

RIMBA RAYA BIODIVERSITY RESERVE PROJECT - YEAR-1 MONITORING REPORT (JULY 2009 - JUNE 2010)



Document Prepared By Leslie Bolick & Todd Lemons (InfiniteEARTH Limited) and
Faisal Faud (PT Rimba Raya Conservation)

Project Title	Rimba Raya Biodiversity Reserve Project
Version	V3.4
Report ID	MonitoringReportY-1
Date of Issue	22 May 2013
Project ID	674
Monitoring Period	01-07-2009 to 30-06-2010
Prepared By	Leslie Bolick & Todd Lemons (InfiniteEARTH Limited) and Faisal Faud (PT Rimba Raya Conservation)
Contact	InfiniteEARTH Suite-8/A, The Ritz Plaza, 122 Austin Road, Tsim Sha Tsui Kowloon, Hong Kong Contact: Todd Lemons Email: contact@infinite-earth.com Web: www.infinite-earth.com

TABLE OF CONTENTS

1	Project Details	9
1.1	Summary Description of Project.....	9
1.2	Sectoral Scope and Project Type	10
1.3	Project Proponent.....	10
1.4	Other Entities Involved in the Project.....	10
1.5	Project Start Date	13
1.6	Project Crediting Period	13
1.7	Project Location	13
1.8	Title and Reference of Methodology.....	13
2	Implementation Status	14
2.1	Implementation Status of the Project Activity.....	14
2.2	Project Description Deviations	14
2.3	Grouped Project	14
3	Data and Parameters.....	14
3.1	Data and Parameters Available at Validation.....	14
3.2	Data and Parameters Monitored	26
3.3	Description of the Monitoring Plan.....	41
3.3.1	Purpose	41
3.3.2	Methodology	41
3.3.3	Monitoring Areas.....	41
3.3.4	Approach	42
3.3.5	Monitoring Components	44
3.3.6	Adaptive Management Context	46
3.3.7	Boundary	47
3.3.8	Stratification	49
3.3.9	Forest Protection.....	54
3.3.10	Land Cover and Land Use Change	69
3.3.11	Fire	72
3.3.12	Selective Logging.....	79
4	Quantification of GHG Emission Reductions and Removals	79
4.1	Baseline Emissions.....	79
4.1.1	Total Gross Baseline Emissions	79
4.1.2	Non-Permanence Risk Assessment & Deduction	81

4.2	Project Emissions	84
4.2.1	Estimation of GHG emissions due to logging	84
4.2.2	GHG Emissions due to fire	90
4.3	Leakage	93
4.3.1	Displacement Leakage Approach to Monitoring	93
4.4	Summary of GHG Emission Reductions and Removals.....	110
4.4.1	Introduction: Background on Carbon Accounting	110
5	Additional Information	114

TABLES:

Table 1. Project Profile Highlights.....	9
Table 2. Roles and responsibilities of project proponent	10
Table 3. Roles and responsibilities of associates	11
Table 4: Parameters available at Validation.....	14
Table 5: Parameters Monitored	26
Table 6. Monitoring Components: Project Conditions and Forest Protection	44
Table 7. Monitoring Components: Land Change Assessment for Carbon Accounting	45
Table 8. Land Conditions along the North Buffer boundary	48
Table 9. Rimba Raya Land Use / Land Cover Classes	49
Table 10 Summary Monitoring Table	63
Table 11. Threats Analysis – Threats / Resource Value Index Matrix.....	68
Table 12. Land Cover Change in Areas of Land Disturbance.....	71
Table 13. Number of Hotspots in Rimba Raya 2001-2010	73
Table 14: Total Gross GHG emissions avoided due to project activities.....	82
Table 15. Mawas Logging Gap Data – Biomass Carbon Loss.....	84
Table 16. Pre-project logging activity surveyed.....	85
Table 17. New Logging Activity Surveyed.....	86
Table 18. Logging Activities at “Exapator stream”.....	88
Table 19. Logging activities at “Sendurian stream”.	89
Table 20. Logging Gap Data	90
Table 21. Estimation of aboveground biomass emissions from burning	91
Table 22. Parameters used in estimation of aboveground biomass emissions from burning.....	92
Table 23. Landcover of Burned Areas – Kerangas Forest and Scrub are on sandy soils (non-peat)	92
Table 24. Parameters used in estimation of belowground biomass emissions from burning	93
Table 25. Estimation of emissions from burning belowground biomass	93
Table 26. PT BEST Group oil palm concessions in Indonesia.....	95
Table 27. Estimation of emissions in aboveground biomass from timber extraction.....	111



MONITORING REPORT: *vcs Version 3*

Table 28. Year-1 Avoided Carbon Emissions.....113

Table 29: VCU Vintages 113

FIGURES

Figure 1: Project Location	13
Figure 2: Rimba Raya Project Management Zone and Carbon Accounting Area.....	42
Figure 3: Framework for Adaptive Management	46
Figure 4. Land Cover Classification Map for Rimba Raya Carbon Accounting Area 2009.....	52
Figure 5. Land Cover Classification Map for Rimba Raya Carbon Accounting Area 2010.....	53
Figure 6. Process Flow Chart for Routing Patrols	56
Figure 7. Process Flow chart for those Joint Patrols.	57
Figure 8. Sample copy of a “Routine Patrol Log”.....	58
Figure 9. Non-Routine Field Patrol Report.....	60
Figure 10. Example of a SIRCAP (Serious Incidence Report).....	62
Figure 11. Threats Map for Northern Extent.....	65
Figure 12. Threats Map for Central Extent.	66
Figure 13. Threats Map for Southern Extent.	67
Figure 14. 2009 – 2010 Landcover Change – North CAA	70
Figure 15. 2009 – 2010 Landcover Change – South CAA.....	71
Figure 16. Fire Hotspots Data Acquisition and Assessment Process Flow	73
Figure 17. Spatial Distribution of Fire Hotspots in Rimba Raya Region 2001-2009.....	74
Figure 18. Map of Fire Hotspots in Rimba Raya Region Monitoring Year-1.....	75
Figure 19. Map of Ground Survey Locations of Fire Hotspots in Rimba Raya PMZ Monitoring Year-1.....	76
Figure 20. Process Flow for MODIS Acquisition and Assessment for Burn Area Mapping	77
Figure 21. MODIS burn scar mapping of Central Kalimantan (no burn scars in Rimba Raya)	78
Figure 22. GIS plots of Tasrun Stream logging gaps.....	87
Figure 23. GIS plots of Exapator Stream logging gaps.....	88
Figure 24. GIS plots of Sendurian Stream logging gaps.....	89
Figure 25. PT BEST Group oil palm concessions in Indonesia.....	96
Figure 26. PT BEST Group undeveloped oil palm concessions in Indonesia.....	97

Figure 27. Unpermitted activity shifting leakage monitoring zone for Rimba Raya based on 100km distance from PT BEST Agro's CPO processing mills in Pangkalan Bun and Sampit, Central Kalimantan.....	100
Figure 28. Results of the first three steps of plantation expansion leakage monitoring. Forested areas shown represent existing forest in 2000 for the 100km monitoring zone.....	101
Figure 29. Existing oil palm concession licenses at project start. GIS data represents government mapping obtained through NGOs and represents the best available data as of July 2009.....	102
Figure 30. Existing palm oil plantations at project start interpreted and digitized from Landsat 7 ETM+ satellite imagery path-row 118-061 and 118-062 June 7; 119-061 and 199-062 May 13; 120-061 and 120-062 August 8. 103	
Figure 31. Leakage risk areas representing forests in 2000 inside the 100km distance buffer to CPO plants and excluding permitted concessions and existing plantations. Forests inside conservation areas are also monitored for leakage.....	104
Figure 32. Example of overlay process to detect and highlight new forest conversion to palm oil.	105
Figure 33. 2009-2010 Palm oil conversion activity in the illegal plantation expansion leakage monitoring zone – none associated with PT BEST	107

ANNEXES

Annex 1	Monitoring Plan
Annex 2	FMEA & Control Plan
Annex 3	Field Report on Carbon Accounting Area Boundary Marking.doc
Annex 4	Landcover Accuracy Assessment
Annex 5	SIR-CAPS
Annex 6	<i>This annex has been deleted</i>
Annex 7	Report of Survey Activity Rimba Raya - Yappi 2010
Annex 8	Brief Report on Fire Hotspot Monitoring - Imanda 2010
Annex 9	Brief Report on Burn Area Mapping- Imanda 2010
Annex 10	Fire Plan and Community Training
Annex 11	Statement of Findings

1 PROJECT DETAILS

1.1 Summary Description of Project

The Rimba Raya Biodiversity Reserve Project, an initiative by InfiniteEARTH, aims to reduce Indonesia's emissions by preserving 63,828 hectares of tropical peat swamp forest in its Project Management Zone with a Carbon Accounting Area comprised of 47,237 hectares. Situated next to Tanjung Puting National Park in the Seruyan River watershed, Rimba Raya is rich in biodiversity including the endangered Bornean orangutan. The project area was slated by the Provincial government to be converted into four palm oil estates. These planned estates now comprise the 47,237 hectare Rimba Raya Carbon Accounting Area, which is monitored for the life of the project to protect and account for Rimba Raya carbon stores. A project profile can be seen in Table 1 below.

Table 1. Project Profile Highlights

Project Owner	PT Rimba Raya Conservation
Project Developer	Infinite-Earth Limited
NGO Partner & Project Beneficiary	Orangutan Foundation International
Host Country	Indonesia
Region	Kalimantan (Island of Borneo)
Province	Central Kalimantan
Regency	Seruyan
Forest Type	HCV Tropical Peat Swamp Forest
Total Project Management Zone	63,828 ha
Estimated Total Avoided Emissions in Project Management Zone	>350 million t COR₂Re
Total Area at Risk of Deforestation	63,828 ha
Project Area (Carbon Accounting Area)	47,237 ha
Total Reduced Emissions in Project Area (Carbon Accounting Area)	104,886,254 t CO₂e
Project Start Date by Project Developer	November 2008
Crediting Period Start Date	July 2009
Primary Deforestation Driver	Planned Deforestation (Palm Oil supported by government policy)
REDD Standards	VCS & CCBA
Methodology	<i>"VM0004 Methodology for Conservation Projects that Avoid Planned Land Use Conversion in Peat Swamp Forests, v1-0"</i>

1.2 Sectoral Scope and Project Type

The Rimba Raya project follows the framework of Reducing Emissions from Deforestation and Degradation (REDD) through Avoided Planned Deforestation (APD). This project is not a grouped project.

1.3 Project Proponent

InfiniteEARTH is the principal project proponent, responsible for the design and implementation of the project via its local operational entity, PT. Rimba Raya Conservation. A number of other institutions are involved in implementing specific programs or components of the project. The primary responsibilities and skill sets and the organizational structure are elaborated in Table 2 and Table 3

Table 2. Roles and responsibilities of project proponent

Entity	Description	Function
InfiniteEARTH Suite-8/A, The Ritz Plaza 122 Austin Road, Tsim Sha Tsui Kowloon, Hong Kong Contact: Todd Lemons Email: contact@infinite-earth.com Web: www.infinite-earth.com	Infinite-Earth is a company dedicated to the development of economically viable solutions to climate change and environmental degradation by addressing the underlying drivers of deforestation - poverty. The company's projects are internally mandated to go "Beyond Carbon and Beyond Sustainability". To that end, Infinite-Earth projects focus on the preservation of Endangered Species Habitat, High Conservation Value Forests, and the protection of National Parks through the creation of social and physical buffer zones. Additionally, projects are designed to meet the UN Millennium Development Goals by funding sustainable development of rural communities through capacity building and technology transference of low impact technologies such as solar, fuel efficient cook stoves, aquaponics, agro-forestry "jungle crops", and social benefits programs such as health care, early childhood education materials and tools such as "One Laptop per Child". The company was founded and is staffed by a group of seasoned professionals from broad multi-disciplinary backgrounds including: International Project Development, Sustainable Forestry, Conservation, Tropical Forest Ecology, Remote Sensing, GIS, Carbon Science, Finance and Marketing.	Forest Protection, Carbon Monitoring, Project Management, Community-based Enterprise Development, Carbon Sales

1.4 Other Entities Involved in the Project

All entities involved in the Project are listed in Table 3.

Table 3. Roles and responsibilities of associates

Entity	Description	Function
Orangutan Foundation International (OFI) Jalan Hasanuddin No. 10 Blk DKD Pangkalan Bun Kalimantan Tengah 74111 Indonesia Contact: Dr. Biruté Galdikas Tel: +62 0532-24778	Orangutan Foundation International is a nonprofit organization dedicated to the conservation of wild orangutans and their rainforest habitat in Indonesia and Malaysia. Founded in 1986 by scientist and conservationist Dr. Biruté Mary Galdikas and her former doctoral student, Dr. Gary Shapiro, OFI focuses on three objectives: research, conservation, and education. OFI also disseminates information about the orangutan to galvanize policymakers and the public toward an appreciation of orangutans and their highly endangered status. For more than three decades Dr. Biruté Mary Galdikas has studied and worked closely with the orangutans of Indonesian Borneo in their natural habitat, and is today the world's foremost authority on the orangutan. OFI will continue to provide a long-term local presence to the efforts of the Rimba Raya project and their function will be to continue to do what they have done for 40 years – protect orangutan habitat.	Forest Protection, Ground Surveying
Forest Carbon Jalan Kemang Selatan VIII, #5A Kemang Jakarta Selatan 75123 Indonesia Contact: Scott Stanley Email: info@forest-carbon.org Web: www.forest-carbon.org	Forest Carbon, a consulting firm was formed in early 2007 to address the need for a highly technical and regionally focused organization in Indonesia. Forest Carbon provides technical and project development services for carbon baseline measurement, project design, implementation, and monitoring of carbon forestry projects for the voluntary and compliance markets on REDD and Improved Forest Management. Forest Carbon is comprised of a core team of experts with extensive Indonesian experience in the fields of silviculture, tropical ecology, GIS/remote sensing, and social forestry. Key staff members in Forest Carbon have been actively working in the carbon forestry space in Indonesia since 2006. They have worked extensively on some of Indonesia's earliest projects for the voluntary (VCS and CCBA) and pre-compliance markets (REDD) for both non-profit organizations and private sector project developers.	Carbon Baseline, Ground Surveying, Carbon Monitoring

Winrock International 2121 Crystal Drive Suite 500 Arlington, Virginia 22202 United States of America Contact: Nancy Harris Email: information@winrock.org Web: www.winrock.org	Winrock International is a leading voice and active participant in the global environment and climate change arena. For over a decade, Winrock has been the organization trusted worldwide to bring the most cutting edge, proven information and services for greenhouse gas assessment in agriculture, forestry, and other land uses. Ecosystem Services fulfills Winrock's mission by developing innovative approaches to carbon estimation and disseminating this information to organizations and communities worldwide so they can participate in new markets. Winrock International was created in 1985 with the merger of three institutions: the International Agricultural Development Service, the Winrock International Livestock Research and Training Center, and the Agricultural Development Council (A/D/C).	Carbon Methodology
PT Daemeter Consulting Jl. Tangkuban Perahu No.6 Bogor, Jawa Barat 16151 Indonesia Contact: Gary Paoli Email: info@daemeter.org Web: www.daemeter.org	PT Daemeter Consulting is an independent firm based in Bogor, Indonesia, specializing in the provision of technical services to promote responsible management of forest and agricultural landscapes. Daemeter has expertise in social, ecological and political dimensions of sustainability in Indonesia, with emphasis on High Conservation Value identification and management - Social and cultural surveys - Public consultation and stakeholder engagement - Ecosystem mapping using remote and field based methods - Biodiversity surveys - Certification mentoring.	Biodiversity Monitoring
World Education World Education Jalan Tebet Dalam IV-D Number 5A Jakarta 12810 Indonesia Contact: Handoko Widagdo Email: weindo@indo.net.id Web: www.worlded.org	World Education is well known for its global work in environmental education, community development, maternal and child health, school governance, integrated literacy, small enterprise development, and refugee training. Since its founding in 1951, World Education has worked in over 60 countries in all regions of the world to provide training and technical assistance in many sectors. World Education supports the development of many types of indigenous non-governmental organizations (NGOs) and community-based organizations (CBOs) to achieve long-term results.	Social and Agricultural Education, Community-based Enterprise Development
Potters for Peace P.O. Box 1043 Bisbee, Arizona 85603 520-249-8093 United States of America Contact: Peter Chartrand E-mail: peterpfp@gmail.com Web: www.pottersforpeace.org	Since 1998, Potters for Peace , a member of the World Health Organization's International Network to Promote Household Water Treatment and Safe Storage, has been assisting in the production worldwide of a low-tech, low-cost, colloidal silver-enhanced ceramic water purifier (CWP). Field experience and clinical test results have shown this filter to effectively eliminate approximately 99.88% of most water born disease agents.	Social and Agricultural Education, Community-based Enterprise Development

MBK Ruko Asiatic Blok B 15/59 Jalan Permata SariLippo Karawaci Barat UKabupatenTangerangU 15810 Indonesia Contact: Dr. Shafiq Dhanani Email:shafiq.dhanani@mbk-ventura.com Web: www.mbk-ventura.com	MBK (Mitra Bisnis Keluarga) stands for “Family Business Partners”. MBK is a non-bank financial company (NBFC) regulated by the Ministry of Finance and with a venture capital license issued in November 2006. Using the classic Grameen Bank methodology, MBK provides working capital to low-income households in Indonesia in order to raise their family incomes and living standards.	Community-based Enterprise Development
Health in Harmony Health In Harmony 4110 SE Hawthorne Blvd, #246 Portland, Oregon 97214 United States of America Contact: Kinari Webb Email:kinariwebb@healthinharmony.org Web:www.healthinharmony.org	Health in Harmony supports an innovative program in West Kalimantan, Indonesia, that partner with local communities to integrate high quality, affordable Health care with strategies to protect the threatened rain forest.	Health Immunization & Programs

1.5 Project Start Date

The Rimba Raya project start date is November, 2008.

1.6 Project Crediting Period

This report summarizes monitoring for the Year-1 crediting period commencing July 1, 2009 and ending June 30, 2010. Baseline GHG emissions reductions assessed during the monitoring activities are presented in Section 4 of this report. The total number of years covered by this monitoring report is 1 year.

1.7 Project Location

Rimba Raya is located in the Seruyan Regency, in the province of Central Kalimantan, Indonesia (right). The 63,828 hectare Project Management Zone, lies between 112°01'12" - 112°28'12" east longitude and 02°31'48"- 03°21'00" south latitude and is bounded by Tanjung Puting National Park in the west, the Java Sea in the south, the Seruyan River in the east, and a palm oil concession in the north (Figure 1). (Note that this palm oil concession, formerly leased by KUCC is now managed by WSSL.) The Project Management Zone surrounds and protects the 47,237 ha Carbon Accounting Area (CAA), which defines the boundary for carbon monitoring and accounting.

1.8 Title and Reference of Methodology

The VCS methodology (including monitoring requirements) employed by this project is the Approved VCS Methodology “VM0004 Version 1.0 Methodology for Conservation Projects that Avoid Planned Land Use Conversion in Peat Swamp Forests, Sectoral Scope 14”, which has been validated under the VCS double-approval process. This methodology was developed by Winrock



Figure 1: Project Location

International for the Mawas Peat Swamp Conservation project, and is relevant for planned conversion of peat swamps throughout Southeast Asia. The methodology is particularly applicable to the Rimba Raya Project because it is also located in peat swamp, less than 150km from Mawas, and is categorized as an Avoided Planned Deforestation (APD) project type.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

During this monitoring period the major Project activities include monitoring and protecting the Project Boundaries. This activity has been funded and supported by Infinite Earth and Orangutan Foundation International (OFI). More detail of these activities are presented in Section 3.3.9 of this report. Progress towards initiating the Implementation schedule proposed in the validated Project documents will commence once verified and project revenue starts to flow from the sale of VERs.

A clear description of how leakage is monitored is presented in Section 4.3. The incidence of fire is monitored and accounted for and is the primary factor related to the non-permanence risk assessment. The monitoring of fire and its effect on the net reductions is presented in Section 3.3.11 of this report.

2.2 Project Description Deviations

The Project Management Zone of 91,215 hectares was described and spatially delineated in the validated Project Documentation. Since validation the Project Management Zone, managed by the Project Proponent has been slightly reduced to 63,828 hectares.

The carbon accounting area (CCA) has not changed. As such the deviation to the Project Management Zone has no impact on the net GHG reductions from the Project activities.

2.3 Grouped Project

This is not a grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Table 4: Parameters available at Validation

Data Unit / Parameter:	CF
Data unit:	Dimensionless
Description:	Carbon fraction of dry matter
Source of data:	IPCC default value = 0.50
Value applied:	0.50
Purpose of the data:	used in multiple spreadsheets in biomass => carbon calculations
Any comment:	

Data Unit / Parameter:	$A_{B, it}^{logged}$
------------------------	----------------------

Data unit:	Ha
Description:	Area of land logged under the baseline scenario for stratum i, in time t
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Value applied:	Rate 2,800 ha/yr (stratum i, time t)
Purpose of the data:	Used in Timber Extraction spreadsheet
Any comment:	The area logged was assumed to be the area cleared in all landcover types classified as forest. The expected annual rate of conversion was determined by analyzing historical rate of conversion by the baseline agent.

Data Unit / Parameter:	<i>P</i>
Data unit:	Dimensionless
Description:	percent of harvest industrial roundwood going into long term wood products
Source of data:	Industry standard value: FAO 1995. FAO Yearbook: Forest products. FAO For. Serv. No. 28, FAO, Rome, 422 p.
Value applied:	0.25
Purpose of the data:	Used in Timber Extraction spreadsheet
Any comment:	In the project region, the proportion of harvested wood that goes into long-term wood products was obtained using FAO data for Indonesia cited in Winjum et al. (1998)

Data Unit / Parameter:	<i>AP</i>
Data unit:	m ²
Description:	Plot Area
Source of data:	Aerial plot measurement
Value applied:	10,000
Purpose of the data:	parameter created but not used
Any comment:	eq 38 not used since allometric method not selected as allowed by the methodology p. 20; eq 32 not used because different AIM Step

	calculations were made.
--	-------------------------

Data Unit / Parameter:	<i>BEF</i>
Data unit:	Dimensionless
Description:	Biomass expansion factor for conversion of biomass of merchantable volume to above-ground biomass
Source of data:	Literature Values
Value applied:	
Purpose of the data:	Parameter not used
Any comment:	eq 34 not used (since BEF method not selected as allowed by the methodology p. 20; eq 8 not used because different AIM Step calculations were made.

Data Unit / Parameter:	Φ
Data unit:	g cm ³
Description:	Volume-weighted average wood density
Source of data:	Literature Value: Reyes, Brown, Chapman and Lugo (1992) mean wood density for tropical Asia represented by 428 species, SE = 0.007
Value applied:	0.57 (SD = 0.145)
Purpose of the data:	Used in Biomass Burning Spreadsheet
Any comment:	eq 68 used for leakage calculation; eq 34 not used (since BEF method not selected as allowed by the methodology p. 20; eq 8 not used because different AIM Step calculations were made.

Data Unit / Parameter:	<i>PBBB_{it}</i>
Data unit:	Dimensionless
Description:	average proportion of CB,AC _{it} burnt under the baseline scenario in stratum i, time t
Source of data:	methodology p. 16
Value applied:	1
Purpose of the data:	Used in Biomass Burning -BL E51
Any comment:	As per the methodology p. 16 "because the land is

	being cleared for another land use in the baseline scenario, all of the biomass that is not extracted as timber is assumed to be burned and therefore this methodology the proportion burned in the baseline PBBB, it is assumed to be equal to 1."
--	---

Data Unit / Parameter:	CE
Data unit:	Dimensionless
Description:	Average biomass combustion efficiency
Source of data:	IPCC default =0.50
Value applied:	0.50
Purpose of the data:	Used in Biomass Burning spreadsheet
Any comment:	

Data Unit / Parameter:	$A_{cleared\ B, it}$
Data unit:	Ha
Description:	Average annual area of deforestation by the baseline agent of deforestation for the 5 years prior to project implementation
Source of data:	GPS coordinates and/or remote sensing data and or/legal parcel records
Value applied:	Rate 2,800 ha/yr (stratum i, time t)
Purpose of the data:	
Any comment:	The expected annual rate of conversion was determined by analyzing historical rate of conversion by the baseline agent.

Data Unit / Parameter:	N/C ratio
Data unit:	Dimensionless
Description:	Nitrogen-carbon ratio
Source of data:	IPCC default =0.01
Value applied:	0.01
Purpose of the data:	used in Biomass Burning spreadsheet
Any comment:	

Data Unit / Parameter:	ER _{N2O}
Data unit:	t CO2-e (t C)-1
Description:	Emission ratio for N2O
Source of data:	IPCC default value =0.007
Value applied:	0.007
Purpose of the data:	see Biomass Burning spreadsheet
Any comment:	

Data Unit / Parameter:	ER _{CH4}
Data unit:	t CO2-e (t C)-1
Description:	Emission ratio for CH4
Source of data:	IPCC default value = 0.012
Value applied:	0.012
Purpose of the data:	see Biomass Burning spreadsheet
Any comment:	

Data Unit / Parameter:	GWP _{N2O}
Data unit:	t CO2-e (t N2O)-1
Description:	Global Warming Potential for N2O
Source of data:	Methodology =310 for the first commitment period
Value applied:	310
Purpose of the data:	see Biomass Burning spreadsheet
Any comment:	Used in eq 15. Eq 54 not calculated – as palm oil plantations operate on a 25-30 year timeframe, emissions from harvest rotations were not considered in baseline estimation. This is conservative.

Data Unit / Parameter:	GWP _{CH4}
Data unit:	t CO2-e (t CH4)-1
Description:	Global Warming Potential for CH4
Source of data:	Methodology =21 for the first commitment period

Value applied:	21
Purpose of the data:	see Biomass Burning spreadsheet
Any comment:	Used in eq 16. Eq 55 not calculated – as palm oil plantations operate on a 25-30 year timeframe, emissions from harvest rotations were not considered in baseline estimation. This is conservative.

Data Unit / Parameter:	<i>Dbh</i>
Data unit:	Cm
Description:	diameter at breast height of tree
Source of data:	Field Measurement.
Value applied:	See Carbon Survey Report data
Purpose of the data:	
Any comment:	Not used in eq 24,25. DBH was used in allometric equation by Chave et al. (2005) to estimate aboveground biomass from survey plots to test/validate biomass estimation equations.

Data Unit / Parameter:	$A_{it}^{planted}$
Data unit:	Ha
Description:	area of biomass growth on future land use in the baseline scenario in stratum <i>i</i> at time <i>t</i>
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Value applied:	Rate 2,800 ha/yr
Purpose of the data:	Based on historical rate of plantation conversion by the baseline agent. See discussion Baseline Report. For values see oil palm regrowth worksheet. Annual area of planting cohorts A-F shown in columns E, I, M, Q, U, Y.
Any comment:	Strata based on concession boundaries. Time based on staggered concession development and planting north to south.

Data Unit / Parameter:	age_{peak}
------------------------	--------------

Data unit:	Years
Description:	age of stand at peak production
Source of data:	literature values : Data reported in Cannell M.G. R. 1982. World Forest Biomass and Primary Production Data. Academic Press. London. 391 pp.
Value applied:	14
Purpose of the data:	See discussion Baseline Report Oil Palm Growth Model Data
Any comment:	

Data Unit / Parameter:	$D_{B,,drain,it}$
Data unit:	Cm
Description:	average depth of peat drainage or average depth to water table under the baseline scenario in stratum i, time t
Source of data:	Methodology default value = 100 cm
Value applied:	100
Purpose of the data:	See Peat Drainage spreadsheet
Any comment:	Note that peat depth across the project area is greater than the peat depth lost via subsidence and burning in the baseline scenario over the project life, therefore the net peat drainage depth of no more than 1 meter is used - Condition F of the methodology.

Data Unit / Parameter:	$A_{B,drain,it}$
Data unit:	Ha
Description:	area of drainage impact under the baseline scenario in stratum i, time t
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Value applied:	See Peat Drainage spreadsheet
Purpose of the data:	
Any comment:	Strata comprised of concession boundaries and

	land cover (all types except kerangas forest and kerangas scrub which overlay sandy soil). Note peat drainage emissions are cumulative, expanding to cover the full extent of concessions, then continuing over the life of the project.
--	--

Data Unit / Parameter:	D_{peat}
Data unit:	Meters
Description:	average depth of peat in project area
Source of data:	Field Measurements
Value applied:	4.3
Purpose of the data:	See Carbon Survey Report
Any comment:	

Data Unit / Parameter:	$D_{B,burn,it}$
Data unit:	cm
Description:	depth of peat burned under the baseline scenario in stratum i at time t;
Source of data:	Literature value: Couwenberg et al. (2009) cited in the methodology p. 36
Value applied:	34cm
Purpose of the data:	
Any comment:	According to the methodology p. 37 "The depth of peat burned shall be assumed to be equal to the drainage depth, minus a critical threshold of 40 cm above the drainage depth. If the difference between drainage depth and the critical threshold exceeds 34 cm, then the maximum burn depth of 34 cm shall be applied." Since drainage depth for the baseline is 100cm, a burn depth of 34 cm is used.

Data Unit / Parameter:	$A_{B,burn,it}$
Data unit:	Ha
Description:	area of peat burned under the baseline scenario in stratum i at time t;
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned

	or controlled or previously owned or controlled by the baseline agent of deforestation
Value applied:	See Peat Burning spreadsheet
Purpose of the data:	
Any comment:	Strata comprised of concession boundaries and land cover (all types except kerangas forest and kerangas scrub which overlay sandy soil). Note burning is a one-time event occurring during years 1-8 of staggered concession development. Estimated rate of burning = rate of deforestation and clearing.

Data Unit / Parameter:	BD_i
Data unit:	g cm ⁻³ = t m ⁻³
Description:	Bulk density of peat in stratum I (g cm ³ = t m ³)
Source of data:	Default value
Value applied:	0.14
Purpose of the data:	see Peat Burning spreadsheet
Any comment:	

Data Unit / Parameter:	EF_{CO2}
Data unit:	g CO ₂ (t peat) ⁻¹
Description:	CO ₂ emissions from the combustion of peat
Source of data:	Literature value. Muraleedharan et al. (2000) cited in the methodology p. 38
Value applied:	185,000
Purpose of the data:	Peat Burning spreadsheet
Any comment:	As per the methodology, the emission factors for peat combustion at the lower temperatures were assumed in the ex ante baseline estimates, as this results in lower overall GHG emissions (CO ₂ + CH ₄ reported as CO ₂ equivalents) and thus a conservative baseline scenario.

Data Unit / Parameter:	EF_{CH4}
Data unit:	g CH ₄ (t peat) ⁻¹

Description:	CH4 emissions from the combustion of peat
Source of data:	Literature value
Value applied:	5,785 g/ton peat
Purpose of the data:	Peat Burning – BL worksheet cell E6
Any comment:	As per the methodology, the emission factors for peat combustion at the lower temperatures were assumed in the ex ante baseline estimates, as this results in lower overall GHG emissions (CO2 + CH4 reported as CO2 equivalents) and thus a conservative baseline scenario.

Data Unit / Parameter:	<i>LDF</i>
Data unit:	t C m-3
Description:	Logging Damage Factor for calculating the biomass of dead wood created during logging operations per cubic meter extracted
Source of data:	Default value of 0.37 t C m-3 from 534 logging gaps measured by Winrock International in Bolivia, Belize, Mexico, the Republic of Congo, Brazil and Indonesia may be used for tropical broadleaf forests.
Value applied:	0.37
Purpose of the data:	
Any comment:	

Data Unit / Parameter:	<i>PML_{FT}</i>
Data unit:	%
Description:	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type to which displacement of logging activities is likely to occur.
Source of data:	GIS data from landcover/forest maps published by Ministry of Forestry. All forest types in which commercial logging could take place within PT Best concessions were considered.
Value applied:	< 0.20
Purpose of the data:	
Any comment:	There is minimal remaining forest in PT BEST concessions outside Rimba Raya, therefore a

	relative value of < 0.20 was sufficient for determining that PML_{FT} is > 0.15 less than PMP_i (methodology p. 41) and therefore the highest market leakage deduction factor is selected and applied. This results in the most conservative (largest) deduction from the baseline estimate for market leakage as a result of Rimba Raya's comparatively high timber volume being removed from PT BEST concession's timber potential.
--	---

Data Unit / Parameter:	$V_{B,it}$
Data unit:	m^3
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:	Source of data same as biomass logged parameter.
Value applied:	Embedded in equation 68, see biomass burning spreadsheet
Purpose of the data:	Note that this volume does not include logging slash left onsite. Extracted volumes reported are gross volumes removed.
Any comment:	

Data Unit / Parameter:	PMP_i
Data unit:	%
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data:	unpublished data from Mawas, Winrock 2008
Value applied:	Mean 0.36, SD 0.169
Purpose of the data:	Same as B logged (Biomass Extracted as Merchantable Timber >30cm in Timber Extraction spreadsheet)
Any comment:	Mawas data provides complete dataset applicable to Rimba Raya project site. Average proportion of merchantable timber across 93 logging gaps

Data Unit / Parameter:	$HistHa_i$
Data unit:	Ha

Description:	Average annual area of deforestation by the baseline agent of the planned deforestation in stratum i for the 5-10 years prior to project implementation
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Value applied:	6113.7
Purpose of the data:	See discussion Baseline Report
Any comment:	

Data Unit / Parameter:	$A_{defLK,it}$
Data unit:	Ha
Description:	The total area of deforestation by the baseline agent of the planned deforestation in stratum i at time t
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Value applied:	Not calculated as of year 1 (no leakage)
Purpose of the data:	Legal records will include government permits to deforest including concession licenses.
Any comment:	Ex-ante, project proponents shall determine and justify the likelihood of leakage based on characteristics of the baseline agent. To be calculated if activity shifting leakage is detected. See Monitoring plan discussion.

3.2 Data and Parameters Monitored

Table 5: Parameters Monitored

Data Unit / Parameter:	$N_{gapsP, it}$
Data unit:	dimensionless
Description:	number of logging gaps detected in stratum i , time t in the project area
Source of data:	Field data – see field survey report, Yappi 2010
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	40 (year 1)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$L_{log, tr, tk}$
Data unit:	m
Description:	length of log extracted from timber tree tr in stratum i , gap k , measured as the distance from stump to base of crown, less the length of any pieces of bole left on site
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>D bottom, tr, ik</i>
Data unit:	Cm
Description:	Diameter at the stump end of log extracted from timber tree tr in stratum i, gap k
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>D top, tr, ik</i>
Data unit:	Cm
Description:	diameter at the crown end of log extracted from timber tree tr in stratum i, gap k
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	ϕ_i
Data unit:	t m ⁻³
Description:	Wood density ⁵² of extracted log in stratum <i>i</i>

Source of data:	Literature Value: Reyes, Brown, Chapman and Lugo (1992) mean wood density for tropical Asia represented by 428 species, SE = 0.007
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	0.57 (SD = 0.145)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>CF</i>
Data unit:	dimensionless
Description:	Carbon fraction of dry matter (extracted log)
Source of data:	IPCC default = 0.50 used in Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	n/a
Frequency of monitoring/recording:	
Value monitored:	0.50
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$D_{s,tr,ik}$
Data unit:	Cm
Description:	Diameter of the stump of the logged timber tree tr in stratum i, gap k
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$H_{tr,ik}$
Data unit:	M
Description:	Height of tree tr in stratum i, gap k
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$D_{pce-b,tr, ik}$
Data unit:	Cm
Description:	Diameter of bottom end of piece pce left from timber tree tr in stratum i, gap k
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	

Calculation method:	
Any comment:	

Data Unit / Parameter:	$L_{pce,tr,ik}$
Data unit:	m
Description:	Length of piece pce left from timber tree tr in stratum i, gap k
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$D_{pce-t,tr,ik}$
Data unit:	Cm
Description:	Diameter of top end of piece pce left from timber tree tr in stratum i, gap k: cm
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	See logging gap spreadsheet (Winrock 2008)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$D_{logging\ drain, it}$
Data unit:	Cm
Description:	Average depth of peat drainage or average depth to water table in drained area of stratum i, time t during the dry season
Source of data:	Field measurements
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	No new logging canals detected (year 1)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{logging\ peatimpact, it}$
Data unit:	Ha
Description:	Area of drainage impact in stratum i, time t
Source of data:	Calculated in GIS
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	No new logging canals detected (year 1)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	CE
Data unit:	Dimensionless
Description:	Average biomass combustion efficiency
Source of data:	IPCC default =0.50

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	NA
Value monitored:	0.50
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$MC_{burnedP,AG,it}$
Data unit:	t C ha ⁻¹
Description:	Estimated aboveground carbon stock after burning under the project case for stratum i, time t
Source of data:	Field measurements
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	n/a (not measured)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	N/C_{ratio}
Data unit:	Dimensionless
Description:	Nitrogen-carbon ratio
Source of data:	IPCC default=0.01
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	0.01
Monitoring equipment:	

QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	ER_{N2O}
Data unit:	$t\ CO_2-e\ (t\ C)^{-1}$
Description:	Emission ratio for N_2O
Source of data:	IPCC default value=0.007
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	0.007
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	ER_{CH4}
Data unit:	$t\ CO_2-e\ (t\ C)^{-1}$
Description:	Emission ratio for CH_4
Source of data:	IPCC default value =0.012
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	0.012
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	GWP_{N2O}
Data unit:	$t\ CO_2-e\ (t\ N_2O)^{-1}$

Description:	Global Warming Potential for N ₂ O
Source of data:	Methodology = 310 for the first commitment period
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	310
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	GWP_{CH_4}
Data unit:	t CO ₂ -e (t CH ₄) ⁻¹
Description:	Global Warming Potential for CH ₄
Source of data:	Methodology = 21 for the first commitment period
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	21
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{p,burn,it}$
Data unit:	Ha
Description:	Area burned in stratum i, time t in the project area
Source of data:	Field measurements or using high resolution digital aerial imagery
Description of measurement methods and procedures to be applied:	GIS analysis of satellite imagery and ground-truth data
Frequency of monitoring/recording:	

Value monitored:	array
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$D_{P, burn, it}$
Data unit:	Meters
Description:	Depth of peat burned under the project scenario in stratum i at time t:
Source of data:	Methodology default value
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	0.34 m
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	BD_i
Data unit:	g cm-3 = t m-3
Description:	Bulk density of peat in stratum i
Source of data:	Default value
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	0.14
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	EF_{CO_2}
Data unit:	$g\ CO_2\ (t\ peat)^{-1}$
Description:	CO ₂ emissions from the combustion of peat
Source of data:	Literature value: Muraleedharan et al. (2000) cited in Methodology p. 38
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	185,000
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	EF_{CH_4}
Data unit:	$g\ CH_4\ (t\ peat)^{-1}$
Description:	CH ₄ emission from the combustion of peat
Source of data:	Literature value: Muraleedharan et al. (2000) cited in Methodology p. 38
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	5,785
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{P, LCC, it}$
Data unit:	Ha
Description:	Area that underwent land cover change in stratum i, monitoring year t:
Source of data:	High resolution digital aerial imagery or field

	measurements
Description of measurement methods and procedures to be applied:	GIS and satellite image analysis
Frequency of monitoring/recording:	
Value monitored:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A^{LCCn}_{peatimpact,it}$
Data unit:	Ha
Description:	Area of drainage impact due to land cover change in stratum i, monitoring year t
Source of data:	Calculated in GIS
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$D_{LCC\ drain,it}$
Data unit:	Cm
Description:	Average depth of peat drainage or average depth to water table in the deforested area under the project scenario in stratum i, time t
Source of data:	Field measurements or estimated from literature values if measurements not available
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	

Value monitored:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{cleared\ B, it}$
Data unit:	Ha
Description:	Average annual area of deforestation by the baseline agent of deforestation for the 5 years prior to project implementation
Source of data:	GPS coordinates and/or remote sensing data and or/legal parcel records
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	Rate 2,800 ha/yr (stratum i, time t)
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{defLK, t}$
Data unit:	Ha
Description:	The total area of deforestation by the baseline agent of the planned deforestation at time t
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	
Monitoring equipment:	

QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>WoPA</i>
Data unit:	Ha
Description:	Total (cumulative) area of forest cleared by the baseline agent of planned deforestation in stratum i at time t
Source of data:	Analysis of remote sensing data and/or legal records and /or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>HistHa</i>
Data unit:	Ha
Description:	Average annual area of deforestation by the baseline agent of deforestation for the 5 years prior to project implementation
Source of data:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	6113.7
Monitoring equipment:	

QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	PMP_i
Data unit:	%
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data:	Field measurements from Mawas logging gap assessment (Winrock 2008)
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	Mean 0.36, SD 0.169
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

3.3 Description of the Monitoring Plan

3.3.1 Purpose

The purpose of monitoring for carbon accounting is to ensure that the estimates of GHG removals presented in the VCS Project Document are being met, and to identify and account for any unplanned reductions in project carbon stocks, increase in project emissions or possible leakage outside the project boundary. Additionally, monitoring the project implementation will enable project proponents to objectively assess project components, identify gaps and deficiencies and use this information to improve both monitoring and management. This adaptive management approach is a key feature of the Rimba Raya program.

3.3.2 Methodology

The methodology outlines methods for monitoring land use change, forest degradation and carbon pools and forms the basis for implementing the monitoring plan. This methodology provides a reference for monitoring, reporting, and verification required for evaluating project performance and supports the accurate determination of carbon offsets by project activities.

The methodology was designed so that all necessary field measurements (including measurements of baseline carbon stocks) could, if desired, be performed up front - prior to project implementation thus limiting monitoring activities over the crediting period to monitoring new activities and area changes only. This monitoring section uses various formulae presented in the methodology and the reader should access that report for their full listing and their justification for use in monitoring.

3.3.3 Monitoring Areas

The entire Project Management Zone (PMZ) is managed to protect forests and peat through a slate of forest conservation and community development programs described in the Climate Community and Biodiversity (CCB) Project Design Description. The project implementation is monitored annually, including the project boundary and the area inside the project boundary (Carbon Accounting Area), which are protected from land use change activities that reduce carbon stocks or increase peat emissions.

In the northern part of the Project Management Zone, 3 to 20 km from the Carbon Accounting Area, a physical buffer around the WSSL palm oil plantation protects the forests of the Seruyan River Watershed (Palm Oil Buffer East). *Originally, an environmental buffer zone was created to protect the northeastern border of the Tanjung Puting National Park but project proponents were forced to relinquish this buffer zone to palm oil as a condition of receiving their land-use license from the Ministry of Forestry.

Carbon Accounting Area buffers include North Buffer, which provides a physical barrier and hydrologic buffer 3 km from the WSSL plantation, Seruyan Buffer that protects the east side of the CAA and Java Sea Buffer that protects the south and Tanjung Puting National Park which protects the CAA on the West. The Total Project Management Area and the CAA itself form a buffer for Tanjung Puting National Park.

The Carbon Accounting Area (CAA) is divided into four monitoring regions. Carbon-North is accessed by the Baung River and the Seruyan River from Palingkau village south to Baung village. This area includes permanent biomass transects T1, T2 and T7 and Post Setiung. Carbon-Central is accessed by the Sigintung River and the Seruyan River in the vicinity of Jahitan and Muara Dua villages and includes permanent biomass transects T8, T3 and T4 and Post Sigintung. Carbon-South-Seruyan is accessed by the Seruyan River in the vicinity of Tanjung Rengas village and includes permanent biomass transects T5 and T6. Carbon-South-Sea is accessed by the Java Sea coast and does not include permanent biomass transects.

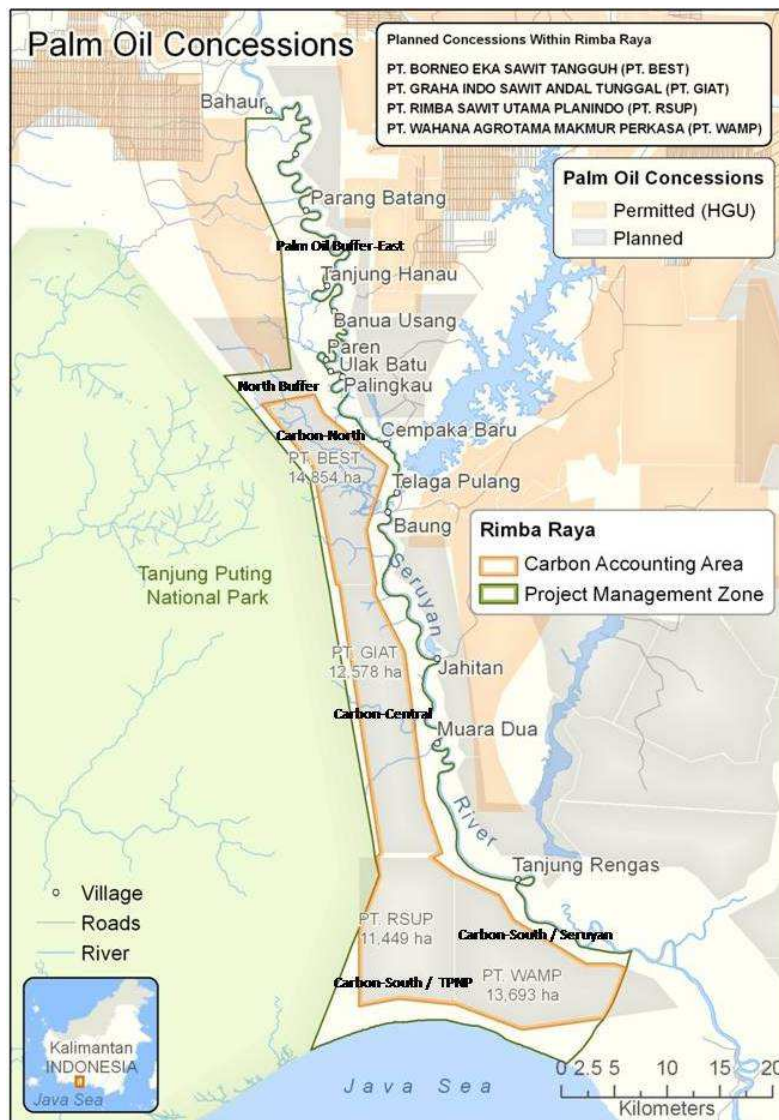


Figure 2: Rimba Raya Project Management Zone and Carbon Accounting Area

3.3.4 Approach

Annual monitoring activities consist of remote sensing and G.I.S. analysis, routine field patrols and directed field sampling in areas prioritized by systematic site assessments. The monitoring system takes a hierarchical approach starting with medium resolution (30-50m) satellite imagery, then high resolution satellite or aerial imagery (5-10m), and finally with ground patrols.

A key feature of the Rimba Raya monitoring plan is to employ spatial data and tools to systematically monitor land cover change, forest degradation and carbon pools in the project area and project buffer. This is combined with ground-based surveys to investigate and record information on any activities that affect project carbon stocks and peat emissions (e.g. fire, logging). Such an approach improves the efficiency and effectiveness of directed field visits, which is essential for reliably monitoring the Rimba Raya project boundary in extensive and inaccessible peat swamplands.

This type of approach to field monitoring has been employed by project partner, Orangutan Foundation International, in the project area since 2004. Rimba Raya monitoring builds on the existing field reconnaissance, forest survey and G.I.S. team training, protocols and monitoring systems already in place for many years.

Section 16.2 Sampling Framework of the methodology

The monitoring methodology was designed so that all sampling can involve temporary plots and can occur at the beginning of the project.

Permanent plots are not required for monitoring, however project proponents have elected to monitor biomass plots over the life of the project in order to improve the understanding of forest and biomass change over time in Rimba Raya for informing ongoing carbon assessments and science. Biomass plots were surveyed for the carbon assessment July-September 2009 and these data and results are included in the Carbon Assessment Survey Reports and the Baseline Report.

Biomass plots and transects surveyed during the Carbon Assessment were rechecked and permanently marked during Year 1 monitoring. These sites will be rechecked annually and resurveyed every 4-5 years and survey data added to the project database.

3.3.5 Monitoring Components

There are eight major components of monitoring: three that are focused on project conditions and forest protection (Table 6) and five that are focused on annual land change assessment for carbon accounting (Table 7).

Table 6. Monitoring Components: Project Conditions and Forest Protection

Monitoring Component (pg ref in Meth)	Activity and Years	Times and periods	Detection frequency	Remote sensing data, resolution, coverage and years	Field survey frequency	Reporting frequency
Boundary (p. 67)	Mark in field [Yr1 temp stakes on boundary with palm oil, Yr2& Yr3 permanent stakes in other high risk areas – replace as needed]	Year-end	Non-specific	n/a	1 field survey annually	Annually
	Patrol Yr1-Yr30		Annually	ALOS 50m or Landsat 30m + high res aerial or satellite imagery (1-5m) every 2 years starting Yr2		
Stratification (p. 68)	Land cover classification (Yr1 develop model, Yr2-3 refine model, Yr 4-30 apply standard model)	Year-end	Annually	ALOS 50m or Landsat 30m + field data + sample high res aerial or satellite imagery (1-5m) for accuracy assessment in Yr 1,3,5 etc. Full coverage high res aerial or satellite imagery (1-5m) + field data in Yr 2,4,6 etc.	1 field survey annually	Annually
Forest Protection (p. 68)	Routine patrols and as-needed intervention (expanding coverage and intensity of intervention Yr-1 to Yr-3 in conjunction with community and stakeholder involvement)	Year-round	Quarterly	ALOS 50m or Landsat 30m + SPOT and high resolution imagery collected for boundary and strata monitoring	1 patrol quarterly and as-needed	Quarterly

Table 7. Monitoring Components: Land Change Assessment for Carbon Accounting

Monitoring Component (page reference in Methodology)	Activity and Years	Times and periods	Detection frequency	Remote sensing data, resolution, coverage and years	Field survey frequency	Reporting frequency
Land change (p. 70, 83)	Detection and area calculation of land change caused by agents other than logging or fire (e.g. mechanical clearing)	Year-round	Semi-annually	Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution) as needed to support analysis and field surveys	2-3 field surveys annually	Annually
Logging (p. 71)	Detection and area calculation of deforestation caused by logging	Year-round with increased activity during wet season	Semi-annually	high resolution imagery (aerial or satellite with 1-5m resolution) as needed for logging gap analysis	2-3 field surveys annually	Annually
	Detection and survey of transport canal-building associated with logging			high resolution imagery (aerial or satellite with 1-5m resolution) and ground data		
Fire (p.78)	Detection of fire ignitions, calculation of burn areas (deforestation associated with fire)	Year-round with increased activity during dry season	Monthly, weekly, daily	MODIS imagery (1 km thermal band detects fires as small as 100m2 and imagery is collected and posted daily)	2-3 field surveys annually	Annually
Biomass plot surveys (not required)	Survey of above ground biomass originally conducted for the baseline carbon assessment	End of year	None	linked to high resolution aerial imagery (1-5m)	1 field survey every five years	10-year baseline reports
Leakage (p.40)	new permit activity	Year-round (first five years of project 2009-2014)	Quarterly	n/a	n/a	Annually
	Spatial analysis of new palm oil in areas of possible leakage	End of year (first five years of project 2009-2014)	Annually	Landsat 30m for palm oil boundary interpretation and delineation	none	Annually

3.3.6 Adaptive Management Context

Given the pioneering status of the project, the fact that the industry, the science, the standards and protocols are all in a nascent state, project proponents have adopted an “adaptive management” approach, in particular with regard to monitoring. There is a wide variety and complexity of field conditions among REDD projects and even within the same project across areas, seasons and years. Therefore the standard template prescribed by the methodology is applied in Year 1 with the expectation of making changes and improvements to inherent variation encountered on the ground. As such, project proponents intend to “learn my doing” and commit to creating an environment of “continuous improvement” through the adaptive management process.

The proposed 3-year ramp-up to full implementation of monitoring activities is part of this adaptive management strategy. Given the extent of the area, the intensity of proposed monitoring activities and the required infrastructure, it is unrealistic to expect to build a complete, effective, project-specific monitoring system in less than three years, especially as Years 1 and 2 are being used to inform necessary changes to refine and improve annual monitoring. Lastly, the related science and technology is developing quickly and project proponents expect to be able to deploy new technologies and REDD-specific datasets by year three (e.g. ALOS data for biomass assessment and LIDAR systems for forest degradation and hydrologic analysis).

3.3.6.1 Adaptive Management Framework – FMEA & Control Plan

The framework for this Adaptive Management strategy is a “Closed Loop, Self-Informing Information Flow & Process Control System”, depicted below in Figure 3.

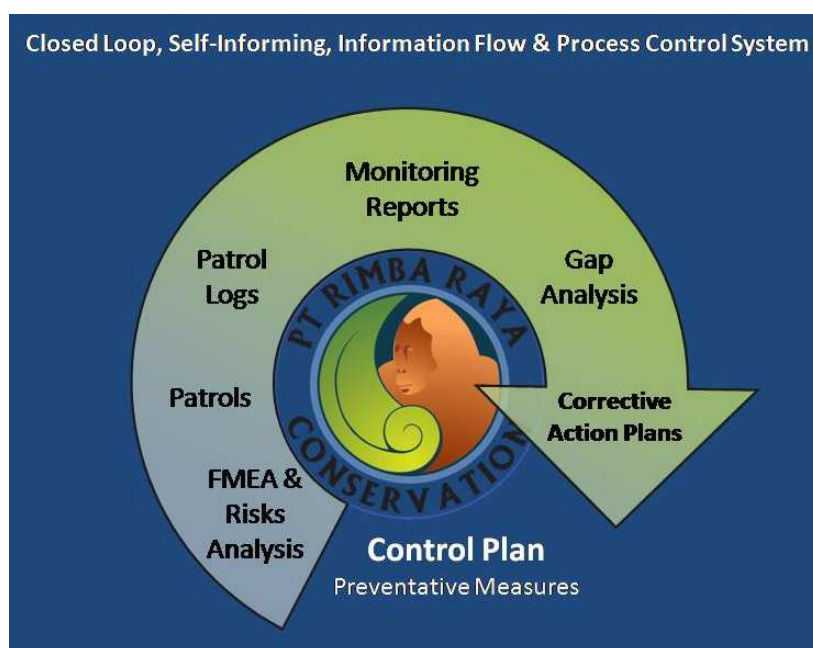


Figure 3: Framework for Adaptive Management

In this system, Monitoring activities are organized into two classes: Major Threats to Carbon Stocks (Land Cover Change) and Threats to Biodiversity with minimal or moderate threats to carbon stocks (Degradation). A Failure Modes & Effects Analysis is conducted and a resulting Risk Assessment Index is assigned to each possible “Failure Mode” (Fire, Logging, Agriculture, etc). Control Plans are created to address possible modes of failure from which Field SOPs are then devised. Patrols generate Patrol Logs, which inform Monitoring Reports. Management

then assesses summary monitoring reports and performs a Gap Analysis from which Corrective Action Plans are developed. These then inform and update the Control Plan, thereby closing the loop and ensuring a system of continuous improvement through a “learn by doing” adaptive management process. This framework and its implementation are more fully described in section 3.3.9 of this report. (See Annex 2 - FMEA & Control Plan).

3.3.7 Boundary

3.3.7.1 Boundary Monitoring Plan

The project implementation is monitored annually, including the project boundary and the area inside the project boundary, which are protected from land use change activities that reduce carbon stocks or increase peat emissions. Since the project boundary is not a functionally discrete hydrologic unit, a 3km buffer zone surrounding the project boundary is also monitored to ensure that no drainage activities have occurred within a project year that could potentially impact peat emissions inside the project boundary as required by the methodology. Both the project boundary and the 3km buffer zone are monitored for new drainage activities over the life of the project.

The Carbon Accounting Area was moved south during project design so that the project boundary is situated >3km from the southern boundary of WSSL oil palm plantation. The “North Buffer” area is monitored to ensure no new drainage activities occur within 3 km of the CAA boundary. Additionally, the project extends monitoring and management to a Project Management Zone (PMZ) that covers 63,828 ha including the 47,237 Carbon Accounting Area (CAA), providing a substantial additional buffer to project carbon stocks.

3.3.7.2 Legal boundary and GIS delineation

The 47,237 ha Carbon Accounting Area boundaries are coincident with the boundaries of four planned palm oil concessions, adjusted to exclude a hydrologic buffer 3 km south of the existing WSSL palm oil plantation. GIS data delineating government-approved plantation concessions, “ijin lokasi”, were used to define the CAA boundary. The GIS boundary and project area are considered final with no expected changes in Rimba Raya’s final license.

GIS data were also obtained for the Project Management Zone, defined by the Ministry of Forestry’s Area Verification for the project. These GIS data obtained from government sources and matching the Area Verification map, bound an area of 63,828 ha. This boundary is currently undergoing final adjustment and approval. Any changes to this area will not affect the Carbon Accounting Area boundary.

3.3.7.3 CAA Boundary Marking and Field Survey

Following GIS adjustments, PMZ and CAA boundaries were uploaded to GPS units for boundary marking, field reconnaissance and monitoring. The area inside the PMZ is monitored as part of ongoing forest protection and management activities conducted by RRC, OFI and other stakeholders. The geo-referenced boundary for the PMZ was used to identify the limits of project management and monitoring in the field. Signs marking Rimba Raya have been posted in key areas of potential land use conflict. Sign postings will be expanded during monitoring years 2 and 3 and maintained for the life of the project. Monitoring survey and patrol activities in the PMZ during project start up and Year-1 monitoring included directed field surveys, expedition patrols and regular patrols by RRC, OFI and stakeholder field teams.

The CAA was directly monitored for any land use or land cover change, and boundaries were marked in the field by navigating to locations defining turning points uploaded to GPS receivers from GIS boundary data (See Annex 3



Boundary Survey Report). Each location was marked in the field with a tall wooden stake and a GPS point was collected of the actual marker location. Land condition and human activities were assessed and recorded at each boundary marker and photos were taken in cardinal directions at each point. Results of the CAA survey and boundary marking are included in Boundary Survey Report (Annex 3). GPS and photo data have been stored in the Rimba Raya database. CAA boundary and area monitoring included protection patrols and surveys of land condition, fire

hotspots and logging areas and are presented in Sections 3.3.6, 3.3.9, 3.3.10 and 3.3.11 of this monitoring report.

3.3.7.4 North Buffer Boundary Marking

Boundary monitoring activities also included surveying and marking the north buffer area of the CAA, described in the survey report Boundary Survey Report (Annex 3). In this zone, a 1-meter wide east-west ditch marks the southern boundary of the WSSL palm oil plantation. This line also represents the northern limit of the 3km buffer, which was marked in the field using the same process as the CAA boundary: navigating to uploaded GPS points and staking the boundary in the field with signposts. In this case, where land use conflict has high potential, sign posts are marked every 50 meters, forming a visual “fence” clearly demarcating the Rimba Raya project area.

Permanent posts were installed following temporary boundary marking. Posts were installed on each 50-meter mark, distance between posts rechecked, and new GPS locations recorded for each marker. Stakes were made of strong wood or pipe then were painted blue to indicate a boundary mark. Signs secured to the top of boundary posts were made of pressed plastic, weather resistant, and expected to be long-lasting. Rimba Raya sign posts were also installed at the entrance into the buffer zone from the main palm oil road towards the settlement of Kopi and entrance to the palm oil buffer west at the access road to the Post Hanau Orangutan Rehabilitation Center.

The resurvey found no disruption to the original pegs or temporary marks, and boundary conditions were as they were at the original at the time of measurement (Table 8).

Table 8. Land Conditions along the North Buffer boundary

Marker Number	Land Condition	Length
1 – 5	Peat Swamp Forest	250 m
5 - 9	Open Peat Swamp / Limits of Palm Oil Drainage Canal	200 m
9 - 30	Open Land / Limits of Palm Oil Drainage Canal	1,050 m
30 - 40	Peat Swamp Forest	500 m
40 - 55	Peat Swamp Forest / Limits of Palm Oil Drainage Canal	750 m
55 - 57	Peat Swamp Forest	100 m

3.3.7.5 North Buffer Survey and Patrol

Directed field patrols of the north buffer area were conducted in April and June, 2010 during the boundary marking effort, to look for evidence of new drainage canals in the buffer zone. No new canals were found. RRC, stakeholders and community members, who regularly traverse the area by road from KUCC plantation to the temporary settlement “Kopi” on the Baung River, also carry out routine monitoring of the buffer. From this point south, the buffer is bisected by the Baung River, which is regularly used by fishermen. Rimba Raya community members have also planted small gardens on grasslands in the buffer area south of the palm oil plantation. These villagers have a direct stake in patrolling and preventing any encroachment by palm oil, especially canal-building which would have a direct, negative impact on their fruit and vegetable gardens.

3.3.8 Stratification

3.3.8.1 Stratification Monitoring Plan

Land cover classification was used to stratify the Rimba Raya Carbon Accounting Area and Project Management Zone. Stratification of the project area is monitored periodically because new data may become available to refine strata boundaries and/or classification. Additionally, as suggested in the methodology, two different strata may become similar enough over time to justify their merging. The Ex Post stratification is used to verify the applicability of the Ex Ante stratification and refine procedures that facilitate cost-effective, consistent and accurate monitoring of carbon stock changes of the project during the crediting period.

3.3.8.2 Landcover Classification 2009

Following a review of regional 2003 landcover mapping by Ministry of Forestry and multiple land cover classification efforts for Rimba Raya based on more recent satellite imagery, comprehensive land cover classification and mapping was conducted based on 2008 Landsat imagery prior to the start of Year-1 monitoring. Methods combined automated pixel-based classification with manual delineation of landcover class boundaries informed by high resolution aerial photography and ground survey data in order to optimize accuracy, efficiency and consistency in land cover mapping. Preliminary carbon accounting for the baseline scenario was conducted based on this land cover assessment, after grouping classes to better reflect significant variation in above-ground carbon.

For Year 1 monitoring, the classification scheme was further improved (Table 4) to better reflect ground conditions in Rimba Raya while remaining relevant to regional and national land cover classification schemes. Using the revised classification scheme, land cover mapping was updated to 2009 Landsat imagery (February 2009 ETM+ path/row 119/062) and is described in the Landcover Assessment report. Mapping was conducted using ArcGIS software to interpret raw and classified imagery, delineate and assign land cover classes. The Minimum Mapping Unit (MMU) was set to 2 ha and the view frame scale set to 1:24,000 fixed in ArcMap in order to ensure consistency in mapping detail across the project area. The 2009 land cover classification is the stratification upon which the final baseline carbon accounting was conducted.

The current Rimba Raya land cover classification scheme aims to balance specificity in defining classes with important variation in biomass and generality that produces annual consistency in classification and subsequent robustness in change analysis. It should be noted that class descriptions, while substantially refined in Year 1 monitoring, remain qualitative. Quantitative vegetation analysis based on directed field surveys are being conducted in Year 2, linked to the classification scheme and to remote sensing data and used to improve the robustness of the land cover classification.

Table 9. Rimba Raya Land Use / Land Cover Classes

Class Name	Description
Lowland forest	Lowland mixed dipterocarp forest on mineral soils. This is a “dry land” or non-swamp forest type and is found only in the northwestern portion of the PMZ where there are elevation gains of ca. 30-40 meters asl.
Lowland forest (lightly degraded)	Lowland mixed dipterocarp forest on mineral soils with some apparent logging damage, adjacent to lowland forest. Note that the term “degraded” is used rather than the Ministry of Forestry term “secondary” which implies forest succession from clear-cutting.
Lowland forest (highly degraded)	Lowland mixed dipterocarp forest on mineral soils with heavy damage from logging and fire. Occurs in the northwestern portion of the PMZ between lowland forest and low, sparse vegetation cover associated with burning and land clearing adjacent to WSSL palm oil plantation.
Peat swamp forest (lightly degraded)	Peat swamp forest, locally “hutanrawa” denoting seasonally wet forests on peat substrate. All peat swamp forests in Rimba Raya are lightly to highly degraded by

	selective logging.
Peat swamp forest (highly degraded)	Peat swamp forest patches bordering areas of intensive human activity and/or recent deforestation. These areas remain in forest cover but have more apparent damage and therefore lower expected biomass than lightly degraded forest. These forests are at high risk of loss.
Peat shrubland	Formerly peat swamp forests, these areas were deforested by fire in the last ten years. Seasonally wet areas characterized by shrubby regrowth and scattered remnant trees.
Kerangas forest	Heath and scrub forest on sandy soils. Isolated patches in peat swamp forest along the western border of RR, including survey transect 7. More prevalent in the south, where air photos show loose canopies of even height, lacking the broad leaves of peat swamp and lowland forest. Visually distinct on satellite imagery (e.g. smooth in texture) but not recognized in Ministry of Forestry mapping which classifies this type with swamp or dry forest depending on location. Relatively rare type, highly susceptible to fire and conversion to open sand scrub.
Open kerangas scrub (locally "padang")	Open sandy soils with patches of scrub forest or thin scrubby vegetation. In West Kalimantan and Sarawak, these areas are known as kerangas, but in Rimba Raya are locally named "padang". These are former heath or kerangas forests that have burned. Bright white sand may be apparent on imagery, or not depending on whether herb cover is present. These areas are often underlain with a hardpan and may be flooded during the wet season. Presence of standing water has confused some previous land cover interpretations of the area (e.g. Ministry of Forestry mapped some areas in the south as "swamp"). These ancient beach areas may intergrade with peatland areas in Rimba Raya, as in the northwestern part of the PMZ.
Cultivated land with shrubs	Repeatedly burned cultivation land, locally "ladang", often abandoned after several years of cultivation. Active cultivation land may appear bright green on imagery from post-fire herbaceous growth. Old ladang often has woody shrubs and scattered trees.
Oil palm plantation	In the Rimba Raya vicinity, all plantation agriculture is oil palm plantation and is currently confined to the WSSL concession in the north, with some recent expansion into the PMZ.
Low, sparse vegetation cover	Areas with sparse grass or herb cover or bare ground, usually associated with recent, severe or frequent burning in areas of human activity. Most of these areas have been cleared by fire but are interpreted to be outside cultivation lands.
Seasonally inundated wetlands	Locally "danau" or seasonal lake, most of these areas were formerly peat swamp forests that have been logged and burned. Where these are adjacent to rivers, flooding may be semi-permanent. Most are sedge-dominated.
Open water	Deep water with no vegetation, especially on or near the Seruyan River and lower reaches of the Baung River

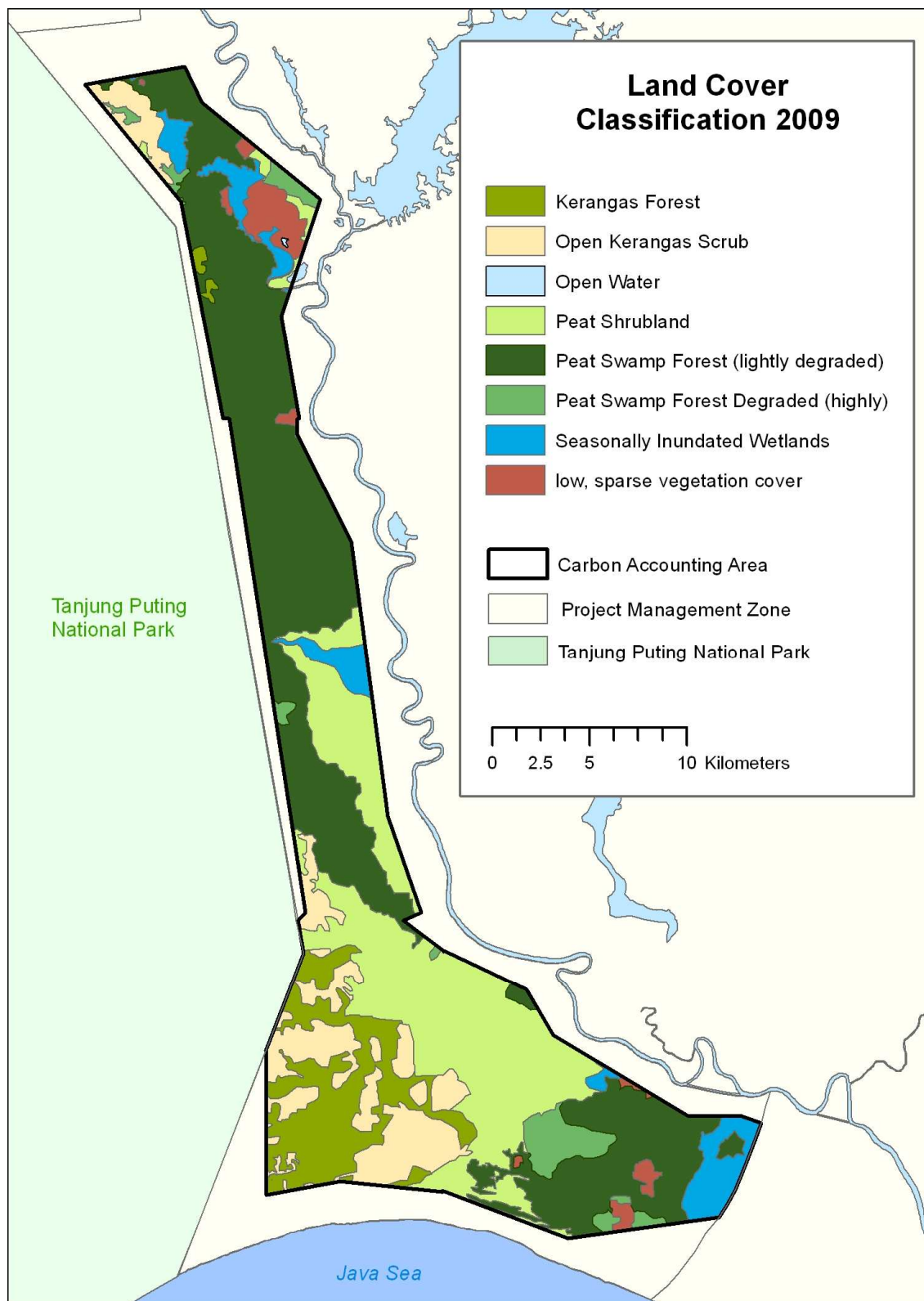


Figure 4. Land Cover Classification Map for Rimba Raya Carbon Accounting Area 2009

3.3.8.3 Landcover Accuracy Assessment

A landcover accuracy assessment was conducted to validate the 2009 land cover classification for Rimba Raya and quantify map accuracy, by comparing the satellite image-based landcover map to reference data from aerial photos flown July 2009 (see Annex 4). Aerial survey flight lines cover approximately 40% of the Rimba Raya Project Management Zone and all major landcover classes were represented in the aerial photos. Lowland forest classes, representing 5.9% of the total Project Management Zone, were not represented by aerial photos. All classes in the carbon accounting area were represented in the aerial photo reference data. A total of 342 sample points were used for the accuracy assessment.

Allocation of sample points to land cover classes was through stratified random sampling based on land cover class area, with a 20-sample minimum for the smallest classes where reference data were available. Reference labels containing the land cover class name interpreted from aerial photos were created for sample points. The initial set of 250 reference labels was created by an independent GIS analyst familiar with ground conditions and map interpretation in peat swamp forest. Map labels for the sample points were compared with reference labels and an error (confusion) matrix generated.

A weighted kappa coefficient of 0.78 indicated there is good agreement between map classes interpreted from satellite imagery and aerial photo data. Landcover is used as the primary stratification for carbon accounting; therefore results of this analysis have been used to quantify uncertainty for carbon estimation. The landcover accuracy assessment will also be used to improve map classification and design a field-based survey for quantitative vegetation analysis for the project.

CONCLUSIONS: An overall classification accuracy of 81.3% was obtained. The predominant class by area, lightly degraded peat swamp forest which covers 30,445 ha or 33.5% of Rimba Raya, was mapped with 90.0% accuracy.

3.3.8.4 Landcover Classification 2010

As part of Year 1 monitoring, landcover classification was performed on 2010 Landsat imagery (January 2010 TM path/row 119/062) which was exceptionally cloud-free and represents the best available recent optical imagery to date. Note that this data is from the Landsat TM sensor, which is the predecessor to ETM+ but produces imagery without the Scan-Line Corrector issue (e.g. no data gaps). 2010 classification used the same scheme and methods used in 2009 land cover classification described above. The final 2010 landcover classification (Figure 5) is the stratification upon which Year 1 land cover change analysis and carbon accounting were conducted.

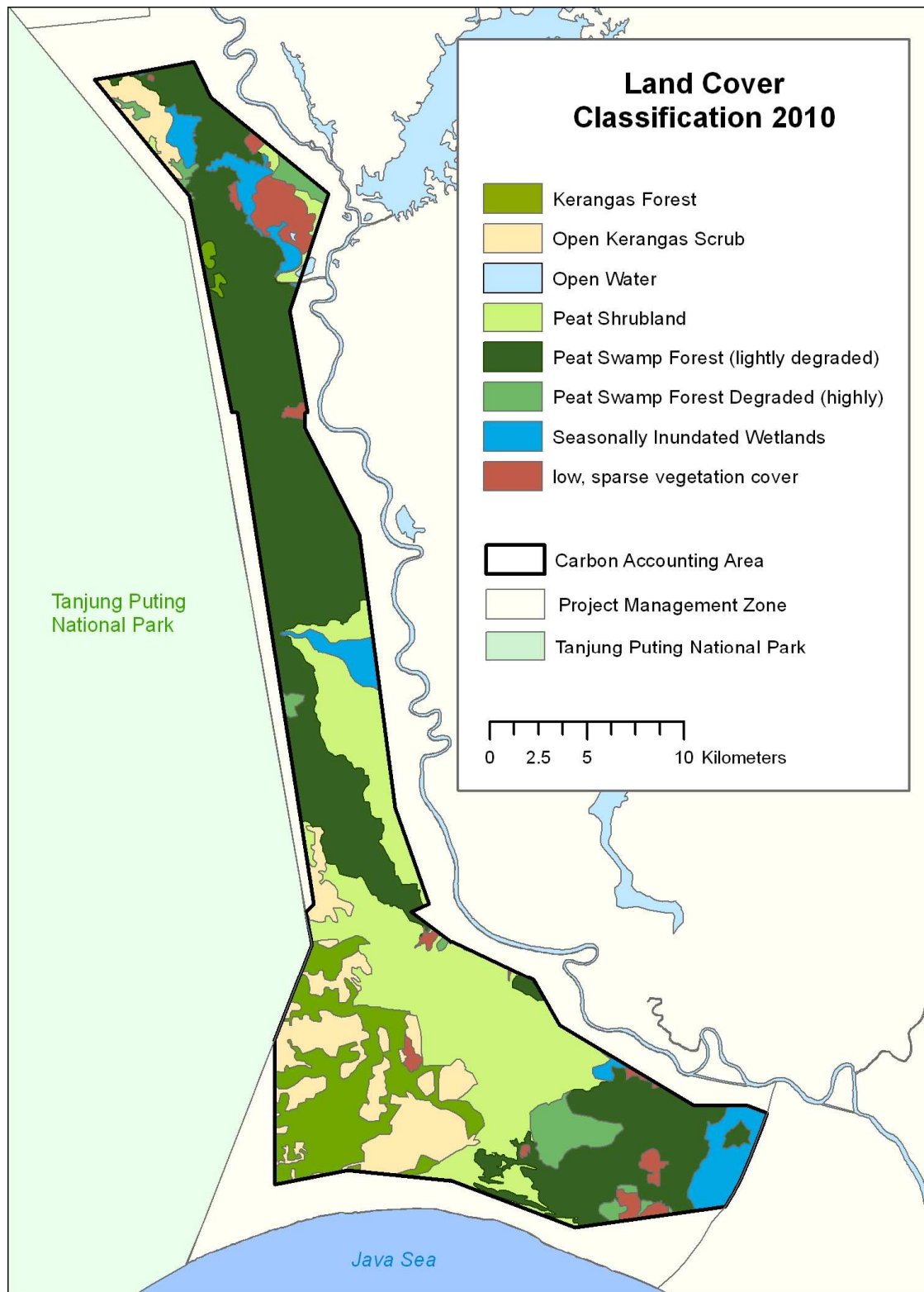


Figure 5. Land Cover Classification Map for Rimba Raya Carbon Accounting Area 2010

3.3.8.5 Landcover Classification and Stratification Monitoring Assessment

Landcover classification provides the primary stratification for biomass assessments and above-ground carbon accounting at Rimba Raya and is currently in its fifth generation of improvement since the project start in 2008. The current classification represents significant improvement in boundary delineation and interpretation based on ground and aerial reference data combined with extensive field experience, satellite image review and application of a number of automated models and manual methods of classification.

The achievements in Year 1 were to:

- Develop and apply a classification scheme most appropriate to Rimba Raya carbon stock assessment
- Create an accurate representation of Rimba Raya land cover types
- Test and determine the best use for all readily available satellite image data
- Develop and apply an appropriate model for inter-annual land cover classification and change analysis

Guidance for Year 2 monitoring is to:

- Develop a quantitative basis for the current land cover classification scheme
- Apply the refined classification scheme; assess and document any changes in 2009 and 2010 mapping
- Continue assessments based on available optical data but also employ ALOS PALSAR and test LIDAR
- Continue applying the current classification model but also test automated methods using non-optical datasets
- Develop and employ SOPs to guide image processing and classification

3.3.9 Forest Protection

3.3.9.1 Forest Protection Monitoring Plan

As part of monitoring forest protection activities, any increases in GHG emissions that occur within the project boundary after the start of the project are being recorded and deducted from the *ex ante* estimate of baseline emissions. The methodology describes a patrol log to be maintained showing the date, area covered indicated by GPS track, and type of disturbance that occurred including the following detailed information:

- Area where natural or anthropogenic disturbances (including fire, illegal logging and other land use change) occurred within the project boundary by date, location, biomass lost or affected, and the preventative or curative measures implemented.
- Number and location of logging gaps by date, biomass lost or affected, and the preventative or curative measures implemented.
- Area and approximate depth of peat burned within the project area by date, location, and the preventative or curative measures implemented.
- Area of peat, if any, that was drained within the project boundary by date, location, estimated peat emissions, and the preventative or curative measures implemented.

3.3.9.2 Forest Protection and Activities

Rimba Raya forest patrols have been ongoing since 2000 and cover a diversity of stakeholders (e.g. RRC, OFI, BKSDA, TNTP, and communities), modes (e.g. remote sensing and GIS analysis, field surveys, routine field patrols, joint stakeholder field expeditions, community-based informant system) and reporting schemes (spatial analysis, GPS data collection, post and radio patrol logs, stakeholder reports). Therefore rather than developing and implementing a simple patrol log system in a previously unpatrolled area, the task for Year-1 monitoring in

Rimba Raya was to compile, assess and employ existing patrol systems to continue area monitoring and protection and inform an improved management system in Year-2.

In order to make use of data from a variety of sources, an FMEA approach was undertaken. A failure modes and effects analysis (FMEA) is a procedure in product development and operations management for analysis of potential failure modes within a system for classification by the severity and likelihood of the failures. Failure modes are any errors or defects in a process, design, or item, especially those that affect the primary stakeholder, and can be potential or actual. Effects analysis refers to studying the consequences of those failures.

A successful FMEA activity helps a team to identify potential failure modes based on past experience with similar products or processes, enabling the team to design those failures out of the system with the minimum of effort and resource expenditure, thereby reducing development time and costs. It is widely used in manufacturing industries in various phases of the product life cycle and is now increasingly finding use in the service industry and environmental management.

3.3.9.3 *Summary of Year-1 Forest Patrols*

For Year 1 monitoring, Rimba Raya has leveraged the 40-year experience of OFI and has adapted their procedures as outlined in the SOP for Field Patrols. Forest Patrols are organized under three regimes:

- Routine Daily Field Patrols
- Incident Based Non-Routine Field Patrols
- Annual Monitoring Event Field Survey.

Figure 6 is a copy of the “Process Flow Chart for Routine Patrols”. Figure 7 is a copy of the Process Flow Chart for Joint Patrols”. Figure 8 shows a sample copy of a “Routine Patrol Log”. Figure 9 show a copy of a “Non-Routine Patrol Log” and Figure 10 shows a copy of a “Serious Incidence Report & Corrective Action Plan (SIR-CAP)”.

Additionally, OFI and Rimba Raya conduct Joint Patrols with other stakeholders such as BKSDA and the Tanjung Puting National Park Management Authority.

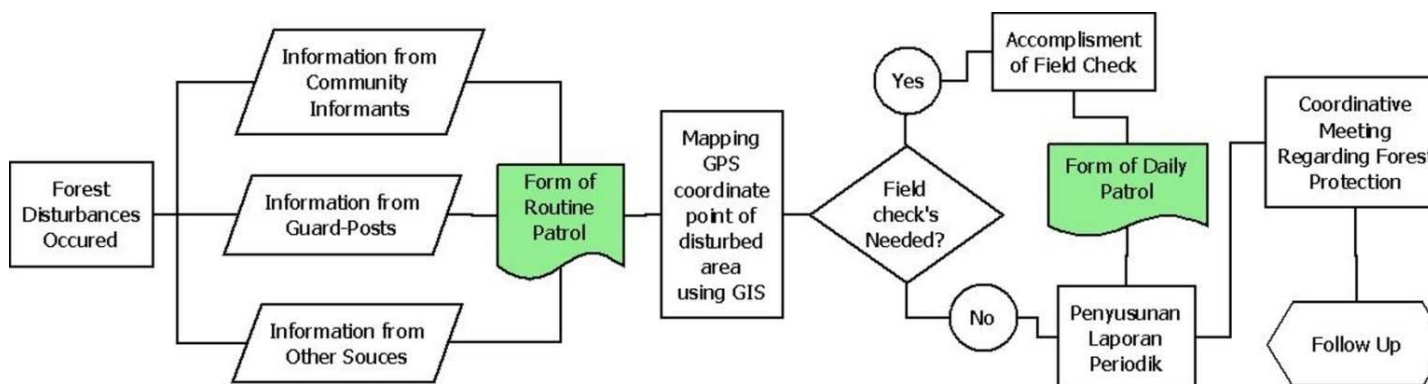


Figure 6. Process Flow Chart for Routing Patrols

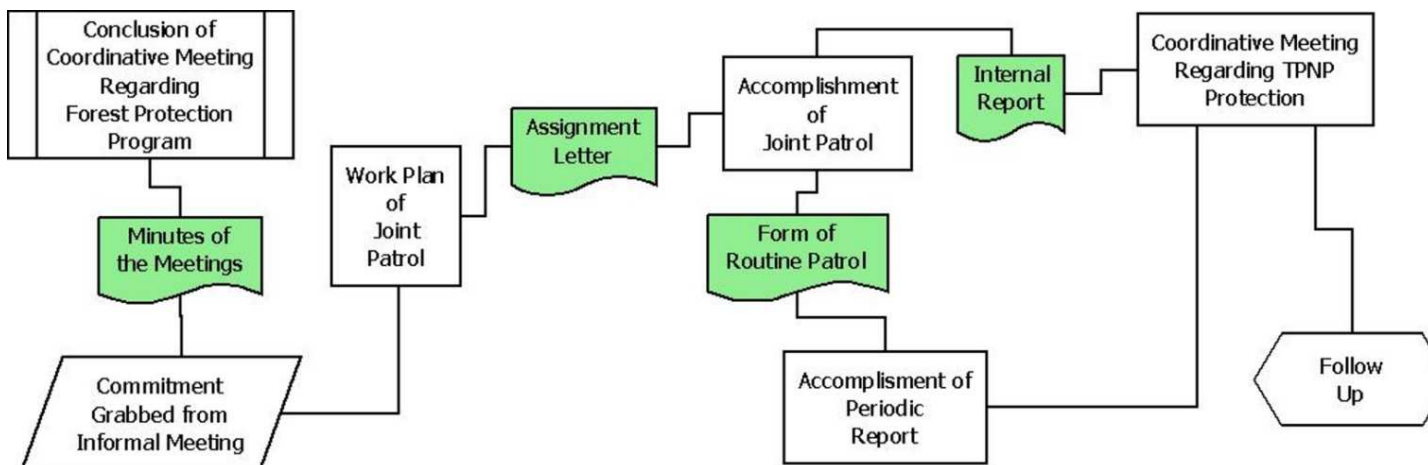


Figure 7. Process Flow chart for those Joint Patrols.

Waktu Pelaksanaan: 07 Juli 2010

Format Laporan Kegiatan PATROLI RUTIN - OFI

Waypoint	Jenis lahan				Lahan semak				Lahan veg. rendah				Rata2		Jenis tanah				Kedalaman Air				Dampak Kerusakan				Penyebab Kerusakan				Waktu Kerusakan						
	TT	RW	HS	Pdg	Lain	Alang2	Beruta	Lain2	Denau	Tambak	Lahan dibuka	Lahan tdk dipakai	Lain	Tinggi	Lebar	Pasir	Gam but	Lum pur	Tanah liat	Lainnya	Kering	Sampai	Sampai	Sampai	Sampai	Tinggi	Sedang	Rendah	Lainnya	Keha	Loging	Pertam	Perta	Lainnya	Aktiv	Waktu	
001														15m	3m																						
002-90/023														20/25m	4m																						
003-15/023														20m	3.0m																						
003-7																																					
032-6 5/0														3m	1m																						
055-31																																					
055-32 5/0														15m	3m																						
063-40																																					
064-41														10m	2.5m																						
080-57																																					

Waypoint	Pemukiman		Rute logging			Tipe jalan yg dilalui			Sungai		Desa	Aktivitas	Pertam-bangan	Sarang Orangutan		Keterangan Lain
	1 s/d 5	> 5	Rel	Teteh	Rata	Berlum pur	U/fin motor	Jalan Setapak	Nama sungai	Keda Laman				Nama desa	Sawmill	
001																Keterangan → Foto → 0195 → phn → Kelangan → Kumpu. Foto → 0196 → 0197, 0198, 0199, 0200, 0201, 0202, 0203, 0204, 0205, 0206, 0207, 0208, 0209, 0210, 0211, 0212, 0213, 0214, 0215, 0216, 0217, 0218, 0219, 0220, 0221, 0222, 0223, 0224, 0225, 0226, 0227, 0228, 0229, 0230, 0231, 0232, 0233, 0234, 0235, 0236, 0237, 0238, 0239, 0240, 0241, 0242, 0243, 0244, 0245, 0246, 0247, 0248, 0249, 0250, 0251, 0252, 0253, 0254, 0255, 0256, 0257, 0258, 0259, 0260, 0261, 0262, 0263, 0264, 0265, 0266, 0267, 0268, 0269, 0270, 0271, 0272, 0273, 0274, 0275, 0276, 0277, 0278, 0279, 0280, 0281, 0282, 0283, 0284, 0285, 0286, 0287, 0288, 0289, 0290, 0291, 0292, 0293, 0294, 0295, 0296, 0297, 0298, 0299, 0300, 0301, 0302, 0303, 0304, 0305, 0306, 0307, 0308, 0309, 0310, 0311, 0312, 0313, 0314, 0315, 0316, 0317, 0318, 0319, 0320, 0321, 0322, 0323, 0324, 0325, 0326, 0327, 0328, 0329, 0330, 0331, 0332, 0333, 0334, 0335, 0336, 0337, 0338, 0339, 0340, 0341, 0342, 0343, 0344, 0345, 0346, 0347, 0348, 0349, 0350, 0351, 0352, 0353, 0354, 0355, 0356, 0357, 0358, 0359, 0360, 0361, 0362, 0363, 0364, 0365, 0366, 0367, 0368, 0369, 0370, 0371, 0372, 0373, 0374, 0375, 0376, 0377, 0378, 0379, 0380, 0381, 0382, 0383, 0384, 0385, 0386, 0387, 0388, 0389, 0390, 0391, 0392, 0393, 0394, 0395, 0396, 0397, 0398, 0399, 0400, 0401, 0402, 0403, 0404, 0405, 0406, 0407, 0408, 0409, 0410, 0411, 0412, 0413, 0414, 0415, 0416, 0417, 0418, 0419, 0420, 0421, 0422, 0423, 0424, 0425, 0426, 0427, 0428, 0429, 0430, 0431, 0432, 0433, 0434, 0435, 0436, 0437, 0438, 0439, 0440, 0441, 0442, 0443, 0444, 0445, 0446, 0447, 0448, 0449, 0450, 0451, 0452, 0453, 0454, 0455, 0456, 0457, 0458, 0459, 0460, 0461, 0462, 0463, 0464, 0465, 0466, 0467, 0468, 0469, 0470, 0471, 0472, 0473, 0474, 0475, 0476, 0477, 0478, 0479, 0480, 0481, 0482, 0483, 0484, 0485, 0486, 0487, 0488, 0489, 0490, 0491, 0492, 0493, 0494, 0495, 0496, 0497, 0498, 0499, 0500, 0501, 0502, 0503, 0504, 0505, 0506, 0507, 0508, 0509, 0510, 0511, 0512, 0513, 0514, 0515, 0516, 0517, 0518, 0519, 0520, 0521, 0522, 0523, 0524, 0525, 0526, 0527, 0528, 0529, 0530, 0531, 0532, 0533, 0534, 0535, 0536, 0537, 0538, 0539, 0540, 0541, 0542, 0543, 0544, 0545, 0546, 0547, 0548, 0549, 0550, 0551, 0552, 0553, 0554, 0555, 0556, 0557, 0558, 0559, 0560, 0561, 0562, 0563, 0564, 0565, 0566, 0567, 0568, 0569, 0570, 0571, 0572, 0573, 0574, 0575, 0576, 0577, 0578, 0579, 0580, 0581, 0582, 0583, 0584, 0585, 0586, 0587, 0588, 0589, 0590, 0591, 0592, 0593, 0594, 0595, 0596, 0597, 0598, 0599, 0600, 0601, 0602, 0603, 0604, 0605, 0606, 0607, 0608, 0609, 0610, 0611, 0612, 0613, 0614, 0615, 0616, 0617, 0618, 0619, 0620, 0621, 0622, 0623, 0624, 0625, 0626, 0627, 0628, 0629, 0630, 0631, 0632, 0633, 0634, 0635, 0636, 0637, 0638, 0639, 0640, 0641, 0642, 0643, 0644, 0645, 0646, 0647, 0648, 0649, 0650, 0651, 0652, 0653, 0654, 0655, 0656, 0657, 0658, 0659, 0660, 0661, 0662, 0663, 0664, 0665, 0666, 0667, 0668, 0669, 0670, 0671, 0672, 0673, 0674, 0675, 0676, 0677, 0678, 0679, 0680, 0681, 0682, 0683, 0684, 0685, 0686, 0687, 0688, 0689, 0690, 0691, 0692, 0693, 0694, 0695, 0696, 0697, 0698, 0699, 0700, 0701, 0702, 0703, 0704, 0705, 0706, 0707, 0708, 0709, 0710, 0711, 0712, 0713, 0714, 0715, 0716, 0717, 0718, 0719, 0720, 0721, 0722, 0723, 0724, 0725, 0726, 0727, 0728, 0729, 0730, 0731, 0732, 0733, 0734, 0735, 0736, 0737, 0738, 0739, 0740, 0741, 0742, 0743, 0744, 0745, 0746, 0747, 0748, 0749, 0750, 0751, 0752, 0753, 0754, 0755, 0756, 0757, 0758, 0759, 0760, 0761, 0762, 0763, 0764, 0765, 0766, 0767, 0768, 0769, 0770, 0771, 0772, 0773, 0774, 0775, 0776, 0777, 0778, 0779, 0780, 0781, 0782, 0783, 0784, 0785, 0786, 0787, 0788, 0789, 0790, 0791, 0792, 0793, 0794, 0795, 0796, 0797, 0798, 0799, 0800, 0801, 0802, 0803, 0804, 0805, 0806, 0807, 0808, 0809, 0810, 0811, 0812, 0813, 0814, 0815, 0816, 0817, 0818, 0819, 0820, 0821, 0822, 0823, 0824, 0825, 0826, 0827, 0828, 0829, 0830, 0831, 0832, 0833, 0834, 0835, 0836, 0837, 0838, 0839, 0840, 0841, 0842, 0843, 0844, 0845, 0846, 0847, 0848, 0849, 0850, 0851, 0852, 0853, 0854, 0855, 0856, 0857, 0858, 0859, 0860, 0861, 0862, 0863, 0864, 0865, 0866, 0867, 0868, 0869, 0870, 0871, 0872, 0873, 0874, 0875, 0876, 0877, 0878, 0879, 0880, 0881, 0882, 0883, 0884, 0885, 0886, 0887, 0888, 0889, 0890, 0891, 0892, 0893, 0894, 0895, 0896, 0897, 0898, 0899, 0900, 0901, 0902, 0903, 0904, 0905, 0906, 0907, 0908, 0909, 0910, 0911, 0912, 0913, 0914, 0915, 0916, 0917, 0918, 0919, 0920, 0921, 0922, 0923, 0924, 0925, 0926, 0927, 0928, 0929, 0930, 0931, 0932, 0933, 0934, 0935, 0936, 0937, 0938, 0939, 0940, 0941, 0942, 0943, 0944, 0945, 0946, 0947, 0948, 0949, 0950, 0951, 0952, 0953, 0954, 0955, 0956, 0957, 0958, 0959, 0960, 0961, 0962, 0963, 0964, 0965, 0966, 0967, 0968, 0969, 0970, 0971, 0972, 0973, 0974, 0975, 0976, 0977, 0978, 0979, 0980, 0981, 0982, 0983, 0984, 0985, 0986, 0987, 0988, 0989, 0990, 0991, 0992, 0993, 0994, 0995, 0996, 0997, 0998, 0999, 1000

Figure 8. Sample copy of a "Routine Patrol Log".

If a potentially serious incident is reported (by Routine Monitoring Patrols), then a Non-Routine Field Patrol is dispatched and a Non-Routine Field Patrol Report is generated in the field seen here in Figure 9.



FORM LAPORAN HARIAN

ORANGUTAN FOUNDATION INTERNATIONAL

Periode Bulan : *Nov - Dec*
 Tahun : *07*
 Nama Pos : *07*

No	Tanggal	Lokasi Pos	KODE RADIO																						
			1A	2A	3A	4A	5A	6A	7A	8A	1B	2B	3B	4B	1C	2C	3C	4C	5C	1D	2D	3D	4D	5D	
1	<i>28 / 11 / 07</i>	Pos 51														✓	✓	✓					✓	✓	
		Pos Tengawang															✓		✓					✓	✓
		Pos Tanjung Hanau															✓		✓					✓	✓
		Pos Baung						<i>20</i>									✓		✓					✓	
		Pos Ulin						<i>3</i>									✓		✓					✓	✓
		Pos Sigintung		<i>2</i>													✓		✓					✓	✓
		Pos Kuda Laut														✓	✓		✓					✓	✓
		Pos Natal Tengah														✓	✓		✓	✓	✓			✓	✓
Pos Muara Ali																	✓					✓	✓		
2	<i>29 / 11 / 07</i>	Pos 51														✓		✓					✓	✓	
		Pos Tengawang														✓		✓					✓	✓	
		Pos Tanjung Hanau														✓		✓					✓	✓	
		Pos Baung		<i>5</i>				<i>20</i>								✓		✓					✓	✓	
		Pos Ulin														✓		✓					✓	✓	
		Pos Sigintung		<i>2</i>				<i>3</i>								✓		✓					✓	✓	
		Pos Kuda Laut														✓	✓		✓		✓		✓	✓	
		Pos Natal Tengah		<i>3</i>												✓	✓		✓	✓	✓		✓	✓	
Pos Muara Ali																✓					✓	✓			
3	<i>30 / 11 / 07</i>	Pos 51														✓		✓					✓	✓	
		Pos Tengawang														✓		✓					✓	✓	
		Pos Tanjung Hanau														✓		✓					✓	✓	
		Pos Baung						<i>20</i>								✓		✓					✓	✓	
		Pos Ulin														✓		✓					✓	✓	
		Pos Sigintung		<i>2</i>												✓		✓					✓	✓	
		Pos Kuda Laut														✓	✓		✓		✓		✓	✓	
		Pos Natal Tengah		<i>10</i>												✓	✓		✓	✓	✓		✓	✓	
Pos Muara Ali														✓		✓					✓	✓			
4	<i>01 / 12 / 07</i>	Pos 51														✓		✓					✓	✓	
		Pos Tengawang														✓		✓					✓	✓	
		Pos Tanjung Hanau														✓		✓					✓	✓	
		Pos Baung		<i>2</i>				<i>20</i>								✓		✓					✓	✓	
		Pos Ulin														✓		✓					✓	✓	
		Pos Sigintung		<i>3</i>												✓		✓					✓	✓	
		Pos Kuda Laut														✓	✓		✓		✓		✓	✓	
		Pos Natal Tengah														✓	✓		✓	✓	✓		✓	✓	
Pos Muara Ali																✓					✓	✓			

Figure 9. Non-Routine Field Patrol Report

Laporan Kejadian yang Memerlukan Perhatian & Rancang Tindak

Serious Incidence Report & Corrective Action Plan



1. PERMASALAHAN / PROBLEM STATEMENT		BSW-0001 2010.01.02	
Kebakaran hutan di sekitar Pos Hanau (Release Camp), tanggal 03-09 September 2009.			
Foto / Photo			
Rincian Masalah Specify Problem			
Apa What	Kebakaran hutan yang cukup besar. Penanganan kebakaran hutan memerlukan waktu yang lama.	Penyebab Cause	Api diperkirakan berasal dari perladangan masyarakat di sisi utara, berdekatan dengan perkebunan sawit yang menjalar ke areal sekitar Post Hanau.
Di Mana Where	Area Camp Tanjung Hanau (Orangutan Release Camp)	Siapa Who	OFI (7 staff) bersama aparat TINTP-SPTN I (2 orang) melaksanakan pemadaman.
Tingkat Kegentingan Extent	Sangat genting, mengingat lamanya waktu kebakaran serta lokasinya yang dekat dengan areal release orangutan.	Tindakan cepat yg Dilakukan Immediate Action	Kegiatan pemadaman api dilakukan bersama aparat TINTP SPTN I, OFI mendukung kegiatan ini berupa tenaga dan logistik.
2. RANCANG TINDAK PERBAIKAN (RTP) / CORRECTIVE ACTION PLAN			
Tindakan Perbaikan Corrective Actions	Dalam pemadaman kebakaran ini, diperlukan upaya perbaikan sbb.: (1) Deteksi dini yang lebih intensif, dengan membuat "Peta Indikasi Kebakaran Hutan Bulanan" khususnya di sekitar Pos Hanau yang dari tahun ke tahun memang rawan kebakaran, utamanya pada periode musim kering; (2) Koordinasi lebih kuat dengan pihak TPNP dan KMPA; (3) Penambahan jumlah regu pemadam kebakaran; dan (4) Pengadaan peralatan pemadaman kebakaran yang lebih lengkap.	Siapa / Who Manajemen OFI dan PT. Rimba Raya Dimulai / Begin 01 Oktober 2009 Berakhir / End 31 Desember 2009 Pihak Ketiga / 3rd Parties (a) Dishutbun Kab. Seruyan, TINTP, BKSDA SKW II (b) WSSL Timur (c) KMPA Tindaklanjuti Follow-up date Terus dilakukan pemantauan perkembangan, dan akan dievaluasi pada 02/01/2010	
Evaluasi Keberhasilan RTP Evaluation of CAP	Masih kurang memuaskan. Deteksi dini terhambat oleh jangkauan patroli personil Pos Hanau yang terbatas, akibat minimnya sarana transportasi. Pihak TPNP-BKSDA juga memiliki keterbatasan personil, peralatan dan jangkauan. Peralatan pemadaman kebakaran belum dapat dilengkapi, dan pemetaan sumber air belum dilakukan.	Diperiksa Oleh / by Manajemen OFI dan PT. Rimba Raya Tgl. / Date 02 Januari 2010 Status Perlu tindak lanjut lain, berkaitan dengan rencana kerja PT. Rimba Raya dalam penanganan kebakaran. Dievaluasi dalam semester pertama, bulan Juni 2010. Tandatangan Signature	

Figure 10. Example of a SIRCAP (Serious Incidence Report)

If the incident is in fact determined to be a serious incident then a SIR-CAP is filed (Serious Incidence Report & Corrective Action Plan). A serious incidence is defined by severity (intensity) and extent and includes the following criteria:

- Any fire ignition determined to be of a serious nature in extent or intensity (degree of magnitude)
- Any illegal logging other than small pole gathering for personal use
- Any mining other than small scale (personal) pit mining (e.g. for zircon) where chemical leaching is not used
- Any deforestation event (horticulture) that leads to land cover change

Three SIR-CAPs were filed in this monitoring year, all involving fire. See Annex 5.

All of the above data sets are compiled into Table 10, which then summarizes the field patrol reports for Year-1 Monitoring. Currently the project area has three permanent guard posts (as seen in the photo) from which regular patrols are conducted daily. During its three year ramp-up plan for monitoring activities, Rimba Raya will build at least 7 more posts plus establish a monitoring post at each village. Over that period of time, frequency of patrols and the robustness and rigor of data are being improved as infrastructure and staff increases and as protocols and procedures are improved in a "learn by doing" environment of continuous improvement.

Many of the activities recorded have little direct effect on carbon stocks (e.g. fishing). The presence of human activity within the project management zone and the carbon accounting area however presents opportunities for degradation and potential land cover change that may not be directly related to the immediate activity. Additionally, recording these "benign" activities begins to give project proponents an idea of the areas of stresses on the forest in terms of resources and area. This then helps to inform what community programs need to be designed to offset those pressures.

As the final step in the "Closed Loop Process Flow and Control Plan described in Section 3.3.6.1, the summary table of monitoring activities informs a Gap Analysis, which in turn informs Corrective Action Plans for the process, which then finally loop back into the overarching Control Plan. This Year-1 Monitoring Gap Analysis has informed the following Corrective Action Plans and Process Control changes.

- Year-1 monitoring reported a high incidence of fire ignitions outside the carbon accounting area but within the project management zone in the buffer areas around the palm oil estates on the northern boundary. Under its new agreement with the Conservation and Fire Department of the Forestry Bureau (BKSDA), patrols and enforcement are being concentrated in these areas in Year-2.

Table 10 Summary Monitoring Table

	Buffer-North		Carbon-North		Carbon Central		Carbon-S/Seruyan		Carbon-S/TPNP		Remote		Total	Index
Posts	51	Other	Setiung	Other	Sigintung	Other	Other	Other	Other	Other	Landsat	SPOT		
Hunting	0	0	0	0	20	0	0	0	0	0			20	3
Fishing	0	0	758	0	390	0	0	0	0	0			1148	10
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Illegal logging	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Illegal Mining	0	0	0	0	0	0	0	0	0	0			0	0
Gembor Harvesting	0	0	0	0	623	0	0	0	0	0			623	10
Jelutung Tapping	0	0	0	0	0	0	0	0	0	0			0	0
Rattan Collection	8	0	0	0	0	0	0	0	0	0			8	0
Fire Spots	17	0	0	0	0	0	0	0	0	0	0	0	17	3
Agriculture Spot	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining Spots	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Logging Spots	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	25	0	758	0	1033	0	0	0	0	0	0	0	1816	

Some activities (e.g. fishing and Jelutung tapping) do not represent immediate threats to carbon stocks (Land Cover Change) and are therefore classified as activities leading to possible "Degradation". As such, they do not inform Corrective Actions that address deficiencies in the monitoring process but do induce curative and preventative measures in the form of the various income substitution and enhancement programs planned by project proponents as a means of alleviating pressures on the surrounding environment.

Lastly, an intensive ground survey of the project area covering hundreds of high risk target points is conducted annually as part of the actual Annual Monitoring Event. This data is detailed in Sections 3.3.9 and 3.3.10 of this report.

3.3.9.4 High Risk Areas – Threats Analysis

Rimba Raya is an extensive area dominated by peat swamp forests that are accessible only by waterways, trails and old logging rails. Recent human activities in the Reserve have been concentrated on these access routes to the interior from the Seruyan River and its major tributaries the Baung and Sigintung Rivers.

In order to further improve and direct monitoring and management, a spatially-based threats analysis was conducted to identify areas of particularly high risk within the 63,828 ha PMZ and 47,237 ha CAA. The first GIS threats assessment was conducted based on field reconnaissance in March 2009 (Bolick 2009) prior to the start of Year-1 monitoring. This map analysis highlighted village areas and access points along the Seruyan River as places of high potential human activity and impact, which informed protection patrols and monitoring early in the project (Figure 11, Figure 12, Figure 13).

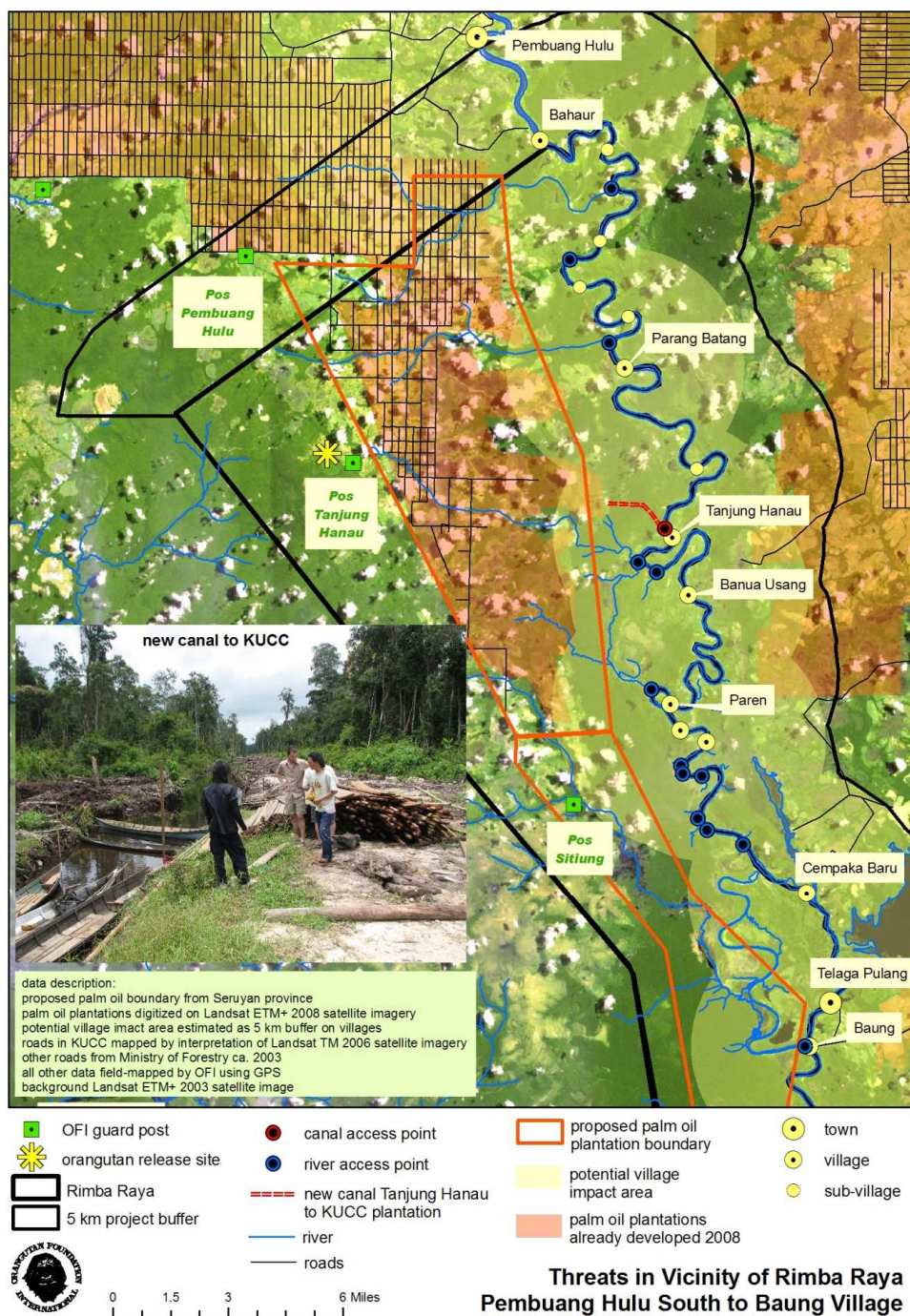


Figure 11. Threats Map for Northern Extent.

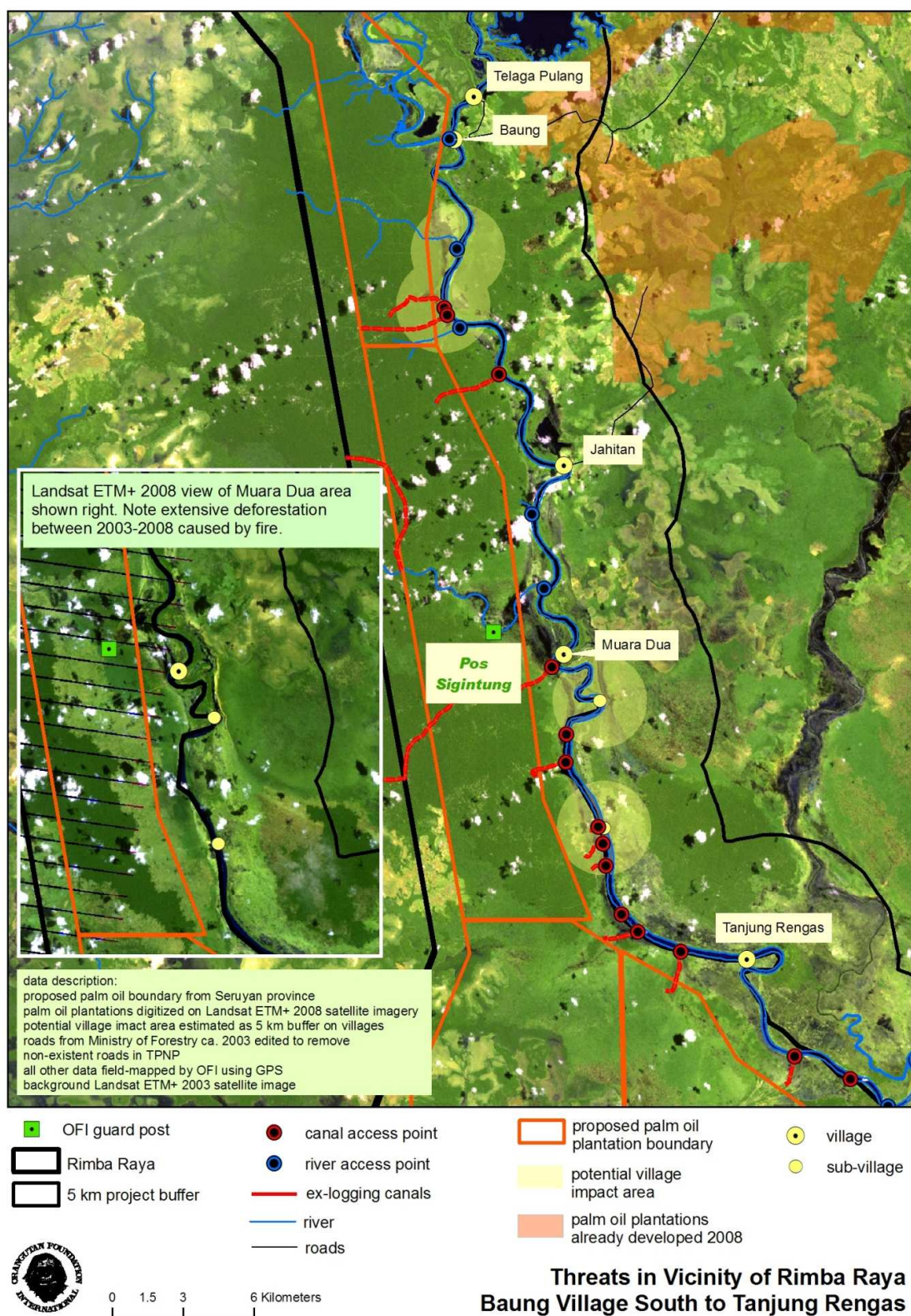


Figure 12. Threats Map for Central Extent.

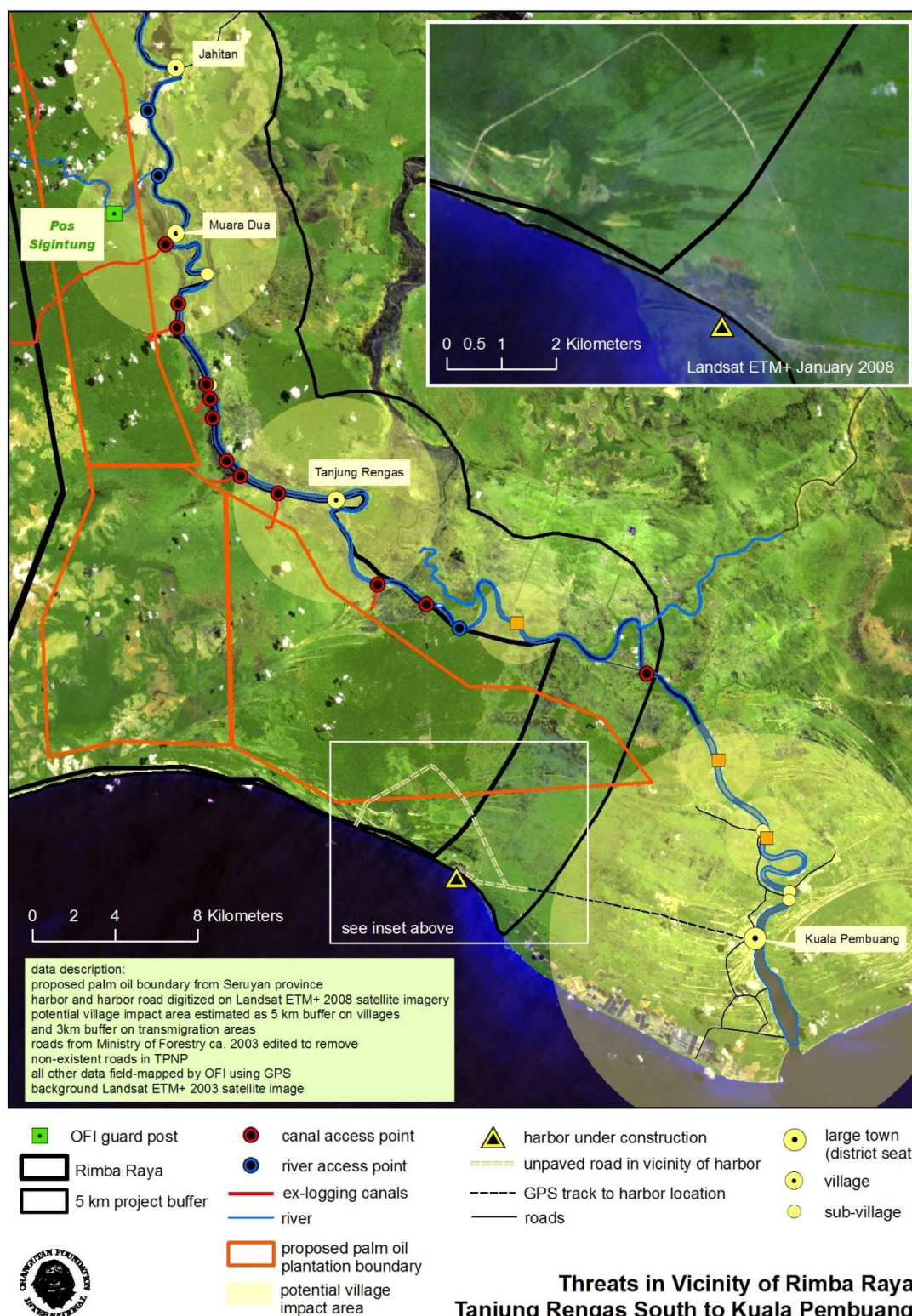


Figure 13. Threats Map for Southern Extent.

This initial model for threats analysis have been further refined so that threat type (i.e. logging or fire) and level (i.e. high, medium, low) can be assessed based on a number of factors (e.g. land cover type, proximity to access) and monitoring prioritized based on resource value combined with threat level. The tables below show model parameters and values for logging threat, fire threat, resource value and priority monitoring:

Logging threat = forest + proximity to village + proximity to access + proximity to transport network

Fire threat = non-forest + proximity to village + proximity to access + proximity to recent burns

Resource value = CAA + peat + forest

Priority monitoring = Resource value + Logging/Fire Threat

Table 11. Threats Analysis – Threats / Resource Value Index Matrix

Logging Threat Value Indexes	Threat Value Index (< 1km)	Threat Value Index (1-3km)	Threat Value Index (3-5km)	Fire Threat Value Indexes	Threat Value Index (< 1km)	Threat Value Index (1-3km)	Threat Value Index (3-5km)
Peat Swamp Forest (lightly degraded)	24	18	12	Peat Swamp Forest (lightly degraded)	30	24	18
Peat swamp forest (highly degraded)	18	12	6	Peat swamp forest (highly degraded)	24	18	12
Peat Shrubland	12	6	0	Peat Shrubland	18	12	6
Non-Forest	0	0	0	Non-Forest	12	6	0

Highlighted cell indicates High Risk Index + High Resource Value = High Priority. During the Year-2 Monitoring period, this analysis is being expanded to include and produce the following GIS maps:

- Risk Map
- Resource Value Map
- Priority Protection Map

3.3.9.5 Annual Monitoring Event Field Survey

Based on the High Risk Threats Map and the Threat/Resource Value Index Analysis a proactive and highly targeted Monitoring Patrol was designed to provide intensified coverage of these areas. On these patrols extensive GPS data was collected including:

- Evidence of logging
 - o GPS track of logging trail or logging canal
 - o GPS coordinate of each logging event
 - o DBH of remaining stump

- o Species
- o Landcover conditions including clearing, degradation, drainage, etc
- Evidence of Fire Hot Spots
 - o GPS boundary track for the boundary of large burn scars
 - o GPS coordinate for burn spots
 - o Depth of peat burn for intensive burns
 - o Landcover conditions including clearing, degradation, drainage, etc
- Evidence of Land Clearing
 - o GPS boundary track of large land cover change areas
 - o GPS coordinate for small plots
 - o Type of activity
 - o Landcover conditions including clearing, degradation, drainage, etc.

A full report of these activities can be found in the annual survey report (Annex 7). Results from these surveys are integrated into the annual GIS Landcover Change Analysis, which is then quantified for biomass loss and resulting carbon stocks loss. This final analysis informs Corrective Action Plans and serves as a basis for the subsequent year's monitoring activities.

3.3.10 Land Cover and Land Use Change

Section 19.2 of the Methodology

"Monitoring land cover and land use change within the project boundary must occur to ensure that any GHG benefits achieved by project activities during the crediting period are real, permanent and secure. Therefore, any decreases in carbon stocks or increases in peat emissions that occur inside the project boundary after the start of the project must be accounted for, including the GHG emissions from any land cover change that may occur within the project area over the crediting period."

3.3.10.1 Land Cover Change Monitoring Plan

Land cover change during the monitoring period is assessed by two different approaches: 1) remote sensing and GIS assessment and 2) ground survey and patrols. The spatial analysis approach has the advantage of being synoptic, systematic, efficient and accurate but cannot provide detail, which informs impact assessment and management. As a complement to this top-down approach, ground survey and patrol data provide detail about the nature, cause and effect of land change, but cannot be used alone to reliably monitor and quantify land change over expansive areas on an annual basis. A combined approach takes advantage of both broad-scale spatial analysis and fine-scale ground assessments in order to conduct accurate and reliable monitoring in a way that informs and improves project monitoring and management.

3.3.10.2 Top-Down Assessment: Spatial Analysis

The first step in assessing annual emissions associated with degradation and deforestation is to conduct a systematic analysis of land cover change over the monitoring year, based on quantifying the areal difference between Year *t* and Year *t*+1 land cover. Land cover classification is carried out according to methods detailed in the stratification section then a post-classification change analysis is conducted by overlaying annual land cover maps.

3.3.10.3 Bottom-Up Assessment: Ground Surveys

In some cases, the top-down assessment directs ground surveys (e.g. patrols sent to investigate fire hotspots detected on satellite imagery) but ground surveys are also initiated independently of spatial analysis (e.g. routine patrols or patrols sent in response to communications about land use activities). Furthermore, ground patrols are used to record details about carbon impacts that also appear in satellite image assessments, but are also used to discover and record small-scale carbon impacts that do not appear on imagery.

3.3.10.4 Land Cover Change Methods 2009-2010

Land cover classification was conducted for Rimba detailed in the Landcover and Accuracy Assessment reports. Land cover classification provides the basis for project stratification and land cover change analysis.

Land cover disturbance and potential land cover change areas were identified and delineated by overlaying 2009 land cover boundaries on 2010 satellite imagery in ArcGIS software. Areas of ground disturbance were easily identified on cloud-free Landsat 5 TM imagery and twelve areas of disturbance and potential land cover change were delineated totaling 270.2 hectares. These areas were further investigated in GIS using ancillary data (e.g. fire hotspots) and in the field to determine whether the land disturbance resulted in land cover change and if so, the land cover type change. Impact type (e.g. logging, fire, oil palm or other land clearing) was assessed for calculating GHG emissions reductions and is presented in the following sections.

3.3.10.5 Land Cover Change Results 2009-2010

Figure 14 and Figure 15 show the land disturbance polygons delineated on satellite imagery. Table 12 shows the 2009 and 2010 land cover classification and area for each of the twelve land disturbance areas and the type of associated land change.

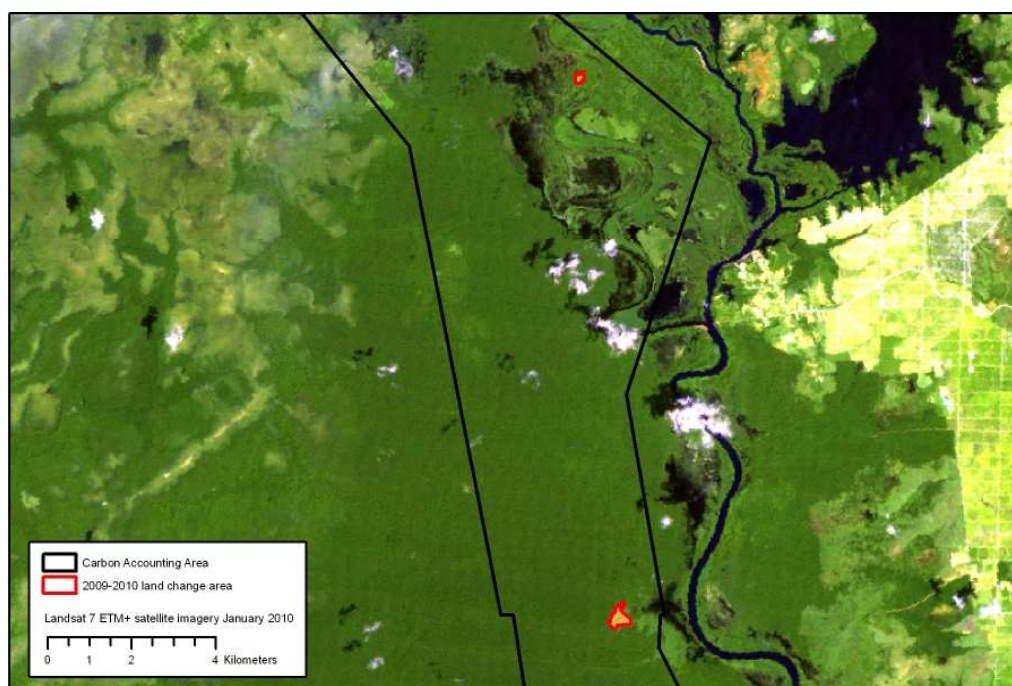


Figure 14. 2009 – 2010 Landcover Change – North CAA

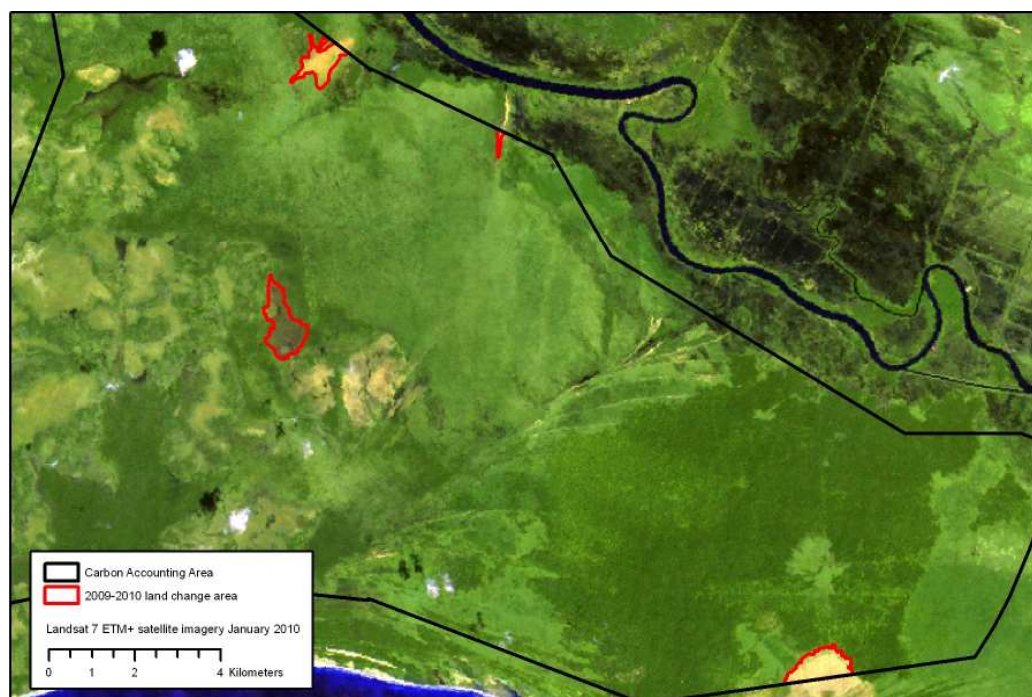


Figure 15. 2009 – 2010 Landcover Change – South CAA

Table 12. Land Cover Change in Areas of Land Disturbance

Polygon	2009 Land Cover	2010 Land Cover	Area (ha)	Change Type
1	low, sparse vegetation cover	low, sparse vegetation cover	1.2	no change
2	Peat Swamp Forest Degraded (highly)	low, sparse vegetation cover	69.7	deforestation
3	Peat Swamp Forest (lightly degraded)	low, sparse vegetation cover	11.1	deforestation
4	Peat Swamp Forest (lightly degraded)	low, sparse vegetation cover	8.3	deforestation
5	Peat Swamp Forest (lightly degraded)	low, sparse vegetation cover	4.2	deforestation
6	Peat Shrubland	low, sparse vegetation cover	4.7	non-forest change
7	Peat Shrubland	low, sparse vegetation cover	54.9	non-forest change
8	Seasonally Inundated Wetlands	low, sparse vegetation cover	1.7	non-forest change
9	low, sparse vegetation cover	low, sparse vegetation cover	11.8	non-forest change

10	Kerangas Forest	low, sparse vegetation cover	7.8	deforestation
11	Open Kerangas Scrub	low, sparse vegetation cover	92.0	non-forest change
12	Peat Shrubland	low, sparse vegetation cover	2.9	non-forest change
	Total Area		270.2	

CONCLUSIONS: Land cover disturbance and land cover change was detected on 270.2 ha in the CAA for which GHG emissions are quantified based on land change type

3.3.11 Fire

3.3.11.1 Fire Monitoring Plan

Fire monitoring is conducted over a range of frequencies depending on the season and fire conditions and relies on the Fire Information for Resource Management System (FIRMS) delivery of MODIS satellite maps of hotspot and fire locations. After the rainy season begins, usually December, fire map data are monitored monthly. As the dry season approaches, usually July, fire map data are being monitored weekly. And at the height of fire season, usually August-October, fire data is monitored daily.

During the fire season, satellite monitoring is implemented as part of the comprehensive fire plan described in the VCS PD and are being used to direct and deploy fire fighting and survey teams on an as-needed basis. Fire monitoring and response activities are being reported annually at the end of fire season surveys.

At the end of the fire season, the presence or absence of burning within the project boundary in a given monitoring year is determined by analyzing medium resolution remote sensing data. If no fires are detected within the project boundary or within a 1 km buffer zone around the project boundary in the monitoring year, then it is assumed that there were no GHG emissions associated with burning within the project boundary and *fire itE* = 0.

If burned areas are detected within the project boundary or within a 1 km buffer of the project boundary in the monitoring year, then geo-referenced, high resolution aerial imagery or geo-referenced ground measurements will be collected over these areas and the location and area of all fire scars are calculated and recorded.

3.3.11.2 Fire Hotspots

Fire ignition sites or “hotspots” can be derived by applying thermal analysis algorithms to NOAA-MODIS data. Daily updates of fire hotspot data in Kalimantan is available online and is downloaded for Rimba Raya from <http://firefly.geog.umd.edu/firemap/> and <http://www.weather.gov.sg/wip/web/ASMC>. The Fire Hotspots data acquisition and processing flow is illustrated in Figure 16. (See Annex 8 for Fire Hotspot analysis report).

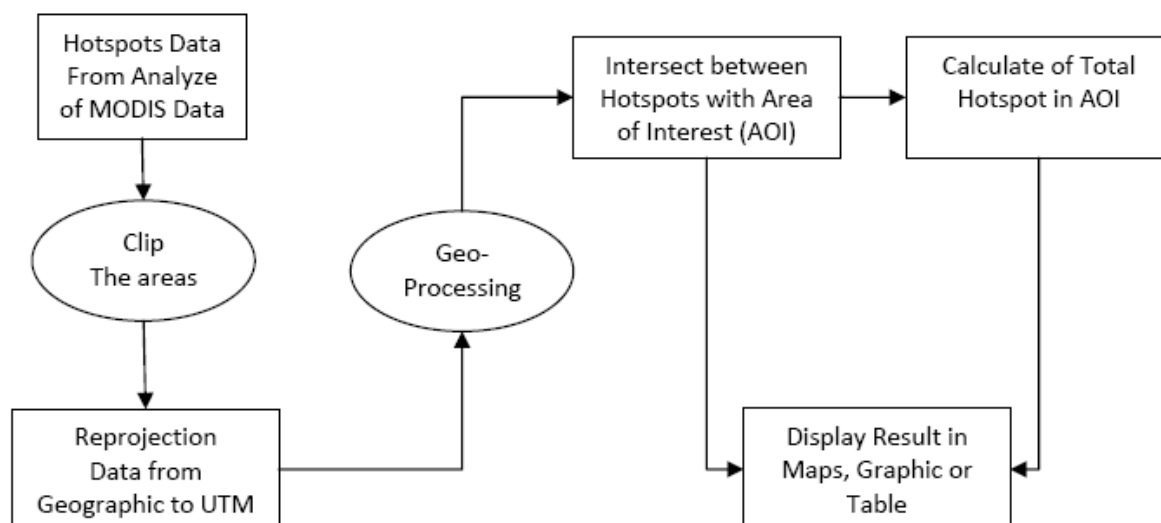


Figure 16. Fire Hotspots Data Acquisition and Assessment Process Flow

The hotspot analysis of Rimba Raya area is distributed weekly to BKSDA, TPNP management, the District of Seruyan (planned) and other relevant stakeholders. The distribution of fire hotspots in Rimba Raya in Table 13 and Figure 17 - Figure 19 below, shows the distribution of these hot spots can be clustered or individual. Clustered hotspots indicate more fire ignitions and larger burn areas which can be detected and measured on the ground.

Table 13. Number of Hotspots in Rimba Raya 2001-2010

Rimba Raya Monitoring Area	Number of Hotspots by calendar year (2001-2010)									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PMZ	8	116	35	115	15	319	3	0	63	0
CAA	1	65	21	79	4	248	0	0	40	0

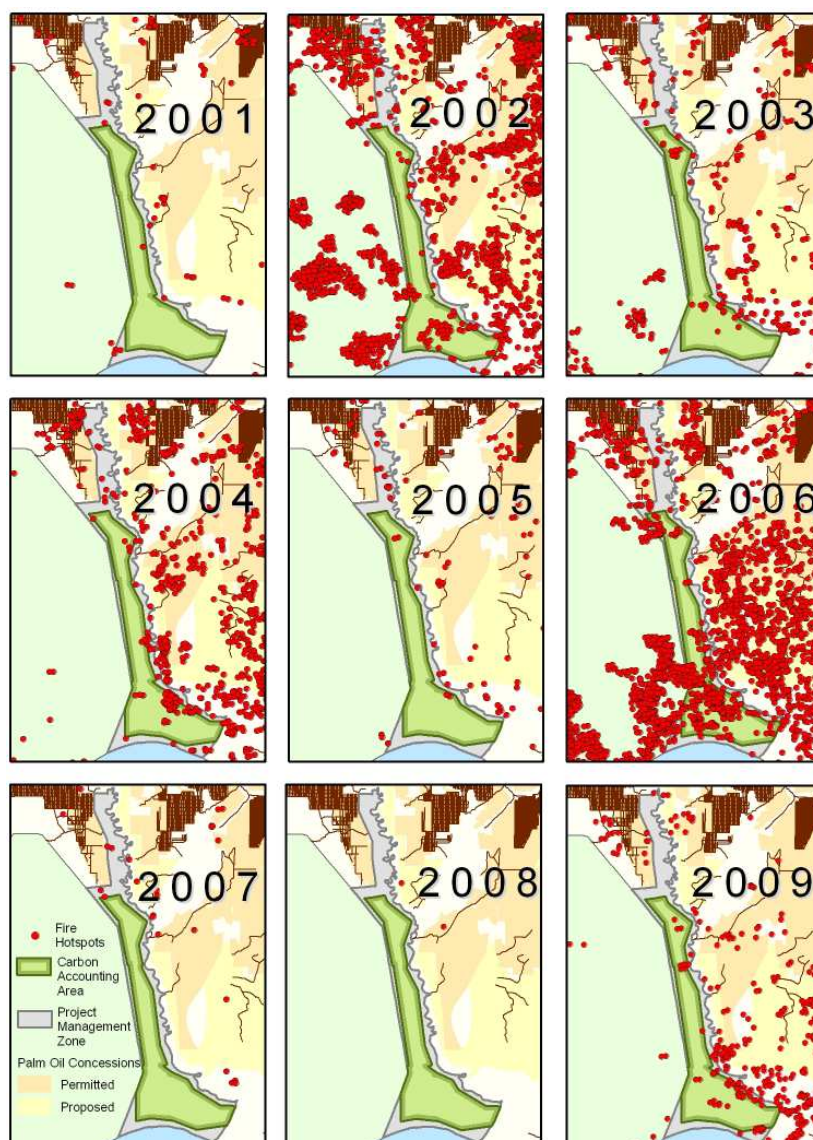


Figure 17. Spatial Distribution of Fire Hotspots in Rimba Raya Region 2001-2009

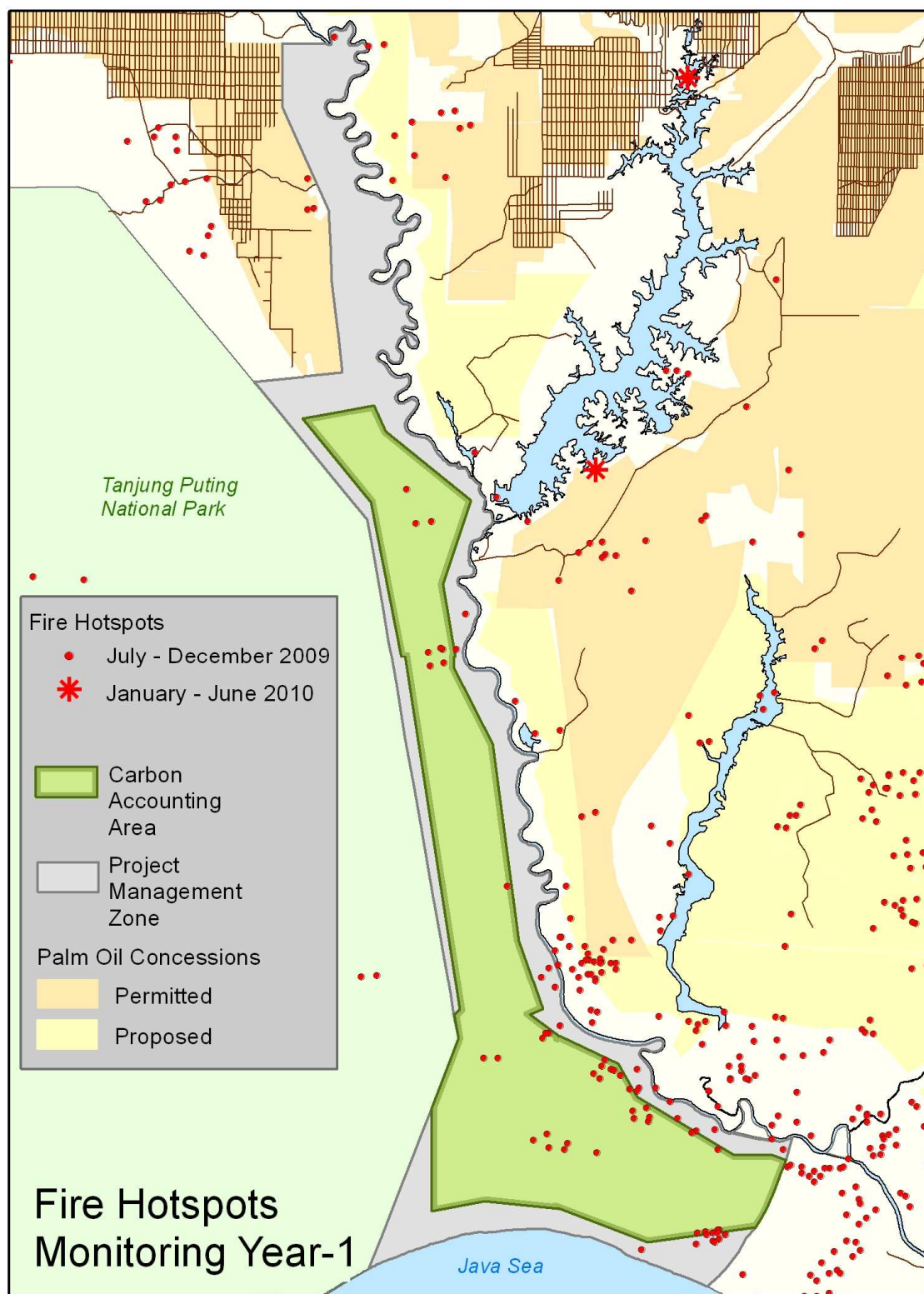


Figure 18. Map of Fire Hotspots in Rimba Raya Region Monitoring Year-1

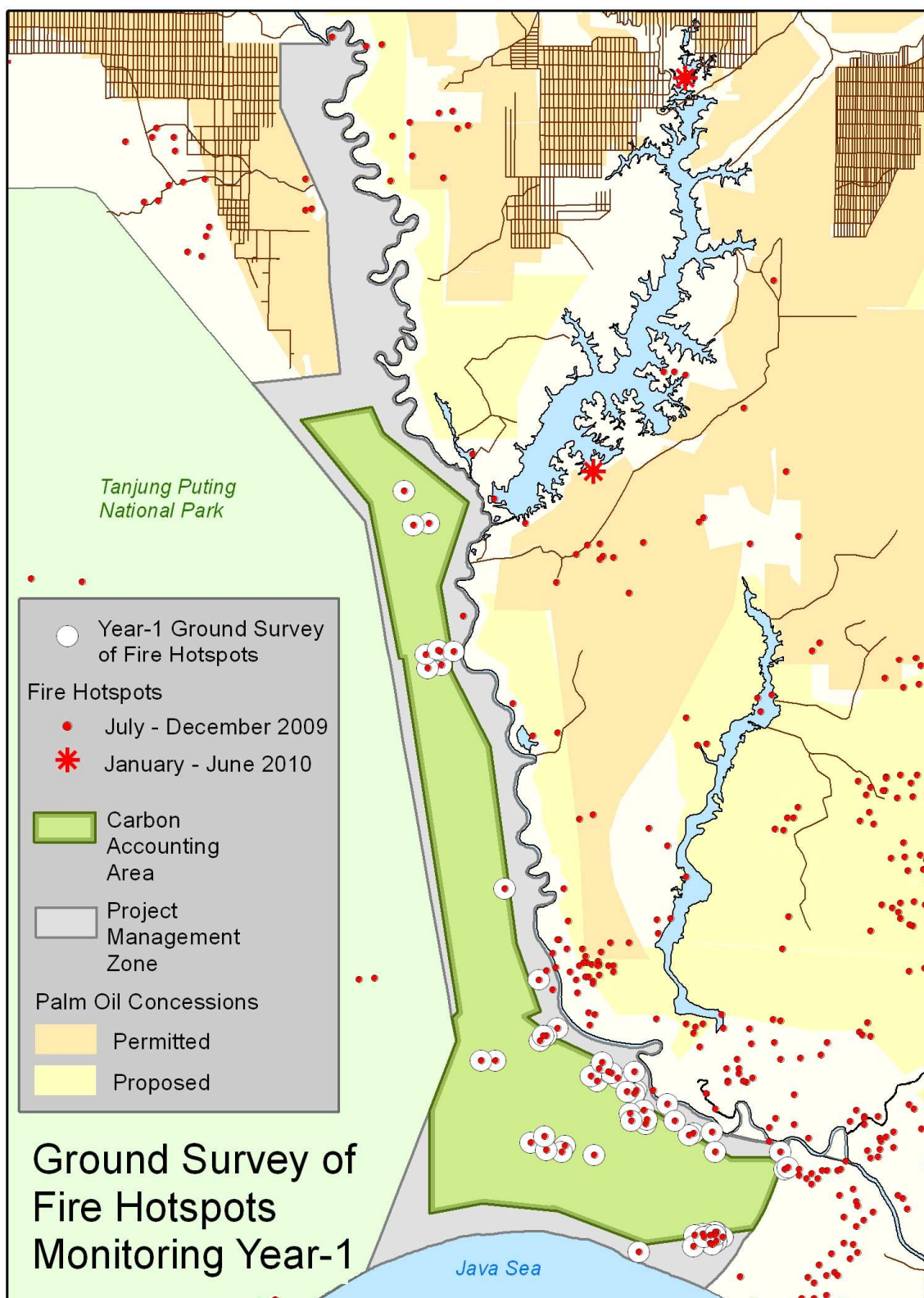


Figure 19. Map of Ground Survey Locations of Fire Hotspots in Rimba Raya PMZ Monitoring Year-1

Based on the overview of fire hotspots in Rimba Raya, management aimed at fire prevention rather than fire control could reasonably have a more significant impact on carbon stock protection in the project area.

3.3.11.3 Ground Surveys

The hotspot analysis is the primary information available to Rimba Raya stakeholders for directing management activities. Based on hotspot mapping, patrols are conducted to assess fire activity and fire damage in the field. Joint patrols may consist of OFI and BKSD staff and community members. These joint patrols have been ongoing since 2000 in northeastern Tanjung Puting and Rimba Raya and cover a diversity of stakeholders (See detailed joint patrol scheme in Section 3.3.9.2).

3.3.11.4 MODIS Burn Areas

In addition to fire hotspot mapping, more serious fires can be detected on MODIS satellite imagery that registers fire burn scars. MODIS offers unique spatial and radiometric capabilities for burn areas detection. And there is a direct link between the availability of information about burned areas and the decision making process for effective fire management. The primary objective of Burn Areas analysis is to provide information about burn areas in Rimba Raya Area using MODIS satellite images to assess land cover change caused by fire damage and also to produce maps of fire risk. The overall processing flow of the MODIS burn data assessment is illustrated in Figure 20 (also see Annex 9 for the MODIS burn area assessment report).

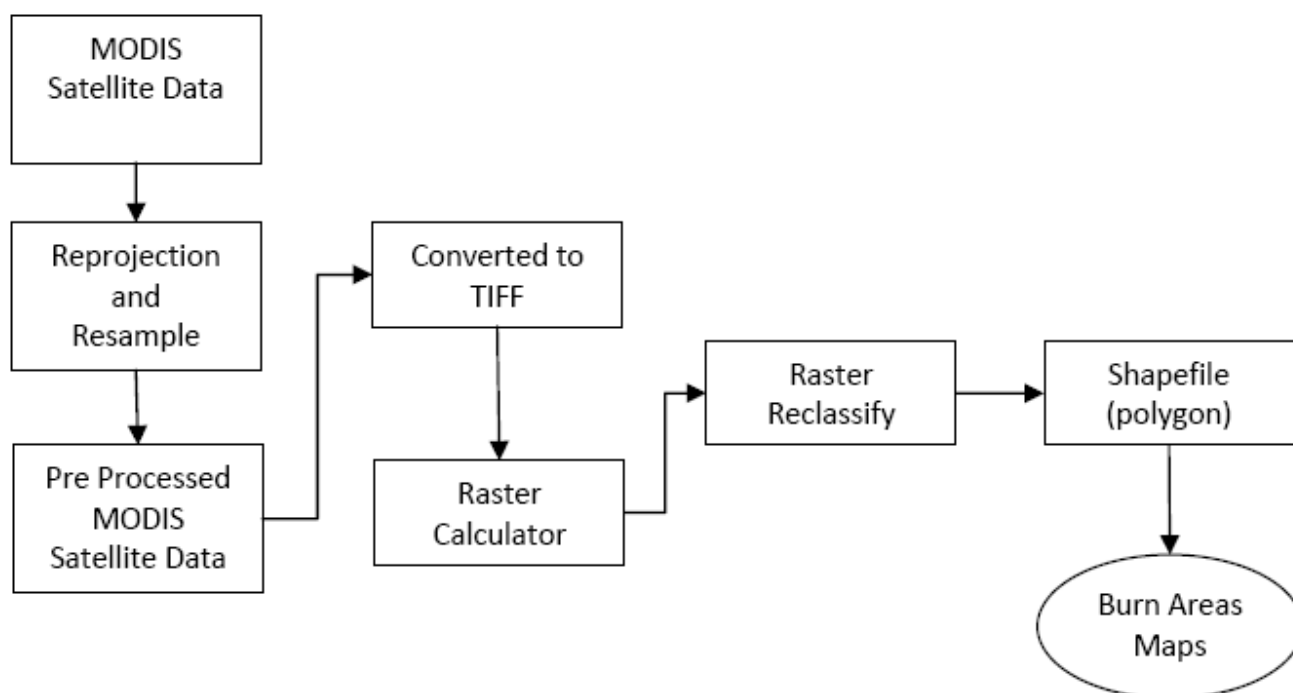


Figure 20. Process Flow for MODIS Acquisition and Assessment for Burn Area Mapping

Burn area detection and mapping provides basic information for fire management. MODIS analysis for January 2009 to April 2010 shows no detectable burns during this time period (Figure 21).

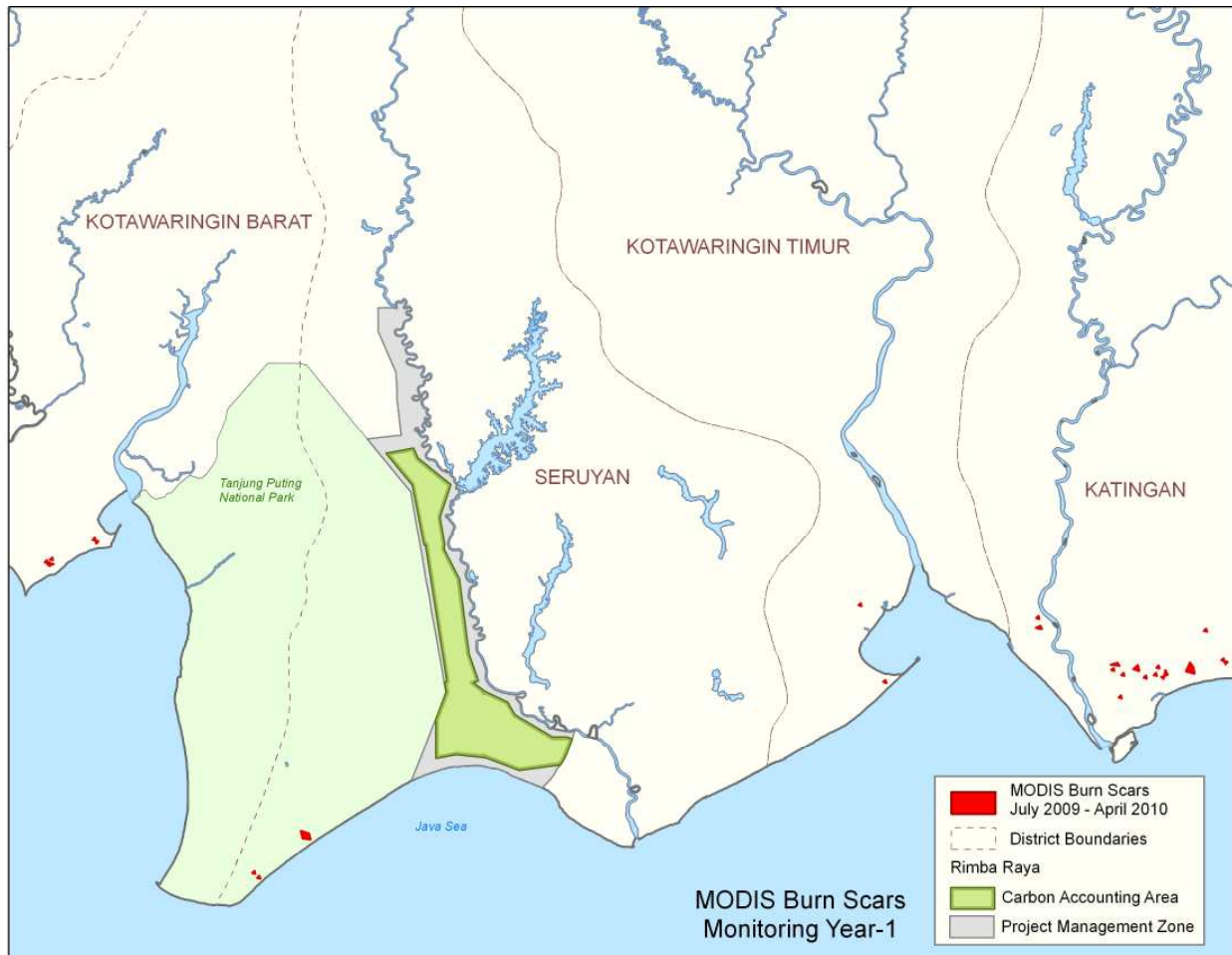


Figure 21. MODIS burn scar mapping of Central Kalimantan (no burn scars in Rimba Raya)

CONCLUSIONS: 55 fire hotspots and 0 burn scars were detected from satellite imagery during Year-1.

3.3.11.5 Fire Management Year 2

The Rimba Raya project has been subjected to fires over its recent history mostly resulted from human induced fires for agricultural land clearing. Thus, avoiding these fires from occurring is the main objective for fire management. This is being achieved through social approach as well as technical approach. Inhibiting the drainage of peat, putting in place a fire management system including fire watchtowers to rapidly detect, isolate and extinguish any fires that do occur are among of technical measures. Involvement of surrounding communities and other stakeholders is acknowledged by PT. RRC as the key feature on the improvement of fire management program (see Annex 10).

According to the Environmental Impact Management Plan and Environment Impact Monitoring Plan (UKL-UPL) of PT Rimba Raya era 2010, several activities are being conducted for the following years of PT. RRC operation related to the fire management, which are:

- Structure the fire management organization and fulfill the manpower
- Prepare fire prevention and suppression plan with such implementation phase
- Performed formal agreement between PT. RR and BKSDA on fire management development
- Develop SOP on Fire Management
- Conduct training and capacity building events on fire management

- Develop and assist community fire guards (*Kelompok Masyarakat-KMPA*)
- Complete equipment and fire management infrastructure
- Begin fire awareness and educational program.

3.3.12 Selective Logging

3.3.12.1 Logging Monitoring Background and Purpose

Applicability Condition H of the Methodology

“Activities that involve the utilization of natural resources within the project boundary that do not lead to deforestation are permitted (e.g. selective logging, collection of NTFPs, fuel-wood collection, etc.) as this degradation is accounted for in the monitoring methodology.

Condition I: the biomass of vegetation within the project boundary at the start of the project is at steady-state, or is increasing due to recovery from past disturbance, and so monitoring of project GHG removals by vegetation can be conservatively neglected if desired.”

Selective logging is permitted in Rimba Raya and is occasionally practiced by local villagers, working alone or in small groups to take small amounts of timber for subsistence use or for local sale. Rimba Raya is situated in former logging concessions of peat swamp forest and the area has been selectively logged for two decades by commercial timber organizations. Therefore the most valuable timber has been removed. Furthermore, old logging access routes are already established for timber removal to the Seruyan River and these existing routes are sufficient to support small-scale selective logging characteristic of the area.

Hand-logging is conducted on a small scale, where individuals and small groups (typically 1-4 people) extract logs on a selective basis to supply subsistence and local cash needs. This activity is infrequent and sparsely distributed across Rimba Raya’s 63,828 ha area including the 47,237 ha Carbon Accounting Area, and amounts to low levels of degradation annually.

Rimba Raya forests have been recovering from large-scale commercial logging since the 1990’s and most old forest gaps are filled in with secondary regeneration of varying tree heights. As suggested by the Methodology and as measured in similar sites, it is expected that above-ground biomass accumulation substantially exceeds biomass loss associated with selective logging in the project area. Given that Rimba Raya’s 10-20 year old regenerating peat swamp forests are expected to more than compensate for continued low levels of aboveground biomass timber emissions associated with small-scale selective logging, the primary focus of logging emissions monitoring is aimed at protecting against, monitoring and surveying all new construction of logging canals that drain peat and lead to long-term emissions.

There are three components to GHG emissions that occur due to logging in descending order of importance: (1) emissions from peat drainage associated with new logging canal construction (2) changes in biomass caused by the extraction of timber and (3) damage to residual trees from the logging activities.

The monitoring methodology was designed to enable project participants to estimate an average emission factor per logging gap prior to the start of the project if desired; thus the only monitoring that is necessary over the crediting period is to detect the number of logging gaps and area of new peat drainage present within the project boundary in a given year t.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1 Total Gross Baseline Emissions

Section 2 of the methodology

Baseline net GHG emissions are not monitored in this methodology. The methodology prescribes validity of the baseline identified ex ante at the start of the project activity for the crediting period, thereby

avoiding the need for monitoring the baseline over the crediting period, and achieves savings in the costs associated with baseline monitoring.

The gross GHG emissions avoided by preventing the establishment of palm oil plantations in the project area are presented in Non-Permanence Risk Assessment & Deduction

A Non-Permanence Risk Assessment has been conducted.

A **10% Risk Buffer** resulted and appropriate deductions have been taken in the final calculation of the VCUs. See Section 3.4.1.5 below.

Table 14. This summary table is broken down by component and shows that peat drainage is overwhelmingly the most significant source of GHG emissions associated with palm oil development. Under the VCS, the baseline must be reassessed after ten years. Therefore, the baseline emissions in the first ten years should be the focus of attention; estimates beyond the 10-year window are subject to change as new policy measures are instituted and new data become available.

Total Gross Baseline emissions after leakage deductions are **2,462,212 t CO₂e** in year one, **40,660,403 t CO₂e** over the first ten years and **131,107,818 t CO₂e** for the 30 year life of the project.

4.1.2 Non-Permanence Risk Assessment & Deduction

A Non-Permanence Risk Assessment has been conducted.

A **10% Risk Buffer** resulted and appropriate deductions have been taken in the final calculation of the VCU. See Section 3.4.1.5 below.

Table 14: Total Gross GHG emissions avoided due to project activities.

Yr of Project	Em. from timber (t CO ₂ e)	Em. from biomass burning (t CO ₂ e)	Growth of oil palm (t CO ₂ e)	Em. from peat burning (t CO ₂ e)	Em. from peat drainage (t CO ₂ e)	Total Gross CO ₂ e Baseline emissions (t CO ₂ e)	Market Leakage Deductions (t CO ₂ e)	Total Gross Emissions after Market Leakage Deduction (t CO ₂ e)	Total Gross Cumulative CO ₂ e emissions (t CO ₂ e)
1	558,684	557,304	0.00	764,128	582,096	2,462,212	0	2,462,212	2,462,212
2	942,209	932,655	0.00	1,269,325	1,708,385	4,852,575	(1,198,394)	3,654,181	6,116,393
3	691,873	932,655	(65,314)	1,269,325	2,785,138	5,613,677	(2,021,067)	3,592,611	9,709,003
4	62,147	749,749	(161,729)	1,018,935	3,939,956	5,609,057	(1,484,087)	4,124,970	13,833,973
5	0	517,836	(301,696)	700,845	4,578,892	5,495,876	(133,306)	5,362,569	19,196,543
6	0	222,239	(467,616)	368,692	4,915,015	5,038,330	0	5,038,330	24,234,873
7	0	0	(635,119)	0	4,915,015	4,279,896	0	4,279,896	28,514,769
8	0	0	(776,046)	0	4,915,015	4,138,969	0	4,138,969	32,653,738
9	0	0	(888,679)	0	4,915,015	4,026,336	0	4,026,336	36,680,074
10	0	0	(934,685)	0	4,915,015	3,980,330	0	3,980,330	40,660,403
11	0	0	(928,570)	0	4,915,015	3,986,445	0	3,986,445	44,646,849
12	0	0	(886,764)	0	4,915,015	4,028,251	0	4,028,251	48,675,099
13	0	0	(823,155)	0	4,915,015	4,091,860	0	4,091,860	52,766,959

14	0	0	(748,225)	0	4,915,015	4,166,790	0	4,166,790	56,933,749
15	0	0	(669,362)	0	4,915,015	4,245,653	0	4,245,653	61,179,402
16	0	0	(591,475)	0	4,915,015	4,323,540	0	4,323,540	65,502,941
17	0	0	(517,618)	0	4,915,015	4,397,397	0	4,397,397	69,900,338
18	0	0	(449,513)	0	4,915,015	4,465,502	0	4,465,502	74,365,840
19	0	0	(387,968)	0	4,915,015	4,527,047	0	4,527,047	78,892,887
20	0	0	(333,183)	0	4,915,015	4,581,832	0	4,581,832	83,474,719
21	0	0	(284,974)	0	4,915,015	4,630,041	0	4,630,041	88,104,760
22	0	0	(242,933)	0	4,915,015	4,672,082	0	4,672,082	92,776,842
23	0	0	(206,529)	0	4,915,015	4,708,486	0	4,708,486	97,485,328
24	0	0	(175,186)	0	4,915,015	4,739,829	0	4,739,829	102,225,157
25	0	0	(148,324)	0	4,915,015	4,766,691	0	4,766,691	106,991,848
26	0	0	(125,387)	0	4,915,015	4,789,628	0	4,789,628	111,781,476
27	0	0	(105,861)	0	4,915,015	4,809,154	0	4,809,154	116,590,630
28	0	0	(89,281)	0	4,915,015	4,825,734	0	4,825,734	121,416,364
29	0	0	(75,231)	0	4,915,015	4,839,784	0	4,839,784	126,256,148
30	0	0	(63,345)	0	4,915,015	4,851,670	0	4,851,670	131,107,818
Totals	2,254,913	3,912,438	(12,083,770)	5,391,249	136,469,842	135,944,672	(4,836,855)		

4.2 Project Emissions

4.2.1 Estimation of GHG emissions due to logging

Section 19.2.1 of the Methodology

“The logging emission factor is estimated to link a readily monitored component (number of logging gaps detected in the monitoring year) with the total aboveground carbon impact. An initial set of ground measurements in logging gaps shall be completed at the beginning of the project or over the life of the project. The size of each gap k , the dimensions of the felled tree and commercial log and trees that are severely damaged or killed as a result of the tree fall are measured. The area of new canal construction is also monitored to estimate emissions from peat drainage over the monitoring interval.”

The GHG emissions attributable to logging within the project boundary over the monitoring period are estimated as:

$$E_{p,it}^{\text{logging}} = (N_{p,it}^{\text{gaps}} \cdot EF_{\text{logging},i}) + E_{\text{drainage},it}^{\text{logging}}$$

where:

$E_{p,it}^{\text{logging}}$ = GHG emissions due to logging in the project area; t CO₂-e

$N_{p,it}^{\text{gaps}}$ = number of logging gaps detected in stratum i , time t in the project area;
dimensionless

$EF_{\text{logging},i}$ = average logging emission factor for stratum i ; t CO₂-e (logging gap)⁻¹

$E_{\text{drainage},it}^{\text{logging}}$ = CO₂ emissions from peat drainage in stratum i at time t ; t CO₂-e

Methods for estimating the carbon impacts of logging activities have been documented previously in Pearson et al. (2006) and Brown et al. (2006) and were applied in the Mawas site near the Rimba Raya project area (unpublished data Winrock, 2008). At Mawas, 43 logging gaps were surveyed to obtain estimates for carbon loss associated with timber extracted, tree biomass logged but not extracted and tree biomass damaged due to logging at the site (Table 15). Average total carbon loss was estimated to be 1.16 t/C ha at each logging gap for logged trees with an average size of 39.25 cm DBH.

Table 15. Mawas Logging Gap Data – Biomass Carbon Loss

Mawas Logging Gap Data	Mean
DBH (cm) (average 43 logging gaps)	39.25
Extracted biomass carbon (t C) per gap	.28
Non-Extracted biomass carbon (t C) per gap	.54
Damage biomass carbon	0.43
Total EF logging biomass carbon	1.16

The monitoring methodology was designed to enable project participants to estimate an average emission factor (EF) per logging gap prior to the start of the project if desired; thus the only monitoring that is necessary over the crediting period is to detect the number of logging gaps and area of new peat drainage present within the project boundary in a given year t .

Survey and calculation methods comprised five steps:

STEP 1. Detect all logging gaps $N_{P,it}^{gaps}$

The aerial photo based method of logging gap detection was tested using July 2009 aerial photos, flown for the carbon survey assessment. Aerial photos were reviewed to evaluate logging gaps and detection methods. This review showed no new logging gaps among selected photos but also showed that gap detection is difficult given the canopy and ground characteristics of the project. In peat swamps, bare soil does not provide a visual cue for logging detection as seen in other tropical forest sites. In the project area, water and vegetation cover are predominant in the understory, so missing trees in the overstory are not easily spotted. Furthermore, high variation in canopy architecture, dominated in many places by abundant small tree crowns and regenerating rails and gaps from past logging activities are expected to significantly limit consistent year to year gap mapping required for gap detection using aerial methods.

Given the context of the project area and the limitations of aerial based methods for logging gap detection, it was determined that a field-based approach to logging gap detection would be used in Year 1 in order to develop key parameters for calculating logging emissions according to the methodology. Other remote methods are being tested in Year 2, including LIDAR, as discussed in Section 3.3.8.5.

Based on the preliminary threats analysis and information collected during protection patrols discussed in Section 3.3.9.4, potential logging areas were identified. Of these areas, logging sites confirmed by satellite imagery and/or community surveys were the targets of directed field monitoring. Three potential logging areas were identified and field survey teams were organized to search these areas, find any logging sites and conduct detailed surveys if year 1 logging activity was discovered.

CONCLUSIONS: Surveys recorded 40 treefall gaps each associated with a logged timber species.

STEP 2. Conduct surveys of timber extracted at logging sites

Surveys of each logging site were conducted to record timber extraction including tree species and diameter (identified and measured at remaining stump). Forty trees were recorded, including common peat swamp forest hardwoods *Combretocarpus rotundatus* (perapat), *Ganua motleyana* (ketiau) and *Shorea smithiana* (lanan). Logged tree diameters averaged 51.0 cm.

For each tree recorded, its path to the main waterway was mapped, thus confirming the access route type (logging rail or logging transport canal) and verifying that no logging transport canals were constructed during Year-1 monitoring.

Survey description, data tables and site maps of logging gaps are presented below. Surveys were recorded at three locations where logging activities were found.

Site 1. Baung River access by Stream Tasrun :

A distance of 5.7 km of the primary stream from the Seruyan was surveyed. This section was the site of former selective logging. The survey team recorded 40 logged trees with varying diameter starting from 41 cm (Ketiau) up to 103 cm (Merang). Logged timber species (local names) include: Perapat, Bentuka, Lanan, Merang, Ketiau, Banitan, Kumpang, and Jelutung. These logged trees are scattered in the northern area of the site.

Table 16. Pre-project logging activity surveyed

No	Species Name	Local Name	Amount	Average diameter
1	<i>Combretocarpus rotundatus</i>	Perapat	15	78 cm
2	<i>Ganua motleyana</i>	Ketiau	8	43 cm
3	<i>Shorea smithiana</i>	Lanan	6	57 cm
4	<i>Lophopetalum javanicum</i>	Bentuka	5	48 cm
5	<i>Polyalthia rumphii</i>	Banitan	3	38 cm
6	<i>Tetramerista glabra</i>	Merang	1	103 cm
7	<i>Horsfieldia sp</i>	Kumpang	1	36 cm
8	<i>Dyera costulata</i>	Jelutung	1	83 cm

At the end of this stream was found connection to new stream 120m toward the south with a smaller size than primary stream and in which there is also a logging deck (locally pelabuhan or port) used for temporarily holding timber before transporting it on the river. The logging deck covered an area 6 x 10 meters which was connected by logging rail for 150 m continuing toward the south to "high ground" area on mineral soils. There, the new logging activity was found, including the extraction of 2 individuals of ulin (ironwood), a prized but scarce hardwood.

Table 17. New Logging Activity Surveyed

No	Species Name	Local Name	Amount	Diameter
1	<i>Eusideroxylon zwageri</i>	Ulin	2	64 / 85 cm
2	<i>Palaquium walsuranfolium</i>	Nyatuh	1	105 cm
3	<i>Camptosperma sp</i>	Terantang	1	38 cm
4	<i>Shorea smithiana</i>	Lanan	1	41 cm

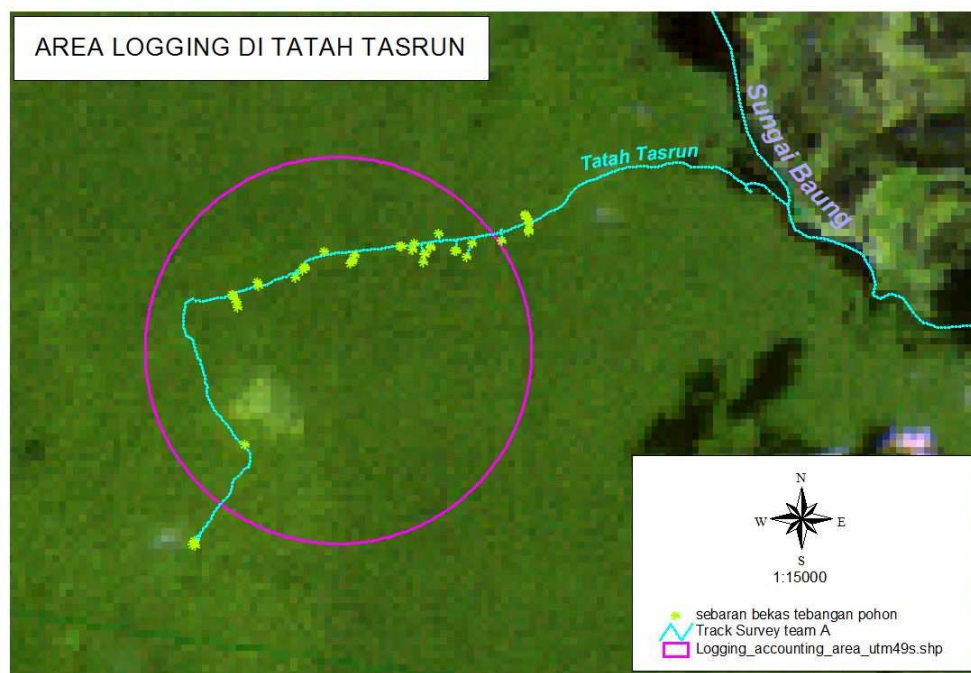


Figure 22. GIS plots of Tasrun Stream logging gaps

Site 2. Seruyan River access by Exapator Stream:

The distance from the Seruyan to reach the logging area is 2 km, which continues with the path at the swamp for 200 meters. Unlike the logging activities at Tasrun stream, at this location all the concentration of logging activities are in the same region with a total area of ± 3 ha.

At this location was recorded 24 gaps with logged trees with diameters of 40-71 cm from 12 species of trees.

Table 18. Logging Activities at “Exapator stream”.

No	Species Name	Local Name	Amount	Diameter
1	<i>Cratoxylum glaucum</i>	Idat	5	40 - 61 cm
2	<i>Polyalthia rumphii</i>	Banitan	4	39 -52 cm
3	<i>Camptosperma sp</i>	Terantang	3	40 - 41 cm
4	<i>Dyera costulata</i>	Jelutung	2	42 / 43 cm
5	<i>Shorea smithiana</i>	Lanan	2	70 / 71 cm
6	<i>Kompassia sp</i>	Bengaris	2	59 / 62 cm
7	<i>Eugenia Sp</i>	Ubar	1	52 cm
8	<i>Ganua motleyana</i>	Ketiau	1	40 cm
9	<i>Michelia montana</i>	Asam-asam	1	42 cm
10	<i>Evodia Sp</i>	Bekacang	1	45 cm
11	<i>Diospyros frutescens</i>	Bekunyit	1	42 cm
12	<i>Diospyros maingayi</i>	Lamanaduk	1	38 cm

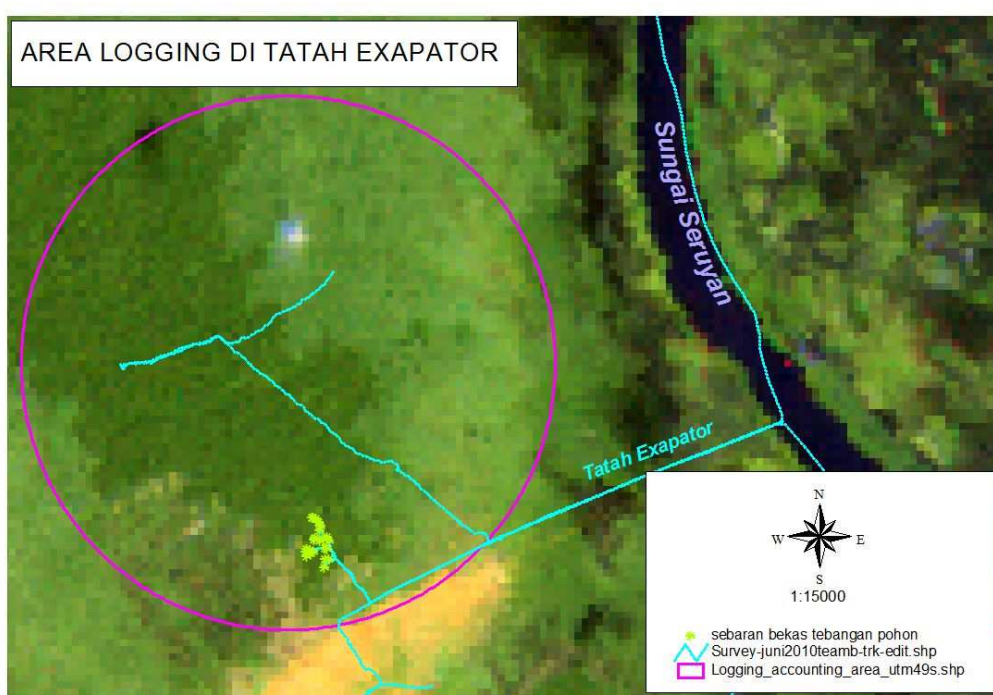


Figure 23. GIS plots of Exapator Stream logging gaps

Site 3. Seruyan River access by Sendurian Stream:

The length of the stream until the logging area is 2.6 km, similar to logging activity at Sendurian stream, at this location all the concentration of logging activities are in the same region with an area of ± 2 Ha. In this location, there is only one location identified as logging activity for 800 yards before the location of more concentrated logging activities. At the main logging site the survey team recorded 11 points of logged trees with diameter of 40-71 cm from one type of acacia tree.

Table 19. Logging activities at "Sendurian stream".

No	Species Name	Local Name	Amount	Diameter
1	<i>Calophyllum Sp</i>	Penaga	7	41 - 62 cm
2	<i>Shorea smithiana</i>	Lanan	2	39 - 52 cm
3	<i>Diospyros frutescens</i>	Bekunyt	2	40 - 41 cm

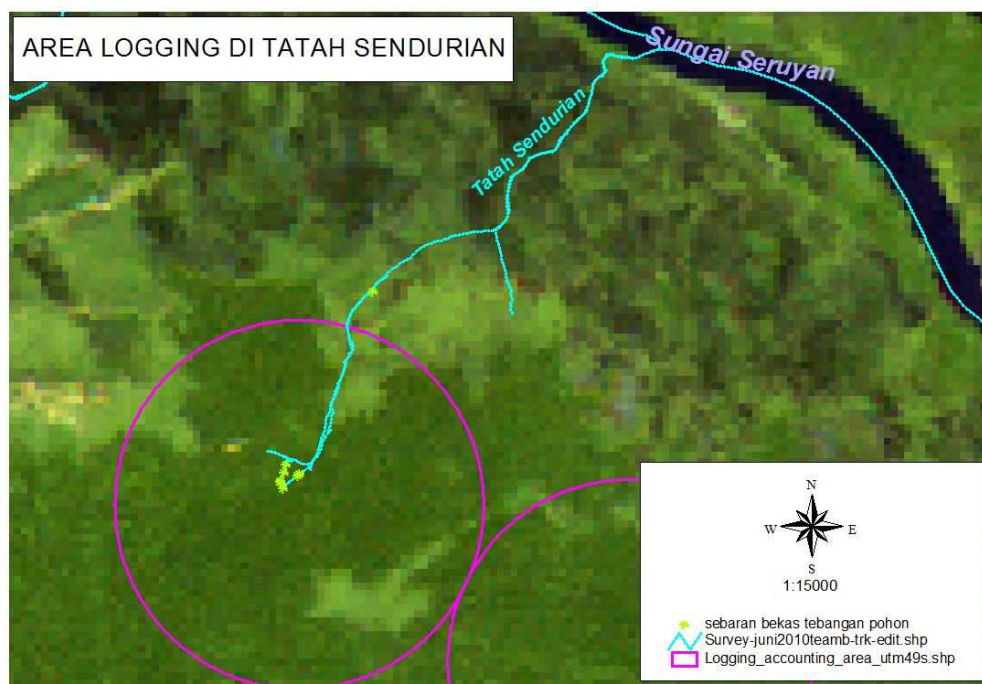


Figure 24. GIS plots of Sendurian Stream logging gaps

STEP 3. Estimate an average logging emissions factor for each stratum $EF_{logging,i}$

Initial ground measurements were recorded in logging gaps during Year-1 monitoring. These data were used as a site-based comparison to select the most applicable logging emissions factor from published studies in the region. A project-specific logging emissions factor will be developed by Year-3 of monitoring as allowed by the Methodology which specifies that survey data may be collected over the project life. Year-1 pilot field data on logging site characteristics will also be used to design these surveys.

Applying the Mawas assessment of EF to Rimba Raya and adjusting for the slightly larger tree sizes surveyed at Rimba Raya during monitoring (mean 51.0 cm DBH), an estimated 1.50 t/C ha are lost per logging gap at Rimba Raya, as can be seen in Table 20 below.

Table 20. Logging Gap Data

Rimba Raya Logging Gap Data	Mean
DBH (cm) (average 40 logging gaps)	51.0
Total estimated EF logging biomass carbon	1.50

STEP 4. Calculate CO₂ emissions from peat $E_{drainage, it}^{logging}$ drainage

All access routes to all timber extraction sites were recorded in the field and no new logging transport canals were found. Transport canals were also the target of active searches during all other monitoring field work.

CONCLUSIONS: Across hundreds of kilometers walked by field teams over Monitoring Year-1 no new transport canal or any other peat drainage activity was discovered. Therefore it is concluded the emissions due to logging drainage = 0 for Year-1.

STEP 5. Calculate GHG emissions attributable to logging

CONCLUSIONS: EF logging = 1.50 t/C ha was applied across 40 gaps at Rimba Raya to obtain an estimated 60 t/C and 220 CO₂ emissions lost to logging during Year-1.

Options for automated gap detection will be further explored in Year 2 in order to develop a systematic, automated and feasible method of assessing logging gaps, forest degradation and possible peat disturbance.

LIDAR image data may offer a good alternative to optical-based sensors for automated methods of gap detection in the tropics using remotely sensed data. These data can be used for surface feature extraction (trees and gaps), hydrologic modeling and accurate mapping of vegetation structure and biomass. LIDAR is currently being tested at several sites in Kalimantan and its potential explored further for Rimba Raya.

4.2.2 GHG Emissions due to fire

$E_{p, it}^{fire}$ refers to emissions from all fires that occur inside the project boundary over the monitoring period. Limited and isolated fires did occur during the monitoring period. Burned areas were determined through the spatial analysis and ground truthing survey of the 2009 – 2010 landcover changes derived from cloud free Landsat TM (5) imagery and are described in Section 3.3.10, in conjunction with fire hotspot and burn area data.

In accordance with the methodology, emissions from fire damage is partitioned into CO₂, CH₄ and N₂O emissions resulting from the burning of aboveground and belowground (peat) biomass. Above and belowground emissions from fire are considered individually in the tables below.

4.2.2.1 Aboveground Biomass Burning

Aboveground emissions are those arising from the combustion of live, aboveground, biomass during wildfires. Using data from the 2009 – 2010 landcover change spatial analysis, the total area of each burned strata layer within the CAA was calculated using ArcGIS. Area, biomass, carbon stock and the corresponding emissions were then calculated independently for each of the seven strata and reported in Table 15. Aboveground biomass burning calculations use IPCC default parameter values for N/C ratio, Global Warming Potentials and combustion efficiency, in the calculation of CO₂, CH₄, and N₂O emissions, summarized in Table 16.

Table 21. Estimation of aboveground biomass emissions from burning

MONITORING YEAR 1									
	Biomass in land cover type	Carbon in land cover type	Timber extraction	Carbon remaining	CO ₂ emission	CH ₄ emission	N ₂ O emission	Total CO ₂ e	Total Emissions
Strata	(t d.m. ha ⁻¹)	(t C ha ⁻¹)	(t C ha ⁻¹)	(t C ha ⁻¹)	(t CO ₂ ha ⁻¹)	(t CO ₂ ha ⁻¹)	(t CO ₂ ha ⁻¹)	(t CO ₂ e ha ⁻¹)	(t CO ₂ e ha ⁻¹)
Peat Swamp Forest (lightly degraded)	206	103.00	0.00	103.00	188.83	17.30	1.76	208	4,907
Peat Swamp Forest Degraded (highly)	128	64.00	0.00	64.00	117.33	10.75	1.09	129	9,000
Peat Shrubland (<30% Tree Cover)	49	24.50	0.00	24.50	44.92	4.12	0.42	49	3,088
Kerangas Forest	86	43.00	0.00	43.00	78.83	7.22	0.73	87	675
Kerangas Open Scrub	58	29.00	0.00	29.00	53.17	4.87	0.49	59	5,386
Low, sparse vegetation cover	10	5.00	0.00	5.00	9.17	0.84	0.09	10	131
Seasonally Inundated Wetlands	14	7.00	0.00	7.00	12.83	1.18	0.12	14	24
TOTAL emissions from ABG biomass burnt	270								23,211

Table 22. Parameters used in estimation of aboveground biomass emissions from burning

Aboveground Biomass Burning Parameters	
IPCC defaults:	Value
N/C ratio	0.01
Emission ratio for CH ₄	0.012
Emission ratio for N ₂ O	0.007
Global Warming Potential for CH ₄	21
Global Warming Potential for N ₂ O	310
Combustion Efficiency:	0.5
Proportion Burned:	1

CONCLUSIONS: In total, **23,211 tCO₂e** emissions were released as a result of aboveground biomass burning.

4.2.2.2 Belowground Biomass Burning

Landcover changes due to fires within the PMZ and CAA resulted in the loss of belowground peat biomass. Fires occurred across 270 hectares of the project area. 100 ha of the burned area consisted of kerangas forest and kerangas open scrub, which lies on sandy (non-peat) soils (Table 23). Therefore 170 ha of the burned area were assumed to burn peat soils, conservatively calculated to burn to a depth of 34 cm, as prescribed by the methodology.

Table 23. Landcover of Burned Areas – Kerangas Forest and Scrub are on sandy soils (non-peat)

Landcover Stratification of Burned Areas in CAA	
Landcover Class	Area Burned (ha)
Peat Swamp Forest (lightly degraded)	24
Peat Swamp Forest Degraded (highly)	70
Peat Shrubland (<30% Tree Cover)	62
Kerangas Forest	8
Kerangas Open Scrub	92
Low, sparse vegetation cover	13
Seasonally Inundated Wetlands	2
TOTAL Area Burned	270
Total Area Burned in peat	170
Total Area Burned in non-peat	100

In accordance with the methodology calculations of total peat burn emissions were derived using parameters including area burned, burn depth, peat bulk density, mass and emissions factors. IPCC default and methodology values were used for all parameters including peat bulk density (0.14 g cm^{-3}). Parameters values are summarized in Table 24. Total emissions from burning belowground biomass are presented in Table 25.

Table 24. Parameters used in estimation of belowground biomass emissions from burning

Belowground Biomass Burning Parameters		
IPCC defaults:	Value	Units
scaling factor (ha to m^2)	10000	
depth of peat burned	0.34	m
peat bulk density	0.14	g cm^{-3}
CO ₂ emission factor	185,000	$\text{g CO}_2 (\text{t peat})^{-1}$
CH ₄ emission factor	5,785	$\text{g CH}_4 (\text{t peat})^{-1}$
CH ₄ Global Warming Potential	21	
Scaling factor (g to t)	0.000001	

Table 25. Estimation of emissions from burning belowground biomass

Estimation of emissions due to wildfire from burning of the belowground biomass					
Belowground Soil Type	Area Burned (ha)	Mass of peat burned (t)	CO ₂ emissions (t CO ₂ e)	CH ₄ emissions (t CO ₂ e)	Total peat burn emissions (t CO ₂ e)
Peat	170	80,920	14,970	87	15,057

CONCLUSIONS: In total, **15,057 tCO₂e** emissions were released as a result of peat burning.

4.3 Leakage

4.3.1 Displacement Leakage Approach to Monitoring

4.3.1.1 Definition of Leakage

Section 10 of the Methodology

"Leakage (LK) represents the increase in GHG emissions by sources which occur outside the project boundary that are measurable and attributable to the project activity. Leakage is assumed to occur as a result of the displacement of economic activities (i.e., planned land use conversion) to areas outside the project that lead to deforestation and land use change, estimated in units of t CO₂-e. Thus, as a result of the project activity, the baseline activity of planned land use change may be temporarily or permanently displaced from within the project boundary to areas outside the project boundary.

“Activity shifting leakage shall be assessed for five full years beyond the date at which deforestation was projected to occur in the baseline.”

4.3.1.2 Description of Leakage Monitoring

Leakage monitoring is conducted for five years beyond the date at which deforestation was projected to occur in the baseline (July 2009 - July 2014) in accordance with the methodology. Five main points outline leakage monitoring and are described below:

1. PT BEST operates plantations only in Central Kalimantan
2. All existing PT. BEST concessions will be monitored for development and/or expansion
3. Any new PT. BEST concession in Indonesia will be monitored
4. Unpermitted plantation expansion will be monitored within PT BEST's infrastructure
5. The area of activity shifting leakage and carbon impact will be assessed and reported at each verification

4.3.1.3 PT BEST operates plantations only in Central Kalimantan

In Rimba Raya, the agent of proposed deforestation and conversion to oil palm plantation is PT BINTANG ERA SINAR TAMA (BEST) Investment Holding. The BEST Group, established in Surabaya by the Tjajadi Family in 1982, is involved in many aspects of the edible vegetable oil business, primarily processing, transport, holding and trading palm oil but also including cultivation.¹

The only palm oil plantations owned or operated by PT. BEST are located in Central Kalimantan, which are served by Group-owned crude palm oil (CPO) mills in Pangakalan Bun and Sampit. All other PT BEST activity is focused in several major commercial and port cities in Java and Sumatra (e.g. processing plants in Semarang, Surabaya and Medan; tank farms in Belawan and Jakarta) and in regional transport by Group-owned road-tankers and ships.

PT BEST oil palm concessions are limited to four districts in Central Kalimantan and total 139,424 ha on 15 parcels according to government GIS data for HGU and Izin Lokasi permits in Central Kalimantan (Figure 25. PT BEST Group oil palm concessions in Indonesia and Table 26. PT BEST Group oil palm concessions in Indonesia). This data augments information on permit licenses, which were also researched. Where concession name or concession location identified in permit records made a close match to the GIS data, the concession was conservatively, considered to be affiliated with PT BEST.

¹ This description is sourced from <http://www.asiacategory.com/co11011.html> with reference to the PT BEST company website <http://www.best-palmoil.com> and confirmed by the Indonesian Ministry of Forestry to RRC.

Table 26. PT BEST Group oil palm concessions in Indonesia

LABEL	NAME	hectares
1	PT. WANA SAWIT SUBUR LESTARI SK74 north	4,487
2	PT. WANA SAWIT SUBUR LESTARI SK74 south	8,836
3	PT. WANA SAWIT SUBUR LESTARI SK73	7,290
4	PT. WANASAWIT SUBUR LESTARI kucc north	5,708
5	PT. WANASAWIT SUBUR LESTARI kucc south	8,161
6	PT. BANGUN JAYA ALAM PERMAI south	10,824
7	PT. BANGUN JAYA ALAM PERMAI north	11,358
8	PT. BANGUN JAYA ALAM PERMAI east	2,116
9	PT. HAMPARAN MASAWIT BANGUN PERSADA north	4,638
10	PT. HAMPARAN MASAWIT BANGUN PERSADA south	6,642
11	PT. HAMPARAN MASAWIT BANGUN PERSADA east	8,135
12	PT. TUNAS AGRO SUBUR KENCANA north	8,830
13	PT. TUNAS AGRO SUBUR KENCANA south	12,641
14	PT. BERKAH ALAM FAJAR MAS	20,005
15	PT. BAHUR ERA SAWIT TAMA	19,754
	TOTAL	139,424

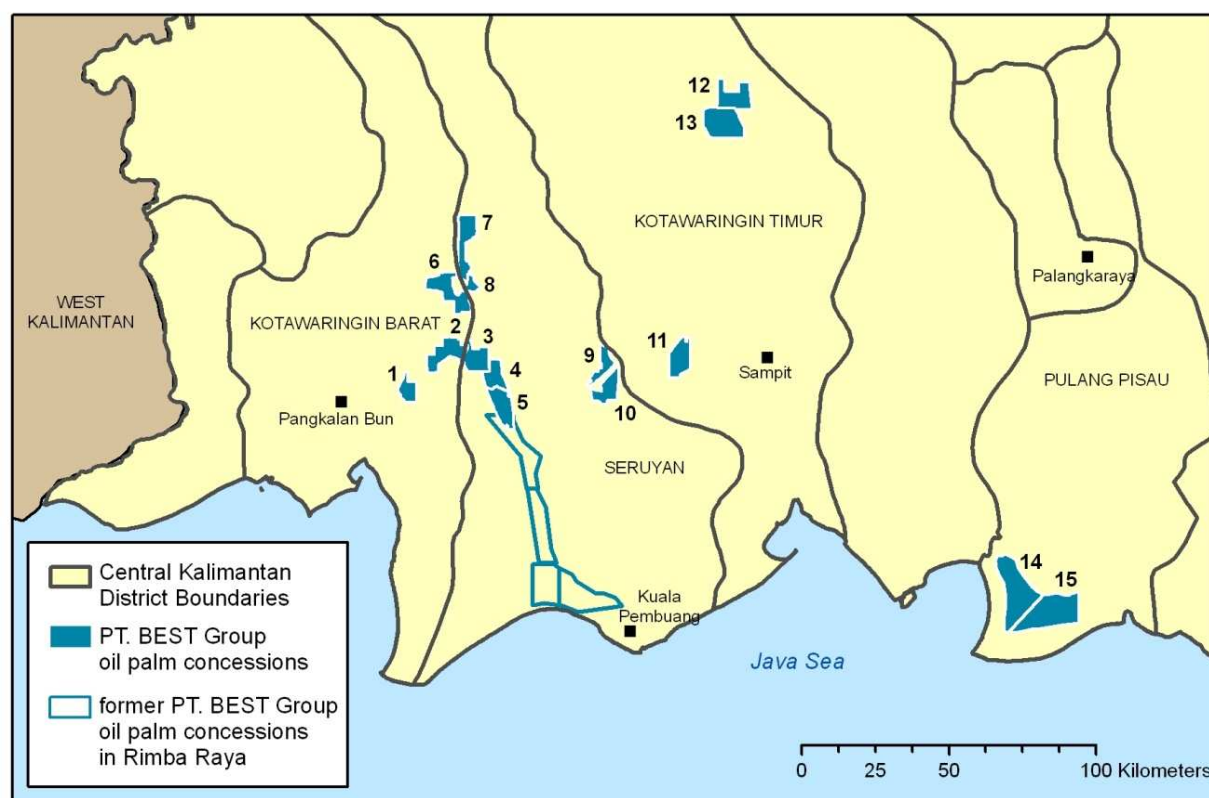


Figure 25. PT BEST Group oil palm concessions in Indonesia

4.3.1.4 Monitoring all existing PT. BEST concessions for development and/or expansion

PT BEST concessions identified in Table 26 and Figure 25. PT BEST Group oil palm concessions in Indonesia were viewed on satellite imagery (Landsat ETM+ February 2009, January 2010) to determine the extent of existing oil palm plantations, which are easily distinguished from other land cover types in Landsat data. This assessment showed that 12 of 15 concessions are already in plantation and are therefore not potential leakage sites (Figure 26).

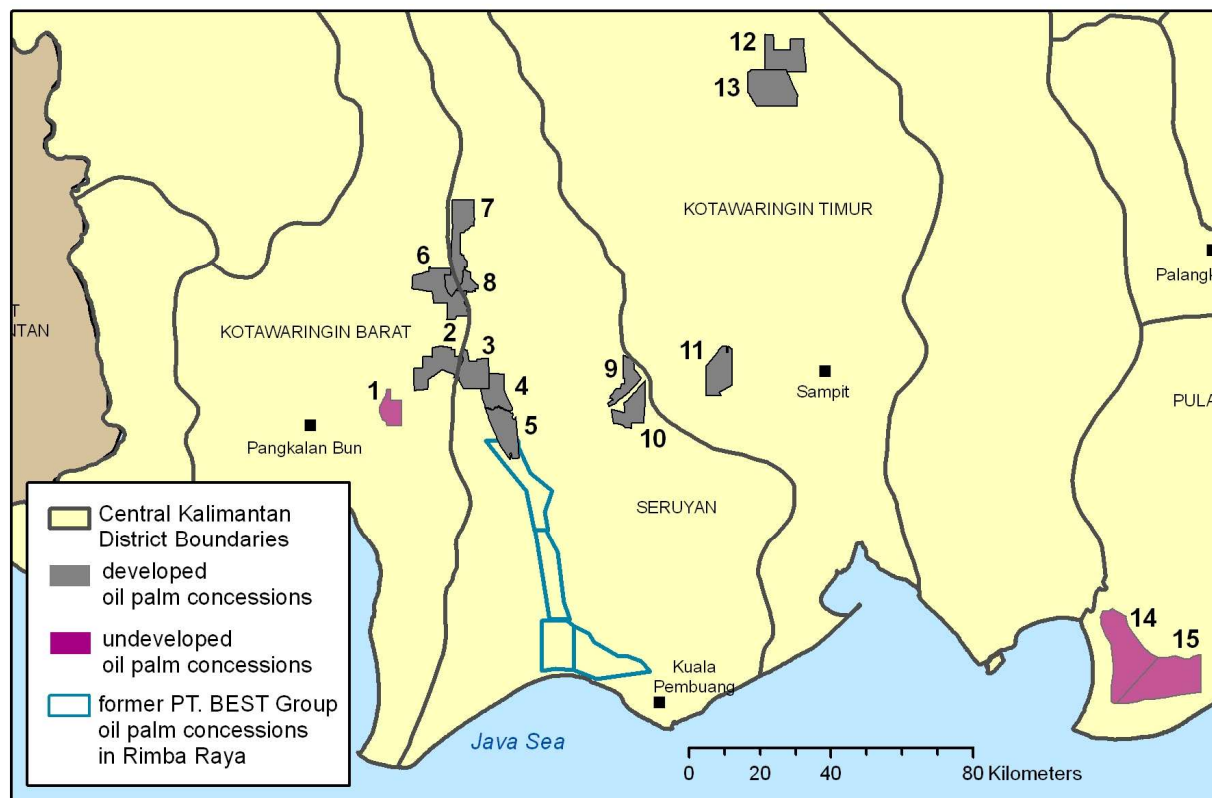


Figure 26. PT BEST Group undeveloped oil palm concessions in Indonesia

The three remaining concessions are being monitored during the 5-year period to stay informed on PT BEST activities, and any changes on these concessions will be detailed in annual monitoring reports. However, project proponents do not consider these permitted concessions to be potential leakage sites based on the following points supported by the methodology:

1. These areas have already been granted, therefore future conversion to plantation on these 3 concessions would not be considered an increase in area of government permits to PT BEST.

Section 10.2 of the Methodology

“At each verification, documentation shall be provided covering the other lands controlled by the baseline agent where leakage could occur, including, at a minimum, their location(s), area and type of existing land use(s), and management plans. It must also be demonstrated that the total area of government permits (for deforestation activities) that have been granted to the baseline agent of deforestation has not increased due to the implementation of project activities.”

2. These concessions are primarily deforested and heavily degraded, therefore conversion to palm oil would have a negligible effect on aboveground carbon.

Section 10.2 of the Methodology

“No increases in GHG emissions caused by displacement of activities associated with the project are expected and $LK = 0$ if it can be demonstrated that all pre-project activities are displaced to degraded, non-forest land on mineral soils outside the project boundary that have negligible aboveground carbon stocks and that have been non-forest for at least ten years.”

3. The land use plans for concession development were in place at the project start for these 3 concessions, so future development would not constitute a change in land use designation.

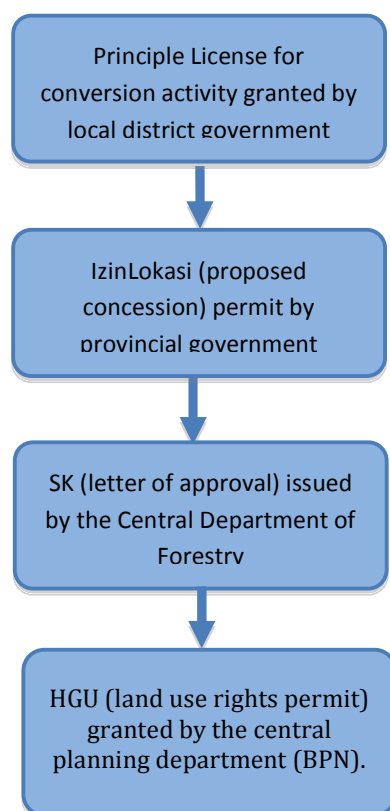
Section 10.2 of the Methodology

"In such cases, the project shall demonstrate that the management plans and/or land-use designations of other lands controlled by the baseline agent of deforestation have not materially changed as a result of the planned project (e.g., designating new lands as plantation concessions, increasing harvest rates in lands already managed for plantation products, clearing intact forests for plantation establishment);"

4.3.1.5 Monitoring PT. BEST concession in Indonesia

Project proponents will also look beyond the known lands controlled by PT BEST at the beginning of the five-year monitoring period and investigate whether any new lands have come under their control. This will be accomplished by monitoring new concession licenses granted to PT BEST by the Indonesian government, through national, provincial and district land permitting offices. The following description provides background on the license process, which has informed permit monitoring.

Concession license process in Central Kalimantan



In Indonesia, district and provincial land use planning are designed to follow national land use planning established by the Ministry of Forestry. National spatial planning maps describe various land use zones such as: production forest, conservation forests, protected forests, and agricultural conversion areas. Agricultural conversion areas are designated as the legal zones where agricultural crops such as rubber and palm oil can be planted as permitted at the provincial and district levels. Conversion of forest areas outside of these zones is normally prohibited.

In Central Kalimantan, and Seruyan District, in particular, palm oil development regularly follows a bottom-up licensing process for forest conversion to agriculture. The district government is the first in the chain of approvals to grant a license that follows a typical pattern (shown left).

Thus, at any given time, there are proposed concessions (those holding an Izin Lokasi) and licensed concessions (those holding a HGU) throughout the province, with the majority of these concentrated on the centers of palm oil production. In Central Kalimantan this permitting process constitutes legal palm oil plantation development and most existing palm oil plantations are developed within or adjacent to these boundaries.

Obtaining a legal license by this process takes 2-3 years, so that legal activity shifting, e.g. obtaining a new HGU prior to plantation development, is not expected to occur in less than two years after the project start and planned concessions are canceled.

4.3.1.6 Monitoring unpermitted (illegal) plantation expansion

There is a substantial amount of spatial data available that can be used to identify potential leakage, including satellite imagery for mapping plantation conversion and GIS data for overlaying mapped concession boundaries and agents. These data provide a direct method of investigating leakage and determining impact area for quantifying carbon stock and emission changes. Satellite image and GIS analysis are especially valuable for monitoring unpermitted plantation expansion beyond their legal boundaries. The series of steps below describes the process of monitoring unpermitted plantation development. These steps operationalize the general methodology requirement to monitor all activity-shifting leakage by the deforestation agent.

4.3.1.7 Unpermitted plantation expansion monitoring steps

Leakage monitoring for unpermitted plantation expansion is accomplished through a multi-step process that relies primarily on linking actual palm oil conversion derived from satellite image analysis with land-use planning maps and permits. Stratification is employed at Step 3 to focus the leakage analysis and then again in Step 6 to refine impact assessment for carbon stock and emissions changes if leakage is detected. Steps 1-3 are conducted up-front prior to monitoring. Steps 4-6 are conducted every year during monitoring and Steps 7-8 are conducted if Steps 4-6 show the occurrence of leakage.

Establish unpermitted plantation expansion monitoring zone at project start:

STEP 1. Identify agent, assess holdings and operations

STEP 2. Establish agent-specific operational distance monitoring zone for unpermitted plantation expansion

STEP 3. Stratify monitoring zone to define leakage risk areas

Conduct annual monitoring for unpermitted plantation expansion:

STEP 4. Monitor and update permitted concessions maps

STEP 5. Monitor and map actual oil palm plantations (potential leakage sites)

STEP 6. Overlay permitted concessions and actual plantations to determine leakage

Details of unpermitted plantation expansion monitoring process

STEP 1. Identify agent, assess holdings and operations

PT BEST Agro International, a large Oil Palm Conglomerate with long-term lease rights to 15 concessions in Central Kalimantan, 12 of which are already developed to palm oil. The remaining 3 are primarily deforested.

STEP 2. Establish agent-specific operational distance monitoring zone for unpermitted plantation

Palm oil concessionaires rely on transportation infrastructure to haul edible grade oil palm fruit to Crude Palm Oil (CPO) processing mills within 24 hours of harvest. This places a significant operational constraint on concessionaires who must locate plantations close to processing plants especially where road conditions are poor. In Central Kalimantan, this presents an effective operational zone of no more than 100km from palm oil plantation to CPO plant. Illegal plantation expansion, if it occurs, would be expected to occur within these zones.



All of the PT BEST concessions currently under operation were developed around and are dependent on two CPO processing mills, one in Pangkalan Bun and one in Sampit. These locations form the centers of 100km operational constraint zones for monitoring illegal plantation expansion (Figure 27). Note that undeveloped concessions 14 and 15 lie outside of this monitoring zone and are cut off from Sampit by extensive deep swamps of Sebangau National Park. Currently there are no plantations in this region to monitor for expansion and no infrastructure to develop them. These concessions will be monitored as described above and infrastructure development, expected to develop south from Palangkaraya will also be monitored. Should this infrastructure and/or plantations develop during the leakage monitoring period, illegal expansion beyond permitted borders will also be monitored.

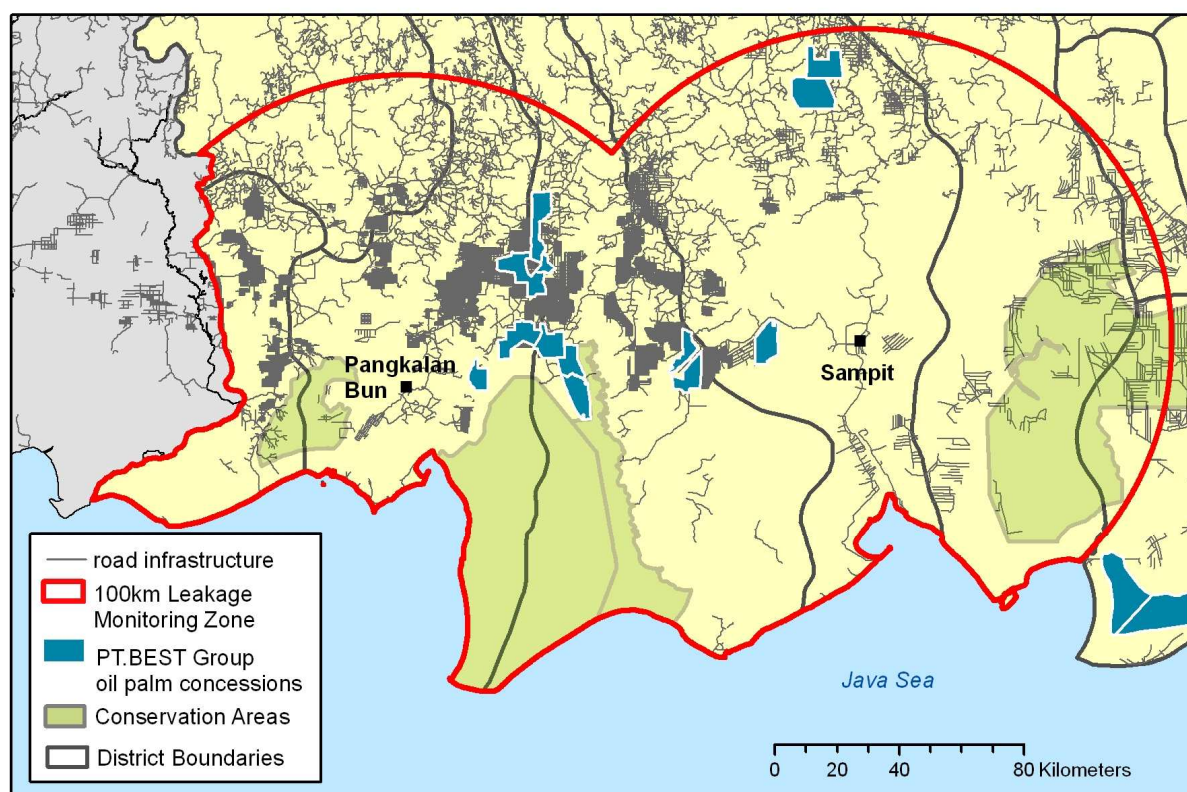


Figure 27. Unpermitted activity shifting leakage monitoring zone for Rimba Raya based on 100km distance from PT BEST Agro's CPO processing mills in Pangkalan Bun and Sampit, Central Kalimantan.

STEP 3. Stratify monitoring zone to define leakage risk areas

The unpermitted plantation expansion monitoring zone is stratified by land use and land planning information in order to focus the area of analysis to those places where leakage could occur. This analysis is carried out in GIS using overlays of spatial data to include or exclude certain layers as follows:

1. Include 100km areas centered on palm oil processing plants in Pangkalan Bun and Sampit
2. Exclude project area (Rimba Raya) and provinces where agent does not operate (West Kalimantan)
3. Include only areas that were forested in 2000
4. Exclude all permitted oil palm concessions at project start (2009 Izin Lokasi and HGU permits)
5. Exclude all existing palm oil plantations at project start (2009 Landsat mapping)

Results of the first three overlays are shown in Figure 28. GIS data layers for HGU and Izin Lokasi permits (Figure 29) were combined then overlaid with monitoring zone forests to exclude all areas already permitted for conversion at the project start. Concession boundaries were buffered by 500 meters in GIS to eliminate errors associated with mapping and reduce the number of “sliver” polygons produced by spatial mismatches in data layers. Tests of buffer distance were conducted to insure that the buffered GIS file captures actual palm oil expansion outside permit boundaries.

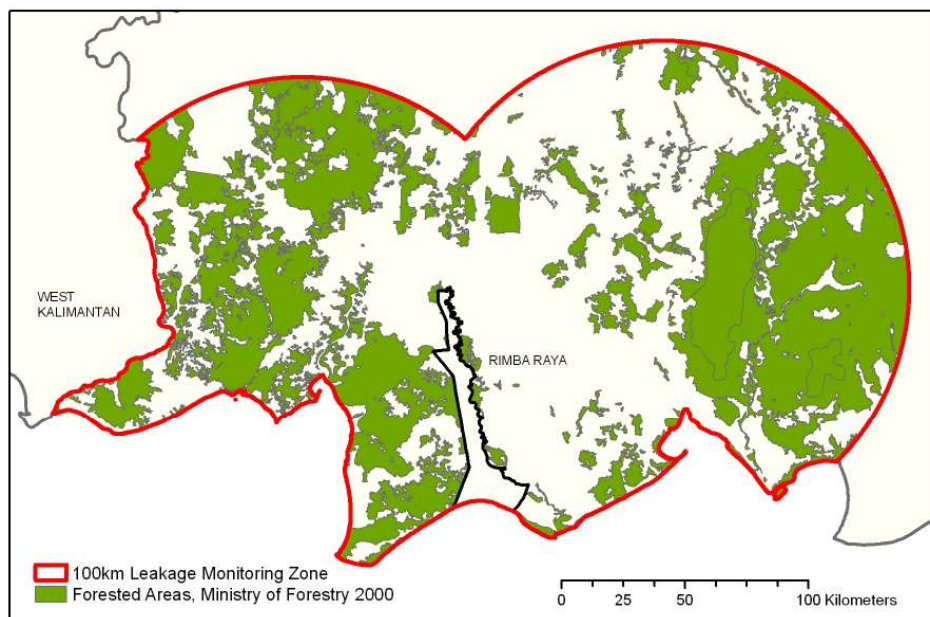


Figure 28. Results of the first three steps of plantation expansion leakage monitoring. Forested areas shown represent existing forest in 2000 for the 100km monitoring zone.

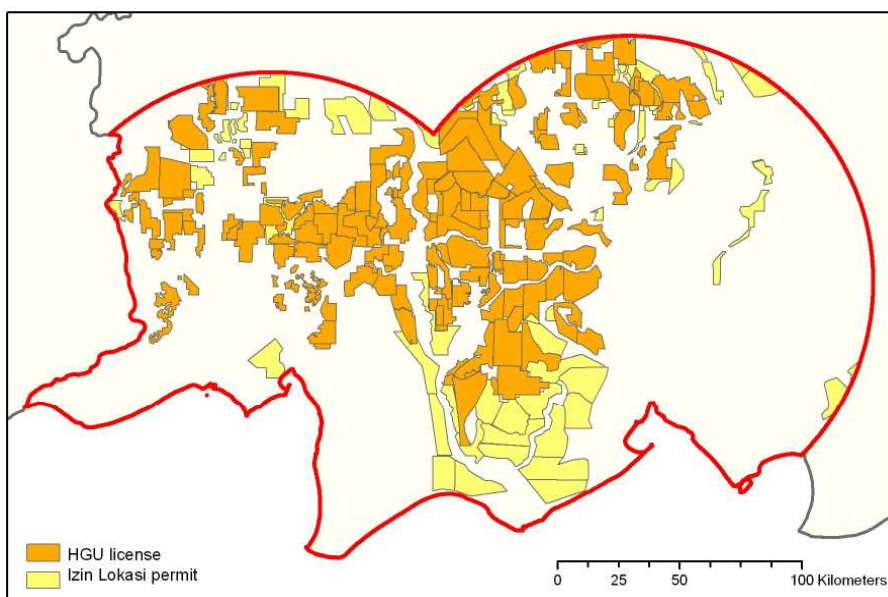


Figure 29. Existing oil palm concession licenses at project start. GIS data represents government mapping obtained through NGOs and represents the best available data as of July 2009.

All existing palm oil plantations in the monitoring zone at project start were interpreted and digitized on Landsat ETM+ satellite imagery (Figure 30). Six scenes were required to cover the monitoring zone and images were searched to find cloud-free images closest to the project start date. Two scenes each from three dates: May 13, June 7 and August 8 were selected and downloaded, bands stacked and geo-referenced if displays saved for import into ArcGIS for digitizing. Palm oil boundaries were conservatively interpreted to include already-constructed plantation blocks. Mapping shows that most HGU concessions have already been converted to plantation and conversely, the majority of palm oil conversion has occurred in or adjacent to permitted concessions. An earlier pilot study outside of PT BEST concessions showed a 15% encroachment in area beyond permitted concessions.

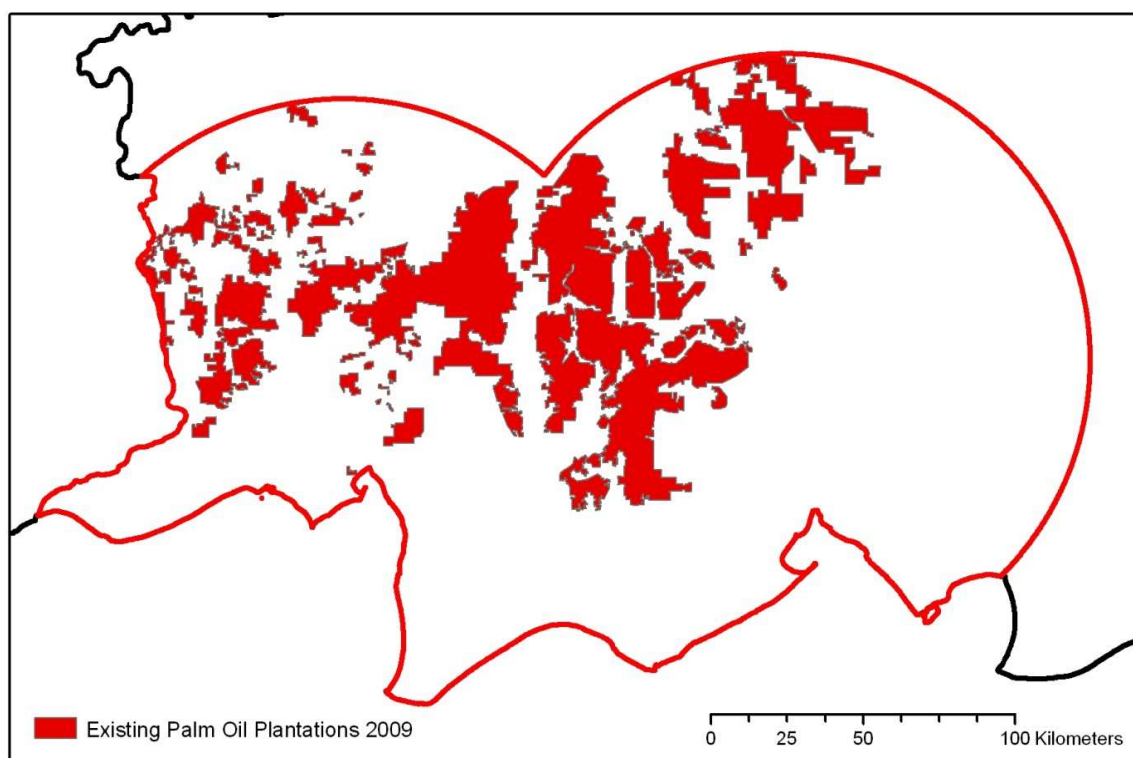


Figure 30. Existing palm oil plantations at project start interpreted and digitized from Landsat 7 ETM+ satellite imagery path-row 118-061 and 118-062 June 7; 119-061 and 199-062 May 13; 120-061 and 120-062 August 8.

After removing permitted and existing palm oil plantations, the remaining areas forested in 2000 are being monitored for plantation conversion and expansion (Figure 31). Note that conservation areas (except the project) are included in leakage monitoring although palm oil conversion is not expected to occur in these areas.

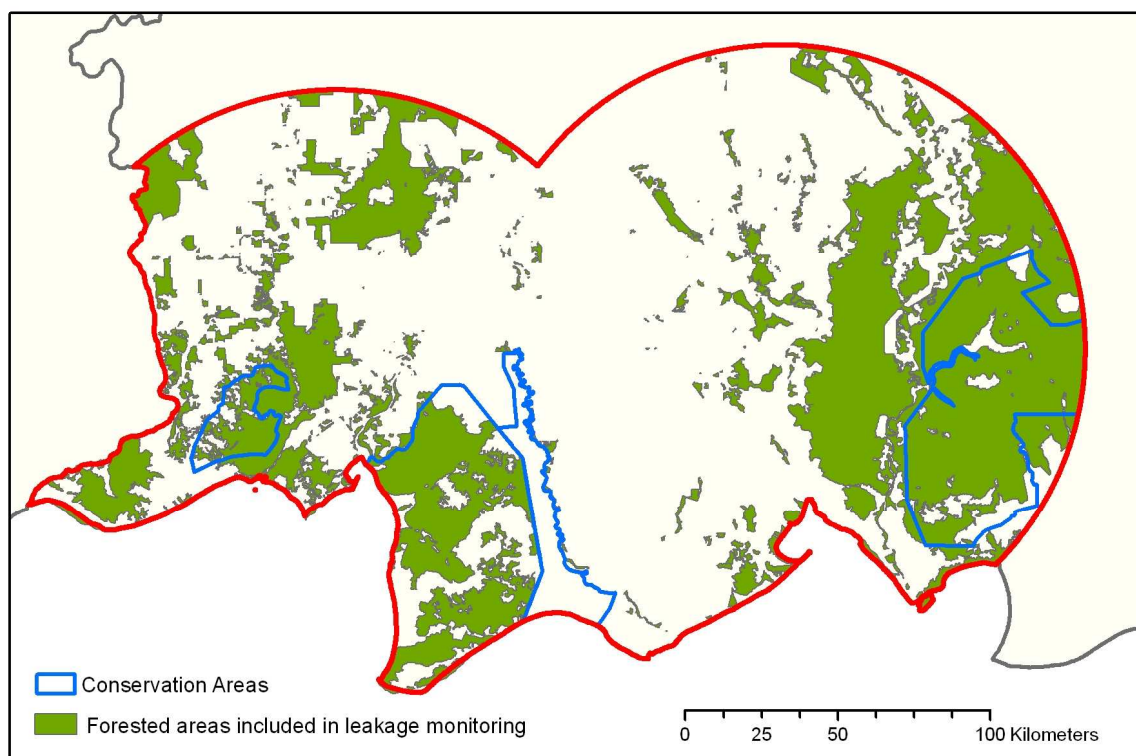


Figure 31. Leakage risk areas representing forests in 2000 inside the 100km distance buffer to CPO plants and excluding permitted concessions and existing plantations. Forests inside conservation areas are also monitored for leakage.

STEP 4. Monitor permits and update concession maps

Researching new licenses and updating GIS data on concession boundaries is the first step of the annual leakage monitoring process. Permits are searched to identify any new license activity by PT. BEST. In Step 3, the current status of existing concessions (holding a HGU) and proposed concessions (holding an Izin Lokasi) was established at both the District and Provincial levels. This map and list of existing and planned conversion areas represents the known area and location of planned land conversion within the District and Province at the project start. The current HGU and Izin Lokasi map (shown in Figure 29) will be updated to add any new license boundaries and improve mapping for existing boundaries consistent with government planning office GIS

STEP 5. Monitor and update oil palm plantation boundaries (potential leakage sites)

Mapping new palm oil conversion lands consists of overlaying year t mapped plantations onto year $t+1$ satellite imagery and digitizing all new and/or expanded plantations in the entire 100 km monitoring zone (updating Figure 30). New areas of palm oil plantation are then overlaid with leakage risk areas (Figure 31) to identify all areas of potential leakage on the ground. The example in Figure 32 illustrates this process. In this case, palm oil conversion had begun inside permitted concessions prior to project start, but then expanded beyond concession boundaries and into the leakage risk area where it was detected

during the GIS overlay process. The spatial overlay approach facilitates both a visual and quantitative assessment of potential leakage.

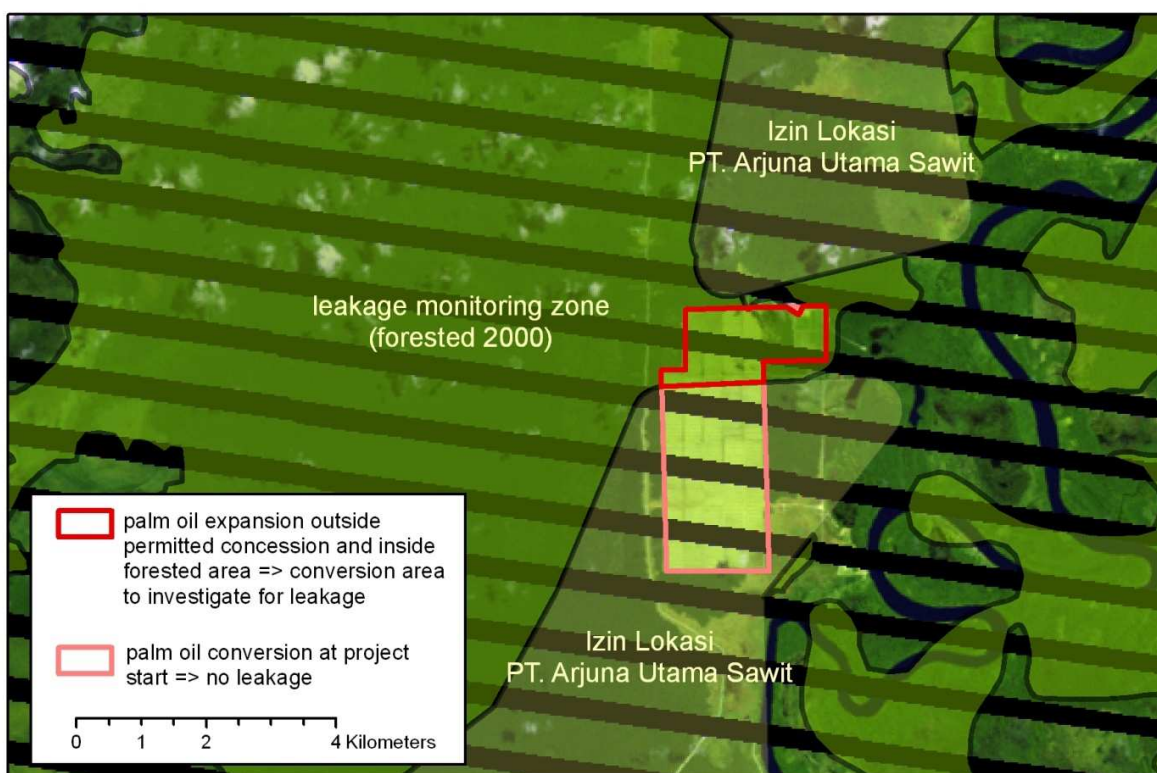


Figure 32. Example of overlay process to detect and highlight new forest conversion to palm oil.

STEP 6. Overlay concession boundaries and palm oil plantations to determine agent

If new deforestation is detected within the leakage monitoring zone and is confirmed to be new activity outside a pre-existing concession license, then Step 6 is carried out to determine the agent of deforestation. Overlay analysis of updated concession boundaries (Step 4) and palm oil expansion (Step 5) is used to identify the agent or possible agents responsible for conversion. As illustrated in Figure 32, overlaying concession boundaries provides information about agents. In this case, plantation conversion extended 1.5 km between two concessions for which an Izin Lokasi had been granted to PT. Arjuna Utama Sawit. Since this company is not an affiliate of PT BEST, whose closest concession is 75 km distant, we can conclude that PT BEST is not the agent of this conversion and therefore this palm oil expansion does not represent leakage associated with Rimba Raya. If it is determined that PT BEST is the likely agent, then steps 7 and 8 will be carried out to confirm and quantify leakage.

Assess the area of activity shifting leakage and quantify impact to carbon

Any activity shifting leakage detected during monitoring including leakage in existing or new PT BEST concessions and unpermitted plantation conversion, will be assessed and reported annually in accordance with the methodology.

Conduct site-level analysis to confirm leakage and stratify area

If it is determined that PT BEST is the likely agent of leakage, then a site-scale analysis is conducted to confirm the agent and develop data for carbon accounting. First, the boundary of the new or expanded palm oil concession will be delineated using concession permit maps and the best available satellite imagery. Then the leakage area will be stratified using the same procedures and vegetation classes as used for Rimba Raya.

4.3.1.8 Assess net carbon stock changes and GHG emissions associated with leakage

Following leakage area delineation and stratification, carbon stock changes and continued GHG emissions will be calculated according to the methodology. Emissions that result from displacement of pre-project activities to areas outside the project boundary are estimated as:

$$LK = \sum_{i=1}^{i^*} \sum_{t=1}^{t^*} LKA_{planned\ i,t} \cdot \Delta C_{it}$$

where:

- LK = Leakage emissions resulting from displacement of economic activities; tCO₂e
- $LKA_{planned\ i,t}$ = the area of activity shifting leakage in stratum i, at time t; ha
- ΔC_{it} = average carbon stock changes and greenhouse gas emissions in all pools in stratum i, tCO₂e ha⁻¹
- i = 1, 2, 3, ..., m_{LK} leakage strata
- t = 1, 2, 3, ..., t^* years elapsed since the start of the project activity

4.3.1.9 Monitoring Period and Reporting

The area of activity shifting leakage will be assessed for five full years beyond the date at which deforestation was projected to occur (July 2009). And emissions resulting from activity shifting will be tracked beyond the initial year of clearing as required and described by the Methodology Section 10.2.2.

At each verification, documentation will be provided covering lands controlled by PT BEST where leakage could occur, including their location, area and type of existing land use(s) and management plans. The status of government permits that have been granted to PT BEST will also be reported.

4.3.1.10 Results: Displacement Leakage Monitoring Year 1

PT BEST activities were monitored during the Year-1 period July 2009 – June 2010. As of June 2010, the following information was determined:

Status of Permitted PT BEST holdings

- PT BEST group controls 15 concessions in 4 districts of Central Kalimantan totaling 139,424 ha (Figure 24 above).
- Satellite image analysis shows that 12 of 15 concessions are already developed to palm oil plantation (Figure 25 above).
- On remaining concessions totalling 44,246 ha (1) is comprised of approximately 2500 ha of disturbed peat swamp forest in a matrix of open kerangas scrub and concessions (14) and (15) are deforested.

- These permits are confirmed by government records. All three concessions are already designated for conversion to oil palm plantation and are therefore not sites of potential leakage. However, these sites will be monitored in year 2-5 to maintain information about PT BEST activities.

CONCLUSIONS: Following research at district, province and central government offices, no new permits have been allotted to PT BEST group (See Annex 11 - "Statement of Findings"). Therefore, **leakage for legal (permitted) concessions is zero.**

4.3.1.11 Status of Unpermitted Palm Oil Expansion

All palm oil plantations on all lands inside the 100km buffer monitoring zone centered on PT BEST CPO mills in Pangakalan Bun and Sampit, were delineated on Landsat satellite imagery (2009 and 2010 scenes 118-61, 118-62, 119-61, 119-62, 120-61, 120-62) . Results are shown in Figure 33. All areas of plantation expansion outside of planned concession areas occur adjacent to developed concessions owned by agents other than PT BEST. Therefore these presumably illegal expansion sites cannot plausibly be linked to PT BEST.

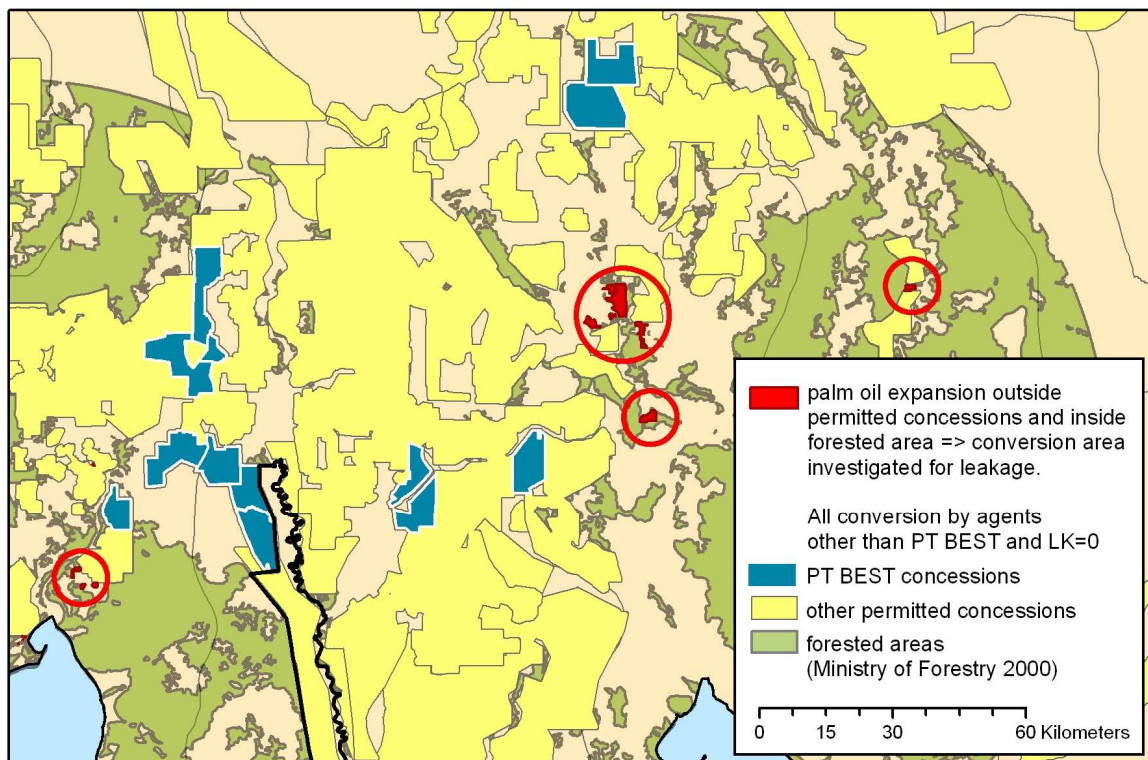


Figure 33. 2009-2010 Palm oil conversion activity in the illegal plantation expansion leakage monitoring zone – none associated with PT BEST

CONCLUSIONS: This assessment showed all plantation activity during monitoring year 1 took place in concessions allotted to other palm oil companies, with **no illegal expansion or new plantation activity by PT BEST.**

CONCLUSIONS: Four sites of potential leakage - palm oil expansion outside concessions boundaries – were detected and researched (see example in Figure 31 and summary results in Figure 32. All sites were determined to be **caused by agents other than PT BEST**.

4.3.1.12 Market Leakage Deduction (not monitored)

In accordance with the methodology, a deduction against the biomass of timber extracted under the baseline scenario must be estimated for Market Leakage by implementing steps outlined in Section 10.1 in the methodology:

Section 10.1 of the Methodology

When REDD project activities result in reductions in wood harvest, it is likely that production could shift to other areas of the country to compensate for the reduction. Therefore, in cases where the project area would be harvested for commercial timber before clearing the site for a new land use, market effects leakage must be estimated as the baseline emissions from logging multiplied by a leakage factor:

$$LK_{MarketEffects} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{LK}} LK_{ME,it} \quad (66)$$

$$LK_{ME,it} = LF_{ME,i} * C_{B,XBT,it} \quad (67)$$

Where:

$LK_{MarketEffects}$	= Total GHG emissions due to market effects leakage through decreased harvest; t CO ₂ e
$LK_{ME,it}$	= Total GHG emissions due to market effects leakage through decreased harvest in stratum i at time t ; t CO ₂ -e
$LF_{ME,i}$	= Leakage factor for market effects calculations; dimensionless
$C_{B,XBT,it}$	= Carbon emission due to displaced timber harvests in the baseline scenario in stratum i at time t ; t CO ₂ -e

The amount of leakage is determined by where harvesting would likely be displaced to. If in the forests to which displacement would occur a lower proportion of biomass in commercial species is in merchantable material than in the project area, then more trees will need to be cut to supply the same volume and thus higher emissions should be expected. In contrast, if a higher proportion of biomass of commercial species is merchantable in the displacement forest than in the project forest, then a smaller area would need to be harvested and lower emissions would result.

Each project thus shall calculate within each stratum the proportion of total biomass in commercial species that is merchantable (PMP_i). Merchantable biomass per stratum is conservatively defined as the total volume (converted to biomass) of all commercially valuable trees within a stratum that are above the minimum size class sold in the local timber market (see Applicability Condition J). PMP_i is therefore equal to the merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries. PMP_i shall then be compared to the mean proportion of total biomass that is merchantable for each forest type ($PMLFT$) to which displacement is likely to occur.

The following deduction factors ($LF_{ME,i}$) shall be used:

PML_{FT} is equal (± 0.15) to PMP_i	$LF_{ME,i} =$	0.4
PML_{FT} is > 0.15 less than PMP_i	$LF_{ME,i} =$	0.7
PML_{FT} is > 0.15 greater than PMP_i	$LF_{ME,i} =$	0.2

Where:

PML_{FT}	= Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type; dimensionless
PMP_i	= Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries; dimensionless
$LF_{ME,i}$	= Leakage factor for stratum i market-effects calculations; dimensionless

Instead of applying the default market leakage discounts, project proponents may opt to estimate the project's market leakage effects across the entire country and/or use analysis(es) from other similar projects to justify a different market leakage value. A description of the market leakage assessment, including steps for determining where leakage is likely to occur (i.e., to which forest types leakage is likely to occur) and what the carbon stocks of those lands are, shall be outlined in the PDD. The outcome of this assessment conducted at first VCU issuance (whether using default discounts or project specific analysis(es)) shall be subject to the VCS double approval process. Market leakage assessments conducted at validation stage and at verification other than the first VCU issuance are not required to undergo the double approval process.

The next step is to estimate the emissions associated with the displaced logging activity – this is based on the total volume that would have been logged in the project area in the baseline scenario. The emission due to the displaced logging has two components: the biomass carbon of the extracted timber and the biomass carbon in the forest damaged in the process of timber extraction:

$$C_{B,XBT,it} = \left([V_{B,it} * \phi_i * CF] + [V_{B,it} * LDF] \right) * \frac{44}{12} \quad (68)$$

Where:

$C_{B,XBT,it}$	= Carbon emission due to displaced timber harvests in the baseline scenario in stratum i at time t ; t CO ₂ -e
$V_{B,it}$	= Volume to be extracted under the baseline scenario in stratum i at time t ; m ³
ϕ_i	= volume-weighted average wood density; t d.m. m ⁻³ merchantable volume
CF	= carbon fraction of dry matter (0.5 t C / t biomass); dimensionless
LDF	= Logging damage factor; t C m ⁻³ (default 0.37 t C m ⁻³)
i	= 1, 2, 3, ..., m_{BL} baseline strata
t	= 1, 2, 3, ..., t^* years elapsed since the projected start of the REDD project activity

The total volume to be extracted under the baseline scenario in stratum i at time t (VB_{it}) can be estimated by multiplying the plot-level volume per stratum (MVB_{it} see Eq. 34) by the area cleared or logged in stratum i at time t ($A_{cleared, it}$ or $A_{logged, it}$).

The logging damage factor (LDF) is a representation of the quantity of emissions that will ultimately arise per unit of extracted timber (m^3). These emissions arise from the non-commercial portion of the felled tree (the branches and stump) and trees incidentally killed during tree felling. The default value given here comes from the slope of the regression equation between carbon damaged and volume extracted based on 534 logging gaps measured by Winrock International in Bolivia, Belize, Mexico, the Republic of Congo, Brazil, and Indonesia.

Leakage from Market Effects was taken as one-time² deduction of **-4,836,855 t CO₂e**.

4.4 Summary of GHG Emission Reductions and Removals

4.4.1 Introduction: Background on Carbon Accounting

Carbon accounting follows the procedure described by the approved methodology. It describes calculation of actual (*ex post*) net GHG emissions avoided within the project boundary as a result of the project activities. GHG emissions reductions are calculated as the sum of observed emissions from logging, fires and land cover change (deforestation) for all strata during each monitoring year.

GHG emissions avoided were thus calculated as follows:

$$C_{ACTUAL} = C_{BSL} - C_{PRJ}$$

where

C_{ACTUAL} = actual net greenhouse gas emissions avoided; t CO₂-e

C_{BSL} = sum of peat emissions and carbon stock changes in aboveground biomass under the baseline scenario; t CO₂-e

C_{PRJ} = sum of emissions that occur within the project boundary; t CO₂-e

The subject of annual monitoring is focused on the calculation of C_{PRJ} , defined as:

$$C_{PRJ} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{ps}} E_{P,it}^{logging} + E_{P,it}^{fire} + E_{P,it}^{LUC}$$

where

C_{PRJ} = sum of emissions that occur within the project boundary as a result of emissions that were unanticipated and/or unable to be avoided by project activities; tCO₂-e

$E_{P,it}^{logging}$ = GHG emissions due to logging in stratum i , time t ; tCO₂-e

² Market leakage is not monitored but is taken as a one-time, up front over a five-year period coinciding with estimated clearing rates and time periods.

$E_{P,it}^{fire}$ = GHG emissions due to fire in stratum i , time t ; tCO₂-e

$E_{P,it}^{LUC}$ = GHG emissions due to land use/cover change in stratum i , time t ; tCO₂-e

i = 1, 2, 3, ..., m strata

t = 1, 2, 3, ..., t^* years

The calculation of total actual avoided Year-1 emissions are discussed and summarized below.

4.4.1.1 GHG Emissions

Changes in landcover change/use were detected in the analysis of 2009-2010 satellite imagery. Further spatial analysis and ground surveys were carried out to assess the nature and impact land change and the impact on carbon stocks and emissions.

4.4.1.2 GHG Emissions due to Land Use / Land Cover (LU/LC) changes ($E_{P,it}^{LUC}$)

$E_{P,it}^{LUC}$ refers to emissions associated with the area of land for which land cover changes occur that are not due to fire or logging. In the 2009-2010 period, the only changes in land cover/use were the result of isolated fires, not local or commercial land clearing or other sources that would be covered under the definition of $E_{P,it}^{LUC}$. Thus, $E_{P,it}^{LUC}$ is determined to be "0" as an emission source over the monitoring period.

4.4.1.3 Logging ($E_{P,it}^{logging}$)

$E_{P,it}^{logging}$ refers to emissions associated with the area of land for which logging and logging gaps occurred. Logging within the PMZ and CAA has been shown to be small scale and community level. However, these emissions are still accounted in monitoring as shown in Table 27.

Table 27. Estimation of emissions in aboveground biomass from timber extraction

Stratum	Actual # of logging gaps detected	Carbon extracted as timber (t C)	CO ₂ emissions (t CO ₂)
Peat Swamp Forest (lightly degraded)	40	59.98	219.93
Peat Swamp Forest Degraded (highly)	0	0.00	0.00
Peat Shrubland (<20% Tree Cover)	0	0.00	0.00
Kerangas Forest	0	0.00	0.00
Kerangas Open Scrub	0	0.00	0.00
Low, sparse vegetation cover	0	0.00	0.00
Seasonally Inundated Wetlands	0	0.00	0.00
* Weighted average CO ₂ emissions were used in each concession based on the proportion of each land cover type present.			220

CONCLUSIONS: In total, 220 tCO₂e emissions were released as a result of timber extraction.

4.4.1.4 Indirect Impacts (Displacement and Market Leakage)

As described in Section 4.3, in the Year-1 monitoring period, it was demonstrated that no new land conversion permits were issued to PT BEST and that illegal plantation expansion in PT BEST's current area of influence, was carried out by agents other than PT BEST. Since activity-shifting leakage has not occurred over the Year-1 monitoring period, displacement leakage emissions are "0".

Market leakage is not monitored in this methodology but is accounted one-time at the beginning of the project and deducted against the baseline over a five-year period. The market leakage deduction period begins Year 2 when according to the methodology, possible shifting of timber extraction activities displaced from the project area, but remaining outside of lands controlled by PT BEST could occur. Market leakage calculations are detailed in the Baseline calculation spreadsheet.

CONCLUSIONS: Leakage Displacement (Activity Shifting) is determined to be "0".

CONCLUSIONS: Leakage from Market Effects was taken as a one-time deduction of **-4,836,855 t CO₂e** as detailed in the Baseline calculations.

4.4.1.5 Summary of Carbon Accounting (Carbon Emissions Avoided in Year-1)

The sum total of avoided carbon emissions is expressed in terms of the baseline expected carbon emissions after Year-1, less deductions for emissions from $E_{P,it}^{fire}$, $E_{P,it}^{LUC}$ and $E_{P,it}^{logging}$ as well as any emissions identified as Leakage.

Thus:

$$C_{ACTUAL} = C_{BSL} - C_{PRJ}$$

where

$$C_{ACTUAL} = 1,931,282 = \text{actual net greenhouse gas emissions avoided; t CO}_2\text{-e}$$

$$C_{BSL} = 1,969,770 = \text{sum of peat emissions and carbon stock changes in aboveground biomass under the baseline scenario; t CO}_2\text{-e (after all buffers and deductions)}$$

$$C_{PRJ} = 38,488 = \text{sum of emissions that occur within the project boundary; t CO}_2\text{-e}$$

The subject of annual monitoring is focused on the calculation of C_{PRJ} , defined as:

$$C_{PRJ} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{ps}} E_{P,it}^{logging} + E_{P,it}^{fire} + E_{P,it}^{LUC}$$

where

$$C_{PRJ} = 38,488 = \text{sum of emissions that occur within the project boundary as a result of emissions that were unanticipated and/or unable to be avoided by project activities; tCO}_2\text{-e}$$

$$E_{P,it}^{logging} = 220 = \text{GHG emissions due to logging in stratum i, time t; tCO}_2\text{-e}$$

$$E_{P,it}^{fire} = 38,268 = \text{GHG emissions due to fire in stratum i, time t; tCO}_2\text{-e}$$

$$E_{P,it}^{LUC} = 0 = \text{GHG emissions due to land use/cover change in stratum i, time t; tCO}_2\text{-e}$$

Results of Year-1 monitoring deductions against Baseline Carbon Emissions avoided are summarized in Table 28.

CONCLUSIONS: In total, **-38,488 tCO₂e** emissions were released as a result of unplanned activity in the project area and have been deducted from the Baseline for a Year-1 total and after all buffers and deductions have been made the final VCUs to be allocated are **2,181,352 tCO₂e**.

Table 28. Year-1 Avoided Carbon Emissions

Year-1 Avoided Carbon Emissions	
Factor	Value
Expected Emissions	
Year-1 Baseline Carbon Emissions	2,462,212
Observed Emissions	
Emissions from Fire	
Aboveground Biomass	23,211
Belowground Biomass	15,057
Emissions from Land Use / Land Change	0
Emissions from Logging	220
Emissions from Leakage	0
Total Year-1 Emission Reduction	(38,488)
Net Year-1 Carbon Stocks	2,423,725
Buffer Allocation (10%)	242,373
VCU Allocation	2,181,352

The reporting period of the project spans two equal halves of two calendar years (i.e. 6 months of 2009 and 6 months of 2010). Table 29 presents the VCUs from the Year-1 monitoring period in vintages for the purposes of reporting on the Markit registry.

Table 29: VCU Vintages

Year	Net VCU allocation	Buffer Allocation
2009 (Jul – Dec)	1,090,676	121,186
2010 (Jan – Jun)	1,090,676	121,187

5 ADDITIONAL INFORMATION

Annex 1	Monitoring Plan
Annex 2	FMEA & Control Plan
Annex 3	Field Report on Carbon Accounting Area Boundary Marking.doc
Annex 4	Landcover Accuracy Assessment
Annex 5	SIR-CAPS
Annex 6	<i>This annex has been deleted</i>
Annex 7	Report of Survey Activity Rimba Raya - Yappi 2010
Annex 8	Brief Report on Fire Hotspot Monitoring - Imanda 2010
Annex 9	Brief Report on Burn Area Mapping- Imanda 2010
Annex 10	Fire Plan and Community Training
Annex 11	Statement of Findings