \right) \quad \text{Equation LK-ASP 7}$$

Where:

$\Delta C_{LK-AS,planned}$ Net CO_2 emissions due to activity shifting leakage for projects preventing planned deforestation; t CO_2-e

$\Delta C_{BSL,planned}$ Net CO_2 emissions in the baseline from planned deforestation in the project area;
t CO_2-e

PF_c Proportion of available area for production of commodity c that is currently forested; dimensionless;

$LK_{CP-ME,c,i}$ Leakage factor for displacement of class of planned deforestation agents; Dimensionless

C	1, 2, 3, ... C commodities
I	1, 2, 3,… M strata
T	1,2,3,…. t* years elapsed since the start of the REDD project activity

3.6.3 The special case of peatlands

Under the LK-ASP module, if the planned deforestation land-use can be conducted on drained peatlands, the specific agent of deforestation must be known, and activity-shifting onto drained peatlands must be prevented via some form of contract or agreement. As timber harvesting does not involve drainage of peatlands, this provision is not necessary. In addition, logging roads would not be developed on peatland areas and have been excluded from this project. Any proposed agricultural conversion activities have been conservatively omitted from the baseline scenario of this project.

3.6.4 Parameters

The following series of tables describes the parameters not monitored under the monitoring program.

Data / Parameter:	PF_c
Data Unit:	Dimensionless
Used in equations:	7
Description:	Proportion of available area for production of commodity c that is currently forested
Source of data:	
Value applied:	LK-ASP 7
Justification of choice of data or description of measurement methods and procedures applied:	This value will be assumed to be 1 (i.e. displacement is to 100% forested areas), since displacement of logging activities dictates that the displacement area must be forested. This assumption will be re-evaluated if the baseline involves conversion to agricultural products.
Any comment:	

Data / Parameter:	$A_{planned,i}$
Data Unit:	Ha
Used in equations:	BL-PL 3
Description:	Total area of planned deforestation over the fixed baseline period for stratum i
Source of data:	The nature of deforestation activities were based on the FMDP for the April Salumei Forest Management Area, in addition to an analysis of typical deforestation rates within six proxy areas. The location of the deforestation activity within the Project Area was predicted and spatially modelled using the IDRISI model.

Value applied:	Over the fixed baseline period 22nd May 2009 – 21st May 2019 Infrastructure related deforestation – 964 hectares per year OR 17,354 hectares over the first 19 years of the project.
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	

3.7 Estimation of emissions from market leakage (LK-ME)

3.7.1 Applicability

Calculating market-effects leakage from REDD projects is mandatory where the process of deforestation involves timber harvesting for commercial markets. This is because the project activity will reduce levels of wood harvest substantially and permanently, and therefore the risk of production shifting to other areas of the country to compensate for the reduction must be accounted for.

3.7.2 Procedures

Total leakage due to market effects was calculated as equal to the sum of market effects leakage through decreased timber harvest. Leakage due to decreased harvest for fuelwood/charcoal product was excluded, as the PRA suggested that threat was not present in the project area, except in very small quantities for household use. As a result, the following equation was applied:

$$\Delta C_{LK-ME} = LK_{MarketEffects,timber}$$ Adapted from Equation LK-ME 1

Where:

ΔC_{LK-ME} Net greenhouse gas emissions due to market- effects leakage; t CO_2-e

$LK_{MarketEffects,timber}$ Total GHG emissions due to market- effects leakage through decreased timber harvest; t CO_2-e

3.7.3 Market-Effects Leakage Through Decreased Timber Harvest

Leakage due to market effects was calculated using a ‘leakage factor’ approach in accordance with the following equation:

$$LK_{MarketEffects,timber} = \sum_{i=1}^{M} \left(LF_{ME} \times AL_{T,i} \right)$$ Equation LK-ME 2

Where:

$LK_{MarketEffects,timber}$ Total GHG emissions due to market- effects leakage through decreased timber harvest; t CO_2-e

LF_{ME}	Leakage factor for market-effects calculations; dimensionless
$AL_{T,i}$	Summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project; t CO_2-e
i	1,2,3,…M strata

This involved determining where in the country logging might be displaced to when timber supply from the project area is reduced. It was determined that logging displaced due to the deforestation of the roads would be displaced to the approved surrounding FMA and is therefore accounted for in the IFM-LtP quantification section of this Project (i.e. that the timber harvest company would extract up to its annual allowable cut and that timber lost for road construction would be in addition to the annual allowable cut. The leakage from timber extraction is accounted for based on annual allowable cut in the VM010 strata of this Project).

$$AL_{T,i} = \sum_{t=1}^{t} \left(C_{BSL,XBT,i,t} \right)$$ Equation LK-ME 3

Where:

$AL_{T,i}$	Summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project; t CO_2-e
$C_{BSL,XBT,i,t}$	Carbon emission due to displaced timber harvests in the baseline scenario in stratum i in time t; t CO_2-e
i	1, 2, 3, …M strata
t	1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

The carbon emission due to the displaced logging was calculated according to two components: the biomass carbon of the extracted timber (see also module CP-W which uses the same equation) and the biomass carbon in the forest damaged in the process of timber extraction:

$$C_{BSL,XBT,i,t} = \left(\left[V_{BSL,EX,i,t} \times D_{mn} \times CF \right] + \left[V_{BSL,EX,i,t} \times LDF \right] + \left[V_{BSL,EX,i,t} \times LIF \right] \right) \times \frac{44}{12}$$ Equation LK-ME 4

Where:

$C_{BSL,XBT,i,t}$	Carbon emission due to timber harvests in the baseline scenario in stratum i at time t; t CO_2-e
$V_{BSL,EX,i,t}$	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t; m^3
D_{mn}	Mean wood density of commercially harvested species; t d.m.m^{-3}.
CF	Carbon fraction of biomass for commercially harvested species j; t C t d.m.$^{-1}$.
LDF	Logging damage factor; t C m^{-3}
LIF	Logging infrastructure factor; t C m^{-3}
i	1, 2, 3, … M strata

t 1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

A summary of all parameters used for these calculations is provided in Table 33.

Table 33: LK-ME Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	t C t d.m.$^{-1}$
Used in equations:	LK-ME 4
Description:	Carbon Fraction of Dry Matter
Source of data:	IPCC Good Practice Guidance
Value applied:	Default value 0.47 t C t^{-1} d.m.
Justification of choice of data or description of measurement methods and procedures applied:	No species specific values available.
Any comment:	

Data / Parameter:	D_{mn}
Data Unit:	t d.m.m^{-3}
Used in equations:	LK-ME 4
Description:	Mean wood density of commercially harvested species
Source of data:	Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database.[28] Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0. Must use the same value in the CP-W module if this module is used.
Value applied:	0.60
Justification of choice of data or description of measurement methods and procedures applied:	

[28] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

Any comment:	

Data / Parameter:	*LDF*
Data Unit:	t C m^{-3}
Used in equations:	LK-ME 4
Description:	Factor for calculating the biomass of dead wood created during logging operations per cubic meter extracted
Source of data:	Measured by Winrock International from 774 logging gaps in Bolivia, Belize, the Republic of Congo, Brazil and Indonesia (Annex 1 LK-ME)
Value applied:	Default value for broadleaf and mixed forests of 0.53 t C m^{-3}
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	This value will be updated if improved and/or locally specific data becomes available. This update may occur prior to the 10 year mandatory baseline revision.

Data / Parameter:	LIF
Data Unit:	t C m^{-3}
Used in equations:	LK-ME 4
Description:	Factor for calculating the emissions arising from the creation of logging infrastructure (roads, skid trails and decks) during logging operations per cubic meter extracted
Source of data:	Calculated from 1,839 hectares of logging concessions analysed by Winrock International in the Republic of Congo and Brazil, may be used for tropical broadleaf forests (Annex 1 LK-ME)
Value applied:	Conservative default value of 0.29 t CO_2-e m^{-3}
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	This value will be updated if improved and/or locally specific data becomes available. This update may occur prior to the 10 year mandatory baseline revision.

Data / Parameter:	PML_{FT}

Data Unit:	%
Used in equations:	
Description:	Mean merchantable biomass (annual allowable cut) as a proportion of total FMA Area
Source of data:	Forest Trends analysis of FMA operations in Papua New Guinea (Forest Trends, 2011)
Value applied:	0.46
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

Data / Parameter:	PMP_{FT}
Data Unit:	%
Used in equations:	
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum *i* within the project boundaries
Source of data:	Forest Trends analysis of FMA operations in Papua New Guinea (Forest Trends, 2011)
Value applied:	0.30
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

Data / Parameter:	$V_{BSL,EX,i,t}$
Data Unit:	m^3
Used in equations:	LK-ME 4
Description:	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t
Source of data:	The FDMP plan prepared by Road Timber Co combined with the April River Timber Harvest Plan.
Value applied:	460,000m^3 ha^{-1} yr^{-1}
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	This value will not be updated, as the plan is considered the best estimate of the logging practices that would have occurred in the Project Area.

3.8 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB)

3.8.1 Applicability

This module was applied to all forest types and age classes, as per the requirements of the REDD-MF module. Non-tree aboveground biomass was included as part of the project boundary. Although this pool was not mandatory as the non-forest land use is assumed to be permanently maintained roads, which have zero non-tree aboveground biomass. Belowground (tree and non-tree) biomass was included because root allometric equations were available and therefore estimations based on Project Area specific forest inventory could be made. In addition the REDD-MF module recommends the inclusion of this pool.

3.8.2 Procedures

- **Frequency of measurement for baseline above- and belowground biomass stocks**

Measurements of initial stocks employed in the baseline took place in 2012, which is three years after the project start date. This meets the module requirement that initial measurement must be made within ±5 years of the project start date (i.e. t=0). As per the module, it is assumed that the above- and belowground biomass stock estimates will remain valid in the baseline (i.e. treated as constant) for 10 years, after which they will be re-estimated from new field measurements.[29]

[29] At the time of re-measurement, the newly re-measured carbon stock value will be used for the subsequent crediting period if it is within the 90% confidence interval of the t=0 estimate. If it is not within the 90% confidence interval, the t=0 stock estimate takes precedence and is re-employed.

- **Part 1: Aboveground tree biomass: Estimation of carbon stocks in aboveground tree biomass ($C_{AB\_tree,i}$)**

The mean carbon stock in aboveground tree biomass per unit area was estimated based on field measurements via sampling using fixed area plots. An allometric equation from the peer reviewed literature (i.e. Chave et al, 2005) to estimate biomass from measured tree dimensions was applied. The procedures applied are described in more detail below.

Option 1. Fixed Area Plots with Allometric Equation method

Step 1: A field carbon survey was conducted between May and June 2012, to collect information on stocking, tree species, DBH, aboveground non-tree biomass and litter within the Project Area. A detailed description of the field sampling procedures is provided in the supporting documentation. All trees within the plots with a DBH above 10cm were recorded. This minimum DBH will be held constant for the duration of the project.

Step 2: In the absence of species specific or national specific allometric equations in Papua New Guinea, the Chave, et. al. (2005) equation for wet tropical forests was applied. This widely used equation relates DBH and species specific wood density (ρ) to estimate Above Ground Biomass (AGB) per tree measured in the forest plots.

$$f_j(DBH,\rho)_{ab} = \rho \times \exp(-1.239 + 1.98 \times \ln(DBH) + 0.207 \times (ln(DBH))^3$$ Equation - Chave 2005

Where:

$f_j(DBH,\rho)_{ab}$ = aboveground biomass kg d.m. ha^{-1}

ρ = species specific wood density g cm^{-3}

DBH = diameter at breast height (i.e. 1.3m) cm

Validation of applicability

In order to validate the applicability of the Chave equations used to estimate AGB, the source data used to develop the equation was reviewed. The Chave equation collates destructive sampling data from 27 different tropical forest sites, and it was confirmed that one of these sites was a wet, old growth forest type measured at Marafunga in Papua New Guinea. The latitude and longitude of these measurements was entered into Google Earth, and the site was found to be located 313 km to the south east of the Project Area. It can be concluded that the Chave equation is representative of the forest type/species and conditions in the Project Area, and that it covers the range of potential independent variable values. Furthermore, the Chave equation is listed as one of the preferred equation in the parameters section of the CP-AB module.

Step 3: Carbon stock in AGB was calculated using data collected in Step 1 for each individual tree in the sample plot located in stratum *i* using the Chave equation. The sum the carbon stocks in the sample plot was then calculated according to the equation below. Note that because the Chave equation covers all tropical species, there was no need to calculate carbon stock separately for each species group *j*:

$$C_{AB\_tree,sp,i} = \sum_{j}^{S} \sum_{l=1}^{N_{j,sp,i}} f_j(X, Y \ldots) \times CF_j$$ Equation CP-AB 1

Where:

$C_{AB\_tree,sp,i}$ Carbon stock in aboveground biomass of trees in plot sp in stratum i; t C

CF_j Carbon fraction of biomass for species group j; t C t^{-1} d.m.

$f_j(X,Y..)$ Aboveground biomass of trees based on allometric equation for species group j based on measured tree variable(s); t. d.m. $tree^{-1}$

i 1, 2, 3, …M strata

j 1, 2, 3 … S tree species

l 1, 2, 3, … $N_{j,sp,i}$ sequence number of individual trees of species group j in sample plot sp in stratum i

Step 4: The mean carbon stock in AGB for each stratum was then converted to carbon dioxide equivalents using the equation below:

$$C_{AB\_tree,i} = \sum_{sp=1}^{P_i} \frac{C_{AB\_tree,sp,i}}{A_{sp,i}} \times \frac{44}{12}$$ Equation CP-AB 2

Where:

$C_{AB\_tree,i}$ Mean aboveground biomass carbon stock in stratum i; t CO_2-e ha^{-1}

$C_{AB\_tree,sp,i,t}$ Aboveground biomass carbon stock of trees in sample plot sp of stratum i , t C

A_{spi} Area of sample plot sp in stratum i; ha

sp 1, 2, 3 … Pi sample plots in stratum i

i 1, 2, 3 … M strata

$^{44}/_{12}$ Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

- **Part 2: Belowground tree biomass: Estimation of carbon stocks in belowground tree biomass (CBB_tree,i)**

The mean carbon stock in belowground tree biomass per unit area was estimated based on field measurements of aboveground parameters in sample fixed area plots.
A root to shoot ratio was multiplied by the AGB carbon stock, calculated in Part 1, Options 1, to calculate belowground from aboveground biomass.

Option 1: Fixed area plots with root to shoot ratio

Step 1: Belowground tree biomass carbon stock was calculated for each plot in accordance with the following equation:

$$C_{BB_{tree},sp,i} = R \times C_{AB_{tree},sp,i}$$ Equation CP-AB 5

Where:

$C_{BB\_tree,sp,i}$	Belowground tree biomass carbon stock of trees in plot sp, in stratum i; t C
$C_{AB\_tree,sp,i}$	Aboveground tree biomass carbon stock of trees in plot sp, in stratum i; t C
R	Root to shoot ratio; t root d.m. t^{-1} shoot d.m.
i	1, 2, 3, …M strata

A root:shoot ratio of 0.37 t root dm/t AGB was assumed, based on the value for tropical rainforest reported in Table 4.4 of the IPCC Guidelines for AFOLU (2006).

Step 2: The mean belowground tree biomass carbon stock for each stratum was then converted to carbon dioxide equivalents using the equation below:

$$C_{BB_{tree},i} = \sum_{sp=1}^{Pi} \frac{C_{BB_{tree},sp,i}}{A_{sp,i}} \times \frac{44}{12}$$ Equation CP-AB 6

Where:

$C_{BB\_tree,i}$	Mean belowground tree biomass carbon stock in stratum i; t CO_2-e ha^{-1}
$C_{BB\_tree\_sp,i}$	Mean belowground tree biomass carbon stock of trees in plot sp, in stratum i; t C
A_{spi}	Area of sample plot sp in stratum i; ha
sp	1, 2, 3 … Pi sample plots in stratum i
i	1, 2, 3 … M strata
$^{44}/_{12}$	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

- **Part 3: Aboveground non-tree biomass: Estimation of carbon stocks in aboveground non-tree woody biomass ($C_{AB\_nontree,i}$)**

The non-tree woody aboveground biomass pool was defined as trees smaller than the minimum tree size measured in the tree biomass pool (i.e. <10cm), all shrubs, and all other non-herbaceous live vegetation. Non-tree vegetation in primary intact tropical forest was sampled using destructive sampling frames in sampling plots. A brief summary of the field procedures is provided in the section below. A more detailed explanation of the field procedures was provided in the supporting documentation (Annex 9).

Because in all cases, aboveground non-tree biomass was measured using the sampling frame method, a modified version of CP-AB equation 9 was used to calculate the mean carbon stock in the aboveground non-tree biomass.

$$C_{AB_{nontree},i} = C_{AB_{nontree_{sample}},i}$$ Modified from equation CP-AB 9

Where:

$C_{AB\_nontree,i}$	Mean aboveground non-tree biomass carbon stock in stratum i; t CO_2-e ha^{-1}
$C_{AB\_nontree\_sample,i}$	Mean aboveground non-tree biomass carbon stock in stratum i from sample frame method; t CO_2-e ha^{-1}
i	1, 2, 3 … M strata

Option 1. Sampling Frame Method:
Large square frames of $1m^2$ were used to collect non-tree vegetation. The frame was placed systematically in the opposite corner of the 'start' point for the biomass plot[30]. At each location, all vegetation originating from inside the frame was cut at the base and weighed. One representative subsample of the cut material was weighed to obtain its wet mass. The collected subsample was taken to a laboratory, oven dried and weighed to determine the dry mass. The wet to dry ratio of the subsample was then used to estimate the dry mass of the original sample.

The following equation was applied to estimate the mean carbon stock per unit area in the aboveground non-tree biomass for each stratum:

$$C_{AB_{nontree\_sample},i} = \sum_{sfp=1}^{SFPi} \frac{C_{AB_{nontree\_sample},sf,i}}{A_{sfp,i}} \times CF \times \frac{44}{12}$$ Equation CP-AB 10

Where:

$C_{AB\_nontree\_sample,i}$	Carbon stock in aboveground non-tree vegetation in sampling plot in strata i from sample method; t CO_2-e ha^{-1}
$C_{AB\_,nontree\_sample,sp,i}$	Carbon stock in aboveground non-tree vegetation in sample plot sfp in stratum i from sampling frame method; t d.m.
CF_j	Carbon fraction of dominant non-tree vegetation j; t C t $d.m.^{-1}$
A_{sfpi}	Area of non-tree sampling plot s fp in stratum i; ha
sfp	1, 2, 3 … SFPi sample plots in stratum i
i	1, 2, 3 … M strata

[30] See Annex 9

$^{44}/_{12}$	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

- **Part 4: Belowground non-tree biomass: Estimation of belowground carbon stocks in non-tree vegetation ($C_{BBnontree,i}$)**

The mean carbon stock in belowground biomass per unit area was estimated based on field measurements of aboveground parameters in sample plots. As for ABG tree carbon stock, root to shoot ratios were applied to the aboveground non-tree biomass estimate to calculate belowground from aboveground biomass. The same root:to shoot ratio as for tree biomass (i.e. 0.37) was assumed to apply for the non-tree biomass. The following equation was then applied to estimate the belowground biomass from aboveground biomass carbon stock in non-tree vegetation in sample plot sp of stratum i, t C:

$$C_{BB_{nontree},i} = C_{ABnontree,i,sp} \times R \qquad \text{Equation CP-AB 13}$$

Where:

$C_{AB\_nontree,i,sp}$	Aboveground biomass carbon stock in non-tree vegetation in sample plot sp of stratum i, t C
$C_{BB\_nontree,i,sp,t}$	Belowground biomass carbon stock in non-tree vegetation in sample plot sp of stratum i, t C
R	Root to shoot ratio; t root d.m. t^{-1} shoot d.m.
I	1, 2, 3 … M strata
sp	1, 2, 3 … Pi sample plots in stratum i

The mean carbon stock in belowground biomass for each stratum was then converted to carbon dioxide equivalents:

$$C_{BB\_nontree,i} = \sum_{sp=1}^{Pi} \frac{C_{BB_{nontree},sp,i}}{A_{sp,i}} \times \frac{44}{12} \qquad \text{Equation CP-AB 14}$$

Where:

$C_{BB\_nontree,i}$	Mean belowground biomass carbon stock in stratum i; t CO_2-e ha^{-1}
$C_{BB\_nontree,i,sp}$	Belowground biomass carbon stock in non-tree vegetation in sample plot sp of stratum i; t C
A_{spi}	Area of sample plot sp in stratum i; ha
sp	1, 2, 3 … Pi sample plots in stratum i
i	1, 2, 3 … M strata
$^{44}/_{12}$	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

Table 34: CP-AB Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	tC t^{-1} d.m.
Used in equations:	CP-AB 1, 10
Description:	Carbon fraction of dry matter
Source of data:	IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3
Value applied:	Default value 0.47 tC t^{-1} d.m. was used.
Measurement procedures (if any)	None
Any comment:	The default values should be used for all species.

Data / Parameter:	fj(X,Y)
Data Unit:	t d.m. $tree^{-1}$
Used in equations:	1,3
Description:	Allometric equation for species j linking measured tree variable(s) to aboveground biomass of living trees, expressed as t d.m. $tree^{-1}$
Source of data:	In the absence of a National allometric equation specific to Papua New Guinea, an allometic was selected based on DBH and species specific wood density from Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.-P. Lescure, B. W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145: 87-99. The equation was developed from 416 trees (42 of which were from Papua New Guinea), and is based on a statistically significant regression with an r^2 = 0.99
Value applied:	$f_j(DBH,\rho)_{ab} = \rho \times \exp(-1.239 + 1.98 \times \ln(DBH) + 0.207 \times (ln(DBH))^3$ Where: $f_j(DBH,\rho)_{ab}$ = aboveground biomass kg d.m. ha^{-1} ρ = species specific wood density g cm^{-3} DBH = diameter at breast height (i.e. 1.3m) cm
Measurement procedures (if any)	
Any comment:	Should allometrics for Papua New Guinea be available when the baseline is renewed, the Chave equation will be replaced by the locally developed equation.

Data / Parameter:	R
Data Unit:	t root d.m. t^{-1}shoot d.m.
Used in equations:	CP-AB 5, 13
Description:	Root to shoot ratio appropriate to species or forest type/biome. The root to shoot ratio is applied as belowground biomass per unit area:aboveground biomass per unit area (not on a per stem basis)
Source of data:	Table 4.4 of the IPCC Guidelines for AFOLU (2006).
Value applied:	A root:shoot ratio of 0.37 t root dm/t AGB was assumed, based on the value for tropical rainforest reported in
Measurement procedures (if any)	
Any comment:	Global values from Table 4.4 of the AFOLU Guidelines were selected by choosing the climatic zone and forest type that most closely matches the April Salumei Project Area. The mean values of default values selected from Table 4.4 of the AFOLU Guidelines are considered conservative.

3.9 Estimation of carbon stocks in the litter pool (CP-L)

3.9.1 Applicability

The (optional) litter pool was included as part of the Project boundary (see Table 18).

3.9.2 Procedure

- Frequency of measurements for baseline litter stocks

Measurement of the initial carbon stock in the litter pool took place as part of the field inventory undertaken between May and June 2012. This meets the module requirement that measurements are taken within 5 years from the project start date.

- Part 1. Ex-ante estimation of carbon stocks in litter

The mean carbon stock per unit area of litter in the Project Area was calculated as follows:

$$C_{LI,i} = \frac{10}{A_{sp,i}} \times \sum_{sp=1}^{Pi} B_{LI,sp,i} \times CF \times \frac{44}{12}$$ Equation CP-L 1

Where:

$C_{LI,i}$	Mean carbon stock in litter for stratum i; t CO_2-e ha^{-1}
$B_{LI,sp,i}$	Biomass of litter in sample plot *sp* in stratum i; kg d.m.
CF	Carbon fraction; t C t^{-1}d.m.
$A_{sp,i}$	Total area of all sample plots in stratum i; m^{-2}
sp	1, 2, 3, … Pi sample plots in stratum i
i	1, 2, 3, … M strata
44/12	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

Litter samples were collected from field sample plots using a 1m sampling frame. More details about the field inventory procedures are provided in the supporting documentation (Annex 9). In summary, the fresh (wet) weight of all litter collected within the sampling frame was weighed in the field. A sub-sample of this litter was collected and taken back to the laboratory, where it was dried to a constant weight. This was used to create a dry weight:wet weight ratio, which was then multiplied by the wet weight of the sample to calculate the biomass of litter in each sample plot ($B_{LI,sp,i}$) according to the following equation (not listed in the CP-L module):

$$B_{LI,sp,i} = \left(\frac{subsample\ dry\ mass}{subsample\ fresh\ mass}\right) * fresh\ mass\ of\ whole\ sample$$

The following Table describes the list of data and parameters that were used in the calculation of litter carbon stocks.

Table 35: CP-L Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	tC t^{-1} d.m.
Used in equations:	CP-L 1
Description:	Carbon fraction of dry matter
Source of data:	CP-L Module
Value applied:	Default value 0.37 tC t^{-1} d.m. is used.
Measurement procedures (if any)	None
Any comment:	None

3.10 Estimation of carbon stocks in the long-term wood products pool (CP-W)

3.10.1 Applicability

Deforestation in the baseline scenario is due to road construction for a timber harvesting operation. As a result, it seems likely that wood removed during the road construction would have been converted to wood products destined for commercial markets. In addition, the wood project pool is determined to be significant. As a result, the wood products pool is part of the Project boundary (see Table 18).

3.10.2 Procedure

- **Frequency of Update of oxidation factors**

The approach outlined in the CP-W module employs a series of emission factors for Wood Waste, (WW), the Short Lived Fraction of wood products with a service life of less than 5 years (SLF), and the additional Oxidised Fraction (OF) with a service life of between 5 – 100 years. The emission factors for each of the wood product categories are derived by Winjum et al. 1998, and were updated in accordance with the requirements of VCS Standard version 3, which required accounting for medium-term wood products. The project proponent will review the peer reviewed literature at least every 10 years, to identify and utilise improved, empirically-based and locally-appropriate emission factors.

- **Ex ante estimation of carbon stocks in the wood products pool in the baseline**

Section 4.5.3 of the VCS AFOLU Requirements specifies that all wood products with a service life of between 3 and 100 years must be accounted for via a 20 year decay function. Wood products with a 100 year service life are assumed to be permanently sequestered, and all other wood products are assumed to be emitted at the time of harvest.

The module allows for two methods for calculation of the volume of timber extracted during harvest. As the project has an approved timber harvest plan which specifies the harvest intensity per strata (i.e. volume extracted per hectare), Option 1 of CP-W was applied.

Option 1: Direct Volume Extraction Estimation

Step 1: Identification of wood product classes

The wood product classes were assumed to be the same as those specified in the FMDP, being: sawn timber; veneer and ply; and log export. It is assumed that it would not make sense for the logging company to sell timber harvested from the roads into a different market than timber harvested from the adjacent logging areas.

Step 2: Calculation of biomass carbon of the volume extracted by wood product type ty within the project boundary

For the purposes of estimating the volume of timber extracted as wood product from the deforested areas, it was assumed that the logging company would harvest all trees down to a 20cm DBH. While this is below the minimum merchantable log volume allowed for commercial timber harvesting, the construction of roads necessitates removal of all trees, regardless of size. Therefore it was conservatively assumed that the logging company would salvage any commercial value from species regardless of size. Our own forest inventory data was used to calculate the merchantable volume of all trees above 20cm DBH, using a merchantable volume equation provided by the Papua New Guinea Forest Authority. The 20cm+ merchantable volume estimate was already expressed on a per hectare basis, and therefore a modified version of the CP-W equation (to remove the division by area) was applied, as per the equation below:

$$C_{XB,ty,i} = \sum_{j=1}^{S} \left(V_{ex,ty,j,i} \times D_j \times CF_j \times \frac{44}{12} \right)$$ Modified from equation CP-W 1

Where:

$CXB_{w,fcl,t}$	Mean carbon stock of extracted biomass carbon by class of wood product ty from stratum i; tCO_2-e ha^{-1}
$V_{ex,ty,j}$	Volume of timber extracted from within stratum i (does not include slash left onsite) by species j and wood product class ty; m^3
D_j	Mean wood density of species j; t d.m.m^{-3}
CF_j	Carbon fraction of biomass for tree species j; tC t^{-1}d.m.
j	1, 2, 3 … S tree species; dimensionless
ty	wood product class – defined as sawnwood (s), wood based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
$44/12$	Ratio of molecular weight of CO_2 to carbon; dimensionless

The wood density value used was the weighted mean average of all commercial species listed in the FMDP.

Step 3: Calculation of the proportion of biomass carbon extracted that remains sequestration in long-term wood products after 100 years.

The following equation was then applied to calculate the quantity of extracted biomass carbon that enters the wood products pool:

$$C_{WP,i} = \sum_{ty=s,w,oir,p,o} C_{XB,ty,i} \times (1 - WW_{ty})$$ Equation CP-W 2

Where:

$C_{WP,i}$	Carbon stock entering the wood products pool from stratum i; t CO_2-e ha^{-1}
$C_{XB,ty,i}$	Mean stock of extracted biomass carbon by class of wood product ty from stratum i; t CO_2-e ha^{-1}
WW_{ty}	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product ty; dimensionless
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
i	1, 2, 3, … M strata

Step 4: Calculate the amount of wood products entering the pool at the time of deforestation that is expected to be emitted over a 100-year timeframe

The following equation was applied to calculate the amount of carbon in the wood products pool that will be expected to be emitted in the 100 years after harvest.

$$C_{WP100,i} = C_{WP,i} - C_{WP,i} \times (1 - SLF_{ty}) \times (1 - OF_{ty})$$ Equation CP-W 3

Where;

$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i; t CO_2-e ha^{-1}
$C_{WP,i}$	Carbon stock entering wood products pool at time of deforestation from stratum i; t CO_2-e ha^{-1}
SLF_{ty}	Fraction of wood products that will be emitted to the atmosphere within 3 years of timber harvest by class of wood product ty; dimensionless
OF_{ty}	Fraction of wood products that will be emitted to the atmosphere between 3 and 100 years of timber harvest by class of wood product ty; dimensionless
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
i	1, 2, 3, … M strata

The carbon decay functions for the wood product pools were applied as part of the BL-PL module.

Table 36: CP- W Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF_j
Data Unit:	t C t^{-1} d.m.
Used in equations:	CP-W 1
Description:	Carbon fraction of dry matter in t C t^{-1} d.m. for species j
Source of data:	Default value is used.
Value applied:	0.47
Measurement procedures (if any)	None
Any comment:	None

Data / Parameter:	Dj
Data Unit:	t d.m. m^{-3}
Used in equations:	CP-W 1
Description:	Basic wood density in t d.m. m^{-3} for species j
Source of data:	Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database.[31] Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.
Value applied:	0.60
Measurement procedures (if any)	None
Any comment:	None

Data / Parameter:	SLF_{ty}
Data Unit:	dimensionless
Used in equations:	CP-W 2
Description:	Fraction of wood products that will be emitted to the atmosphere within 3 years of production by class of wood product ty.
Source of data:	Winjum et al. 1998, updated to reflect changes to the VCS Standard version 3, which defines the medium term fraction as all wood products that decay between 3 – 100 years after harvest.

[31] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

<table>
<tr><td>Value applied:</td><td><table><tr><th>Wood Product Class</th><th>SLF</th></tr><tr><td>Sawnwood</td><td>0.12</td></tr><tr><td>Woodbase Panel</td><td>0.06</td></tr><tr><td>Other industrial Roundwood</td><td>0.18</td></tr><tr><td>Paper and Paperboard</td><td>0.24</td></tr><tr><td>Other classes of wood products</td><td>1.0</td></tr></table></td></tr>
<tr><td>Measurement procedures (if any)</td><td>None</td></tr>
<tr><td>Any comment:</td><td>Parameter values were updated in accordance with the new VCS Requirements for wood product accounting, as per the values reported in VCS Approved methodology, VM003</td></tr>
</table>

Data / Parameter:	WW_{ty}
Data Unit:	dimensionless
Used in equations:	CP-W 2
Description:	Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood product ty.
Source of data:	Winjum et al. 1998
Value applied:	WW is therefore equal to $CXB,_{ty}$ multiplied by 0.24 for developing countries.
Measurement procedures (if any)	None
Any comment:	Parameter values to be updated if new empirically based peer-reviewed findings become available.

3.11 Estimation of greenhouse gas emissions from biomass burning (E-BB)

3.11.1 Applicability

Fire in the baseline is optionally excluded. Where fires occur ex-post the module is used to account greenhouse gas emissions.

3.11.2 Procedure

Fire is not used for the deforestation related to road development (i.e. infrastructure related deforestation). Where fires occur ex-post, this model is used to account for greenhouse gas emissions. The most likely biomass burning in the project scenario will be small scale: Burning in forest land remaining forest land (associated with traditional gardening).

Greenhouse gas emissions from biomass burning are determined using the following equation:

$$E_{BiomassBurn,i,t} = \sum_{g=1}^{G}\left(\left(\left(A_{burn,i,t} \times B_{i,t} \times COMF_i \times G_{g,i}\right) \times 10^{-3}\right) \times GWP_g\right) \qquad \text{Equation E-BB 1}$$

Where:

$E_{BiomassBurn,t}$	Greenhouse emissions due to biomass burning as part of deforestation activities in stratum i in year t; tCO_2-e of each GHG (CO_2, CH_4, N_2O)
$A_{burn,i,t}$	Area burnt for stratum i at time t; ha
$B_{i,t}$	Average aboveground biomass stock before burning stratum i, time t; tonnes d. m. ha^{-1}
$COMF_i$	Combustion factor for stratum i; dimensionless (see annex 1 for default values as derived from Table 2.6 of IPCC, 2006)
$G_{g,i}$	Emission factor for stratum i for gas g; kg t^{-1} dry matter burnt (see section III and annex 2 for default values as derived from Table 2.5 of IPCC, 2006)
GWP_g	Global warming potential for gas g; t CO_2/t gas g (default values from IPCC SAR: CO_2 = 1; CH_4 = 21; N_2O = 310)
g	1, 2, 3 ... G greenhouse gases (to include CO_2[32]; CH_4; and N_2O)
i	1, 2, 3 …M strata
t	1, 2, 3, … t* years elapsed since the start of the REDD project activity

The average aboveground biomass stock before burning for a particular strata is estimated according to:

$$B_{i,t} = \left(C_{AB_{tree},i,t} + C_{DW,i,t} + C_{LI,i,t}\right) \times \frac{12}{44} \times \left(\frac{1}{CF}\right) \qquad \text{Equation E-BB 2}$$

[32] Carbon dioxide is omitted as carbon dioxide emissions are calculated in CP-AB as stock change.

Where:

$B_{i,t}$	Average aboveground biomass stock before burning for stratum i, time t; tonnes d. m. ha^{-1}
$C_{AB\_tree,i,t}$	Mean aboveground biomass carbon stock in stratum i at time t; t CO_2-e ha^{-1} (estimated using the CP-AB)
$C_{DWi,t}$	Carbon stock in dead wood for stratum i, at time t; t CO_2-e ha^{-1} (estimated using CP-D)
$C_{LI,i,t}$	Mean carbon stock in litter for stratum i, at time t; t CO_2-e ha^{-1} (estimated using CP-L)
12/44	Inverse ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}
CF	Carbon fraction of biomass; t C t^{-1} d.m. (default carbon fraction of biomass is 0.47 tC t^{-1} d.m.
i	1, 2, 3 …M strata
t	1, 2, 3, … t* years elapsed since the start of the REDD project activity

Table 37: E-BB Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	tC t^{-1} d.m.
Used in equations:	E-BB 2
Description:	Carbon fraction of dry matter
Source of data:	IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3
Value applied:	Default value 0.47 tC t^{-1} d.m. is used.
Measurement procedures (if any)	None
Any comment:	None

Data / Parameter:	$COMF_i$
Data Unit:	Dimensionless
Used in equations:	E-BB 1
Description:	Combustion factor for stratum i (vegetation type)
Source of data:	Default values in Table 2.6 of IPCC, 2006 (Annex 2)
Value applied:	(see table below)
Measurement procedures (if any)	None
Any comment:	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread). Default values shall be updated whenever new guidelines are produced by the IPCC.

Value applied:

Vegetation Type	**Subcategory**	**Mean**	**SD**
Primary Tropical Forest	Primary Tropical Forest	0.32	0.12
Secondary Tropical Forest (slash and burn)	Young Tropical Forest (3-5 years)	0.46	-
Secondary Tropical Forest (slash and burn)	Intermediate Tropical Forest (6-10 years)	0.67	0.21
Secondary Tropical Forest (slash and burn)	Advanced Tropical Forest (14-17 years)	0.50	0.10

Data / Parameter:	G_{gi}
Data Unit:	g kg^{-1} dry matter burnt
Used in equations:	E-BB 1
Description:	Emission factor for stratum i for gas g
Source of data:	Defaults sourced from Volume 4, Chapter 2 of the IPCC 2006 Inventory Guidelines, Table 2.5.
Value applied:	(see table below)
Measurement procedures (if any)	None
Any comment:	Default values shall be updated whenever new guidelines are produced by the IPCC.

Category	**CO_2**	**CH_4**	**N_2O**
Tropical Forest	1580	6.8	0.20

3.12 Estimation of uncertainty for REDD project activities (X-UNC)

3.12.1 Applicability

The mandatory uncertainty module was applied to estimate uncertainty of estimates of emissions and removals of CO_2-e generated from REDD project activities. The module focuses on the following sources of uncertainty:

- Determination of rates of deforestation
- Uncertainty associated with estimation of stocks in carbon pools and changes in carbon stocks
- Uncertainty in assessment of project emissions

Where an uncertainty value was not known or could not be simply calculated, justification was provided in the parameter tables demonstrating that the selected number was indisputably conservative and subsequently an uncertainty of 0% was used.

A precision target of a 95% confidence interval equal to or less than 15% of the recorded value was targeted. Sufficient measurement plots were targeted to achieve this precision level across the significant measured stocks.

3.12.2 Procedures

- Part 1 – Uncertainty in Baseline Estimates

Step 1: Assess uncertainty in projection of baseline rate of deforestation

As the rate of deforestation is derived from measurements taken in proxy areas, the uncertainty is equal to the 95% confidence interval as a percentage of the mean of the area deforested in each proxy ($D\%_{pn}$) divided by the number of years over which deforestation occurred in each proxy (Yrs_{pn}).

Uncertainty is calculated according to:

$$Uncertainty = SE\ x\ t$$ Equation X-UNC A

Where:

Uncertainty	in units of tCO_2e / ha
SE	standard error of the estimate in tCO_2e / ha)
t	t value for n-1 from standard tables

and

$$SE = \frac{SD}{\sqrt{n}}$$ Equation X-UNC B

Where ,

SD	standard deviation in unots of tCO_2e /ha
n	number of plots/samples, dimensionless

Step 2: Assess uncertainty of emissions and removals in project area

Uncertainty was calculated for the aboveground biomass, belowground biomass and litter pools. The total uncertainty of all pools was combined and expressed as the 95% confidence interval as a percentage of the mean using the following equation.

$$\mathrm{Uncertainty_{BSL,SS,i}} = \frac{\sqrt{\sum_1^n (\mathrm{U_{BSL,SS,i,pool\#}} \times \mathrm{E_{BSL,SS,i,pool\#}})^2}}{\sum_{i=1}^{M} \mathrm{E_{BSL,SS,i,pool\#}}}$$ Equation X-UNC 4

Where:

$Uncertainty_{BSL,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in the baseline case in stratum *i*; %
$U_{BSL,SS,i,pool\#}$	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case in stratum *i* (1,2…n represent different carbon pools and/or GHG sources); %
$E_{BSL,SS,i,pool\#}$,	Carbon stock or GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in stratum *i* (1,2…n represent different carbon pools and/or GHG sources) in the baseline case; t CO_2-e
i	1, 2, 3 …*M* strata

Step 3: Estimate total uncertainty in baseline scenario

The total uncertainty across all combined strata was calculated using the following equation:

$$\text{Uncertainty}_{\text{BSL,SS}} = \frac{\sqrt{\sum_1^n (\text{U}_{\text{BSL,SS,i}} * \times \text{E}_{\text{BSL,SS,i}})^2}}{\sum_{i=1}^{M} \text{E}_{\text{BSL,SS,i}}}$$ Equation X-UNC 5

Where:

$Uncertainty_{BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the baseline case; %
$Uncertainty_{BSL,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in stratum *i* in the baseline case; %
$E_{BSL,SS,i}$	Sum of combined carbon stocks and GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning in stratum *i* (1,2…n represent different carbon pools and/or GHG sources) multiplied by the area of stratum *i* (A_i) in the baseline case; t CO_2-e
i	1, 2, 3 …*M* strata

Incorporating rate uncertainty:

$$\text{Uncertainty}_{\text{BSL,t*}} = \sqrt{\left(\text{Uncertainty}_{\text{BSL,RATE,t*}}{}^2 + \text{Uncertainty}_{\text{BSL,SS}}{}^2\right)}$$ Equation X-UNC 6

Where:

$Uncertainty_{BSL,t*}$	Cumulative uncertainty in baseline scenario through time t; %
$Uncertainty_{BSL,RATE}$	Cumulative uncertainty in the baseline rate of deforestation through time t; %
$Uncertainty_{BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the baseline case; %
i	1, 2, 3, …*M* strata

- **Part 2 – Uncertainty Ex-Post in the With-Project Scenario**

Area of deforestation or degradation in the with-project scenario was calculated directly using the same accuracy assessment criterion as used in the baseline (i.e. a required accuracy of 90% or more—see module BL-UP).

$$\text{Uncertainty}_{\text{P,i}} = \frac{\sqrt{\sum_1^n (\text{U}_{\text{P,SS,i,pool\#}} \times \text{E}_{\text{P,SS,i,pool\#}})^2}}{\sum_{i=1}^{M} \text{E}_{\text{P,SS,i,pool\#}}}$$ Equation X-UNC 7

Where:

$Uncertainty_{P,i}$	Uncertainty in the combined carbon stocks and greenhouse gas sources in the with-project case in stratum i; %
$U_{P,SS,i,pool\#}$	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks, greenhouse gas sources and leakage emissions in the with-project case in stratum i (1,2…n represent different carbon pools and/or GHG sources); %

$E_{P,SS,i,pool\#}$	Carbon stock or GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning) in stratum i (1,2…n represent different carbon pools and/or GHG sources) in the with-project case; t CO_2-e
i	1, 2, 3 …M strata

To assess uncertainty across combined strata:

$$Uncertainty_P = \frac{\sqrt{(Uncertainty_{P,i1} \times E_{P,i1})^2 + (Uncertainty_{P,i2} \times E_{P,i2})^2 + \cdots + (Uncertainty_{P,iM} \times E_{P,iM})^2}}{E_{P,i1} + E_{P,i2} + \cdots + E_{P,iM}}$$ Equation X-UNC 8

Where:

$Uncertainty_P$	Total uncertainty in project scenario; %
$Uncertainty_{P,i}$	Uncertainty in baseline project in stratum i; %
$E_{P,SS,i}$	Sum of combined carbon stocks and GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning in stratum i (1,2…n represent different carbon pools and/or GHG sources) multiplied by the area of stratum i (Ai) in the with-project case; t CO_2-e
i	1, 2, 3 …M strata

- Part 3 – Total Error in REDD Project Activity

Calculation of leakage is conservative in all instances and therefore uncertainty is not considered here. Total project uncertainty is therefore equal to the combined uncertainty in baseline and with-project estimates:

$$C_{REDD_{ERROR},t*} = \sqrt{\left(Uncertainty_{BSL,t*}{}^2 + Uncertainty_P{}^2\right)}$$ Equation X-UNC 9

Where:

$C_{REDD\_ERROR,t*}$	Cumulative uncertainty for REDD project activity through time t; %
$Uncertainty_{BSL,t*}$	Cumulative uncertainty in baseline scenario through time t; %
$Uncertainty_P$	Total uncertainty in the with-project scenario; %
t	1,2,3,....t* years elapsed since the start of the REDD VCS project activity

No ex post (re-)measurements of carbon pools or GHG sources will be made in the first fixed baseline period. Therefore uncertainty from these sources is already included in $Uncertainty_{BSL,t*}$. Cumulative project uncertainty through time t is therefore equal to uncertainty in baseline estimates:

$$C_{REDD_{ERROR},t*} = Uncertainty_{BSL,t*}$$ Equation X-UNC 10

Where:

$C_{REDD\_ERROR,t*}$	Cumulative uncertainty for REDD project activity through time t; %

$Uncertainty_{BSL,t^*}$	Cumulative uncertainty in baseline scenario through time t; %
t	1, 2, 3, …t* years elapsed since the start of the REDD VCS project activity

- Part 4 – Implications for Project Accounting

The allowable uncertainty under this methodology is +/- 15% of $C_{REDD,t}$ at the 95% confidence level. Where this precision level is met then no deduction should result for uncertainty.

Where uncertainty exceeds 15% of $C_{REDD,t}$ at the 95% confidence level then the deduction shall be equal to the amount that the uncertainty exceeds the allowable level. The adjusted value for $C_{REDD,t}$ to account for uncertainty is calculated as:

$$Adjusted\_C_{REDD,t} = C_{REDD,t} \times (100\% - C_{REDD\_ERROR,t^*} + 15\%) \qquad \text{Equation X-UNC 11}$$

Where:

$Adjusted\_C_{REDD,t}$	Cumulative total net GHG emission reductions through time *t* adjusted to account for uncertainty; t CO_2-e
$C_{REDD,t}$	Cumulative total net GHG emission reductions through time *t*; t CO_2-e
C_{REDD_ERROR,t^*}	Cumulative uncertainty for REDD project activity through time *t*; %
t	1, 2, 3, …*t* years elapsed since the start of the REDD VCS project activity

Table 38: X-UNC Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	$C_{REDD,t}$
Data Unit:	tCO_2-e
Used in equations:	X-UNC 11
Description:	Net anthropogenic greenhouse emissions reductions at time t;
Module parameter originates in:	REDD-MF
Any comment:	

Data / Parameter:	$D\%_{pn}$
Data Unit:	%
Used in equations:	Uncertainty in baseline rate
Description:	Percent of deforestation in land parcel *pn* etc of a proxy area as a result of planned deforestation as defined in this module
Module parameter originates in:	BL-PL
Any comment:	

Data / Parameter:	Yrs_{pn}
Data Unit:	Years
Used in equations:	Uncertainty in baseline rate
Description:	Number of years over which deforestation occurred in land parcel *pn* in proxy area;
Module parameter originates in:	BL-PL
Any comment:	

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS – IFM METHODOLOGY (VM0010)

4.1 Baseline Emissions

4.1.1 Section 6.1 Selection of the baseline

Refer to Section 0 above.

4.1.2 Section 6.2 Modelling of the baseline scenario

Unfortunately no historical records of prior harvesting activities by the Road Timbers logging company could be found, as required for the 'Historical Baseline Scenario' option under the Methodology. Therefore a combination of the 'historical' and 'common practice' options were used to model the baseline scenario. It was conservatively assumed that the logging company would follow the legal plan as set out in its FMDP (Annex 14), and a timber harvest plan for the April River area (Annex 10). This data was used to generate a spatially defined 'Timber Harvest Plan' for the entire Project Area, as required under the Methodology. A summary of the variables in the Timber Harvest Plan is provided in Table 39.

Table 39: Requirements of the Timber Harvest Plan

	Plan Requirement	Value	Source of data / calculation methodology
A	Forest inventory volume (merchantable volume per ha)	460,000 m^3 yr^{-1} 93.5 m^3 ha^{-1}	380,000 m^3 specified in Section 9.3 of the FMDP (Figure 28) combined with 80,000 m^3 in the April River Plan (Figure 29).
B	Non-operable areas	367,412 ha	Based on operable area specified in Section 9.3 of the FMDP. Calculated as Gross Forested Area (582,762ha) – Net Operable Area (4917.68 ha x 40 yrs = 196,707 ha) = Non Operational Area
C	Annual operable areas	4,918 ha harvested annually	Based on merchantable volume and annual allowable cut specified in the timber harvest plans. Geographic extent of operable areas created as digital files in ArcGIS, based on items a and b above.
D	Transportation systems (logging roads etc)	Logging roads and infrastructure	Specified in FMDP and April River Timber Plan, including primary secondary and tertiary roads and logging landings. As road areas are deforested, these were accounted for under VM0007, as described in Section 3 of this Project Document.
E	List of harvest and transport machinery	Specified in Section 7.4 of the FMDP. Machines used for road construction include: Bulldozer (CAT D8N and CAT D7H); Front end loader (CAT 966); Motorgrader (CAT 140G); Vibratory roller (CAT CS-323); Tipping truck (18 t); 4 wheel drive x 2; Gang/transport truck. Machines used for logging: Wheel and crawler tractors. Chainsaws.	

Figure 28: Extract of Section 9.3 of the FMDP, providing key data for the Timber Harvest Plan

9.3 The planned productivity

Volume harvested annually	380,000 m3
Gross volume per ha.	55.302 m3
Net Volume harvestable	48.11 m3/ha
Area harvested annually	6,871 ha.
Average skidding distance	50 m
Average road density within the forest	10m/ha

Figure 29: Extract from April River Timber Harvest Plan

Project Location:

a. Forest Resource; 230km up the Sepik river,95km to Wewak by a low standard road. Location is about 100km South- West of Wewak, East Sepik Province

b. Industrial Site: (Camp Site)	Alternatives are Bitara and Bukabuki
c. Town Site:	Alternatives are Bitara and Bukabuki
d. Port Site:	Yamanambu Delta

Forest Resource:

a. Log harvest per year:	80,000 m3
b. Total merchantable log volume:	5,000,000 m3

Figure 30: Extract from Section 5.4 of the FMDP, providing key data for the Timber Harvest Plan

Use	Annual AAC(m3)	%	Cutting Cycle	Estimate(m3)
Export logs	190,000	50	26.638 x 382.762 ha./40 years.	245,900
Ply/Veneer	160,000	42	12.219 x 382,762 ha./40 years.	116,924
Sawlogs	30,000	8	16.444 x 382,762 ha./40 years.	157,353

While a few trees have plywood potential, other species will be used to provide Sustained annual yield. Potential volume from other species = 192,253 m3.

Figure 31: Volume inventory data from April River Plan

b. Volume of Timber on Species

Based on data obtained from forestry following the survey done in 1993 by Unitech Consultants, the distribution of species (over 1% of the total,based on the volume of trees 50cm diameter and over) is given below:

Species	Volume per hectare DIAMETER CLASSES		
	20-49cm cu.m/ha	>50cm cu.m/ha	% of total >50cm
Pometia pinnata	3.402	5.418	9.79
Dysoxylum spp	4.492	5.382	9.73
Syzygium papuasica	2.256	3.713	6.71
Cryptocarya	2.850	2.388	4.32
Canarium indicum	2.279	2.359	4.26
Agathis (log)	0.516	2.024	3.66
Terminalia	1.420	1.810	3.27
Elmerrillia papuana	0.068	1.700	3.07
Homalium Foetidum	0.504	1.516	2.74
Litsea	1.830	1.458	2.64
Buchanania	0.791	1.275	2.31
Alstonia excl. scholaris	0.316	1.046	1.89
Protium macgregorii	0.805	0.973	1.76
Neonauclea	0.255	0.913	1.65
Planchonella	0.500	0.895	1.62
Campnosperma brevipetiolata	0.266	0.867	1.57
Octomeles sumatrana	0.198	0.842	1.52
Xanthophyllum papuanum	0.294	0.826	1.49
Flindersia	0.394	0.754	1.36
Intsia	0.042	0.694	1.26
Planchonia papuana	0.062	0.685	1.24
Celtis	0.539	0.647	1.17
calophyllum inophyllum	0.648	0.617	1.12
Maniltoa	0.467	0.593	1.07
Others	13.386	15.907	28.78
Total	38.230	55.312	100.00

This data from the Timber Harvest Plan was used to create a Timber Harvesting Schedule, a summary of which is provided in

Table 40. The yearly harvest volume by species harvested is provided in the Master Calculation Spreadsheet (Tab: 'VM10-2.2').

Table 40 Data included in the timber harvesting schedule

	Plan Requirement	Source of data / calculation methodology
A	Species to be harvested	Specified in Table 4 of the FMDP and page 8 of the April River Plan
B	Year in which timber harvest is scheduled to occur	2009
C	Years each land is in a post-harvest state	A felling cycle of 40 years is assumed, as stated in the FMDP. Although it is consistent with the Forest Code of Practice, this is conservative, it is understood that logging companies in PNG frequently return after a 20-30 year harvest rotation (Sherman, et. al., 2008)
D	Min and max diameters for harvesting	30cm DBH, based on verification of the FMDP data and discussions with experts (Forest Research Institute and University of Melbourne).
E	Planned harvesting regime	Species selective logging
F	Technical specifications for wood products to be harvested	Export logs must be greater than 50cm DBH Logs processed locally (ply/veneer & sawlogs) are harvested down to 30cm DBH
G	Total volumes to be harvested, by wood product category	Export logs: 230,000 m^3 yr^{-1} Ply/veneer: 193,684 m^3 yr^{-1} Sawlogs: 36,316 m3 m^3 yr^{-1}

4.1.3 Section 6.3: Stratification

Refer to Section 3.4.

4.1.4 Section 7.1 Additionality

Refer to Section 2.5.

4.1.5 Section 8.1: Calculation of carbon stocks in commercial timber volumes

A detailed forest inventory of the Project Area was conducted as required under the Methodology, because the merchantable volume estimates in the FMDP were more than 10 years old. Merchantable volume for all trees in each plot was calculated using a volume equation specified in the PNG Forest Inventory Planning System database.[33] This equation is used by the PNGFA for the estimation of merchantable timber volumes. The estimate of merchantable volume for each species *j* in the plots was summed for each of the size classes specified in the FMDP (i.e. 20 – 49cm DBH; > 50cm DBH) using equation 1 of the Methodology, as described below.

[33] The equation is: V (m^3 ha^{-1}) =1.116*0.00007854*($DBH^{2.4762}$)

$$V_{j,i,sp} = \sum_{l=1}^{L} V_{l,j,i,sp}$$ (VM0010 Equation 1)

Where:

$V_{j,i,sp}$	merchantable volume for species *j* in stratum *i* in sample plot *sp*, m^3;
$V_{l,j,i,sp}$	merchantable volume for tree *l* of species *j* in stratum *i* in sample plot *sp*; m^3
L	1, 2, 3 …*L* sequence of individual trees in sample plot;
i	1, 2, 3 …*M* strata;
Sp	1, 2, 3 …*SP* sample plots; and
j	1, 2, 3 …*J* tree species.

The mean merchantable volume for all species *j* in the three operational stratum *i* (i.e. sawn timber, veneer and ply; export logs), across all plots was calculated using Equation 2 of the Methodology:

$$V_{j,i|BSL} = \frac{1}{SP} * \sum_{sp=1}^{SP} \frac{V_{j,i,sp}}{A_{sp}}$$ VM0010 Equation 2

Where:

$V_{j,i|BSL}$	mean merchantable volume per unit area of species *j* in stratum *i* in the baseline scenario, $m^3 \cdot ha^{-1}$;
$V_{j,i,sp}$	merchantable volume for species *j* in stratum *i* in sample plot *sp*; m^3;
A_{sp}	area of sample plot *sp*, ha;
i	1, 2, 3 …*M* strata;
Sp	1, 2, 3 …*SP* sample plots; and
j	1, 2, 3 …*J* tree species.

The results are summarised in Table 41 below.

Table 41 Results of merchantable volume calculations

Diameter class	Standing volume – our dataset (m^3 ha^{-1})
> 50cm	37.47
20 – 40cm	107.70
Total	145.17

Our field inventory volume estimate was higher than the merchantable volume estimate required to achieve the Annual Allowable Cut (AAC) as stated in the FDMP and April River harvest plan, As a result, the merchantable volume estimates from the FDMP and April River plan were conservatively used for the timber harvest schedule, as required under the Methodology (i.e.: 93.54 m^3 ha^{-1} yr^{-1}, or 460,000 m^3 yr^{-1}).

In order to determine the proportion of merchantable volume removed as wood products, the mean carbon stock per hectare of harvested biomass (i.e. harvested biomass including the stem, branches, leaves and twigs) for each of the 23 species *j* specified for harvest in the FMDP, for each of the three operational strata *i* (sawnwood, veneer and ply, export logs), was calculated using Equation 3 from the Methodology, as shown below.

$$C_{HB,j,i|BSL} = V_{EX,j,i|BSL} * BCEF_R * CF_j \qquad \text{VM0010 Equation 3}$$

Where:

$C_{HB,j,i|BSL}$	mean carbon stock of harvested biomass per unit area for species *j* in stratum *i*, tC·ha^{-1};
$V_{EX,j,i|BSL}$	mean volume of extracted timber per unit area for species *j* in stratum *i*, m^3·ha^{-1};
$BCEF_R$	biomass conversion and expansion factor applicable to wood removals in the project area, t.d.m m^{-3};
CF_j	carbon fraction of biomass for species *j*, tC t $d.m.^{-1}$;
i	1, 2, 3 …*M* strata; and
j	1, 2, 3 …*J* tree species.

Of this harvested biomass, the amount extracted as wood products was calculated using Equation 4 of the Methodology as shown below. This calculation was done for each of the 23 species *j* and stratum *i*, assuming wood densities based as specified in the IPCC good Practice Guidance for Land Use, Land Use Change and Forestry (Penman et al, 2003), or the World Agroforestry Centre wood density database.[34] All wood density values are listed on the 'WdDensity' tab on the Master Calculation spreadsheet.

$$C_{EX,j,i|BSL} = V_{EX,j,i|BSL} * D_j * CF_j \qquad \text{VM0010 Equation 4}$$

Where:

$C_{EX,j,i|BSL}$	mean carbon stock of extracted timber per unit area for species *j* in stratum *i*; tC·ha^{-1};
$V_{EX,j,i|BSL}$	mean volume of extracted timber per unit area for species *j* in

[34] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

	stratum *i*; in $m^3 \cdot ha^{-1}$;
D_j	basic wood density of species *j*; t d.m. m^{-3};
CF_j	carbon fraction of biomass for species *j*, tC t d.m.$^{-1}$;
i	1, 2, 3 …*M* strata; and
j	1, 2, 3 …*J* tree species.

Table 42: Data and parameters not monitored (default values or measured one time)

Data / parameter:	$V_{l,j,i,sp}$
Data unit:	m^3
Used in equations:	VM0010 Equation 1
Description:	Merchantable volume for tree *l* of species *j* in sample plot *sp* in stratum *i*
Source of data:	Merchantable volume for all trees in each plot was calculated using a volume equation specified in the PNG Forest Inventory Planning System database.[35]
Measurement procedures (if any):	Refer to Forest Carbon Stock report
Any comment:	Since our field inventory volume estimate was higher than the volume estimate as stated in the FDMP and April River Plan, the merchantable volume estimate from the FDMP and April River Logging Plan was used for the timber harvest schedule, as required under the Methodology (i.e.: 93.54 m^3 ha^{-1} yr^{-1}, or 460,000 m^3 yr^{-1}).

Data / Parameter:	CF
Data Unit:	tC t^{-1} d.m.
Used in equations:	VM0010 Equation 3, 4
Description:	Carbon fraction of dry matter
Source of data:	IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3
Value applied:	Default value 0.47 tC t^{-1} d.m. was used.
Measurement procedures (if any)	None
Any comment:	The default values should be used for all species.

Data / Parameter:	D_j
Data Unit:	t d.m.m^{-3}
Used in equations:	VM0010 Equation 4
Description:	Mean wood density of commercially harvested species

[35] The equation is: V (m^3 ha^{-1}) =1.116*0.00007854*($DBH^{2.4762}$)

Source of data:	Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database.[36] Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.
Measurement procedures (if any):	N/A
Any comment:	

Data / parameter:	$BCEF_R$
Data unit:	t.d.m m^{-3}
Used in equations:	VM0010 Equation 3, 18
Description:	Biomass conversion and expansion factor applicable to wood removals in the project area
Source of data:	A BCEF of 2.339 t dm^{-1} m^3 was assumed, from Markland and Schoene, 2006. In the absence of country specific data, this report provides a regional figure for Oceania which includes PNG. The report can be downloaded from: ftp://ftp.fao.org/docrep/fao/010/ah849e/ah849e00.pdf
Measurement procedures (if any):	N/A
Any comment:	When selecting a $BCEF_R$ the minimum DBH must be compatible with the minimum DBH specified in the timber harvest plan. Default values shall be updated whenever new guidelines are produced by the IPCC

4.1.6 Step 8.1.2: Calculation of dead wood (logging slash) generated in the process of timber harvest

In order to determine the amount of carbon left on the forest floor as logging slash (for each species j in stratum i), the results from Equation 3 were extracted from the results of Equation 4, as specified in Equation 5 of the Methodology.

$$\Delta C_{DWSLASH,i,p|BSL} = \left[\sum_{j=1}^{J}\left(C_{HB,j,i|BSL} - C_{EX,j,i|BSL}\right)\right] \quad \text{VM0010 Equation 5}$$

Where:

[36] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

$\Delta C_{DWSLASH,i,p\|BSL}$	change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum i in land parcel p, in tC ha-1;
$C_{HB,j,i\|BSL}$	mean carbon stock of harvested biomass per unit area for species j in stratum i, tC·ha^{-1};
$C_{EX,j,i\|BSL}$	mean carbon stock of extracted timber per unit area for species j in stratum i, tC·ha^{-1};
i	1, 2, 3 …M strata; and
j	1, 2, 3 …J tree species.
P	*1, 2, 3* ...P land parcels.

No external inputs were required for this step, as all inputs were based on the results of previous calculations.

4.1.7 Section 8.1.3: Calculation of baseline carbon sequestered in wood products

Equation 6 was applied to sum the carbon stock of extracted wood products for all species:

$$C_{EX,i|BSL} = \sum_{j=1}^{J} C_{EX,j,i|BSL}$$ VM0010 Equation 6

Where:

$C_{EX,i\|BSL}$	change in carbon stock of extracted wood products resulting from timber harvest per unit area in stratum i in land parcel p, in tC ha^{-1};
$C_{EX,j,i\|BSL}$	Mean carbon stock of extracted wood per hectare, tC ha^{-1};
i	1, 2, 3 …M strata; and
j	1, 2, 3 …J tree species.

According to the VCS AFOLU Requirements, the amount of carbon stored in wood products that would decay within 3 years after harvest [i.e. the Wood Waste (WW) and the Short Lived Fraction (SLF)], are assumed to be emitted at the time of harvest. Wood products that are retired between 3 and 100 years after harvest (i.e. the Additional Oxidised Fraction, OF), must be accounted according to a 20 year linear decay function.

The amount of carbon stored as wood waste and assumed to be immediately emitted to the atmosphere was calculated using Equation 7 below.

$$C_{WP0,i|BSL} = \sum_{k} C_{EX,i,k|BSL} * (WW_k + SLF_k)$$ VM0010 Equation 7

Where:

$C_{WP,0\|BSL}$	carbon stock of extracted timber from stratum i that is assumed to be emitted immediately at the time of harvest, in tC·ha^{-1};
$C_{EX,i\|BSL}$	mean carbon stock of extracted timber per unit area in stratum i, for wood product type k, tC·ha^{-1};
WW_k	fraction of biomass carbon from wood waste immediately emitted as a byproduct of milling operations for wood product k, dimensionless;
i	1, 2, 3 …M strata; and
k	Wood products (sawnwood, wood base products, etc)

The amount of extracted carbon stock that is assumed to enter the wood products pool is calculated as all wood products that are not immediately emitted at the time of harvest, as per Equation 8.The same wood waste value as for Equation 7 was used.

$$C_{WPi|BSL} = \sum_k C_{EX,i,k|BSL} - C_{WP0,i|BSL}$$

VM0010
Equation 8

Where:

$C_{WPi,i\|BSL}$	carbon stock of extracted timber from stratum i that is assumed to enter the wood products pool at the time of harvest, in tC·ha^{-1};
$C_{EX,i\|BSL}$	mean carbon stock of extracted timber per unit area in stratum i, for wood product type k, tC·ha^{-1};
$C_{WP0i\|BSL}$	carbon stock of extracted timber from stratum i that is assumed to be emitted immediately at the time of harvest, in tC·ha^{-1};
i	1, 2, 3 …M strata; and
k	Wood products (sawnwood, wood base products, etc)

The amount of carbon assumed to be emitted over 100 years (and subject to the 20 year decay function) was calculated using Equation 9 below. The appropriate OF emission factors were matched to the wood product categories specified in the FDMP, as described in the table below.

Table 43: Corresponding Wood product categories

Product category as per Timber harvest plans	**Corresponding product category in Winjum et al**
Sawn timber	Sawnwood
Veneer and ply	Wood based panels
Export logs	Sawnwood

$$C_{WP100,i|BSL} = C_{WP,i|BSL} * OF_k$$ VM0010 Equation 9

Where:

$C_{WP100,i,p\|BSL}$	Amount of carbon stored in wood products that are emitted over the 100 years after harvest from stratum i in land parcel p, tC ha^{-1};
$C_{WP0i\|BSL}$	carbon stock of extracted timber from stratum i that is assumed to be emitted immediately at the time of harvest, in tC·ha^{-1};
OF_k	fraction of biomass carbon for wood product type k that will be emitted to the atmosphere between 3 and 100 years of timber harvest, dimensionless; and
i	1, 2, 3 …M strata.

Table 44: Data and parameters not monitored (default value or estimated one time)

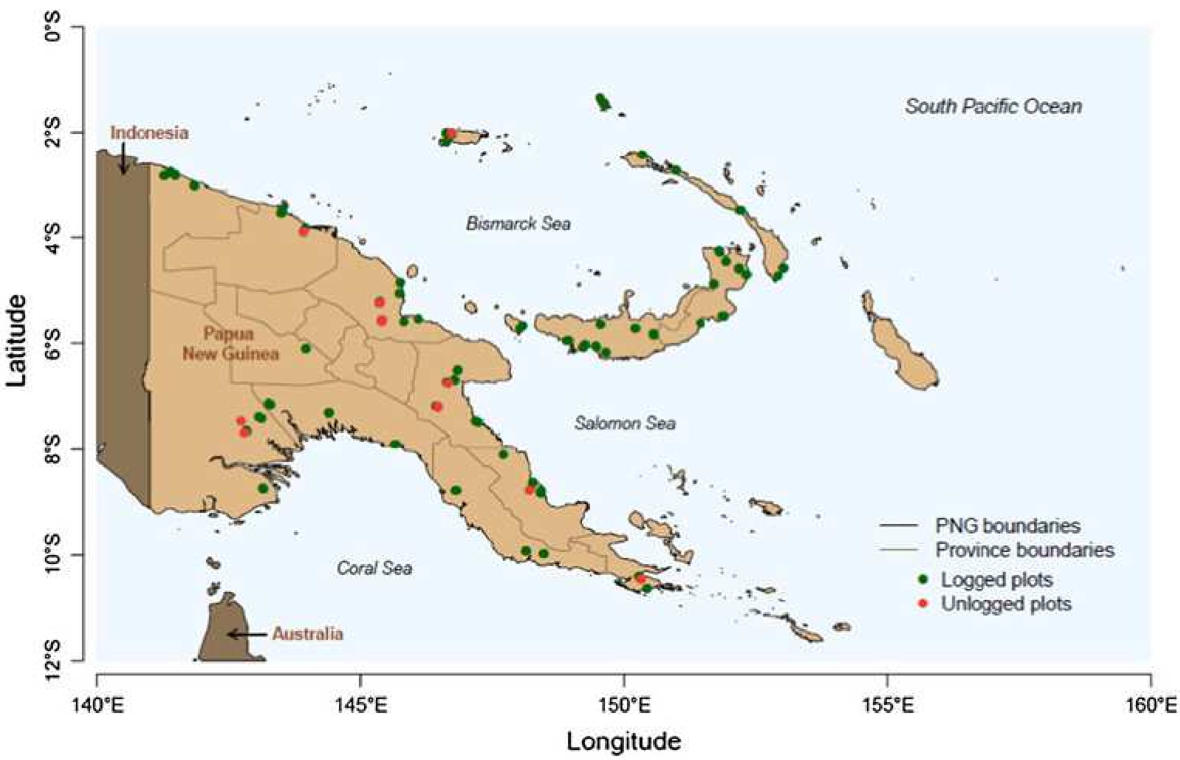
Data / parameter:	*OF,SLF,WW*
Data unit:	kg kg^{-1}
Used in equations:	VM0010 Equation 7, 8, 9
Description:	*OF* = Fraction of wood products that will be emitted to the atmosphere between 3 and 100 years after production; *SLF* = Fraction of wood products that will be emitted to the atmosphere within 3 years of production; and *WW* = Fraction of extracted biomass effectively emitted to the atmosphere during production Wood waste fraction (WW): Winjum et al 1998 indicate that the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 19% for developed countries, 24% for developing countries. Short-lived fraction (SLF) Winjum et al 1998 give the following proportions for wood products with short-term (<5 yr) uses (applicable internationally): Sawnwood 0.12 Woodbase panels 0.06 Other industrial roundwood 0.18 Paper and Paperboard 0.24 Additional oxidized fraction (OF) Winjum et al 1998 gives annual oxidation fractions for each class of wood products split by forest region (boreal, temperate and tropical). This methodology projects these fractions over 95 years to give the additional proportion that is oxidized between the 3rd and 100th years after initial harvest:
Source of data:	The source of data is the published paper of Winjum et al. 1998
Measurement procedures (if any):	*N/A*
Any comment:	Parameters were updated in accordance with the requirements of the VCS Standard version 3.

Wood Product Class	OF		
	Boreal	Temperate	Tropical
Sawnwood	0.39	0.62	0.86
Woodbase panels	0.62	0.86	0.98
Other industrial roundwood	0.86	0.98	0.99
Paper and paperboard	0.39	0.62	0.99

4.1.8 Section 8.1.4: Change in carbon stocks due to forest regrowth after harvest

The forest regrowth rate after harvest was derived from a forest growth model, developed as part of a study by the University of Melbourne (Fox et al, 2011), using more than 15 years of data from Papua New Guinea's series of Permanent Sample Plots (PSPs), which are located across the country (Figure 32).

Figure 32: Distribution of Permanent Sample Plot locations used by the University of Melbourne for calculation of Papua New Guinea wide forest growth rates



Source: Fox et al (2011)

The University of Melbourne data specifically included measurement of regrowth following selective harvest in Papua New Guinea, and therefore the growth model is very much appropriate for use in the Project. A carbon sequestration rate of 1 t C ha^{-1} yr^{-1} was assumed in Equation 9 as shown below, as this was the measured forest carbon sequestration rate following selective harvest for the PSP located in the Southern Highlands, which is closest to the Project Area.

$$C_{RG,i,p|BSL} = \sum_i RGRi$$ VM0010 Equation 9

Where:

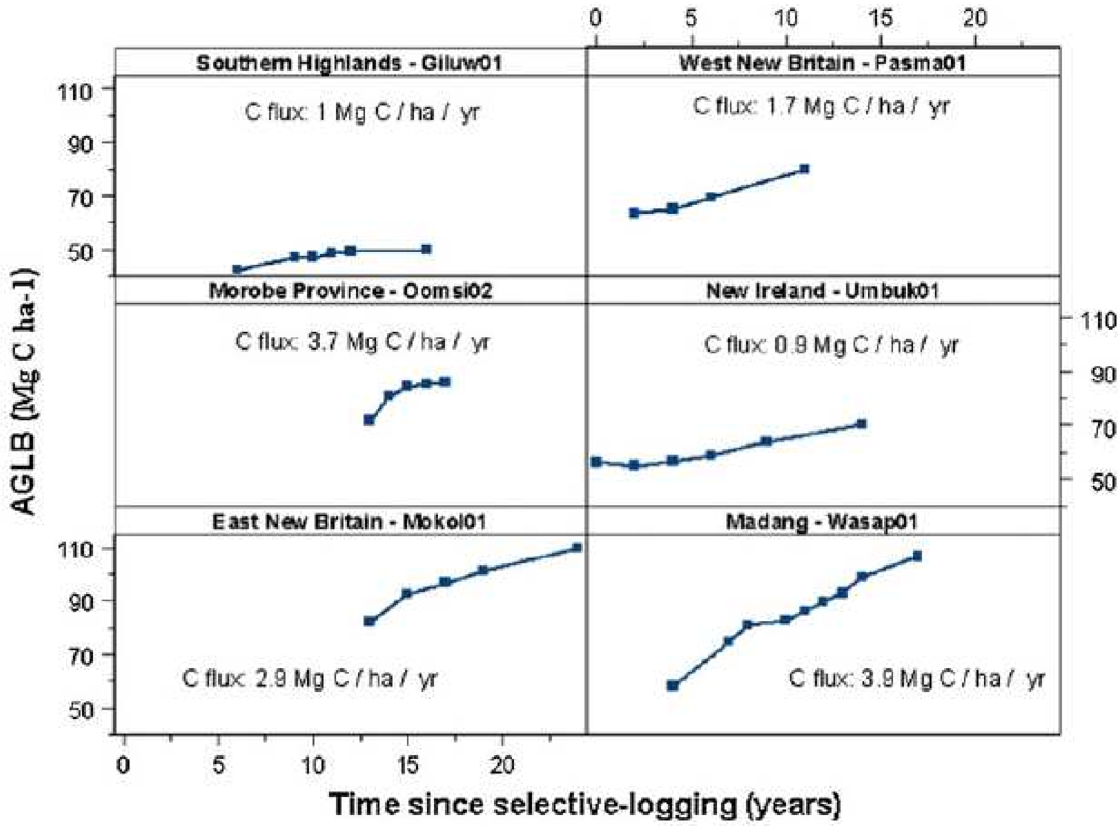
$C_{RG,i,p\|BSL}$	carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC·ha^{-1} yr^{-1};
RGR_i	regrowth rate of forest post timber harvest for stratum i, tC·ha^{-1} yr^{-1}; [37]

[37] See Data and parameters not monitored (default or possibly measured one time) parameter list for information on data selection (p 51).

i 1, 2, 3 …M strata

Figure 33 below shows the assumed growth rate for the project (top left, for Southern Highlands which is the closest proximity to the Project Area), relative to growth rates from other PSPs measured throughout Papua New Guinea.

Figure 33: Recovery of aboveground biomass carbon stock in PSPs after selective harvesting



Source: Fox et al (2011)

In addition, a related study by the University of Melbourne on the Papua New Guinea PSPs, found that only 75% of previously selectively logged plots in Papua New Guinea recovered (or sequestered carbon) after harvesting, while the remaining 25% actually showed a decrease in forest carbon stock (Yosi et al, 2011). This was attributed to poor harvesting practices, subsequent anthropogenic disturbance (shifting cultivation) and fire disturbance. In line with this research, it was assumed that only 75% of the previously harvested areas recovered. The emissions from the remaining 25% of forest area were conservatively excluded.

Table 45 Data and parameters not monitored (estimated or measured one time)

Data / parameter:	RGR_i
Data unit:	$tC.ha^{-1}.yr^{-1}$
Used in equations:	VM0010 Equation 9, 14
Description:	Forest regrowth rate post timber harvest for stratum i
Source of data:	Fox et al (2011), value for Southern Highlands
Measurement procedures (if any):	
Any comment:	

4.1.9 Section 8.1.5: Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks

The calculations in this section all relied upon calculations in the subsequent steps. In other words, there were no external inputs to calculations in this section. The following series of equations were followed, whereby the net change in carbon stock from wood products and logging slash were calculated for all land parcels in the first year since harvest, and then from years 2- 10 since harvest. For years 11-20, the calculations assume there is no more decay from the logging slash.

The net change in carbon stock from wood products and logging slash across all parcels within the **first year of harvest** in the baseline was calculated as:

$$\Delta C_{NET|BSL(1)} = \left(\sum_{i,p} A_{1,i,p} * \sum_{i=1}^{M}(C_{DWSLASH,i,p\backslash BSL}/10) + C_{WP0,i,p\backslash BSL} + (C_{WP100,i,p\backslash BSL}/20))\right)$$ VM0010 Equation 11

Where:

$NET|BSL(1)$	net change in carbon stock across all parcels in the baseline scenario in the first year since harvest in the baseline scenario, in tC;
$\Delta C_{DWSLASH,i,p\backslash BSL}$	change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum i in land parcel p, in tC ha^{-1};
$\Delta C_{WP0,i,p\backslash BSL}$	change in carbon stock resulting from wood product conversion and retirement from stratum i in land parcel p, that is assumed to be emitted in the first year of harvest in the baseline tC ha^{-1};
$\Delta C_{WP100,i,p\backslash BSL}$	Amount of carbon stored in wood products that are emitted in the 100 years after harvest from stratum i in land parcel p, tC ha^{-1};
$A_{1,i,p}$	the area of stratum i in land parcel p that was harvested 1 year ago, ha; [38]
	1, 2, 3 …M strata; and

[38] See *Data and parameters not monitored (default or possibly measured one time)* parameter list for information on data selection (p 51).

1, 2, 3 ...P land parcels harvested within the crediting period.

The net change in carbon stock from wood products and logging slash across all parcels the **years 2 – 10** since harvest in the baseline was calculated as:

$$\Delta C_{NET|BSL(2-10)} = \sum_{i,p} A_{2-10,i,p} ** \sum_{i=1}^{M} ((\Delta C_{DWSLASH,i,p\backslash BSL}/10) + (\Delta C_{WP100,i,p\backslash BSL}/20))$$

VM0010 Equation 11

Where:

$\Delta C_{NET\|BSL(2-10)}$	net change in carbon stock across all parcels in the baseline scenario in years 2 - 10 since harvest in the baseline scenario, in tC;
$\Delta C_{DWSLASH,i,p\backslash BSL}$	change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum i in land parcel p, in tC ha^{-1};
$\Delta C_{WP100,i,p\backslash BSL}$	Amount of carbon stored in wood products that will be emitted in the 100 years after harvest from stratum i in land parcel p, tC ha^{-1};
$\Delta C_{RG,i,p\backslash BSL}$	carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC ha^{-1};
$A_{2-10,i,p}$	the area of stratum i in land parcel p that was harvested between 2 and 10 year ago, ha; [39]
i	1, 2, 3 …M strata; and
p	*1, 2, 3 ...P* land parcels harvested within the crediting period.

The net change in carbon stock from wood products across all parcels the **years 11 – 20** since harvest in the baseline was calculated as:

$$\Delta C_{NET|BSL(11-20)} = \sum_{i,p} A_{11-20,i,p} * \sum_{i=1}^{M} (\Delta C_{WP100,i,p\backslash BSL}/20)$$

VM0010 Equation 13

[39] See *Data and parameters not monitored (default or possibly measured one time)* parameter list for information on data selection (p 51).

Where:

$\Delta C_{NET\|BSL(11\text{-}20)}$	net change in carbon stock across all parcels in the baseline scenario in years 11 - 20 since the start of the project activity, in tC;
$\Delta C_{WP100,i,p\backslash BSL}$	Amount of carbon stored in wood products that will be emitted in the 100 years after harvest from stratum i in land parcel p, tC ha^{-1};
$\Delta C_{RG,i,p\backslash BSL}$	carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC ha^{-1};
$A_{11-20,i,p}$	the area of stratum i in land parcel p that was harvested between 11 and 20 years ago, ha; [40]
i	1, 2, 3 …M strata; and
p	*1, 2, 3 ...*P land parcels harvested within the crediting period.

The net change (sequestration) in carbon stock due to forest regrowth across all parcels in all years since harvest in the baseline scenario was calculated according to equation 14.

$$\Delta C_{NET|BSL(1+)} = \sum_{i,p} A_{t*} * \sum_{i=1}^{M} (-\Delta C_{RG,i,p\backslash BSL})$$

VM0010 Equation 14

Where:

$\Delta C_{NET\|BSL(1+)}$	net change in carbon stock across due to forest regrowth in all parcels that have been harvested in the baseline scenario, in tC;
$\Delta C_{RG,i,p\backslash BSL}$	carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC ha^{-1};
A_{t*}	Cumulative area harvested until time t*, ha; [41]
t*	1,2,….10, time elapsed since the start of the project, in years;
i	1, 2, 3 …M strata; and
p	*1, 2, 3 ...*P land parcels harvested within the crediting period.

[40] See Data and parameters not monitored (default or possibly measured one time) parameter list for information on data selection (p 51).

[41] See Data and parameters not monitored (default or possibly measured one time) parameter list for information on data selection (p 51).

The net change in carbon stock across all parcels harvested over each year of the project crediting period in the baseline scenario since the start of the project activity was calculated as:

$$\Delta C_{NET|BSL,t*} = \sum_{p=1}^{P} \Delta C_{NET,p|BSL(1)} + \Delta C_{NET,p|BSL(2-10)} + \Delta C_{NET,p|BSL(11-20)} + \Delta C_{NET,p|BSL(1+)}$$

VM0010 Equation 15

Where:

$\Delta C_{NET\|BSL,t*}$	net change in carbon stock across all parcels in the baseline scenario in the year t* since the start of the project activity, in tC;
$\Delta C_{NET,p\|BSL(1)}$	net change in carbon stock in the baseline scenario for all parcels p that are within 1 year of harvest in the baseline scenario, in tC;
$\Delta C_{NET,p\|BSL(2-10)}$	net change in carbon stock in the baseline scenario for all parcels p, that were harvested between 2 – 10 years ago in the baseline scenario, in tC;
$\Delta C_{NET,p\|BSL(11-20)}$	net change in carbon stock in the baseline scenario in parcel p, that were harvested betwen 11 – 20 years ago in the baseline scenario, in tC;
$\Delta C_{NET,p\|BSL(1+)}$	net change in carbon stock due to forest growth in the baseline scenario for all parcels p that have been harvested in the baseline scenario, in tC;
t*	time elapsed since the start of the project, in years; and
p	*1, 2, 3 ...P* land parcels harvested within the crediting period.

Finally, the net carbon stock change in the baseline scenario was converted to net greenhouse gas emissions by multiplying by the ratio of molecular weights of carbon dioxide and carbon:

$$GHG_{NET|BSL,t*} = \Delta C_{NET|BSL,t*} * \frac{44}{12}$$

VM0010 Equation 16

Where:

$GHG_{NET\|BS,t*L}$	net greenhouse gas emissions in the baseline scenario in the year t* since the start of the project activity, tCO_2e;
$\Delta C_{NET\|BSL}$	net change in carbon stock across all parcels in the baseline scenario in the year t* since the start of the project activity, tC; and
44/12	ratio of molecular weights of carbon dioxide and carbon, tCO_2-e tC^{-1}.

4.2 Project Emissions

4.2.1 Section 8.2.1: Ongoing forest growth in the project scenario

This section is not applicable, as forest growth in the project scenario will be conservatively excluded from the calculation of Emission Reductions. As a result, Equations numbers 17 – 20 will not be used for this Project.

4.2.2 Section 8.2.2: Forest disturbance in the project scenario

4.2.3 Natural disturbance – fire

Emissions due to natural disturbance from fire are only required to be accounted for *ex-post*. In other words, emissions due to fire must be picked up as part of the forest monitoring program. For the purposes of the *ex-ante* estimate, it was assumed there were no fires over the first monitoring period, as anecdotal evidence suggests that there is a very low risk of fire in the Project Area.

As specified in the Monitoring Plan (Section5.11.1), fire hotspot data will be mapped for each year between 2009 and 2012. To calculate the emissions from these fires, Equation 22 will be applied to determine the amount of carbon stock that would be present in the project scenario, but not in the baseline scenario. The extracted volume and BCEF will be calculated or used for previous steps.

$$B_{i,t|PRJ} = \sum_{j=1}^{J} \{V_{EX,i,j|BSL} * BCEF_R\}$$ VM0010 Equation 22

Where:

$B_{i,t\|PRJ}$	average aboveground biomass stock present in the project scenario but absent in the baseline before burning for stratum i, time t, t d. m. ha^{-1};
$V_{EX,j,i\|BSL}$	mean volume of extracted timber per unit area for species j in stratum i, $m^3 \cdot ha^{-1}$;
$BCEF_R$	biomass conversion and expansion factor applicable to wood removals in the project area, t.d.m m^{-3}; [42]
i	1, 2, 3 …M strata;
j	1, 2, 3 …J tree species; and
t	1, 2, 3, … $t*$ years elapsed since the start of the IFM project activity.

[42] See Data and parameters not monitored (default or possibly measured one time) parameter list for information on data selection (p51).

This value will then be put into Equation 21 to estimate the quantity of greenhouse gas emissions from biomass burning:

$$\Delta C_{DIST-FR,t|PRJ} = \sum_{i=1}^{M} A_{burn,i,t} * B_{i,t|PRJ} * COMF_i * G_{g,i} * 10^{-3}.GWP_{CH4}$$ VM0010 Equation 21

Where:

$\Delta C_{DIST\_FR,t\|PRJ}$	net greenhouse gas emissions resulting from fire disturbance in year t, tCO_2e ;
$A_{burn,i,t}$	area burnt for stratum i at time t, ha;
$B_{i,t\|PRJ}$	average aboveground biomass stock present in the project scenario but absent in the baseline scenario before burning stratum i, time t; t d. m. ha^{-1};
$COMF_i$	combustion factor for stratum i, dimensionless;
$G_{g,i}$	emission factor for stratum i for methane, g kg^{-1} dry matter burnt;
GWP_{CH4}	global warming potential for CH_4 (IPCC default: 21), tCO_2e tCH_4^{-1};
i	1, 2, 3 …M strata; and
t	1, 2, 3, … t* years elapsed since the start of the IFM project activity.

Table 46: Data and parameters not monitored (default value or measured one time)

Data / parameter:	$COMF_i$
Data unit:	Dimensionless
Used in equations:	VM0010 Equation 21
Description:	Combustion factor for stratum *i* (vegetation type)
Source of data:	Default values in Table 2.6 of IPCC, 2006
Measurement procedures (if any):	N/A
Any comment:	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread). Default values shall be updated whenever new guidelines are produced by the IPCC

Data / parameter:	G_{gi}
Data unit:	g kg^{-1} dry matter burnt
Used in equations:	VM0010 Equation 21
Description:	Emission factor for stratum *i* for gas *g*
Source of data:	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5
Measurement procedures (if any):	N/A
Any comment:	Default values shall be updated whenever new guidelines are produced by the IPCC

4.2.4 Natural disturbance – non-fire

As per emissions from fire, forest loss due to natural disturbance will be determined *ex-post* based on detection of fire hotspots using MODIS images, for each year from 2009 – 2012. For the ex-ante estimate, emissions due to natural disturbance were assumed to be zero.

As specified in the Monitoring Plan (Section 5.11.1), Equation 23 below will be used to calculate the amount of emissions from this natural disturbance. It was assumed that only the biomass that would have been harvested in the baseline would be 'additional' emissions beyond that which would have occurred in the baseline.

$$\Delta C_{DIST,t|PRJ} = \sum_{i=1}^{M}\left(A_{dist,i,t} * \sum_{j=1}^{J}\{C_{AB,j,i|BSL}\}\right) * \frac{44}{12}$$ VM0010 Equation 23

Where:

$\Delta C_{DIST,t|PRJ}$ net greenhouse gas emissions resulting from non-fire natural disturbance in year t, tCO_2e ;

$A_{dist,i,t}$	area disturbed for stratum i at time t, ha; [43]
$C_{AB,i\|BSL}$	carbon stock in aboveground biomass per unit area in stratum i, $tC \cdot ha^{-1}$;
44/12	ratio of molecular weights of carbon dioxide and carbon, $tCO_2e \cdot tC^{-1}$;
i	1, 2, 3 …M strata;
j	1, 2, 3 …J tree species; and
t	1, 2, 3, … $t*$ years elapsed since the start of the IFM project activity.

4.2.5 Illegal logging

A participatory rural appraisal (PRA) of the communities surrounding the project area was conducted in October 2012. The PRA found that there is currently little or no illegal extraction of trees from the project area (Annex 8). Therefore in accordance with the Methodology, emissions from illegal logging ($\Delta C_{DIST\_IL,i,t|PRJ}$) can be assumed to be zero and no monitoring is needed. However the Methodology requires that the PRA must be repeated every two years, and therefore another PRA will be conducted in 2014.

4.2.6 Net greenhouse gas emissions in the project scenario

All of the calculations in this step were conducted based on calculations in previous steps. Therefore there are no external inputs to these calculations, and the following sequence of equations was followed. *Ex ante* calculations were based on findings from historical land use, land cover change between 2000-2009 in the Project Area. This analysis found no disturbance during this period and therefore it was assumed *ex ante* there was no disturbance (fire, natural disturbance or illegal logging).

Net greenhouse gas emissions in the project scenario for each year *t* are calculated as:

$$\Delta C_{NET,t|PRJ} = \left(\Delta C_{DIST-FR,t|PRJ} + \Delta C_{DIST,t,PRJ} + \Delta C_{DIST-IL,t|PRJ}\right) - \Delta C_{AB,t|PRJ}$$

VM0010 Equation 25

Where:

$\Delta C_{NET,t\|PRJ}$	net greenhouse gas emissions in the project scenario in year t, tCO_2-e;
$\Delta C_{DIST\_FR,t\|PRJ}$	net greenhouse gas emissions resulting from fire disturbance in year t, tCO_2e ;
$\Delta C_{DIST,t\|PRJ}$	net greenhouse gas emissions resulting from non-fire natural disturbance in year t, tCO_2e ;

[43] See *Data and parameters used in monitoring* parameter list for information on data selection (p62).

$\Delta C_{DIST\_IL,t\|PRJ}$	Net carbon stock changes as a result of illegal logging at time t, tCO_2e (note this input is not applicable from 2012 – 2014, due to the PRA revealing little or no illegal logging);
$\Delta C_{AB,t\|PRJ}$	annual carbon stock change in aboveground biomass of trees in year t, $tCO_2e \cdot yr^{-1}$; and
t	*1, 2, 3, … t** years elapsed since start of the project activity.

The net greenhouse gas emissions across the project scenario since the start of the project activity are calculated as:

$$GHG_{NET|PRJ} = \sum_{t=1}^{t^*} \Delta C_{NET,t|PRJ}$$ VM0010 Equation 26

Where:

$GHG_{NET\|PRJ}$	net greenhouse gas emissions in the project scenario since the start of the project activity, tCO_2e;
$\Delta C_{NET,t\|PRJ}$	net greenhouse gas emissions in the project scenario in year t, tCO_2e; and
t	*1, 2, 3, … t** years elapsed since start of the project activity.

4.3 Leakage

4.3.1 Section 8.3.1 Activity shifting leakage

There is no leakage due to activity-shifting. This is because the project proponent, RPM, has control over two other project sites in Papua New Guinea: 1) the Lake Murray REDD project in the District of Middle Fly, Western Province; and 2) the Pile Pile REDD Project in Western Province. The project proponent has signed agreements with the landowners to develop REDD projects in each of these sites, and no harvesting is planned to occur in these areas.

4.3.2 Section 8.3.2: Market leakage

Leakage due to market effects is calculated using a 'leakage factor' approach. This involves determining where in the country logging might be displaced to, when timber supply from the project area is reduced. One of three different leakage factors (0.2, 0.4 or 0.7) must be applied, depending on the total biomass of forest that must be harvested in order to make up for the foregone timber harvested from the project area. It follows that if timber harvest is displaced to forests with a higher proportion of merchantable volume (relative to non-merchantable volume), then less carbon will be emitted from this leakage.

It was determined that logging could be displaced to any other FMA within Papua New Guinea. Therefore dated reported from a study conducted by Forest Trends on the AACs in almost of FMAs in Papua New Guinea was used (Forest Trends, 2006). This study reviewed the sustainable AAC for 25 FMAs in Papua

New Guinea, including the Project Area. A review team of experts was asked to advise on the sustainable AAC that would permit logging in perpetuity in each of the FMAs, taking into account all relevant environmental considerations. This was taken to be a good indicator of the extent to which logging activity shifted from the project area would impact other loggable areas in Papua New Guinea. The PML was calculated as the ratio of the recommended sustainable AAC, relative total FMA area, averaged for all 25 FMAs. The PMP value was the same ratio calculated for the project area. Comparison of the PMP to the PMP value revealed that the April Salumei FMA has a lower proportion of merchantable volume relative to the total concession area (0.3), compared with that of the other FMAs in Papua New Guinea (0.46). As a result, a leakage factor of 0.2 was used.

This calculation approach represents a slight deviation from the methodology, which suggests that PML and PMP should be calculated on the basis of total:merchantable aboveground biomass. Unfortunately however, an extensive literature review could not find any such data reported for other FMAs in Papua New Guinea. Given the comprehensive nature of the Forest Trends study, this was considered an appropriate alternative calculation method. The results of this analysis are provided in the Master Calculation Spreadsheet.

This leakage factor was then used to determine leakage due to market effects by multiplying the net emissions from planned timber harvest activities as per Equation 27:

$$GHG_{LK|LtPF.t*} = LF_{ME} * GHG_{NET|BSL,t*}$$ VM0010 Equation 27

Where:

$GHG_{LK|LtPF,t*}$ is total market leakage as a result of IFM LtPF activities, in the year t* since the start of the project activity, tCO2e;

LF_{ME} is the dimensionless leakage factor for market-effects calculations;

$GHG_{NET|BS,t*L}$ net greenhouse gas emissions in the baseline scenario in the year t* since the start of the project activity, tCO_2e.

Data / parameter:	*PML, PMP*
Data unit:	%
Used in equations:	STEP 5 - Leakage, Box 2.
Description:	Sustainable AAC as recommended by the Forest Trends review team, relative to total FMA area.
Source of data:	Forest Trends (2001).[44]
Any comment:	

[44] http://www.forest-trends.org/documents/files/doc_161.pdf

4.4 Section 8.4: Net project greenhouse gas emission reductions

The net GHG emission reductions resulting at the end of each year over the project crediting period from cessation of timber harvesting in the Project Area was calculated using Equation 28. All inputs to the equation were based on calculations conducted in previous steps.

$$GHG_{CREDITS|LtPF,t*} = GHG_{NET|BSL,t*} - GHG_{NET\backslash PRJ,t*} - GHG_{LK|LtPF,t*}$$ VM0010 Equation 28

Where:

$GHG_{CREDITS|LtPF,t*}$	project greenhouse gas credits associated with the implementation of improved forest management (IFM) activities in the year t* since the start of the project activity, in the project scenario, tCO_2e;
$GHG_{NET|BS,t*L}$	net greenhouse gas emissions in the baseline scenario in the year t* since the start of the project activity, tCO_2e;
$GHG_{NET|PRJ,t*}$	net greenhouse gas emissions in the project scenario in the year t* since the start of the project activity, tCO_2e; and
$GHG_{LK|LtPF,t*}$	total greenhouse gas emissions due to leakage arising outside the project boundary as a result of the implementation of improved forest management (IFM) activities in the year t* since the start of the project activity, in the project scenario, tCO_2e.

4.5 Section 8.4.1.2: Calculation of project Verified Carbon Units

The number of Verified Carbon Units (VCUs) for each year t in the project crediting period was adjusted for uncertainty and risk according to the steps outlined below.

4.5.1 Adjustment for uncertainty

As per the methodology, uncertainty was expressed as a variance ±15% of the mean as at the 95% confidence level. For both baselines, uncertainty of the estimates was based on the variance of the forest inventory data. Even though the planned merchantable volume data was used, for which there was no variance data available, its variance was assumed to be the same as that of our forest inventory data. Project uncertainty was assumed to be equivalent to the error associated with the baseline uncertainty. The total uncertainty was calculated as the square root of the sum of the squares of the baseline and project uncertainty, through propagating the error in the baseline stocks and the error in the project stocks by applying Equation 29:

$$U_{TOTAL|LtPF} = \sqrt{U^2{}_{|PRJ} + U^2{}_{|BSL}}$$ VM0010 Equation 29

Where:

$U_{total\|LtPF}$	total uncertainty for LtPF Project, dimensionless;
$U_{\|PRJ}$	total uncertainty for the improved forest management activities in the project scenario, dimensionless; and
$U_{\|BSL}$	total uncertainty for the baseline scenario, dimensionless.

Since $U_{total|LtPF}$ was less than 0.15, then no deduction for uncertainty was required.

4.5.2 Section 8.4.1.2: Calculation of verified carbon units

The amount of greenhouse gas credits estimated at Step 8.4.1.1 was then adjusted to account for project risk, but deducting the calculated buffer percentage, based on the most recent version of the VCS Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination.

Therefore, the amount of VCUs that can be issued at verification over the monitoring period from 2009 – 2012 was calculated as:

$$VCU_{net|LtPF} = (Credits_{total,t2|LtPF} - Credits_{total,t1|LtPF}) - Bu_{|IFM-VCS}$$ VM0010 Equation 31

Where:

$VCU_{net\|LtPF}$	number of verified carbon units; dimensionless;
$Credits_{total.t1\|LtPF}$	net anthroprogenic greenhouse gas removals by sinks, as estimated for t*=t1 in tCO_2e;
$Credits_{total.t2\|LtPF}$	net anthroprogenic greenhouse gas removals by sinks, as estimated for t*=t2 in tCO_2e; and
$Bu_{\|IFM-VCS}$	total number of credits withheld in VCS buffer account.

5 MONITORING (M-MON)

5.1 Background and Context

To maintain accreditation against the VCS, the project is required to:

- Monitor and report on parameters specified in VM0010 and VMD0015 at least every 5 years but not more frequently than annually
- Maintain project records
- Renew the baseline of the areas stratified as REDD activity areas every 10 years

5.2 Objective and Scope

The primary objective of the monitoring plan is to provide the information necessary to:

- Undertake periodic verification of the project against the VCS; and
- Revisit the baseline at the conclusion of each fixed baseline period (i.e. every 10 years).

The scope of the monitoring plan is to collect data for reporting on[45]:

- The area of forest land converted to non-forest land and associated changes in carbon stocks within the Project Area.
- confirmation of the project activity
- The area of forest land undergoing loss in carbon stock from degradation activities and
- associated changes in carbon stocks;
- The greenhouse gas emissions associated with project implementation.
- The area of forest land undergoing loss in carbon stocks resulting from natural disturbances and illegal logging and any associated changes in carbon stocks.

5.3 Required Information

Information required for verification of the project includes:

- Actual carbon stock changes and GHG emissions within the project area;
- Net anthropogenic GHG emission reduction.

Information required for revisiting the baseline projections includes:

- Information on agents, drivers and underlying causes of deforestation;
- The area and location of baseline deforestation;
- Improved data on the carbon component of the baseline, if available.

Additionally, the monitoring activities will be used to collect and analyse information necessary to:

- Assess the success of the project scenario;
- Determine any variation between ex-ante and ex-post estimations of GHG emissions or carbon stocks; and

[45] Note that as there is no harvesting in the project scenario, there is no unsustainable firewood collection or charcoal production and regrowth of deforested/degraded lands is conservatively omitted.

- Calculate and report net GHG reductions attributed to the project in accordance with the methodology requirements.

5.4 Overview of the Monitoring Process

The Monitoring Plan employs direct field monitoring patrols as well as indirect satellite images and analysis tools to systematically monitor land cover change in the Project Area. Any detection of change from direct or indirect monitoring will trigger a land use change assessment and increased patrols in identified vulnerable areas. Increased patrols would be aimed at reducing future impact on identified at risk areas for more intense patrols.
Figure 34 shows an overview of the Project monitoring and reporting process.

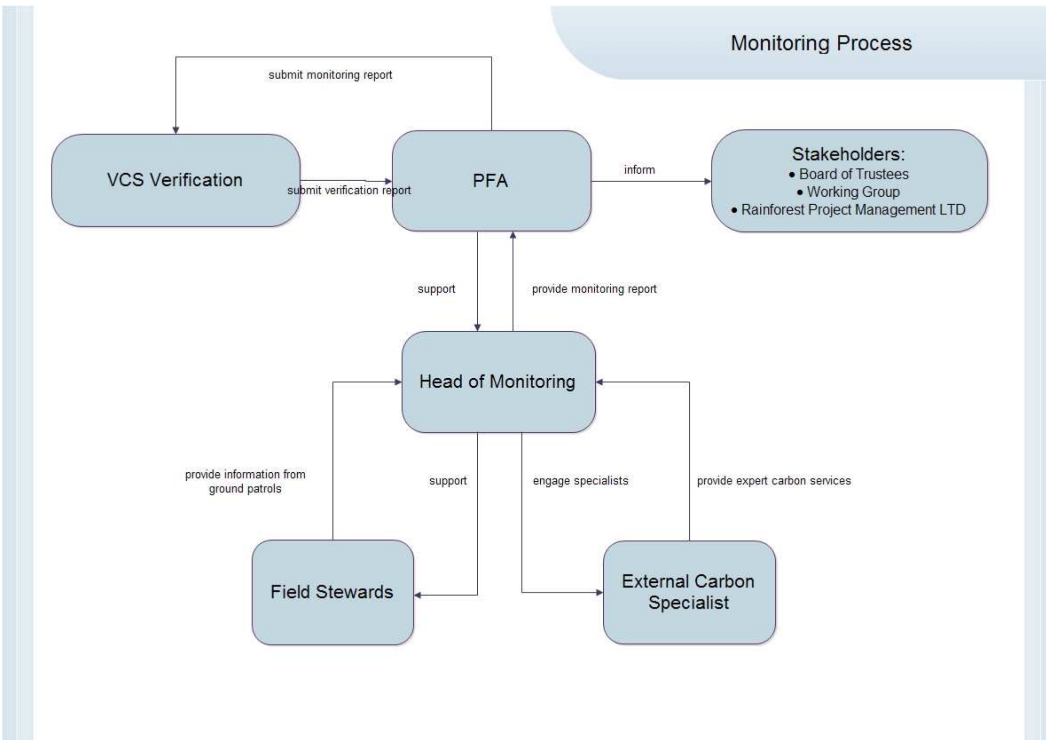


Figure 34: Overview of monitoring process

The monitoring reports developed by the Head of Monitoring will be used to identify project risks and non-conformances which will in turn trigger a corrective action plan (CAPs), if required, which is created between the Head of Monitoring and the Field Stewards. These CAPs inform of any necessary revision of the field standard operating procedures (SOPs), or additional training requirements, thereby enabling a process of continuous improvement through an adaptive management processes as illustrated in Figure 35.

Figure 35: Continuous Improvement of monitoring process

If the monitoring and reporting process identifies disturbance which results in a net loss in the Project Area, then the decision tree in Figure 36 is used to guide responses to the issue.

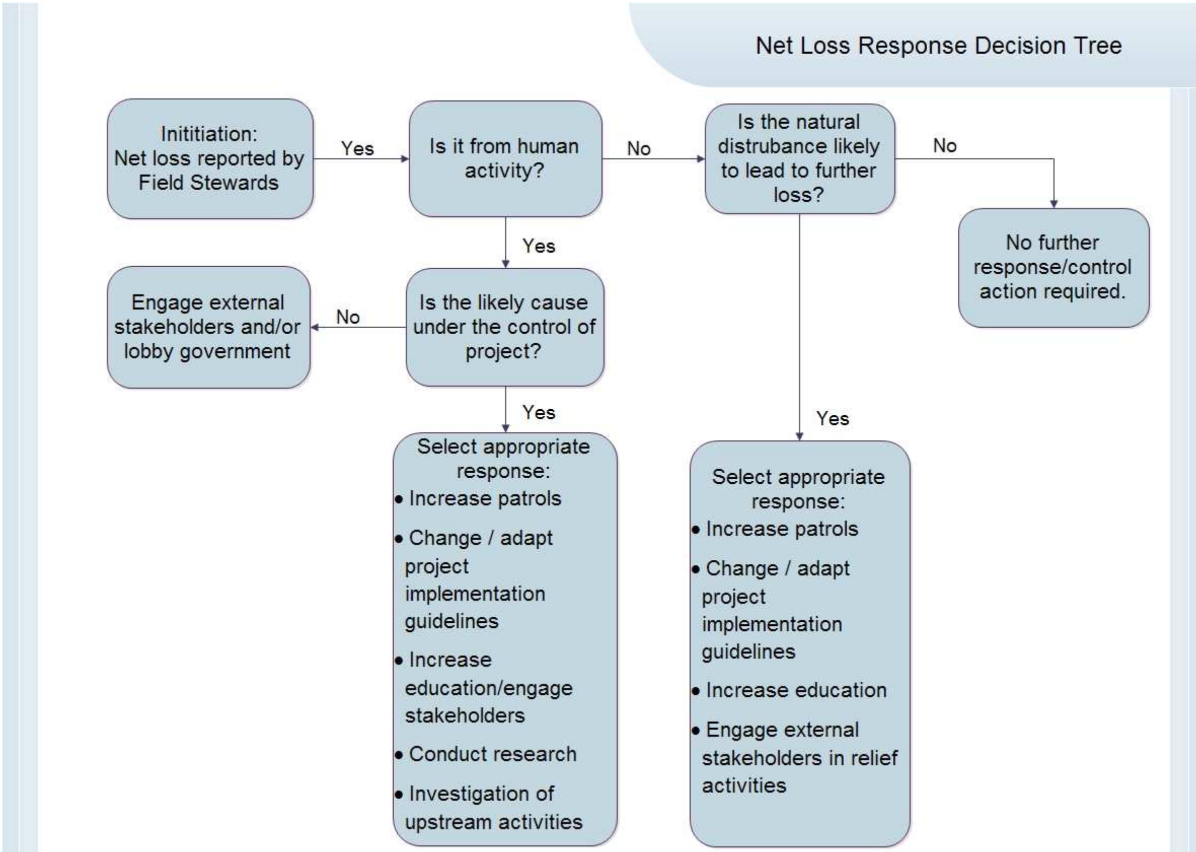


Figure 36: Net Loss Response Decision Tree

5.5 Ground Surveys

Ground surveys will be conducted to gather information from the Project Area. Ground surveys may fall under the following categories:

- Routine Field Patrol
- Incident Based Non-Routine Patrol

Each field patrol requires completion of a field sheet or survey. The information required to be collected from the routine field patrols is detailed against each parameter listed in Section 0.

Routine field patrols will be conducted by the Field Stewards and reported to the Head of Monitoring. Incident based non-routine patrols will also be completed by the Field Stewards and reported to the Head of Monitoring; however the reporting of non-routine patrols will instigate the adaptive management procedures as seen in Figure 36.

5.6 Remote Sensing

Remote sensing techniques will be employed to assess deforestation in the Project Area. Both low and high resolution images will be assessed to detect changes in the project region related to indicators such as infrastructure development, clearing for gardening, fires and other natural disturbances. Changes at this scale are most likely detectable over a longer (12 month) temporal scale and as such this analysis will take place to coincide with the VCS reporting and verification events detailed in Table 49.

The results will be collated into a monitoring report suitable for third party verification.
A summary of identified monitoring components can be found in Table 47 below.

Table 47: Monitoring Activities

Monitoring Component		Activity	Monitoring Frequency	Method	Resources
1	Boundary	Detect integrity of Project Boundary	Annually	Remote Sensing	ALOS 50m or Landsat 30m
2	Stratification	Land Cover classification	Annually	Remote Sensing	ALOS 50m or Landsat 30m + field data
3	Land change	Detection and area calculation of deforestation	Annually	Remote Sensing	Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution) as needed to support analysis and field
4	Logging	Detection and area calculation of degradation from illegal logging	Continual	Fieldwork Remote Sensing	High Resolution Imagery (5m satellite)
5	Fire	Detection of fire ignitions, calculation of burn areas (deforestation associated with fire)	Continual	Fieldwork Remote Sensing	MODIS imagery (1 km thermal band detects fires as small as 100m^2 and imagery is collected and posted daily)
6	Forest Carbon Stock	Field measurement of biomass indicators (i.e. species, height, DBH)	10 yearly	Fieldwork	Project Field Inventory Guide and Data Sheets
7	Leakage	New logging or land conversion permit activity within region of project	Annually	Fieldwork Remote Sensing National Records	Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution)

5.7 Data Archiving

All data collected as part of monitoring program will be archived electronically and be kept at least for two years after the end of the project crediting period. All measurements will be conducted according to relevant standards as described in the parameter tables in Section 0.

Data archiving shall take both electronic and paper forms, and copies of all data shall be provided to relevant project participants/stakeholders. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are to be stored in multiple locations. One copy to be stored in the office of Head of Monitoring and one copy stored in the head office of PFA.

The archives will include:

- copies of all original field measurement data, laboratory data, data analysis spreadsheets;
- estimates of the carbon stock changes in all pools and non-CO_2 GHG and corresponding calculation spreadsheets;
- GIS products; and
- copies of the monitoring reports.

5.8 Organisation and Responsibilities

Table 48: Responsibilities of monitoring staff

Staff	Responsibilities
Pacific Forest Alliance	Third Party review process of monitoring report
	Managing the VCS verification process
	Maintaining and storage of records
	Reporting to project stakeholders
Project Manager/Head of Monitoring	Manage monitoring process
	Plan and coordinated field data collection
	Prepare reports
	Identify Issues
	Implement continual improvement processes
	Supervision of field stewards
	Identify training requirements
	Drafting of Standard Operating Procedures
	Procurement of required support from specialists
Field Steward	Field data collection
	Instrument calibration and maintenance
	Data uploading
	Communication of issues to Head of Monitoring
External Consultants	Delivery of required support as specified by the Head of Monitoring (expected to be remote sensing)

5.9 Monitoring Frequency

The monitoring of parameters required for VM0007 and VM0010 will culminate in the development of a monitoring report for third party verification. This report will be produced annually up until 2015 and bi-annually after 2015 as reported in

Table 49.

Should there be any loss identified in the project area the Net Loss Response procedure (Figure 36) will initiate immediate reporting to the Superintendent and an appropriate response to limit further loss.

The monitoring of parameters for the baseline renewal will culminate in the development of a revision of the baseline estimation of carbon stocks every 10 years. This is scheduled for 2019 (see

Table 49).

Table 49: Frequency of Monitoring and Reporting for VCS verification

Period	Activities	Duration (yrs)	Baseline status
22 May 2009 – 31 December 2012	First monitoring period	3.5	First baseline period
1st January 2013 – 31 December 2014	Second monitoring period	1	
1st January 2014 – 31 December 2015	Third monitoring period	1	
1st January 2015 – 31 December 2016	Fourth monitoring period	1	
1st January 2016 – 31 December 2018	Fifth monitoring period	2	
1st January 2018 – 21 May 2019	Sixth monitoring period	1	
21 May 2019	Baseline Revision	NA	Revised baseline

5.10 Quality Assurance and Quality Control (QA/QC)

Monitoring related QA/QC requirements are documented in a series of Standard Operating Procedures (SOPs) which are summarised in Table 50.

Table 50: Standard Operating Procedures Relevant to VCS Monitoring and Reporting

QA/QC	Description
Data Collection SOP	The remote sensing data, will be verified by the field stewards through ground-truthing if required. QA/QC procedures for specific parameters are described in Section 0.
Data Capture and Storage SOP	The DCS SOP defines the data capture, storage (hard copy and digital format) and data retrieval framework.
Report Development and Release	Technical review or pre-verification of the data, SOP and monitoring report will be conducted by an independent 3rd party, such as the University of Papua New Guinea using a checklist specially developed for this purpose. This report will then be signed off by Pacific Forest Alliance prior to the commencement of the VCS verification process.
Continual Improvement Process	This process will be applied to ensure continuous improvement in all processes involved.
Information and Communication Systems (ICS) SOP	The ICS SOP defines communication methods including communication responsibilities, timing of communication, reporting requirements, events response and the flow in which the communication process should occur.

5.11 Monitoring and Reporting Tasks

Monitoring and reporting tasks are designed to collect and report the information required for periodic verification of the Project, and recalculation of the baseline at the end of the fixed baseline period.

Technical descriptions of monitoring tasks, data collection procedures QA/QC procedures are listed for each parameter in the tables presented in Section 0.

The monitoring plan is divided into two tasks:

- Task 1 – Monitoring and reporting of carbon stock changes and GHG emissions in areas defined as planned deforestation (VM0007)
- Task 2 - Monitoring and reporting for areas defined as conversion of logged to protected forest (VM0010)

5.11.1 Task 1 – Monitoring and reporting of carbon stock changes and GHG emissions in areas defined as planned deforestation (VM0007)

Monitoring in accordance with VM0007 (M-MON) produces the following parameters:

Table 51: Parameters produced from VM0007 monitoring

Parameter	SI Unit	Description
ΔC_P	t CO_2-e	Net greenhouse gas emissions within the project area under the project scenario
$\Delta C_{P,LB}$	t CO_2-e	Net greenhouse gas emissions within the leakage belt in the project case
ADefPA,i,t	Ha	Area of recorded deforestation in the project area in the project case in stratum i at time t
ADefLB,i,t	Ha	Area of recorded deforestation in the leakage belt in the project case in stratum i at time t
Aburn,i,t	Ha	Area burnt in stratum i at time t
ADistPA,i,t	Ha	Area impacted by natural disturbance in stratum i at time t

For the project area the net greenhouse gas emissions in the project case is equal to the sum of stock changes due to deforestation and degradation plus the total greenhouse gas emissions minus any eligible forest carbon stock enhancement:

$$\Delta C_P = \sum_{t=1}^{t^*} \sum_{i=1}^{M} (\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t}) \quad \text{Equation (M-MON 1)}$$

Where:

ΔC_P Net greenhouse gas emissions within the project area under the project scenario; t CO_2-e

$\Delta C_{P,DefPA,i,t}$ Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; t CO_2-e

$\Delta C_{P,Deg,i,t}$ Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* at time *t*; t CO_2-e

$\Delta C_{P,DistPA,i,t}$ Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* at time *t*; t CO_2-e

$GHG_{P-E,i,t}$ Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; t CO_2-e

i 1, 2, 3 ...*M* strata

t 1, 2, 3, ... t* years elapsed since the start of the REDD project activity

For the leakage belt the net greenhouse gas emissions in the project case is equal to the sum of stock changes due to deforestation in the leakage belt:

$$\Delta C_{P,LB} = \sum_{t=1}^{t} \sum_{i=1}^{M} \Delta C_{P,DefLB,i,t}$$ Equation (M-MON 2)

Where:

$\Delta C_{P,LB}$	Net greenhouse gas emissions in the leakage belt in the project case; t CO_2-e
$\Delta C_{P,DefLB,i,t}$	Net carbon stock change as a result of deforestation in the leakage belt the project case in stratum *i* at time *t*; t CO_2-e
i	1, 2, 3 ...*M* strata in the project scenario
t	1, 2, 3, ... *t** years elapsed since the projected start of the REDD project activity

This calculation procedure and the development of periodic monitoring reports for verification purposes is completed by applying four steps (please see below for more details).

Selection and analyses of sources of land-use and land-cover (LU/LC) change data

Medium resolution remotely sensed spatial data will be used (30m x 30m resolution or less, such as Landsat, Resourcesat-1 or Spot sensor data). In general, the same source of remotely sensed data and data analysis techniques must be used within the period for which the baseline is fixed. If remotely sensed data have become available from new and higher resolution sources (e.g. from a different sensor system) during this period then it is possible to change the source of the remotely sensed data. Equally if the same source is no longer available (e.g. due to satellites or sensors going out of service) an alternate source may be used. A change in source data may only occur if the images based on interpretation of the new data overlap the images based on interpretation of the old data by at least 1 year and they cross calibrate to acceptable levels based on commonly used methods in the remote sensing community.

The data collected and analysed will cover the entire Project Area: data shall be available for the year in which monitoring and verification is occurring.

Processing LU/LC Change Data

The remotely sensed data collected must be prepared for analysis. Minimum pre-processing involves geometric correction and geo-referencing and cloud and shadow detection and removal. Guidance for interpretation of remote sensing imagery is given in the GOFC-GOLD 20084 Sourcebook for REDD and shall be followed as appropriate.

Post-processing and accuracy assessment

Post-processing is required to:

1. Map area change detected in the imagery.
2. Calculate the area of each category of change within the project area. This will also be done for the reference region during periodical revisiting of the baseline.

For the calculation of each category of change:

a) At the end of each monitoring period:
   - Calculate the area of each category within the Project Area.
   - Update the Forest Cover Benchmark Maps for the Project Area.

b) Every 10 years (when the project baseline must be revisited) or every five years where conditions trigger more frequent baseline renewal:
   - Calculate the area of each category within the Project Area.
   - Update the Forest Cover Benchmark Maps for the Project Area.

c) Estimate land-use and land-cover (LU/LC) change data in cloud-obscured areas:

d) Multi-date images must be used to reduce cloud cover to no more than 10% of any image. If the areas with 10% cloud cover in either date in question do not overlap exactly, then the rate must come from areas that were cloud free in both dates in question. This must be estimated in % per year. Then, a maximum possible forest cover map must be made for the most recent time period. The historical rate in % must be multiplied by the maximum forest cover area at the start of the period for estimating the total area of deforestation during the period.

e) The overall classification accuracy of the outcome of the previous steps must be 90% or more.

<u>Interpretation and analyses</u>

Monitoring deforestation

An estimate of the emissions resulting from any deforestation that occurs within the Project Area will be developed.

The method used to detect and map deforestation using remotely sensed data will be based on common good practice in the remote sensing field and will depend on available resources and the availability of image processing software. The same method will be used for the entire period for which the baseline is fixed.

The net carbon stock change as a result of deforestation is equal to the area deforested multiplied by the emission per unit area.

$$\Delta C_{P,DefPA,i,t} = \sum_{u=1}^{U} (A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t})$$ Equation (M-MON 3)

$$\Delta C_{P,DefLB,i,t} = \sum_{u=1}^{U} (A_{DefLB,u,i,t} * \Delta C_{pools.P,Def,u,i,t})$$ Equation (M-MON 4)

Where:

$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum *i* at time *t*; t CO_2-e
$\Delta C_{P,DefLB,i,t}$	Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum *i* at time *t*; t CO_2-e
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha
$A_{DefLB,u,i,t}$	Area of recorded deforestation in the leakage belt stratum *i* converted to land use *u* at time *t*; ha
$\Delta C_{pools,Def,u,i,t}$	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; t CO_2-e ha^{-1}
u	*1,2,3,...U* post-deforestation land uses
i	1, 2, 3 ...*M* strata
t	1, 2, 3, ... *t** years elapsed since the start of the REDD project activity

$$\Delta C_{pools,Def,i,t} = C_{BSL,i} - C_{P,post,i} - C_{WP,i}$$ Equation (M-MON 5)

Where:

$\Delta C_{pools,Def,u,i,t}$	Net carbon stock changes in all pools as a result of deforestation in the project case in land use *u* in stratum *i* at time *t*; t CO_2-e ha^{-1}
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum *i*; t CO_2-e ha^{-1}
$C_{P,post,u,i}$	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; t CO_2-e ha^{-1}
$C_{WP,i}$	Carbon stock sequestered in wood products from harvests in stratum *i*; t CO_2-e ha^{-1}
u	*1,2,3,...U* post-deforestation land uses
i	1, 2, 3 ...*M* strata
t	1, 2, 3, ... *t** years elapsed since the start of the REDD project activity

$$C_{post,u,i} = C_{AB\_tree,i} + C_{BB\_tree\ ,i} + C_{AB\_non\ -tree,i} + C_{BB\_non-tree,i} + C_{LI,i}$$ Equation (M-MON 6)

Where:

$C_{P,post,u,i}$	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; t CO_2-e ha^{-1}
$C_{AB\ tree,i}$	Carbon stock in aboveground tree biomass in stratum *i*; t CO_2-e ha^{-1}
$C_{BB\ tree,i}$	Carbon stock in belowground tree biomass in stratum *i*; t CO_2-e ha^{-1}
$C_{AB\ non-tree,i}$	Carbon stock in aboveground non-tree vegetation in stratum *i*; t CO_2-e ha^{-1}
$C_{BB\ non-tree,i}$	Carbon stock in belowground non-tree vegetation in stratum *i*; t CO_2-e ha^{-1}
$C_{LI,i}$	Carbon stock in litter in stratum *i*; t CO_2-e ha^{-1}
u	*1,2,3,...U* post-deforestation land uses
i	*1, 2, 3 ...M strata in the in the project case*

Monitoring degradation

Not Applicable

Monitoring areas undergoing natural disturbance

Where natural disturbances occurs ex-post in the project area such as tectonic activity (earthquake, landslide, volcano), extreme weather (hurricane), pest, drought, or fire that result in a degradation of forest carbon stocks, the area disturbed shall be delineated and the resulting emissions estimated.

Emissions resulting from natural disturbances may be omitted if they are deemed de minimis through the use of the module T-SIG. The application of this tool must be detailed in the monitoring report submitted for verification.

The net carbon stock change as a result of the disturbance is equal to the area disturbed multiplied by the emission per unit area. In situations where the impact of disturbances on forest carbon stocks in a stratum varies spatially, the stratum may be further stratified based on post-natural disturbance carbon stocks. Where this occurs, such stratification by carbon stocks shall be maintained for the project life.

Where the disturbance event occur ex-post in the Project Area, the area disturbed shall be delineated and the area of each post-disturbance stratum must be delineated. The area disturbed in the with-project scenario shall be tracked directly using the guidance provided in Section 0.

For planned deforestation the sum of $A_{DistPA,q,i,t}$ shall be equal to the area of overlap between the delineated area of the disturbance and the summed area of planned deforestation in the project area ($D\%_{planned,i,t} * A_{planned,i}$), summed to the year in which the disturbance occurred.

$$A_{burn,i,t} = \sum_{q=1}^{Q} A_{burn,q,i,t}$$ Equation (M-MON 21)

$$A_{burn,q,i,t} = A_{DisPA,q,i,t}$$ Equation (M-MON 22)

Where:

$A_{DistPA,q,i,t}$	Area impacted by natural disturbance in post-natural disturbance stratum *q* in stratum *i*, at time *t*; ha
$A_{burn,q,i,t}$	Area burnt in post-natural disturbance stratum *q* in stratum *i,* at time *t*; ha
q	*1,2,3,...Q* post-natural disturbance strata where the natural disturbance included fire
i	1, 2, 3 ...*M* strata
t	1, 2, 3, ... *t** years elapsed since the start of the REDD project activity

$$\Delta C_{P,Dist,q,i,t} = C_{BSL,i} - C_{P,Dist,q,i} - C_{WP,q,i}$$ Equation (M-MON 23)

Where:

$\Delta C_{P,Dist,q,i,t}$ Net carbon stock changes in pools as a result of natural disturbance in the project case in post-natural disturbance stratum *q* in stratum *i* at time *t*; t CO_2-e ha^{-1}

$C_{BSL,i}$ Carbon stock in all pools in the baseline case in stratum *i*; t CO_2-e ha^{-1}

$C_{P,Dist,q,i}$ Carbon stock in pools in post-natural disturbance strata *q* in stratum *i*; t CO_2-e ha^{-1}

$C_{Dist,WP,q,i}$ Carbon stock sequestered in wood products from harvests following natural disturbance in post-natural disturbance stratum *q*, in stratum *i*; t CO_2-e ha^{-1}

q *1,2,3,...Q* post-natural disturbance strata

i 1, 2, 3 ...*M* strata

t 1, 2, 3, ... *t** years elapsed since the start of the REDD project activity

$$C_{P,Dist,q,i} = C_{AB\_tree,i} + C_{BB\_tree,i} + C_{AB_{non}-tree,i} + C_{BB_{non}-tree,i} + C_{LI,i}$$ Equation (M-MON 24)

Where:

$C_{P,Dist,q,i}$ Carbon stock in all pools in post-natural disturbance *q* in baseline stratum *i*; t CO_2-e ha^{-1}

$C_{AB\_tree,i}$ Carbon stock in aboveground tree biomass in stratum *i*; t CO_2-e ha^{-1}

$C_{BB\_tree,i}$ Carbon stock in belowground tree biomass in stratum *i*; t CO_2-e ha^{-1}

$C_{AB\_non-tree,i}$ Carbon stock in aboveground non-tree vegetation in stratum *i*; t CO_2-e ha^{-1}

$C_{BB\_non-tree,i}$ Carbon stock in belowground non-tree vegetation in stratum *i*; t CO_2-e ha^{-1}

$C_{LI,i}$ Carbon stock in litter in stratum *i*; t CO_2-e ha^{-1}

q *1,2,3,...Q* post-natural disturbance strata

i 1, 2, 3 ...*M* strata

Monitoring areas undergoing carbon stock enhancement
Not Applicable

Monitoring project emissions
Where significant non-CO_2 greenhouse gas emissions occur within the project boundary, this must be evaluated. For example, where deforestation or degradation occur within the project boundaries and fire is used as a means of forest clearance the non CO_2 emissions may be significant.

To determination which emissions must be included in the calculations the T-SIG tool is to be applied. Emissions are calculated through the application of E-BB.

$$GHG_{P,E,i,t} = E_{BiomassBurn,i,t}$$ Equation (M-MON 30)

Where:

$GHG_{P,E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum *i* in year *t*; t CO_2-e
$E_{FC,i,t}$	Emission from fossil fuel combustion in stratum *i* within the project area in year *t*; t CO_2-e
$E_{BiomassBurn,i,t}$	Non-CO_2 emissions due to biomass burning in stratum *i* in year *t*; t CO_2-e
$N_2O_{direct-N,i,t}$	Direct N_2O emission as a result of nitrogen application on the alternative land use in stratum *i* within the project area in year *t*; t CO_2-e
i	1, 2, 3 …*M* strata
t	*1, 2, 3 …t** years elapsed since the start of the REDD VCS project activity

<u>Monitoring requirements specific to baseline revision</u>
Aboveground Biomass (CP-AB)
At baseline revision the above- and belowground biomass stocks must be re-estimated from new field measurements. For each stratum, where the re-measured estimate is within the 90% confidence interval of the t=0 estimate, the t=0 stock estimate takes precedence and is re-employed, and where the re-measured estimate is outside (i.e. is greater than or less than) the 90% confidence interval of the t=0 estimate, the new stock estimate takes precedence and is used for the subsequent period.
Documentation
A consistent time-series of data on land use-change, and emissions and removals of CO_2 will emerge from periodic monitoring which will be conducted using a consistent methodology applied over time. All methodological procedures described in Sections 5.11 will be documented in the periodic monitoring reports to be submitted for verification.

The following information will be provided in the period monitoring reports:

a) <u>Data sources and pre-processing:</u> Type, resolution, source and acquisition date of the remotely sensed data (and other data) used; geometric, radiometric and other corrections performed, if any; spectral bands and indexes used (such as NDVI); projection and parameters used to georeference the images; error estimate of the geometric correction; software and software version used to perform tasks; etc.

b) Data classification: Definition of the classes and categories; classification approach and classification algorithms; coordinates and description of the ground-truth data collected for training purposes; ancillary data used in the classification, if any; software and software version used to perform the classification; additional spatial data and analysis used for post-classification analysis, including class subdivisions using non-spectral criteria, if any; etc.

c) Classification accuracy assessment: Accuracy assessment technique used; coordinates and description of the ground-truth data collected for classification accuracy assessment; and final classification accuracy assessment.

d) Changes in Data sources and pre-processing / Data classification: If in subsequent periods changes will be made to the original data or use of data:
- Each change and its justification must be explained and recorded; and
- When data from new satellites are used documentation must follow a) to c) above

5.11.2 Task 2 - Monitoring and reporting for areas defined as conversion of logged to protected forest (VM0010)

Monitoring and reporting activities shall cover the following aspects:

- project implementation;
- actual carbon stock changes from project activity; and
- estimation of ex-post net carbon stock changes from disturbance and illegal logging.

The following parameters are monitored in accordance with VM0010:

Table 52: Parameters produced from VM0010 monitoring

Parameter	SI Unit	Description
Illegal PRA		
$A_{burn,i,t}$	Ha	Area burnt in stratum i at time t
$A_{DIST\_IL,i}$	Ha	Area potentially impacted by illegal logging in stratum i
A_{Pi}	Ha	Total area of illegal logging sample plots in stratum i
PMP_i		Annual Allowable Cut as a proportion of total FMA area
A_i	Ha	Area covered by stratum i
DBH	cm	Diameter at breast height of tree

These parameters are required at each verification and are used in equations 16, 17, 19 of VM0010.

$$\Delta C_{WP100,i,p|BSL} = A_{i,p} * (C_{EX,i|BSL} - C_{WP100,i|BSL})$$ Equation (VM0010 - 16)

Where:

$\Delta C_{WP100,i,p\|BSL}$	change in carbon stock resulting from wood product conversion and retirement from stratum i in land parcel p, tC;
$A_{i,p}$	the area of stratum i in land parcel p, ha;
$C_{EX,i\|BSL}$	mean carbon stock of extracted timber per unit area in stratum i, tC ha^{-1};
$C_{WP100,i\|BSL}$	carbon stock sequestered in wood products in stratum i as a result of planned timber harvest in the baseline scenario, in tC ha^{-1};
i	1, 2, 3 …M strata; and
p	1, 2, 3 ...P land parcels.

$$\Delta C_{RG,i,p|BSL} = A_{i,p} * (RGR_i * TH_{i,p})$$ Equation (VM0010 - 17)

Where:

$\Delta C_{RG,i,p\|BSL}$	carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC;
$A_{i,p}$	the area of stratum i in land parcel p, ha;
R_{GRi}	regrowth rate of forest post timber harvest for stratum i, tC ha^{-1} yr^{-1};
$TH_{i,p}$	number of years since timber harvest in stratum i in land parcel p, years;
i	1, 2, 3 …M strata; and
p	1, 2, 3 ...P land parcels.

$$\Delta C_{NET|BSL} = \frac{(\sum_{p=1}^{P} \Delta C_{NET,p|BSL})}{IFM_{CP}} * t^*$$ Equation (VM0010 - 19)

Where:

$\Delta C_{NET\|BSL}$	net change in carbon stock across all parcels in the baseline scenario since the start of the project activity, in tC;
ΔCNET,p|BSL	net change in carbon stock in the baseline scenario in parcel p, in tC;
IFMCP	project crediting period for the IFM project, in years;
t*	time elapsed since the start of the project, in years; and
p	1, 2, 3 ...P land parcels harvested within the crediting period.

Monitoring and reporting of project implementation

Information shall be provided, and recorded in the monitoring report, to establish that:

- the geographic position of the project boundary is recorded for all areas of land;
- the geographic coordinates of the project boundary (and any stratification inside the boundary) are established, recorded and archived. This will be achieved by field survey (e.g. using GPS) or by using georeferenced spatial data (e.g. maps, GIS datasets, aerial photography, or georeferenced remote sensing images);
- commonly accepted principles of forest inventory and management are implemented;
- standard operating procedures (SOPs) and quality control/quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of SOPs already applied in national forest monitoring or available from published handbooks or from the IPCC GPG LULUCF 2003 is recommended; and
- the project plan, together with a record of the plan as actually implemented during the project, shall be available for validation or verification as appropriate.

Stratification

This methodology requires that an ex ante stratification of the project area in the project scenario is described in the VCS-PD as documented in the timber harvest plan, or developed by project proponents through sampling in the project area.

The monitoring plan may include sampling to adjust the number and boundaries of the strata defined ex ante where an update is required because of:

a) unexpected disturbances occurring during the project crediting period affecting differently various parts of an originally homogeneous stratum and/or
b) forest management activities that are implemented in a way that affects the existing stratification in the project scenario.

Monitoring of actual carbon stock changes

Carbon stocks will be measured according to the stock assessment equations in this methodology with field sampling based on forest inventory methods. Various sources exist to assist with the design of a verifiable forest field inventory based on best practice for sampling, data management and analysis (Box 3).

In the project area (or areas) the inventory plan must be specified in the VCS-PD and include:

a) adequate forest stratification, sample size estimation methods and consider uncertainty; and
b) a sampling framework including sample size, plot size, plot shape and information to determine plot location.

To determine the sample size and allocation among strata, this methodology uses the most recent version of the tool for the "Calculation of the number of sample plots for measurements within A/R CDM project activities" approved by the CDM Executive Board.

Carbon stock changes over time shall be estimated by taking measurements in plots at each monitoring event. Monitoring events shall take place at intervals of 5, or preferably 3 years. For intermittent years it is good practice to use extrapolations of trends as they have occurred up till that moment. Monitoring reports can use such extrapolated parameter values for the determination of net emissions by sources and removals resulting from the project.

The design of the sampling regime will be determined by the number of strata and timber harvest the baseline case.

Conservative Approach and Uncertainty

The monitoring report shall document all relevant equations for the ex-ante calculation of net anthropogenic GHG removals by sinks with care and provide transparent estimations for the parameters that are monitored during the project crediting period.

Where relevant it shall be transparently shown that estimates are based on measured or existing published data where possible and project proponents should retain a conservative approach.

An uncertainty analysis will be presented for all estimates from monitoring related to change in area, change in carbon stocks and emissions for both the baseline and project case.

5.12 Data and Parameters Used in Monitoring

5.12.1 VM0007

REDD Methodology Framework (REDD-MF)

Data / Parameter:	Project Forest Cover Monitoring Map
Data Unit:	
Used in equations:	3
Description:	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Value applied	
Source of data:	Remote sensing in combination with GPS data collected during ground truthing. The minimum map accuracy must be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Justification of choice of data or description of measurement methods and procedures applied:	
QA/QC procedures to be applied:	
Any comment:	Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR.

Data / Parameter:	Degradation PRA Results
Data Unit:	
Used in equations:	Section 5.2.2.1
Description:	Participatory Rural Appraisal
Value applied	
Source of data:	PRA
Justification of choice of data or description of measurement methods and procedures applied:	The PRA shall consist of semi-structured interviews / questionnaires. The PRA shall evaluate whether the following activities may be occurring in the project area: - harvesting of fuel wood - harvesting of wood for charcoal production - timber harvest If ≥10% of those interviewed/surveyed believe that degradation may be occurring within the project boundary then the limited on the-ground degradation survey shall be triggered. An additional output of the PRA shall be a depth of penetration of degradation pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting fuel wood, charcoal and/or timber. It is likely that differing distances shall exist for each degradation pressure. If multiple pressures exist in the same stratum the deepest depth of penetration shall be used to define Adeg,i. Frequency: every two years
QA/QC procedures to be applied:	
Any comment:	Ex-ante, an estimation shall be made of degradation in the with project case. If the belief is that zero degradation will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent deforestation.

Data / Parameter:	Result of Limited Degradation Survey
Data Unit:	
Used in equations:	Section 5.2.2.1
Description:	
Value applied	
Source of data:	
Justification of choice of data or description of measurement methods and procedures applied:	Sampled by surveying several transects of known length and width across the access-buffer area (equal in area to at least 1% of ADeg,i) to check whether new tree stumps are evident or not. Frequency: Must be repeated each time the PRA indicates a potential for degradation.
QA/QC procedures to be applied:	
Any comment:	Ex-ante, an estimation shall be made of degradation in the with project case. If the belief is that zero degradation will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent deforestation.

Data / Parameter:	$A_{DefPA,i,u,t}$
Data Unit:	ha
Used in equations:	3
Description:	Area of recorded deforestation in the project area in stratum i converted to land use u at time t
Value applied	
Source of data:	Remote sensing imagery
Justification of choice of data or description of measurement methods and procedures applied:	Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC procedures to be applied:	
Any comment:	Ex-ante, an estimation shall be made of deforestation in the with project case. If the belief is that zero deforestation will occur within the project boundaries then this parameter may be set to zero.

Baseline Carbon Stock Changes and Greenhouse Gas Emissions from Planned Deforestation (BL-UP)

See parameters under CP-AB, E-BB, CP-LI

Carbon Stocks in the above-and belowground biomass of live trees and non-tree pools (CP-AB)

Data / Parameter:	A_{sp}
Data Unit:	ha
Used in equations:	CP-AB 2,6,14
Description:	Area of sample plots in ha
Monitoring Frequency:	Monitoring must occur at least every ten years for baseline renewal. Where carbon stock enhancement is included monitoring shall occur at least every five years
Source of data:	Recording and archiving of number and size of sample plots
Measurement procedures (if any):	
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	
Any comment:	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante. Where part of project monitoring, ex-ante the number and area of sample plots shall be estimated based on projected sample effort relative to projections of growth and emissions.

Data / Parameter:	N
Data Unit:	Dimensionless
Used in equations:	CP-AB 4
Description:	Number of sample points
Value applied:	10
Source of data:	Recording and archiving of number of sample points
Measurement procedures (if any):	
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	
Any comment:	As carbon stock estimation occurs only for the determination of the baseline this parameter is known as *ex-ante*.

Data / Parameter:	DBH
Data Unit:	cm
Used in equations:	CP-AB 1
Description:	Diameter at breast height of a tree in cm
Value applied:	
Source of data:	Field measurements in sample plots
Measurement procedures (if any):	Measured 1.3m aboveground. Measure all trees above minimum DBH of 10cm in the sample plots. Minimum DBH employed in inventories is held constant for the duration of the project.
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied.
Any comment:	Carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante.

Data / Parameter:	A_{sf}
Data Unit:	m^{-2}
Used in equations:	CP-AB 10
Description:	Area of one sampling frame
Value applied:	
Source of data:	Recording and archiving size of sampling frame plot
Measurement procedures (if any):	
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	
Any comment:	Shall be known *ex-ante*.

Greenhouse Gas Emissions from Biomass Burning (E-BB)

Data / Parameter:	$A_{burn,i,t}$
Data Unit:	Ha
Used in equations:	E-BB 1
Description:	Area burnt in stratum i at time t
Module parameter originates in:	M-MON
Any comment:	Corresponding information shall be included in the VCS PD

Data / Parameter:	$C_{AB,tree,i}$
Data Unit:	t CO_2-e ha^{-1}
Used in equations:	E-BB 2
Description:	Carbon stock in aboveground biomass in trees in stratum i
Module parameter originates in:	CP-AB
Any comment:	Corresponding information shall be included in the VCS PD

Data / Parameter:	$C_{LI,i}$
Data Unit:	t CO_2-e ha^{-1}
Used in equations:	E-BB 2
Description:	Carbon stock in aboveground biomass in trees in stratum i
Module parameter originates in:	CP-L
Any comment:	Corresponding information shall be included in the VCS PD

Carbon Stocks in the Long Term Wood Products Pool (CP-W)

Data / Parameter:	A_i
Data Unit:	ha.
Used in equations:	CP-W 1
Description:	Total area of stratum i
Source of data:	Direct forest inventory of the project area, distinguishing commercially viable stocks on the basis of species and tree size, referencing local expert knowledge or a participatory rural assessment (PRA) of harvest practices and markets.
Measurement procedures (if any)	This parameter is updated at baseline renewal when aboveground biomass is re-inventoried as per module CP-AB (at least every 10 years).
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures:	
Any comment:	Ex-ante it is assumed that the strata remains constant during the baseline period.

Data / Parameter:	$V_{ex,i}$
Data Unit:	m^3
Used in equations:	CP-W 1
Description:	The volume of timber in m^3 extracted from within the stratum (does not include slash left onsite), reported by wood product class and preferably species.
Source of data:	Timber harvest records and/or estimates derived from field measurements or remote assessments with aerial photography or satellite imagery.
Measurement procedures (if any)	
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures:	
Any comment:	Note that this volume does not include logging slash left onsite. Data compilers must also make sure that extracted volumes reported are gross volumes removed (i.e. reported volume does not already discount for estimated wood waste, as is often the practice in harvest records). Assignment of volume extracted to wood product class(es), be substantiated on the basis of participatory rural appraisal (PRA) findings (also used to assess potential for degradation in module M-MON) or records of timber sales. Assignment of volume extracted to species, must be substantiated on the basis of either PRA findings, harvest records, or a commercial inventory. Baseline removals will be known ex-ante. With project removals are classed as project emissions and where expected shall be detailed ex-ante alongside evidence on expected harvested volumes.

Estimation of Market-Effects (LK-ME)

Data / Parameter:	PML_{FT}
Data Unit:	%
Used in equations:	Not used directly in any equations, but input factor for LF, used in equation LK-ME 2.
Description:	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type
Source of data:	Ex ante estimate based on field inventory of all biomass. Merchantable biomass is assumed to be all biomass above 50cm DBH.
Measurement procedures:	
Monitoring frequency:	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Any comment:	

Uncertainty for REDD Project Activities (X-UNC)

Data / Parameter:	$E_{BSL\ SS,i,\ pool\#}$
Data Unit:	t CO_2-e
Used in equations:	4, 5
Description:	Carbon stock or GHG sources (e.g. trees, dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the baseline case
Source of data:	The terms denoting significant carbon stocks, GHG sources or leakage emissions from baseline modules (BL-DFW, BL-PL, BL-UP) used to calculate net emission reductions.
Measurement procedures (if any)	
Monitoring frequency:	Monitored at least once every ten years (or when the baseline is revisited)
Quality Assurance / Quality Control:	
Any comment:	Baseline stocks and sources are estimated ex-ante for each baseline period.

Data / Parameter:	$E_{P,SS,i, Pool\#}$
Data Unit:	t CO_2-e
Used in equations:	7, 8
Description:	Carbon stock or GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the with-project case
Source of data:	The terms denoting significant carbon stocks, GHG sources or leakage emissions used in calculating net emission reductions from the following relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA.
Measurement procedures (if any)	
Monitoring frequency:	Monitored at least once every five years. Reported in the Project Monitoring report.
Quality Assurance / Quality Control:	
Any comment:	The *ex-ante* estimation shall be derived directly from the estimations originating in the relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA.

Data / Parameter:	$U_{BSL,SS,i,pool\#}$
Data Unit:	%
Used in equations:	4, 5
Description:	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case (1,2…n represent different carbon pools and/or GHG sources)
Source of data:	Calculations arising from field measurement data
Measurement procedures (if any)	Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level. For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest. For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.
Monitoring frequency:	Monitored at least once every ten years (or when the baseline is revisited)
Quality Assurance / Quality Control:	
Any comment:	Baseline stocks and sources are estimated ex-ante for each baseline period

Data / Parameter:	$U_{P,SS,i,pool\#}$
Data Unit:	%
Used in equations:	7
Description:	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the with-project case (1,2…n represent different carbon pools and/or GHG sources) .
Source of data:	Calculations arising from field measurement data
Measurement procedures (if any)	Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level. For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest. For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.
Monitoring frequency:	Monitored at least once every five years
Quality Assurance / Quality Control:	
Any comment:	*Ex-ante* the uncertainty in the with-project carbon stocks and sources shall be equal to the calculated baseline uncertainty.

5.12.2 VM0010

Data / Parameter:	Illegal Logging PRA results
Data Unit:	
Used in equations:	VM0010 Step 4
Description:	
Source of data:	PRA
Measurement procedures (if any)	The PRA shall evaluate whether timber harvest may be occurring in the project area and shall consist of semi-structured interviews / questionnaires. If ≥ 10% of those interviewed/surveyed believe that illegal logging may be occurring within the project boundary then the limited on-the-ground illegal logging survey shall be triggered. An additional output of the PRA shall be a depth of penetration of illegal logging pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting timber.
Monitoring frequency:	Every two years from the first verification.
Quality Assurance / Quality Control:	
Any comment:	Ex ante estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent illegal logging.

Data / Parameter:	Result of Limited Illegal Logging Survey
Data Unit:	
Used in equations:	VM0010 Step 4
Description:	
Source of data:	Limited on-the-ground illegal logging survey
Measurement procedures (if any)	Sampled by surveying multiple transects of known length and width across the access-buffer area to check whether new tree stumps are evident or not. The access-buffer area shall be equal in area to at least 1% of $A_{DIST\_IL,i}$
Monitoring frequency:	Must to be repeated each time the PRA indicates a potential for illegal logging.
Quality Assurance / Quality Control:	
Any comment:	Ex ante an estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero.

Data / Parameter:	$A_{burn,i,t}$
Data Unit:	Hectares
Used in equations:	VM0010 Equation 17
Description:	Area burnt in stratum i at time t
Source of data:	GPS coordinates and/or Remote Sensing data
Measurement procedures (if any)	N/A
Monitoring frequency:	Areas disturbed shall be monitored at in accordance with the monitoring and reporting schedule.
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Any comment:	Ex ante estimations of areas burned shall be based on historic incidence of fire in the Project region. Analysis of satellite imagery over a historical reference period of 2000-2009 presented no evidence of fire scars in the Project Area.

Data / Parameter:	$A_{dist,i,t}$
Data Unit:	hectares
Used in equations:	VM0010 Equation 17
Description:	Area disturbed in stratum i at time t
Source of data:	GPS coordinates and/or Remote Sensing data
Measurement procedures (if any)	N/A
Monitoring frequency:	Areas disturbed shall be monitored at in accordance with the monitoring and reporting schedule.
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Any comment:	Ex ante estimations of areas disturbed shall be based on historic incidence of natural disturbance in the Project region. Analysis of satellite imagery over a historical reference period of 2000-2009 presented no evidence of natural disturbance in the Project Area.

Data / Parameter:	$A_{DIST\_IL,i}$
Data Unit:	hectares
Used in equations:	VM0010 Equation 19
Description:	Area potentially impacted by illegal logging in stratum i
Source of data:	GIS delineation and ground truthing
Measurement procedures (if any)	$A_{DIST\_IL,i}$ shall be composed of a buffer from all access points (access buffer), such as roads and rivers or previously cleared areas. The width of the buffer shall be determined by the depth of degradation penetration as defined as a PRA output.
Monitoring frequency:	Repeated each time the PRA indicates a potential for degradation
Quality Assurance / Quality Control:	
Any comment:	*Ex ante* a limited survey can be used to determine a likely depth of degradation penetration.

Data / Parameter:	$C_{DIST\_IL,i,t\|PRJ}$
Data Unit:	tCO_2-e
Used in equations:	VM0010 Equation 20
Description:	biomass carbon of trees cut and removed through illegal logging in stratum *i* at time *t*
Source of data:	Field measurements in sample plots
Measurement procedures (if any)	The sampling plan must be designed using plots systematically placed over the buffer zone so that they sample at least 3% of the area of the buffer zone ($A_{DIST\_IL,i}$). The diameter of all tree stumps will be measured and conservatively assumed to be the same as the DBH. Where the stump is a large buttress, several individuals of the same species nearby shall be located and a ratio of the diameter at DBH to the diameter of buttress at the same height above ground as the measured stumps shall be determined. This ratio will be applied to the measured stumps to estimate the likely DBH of the cut tree. The aboveground carbon stock of each harvested tree will be estimated using the allometric regression equations chosen for forest growth in the project scenario. The mean aboveground carbon stock of the harvested trees is conservatively estimated to be the total emissions and to all enter the atmosphere.
Monitoring frequency:	Repeated each time limited sampling of A_{DIST_IL}, indicates illegal logging.
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the *IPCC GPG LULUCF 2003*, is recommended.

Any comment:	If species-specific equations are used and species cannot be identified from stumps then it shall be assumed that the harvested species is the species most commonly harvested. A PRA shall be used to determine the most commonly harvested species.

Data / Parameter:	A_{Pi}
Data Unit:	hectares
Used in equations:	VM0010 Equation 19
Description:	Total area of illegal logging sample plots in stratum i
Source of data:	Ground measurement
Measurement procedures (if any)	A sampling plan must be designed using multiple sample plots systematically placed across the buffer zone so that they sample at least 3% of the area of the buffer zone.
Monitoring frequency:	Not more than five years
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the *IPCC GPG LULUCF 2003*, is recommended.
Any comment:	*Ex ante* estimation should be made of area of plots. This should be set to exactly 3% of the buffer zone *ADIST_IL,i*

Data / Parameter:	PMP_i
Data Unit:	%
Used in equations:	VM0010 STEP 5 - Leakage, Box 4.
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum *i* within the project boundaries
Source of data:	Within each stratum divide the summed merchantable biomass (defined as total gross biomass of a tree 15cm DBH or larger) by the summed total of aboveground tree biomass.
Measurement procedures (if any)	
Monitoring frequency:	Not more than five years
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the *IPCC GPG LULUCF 2003*, is recommended.
Any comment:	*Ex-ante* a time zero measurement shall be made of this factor. The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory ($V_{j,i\|BSL}$), based on legal limits.

Data / Parameter:	$A_{i,}$
Data Unit:	hectares
Used in equations:	VM0010 Equation 16
Description:	Area covered by stratum *i*
Source of data:	GPS coordinates and/or Remote Sensing data and/or legal parcel records
Measurement procedures (if any)	
Monitoring frequency:	
Quality Assurance / Quality Control:	
Any comment:	In the baseline scenario strata areas shall not change through time. In the project scenario it shall be assumed *ex-ante* that stand boundaries and strata areas shall not change through time. *Ex post* adjustments of the project scenario strata may be needed if unexpected disturbances occur during the project crediting period, severely affecting different parts of an originally homogenous stratum. This disturbance will be delineated as a separate stratum for the purpose of monitoring the carbon stock changes.

6 ENVIRONMENTAL IMPACT

6.1 Overview of Environment Act 2000 and Environmental Impact Assessment

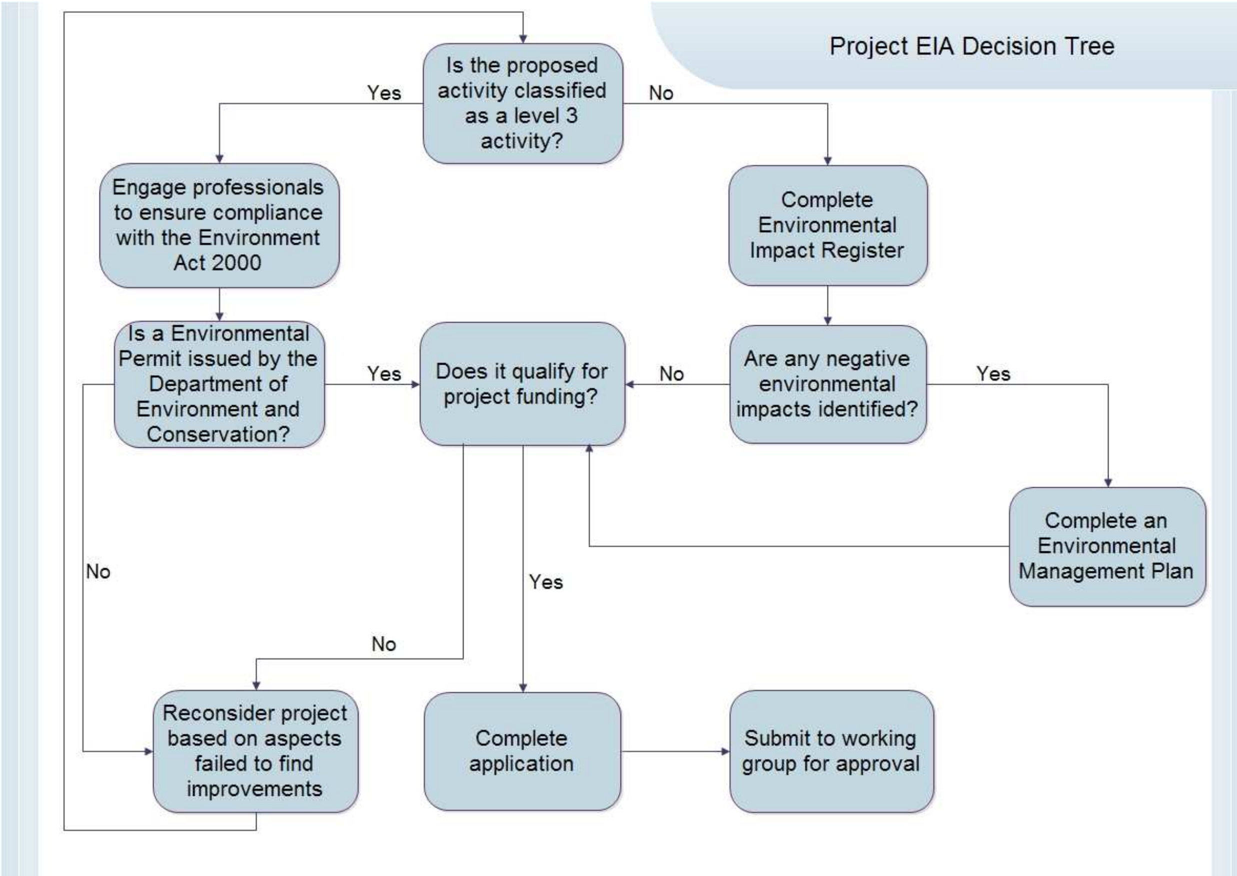
Papua New Guinea's Environment Act 2000 ('the Act') is the primary legislation regulating the environmental impact of development activities.[46] It defines how adverse effects of such activities should be avoided, remedied or mitigated. Under the Act, developers of certain activities must apply to the Papua New Guinea Department of Environment and Conservation (DEC) for authorisation to undertake activities which materially impact the environment. Under the Act, if the development is classed as 'Level 3', the DEC may require the developer to undertake a full Environmental Impact Assessment (EIA). At the time of writing, it is understood that planned activities under the Project are not required to conduct a full EIA under the Act. Nevertheless, the Project will be undertaken in accordance with this Act, as well as all other relevant international and local conventions, laws and regulations, as described in Section 9. A summary of the environmental impact assessment process of proposed Project activities is provided below.

6.2 Proposed project activities and their environmental impact

The primary activity of the April Salumei REDD Project is to avoid commercial timber harvesting of the FMA which typically leads to forest degradation and deforestation in Papua New Guinea (Shearman et al., 2008). As such, the main environmental impacts of the Project are avoided dis-benefits, rather than direct impacts of the project activities themselves. Nevertheless, a range of activities as described in Section 1.8 will be undertaken as part of this Project. To ensure that any potential environmental impacts are minimised, the project commits to conducting a short-form EIA for all existing and new Project activities. This short-form assessment will be used to identify whether any of the activities require a full EIA under the Act (i.e. if they are classed as 'Level 3' activities under the Act). The following diagram explains the decision-making process in undertaking an EIA.

[46] A copy of the Act is available at: faolex.fao.org/docs/texts/Papua New Guinea70607.doc

Figure 37 Environmental Impact Assessment decision tree



Source: EAS for Rainforest Project Management, 2012

Qualified and experienced personnel/contractors will be engaged to ensure all the requirements of the Act are met. Under the EIA decision tree, the first assessment involves determination of whether the Project activities are classed as ‘Level 3’ under the Act. This involves an assessment of whether the activity: 1) involves matters of national importance; or 2) may result in serious environmental harm. If the activity is classed as ‘Level 3’ under the Act, then an EIA must be conducted. This is then submitted for review by the DEC, and if successful, the activities are then issued with an Environmental Permit. At this time, the Project Management Working Group can decide if the activity qualifies for full project funding. However if the DEC refuses to issue a permit for the activity, then the Working Group can decide whether to re-submit the EIA, or to consider not pursuing the activity at all.

If the proposed activity is not classified as a Level 3, then an internal Project EIA procedure will be initiated. This involves completion of an Environmental Impact Register (EIR) template. Table 53 provides an example of this EIR template, as assessed for the Project development phase. If the EIR identifies any negative impacts, then an Environmental Management Plan (EMP) (Table 54) must be completed. This EMP then forms part of the activity application process which is submitted with the completed application to the Working Group. If no negative impacts are identified the application can be assessed against project funding criteria and applications submitted or revised if necessary.

Table 53: Environmental impact register, assessing impacts for the Project development stage

Proposed Activity	**April Salumei REDD Project Development**	
Description of Proposed Activity	**Forest carbon inventory, baseline assessment, community consultation, write project document, conduct validation/verification**	
Impact	**Negative Impact**	**Yes/No**
Physical Environment		
Climate	Does the activity lead to GHG emissions due to deforestation or degradation?	No
Soils	Is soil likely to be disturbed or polluted during proposed activity?	No
Flora	Is flora in the Project Area likely to be affected?	No
Fauna	Does the activity lead to possible reduction of wildlife in the area?	No
People and Communities		
Disruption	Will proposed activities cause disruption to local communities?	Yes
Land use	Is a change in land use likely?	Yes
Health	Are there any effects on health of local people anticipated due to proposed activity?	No
Environmental Quality		
Air Quality	Will emissions from machinery/vehicles increase due to the activity?	Yes
Noise	Is an increase in noise expected during activity?	Yes
Water Quality	Will the proposed activity affect water quality directly or indirectly?	Yes
Waste Management	Is an increase in waste expected due to proposed activity?	Yes

Table 54: Environmental management plan for the Project development stage

Proposed Activity: April Salumei REDD Project Development				**Applicant: Rainforest Project Management**		
Parameters	Potential Adverse Environmental /Social Impacts	Proposed Mitigation Measures	Residual Impact	Implementation Issues		
				Responsibilities	Monitoring	Training
Physical environment						
Climate	Emissions of GHG's will be avoided through establishment of the project. No negative impacts on the environment are expected.	NA	NA	RPM	NA	NA
Soils	Disturbance or pollution of soil is not to expected during project development	NA	NA	NA	NA	NA
Flora	Flora and Fauna will be protected through the project and no adverse effects are expected.	NA	NA	NA	NA	NA
Fauna			NA	NA	NA	NA
People and communities						
Disruption	Disruptions to local communities are expected to be minimal. Some Project activities such as field inventory, stakeholder engagement and meetings may have resulted in slight changes to the business-as-usual activities of the local people. Ongoing communication is important to ensure that negative impacts are kept to a minimum.	Keep disruption in the Project Area to a minimum. Consider customs and daily activities when visiting the Project Area. Always ensure that the communities know when external people are expected in the area, and keep them updated of any changes to itinerary.	Minimal	RPM	Chairman	NA
Land use	Changes to land use may arise as subsistence gardening will have to be kept to demarcated areas in order to achieve Validation.	Consider community needs and customs of affected villages. Delineate specific areas for targeted agricultural activities and educate people	Moderate	Individual ILG's	Chairman	Allow access to plans and conduct training

		on the boundaries and management plans of these areas.				sessions.
Health	Negative effects on health are not anticipated during project development phase.	NA	NA	NA	NA	NA
Environmental Quality						
Air Quality	Minimal emissions through increase in travel for project proponents will arise.	Plan travelling in advance and reduce unnecessary trips. No mitigation measures are necessary as this impact is classified as minimal.	Minimal	RPM	Steward	NA
Noise	Noise impact during travel on rivers	Follow equipment operating procedures and keep travel to a minimum and during reasonable hours.				
Water Quality	Changes to water quality, e.g. due to increase in motorised transport on rivers or increase of human waste through the project development is seen as minimal. The amount of extra people in the Project Area is kept to a minimum.	Follow operating procedures of boats.	Minimal	RPM	Steward	Training in water testing and raising awareness of effects on water quality
Waste Management	Changes to waste management, due to increase in people travelling to the area is expected to be minimal.	Follow good practice with waste disposal. Consider what items to take on the trip and take as much waste out of the area as possible. Follow Standard Operating Procedures for Waste and Fuel Treatment as found in Annex 4.	Minimal	RPM	Steward	

7 STAKEHOLDER COMMENTS

The Project has been under development since 2009, and numerous meetings and communications with Project stakeholders have taken place during this time. Documentation of past Project communications is available to the auditor on request. Please find a summary in Table 55 below.

Table 55: Stakeholder summary

Date	Title	Description
18 Oct 2008	Prime Minister Support Letter	Support for April Salumei FMA for Environmental Income from Carbon Sequestration.
April 2009	First Awareness	Public Notice Preparation Documents Meeting records / Community Views and opinions
May 2009	Letter from JDP&BPC confirming support for project	Reference 01/2009 7th May 2009
21 July 2009	Press Statement for Forest Minister and local MP.	Press Statement from Forest Minister Endorsement of REDD Pilot Project. Press Statement from Local MP and Minister for Correctional Services,
21 July 2009	Executive Director OCCD	OCCD Executive Director Letter of Support for April Salumei Pilot Project.
22 July 2009	Confirmation Letter PMs Legal Advisor	
October 2009	Project Awareness	Provide feedback from May meeting. Travel Planner shows villages visited.
November 2009	GAP Analysis Community consultation	Identification of local level understanding and GAP analysis. Conducted by Forest carbon & Environmental Services.
January 2010	Landowner Company Chairman - Wewak	Meeting in Wewak with landowner Company Chairman. Discuss findings of GAP analysis and outline requirements for forthcoming awareness.
January 2010	Meeting with Government Stakeholders	Commenced discussion with Provincial Government
February 2010	Review of Baseline Data Study Reports	University Papua New Guinea
25 Jan – 5 Feb 2010	Project Awareness	First Awareness Conducted in the Project area villages. Copy of report.
18 – 24 March 2010	Pre Validation trip.	Copy of Pre validation itinerary trip schedule. Undertaken by Scientific Certification Systems.
June 2010	Papua New Guinea Forest Authority	Discussions with Managing Director Mr Kanawi Pouri re the project development.
June 2010	Public Notice – Public Comments	Copy of notice
June 2010	Confirmation of partners with Melanesians Involvement in project	

24 June – 2 July 2010	Project Awareness – Field Visit	Community Awareness in the project impact area communities and villages. Wagu awareness report. Copy of schedule and awareness plan. Formal plans and process to conduct awareness following legal advice from Steeles Lawyers.
12 – 18 July 2010	Project Validation field trip by SCS Validator	Scheduled trip plan and itinerary.
Aug 2010	Vision 2050	Letter of Support from Chief Secretary, Prime Minister & NEC Department.
September 2010	Project Awareness – Distribution of Booklet	Distribution of awareness booklet to ILG Chairman in project area villages.
September 2010	CCB Validation Public Comments and replies to Public comments published.	
February 2011	Papua New Guinea Forest Authority complete survey of area and confirm landowner support for the project.	
February 2011	Engage Environmental Accounting Services to undertake Feasibility Study to determine roadmap to achieving approval to the Verified Carbon Standard.	
March 2011	Feasibility report completed.	Copy of report
September 2011	Presentation to OCCD and PMs Dept,	Presentation made to OCCD and PMs Department regarding the development of the project and milestones
April 2011	Landowner awareness to update landowners with results from feasibility	
April 2011	Engagement of Environmental Accounting Services to undertake technical component of work for Verified Carbon Standard	Document from National Executive Council approving the project and confirming distribution split.
May 2011	CCB Standards Monitoring Report Submitted	Copy of report
May 2011	Purchase of two 23' boats with 40Hp motors for landowners.	Pictures of boats
May 2011	VCS data collection commenced.	
July 2011	Project endorsement letter from Papua New Guinea Vision 2050 under Department of Prime Minister and National Executive Council	Copy of letter
5 July 2011	Brief to Chief Secretary	Brief to Chief to on AS Pilot REDD Project on Landowner Project Evaluation & Awareness Process.
12 July 2011	Papua New GuineaA advertise AS DOS on Post Courier.	AS Development Option Study advertised. Copy of advertisement.

12 July 2011	Congratulations letter from Director Vision 2050 on the announcement of April Salumei Validation & Certification.	Gold Standard awarded under CCBS. Copy of Certificates.
20 July 2011	LO chairmen write to NFA MD comments on DOS.	Copy of letter.
20 July 2011	Brief to LO chairmen on Summary of Project Activity	Copy of brief.
25 Aug 2011	Management Agreement signed between RPML & LO of ASSFMP ESP Papua New Guinea.	Copy of agreement.
September 2011	Confirmation of government support and endorsement for the project by Chief Secretary and Chairman of National Climate Change Committee	Copy of letter
22 Sept 2011	Guidance to Establishing Free, Prior, and Informed Consent for REDD+ Projects in Papua New Guinea. A Case Study Presentation & Discussion.	Attend OCCD Feedback Workshop on FPIC Manual. Copy of document.
23 Sep 2011	Brief to Deputy PM & Minister for Forestry & Climate Change on the project.	Copy of brief.
6 Oct 2011	Letter of support from DPM & Minister for Forest and Climate Change.	Copy of letter.
December 2011	April Salumei Poster	Poster used to present project in Durban UNFCCC Meeting
December 2011	April Salumei REDD Project presented on UNFCCC (COP17) Side Event by Papua New Guinea.	S Hooper and Gideon Joseph attended with the Papua New Guinea government delegation to attend the COP in Durban. Copy of presentation
January 2011	Awareness trip to advise Landowners the outcome of UNFCCC presentation and progress with project.	
6 Feb 2012	Register B'nomo Investments & Certificate Issued by IPA.	Copy of certificate.
February 2012	PFA Booklet Project Overview	Booklet used for presentations to OCCD, Papua New Guinea Forest Authority, ESP and Prime Ministers Department.
19 March 2012	Letter to East Sepik Provincial Administrator for consultation meeting to provide update of the project.	Copy of letter.
28 March 2012	April Salumei Working Group awareness on UNFCCC COP, VCS development and work that will evolve. Field Trip	Copy of report and photos.

April 2012	VCS Feasibility	EAS Complete VCS Feasibility Study
April 2012	Engagement of EAS to undertake VCS work	
29 May 2012	Brief East Sepik Provincial Administrator on the Technical Field Work "Forestry Inventory Assessment" to be carried.	Letter requesting meeting Meeting Minutes and photos.
28 May – 8 June 2012	Project update and awareness & ILG consent agreement signing in each of the project zones.	Copy of report & schedule.
10 May 2012	National Executive Council Approval April Salumei REDD Pilot Project for Papua New Guinea with others.	Copy of approval. NEC 106/2012
22 May 2012	Letter to Provincial Administrator for appointment for meeting	Trip report and itinerary schedule.
28 May – 8 June 2012	Field Forest Inventory Assessment Trip	Copy of itinerary and field assessment report.
9 June 2012	Letter from ASWG Advise RPML on LANCO AGM and ILG elections.	Copy of letter.
2 July 2012	Letter from Law Reform Commission	Constitutional and law Reform Commission outlining legal position of project/s in Papua New Guinea.
15 Aug 2012	Meeting with ASWG Chairmen.	Meeting with chairmen to discuss and plan out the conduction of ILG chairmen & ASWG elections. Copy of meeting minutes.
16 Aug 2012	Meeting with ESPA to brief for project update.	Meeting with DPA and senior staff provided them project update and told them about the coming ILG & ASWG elections. Copy of meeting minutes. Verify.
8 September 2012	LOC Meeting	Meeting of April Salumei Landowner Company Chairman at Maprik, District Administrator and Planner.
6 September 2012	Wosera Gawi District Administration engagement.	Meeting with District Administration to Identify priorities and integrate with Project Plan
September 2012	Health and Education maps ESP	Review of Health and Education facilities in the project area supported by ESP.
5 Oct 2012	ASWG Chairman Project Brief meeting atTalio Lodge.	Copy of brief and discussions.
7 Oct 2012	ASWG Chairmen Training Conducted.	Training on Leadership, Roles & Responsibilities, Needs Analysis, Community Projects Identification, Planning and Budgeting conducted at Yambi District Office. Copy of training charts and doc.

9 -13 Oct 2012	Deed signing with ILG chairmen in the four major project zones.	Copy of report. Photos and videos
16 Oct 2012	AS REDD Project Design & Validation Brief to major stakeholder, Vision 2050, PM & NEC, Papua New Guinea Forest Authority, OCCD, UPapua New Guinea, Post Courier.	Copy of presentation document and list of attendees.
25 Oct 2012	Letter to First Secretary, Ministry of Climate Change.	Letter requesting to brief the Minister for Forest & Climate Change on project status & progress. Copy of letter.

Table 56: Schedule of stakeholder communications

Communication Plan	Deliverable	Description	Delivery Method	Frequency	Owner	Audience
Public	Newsletter	To be produced and distributed to all landowners and displayed in resource centres.	Newsletter	Quarterly	Project Manager	Landowners
	Press Release	Update of the project and activities	Article in National press	6 Monthly	Project Manager	National
	Radio news	Update through the local NBC network	Radio	Monthly	RPM	National
Local Stakeholders	Report	Community Stewards report and revision of the report with the Project Superintendent.	Status Report	Monthly	Community Steward	Project Superintendent
	Review Meeting	Review with all Superintendents	Meeting Minutes	Quarterly	Project Manager	All Superintendents
	Review Meeting	Annual Performance Reviews	Meeting Minutes	Annually	Project Manager	All Superintendents
	Report	Update for the Project Manager	Status Report	Monthly	Project Superintendent	Project Manager
Government Stakeholders	Update Report	Update for the Provincial Government	Status Report	6 Monthly	Project Manager	Provincial Government
	Update meeting	Local Government, meeting with the ILG's	Status Report	Quarterly	Project Manager	ILG's
	Budget planning	District Government meeting of the joint district budget planning committee.	Budget Plan	Quarterly	Project Manager	District Government

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9 APPENDIX 1 –COMPLIANCE WITH INTERNATIONAL & LOCAL CONVENTIONS, LAWS AND REGULATIONS

International laws, regulations and conventions

Convention on Wetlands of International Importance Especially as waterfowl Habitat (Ramsar – 1971)

Otherwise known as the 'Ramsar' Convention, the aim of this Convention is to conserve wetlands and waterfowl habitat. Specifically, the Convention encourages training of personnel in the field of wetland research, management and wardening, along with research and data exchange.

The Project's compliance with this convention is observed via avoided dis-benefits to the wetland sites within the Project Area. This is because unsustainable logging as would have occurred in the baseline scenario, would likely have disrupted the fragile hydrological balance of the wetland and waterfowl habitats in the Project Area. Protection of the areavia a VCS carbon project will avoid logging, wetland drainage and habitat loss in line with the aims of the Ramsar Convention. The Project further complies with the Convention as Community Rangers will be employed and trained to patrol the Project Area, including the wetland areas, as well as to collect and report relevant data.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITIES 1973)

The aim of the CITES Convention is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The Project's compliance with this Convention is evidenced via the training of Community Rangers to patrol the area and liaise with communities. The Rangers will report any illegal activity such as illegal collection or damaging of CITES listed species, and will enact appropriate measures to address the issue.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn – 1979)

The aim of this Convention is to conserve terrestrial, marine and avian migratory species throughout their range, including the conservation of wildlife and habitats.

The Projects compliance with is Convention is evidence by protection of habitats within the Project Area, thereby removing the risk of drainage, logging and/or subsequent deforestation of important terrestrial, riverine and avian habitats.

Convention on Biological Diversity (1992)

The objectives of this Convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

As with all of the aforementioned biodiversity-related agreements, the Projects compliance with this Convention is observed via avoided dis-benefits to the Project Area. This is because unsustainable logging and agricultural conversion disrupts the fragile ecological balance of the this extremely high biodiversity area

United Nations Framework Convention on Climate Change (1992)

The aim of the UNFCCC is to achieve the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

The project has been implemented to reduce GHG emissions in an effort to combat climate change specifically with the REDD mechanism in mind, and therefore the Project is compliant with the UNFCCC.

UN Declaration on the Rights of Indigenous Peoples Rights

The Declaration sets out the individual and collective rights of indigenous peoples, as well as their rights to their land, territories, resources, culture, identity, language, employment, health, education and other issues. It also "emphasizes the rights of indigenous peoples to maintain and strengthen their own institutions, cultures and traditions, and to pursue their development in keeping with their own needs and aspirations". It "promotes their full and effective participation in all matters that concern them and their right to remain distinct and to pursue their own visions of economic and social development".
The project complies with the aims of this UN Declaration in that it provides the local (indigenous) communities with the opportunity to engage, at their own free will, in economic development via the carbon market, protection of their lands, territories and forest resources while also enhancing opportunities for other livelihoods, education, employment and healthcare. Furthermore, the Project aims to protect the forest resource and therefore the general way of life for future generations, including education on traditional ways of life and enhancing community by way of communication, meeting places and skill/knowledge sharing.

Stockholm Declaration of the United Nations Conference in Human Environment (1972)

The Stockholm Declaration states that it is each person's right to freedom, equality, adequate conditions of life; responsibility to protect the environment for present and future generations; to safeguard natural ecosystems, and ensure the capacity of the earth to produce renewable resources is maintained, restored and improved.

The Project provides a mechanism whereby the local community and the Papua New Guinea Government can protect the ecosystems and environment of the Project Area, and lead to an improvement in the socio-economic conditions of the community. In addition, the renewable resources of the area will be maintained and possibly improved by implementation of the Project. The socio-economic well-being of local communities will also be improved through income and community development programs.

Rio Declaration on Environment and Development (1992)

The 'Rio' Declaration aims for people to have a healthy and productive life in harmony with nature. It aims to ensure that development activities within national jurisdiction do not cause damage in areas beyond the national boundary. It also aims to eradicate poverty and encourage sustainable development and environmental protection.

The Project aims to avoid GHG emissions occurring within Papua New Guinea, which would have had an adverse impact on the global climate extending beyond Papua New Guinea's boundaries. In addition, the Project aims to encourage sustainable development and environmental protection in the Project Area, and to increase sustainable livelihoods and education to combat poverty.

Convention on Conservation of Nature in the South Pacific Region 1976

The objective of this Convention is to "To take action for the conservation, utilisation and development of the natural resources of the South Pacific region through careful planning and management for the benefit of present and future generations".

The Project has been developed to conserve, utilise and develop natural resources within the Project Area, and has been carefully planned so that present and future generations share the projects benefits.

Papua New Guinea's Laws, Regulations and Conventions[47]

Papua New Guinea's Constitution

The Project is compliant with Papua New Guinea's Constitution, specifically the fourth goal of the Constitution which is "to ensure that the forest resources of the country are used and replenished for the collective benefit of all PN Guinean, now and for future generations"

The project aims to allow use of the forest for housing, boat building, hunting and low impact gardening with the primary aim to conserve the forest and its resources for use now and in the future.

Forestry Act 1991

The Act is aimed at managing, developing and protecting Papua New Guinea's forest resources; maximising participation in and development of forest resources as renewable assets; utilising the forest resource to achieve economic growth, employment and industry; and encouraging scientific study and research to contribute to sound ecological balance.

The project assists Papua New Guinea in achieving its goals under the Act to protect and use the forest resources (in this case, carbon credits and forest products); while also conserving the forest resource

[47] Relevant laws, regulations and conventions to Papua New Guinea can be accessed at: http://www.ilo.org/dyn/natlex/country_profiles.nationalLaw?p_lang=en&p_country=Papua New Guinea

while achieving economic growth through direct employment, skills development, education, support of alternative livelihoods and direct incomes, and supporting biodiversity and social research in the area.

Environmental Act 2000

The Environmental Act outlines the protection of the environment in accordance with the Fourth National Goal of the Constitution; promotes sustainable development of the environment and economy; states that the social and physical well-being of the people should be supported by the safeguarding the life-supporting capacity of the air, water, soil and ecosystems for present and future generations, and avoiding, remedying and mitigating any adverse effects of activities on the environment.

The Project complies with requirements of the Act to promote sustainable development of the environment (protection) and economy (carbon credits, alternative livelihoods) while supporting the social (education, auxiliary police, community facilities) and physical wellbeing (healthcare) of the local community. The project also avoids the adverse impacts logging would have had on the area.

Investment Promotion Act 1992

The Papua New Guinea Investment Promotion Authority (IPA) was established by the *Investment Promotion Act 1992* to promote and facilitate investment within Papua New Guinea and abroad. The act regulates registration of companies/businesses and the certification of foreign enterprise. The Act requires that investors are required to obtain licences for their area of business interest from the relevant Government agencies in Papua New Guinea.

The Project is a mechanism for foreign investment in Papua New Guinea’s sustainable forests and protection of biodiversity. The project proponent and project developer have obtained the appropriate licences to operate in their area of business, and copies of these licences were provided to the auditor.

Industrial Relations Act 1962

This Act details the settlement of industrial disputes. It is an Act relating to development of industrial relations and the prevention and settlement of industrial disputes. The project complies with this legislation in its development of a formal disputes resolution strategy.

Industrial Health Safety and Welfare Act 1962

This Act relates to industrial safety, health and welfare, and related purposes. It ensures that measurements have been undertaken to ensure the health, safety and welfare of employees in the industrial sector.

The Project will take all necessary steps to ensure the safety of Project staff in situations where industrial activities are undertaken and safety equipment is essential. This is reinforced by the Project Proponent’s policies, especially 4.2 Health, Safety and Environment Policy;, 4.3 Drugs, Alcohol, Beetel Nut & Smoking Policy; 4.4 Emergency Procedures & Evacuation Policy; and 4.11 Fit for Work Policy. These documents were provided to the auditor.

Land Groups Incorporation Act 1974

The purposes of this Act are to encourage greater participation by local people in the national economy by the use of the land; better use of land; greater certainty of title; and more effectual settlement of certain disputes. This is achieved by legal recognition of the corporate status of certain customary and similar groups, and the conferring on them, as corporations, of power to acquire, hold, dispose of and manage land, and of ancillary powers; and encouragement of the self-resolution of disputes within such groups. The Land Groups Incorporation Act provides the legal basis upon which the project consent is based.

Land Act 1996

This Act provides for Papua New Guinea's framework relating to land, to consolidate and amend legislation relating to land, and to repeal various statutes, and for related purposes. The right to traditional land ownership is supported under the Land Act (1996). The project proponents (ILG's) own the land in this project and therefore comply with this Act.

Fauna (Protection and Control) Act 1966

The purpose of this Act is to make provision for the protection, control, harvesting and destruction of fauna, and for related purposes. The prevention of loss of habitat due to logging, and preservation of High Conservation Value species is one of the main biodiversity objectives in this project.

Employment Act No. 54 of 1978 (Consolidated up to 31 March 2001)

This Act relates to the employment of certain persons and lays out conditions of employment. The project has employment policies and procedures and commits to complying with the Act on all matters relating to employment. These policies are outlined in a number of documents addressing employment issues and company policies and procedures.

Child Welfare Act 1961

The welfare of children and related purposes are covered under this Act, it covers the protection and promotion of the rights and well-being of a child. Project objectives, including activities aimed at improving health standards and improving educational opportunities, are consistent with the Child Welfare Act. The Project is committed to recognising the rights of children and is committed to the welfare of children within the Project Area.

Discriminatory Practices Act 1963

This act is to prohibit certain discriminatory practices. 'Discriminatory practice' in this Act means discrimination either of an adverse or of a preferential kind, practiced by a person or group of persons, against or in favour of another person or group of persons for reasons only of colour, race or ethnic, tribal or national origin. The project is committed to provide equal opportunities in the work place. Women and men will be employed by the project, employment decisions will not be based on colour, race or ethnic, tribal or national origin. This is reinforced by the Project Proponents company policies including: 4.1 Equal Opportunity Policy and 4.5 Harassment Policy.

HIV/AIDS Management and Prevention Act 2003

This Act gives effect to the basic rights of life, and gives protection of public health, prevention of the spread of HIV/AIDS and the management of the lives and protection from discriminatory practices of people living with HIV/AIDS and of people who are affected by or believed to have HIV/AIDS. The April Salumei REDD Project is supporting numerous strategies from the Vision 2050, in particular relating to this act is 1.17.3.1 which is aiming to reduce HIV-AIDS to 0.1% of the population aged 15-49yrs.

Workers Compensation Act 1978

This Act provides for compensation to workers and their dependants in respect of injuries suffered by workers arising out of or in the course of their employment, and for related purposes. The project employment policies and procedures related to workers compensation are outlined in Policy 4.7 Leave of Absence Policy.

Papua New Guinea Vision 2050

This document maps out the future direction for Papua New Guinea's socio-economic development. It is underpinned by seven 'Strategic Focus Areas', which are referred to as pillars:

- Human Capital Development, Gender, Youth and People Empowerment;
- Wealth Creation;
- Institutional Development and Service Delivery;
- Security and International Relations;
- Environmental Sustainability and Climate Change;
- Spiritual, Cultural and Community Development; and
- Strategic Planning, Integration and Control

Section 1.8 of this PD describes how Project Activities are being designed in order to meet the requirements of the Vision 2050 document.