THE PURUS PROJECT

A Tropical Forest Conservation Project in Acre, Brazil

CarbonCo, LLC

Document Prepared By
CarbonCo[1], TerraCarbon[2], Carbon Securities[3], and Moura & Rosa[4]

Project Title	The Purus Project
Version	02
Date of Issue	28-December-2012
Prepared By	Brian McFarland[1], James Eaton[2], Pedro Freitas[3], Normando Sales[4], and Wanderley Rosa[4]
Contact	3 Bethesda Metro Center, Suite 700 – Bethesda, Maryland, 20814 – USA Phone: (240) 247-0630 Fax: (240) 638-9110 Email: BMcFarland@CarbonCoLLC.com Website: www.CarbonCoLLC.com

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Purus Project seeks to help protect and conserve tropical forest by providing payments for ecosystem services. This type of project is known as a Reducing Emissions from Deforestation and forest Degradation project (REDD project). Project activities intended to reduce deforestation are implemented in and around a privately-owned property in the State of Acre, Brazil and are funded by payments related to emission reduction credits generated by the project.

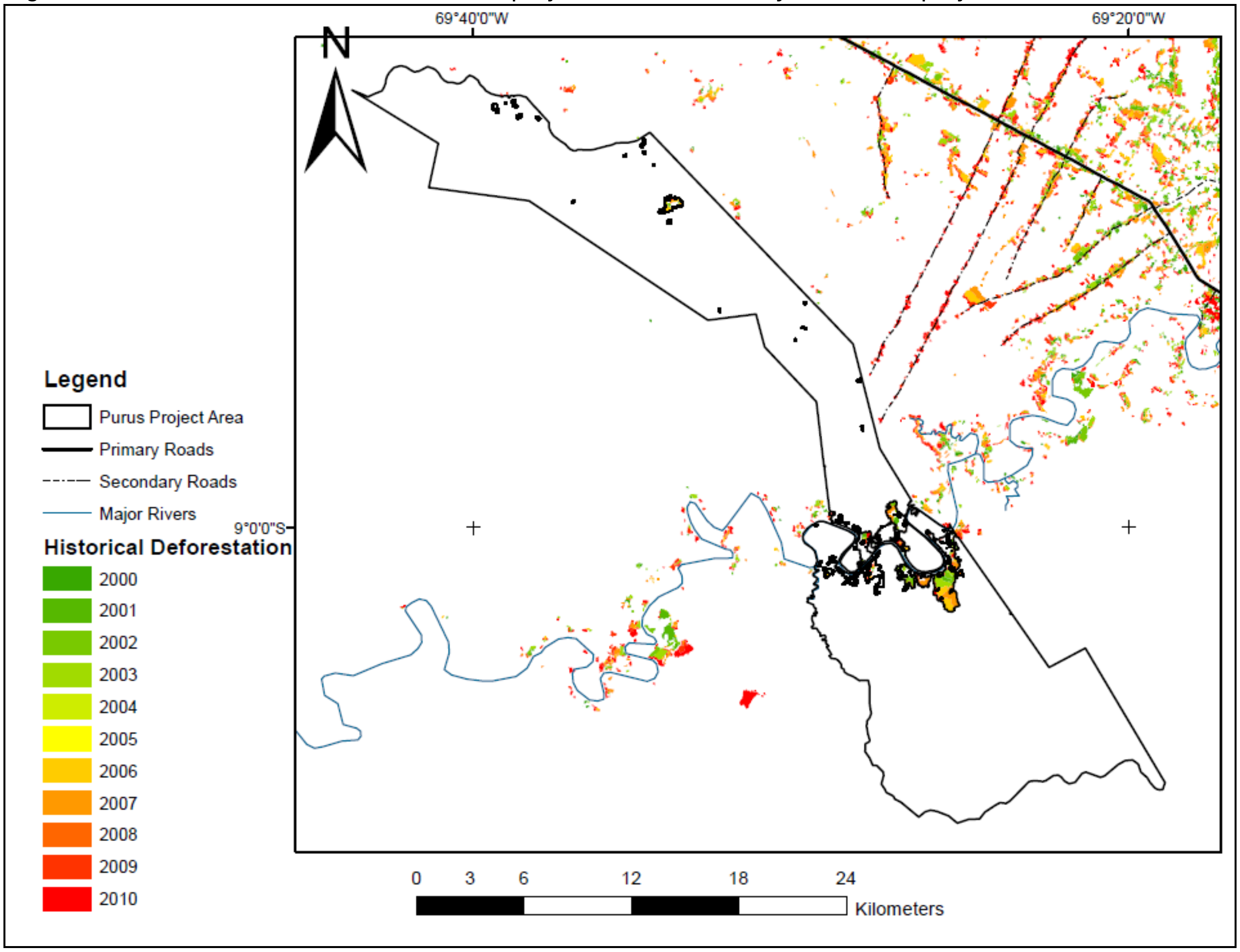
This project is being developed and registered under the Verified Carbon Standard (VCS) and the Climate, Community and Biodiversity Standard (CCBS). Project development activities have included meeting with the local communities surrounding the project area, engaging Acre state officials working on similar strategies at a regional/state level, developing a plan which will result in lowering the pressure on land and forest resources in consultation with the local community, putting into operation the REDD project implementation plan with the help of local partners and Purus Project staff, undertaking a forest carbon inventory, and modelling regional deforestation. Activities implemented as part of the project to reduce deforestation include:

- Community outreach and education;
- Employ local community members as project forest guards or other project staff (to replace other sources of income associated with deforestation and land use);
- Agricultural extension training which will help baseline agents to increase productivity on current lands (thus reducing the pressure to expand their farms in the adjacent forest);
- Reforestation of select non-forest areas and planting woodlots (to provide alternative sources of fuelwood); and
- Sharing a portion of carbon related revenue for communities living on the Moura & Rosa property (replacing other sources of income associated with deforestation and land use).

The above activities will directly address deforestation pressures in the region which are becoming more prevalent.

While the State of Acre historically has a low deforestation rate and a high level of forest governance, the paving of two primary roads BR-364 and BR-317 has greatly increased destruction of primary forests and conversion to cattle pastures. Deforestation pressures on the Purus Project property have increased significantly in the past several years as the paving of BR-364 is nearing completion. BR-364 which runs northwest-southeast, across the north of the state of Acre, is only 20 kilometers distance from the Purus Project area. The section nearest the project property, near the town of Manoel Urbano, was paved between March and August 2011 during the start of the project in May 2011. Upon being fully paved, BR-364 will allow for year-round transportation and most likely increase property values and market access. The Purus River, a major tributary of the Amazon River, runs through the project property potentially connecting areas upstream and downstream from BR-364 to consumer markets. Further, secondary roads are fast approaching the project area (Figure 1.1) providing access to previously hard to reach areas for the agents of deforestation, small scale/subsistence farmers.

Figure 1.1. Deforestation in and around the project area within ten years of the project start date.



There are 18 communities living on the project property, all of which live along the banks of the Purus River. These small scale and subsistence farming communities are the agents of deforestation and clear a portion of forest (often annually) for land to engage in small scale farming and ranching for their livelihoods. Forest is generally cleared over a period of months. The process most often starts in May or June at the beginning of the dry season with the cutting of small trees and vines by machete. Next, the farmer or someone with a chainsaw cuts the larger trees down. The farmer then waits for the dead vegetation to dry for a period of time ranging from two weeks to several months. A portion of the farmers, then use fire to clear the land. Finally crops are planted for a year or two prior to conversion to pasture or the land is directly converted to pasture.

The project baseline has been developed after meeting with local communities to understand their use of the land, and in light of the above mentioned increased accessibility of the project area in the near future. Further, the Purus Project is working closely with the State of Acre and is using a simple historic approach to setting the baseline to conform with Acre State's approach, which is still in development. Finally, data and information provided by the UCEGEO, the Climate Change Institute's GIS department, was used in the development of the baseline.

There are three project proponents undertaking the Purus Project including CarbonCo, LLC ("CarbonCo"), Freitas International Group, LLC ("Carbon Securities"), and Moura e Rosa Empreendimentos Imobiliários LTDA ("Moura & Rosa"). CarbonCo, the wholly-owned subsidiary of Carbonfund.org, is responsible for project finance and managing project development. Carbon Securities acts as a liaison between CarbonCo and Moura & Rosa and provides logistical support during site visits. Moura & Rosa, an Acre based organization created by the Landowners, is primarily responsible for implementation of project activities and day-to-day management of the Purus Project.

A schedule of the important aspects of the project is listed in chronological order in Table 1.1, below.

Table 1.1. Schedule of Key Project Activities.

Project activity	**Date**	**Source/Notes**
Project start date	May 23, 2011	This is the date which the first community members signed the Declaration and Memorandum of Understanding with the project proponents.
Start date and end date of the initial REDD project crediting period.	May 23, 2011 to May 22, 2041	
Validation of the project	Anticipated 2012	
Registration of the project	Anticipated 2012	
First verification	Anticipated 2013	
Date at which the project baseline will be revisited. The baseline must be renewed every 10 years from the project start date.	May 23, 2021	Start of second baseline period

1.2 Sectoral Scope and Project Type

This project is being registered under the Verified Carbon Standard (VCS) as a Reducing Emissions from Deforestation and Degradation (REDD) project and has been developed in compliance with the Verified Carbon Standard[1], Version 3.3 and VCS AFOLU Requirements[2]. The project will reduce emissions from unplanned frontier deforestation.

As only 21.9% of the project area boundary is within 50 meters of land that has been anthropogenically deforested[3] within the 10 years prior to the project start date, location analysis (i.e. spatial modeling of future deforestation) is required, as stipulated in the VM0007 methodology. Further, almost all forest patches within the project area exceed 1,000 hectares.

The Purus Project is not a grouped project.

[1] VCS. 2012 VCS Standard. Version 3.3, 04 October 2012. Verified Carbon Standard, Washington, D.C.
[2] VCS. 2012 Agriculture, Forestry and Other Land Use (AFOLU) Requirements. Version 3.3, 04 October 2012. Verified Carbon Standard, Washington, D.C.
[3] Analysis to determine whether location analysis is warranted is located in the project archive.

1.3 Project Proponents

The three main project proponents are CarbonCo, LLC ("CarbonCo"), Freitas International Group, LLC ("Carbon Securities"), and Moura e Rosa Empreendimentos Imobiliários LTDA ("Moura & Rosa"). CarbonCo, the wholly-owned subsidiary of Carbonfund.org, is responsible for getting the project certified and for project finance. Carbon Securities acts as a liaison between CarbonCo and Moura & Rosa, acts as a translator, and assists with logistics for site visits. Moura & Rosa is an Acre, Brazil-based organization created by the Landowners and is primarily responsible for day-to-day management of the Project and the implementation of activities to stop deforestation. Table 1.2, below, details the role and responsibilities of each project proponent.

Table 1.2. List of Project Proponents.

Contact	Role	Responsibility
CarbonCo, LLC 3 Bethesda Metro Center, Suite 700 Bethesda, Maryland 20814 USA 001-240-247-0630	Project developer	• Finance project development costs • Manage technical contractors helping with project development, the forest carbon inventory, and baseline modeling • Assist with drafting the VCS and CCBS Project Documents • Manage validation and verification process including contracting auditors and addressing Corrective Action Requests
Moura e Rosa Empreendimentos Imobiliários LTDA Avenida Ceará nº364 – Sala 01 – Habitasa – Rio Branco – AC 55-68-3224-0562	Project manager	• Engage with local community to inform and explain the proposed project and gather feedback, and resolve any local issues • Develop and implement a plan to reduce deforestation
Freitas International Group, LLC (Carbon Securities) 201 S. Biscayne Boulevard, 28th Floor Miami, Florida 33131 USA 55-61-3717-1008	Project facilitator	• Serve as a liaison and translator for the landowners and CarbonCo, including establishing meetings with landowners and relevant stakeholders, arranging site visits, providing information and documentation such as previous studies, photographs, and satellite images related to the project

1.4 Other Entities Involved in the Project

Figure 1.2 provides an overview of the relationship of the various project proponents and entities involved in the project. Table 1.3 lists the role of the other entities.

Figure 1.2: Organizational Chart for the Purus Project

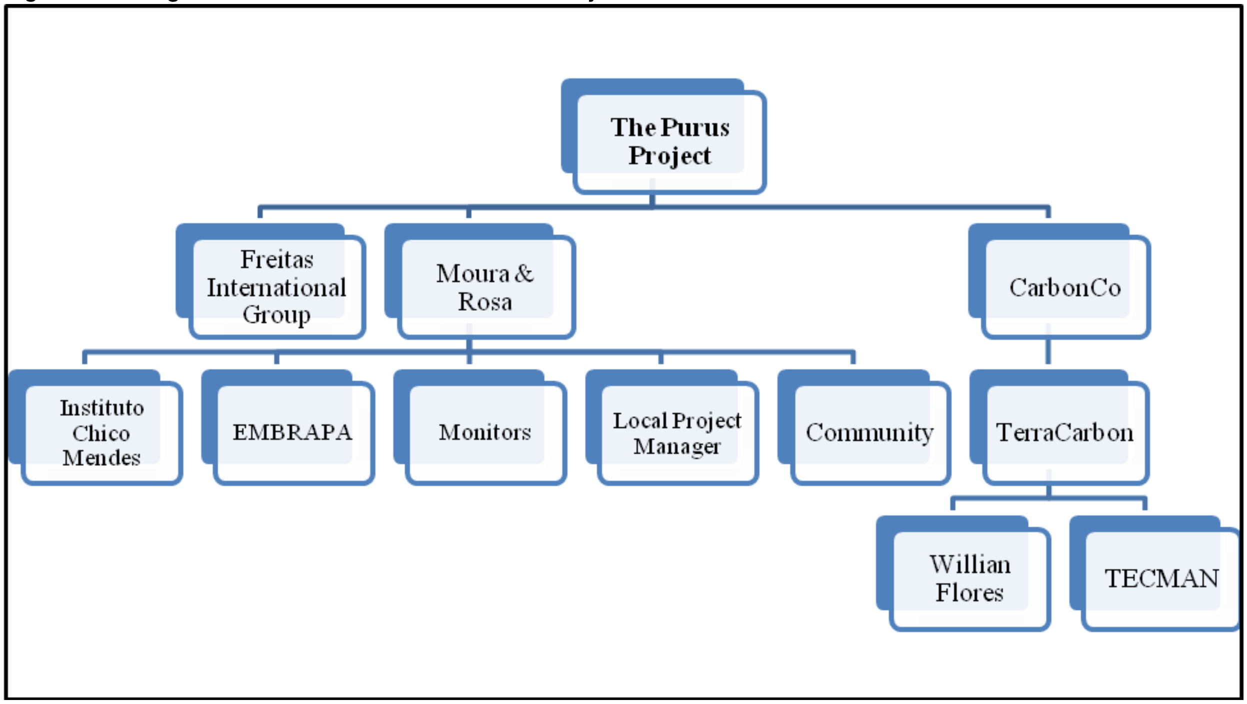


Table 1.3. List of Other Entities Involved in the Project.

Contact	Role	Responsibility
TerraCarbon LLC 5901 N. Sheridan Rd. Peoria, Illinois 61614, USA 001-434-326-1144	Independent Consultant	Co-lead project kickoff. Design and manage forest carbon inventory. Lead baseline development task. Develop project document and advise CarbonCo on all aspects of project development.
TECMAN Rua Copacabana, nº 148, Sala 204, Conjunto Village Maciel, CEP 69.914-380 Rio Branco, Acre, Brasil 55-68-3227-5273	Independent Consultant	Lead and supervise collection of field data during the course of the forest carbon inventory.
Antonio Willian Flores de Melo Universidade Federal do Acre Centro de Ciências Biológicas e da Natureza, Distrito Industrial, CEP 69.915-900 Rio Branco, Acre, Brasil 55-68-3901-2611	Independent Consultant	Delineate project boundaries and perform deforestation modeling used to develop the project baseline.

EMBRAPA Dr. Judson Valentin BR364 Km 14, PO Box 321, CEP 69.900-056 Rio Branco, Acre, Brasil 55-68-3212-3205	Independent Consultant	Provide technical assistance with regard to agricultural extension training, which shall be provided to the local communities
Instituto Chico Mendes Escritório Xapuri - Acre Rua Dr. Batista de Moraes, 495 Centro - CEP 69.930-000 Xapuri, Acre, Brasil 55-68-3224-2365	Local Contact	Informal assistance to Moura & Rosa during project planning phase.
SERVICO NACIONAL DE APRENDIZAGEM RURAL (SENAR-AR-AC) Jefferson Lunardelli Cogo - Superintendente. Rua Quintino Bocaiuva, 1767 – Bosque, CEP 69.909-400. Rio Branco- Acre. 68-3224-1797	Independent Consultant	Provide technical assistance with regard to agricultural extension training for,local communities

1.5 Project Start Date

The Purus Project has a project start date of May 23, 2011 which is the date of the initial signing of the communities' "Declaration"[4] to join the project and when the first social survey took place to gather information on the habits, customs and composition of the communities living in the Purus Project area. To strengthen this agreement, individual Memorandums of Understanding[5] with community members were later signed.

1.6 Project Crediting Period

The Purus Project has an initial project crediting period of 30 years[6], starting on May 23, 2011. The initial baseline period started on May 23, 2011 and is set to continue through May 22, 2021. The initial project crediting period is set to end on May 22, 2041.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

The Purus Project is not considered to be a "Mega Project", as the estimated annual emission reductions for the first baseline period is 89,868 tCO_2e per year, less than the 300,000 tons of CO_2 per year which indicates a "Large Project".

[4] A copy of all "Declaration" can be found in the project archive
[5] Copies of all signed MOUs can be found in the project archive.
[6] An addendum to the initial Tri-Party Agreement between CarbonCo, Carbon Securities and Moura & Rosa stipulates there will be a 60-year project life-time, followed by two renewable terms of 25-years each.

Project	X
Large Project	N/A

Years	Estimated GHG emission reductions (tCO2e)
2011	57,243
2012	69,273
2013	65,490
2014	81,057
2015	112,394
2016	94,195
2017	100,320
2018	88,949
2019	112,025
2020	117,733
Total estimated ERs	898,679
Total number of crediting years	10
Average annual ERs	89,868

1.8 Description of the Project Activity

The Purus Project will mitigate deforestation pressures using a combination of contractual obligations, environmental programs, and social programs intended to improve the livelihoods of community members living in the vicinity of the project area.

There are a variety of social and environmental project activities that will be implemented to help mitigate deforestation pressures. These activities include community engagement, agricultural extension activities, forest patrols in areas under the greatest threat, and improvement of schools and medical clinics.

Engage Local Communities

Moura & Rosa have met with the community about implementing a conservation project for over five years. To further this objective, in 2011 the Purus Project was discussed in greater detail with the community and community members who wanted to join the Purus Project signed a Declaration and a Memorandum of Understanding.

Members of the local community who currently reside on the property have agreed to assist Moura & Rosa to reduce deforestation and protect the local environment in a Memorandum of Understanding. As of April 2012, the majority of community members residing within the Purus Project and the Moura & Rosa property have either signed the MOU or verbally agreed to join the project, with the first community members signing a Declaration on May 23, 2011, the project start date. The key points are listed below.

The Resident, with free, prior and informed consent, hereby acknowledges:

- M&R will allow the Resident to peacefully remain on M&R's property;

- In return for being allowed to remain on M&R's property, the Resident shall work with the other Parties to protect and preserve the ecosystem within M&R's property, protection of trees from being cut down or otherwise destroyed, protection of plant and animal life, preservation of animal habitats, prevention of pollution of Purus River and all other streams and waterways, reduction of runoff and erosion, protection of topsoil, and preservation of medicinal and edible plants;
- Deforestation is currently occurring within M&R's property and the Resident will work with the Parties to eliminate deforestation at the present time and in the future so long as the Resident remains on the property;
- The Resident may be entitled to payments from ecosystem services (specifically carbon credits resulting from mitigating deforestation within the property) if trees are protected; and
- The Resident will immediately report any deforestation to the other Parties.

The engagement of local communities will last throughout the Project Lifetime. This engagement of local communities will achieve net GHG emission reductions by: providing education about the affects of deforestation and the benefits of protecting forest resources; informing the communities about the Project's social projects and programs; and by soliciting ongoing insights from the communities to better design the Project. Furthermore through community engagement, the Project Proponents will reduce the communities' dependence on forest resources by intensifying agriculture and livestock, while also providing alternative income.

Create Project Awareness

This activity is to create project awareness in and around the project area, in nearby communities and towns (e.g., see community engagement and forest patrols, below), and in local and state organizations which also have programs to manage degradation of forested land. This includes meetings with: EMBRAPA and SENAR; Professor Armando Muniz Calouro about biodiversity monitoring plan; the Climate Change Institute of Acre; the Vice-Governor of the State of Acre; and the General Prosecutor Patricia Rego.

Figure 1.3. Photo of Sign near the Purus Project Area.

The project awareness activities will last throughout the Project Lifetime. In addition, project awareness will result in net GHG emission reductions because the Project Proponents will learn about best practices in the State of Acre for mitigating deforestation and the Project Proponents will also better understand how to reduce GHG emissions caused by leakage.

Hire Project Managers and Project Staff

On March 22nd 2012, Moura & Rosa hired Sebastião Marques da Silva (nickname Miguel) and Miguel's spouse Maria Souza de Moura (nickname Socorro) and on April 10th, 2012 they were officially-registered as the full-time, onsite project managers for the Purus Project. The internal management of the project will be coordinated with the help of Miguel, who is the oldest resident on the property, and Socorro. These project managers will work to facilitate communication and transparency in community decisions. As the onsite project managers, they will oversee implementation of social and environmental projects and will be in constant contact with nearby communities.

Project Managers were already hired and the employment of project staff, including such onsite project managers, will last throughout the Project Lifetime. A net reduction in GHG emissions will result from hiring project staff because project staff will receive diversified and increased incomes making such staff less dependent of forest resources.

Acquire Agricultural Extension Services

The communities in and around the Purus Project were surveyed from March 10-12, 2012 to better understand which agricultural extension training courses would be of the most interest. The top ten courses selected, include:

- 1. Production of Bananas
- 2. Production of Chickens
- 3. Learning Banana Recipes
- 4. How to Make Community Profitable
- 5. Production of Corn in Small Areas
- 6. Artisanal Processing of Fish
- 7. Production of Organic Pigs
- 8. Rotational Cattle Pastures
- 9. Cassava
- 10. Household Garden

Moura & Rosa purchased these courses on March 30, 2012 from the Center for Technical Production (CPT) and with the help of EMBRAPA and SENAR will begin teaching these courses in September 2012. Moura & Rosa have also engaged EMBRAPA to provide technicians to assist with onsite trainings related to reforestation for communities in and near the Purus Project. To date, Moura & Rosa have had several meetings with Judson Valentin, Director of EMPRAPA, and an official letter of support has been submitted to EMBRAPA to engage their staff in these trainings. Moura & Rosa have also met with Jefferson Lunardelli Cogo, the Superintendent of SENAR.

Agricultural extension courses have been acquired and the initiation of agricultural extension training will soon begin. The agricultural extension training will take place over the first five years, while the intensification of agricultural practices and livestock shall take place over the Project Lifetime. Agricultural extension services will result in net GHG emission reductions by reducing the communities' dependence on forest resources through intensifying agriculture and livestock, while also providing alternative and diversified incomes.

Help Communities Obtain Land Rights / Delineate Family Areas

Community members that have been living on the land and who made the land productive (e.g., by growing agriculture or raising animals) for ten years have the right to be entitled. Moura & Rosa will voluntarily recognize whatever area is currently deforested and under productive use by each family. The minimum area to be titled to each family is one hundred hectares which is the minimum size that INCRA says a family in the State of Acre needs for a sustainable livelihood. Those communities who have deforested and put under productive use over one hundred hectares will receive the full area that has been deforested. All communities, whether they join the Purus Project or not, will be entitled to the land they have put under productive use. If necessary, this process will be facilitated by an independent group such as FETACRE or the State Department of Acre

Helping communities obtain land rights and delineating family areas will assist the Project Proponents with facilitating the communities' sustainable economic opportunities. This formal recognition of the community's land tenure and the ability of communities to access credit (i.e., due to the property collateral) will reduce GHG emissions as communities will have greater responsibility and ownership over their land. This project activity will primarily take place in the first few years of the Purus Project.

Initiate Patrols/Monitors of Deforestation

Moura & Rosa have purchased a trike and Wanderley Cesario Rosa (i.e., a Managing Director of Moura & Rosa) participated in training classes on how to operate a trike in April 2012. Aerial monitoring of deforestation began in August 2012 and will occur on a weekly basis during the dry season and on a semi-monthly basis during the wet season.

Figure 1.4. Example of Trikes[7].

If and when deforestation is identified, Moura & Rosa will immediately document and transfer this information to Carbon Securities and CarbonCo. Collectively, CarbonCo and Moura & Rosa will discuss the appropriate actions to undertake to counteract reported deforestation.

The monitors will write down observations, document meetings, and share this information among the Project Proponents. A monitoring report will be completed, including the following information:

- Name of Monitor
- Date of Monitor
- Communities Visited
- Meeting Notes with Community
- Grievances and Concerns of Community
- Location and Date of Deforestation

[7] Trikes Brasil. "Photo Gallery," Available: http://www.trikesbrasil.com.br/galeria-de-fotos.html

- Responsible Actor for Deforestation
- Observations Pertaining to Deforestation
- Biodiversity Observed
- Other Notes Related to the Project

In the future, the Project Proponents would like to hire local patrols to monitor deforestation in areas of high deforestation risk including along property boundaries and along paths of transit including rivers, existing paths in the forest, and nearby roads approaching the property. The Project will initially hire two patrollers and will gradually increase the number of patrollers, as necessary. The main responsibilities of the patrollers will be to establish a presence, identify and document any deforestation, and immediately report such deforestation to the local project manager.

Patrolling / monitoring for deforestation has already begun and such activities will last throughout the Project Lifetime. Patrolling / monitoring for deforestation will result in net GHG emission reductions because such patrols/monitors will provide an early detection of deforestation, while also enabling the Project Proponents to identify the specific drivers and agents of deforestation and to implement the appropriate actions to mitigate such deforestation.

Plant Trees

Trees will be planted to reforest select non-forest areas, outside the project boundary. The first reforestation activities will be carried out in 2013 within the areas of permanent preservation (APP) within one hundred meters of the Purus River banks which are legally required under the Brazilian Forest Code. Moura & Rosa will facilitate in 2013 the planting of grass on the banks of the Purus River, in order to deter landslides and the silting of the Purus River channel and then later begin reforestation of these areas. Moura & Rosa also plans to work with EMBRAPA to restore forest cover in other non-forest area using fruit trees and several native species.

The planting of trees will primarily take place during the first three years of the Project. The planting of trees will result in net GHG emission reductions because of carbon sequestration (i.e., it is important to note that such removals will not be credited as VCUs) and due to agroforestry providing alternative incomes to local communities and placing less pressure on forest resources.

Share a Portion of Profits from Sale of Carbon Credits

At the end of the fifth year, the community will start to receive payments for environmental services as a result of their assistance in achieving the social and environmental goals of the Purus Project. The amount of this payment will be tied to the preservation of forests within the communities' one hundred hectares. Carbon revenue will also finance community improvements, including social assistance, the construction of a primary school, the purchase and operation of a school bus boat, and construction of a health center.

The sharing of profits from the sale of carbon credits will last throughout the Project Crediting Period. This sharing of profits will result in net GHG reductions due to both increased and diversified income for communities, as well as by allowing Moura & Rosa to implement social projects and activities.

1.9 Project Location

The Purus Project area is located in Acre, Brazil along the banks of the Purus River about 20 kilometers southwest of Manoel Urbana. The Purus Project area consists of two contiguous properties known as the Seringal Itatinga and Seringal Porto Central. While the two properties total 35,797 hectares, the total project area (i.e., forested area of the property as of the project start date, and 10 years prior) is 34,702 hectares.

Figure 1.5. Map of the Seringal Itatinga and Seringal Porto Central Properties (Google Earth, accessed 2012).

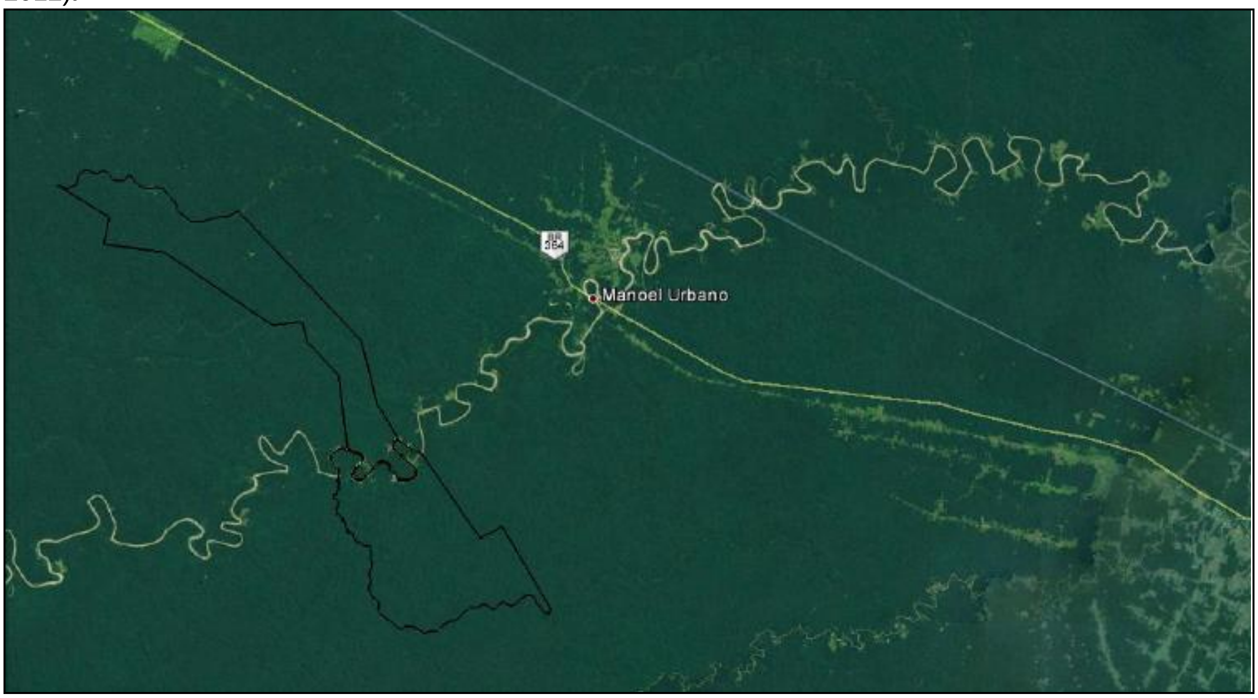


Figure 1.6. 2000 Image of the Purus Project Area, Forest Cover in Light and Dark Green, Deforestation in Pink/Red (ResourceSAT 2000 Image).

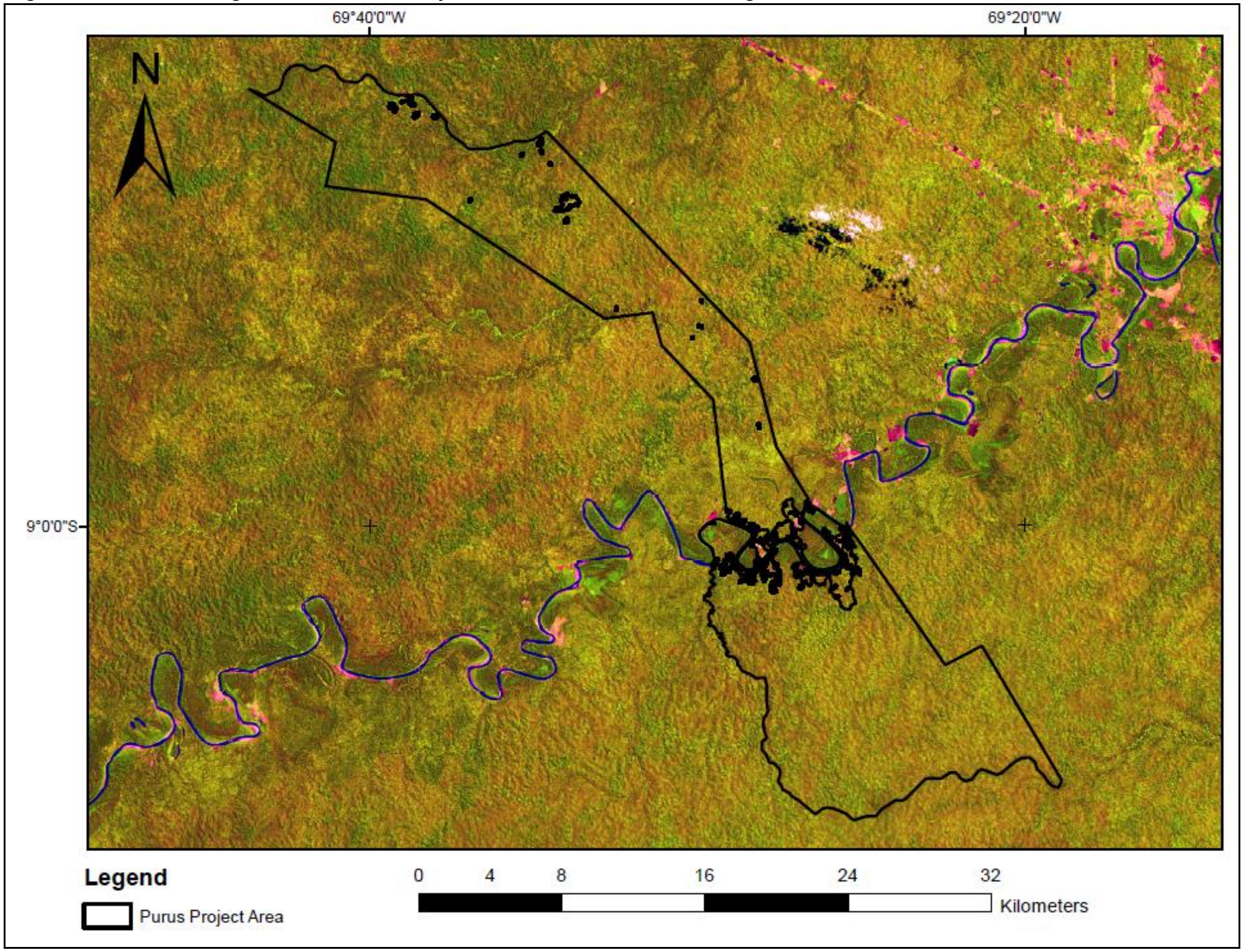
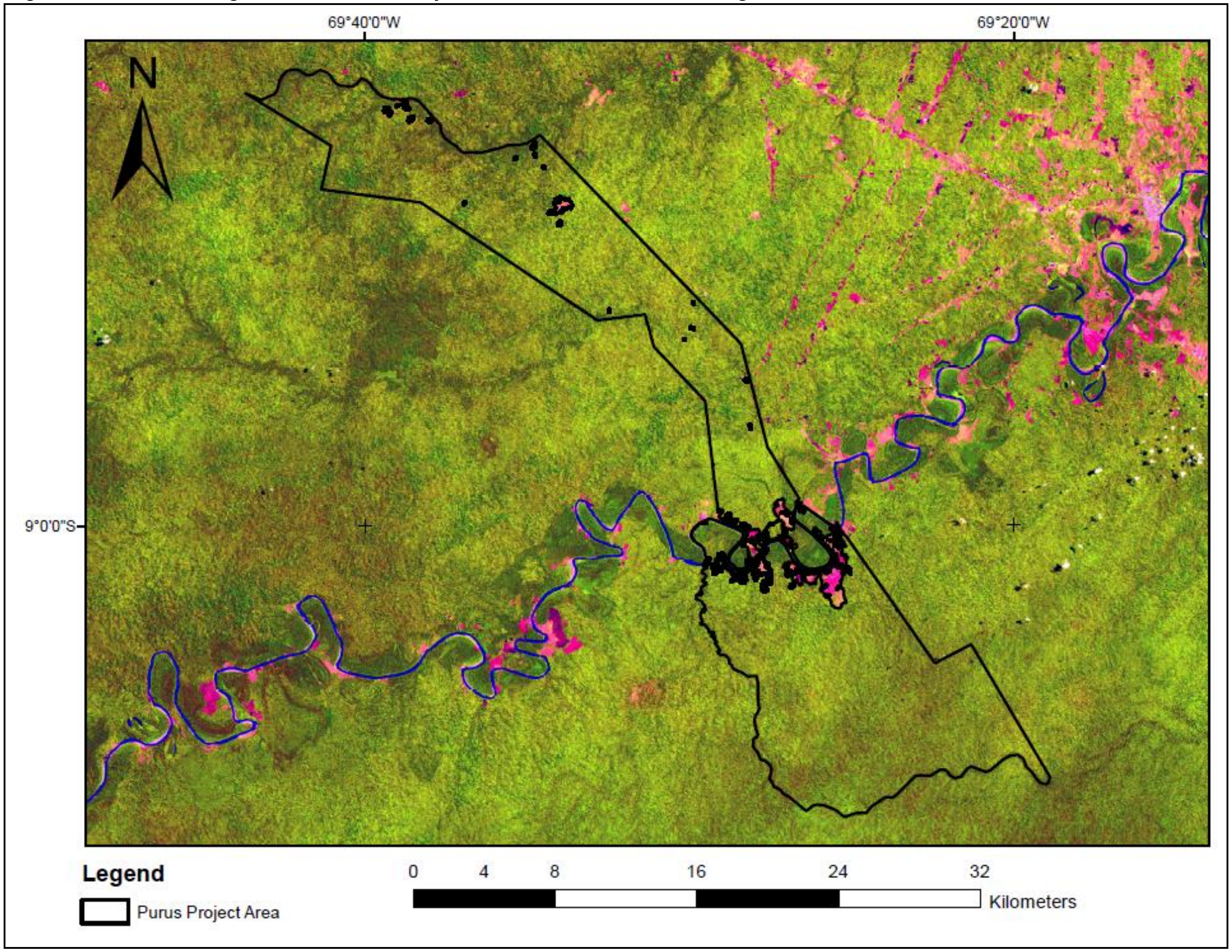


Figure 1.7. 2011 Image of the Purus Project Area, Forest Cover in Light and Dark Green, Deforestation in Pink/Red (ResourceSAT 2010 Image).



1.10 Conditions Prior to Project Initiation

Background information on the project area including environmental variables in and around project region is provided in this section. Further, the project has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction. This is substantiated in this section by documenting the commitment of the Landowners to the conservation of the project area. Moura & Rosa was established specifically to promote the conservation of tropical rain forest, including the project area, and implement projects which result in the preservation of forest in Acre state.

Climate

The climate in the State of Acre is fairly consistent throughout the state. The average annual temperature is 24.5 C[8], while the average annual rainfall is 1,950-2,250 mm/yr. The rainfall in the project area is around 2,100 mm/yr (see Figure 1.8). In general, the rainy season extends from November to April and the dry season from June to September.

Vegetation

The vegetation in the region of the Purus Project area is classified as Floresta Ombrófila Aberta (as open rainforest, RADAMBRASIL[9]). While open rainforest occurs throughout most of Acre State, vegetation differences are driven by geomorphological features and soil type. These differences are manifested in part in the relative proportion of certain species of palms, bamboo and vines.

A vegetation map produced by the State of Acre[10] was used to stratify the project area. The two forest types present in the Purus Project area include: open forest with palm and open forest with bamboo (FAB + FAP in Figure 1.9) and open alluvial forest with palm (FAP-alluvial in Figure 1.9). Aside from differences in palm and hardwood species abundance, the primary differences between these forest types is the relative prevalence of dense bamboo clumps in the former and the greater incidence of vines in riparian areas of the later.

One additional forest type is present in the leakage belt, namely open forest with bamboo and open forest with palm or FAP + FAB. This forest type is hard to distinguishable from FAB + FAP, with the primary difference being the prevalence of bamboo.

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[8] ACRE. Governo do Estado do Acre. Secretaria de Estado de Planejamento e Desenvolvimento Econômico-Sustentável, Secretaria de Estado de Meio Ambiente e Recursos Naturais. Programa Estadual de Zoneamento Ecológico-Econômico do Acre. Zoneamento Ecológico-Econômico do Acre Fase II. Documento Síntese, 2006.

[9] BEZZERA, P.E.L. Compartimentação morfotectônica do interflúvio Solomões-Negro. 2003. 335 f. Tese (Doutorado em Geologia) Universidade Federal do Pará, Belém, 2003.
Brasil. Departamento Nacional da Produção Mineral - Projeto RADAMBRASIL. Geologia, Geomorfologia, Pedologia, Vegetação e Uso Potencial da Terra. Folha V.12 FlS SC 19. Rio Branco; Rio de Janeiro, 1976.

[10] ACRE. Governo do Estado do Acre. Secretaria de Estado de Planejamento e Desenvolvimento Econômico-Sustentável, Secretaria de Estado de Meio Ambiente e Recursos Naturais. Programa Estadual de Zoneamento Ecológico-Econômico do Acre. Zoneamento Ecológico-Econômico do Acre Fase II. Documento Síntese, 2006.

Soils

North of the Purus River the project area is dominated by eutrophic Cambisols (see Figure 1.10). These moderately drained soils are generally shallow and highly susceptible to erosion. Plinthosols stretching along the banks of the Purus Rivers are iron rich clay soils and are considered acidic and nutrient-poor. The soil type south of the Purus River is predominantly vertisols. These moderately deep clay soils have very low permeability.

There are no organic soils (i.e., histosols) in or around the project area or leakage belt.

Rivers

The Purus River is one of the longest tributaries to the Amazon River[11]. It is an important river linking the Ucayali region of Peru with the states of Acre and Amazonas in Brazil (See Figure 1.11). Throughout Acre, the Purus River runs from southwest to northeast toward the state of Amazonas. The course of the Purus River is not set and meanders within the stream bed in the dry season. Erosion of the banks of the Purus River is typical after the wet season as the river level drops[12].

[11] Instituto Brasileiro de Geografia e Estatística, “AC-Politico,” ftp://geoftp.ibge.gov.br/mapas/tematicos/politico/AC_Politico.pdf

[12] ACRE. Governo do Estado do Acre. Secretaria de Estado de Planejamento e Desenvolvimento Econômico-Sustentável, Secretaria de Estado de Meio Ambiente e Recursos Naturais. Programa Estadual de Zoneamento Ecológico-Econômico do Acre. Zoneamento Ecológico-Econômico do Acre Fase II. Documento Síntese, 2006.

Figure 1.8. Precipitation Isolines (30 year average 1961-1991) in the Vicinity of the Project Area.

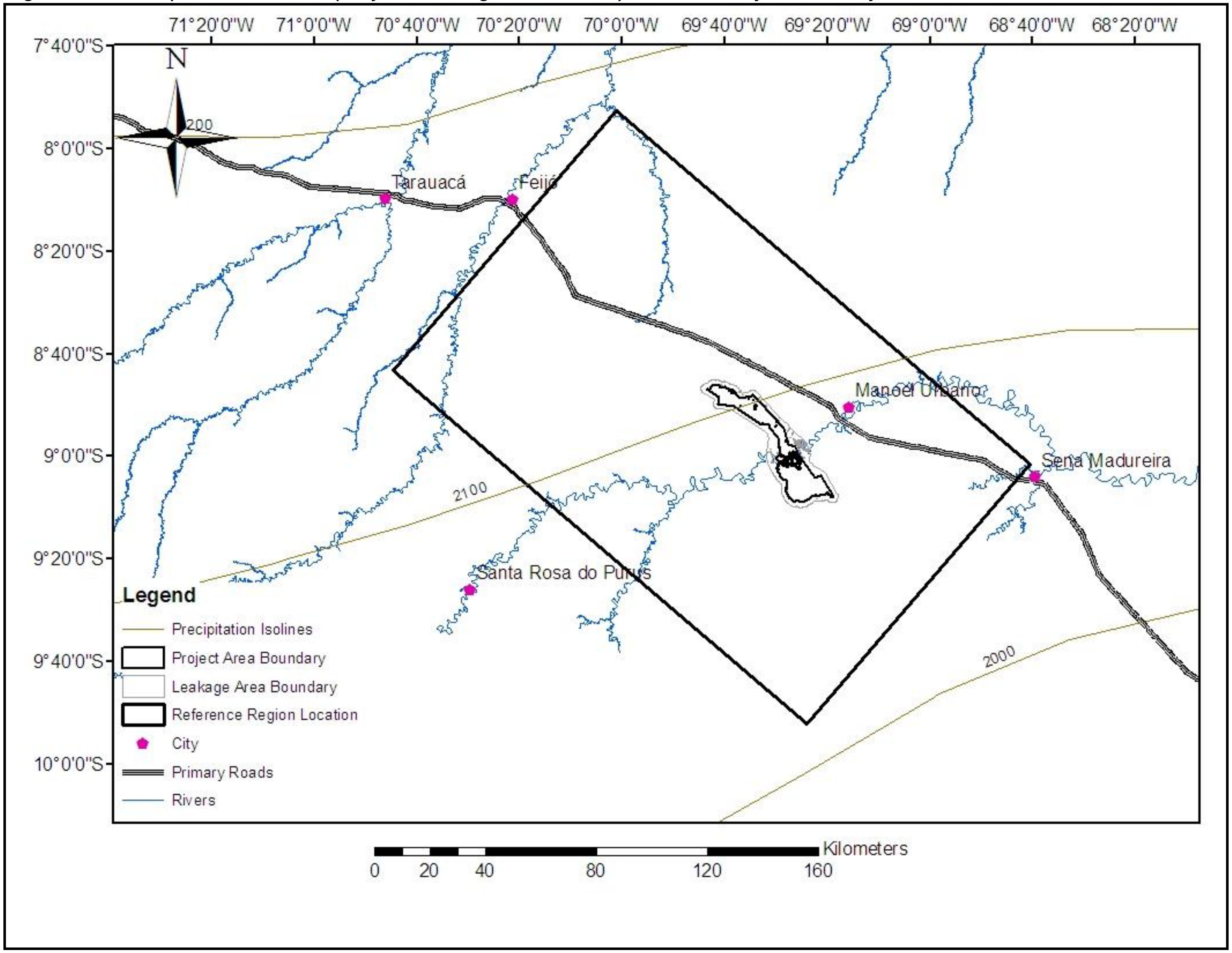


Figure 1.9 Vegetation in the Vicinity of the Project Area.

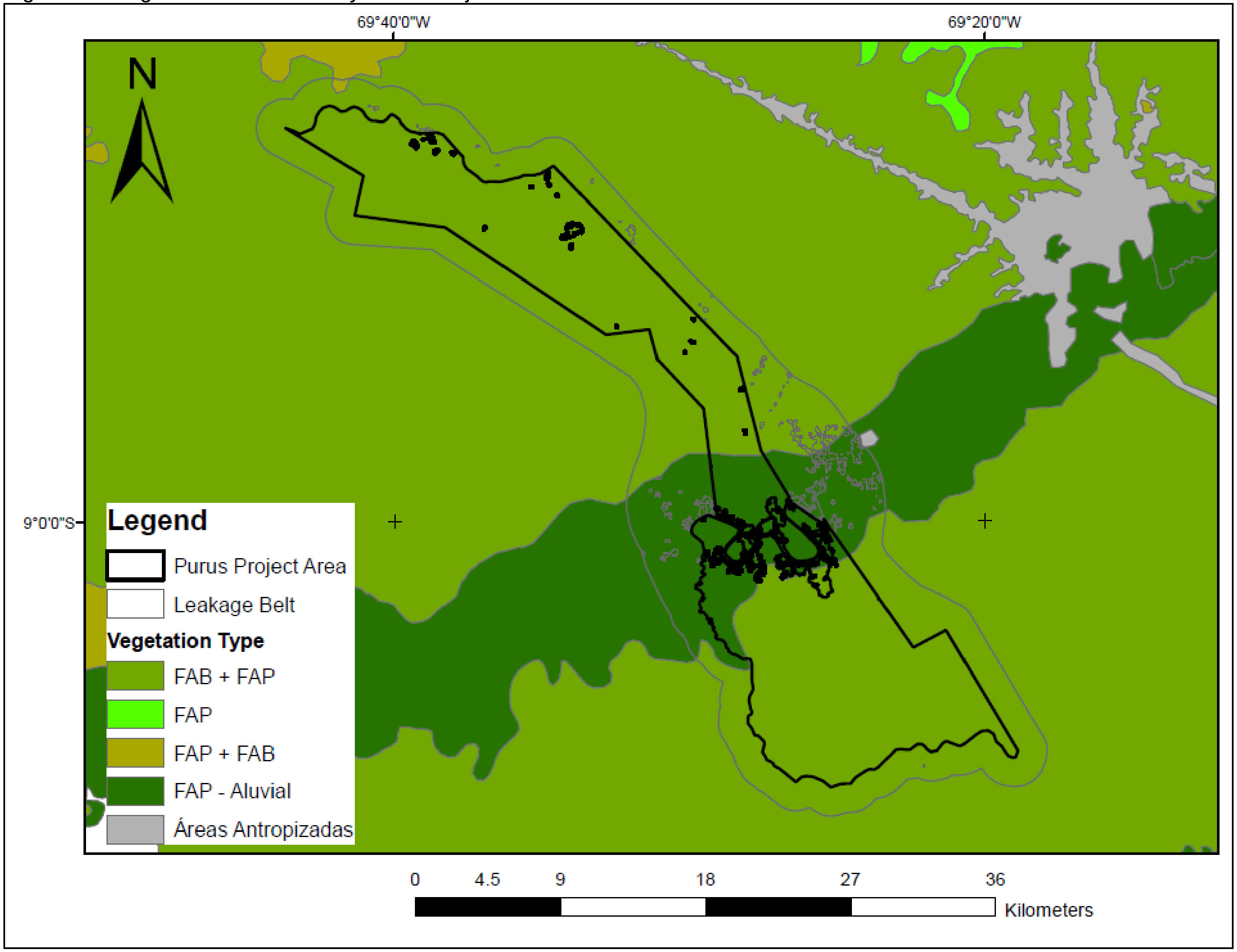


Figure 1.10. Soils in the Vicinity of the Project Area. The Project Area is Outlined in Red.

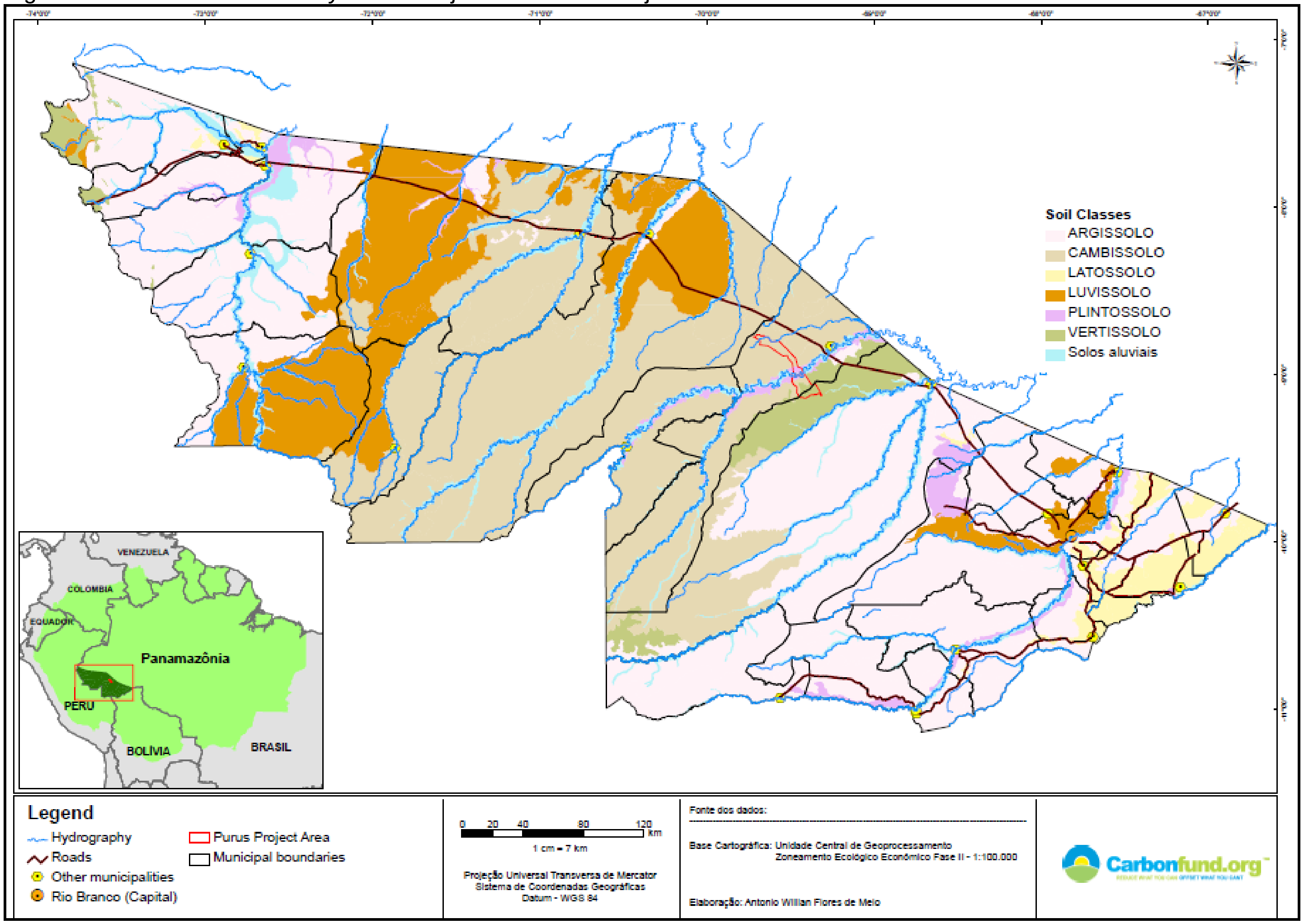
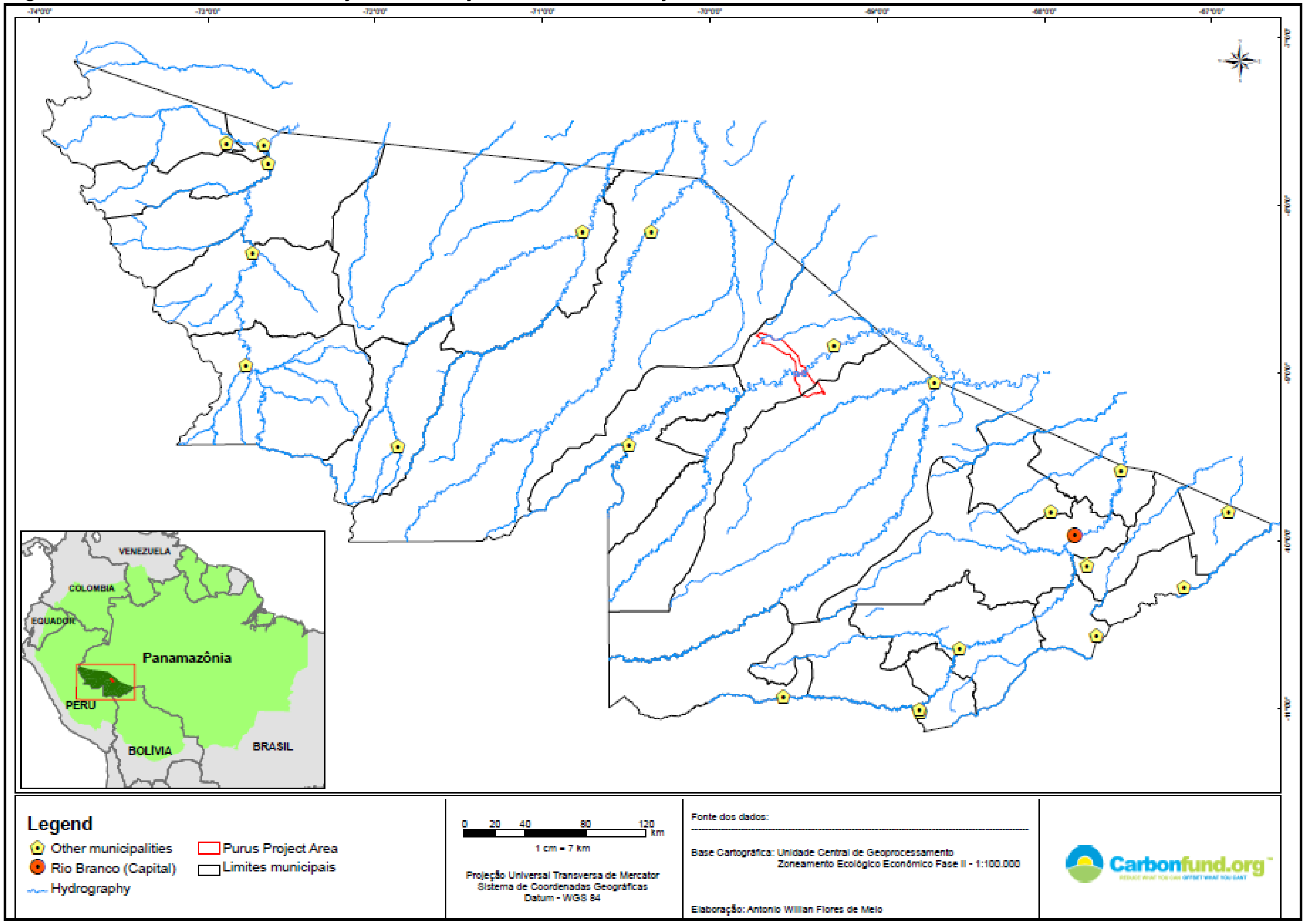


Figure 1.11. Rivers in the Vicinity of the Project Area. The Project Area is Outlined in Red.



History

The project property consists of two adjacent parcels, the Seringal Itatinga and the Central Port Seringal parcel. Historically, and prior to the acquisition of the property by the current landowners, the property was used for rubber tapping

Upon acquiring the property, the landowners initially desired to deploy a livestock operation, which would have involved the deforestation and clear-cutting of 20% of the area (i.e., approximately 7,000 hectares) to accommodate 10,000 to 12,000 head of cattle. The remainder of the property would have come under a forest management plan and hence logging would have occurred. As the livestock and logging operation would have involved the systematic removal of all local residents (i.e., forcing a rural exodus) the landowners choose not to proceed with this option.

After completion of the first forest carbon study of the area, the creation of Moura & Rosa was a dream nurtured by the landowners. Moura & Rosa was later founded in February 2009 to promote the preservation of tropical rainforests situated on the banks of the Purus River in the municipality of Manoel Urbano, Acre State, Brazil (i.e., the Purus Project).

Moura & Rosa was created by Normando Rodrigues Sales and Wanderley Cesário Rosa to ensure the contiunity of ongoing projects and investments targeting the preservation of the Purus Project area. With the possibility of valuing the environmental services from the preservation of the tropical rainforest on the property, the Landowners decided to invest in knowledge, searching for information, studies and site surveys, so that conservation would become a reality while also providing for the families living on the property. The social aspects of the project are envisioned to have multiple effects where the project not only mitigates deforestation, but also helps the families in the area.

Local communities

There are 18 communities living on the project property along the banks of the Purus River. These communities engage in small scale/subsistence farming and ranching (Figure 1.12). In addition these communities hunt and gather in the forest surrounding their farms. Fuelwood collection is sustainable and no resources extracted from the forest are for commercial markets, but rather are used for a largely subsistence livelihood.

Of the thirteen communities on the property surveyed, only two have lived there for less than five years, with six of the communities there for twenty years or longer.

Figure 1.12. Baseline Land-Use Practices Among Communities Include Small Scale Agriculture and Cattle-Ranching.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

All project proponents have maintained compliance with relevant local, state, and national laws, statues and regulatory frameworks.

National Laws and Regulatory Frameworks

The Purus Project abides by Brazilian national laws including the Brazilian Constitution. Chapter 6 of the Brazilian Constitution specifically discusses environmental issues in Article 225[13] , and the project activity aligns with the national mandate as expressed in Article 225 paragraph 4, below.

> Paragraph 4 - The Brazilian Amazonian Forest, the Atlantic Forest, the Serra do Mar, the Pantanal Mato-Grossense and the coastal zone are part of the national patrimony, and they shall be used, as provided by law, under conditions which ensure the preservation of the environment.

Further all provisions of the Brazilian Forest Code are adhered to by the Purus Project.

[13] Georgetown University, “1988 Constitution, with 1996 reforms in English,” http://pdba.georgetown.edu/Constitutions/Brazil/english96.html#mozTocId920049

These include:

- The original Brazil Forest Code entitled, Law No. 4771, September 15, 1965.[14]
- Revision of Brazil Forest Code under Law No. 7803, July 18, 1989.[15]
- Provisional Measure under No, 2166-67, August 24, 2001.[16]

Title of Law

Law Number 4771 of September 15, 1965, entitled "Establishing the new Forest Code."

Summary of Law

Law Number 4771 of September 15, 1965 was the original Brazil Forest Code. A few major provisions of the Forest Code were the establishment of permanent preservation areas (APP), establishment of legal reserves of 50% on properties in the Legal Amazon, and designation of Acre State (among others) as within the Legal Amazon territory.[17] Many of these provisions have been revised since 1965.

Compliance with Law

The Purus Project, as can be documented via satellite imagery or firsthand observations, has respected the Project's permanent preservation areas and legal reserves.

Title of Law

Law Number 6.938 of August 31, 1981 entitled, "Provides for the National Environmental Policy, its aims and mechanisms for the formulation and implementation, and other measures."

Summary of Law

Law Number 4771 of August 21, 1981 is based off Brazil's constitution and established Brazil's National Environmental Policy. Essentially, the "National Policy on the Environment is aimed at the preservation, improvement and restoration of environmental quality conducive to life, to ensure, in the country, conditions for the socio-economic development, the interests of national security and protecting the dignity of life human." Agencies were also established to carry out the National Environmental Policy.[18]

Compliance with Law

The Purus Project have identified, consulted and shall continue to work with the relevant agencies responsible for environmental protection, particularly with respect to REDD projects. Furthermore, the

[14] Presidency of the Republic, "Law No. 4771, September 15, 1965," Available: http://www.planalto.gov.br/ccivil_03/Leis/L4771.htm
[15] Presidency of the Republic, "Law No. 7803, July 18, 1989," Available: http://www.planalto.gov.br/ccivil_03/leis/L7803.htm
[16] Presidency of the Republic, "Provisional Measure 2166-67, August 24, 2001," Available: https://www.planalto.gov.br/ccivil_03/MPV/2166-67.htm
[17] Presidency of the Republic, "Law No. 4771, September 15, 1965," Available: http://www.planalto.gov.br/ccivil_03/Leis/L4771.htm
[18] Presidency of the Republic, "Law No. 6.938, August 31, 1981," Available: http://www.planalto.gov.br/ccivil_03/leis/L6938.htm

Purus Project will seek to conserve soil and water resources, protect rare and threatened ecosystems, and promote the recovery of degraded areas and encourage environmental education.

Title of Law

Law Number 7803 of July 18, 1989 entitled, "Change the wording of Law No. 4771 of September 15, 1965, and repealing Laws Nos. 6535 of June 15, 1978, and 7511 of 7 July 1986."

Summary of Law

Law Number 7803 was the first significant amendment to the original 1965 Forest Code. For example, the permanent preserve areas were reclassified. The Law also stipulated that "the exploitation of forests and succeeding formations, both public domain and private domain, will depend on approval from the Brazilian Institute of Environment and Renewable Natural Resources - IBAMA, and the adoption of techniques of driving, exploitation, reforestation and management compatible with the varied ecosystems that form the tree cover.[19]

Compliance with Law

The Purus Project will abide by the new guidance on permanent preserve areas such as to not clear forests on steep slopes or within one hundred meters proximity to rivers. Any such clearing that has taken place in the past, will be reforested by Moura & Rosa.

Title of Law

The Provisional Measure Number 2166-67 of August 24, 2001 entitled, "Changes the arts. 1, 4, 14, 16 and 44, and adds provisions to Law No. 4771 of September 15, 1965, establishing the Forest Code and amending art. 10 of Law No. 9393 of December 19, 1996, which provides for the Property Tax Territorial Rural - ITR, and other measures."

Summary of Law

The Provisional Measure Number 2166-67 of August 24, 2001 was one of the latest revisions to the original 1965 Forest Code and to the amendments of Law Number 7803. The most relevant change to the Purus Project was the revision of the legal reserve requirement in the Legal Amazon (i.e., including the State of Acre) from 50% to 80% which shall be conserved.[20]

Compliance with Law

As mentioned previously, the Purus Project - as can be documented via remote sensing or firsthand observations - has respected both the Project's permanent preservation areas and the recently revised legal reserve requirement.

[19] Presidency of the Republic, "Law No. 7803, July 18, 1989," Available: http://www.planalto.gov.br/ccivil_03/leis/L7803.htm
[20] Presidency of the Republic, "Provisional Measure 2166-67, August 24, 2001," Available: https://www.planalto.gov.br/ccivil_03/MPV/2166-67.htm

State Laws and Regulatory Frameworks

The project proponents of the Purus Project abide by Acre's state laws and regulatory frameworks. Specifically these include:

- The Acre Forestry Law (Bill Number 1.426 of December 27, 2001); and
- The State System of Incentive for Environmental Services (Bill Number 2.308 of October 22, 2010).

Title of Law

Law Number 1.426, December 27, 2001, entitled, "The Acre Forestry Law."

Summary of Law

The Acre Forestry Law Number 1,426 of December 27, 2001 essentially, "provides for the preservation and conservation of State forests, establishing the State System of Natural Areas, creates the State Forest Fund and other measures." The Law also established the institutional responsibility for the management of State Forests, defines forests, and outlines the administrative penalties for non-compliance.

Compliance with Law

The Purus Project is on private property and thus, this law is not relevant. Nevertheless, the Project Proponents shall contribute to the sustainable use of forest resources, preserve biodiversity, and also "promote ecotourism, recreation, forestry research and education."[21]

Title of Law

Law Number 2.308 of October 22, 2010 entitled, "The State System of Incentive for Environmental Services."

Summary of Law

The State System of Incentive for Environmental Services (SISA) was "created, with the aim of promoting the maintenance and expansion of supply of the following ecosystem products and services:

I - sequestration, conservation and maintenance of carbon stock, increase in carbon stock and decrease in carbon flow;

II - conservation of natural scenic beauty;

III - socio-biodiversity conservation;

IV - conservation of waters and water services;

V - climate regulation;

VI - increase in the value placed on culture and on traditional ecosystem knowledge;

[21] The Governor of the State of Acre, "Acre Forestry Law, December, 27, 2001," Available: http://webserver.mp.ac.gov.br/?dl_id=800

VII - soil conservation and improvement."[22]

Compliance with Law

As a tropical forest ecosystem services project, otherwise known as REDD, the Purus Project shall seek to conserve the forests' carbon stock, while also conserving the natural scenic beauty, biodiversity, water and soil resources, along with working alongside the local communities.

Labor Laws

The Purus Project shall meet, or exceed, all applicable labor laws and regulations and the Project Proponents will inform all workers about their rights.

The following is a list of Brazil's relevant labor laws and regulations:

- The Brazilian Constitution, Chapter II-Social Rights, Articles 7- 11 which addressed:
  - Minimum wage
  - Normal working hours
  - Guidance on vacation and weekly leave
  - Guidance on maternity and paternity leave
  - Recognition of collective bargaining
  - Prohibition of discrimination[23]

In addition to the Constitution, there are two additional decrees related to Brazilian labor laws.

- Consolidação das Leis do Trabalho (CLT): DECRETO-LEI N.º 5.452, DE 1º DE MAIO DE 1943 (Consolidate of Working Laws).[24] This decree gives more clarification on:
  - Hourly, daily, weekly and monthly work hours
  - Employment of minors and women
  - Establishes a minimum wage
  - Worker safety and safe working environments
  - Defines penalties for non-compliance by employers
  - Establishes a judicial work-related process for addressing all worker related issues

[22] State of Acre, "Unofficial Translation, State of Acre, Bill No. 2.308 of October 22, 2010," Available: http://www.gcftaskforce.org/documents/Unofficial%20English%20Translation%20of%20Acre%20State%20Law%20on%20Environmental%20Services.pdf
[23] Massachusetts Institute of Technology, "Brazilian Constitution," Available: http://web.mit.edu/12.000/www/m2006/teams/willr3/const.htm
[24] Presidency of the Republic, "DECRETO-LEI N.º 5.452, DE 1º DE MAIO DE 1943, Available: http://www.planalto.gov.br/ccivil_03/decreto-lei/Del5452.htm

- Estatui normas reguladoras do trabalho rural: LEI Nº 5.889, DE 8 DE JUNHO DE 1973 (Establishes Regular Norms for Rural Workers).[25] This is a complimentary law to the aforementioned 1943 decree because prior to 1973, rural workers did not have the same rights as urban workers. In 1973, this law was established to specify the equality between urban and rural workers, along with compensation for overtime.

With respect to the taxation regulations relevant to the Purus Project, Brazil has the following taxation regulations:

- COFINS (Contribution to Social Security Financing), Lei Complementar Federal 70/1991: This regulation relates to the social contribution to finance social security.
- CSLL (Social Contribution on Net Corporate Profit), Lei Federal 7689/1988: This regulation is the social contribution calculated on net profit.
- FGTS (Length of Service Guarantee Fund), Lei Federal 8036/1990: This regulation is a contribution paid to a fund for each employee hired. When the employee is laid-off, they can take the money as compensation.
- ICMS (Tax on the Circulation of Merchandise and Interstate and Inter-municipal Transportation Services and Communications), Lei Complementar Federal 87/1996 and Lei Complementar Estadual 55/1997: These regulations are a state tax paid when you sell merchandise and thus, is not relevant to the Purus Project.
- IRPJ (Corporate Income Tax), Lei Federal 9430/2996: This regulation is for tax paid on corporate income.
- ISS (Tax on Services of Any Nature), Lei Complementar Federal 116/2003: Each city has a similar law to fulfill the federal law and this regulation is a municipal tax paid on services.
- INSS (Social Security): Lei Federal 8212/1991: This regulation is for contribution paid for the Federal Retirement Fund.
- PIS (Social Integration Tax), Lei Complementar Federal 07/1970: This regulation is for contribution paid to the Social Integration Fund.
- ITR (Rural Land Tax), Lei Federal 9393/1996: This regulation is for tax paid on rural landownership.
- IPTU (Urban Building and Land Tax), Lei Federal 10257/2001: Each city has its complementary and similar law. This regulation is for a municipal tax paid on urban landownership and thus, not relevant to the Purus Project.
- IPVA (Tax on Automotive Vehicles), Lei Federal 8441/1992: Each city has its complementary and similar law. This regulation is for a municipal tax paid on the ownership of vehicles.[26],[27]

Compliance with Law

Agreements between the Project Proponents as well as Agreements between CarbonCo and its contractors stipulate firms to abide by labor laws (for example, wages above Brazil's federal minimum wage) and to assure all employment taxes and insurance are paid.

[25] Presidency of the Republic. "LEI Nº 5.889, DE 8 DE JUNHO DE 1973," Available: http://www.planalto.gov.br/ccivil_03/leis/L5889.htm
[26] Personal Correspondence with Mr. Leonardo Silva Cesário Rosa, Federal Prosecutor
[27] Secretariat of the Federal Revenue of Brazil, "Taxes," Available: http://www.receita.fazenda.gov.br/principal/ingles/SistemaTributarioBR/Taxes.htm

In addition, CarbonCo has an employee handbook to ensure proper guidelines are followed by its employees and contractors. Moura & Rosa also have an explanatory letter on labor rights that will be presented to all of their employees to ensure workers are informed about their rights.

CarbonCo undertakes an annual financial audit by an independent accountant to ensure all taxes, including employment, social and corporate, are paid. Furthermore, Moura & Rosa have provided “Certificado de Regularidade do FGTS – CRF” and the “CERTIDÃO NEGATIVA DE DÉBITOS RELATIVOS ÀS CONTRIBUIÇÕES PREVIDENCIÁRIAS E ÀS DE TERCEIROS” which certify that all taxes (including employee and business) and insurance (including social) are paid.

1.12 Ownership and Other Programs

1.12.1 Right of Use

Review of the landowners and properties on which the Purus Project has been implemented were conducted to ensure full title validity and accuracy. A copy of the title documentation is provided in the project archive including the:

- Certidao de inteiro teor (or certification of full rights), and
- Georeferenced property delineation.

This documentation satisfies the VCS Standard as rights of use “arising by virtue of a statutory, property or contractual right”[28] has been documented.

Carbon Securities conducted an initial search for any pending cases, lawsuits, or other problems associated with the Landowners, their CPF numbers[29] (i.e., Cadastro de Pessoas Físicas), their property, and their company’s CNPJ number. Federal tax issues and liens associated with the Landowners and the project property were assessed using the Cadastro de Pessoas Físicas[30] and INCRA[31] websites. INCRA, or Instituto Nacional de Colonização e Reforma Agrária, is a Brazilian Federal Institute and their website states what types of certifications are required to document appropriate landownership and who can ask for such certifications. Finally, Carbon Securities visited the IBAMA, or Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, website[32] to ensure IBAMA has not blocked landownership titles due to noncompliance with environmental laws and regulation associated with a particular property. State and municipality level documentation[33] further demonstrated authentic land ownership. These local authorities in Acre are able to provide up to a 100-year history of landownership for the properties.

[28] VCS. 2012 VCS Standard. Version 3.3, 04 October 2012. Verified Carbon Standard, Washington, DC
[29] The CPF number is the equivalent of a social security number in the US.
[30] Secretariat of the Federal Revenue of Brazil, “CPF - Cadastro de Pessoas Físicas,” Available: http://www.receita.fazenda.gov.br/PessoaFisica/CPF/CadastroPF.htm and http://www.receita.fazenda.gov.br/
[31] Secretariat of the Federal Revenue of Brazil, “Certidão Negativa - Imóvel Rural,” Available: http://www.receita.fazenda.gov.br/guiacontribuinte/cnd_%20itr.htm
[32] IBAMA, “Certidão Negativa de Débito,” Available: http://www.ibama.gov.br/sicafiext/sistema.php
[33] Ministry of Justice of Brazil, “Cadastro de Cartório do Brasil,” Available: http://portal.mj.gov.br/CartorioInterConsulta/consulta.do?action=prepararConsulta&uf=AC

With respect to private ownership of carbon rights in Brazil, a Presidential Decree on July 7, 1999 by the Brazilian Government established the Inter-ministerial Commission on Global Climate Change as the Designated National Authority for approval of projects under the UNFCCC Kyoto Protocol's Clean Development Mechanism.[34]

José D.G. Miguez, Executive Secretary of the Brazilian Interministerial Commission on Global Climate Change, presented on March 18, 2003 at the Organisation for Economic Co-operation and Development (OECD) Global Forum on Sustainable Development: Emissions Trading Concerted Action on Tradeable Emissions Permits (CATEP) Country Forum. Within the presentation, Mr. Miguez specifically indicated the private sectors ability "to design, develop and implement CDM project activities" in Brazil.[35] This said, there are currently numerous private sector CDM and voluntary carbon market projects in Brazil including projects within the Agricultural, Forestry and Other Land-use (AFOLU) sector.

The Tri-Party Agreement documents the transfer of a portion of these rights from Moura & Rosa to CarbonCo and Carbon Securities.

1.12.2 Emissions Trading Programs and Other Binding Limits

No emission reductions generated by the project are part of an emissions trading program. Further, Brazil does not currently have a national, legally binding limit on greenhouse gas (GHG) emissions nor is there currently a compliance emissions trading program which accepts REDD credits.

1.12.3 Participation under Other GHG Programs

The Purus Project has not been registered, nor is seeking registration, under any other GHG programs. The Purus Project is seeking registration under the Climate, Community and Biodiversity Alliance Standard.[36]

1.12.4 Other Forms of Environmental Credit

The project has not nor intends to create non-VCS GHG emission reductions or any another form of environmental credit. This includes, but is not limited to, biodiversity credits, species banking, water certificates, and nutrient certificates.[37]

1.12.5 Projects Rejected by Other GHG Programs

The project has neither submitted to nor been rejected from any other greenhouse gas program.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The Purus Project is not a grouped project and therefore this section of the project document (PD) is not applicable.

Leakage Management

[34] Ministry of Science, Technology and Innovation, "Designated National Authority (Interministerial Commission on Global Climate Change)," Available: http://www.mct.gov.br/index.php/content/view/14666.html
[35] José D.G. Miguez, "CDM in Brazil," Available: www.oecd.org/dataoecd/9/6/2790262.pdf
[36] The CCB project document is available at http://climate-standards.org/projects/
[37] Forest Trends, "Our Initiatives," http://www.forest-trends.org/#

The baseline agents of deforestation are members of nearby communities and immigrant actors looking for land to convert to pasture.

Project level leakage mitigation activities are largely directed toward helping small scale farmers in the surrounding communities reduce the need to clear lands in the leakage belt. Leakage management activities are largely the same as the project activities, as the target audience, local communities are the same. Leakage management activities include:

- Community outreach and education;
- Potential employment as project forest guard or other project staff (replacing other sources of income associated with deforestation and land use);
- Agricultural extension training will help baseline agents to increase productivity on current lands, (thus reducing the pressure to expand their farms in the adjacent forest); and
- Reforestation of select non-forest areas.

Leakage management activities (and project activities) directed at local agents of deforestation are more fully described in Section 1.8.

Leakage management activities directed at immigrant actors occur as part of state-wide initiatives to reduce deforestation and environmental degradation in Acre. The Purus Project proponents have met and interacted with State officials multiple times who are responsible for implementing these programs, as noted in Section 6.0, and intend to maintain close coordination with the State of Acre throughout project implementation.

Specifically, regarding state-wide actions, recent legislation passed by the State of Acre in October 2010 (Bill No 2.308, October 22 2010, established the State System of Incentive for Environmental Services or SISA. The SISA legislation helps further develop an Acre state run payment for environmental services (PES) scheme. Acre began its PES program in 1999 with subsidies to rubber tappers. The program in its current, more sweeping form was developed through an extensive public consultation process, receiving local and international input that concluded in April 2010. The law establishing the current PES program (SISA) was passed in October 2010.

The SISA program is composed of multiple programs covering a range of environmental services. Among these is the carbon program (Program ISA-Carbono) with multiple sub-programs for implementation (e.g., agriculture intensification) directed toward different populations/land ownerships in the state. It should be noted that the Program ISA-Carbono is not just REDD-focused, but rather includes all forest carbon (e.g. including reforestation).

The SISA program will be managed in part by the newly-created Regulation, Control and Registration Institute (RCRI), and will eventually be housed at “The Technology Foundation of Acre” (FUNTAC). According to Article 1 of the bill[38], it was created “with the aim of promoting the maintenance and expansion of supply of the following ecosystem products and services:

> I - sequestration, conservation and maintenance of carbon stock, increase in carbon stock and decrease in carbon flow;

[38] State of Acre, Brazil. 2010. Bill No. 2.308: To create the State System of Incentives for Environmental Services (SISA). Unofficial translation.

II - conservation of natural scenic beauty;

III - socio-biodiversity conservation;

IV - conservation of waters and water services;

V - climate regulation;

VI - increase in the value placed on culture and on traditional ecosystem knowledge;

VII - soil conservation and improvement.

The Program ISA-Carbono was established to help create and implement economic and financial instruments to achieve emission reduction targets, improve infrastructure and instruments for measurement, quantification and verification, and to assist with registration and transparency. The PES scheme[39] anticipates the provision of the following services to help achieve the above goals:

- Technical Assistance and Rural Extension (ATER) for all segments of rural population;
- Mobilization, communication and strengthening of community organizations; and
- Strengthening of Municipal Plans for Prevention and Control of Deforestation and Fires.

Commercially Sensitive Information

There is no commercially sensitive information in this project description document.

Further Information

None.

[39] Acre Government. 2009. Payments for Environmental Services- Carbon Policy. Rio Branco, Acre, Brazil.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The Purus Project is utilizing the Avoided Deforestation Partners' VCS REDD Methodology, entitled, "VM0007: REDD Methodology Modules (REDD-MF)." The specific modules applied to the Purus Project are listed below.

REDD-MF, REDD Methodology Framework Version 1.3

Carbon Pool Modules:

CP-AB, "VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools," Version 1.0

CP-D, "VMD0002 Estimation of carbon stocks in the dead-wood pool," Version 1.0

Baseline Modules:

BL-UP, "VMD0007 Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation," Version 3.1

Leakage Modules:

LK-ASU, "VMD0010 Estimation of emissions from activity shifting for avoided unplanned deforestation," Version 1.0

Monitoring Module:

M-MON, "VMD0015 Methods for monitoring of greenhouse gas emissions and removals," Version 2.1,

Miscellaneous Modules:

X –STR, "VMD0016 Methods for stratification of the project area," Version 1.0

X-UNC, "VMD0017 Estimation of uncertainty for REDD project activities," Version 2.0

Tools:

T-SIG, CDM tool "Tool for testing significance of GHG emissions in A/R CDM project activities," Version 1.0

T-ADD, "VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities," Version 3.0

T-BAR, "Tool for AFOLU non-permanence risk analysis and buffer determination," Version 3.2

Use of modules, REDD-MF, M-MON, T-ADD, T-BAR, X-UNC, and X–STR, is justified as these modules are always mandatory when using the VM0007 methodology. Further use of modules, BL-UP and LK-ASU, is mandatory in the case of projects focusing on unplanned deforestation. Use of the module T-SIG is justified as it determines whether GHG emissions by sources and/or decreases in carbon pools are insignificant. Finally, CP-AB is justified as it is mandatory in all cases and CP-D is justified as it is mandatory as the dead wood pool is greater in the baseline than project scenario. The above modules are applicable because they meet the applicability conditions of the modules.

2.2 Applicability of Methodology

REDD-MF, REDD Methodology Framework, Version 1.3

Table 2.1: Applicability Conditions and Justifications for the REDD Methodology Framework Module.

Applicability Condition	Justification
Land in the project area has qualified as forest at least 10 years before the project start date.	The project area complies with this condition as mentioned in Section 1.9, with complete forest cover demonstrated for the years 2000 and 2010.
The project area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm^3. If the project area includes a forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable.	As demonstrated in Section 1.10, no organic soils exist within the project area.
Project proponents must be able to show control over the project area and ownership of carbon rights for the project area at the time of verification.	As shown in Section 1.12, the project proponents have the control of the project area and the ownership of the carbon credits.
Baseline deforestation and baseline forest degradation in the project area fall within one or more of the following categories: Unplanned deforestation (VCS category AUDD); Planned deforestation (VCS category APD); Degradation through extraction of wood for fuel (fuelwood and charcoal production) (VCS category AUDD).	Baseline deforestation in the project area falls within the unplanned deforestation category, as the agents of deforestation are small scale farmers who do not have permission to convert forest in the project area to pasture and cropland.
Baselines shall be renewed every 10 years from the project start date.	The baseline will be renewed in May 2021.
All land areas registered under the CDM or under any other carbon trading scheme (both voluntary and compliance-orientated) must be transparently reported and excluded from the project area. The exclusion of land in the project area from any other carbon trading scheme shall be monitored over time and reported in the monitoring reports.	The Purus Project is not registered in any carbon trading scheme or program.
If land is not being converted to an alternative use but will be allowed to naturally regrow (i.e. temporarily unstocked), this framework shall not be used.	Forest clearing in the baseline is followed by establishment of cropland or pasture, both of which prevent forest regrowth.
Where post-deforestation land use constitutes reforestation this framework shall not be used.	The post-deforestation land use in the project area is pasture for livestock grazing or cropland, and is not reforestation.

Leakage avoidance activities shall not include: Agricultural lands that are flooded to increase production (e.g. paddy rice); Intensifying livestock production through use of “feed-lots” and/or manure lagoons.	Leakage avoidance activities do not include flooding agricultural land or creating feed-lots or manure lagoons.

BL-UP, “VMD0007 Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions from Unplanned Deforestation,” Version 3.1

Table 2.2: Applicability Conditions and Justifications for the VMD0007 Module.

Applicability Condition	Justification
Baseline agents of deforestation shall: (i) clear the land for settlements, crop production (agriculturalist) or ranching, where such clearing for crop production or ranching does not amount to large scale industrial agriculture activities; (ii) have no documented and uncontested legal right to deforest the land for these purposes; and (iii) are either resident in the reference region or immigrants. Under any other condition this framework shall not be used.	The baseline agents of deforestation clear the land for settlements, ranching and cropland. These small scale farmers have no legal right to use or deforest the land. These agents of deforestation are from nearby communities and in some cases immigrant actors looking for land to convert for agricultural uses.
It shall be demonstrated that post-deforestation land use shall not constitute reforestation.	The post-deforestation land use in the project area is pasture for livestock grazing or cropland, and is not reforestation.
Where, pre-project, unsustainable fuelwood collection is occurring within the project boundaries modules BL-DFW and LK-DFW shall be used to determine potential leakage.	No fuelwood collection occurs within the project boundaries as evidenced from participatory rural appraisals conducted March 10-12, 2012 and a follow-up PRA conducted December 9, 2012, which clarified fuelwood collection and use practices. Further, Igor Agapejev de Andrade a local forester familiar with the property states “The community uses fuelwood originating from dead wood, usually in areas cleared for agriculture (roçados). Rarely are trees cut down for fuelwood” (pers comm).

M-MON, “VMD0015 Methods for Monitoring of Greenhouse Gas Emissions and Removals,” Version 2.1

Table 2.3: Applicability Conditions and Justifications for the VMD0015 Module.

Applicability Condition	Justification
Emissions from logging may be omitted if it can be demonstrated the emissions are de minimis using T-SIG.	Logging omissions have been omitted as no commercial timber harvest occurs in the baseline or with project case.
If emissions from logging are not omitted as de minimis, logging may only take place within forest management areas that possess and maintain a Forest Stewardship Council (FSC) certificate for the years when the selective logging occurs.	Not applicable

Logging operations may only conduct selective logging that maintains a land cover that meets the definition of forest within the project boundary.	Not applicable
All trees cut for timber extraction during logging operations must have a DBH greater than 30 cm.	Not applicable
During logging operations, only the bole/log of the felled tree may be removed. The top/crown of the tree must remain within the forested area.	Not applicable
The logging practices cannot include the piling and/or burning of logging slash	Not applicable
Volume of timber harvested must be measured and monitored.	Not applicable

2.3 Project Boundary

2.3.1 Sources of GHG Emissions Associated with the Baseline, Project and Leakage

GHG emission sources included in the project boundary are listed in Table 2.4. Justifications are provided when excluded from the project boundaries.

Table 2.4. GHG Emission Sources Included in the Project Boundary.

Source	Gas	Included	Justification/ Explanation
Biomass burning	CO_2	No	CO_2 emissions are already considered in carbon stock changes.
	CH_4	Yes	While CH4 and N2O emissions are conservatively excluded in the baseline, they are included in the with project case where fires occur
	N_2O	Yes	
Fossil Fuel Combustion	CO_2	No	Emissions from fossil fuel combustion in the baseline and project case are minimal. As per methodology module E-FCC “Fossil fuel combustion in all situations is an optional emission source.”
	CH_4	No	Emissions are small and negligible.
	N_2O	No	
Use of fertilizers	CO_2	No	Emissions are small and negligible.
	CH_4	No	
	N_2O	No	Excluded. No increase in fertilizer use is contemplated in the project case as part of leakage mitigation or any other activity.

2.3.2 Carbon Stock Associated with the Baseline, Project and Leakage

This project will include the following carbon pools (see Table 2.5).

Table 2.5: Carbon Pools Included in the Project Boundary.

Carbon pools	Included / Excluded	Justification / Explanation of Choice
Aboveground	Included	Mandatory to include. Tree biomass only is included, which is the most significant pool. Non-tree woody biomass (e.g. shrubs) is less in the baseline (pasture and cropland) than the project case (forest) and is conservatively excluded.
Belowground	Included	Included and treated together with aboveground biomass for completeness to include whole tree (aboveground and belowground) biomass.
Dead Wood	Included	This pool was included as it can represent a significant component of forest biomass.
Harvested Wood Products	Excluded	Excluded as no commercial harvesting for wood products[40] takes place in the baseline (as part of the forest conversion process) or with project scenarios.
Litter	Excluded	Conservatively omitted, as allowed by methodology.
Soil Organic Carbon	Excluded	As per the methodology, exclusion is always conservative. Significant changes in this pool are not expected to occur in the baseline – note that the IPCC default stock change factor for permanent grassland is 1.0, which signifies no change from original, undisturbed (forest) stocks (IPCC 2006GL Vol 4 AFOLU Chapter 6 Grassland, Table 6.2)

1. As noted in the table above, this project will consider three pools of carbon and the applicable modules are: CP-AB "VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools," Version 1.0 and CP-D, "VMD0002 Estimation of carbon stocks in the dead-wood pool," Version 1.0.

2.4 Baseline Scenario

The VCS "Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities" is applied to identify the baseline scenario of the project.

As per Step 1 of the tool, the following alternative land use scenarios were identified.

1. Continuation of pre-project land use with unabated threat of illegal deforestation.
2. Conversion of part of the project area to pasture by the landowners.
3. Sustainable forestry on part or all of the project area.
4. Project activity on the land within the project boundary performed without being registered as a VCS AFOLU project.

[40] The results of the community surveys indicated 0 of 16 communities responded yes to the question, "Do you sell timber?"

All land use scenarios identified above are in compliance with applicable legal and regulatory requirements, except #1, which represents illegal deforestation not undertaken by the landowners or project proponents.

2.4.1 Continuation of the Pre-Project Land Use with Unabated Threat of Illegal Deforestation

While the pre-project land use for the project area was moist tropical forest, this land use is unlikely to continue in the future given land use change patterns and deforestation pressures in the area. Considering the recent increase in deforestation on other parts of the Moura & Rosa property (i.e., those areas outside the project area) and in the region in general brought on by the paving of Brazilian Highway 364 (20 km directly northeast of the property) in 2011, portions of the project area are increasingly likely to be deforested and converted to pasture and cropland by small scale farmers.

There are 18 small scale and subsistence farming communities living on the project property. These farming communities are the agents of deforestation. These communities clear a portion of forest for land to engage in small scale farming and ranching for their livelihoods. Forest is generally cleared over a period of months. The process most often starts in May/June at the beginning of the dry season with the cutting of small trees and vines by machete. Next, the farmer uses their own chainsaw or hires someone with a chainsaw to cut the larger trees down. The farmer then waits for the dead vegetation to dry for a period of time ranging from two weeks to several months. A portion of the farmers, then use fire to clear the land. Finally crops are planted for a year or two prior to conversion to pasture or the land is directly converted to pasture. In cases where fire is not used, the land is planted or grazed without full clearing. In addition to clearing land, the agents of deforestation also rely on the forest surrounding their homesteads for fuelwood to make charcoal, for hunting and gathering, and on occasion for timber.

As the agent of deforestation is small scale farmers, rather than the landowners themselves, this deforestation is unplanned. This deforestation is technically illegal as these agents of deforestation do not have the permission to convert forest land to pasture or cropland; however, this deforestation is rarely prosecuted by authorities. The most likely baseline scenario is continued conversion of moist tropical forest to pasture and cropland by small scale farmers.

Noncompliance with private properties laws is widespread and laws are systematically not enforced in Acre State. Numerous inquiries have been made to relevant state and local authorities to obtain data on levels of enforcement (or e.g., percentage of illegal land invasions resolved) of private property laws. To our knowledge no institutions currently track these cases in a systematic fashion. However, in general, in the Brazilian Amazon there is considerable uncertainty in property rights, owing to the lack of enforcement of laws to protect property rights. Hence, 100% of the areas of the municipality of Manoel Urbano and Sena Madureira (as well as the state of Acre) have insufficient levels of government enforcement of property rights sufficient to prevent or remove illegal land invasions and stop deforestation in accessible areas, as the legal institutions responsible for enforcement have uniform jurisdiction across the municipality and state of Acre. This is evidenced by historic illegal deforestation as documented in Section 3.1. This is further supported by a letter[41] from, the President of the Acre Lawyers Association, Dr. Florindo Poersch where he states:

[41] A copy of this letter is contained in the project database.

In my professional opinion, illegal deforestation in the State of Acre, and particularly in the Municipalities of Manoel Urbano and Sena Madureira are rarely controlled and/or prevented by institutions of environmental control, due to lack of technical personnel and staff of the State Acre to perform this control…

Furthermore, the right to property in rural areas, in the case of invasion is difficult to apply in the State of Acre, due to lack of the judiciary's structure to escalate these demands quickly, and promptly remove invaders.

2.4.2 Conversion of Part of the Project Area to Pasture

Prior to the conception of the Purus Project, the landowners had expressed an interest in conversion of up to 20% of their property to pasture for grazing and rearing of livestock. While this is the most likely scenario for many privately held land in Acre state, this was not the case with the landowners due to perceived difficulty with ready access to markets for livestock and the strong desire to maintain the property as primary tropical rainforest.

2.4.3 Sustainable Forestry on part or all of the Project Area

Prior to the conception of the Purus Project, the landowners had also expressed an interest in sustainable forestry on 80% to 100% of the property. Again, perceived difficulty with access to domestic and international markets for timber and the strong desire to maintain the property as primary tropical rainforest made this option unappealing.

2.4.4 Project Activity on the Land within the Project Boundary Performed without being Registered as the VCS AFOLU Project

Establishment of effective forest conservation in the project area would be unlikely under any non carbon market-related scenario. The implementation of project activities to reduce deforestation pressures is tailored to the communities nearest the project area. It is possible to implement certain social and environmental programs without carbon financing, such as government assistance with agricultural extension. However, these measures on their own are not sufficient to incentivize small scale farmers in the area or new settlers to stop deforestation in and around the project area. It is only through the implementation of significant social and environmental programs, as well as implementation of forest protection measures, such as those documented in Section 1.8, that illegal deforestation can be reduced or prevented in the project area.

2.5 Additionality

The VCS "Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities" is applied to demonstrate additionality for the Purus Project.

2.5.1 Simple Cost Analysis

As the project proponents of this VCS AFOLU project generate no financial or economic benefits other than VCS related income through the project activity, a simple cost analysis is justified.

Forest carbon projects, particularly REDD projects, involve substantial upfront costs ranging from $325,000 to over $650,000. This includes major items such as:

Feasibility Assessments: $10,000 to $25,000

Legal Fees and Translation Costs: $20,000 to $50,000

Site Visits and Project Design Documents Preparation: $100,000 to $250,000

Technical Work: $150,000 to $250,000

Validation Services: $40,000 to $80,000

The project activity produces no revenue, as the project area will be managed for conservation purposes, rather than for commercial timber production, livestock, or crop production. Costs associated with implementing project activities, project development, and VCS project validation are significant, as stated above. Additionally, while the project will incur ongoing costs (related to management and implementation of project activities including forest patrols, social programs, and payments for environmental services), it will not generate future financial benefits other than VCU related income. The project proponents thus generate no financial benefits, and therefore the outcome of a simple cost comparison shows significant project expenditure with no financial return in the absence of VCS-related income, thus making this REDD project impractical in the absence of carbon finance.

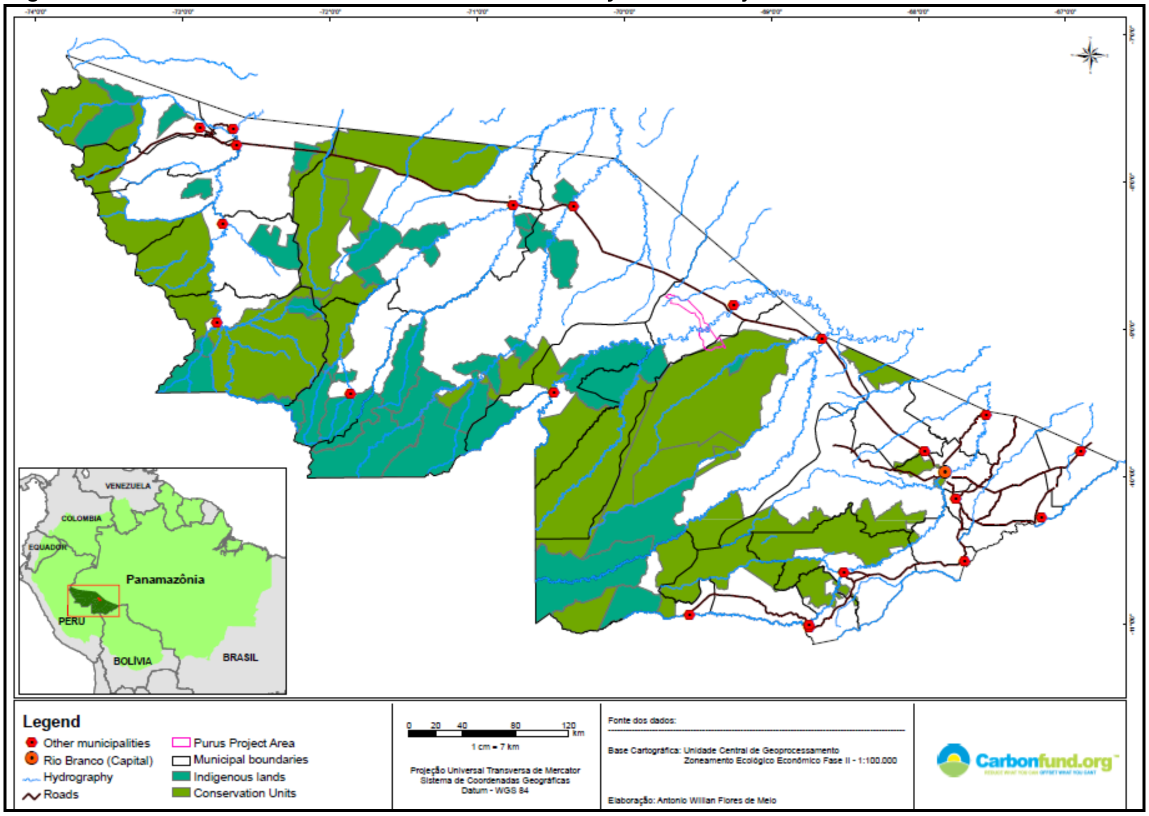
2.5.2 Common Practice

Conservation of privately owned forest land in Acre state is generally limited to designated areas of permanent protection (APP). One requirement of the Brazilian Forest Code is for landowners to maintain 80% of privately owned property as an APP. Regardless of this designation or the property owner's intentions to comply with the law, the APP areas continue to be subject to pressure from illegal deforestation.

Publicly-funded forest conservation efforts on government lands exist. Other forest conservation efforts within Acre state include a series of national, state, and local conservation areas, extractive reserves, and indigenous reserves (see Figure 2.1, below). However, to our knowledge, there are no privately funded projects on private lands with the aim of stopping unplanned deforestation in Acre state without the aid of carbon finance.

While the conservation areas and extractive reserves have had some successes at maintaining forest cover, the essential distinction between these lands and the project area is that the project area is privately owned and does not have access to government resources to deter unplanned deforestation pressures on its land.

Figure 2.1. Forest Conservation Areas in the Vicinity of the Project Area.



2.5.3 Results of the Additionality Analysis

As demonstrated above, the project activity, without revenue from carbon credits, is unlikely to occur and is not a common practice in the region. The project is therefore additional.

2.6 Methodology Deviations

The following deviations to the methodology are applied.

Trees in the Cecropia genus will not be measured as part of the forest inventory. This has been proposed as a deviation as it stands in conflict with the CP-AB requirement that "all the trees above some minimum DBH in the sample plots" be measured.

While sampling lying dead wood using the line intersect method:

- Two 92-meter transect lines were used rather than two 50-meter transect lines;
- The sampling lines did not bisect each sample plot, but rather ran from one plot center to the next; and
- The sampling lines were oriented to the north and east, and no randomization in the bearing of the first line was employed.

For validation of the allometric equation, commercial height was estimated from total height measured in the field by applying a factor of 62.9%. This commercial height to total height ratio is Amazon specific and was developed by Higuchi et al. 1998 (n = 315 trees).

Rather than using a root to shoot ratio to estimate belowground biomass as per the CP-AB module, belowground biomass was estimated using an allometric equation developed by Cairns et al.[42]

The forest inventory has deviated from the criteria for selection (i.e., the equation is based on a datasets comprising at least 30 trees, with an r2 that is ≥ 0.8) and validation of the allometric equation related to palm biomass, however the equation used is likely to result in a conservative estimate of palm biomass for the following reasons:

-Volume is calculated as the volume a parabaloid rather than the volume of a cylinder;

-Only stem biomass is estimated, thus conservatively excluding other aboveground biomass; and

- A conservative measure of basal diameter (i.e., dbh) was used.

A calibration factor of 0.985 was applied to the Brown (1997) equation to ensure use of this equation results in conservative estimates of live aboveground biomass."

In the with-project case, C(post) can conservative be assumed to be zero, not only for natural disturbance (CP,Dist,q,i , as stated in Section 5.2.3 of the M-MON module) but also for deforestation (CP,post,u,i). This deviation is conservative because subtracting zero from the baseline stocks, leads to the conclusion that ΔCpools,Def,u,i,t is equal to C(BSL,i), which leads to the maximum emission in the with project case, which is conservative.

AVFOR will be stratified using information and data derived from official (government) publications, peer-reviewed published sources, or other verifiable sources. Stratification is not limited to the delineation of different strata where contiguous areas of at least 100 ha differ in stocks by ≥20%

[42] Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world’s upland forests. Oecologia 111, 1-11.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 BASELINE EMISSIONS

Development of the project baseline emissions from unplanned deforestation, both rate and location, was conducted in conformance with the VCS modular REDD methodology VM0007, specifically the BL-UP module using the simple historic approach. The project meets the applicability conditions of this module as set out in Section 2.2.

3.1.1 Definition of Boundaries

Project boundaries for the development of the baseline include spatial and temporal boundaries from which information on the historical rate of deforestation is extracted and projected into the future. The rate of deforestation is derived from the reference region for rate, while the reference region for location is used in the spatial modelling component of the baseline. Finally, the leakage belt is the area surrounding the project area, where activity shifting leakage (i.e., deforestation which was displaced from the project area due to implementation of the project activities) is most likely to occur.

3.1.1.1 Spatial Boundaries

Reference Region for Projecting Deforestation Rate

The reference region for rate of deforestation (RRD) has a total area of 2,806,476 hectares[43] and is delineated as shown in Figure 3.1. It excludes the project area and leakage belt, and all nonforested areas at the start of the historical reference period in the year 2000. Further, the reference region has been defined with knowledge of the drivers of unplanned deforestation in the region.

The main agents of deforestation in the RRD are small scale farmers who intend on establishing or expanding pasture and croplands through conversion of forest. The proportion of agriculturalist to ranchers is the same in the RRD as in the project area (Antonio Willian Flores de Melo, pers. Comm).

Community surveys have been implemented in and around the project area and leakage belt to demonstrate the main agents of deforestation lack the legal rights to use the land, and to estimate the proportion of residents versus immigrants.

Maps of the landscape factors, including forest type, soil type, slope, and elevation, that were used to help define the reference region can be found in the project archive. Incorporation of these landscape factors had little effect on delineating the RRD as almost all land in the state is suitable for conversion to pasture and agriculture.

Municipalities within the state of Acre, without a primary highway running through the municipality were excluded from the RRD. Further, as the agents of deforestation are limited in their mobility, only areas within 40 kilometers of primary roads, which is similar to the project area, were included in the RRD.

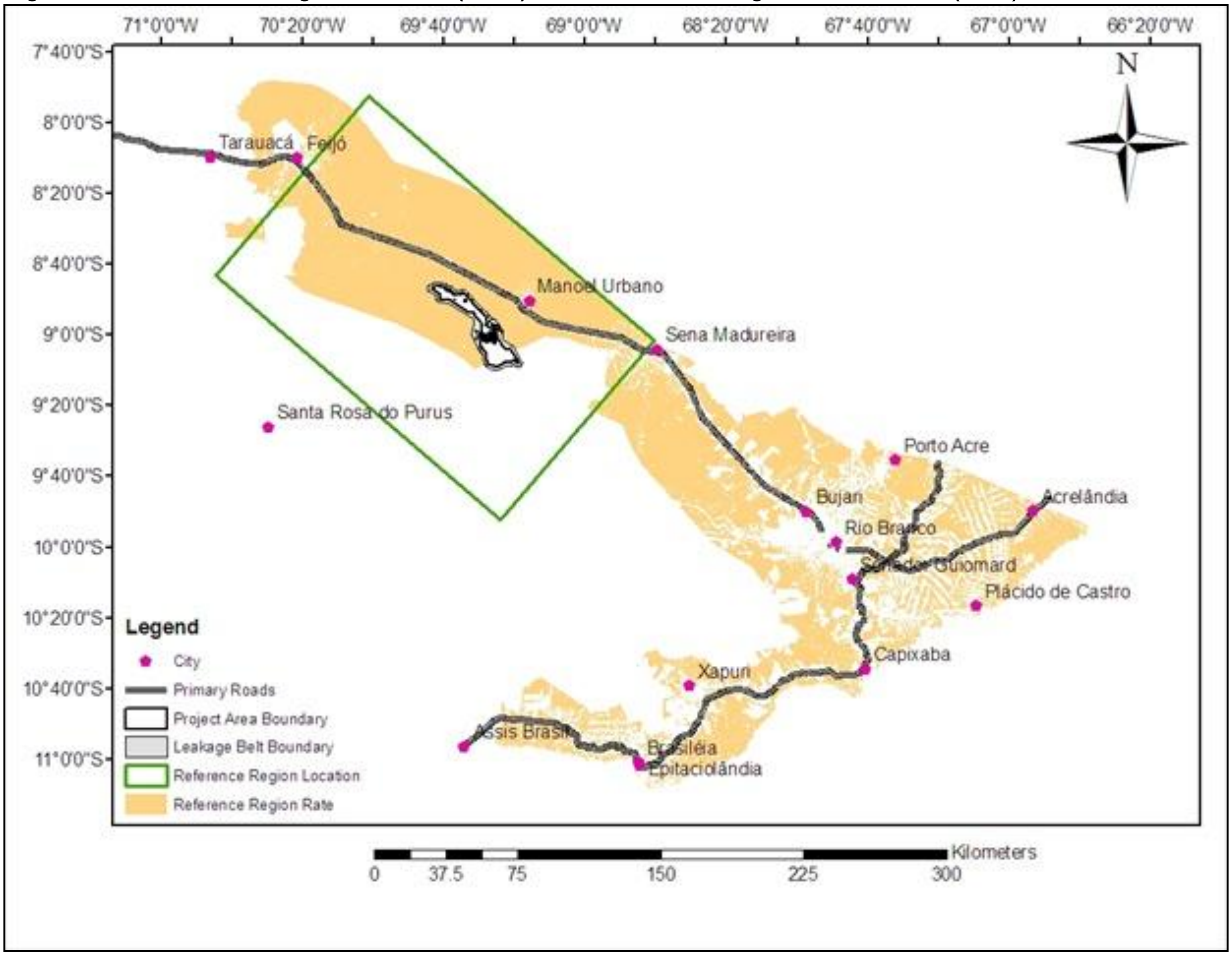
Land tenure was also used to help delineate the RRD. Specifically, municipal, state, and federal forest conservation areas and indigenous reserves were removed from the RRD as these differ from the privately-owned project area.

[43] The area of the RRD is larger than the minimum required (MREF). The MREF was calculated to be 173,344 ha.

<u>Reference Region for Projecting Location of Deforestation</u>

The reference region for projecting location of deforestation (RRL) is delineated as shown in Figure 3.1. The entire RRL is located within Acre state and has an area of 2,394,108 hectares. In agreement with the methodology, it is a single parcel, contiguous with and including the project area and the leakage belt. Further, it is 5.2% non-forest and 94.8% forest and thus in compliance with the methodological requirements of a minimum of 5% non-forest and a minimum of 50% forest. The forest area of the RRL totals 2,269,667 hectares which is within the ±25% of the size of the RRD.

Figure 3.1. Reference Region for Rate (RRD) and Reference Region for Location (RRL).



<u>Project Area</u>

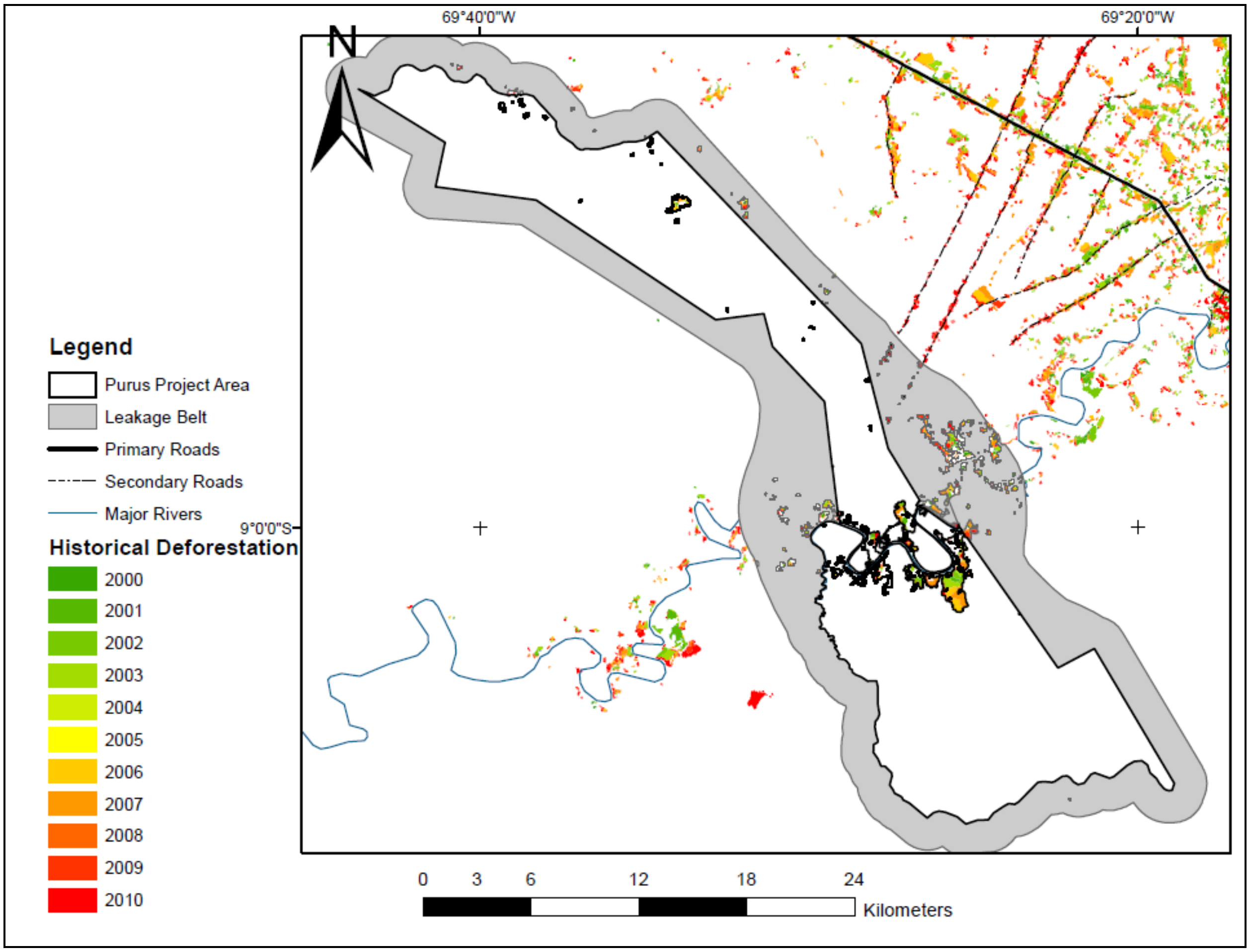
The project area (see Figure 3.2, below) consists of two adjacent properties (see Section 1.9) under threat of deforestation. The project proponents are undertaking project activities, outlined in Section 1.8, in and around the project area to mitigate deforestation pressures and stop deforestation. The total project area is 34,702 hectares and was 100% forested at the start of the project.

<u>Leakage Belt</u>

The leakage belt (see Figure 3.2, below) is the area surrounding or in the immediate vicinity of the project area where leakage caused by activity displacement is expected to occur. It meets the following requirements as outlined in the methodology:

- It is the forest area closest to the project area and meets the minimum area requirement (i.e., ≥90% of project area). The leakage belt covers 32,128 hectares which is 92.6% of the project area.
- All parts of the leakage belt are accessible and reachable by agents of deforestation.
- The leakage belt is conservatively spatially biased in terms of distance of edge of belt from edge of project area. This is exemplified in the fact that the leakage belt is wider nearer the Purus River and near where two secondary roads are approaching the project area.
- The leakage belt is 100% forest at the start of the project.

Figure 3.2. Purus Project Area and Leakage Belt Demonstrating Exclusion of Historically Deforested Areas.



3.1.1.2 Temporal Boundaries

The temporal boundaries of the Purus Project are listed in Table 3.1 below.

Table 3.1 Temporal Boundaries of the Purus Project.

Project activity	Date	Source/Notes
Start date and end date of the historical reference period.	January 1, 2000 to December 31, 2010	Years for which spatially explicit deforestation data is available within 12 years of the project start date.
Start date and end date of the first project baseline period.	May 23, 2011 to May 22, 2021	
Date at which the project baseline will be revisited. The baseline must be renewed every 10 years from the project start date.	May 23, 2021	Start of second baseline period

3.1.2. Estimation of Annual Areas of Unplanned Deforestation

The rate of deforestation was derived from an analysis of deforestation occurring within the RRD during the historical reference period, 2000-2010.

3.1.2.1 Analysis of historical deforestation

UCEGEO, the Central Unit of GIS and Remote Sensing within the Climate Change Institute (ICM) in Acre, produces an annual dataset on the extent and spatial location of all deforestation within the state using Landsat images. This dataset extends back to 1988 with 2010 as the most recent year for which data has been released. While the pixel resolution of 30m x 30m is maintained in the Landsat based dataset, the smallest mapping unit for deforestation is 1 hectare which is in agreement with the Brazilian definition of a forest[44] as set by the Clean Development Mechanism Designated National Authority.

A deforestation map layer at the level of the state is produced annually by UCEGEO. Deforestation maps are cumulative with new annual deforestation data added each year. Therefore the 2010 forest/nonforest map was produced by performing a union of the outline of the state and all mapped deforestation area up to and including deforestation occurring in the year 2010.

An accuracy assessment of the 2010 forest/nonforest map was performed using Google Earth imagery. All images were high resolution (<5m) and collected in 2010 or 2011. A minimum of 50 ground truth points in each land cover class (Forest and Non-Forest) were collected in Google Earth. Points were then compared to the forest/non-forest classification for 2010. The accuracy of the 2010 forest/non-forest map was 96.5% and 92.9% for the forest and non-forest class[45], respectively. This meets the minimum map accuracy of 90% for each class as set forth in the methodology.

[44] The Clean Development Mechanism Designated National Authority in Brazil has set the forest definition as:
1. Minimum tree crown cover of 30 per cent;
2. Minimum land area of 1 hectare; and
3. Potential to reach a minimum tree height of 5 meters at maturity
See http://cdm.unfccc.int/DNA/ARDNA.html?CID=30, accessed March 5, 2012.
[45] More detailed results of the accuracy assessment can be found in the project archive.

3.1.2.2 Estimation of the Annual Areas of Unplanned Baseline Deforestation in the RRD

Annual estimates of deforestation within the RRD were derived by calculating the amount of all deforestation within the boundary of the RRD from the GIS layer of deforestation from 2000-2010 (which already has all the deforestation prior to 2000 removed, see Figure 3.1). The result was the amount of deforestation within the RRD in the historical reference period. This was then summarized by year yielding the results in Table 3.2.

Table 3.2. Annual Amount of Deforestation in the RRD.

Year	Area of deforestation in RRD (ha)
2000	32,452
2001	41,496
2002	66,260
2003	55,247
2004	49,880
2005	58,045
2006	27,787
2007	37,081
2008	16,919
2009	21,456
2010	41,791
Average	40,765

As neither linear or nonlinear regressions resulted in a model with an $r^2 > 0.25$, the mean area deforested across the historical reference period (ABSL,RRD,unplanned,t), located above in Table 3.2, is used for each year in the baseline period.

ABSL,RRD,unplanned,t = 40,765 ha

3.1.2.3 Estimation of Annual Areas of Unplanned Baseline Deforestation in the Project Area

The projected amount of unplanned baseline deforestation in the RRL is estimated using Equation 3.1.

Equation 3.1. Equation to calculate projected area of deforestation in the RRL.

$$\boxed{A_{BSL,RR,unplanned,t} = A_{BSL,RRD,unplanned,t} * P_{RRL}}$$

Table 3.3 Projected Area of Unplanned Baseline Deforestation in the RRL.

Parameter	Description	Value	Justification
ABSL,RR,unplanned,t	Projected area of unplanned baseline deforestation in the reference region for location (RRL) in year t; ha	33,860	
ABSL,RRD,unplanned,t	Projected area of unplanned baseline deforestation in RRD in year t; ha	40,765	Derived in Section 3.1.2.2

PRRL	Ratio of forest area in the RRL at the start of the baseline period to the total area of the RRD; dimensionless	0.831	RRL forested area = 2,331,092 ha RRD area = 2,806,476 ha

ABSL,RR,unplanned,t = 33,860 ha

3.1.3. Location and Quantification of Threat of Unplanned Deforestation

Spatial analysis was conducted with the Dinamica model. Dinamica is a spatially-explicit modelling tool that was used to model the location of deforestation projected in the baseline. For this analysis, Dinamica-EGO was used to produce a weighted risk map of the areas within the project area and leakage belt at risk of deforestation. Translation of the risk map into a scenario map of deforestation for the baseline period was then conducted by allocating deforestation (ABSL,RR,unplanned,t) throughout the RRL to the areas with the highest risk. All analysis was conducted using the Dinamica-EGO software.

This model meets the criteria of (1) being peer-review, (2) transparent, (3) incorporating spatial datasets used to explain patterns of deforestation, and (4) is capable of projecting the location of future deforestation.

All spatial modelling analysis is performed on the reference region for projecting location of deforestation (RRL). The RRL is defined in Section 3.1.1 and encompasses the area surrounding the project area and leakage belt (see Figure 3.1). The spatially explicit deforestation data used to develop and run the model was a Landsat based deforestation dataset, produced by UCEGEO. Data were used for the eleven years (2000-2010) directly prior to the project start date. GIS layers of spatial variables covering the RRL were analyzed under a spatially explicit modelling framework to construct future scenarios of how deforestation is best allocated in the RRL.

<u>3.1.3.1 Preparation of Datasets for Spatial Analysis</u>

Developing a predictive model is an iterative process that requires exploration of the spatial variables that may drive deforestation patterns. Variables that have demonstrated strong correlation with deforestation in the field of land change science are categorized in the methodology into four categories: landscape factors, accessibility factors, anthropogenic factors, actual land tenure and management. All variables must be spatially explicit, and for use in the model must be in raster format. Spatial variable used in the model are called factor maps.

Potential drivers of deforestation were assessed with input from regional experts. Factor maps that were assessed for potential use in the model can be found in the project archive. Assessment of factors that should be included in the model is an iterative process that is done by assessing multiple model runs while removing and adding variables selectively. Performance assessment of the combination of factor maps and their predictive capacity is done at multiple stages of the analysis. This results in a general assessment of the models' accuracy, and can be used to evaluate if factors have increased or decreased the models' performance. A list of the factor maps that were incorporated in the final model is found in Table 3.4.

Table 3.4. Factor Maps that were Incorporated in the Final Spatial Model.

Map Number	Factor Map
1	Elevation
2	Land tenure
3	Land use
4	Livestock
5	Proximity to all roads
6	Proximity to cities
7	Proximity to deforestation in 2006
8	Proximity to deforestation in 2007
9	Proximity to deforestation in 2008
10	Proximity to deforestation in 2009
11	Proximity to deforestation in 2010
12	Proximity to major rivers
13	Proximity to principal roads
14	Proximity to rural population
15	Slope
16	Soil
17	Vegetation

3.1.3.2 Preparation of Risk Maps for Deforestation

Validation of the model is done by comparing the predicted change to actual change for the period from 2006 to 2010. The output of the model is a transition potential map or a "risk map" that expresses the likelihood or potential for a location to transition from forest to deforested on a scale from 0 (minimum potential) to 1 (maximum potential). These values can be ranked in descending order, and this map is used to assign pixels to deforestation.

Quantity of deforestation was estimated in a separate analysis detailed above using average historic rate of deforestation in the RRD. Areas of deforestation were allocated until the quantity of deforestation modelled was exhausted. The procedure was carried out for each year of the projection.

3.1.3.3 Selection of the Most Accurate Deforestation Risk Map

Using the above process, multiple risk maps and the corresponding prediction maps were created for the year 2010. Each prediction map is compared to the actual map from 2010 to assess the model's performance. The measure of performance used as mandated by the methodology is the "Figure of Merit" (FOM) that confirms the model prediction in statistical manner (Pontius et al. 2008[46]; Pontius et al. 2007[47]). The FOM is a ratio of the intersection of the observed change (change between the reference maps in time 1 and time 2) and the predicted change (change between the reference map in time 1 and simulated map in time 2) to the union of the observed change and the predicted change. The FOM

[46] R G Pontius Jr, W Boersma, J-C Castella, K Clarke, T de Nijs, C Dietzel, Z Duan, E Fotsing, N Goldstein, K Kok, E Koomen, C D Lippitt, W McConnell, A Mohd Sood, B Pijanowski, S Pithadia, S Sweeney, T N Trung, A T Veldkamp, and P H Verburg. 2008. Comparing input, output, and validation maps for several models of land change. Annals of Regional Science, 42(1): 11-47.

[47] R G Pontius Jr, R Walker, R Yao-Kumah, E Arima, S Aldrich, M Caldas and D Vergara. 2007. Accuracy assessment for a simulation model of Amazonian deforestation. Annals of Association of American Geographers, 97(4): 677-695.)

ranges from 0%, where there is no overlap between observed and predicted change, to 100% where there is a perfect overlap between observed and predicted change. The highest percent FOM and least number of factor maps used for creating the deforestation risk map must be used as the criteria for selecting the most accurate deforestation risk map to be used for predicting future deforestation.

Equation 3.2. Equation to Determine the "Figure of Merit".

$$FOM = \frac{CORRECT}{CORRECT + Err_A + Err_B}$$

Where,

CORRECT	Area correct due to observed change predicted as change; ha
ErrA	Area of error due to observed change predicted as persistence; ha
ErrB	Area of error due to observed persistence predicted as change; ha

FOM = (7,128ha)/(7,128 ha + 11,049 ha + 22,171 ha) = 0.177

The FOM value 0.177 is greater than the minimum threshold value 0.026, calculated as (61,425 ha /2,394,108 ha).

3.1.3.4 Mapping of the Locations of Future Deforestation

Future deforestation was allocated to pixels on the risk map, with the highest deforestation risk values being deforested first. In this manner the baseline map of deforestation was produced for the project area and leakage belt (Figure 3.3). Further, the area of deforestation was summed by strata for each year in the baseline period (Table 3.5 and Table 3.6).

Figure 3.3. Map of the Predicted Deforestation in the Baseline Period, 2011-2020.

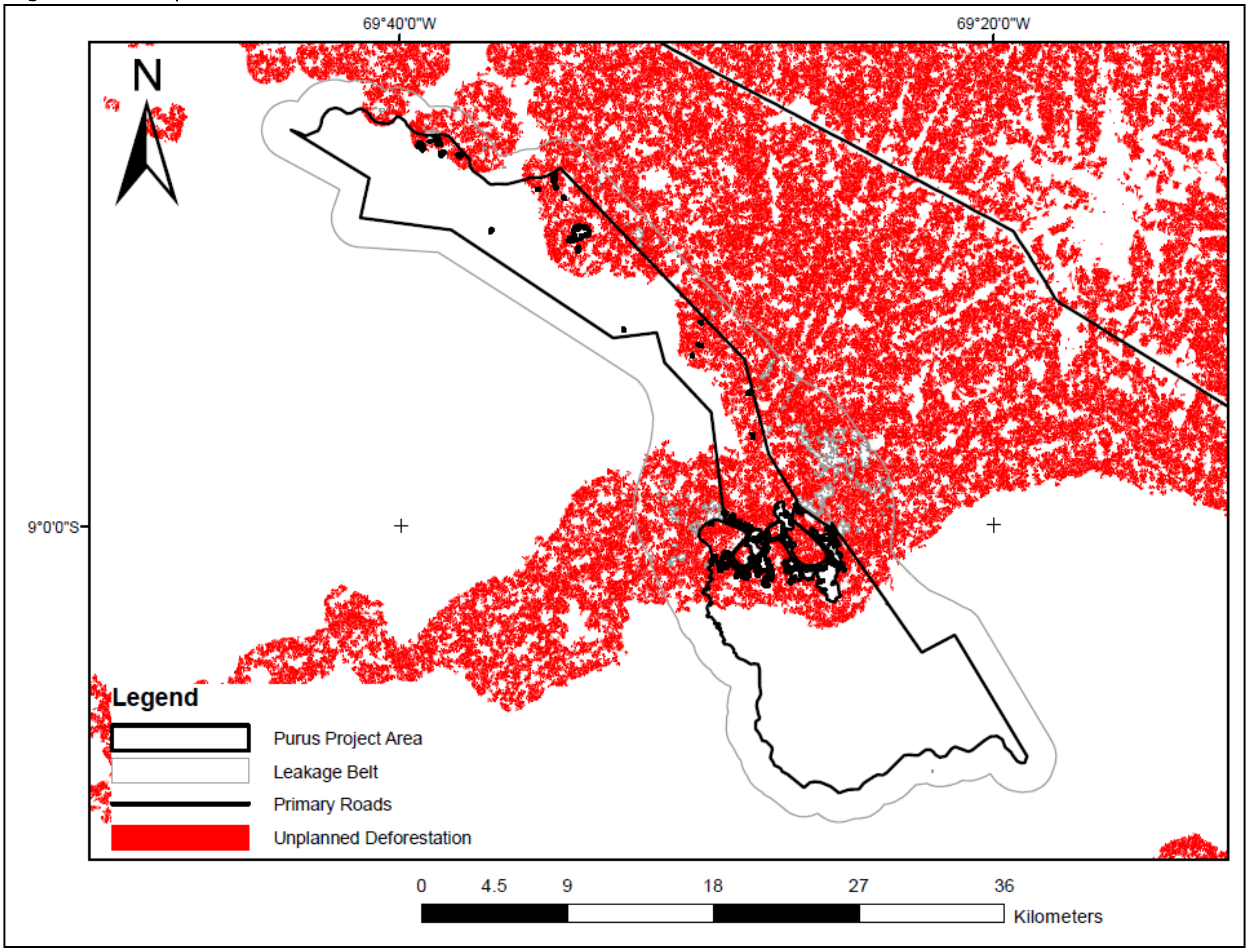


Table 3.5. Amount of Baseline Deforestation in the Project Area.

Year	Amount of deforestation in open forest with palm and bamboo strata (FAB + FAP)	Amount of deforestation in open alluvial forest with palm strata (FAP-alluvial)	Total Deforestation in the Project Area (ha)
2011	223	252	475
2012	248	278	526
2013	295	212	507
2014	293	275	568
2015	457	283	740
2016	358	258	616
2017	431	218	648
2018	351	212	563
2019	449	232	681
2020	533	180	713

Table 3.6. Amount of Baseline Deforestation in the Leakage Belt.

Year	Amount of deforestation in open forest with bamboo and palm strata (FAB + FAP)	Amount of deforestation in open alluvial forest with palm strata (FAP-alluvial)	Amount of deforestation in open forest with palm and bamboo strata (FAP + FAB)	Total Deforestation in the leakage belt (ha)
2011	361	411	0	772
2012	354	466	0	820
2013	477	268	0	745
2014	477	339	0	816
2015	531	341	0	872
2016	472	335	0	806
2017	549	410	0	959
2018	483	417	0	899
2019	440	234	0	674
2020	556	242	0	798

3.1.4. Estimation of Carbon Stock Changes and GHG Emissions

3.1.4.1 Stratification of the Total Area Subject to Deforestation

The project area was stratified, according to module X-STR, using a vegetation map obtained from the State of Acre.[48] The two forest types present in the Purus Project area include: open forest with bamboo and open forest with palm (FAB + FAP) and open alluvial forest with palm (FAP - alluvial). Even though it represents an insignificant percentage (<0.3%), one further strata, open forest with palm and open forest with bamboo (FAP + FAB), was present in the leakage belt. A more in-depth explanation of vegetation strata can be found in Section 1.10. Stratification of the project area and leakage belt is illustrated in Figure 1.9.

Table 3.7. Areas of Strata within the Project Area.

Strata	Vegetation Type	Area (ha)
FAP - Aluvial	Open alluvial forest with palm	4,717
FAB + FAP	Open forest with bamboo (dominant type) and open forest with palm	29,986

Table 3.8. Areas of Strata within the Leakage Belt.

Strata	Vegetation Type	Area (ha)
FAP - Aluvial	Open alluvial forest with palm	6,774
FAB + FAP	Open forest with bamboo (dominant type) and open forest with palm	25,285
FAP + FAB	Open forest with palm (dominant type) and open forest with bamboo	69

[48] ACRE. Governo do Estado do Acre. Secretaria de Estado de Planejamento e Desenvolvimento Econômico-Sustentável, Secretaria de Estado de Meio Ambiente e Recursos Naturais. Programa Estadual de Zoneamento Ecológico-Econômico do Acre. Zoneamento Ecológico-Econômico do Acre Fase II. Documento Síntese, 2006.

3.1.4.2 Estimation of Carbon Stocks and Carbon Stock Changes per Stratum

Forest carbon stocks were directly measured in a forest inventory of the Purus Project area in 2011. Results are detailed in the "Forest biomass carbon inventory for the Purus REDD Project, Acre State, Brazil," which can be found in Annex 1. Results are summarized by forest strata in the tables below.

Equation 3.3. Equation to Calculate Carbon Stocks in all Carbon Pools in Each Forest Stratum.

$$C_{BSL,i} = C_{AB\_tree,i} + C_{BB\_tree,i} + C_{AB\_non-tree,i} + C_{BB\_non-tree,i} + C_{DW,i} + C_{LI,i} + C_{SOC,i}$$

Table 3.9a. Estimation of Carbon Stocks for Stratum FAP-Alluvial.

Parameter	Description	Value	Justification
CBSL,i	Carbon stock in all carbon pools in forest stratum i; t CO_2e ha-1	411.3 t CO_2e ha-1	See forest inventory for calculations.
CAB_tree,i	Carbon stock in aboveground tree biomass in stratum i; t CO_2e ha-1	See forest inventory report for calculations.	
CBB_tree,i	Carbon stock in belowground tree biomass in stratum i; t CO_2e ha-1	See forest inventory report for calculations	
CAB_non-tree, i	Carbon stock in aboveground non-tree biomass in stratum i; t CO_2e ha-1	CAB_non-tree, I = 0	Not included in the project boundary. See Section 2.3.
CBB_nontree,I	Carbon stock in belowground non-tree biomass in stratum i; t CO_2e ha-1	CBB_nontree,I = 0	Not included in the project boundary. See Section 2.3.
CDW,i	Carbon stock in dead wood in stratum i; t CO_2e ha-1	See forest inventory report for calculations	
CLI,i	Carbon stock in litter in the forest stratum i; t CO_2e ha-1	CLI,I = 0	Not included in the project boundary. See Section 2.3.
CSOC,i	Carbon stock in soil organic carbon in the forest stratum i; t CO_2e ha-1	CSOC,I = 0	Not included in the project boundary. See Section 2.3.

Table 3.9b. Estimation of Carbon Stocks for Stratum FAB+FAP.

Parameter	Description	Value	Justification
CBSL,i	Carbon stock in all carbon pools in forest stratum i; t CO_2e ha-1	325.5 t CO_2e ha-1	See forest inventory report for calculations
CAB_tree,i	Carbon stock in aboveground tree biomass in stratum i; t CO_2e ha-1	See forest inventory report for calculations	
CBB_tree,i	Carbon stock in belowground tree biomass in stratum i; t CO_2e ha-1	See forest inventory report for calculations	
CAB_non-tree, i	Carbon stock in aboveground non-tree biomass in stratum i; t	CAB_non-tree, I = 0	Not included in the project boundary. See Section 2.3.

	CO_2e ha-1		
CBB_nontree,I	Carbon stock in belowground non-tree biomass in stratum i; t CO_2e ha-1	CBB_nontree,I = 0	Not included in the project boundary. See Section 2.3.
CDW,i	Carbon stock in dead wood in stratum i; t CO_2e ha-1	See forest inventory report for calculations	
CLI,i	Carbon stock in litter in the forest stratum i; t CO_2e ha-1	CLI,I = 0	Not included in the project boundary. See Section 2.3.
CSOC,i	Carbon stock in soil organic carbon in the forest stratum i; t CO_2e ha-1	CSOC,I = 0	Not included in the project boundary. See Section 2.3.

Table 3.9c. Estimation of Carbon Stocks for Stratum FAP+FAB.

Parameter	Description	Value	Justification
CBSL,i	Carbon stock in all carbon pools in forest stratum i; t CO_2e ha-1	CBSL,I = 512.9 t CO_2e ha-1	
CAB_tree,i	Carbon stock in aboveground tree biomass in stratum i; t CO_2e ha-1	CAB_tree,I = 403.8 t CO_2e ha-1	Used 2011 estimate (110.1 t C/ha) from Salimon et al.[1] for this specific strata.
CBB_tree,i	Carbon stock in belowground tree biomass in stratum i; t CO_2e ha-1	CBB_tree,I = 91.1 t CO_2e ha-1	Estimate (24.8 t C/ha) derived from aboveground biomass using the Cairns et al.[2] equation, as carried out in the forest inventory.
CAB_non-tree, i	Carbon stock in aboveground non-tree biomass in stratum i; t CO_2e ha-1	CAB_non-tree, I = 0	Not included in the project boundary. See Section 2.3.
CBB_nontree,I	Carbon stock in belowground non-tree biomass in stratum i; t CO_2e ha-1	CBB_nontree,I = 0	Not included in the project boundary. See Section 2.3.
CDW,i	Carbon stock in dead wood in stratum i; t CO_2e ha-1	CDW,I = 18.0 t CO_2e ha-1	Used estimate (4.9 t C/ha) derived for the FAB+FAP strata in the forest inventory.
CLI,i	Carbon stock in litter in the forest stratum i; t CO_2e ha-1	CLI,I = 0	Not included in the project boundary. See Section 2.3.
CSOC,i	Carbon stock in soil organic carbon in the forest stratum i; t CO_2e ha-1	CSOC,I = 0	Not included in the project boundary. See Section 2.3.

[1]Salimon et al. 2011. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. Forest Ecology and Management 262: 555-560.
[2]Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world's upland forests. Oecologia 111, 1-11.

Stocks of belowground biomass and dead wood are emitted from the year of conversion/deforestation at a linear rate equal to 1/10 of the initial stock annually, for 10 years. Net emissions (CBSL -C post) from steady decomposition of these pools are elaborated in Tables 3.10 and 3.11, below.

Table 3.10a. Emissions from steady decomposition of belowground biomass post deforestation in the project area ($CBSL_{BB}$ -C $post_{BB,}$ t CO2-e).

Year	BGB Emissions from Deforestation (t CO2)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2011	22,277	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228
2012	24,659		2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466
2013	22,981			2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298
2014	26,279				2,628	2,628	2,628	2,628	2,628	2,628	2,628
2015	33,111					3,311	3,311	3,311	3,311	3,311	3,311
2016	27,903						2,790	2,790	2,790	2,790	2,790
2017	28,568							2,857	2,857	2,857	2,857
2018	25,140								2,514	2,514	2,514
2019	30,062									3,006	3,006
2020	30,542										3,054
Total		2,228	4,694	6,992	9,619	12,931	15,721	18,578	21,092	24,098	27,152

Table 3.10b. Emissions from steady decomposition of belowground biomass post deforestation in the leakage belt ($CBSL_{BB}$ -C $post_{BB,}$ t CO2-e).

Year	BGB Emissions from Deforestation (t CO2)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2011	36,251	3,625	3,625	3,625	3,625	3,625	3,625	3,625	3,625	3,625	3,625
2012	38,958		3,896	3,896	3,896	3,896	3,896	3,896	3,896	3,896	3,896
2013	33,102			3,310	3,310	3,310	3,310	3,310	3,310	3,310	3,310
2014	36,929				3,693	3,693	3,693	3,693	3,693	3,693	3,693
2015	39,158					3,916	3,916	3,916	3,916	3,916	3,916
2016	36,474						3,647	3,647	3,647	3,647	3,647
2017	43,542							4,354	4,354	4,354	4,354
2018	41,333								4,133	4,133	4,133
2019	29,822									2,982	2,982
2020	34,798										3,480
Total		3,625	7,521	10,831	14,524	18,440	22,087	26,441	30,575	33,557	37,037

Table 3.11a. Emissions from steady decomposition of dead wood post deforestation in the project area, ($CBSL_{DW}$ -C $post_{DW}$, t CO2-e).

Year	BGB Emissions from Deforestation (t CO2)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2011	8,362	836	836	836	836	836	836	836	836	836	836
2012	9,259		926	926	926	926	926	926	926	926	926
2013	8,861			886	886	886	886	886	886	886	886
2014	9,974				997	997	997	997	997	997	997
2015	12,883					1,288	1,288	1,288	1,288	1,288	1,288
2016	10,758						1,076	1,076	1,076	1,076	1,076
2017	11,246							1,125	1,125	1,125	1,125
2018	9,796								980	980	980
2019	11,819									1,182	1,182
2020	12,284										1,228
Total		836	1,762	2,648	3,646	4,934	6,010	7,134	8,114	9,296	10,524

Table 3.11b. Emissions from steady decomposition of dead wood post deforestation in the leakage belt ($CBSL_{DW}$ -C $post_{DW}$, t CO2-e).

Year	BGB Emissions from Deforestation (t CO2)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2011	13,600	1,360	1,360	1,360	1,360	1,360	1,360	1,360	1,360	1,360	1,360
2012	14,493		1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449
2013	12,950			1,295	1,295	1,295	1,295	1,295	1,295	1,295	1,295
2014	14,248				1,425	1,425	1,425	1,425	1,425	1,425	1,425
2015	15,200					1,520	1,520	1,520	1,520	1,520	1,520
2016	14,075						1,408	1,408	1,408	1,408	1,408
2017	16,751							1,675	1,675	1,675	1,675
2018	15,763								1,576	1,576	1,576
2019	11,704									1,170	1,170
2020	13,811										1,381
Total		1,360	2,809	4,104	5,529	7,049	8,457	10,132	11,708	12,879	14,260

3.1.4.3 Estimation of the Sum of Baseline Carbon Stock Changes

The sum of baseline carbon stock changes (ΔCTOT) was estimated using Equation 3.4. Parameters for use of Equation 3.4 can be found in Table 3.12. One of the parameters, the total forest carbon stock in areas deforested (CBSL), was calculated as per Equation 3.5. ΔCTOT and CBSL are calculated in Table 3.14 for the project area and 3.15 for the leakage belt.

Equation 3.4. Equation to Calculate the Sum of the Baseline Carbon Stock Change in all Pools up to Time t

$$\Delta C_{TOT} = C_{BSL} - C_{post} - C_{wp}$$

Table 3.12. Estimation of Sum of Baseline Carbon Stock Changes in the Project Area and Leakage Belt.

Parameter	Description	Value	Justification
ΔCTOT	Sum of the baseline carbon stock change in all pools up to time t*; t CO_2e	See calculations below.	
CBSL	Total forest carbon stock in areas deforested; t CO_2e	See calculations below.	See calculations below.
C post	Total post-deforestation carbon stock in areas deforested; t CO_2e	See calculations below.	Option 1, the simple approach, was used in the estimation of post-deforestation carbon stocks. A land use classification produced by the State of Acre[49] indicated that forest in Acre State are converted into three non-forest classes including agriculture, pasture, and urban lands. As the deforestation in the project area is occurring in rural areas, the post-deforestation land uses do not include urban lands, but are limited to pasture and cropland. After a thorough review

[49] ACRE. Governo do Estado do Acre. Secretaria de Estado de Planejamento e Desenvolvimento Econômico-Sustentável, Secretaria de Estado de Meio Ambiente e Recursos Naturais. Programa Estadual de Zoneamento Ecológico-Econômico do Acre. Zoneamento Ecológico-Econômico do Acre Fase II. Documento Síntese, 2006.

			of literature, the best source of information on biomass stocks was a local study by Salimon et al.[50] entitled “Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil”. This peer reviewed study lists biomass values from both pasture (16.0 tons d.m./ha) and cropland (11.6 tons d.m./ha) and was in part supported by the Acre Environment Office and Fundação de Tecnologia do Estado do Acre; two organizations which are helping to develop the Acre state baseline. Salimon et al. lists the aboveground biomass stocks for both pasture and cropland. These values were converted to the total aboveground and belowground biomass stock using root to shoot ratios[51] developed by Jackson et al. and using a carbon fraction of 0.47, as per the VM007 module. The resulting estimate for post-deforestation carbon stocks are 12.8 and 6.0 t C/ha for both pasture and cropland, respectively. As pasture has the highest carbon stock of the post-deforestation land uses, the value of 12.8 t C/ha has been used as the post

[50] Salimon et al. 2011. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. Forest Ecology and Management 262: 555-560.
[51] 0.7 for tropical grasslands and 0.1 for crops as found in Jackson, R.B., Canadell, J., Ehleringer, J.R., Mooney, H.A., Sala, O.E. & Schulze, E.D. 1996. A global analysis of root distributions for terrestrial biomes. Oecologia 108: 389-411.

			deforestation carbon stock. While we recognize the vast majority of this stock is herbaceous and not included with the Purus project boundaries, this value represents a conservative estimate of the post-deforestation carbon stock.
C wp	Total carbon stock in harvested wood products; t CO_2e	0	No commercial harvesting of wood products takes place in either the baseline or with project scenarios.

Figure 3.4. Picture of pasture depicting post-deforestation carbon stocks.

Equation 3.5. Equation to Calculate the Sum of the Baseline Carbon Stock Change in all Pools up to Time t

$$C_{BSL} = \sum_{t=1}^{t*} \sum_{i=1}^{M} ((C_{BSL,i}) * A_{unplanned,i,t})$$

Table 3.13. Parameters used to calculate the total forest carbon stock in areas deforested.

Parameter	Description
CBSL	Total forest carbon stock in areas deforested; t CO2-e
CBSL,i	Carbon stock in all carbon pools in the forest stratum i; t CO2-e ha-1
Aunplanned,i,t	Area of unplanned deforestation in forest stratum i at time t; ha

Table 3.14. Calculation of the Total Forest Carbon Stock in Areas Deforested (CBSL) and the Sum of the Baseline Carbon Stock Change in all Pools up to Time t (ΔCTOT) in the Project Area.

Year	Aunplanned,i,t, FAB + FAP	AAunplanned,i,t, FAP-alluvial)	$CBSL_{AB}$ (t CO2-e)	C $post_{AB}$ (t CO2-e)	$CBSL_{BB}$ -C $post_{BB}$ (t CO2-e)	$CBSL_{DW}$ -C $post_{DW}$ (t CO2-e)	C wp (t CO2-e)	ΔCTOT (t CO2-e)
2011	223.0	251.5	136,261	13,085	2,228	836	0	126,240
2012	247.7	277.8	150,847	14,491	4,694	1,762	0	142,812
2013	295.2	212.3	141,761	13,992	6,992	2,648	0	137,409
2014	293.4	274.8	161,297	15,666	9,619	3,646	0	158,897
2015	457.3	282.6	204,839	20,403	12,931	4,934	0	202,300
2016	358.2	257.9	172,122	16,988	15,721	6,010	0	176,865
2017	430.8	217.6	177,398	17,878	18,578	7,134	0	185,232
2018	351.4	211.6	155,602	15,523	21,092	8,114	0	169,285
2019	449.3	231.9	186,601	18,783	24,098	9,296	0	201,212
2020	532.9	180.2	190,987	19,662	27,152	10,524	0	209,001
Total	3,639.3	2,398.0	1,677,716	166,470	143,103	54,904	0	1,709,253

Table 3.15. Calculation of the Total Forest Carbon Stock in Areas Deforested (CBSL) and the Sum of the Baseline Carbon Stock Change in all Pools up to Time t (ΔCTOT) in the Leakage Belt.

Year	Aunplanned,i,t, FAB + FAP	AAunplanned,i,t, FAP-alluvial)	Aunplanned,i,t, FAP + FAB	$CBSL_{AB}$ (t CO2-e)	C $post_{AB}$ (t CO2-e)	$CBSL_{BB}$ -C $post_{BB}$ (t CO2-e)	$CBSL_{DW}$ -C $post_{DW}$ (t CO2-e)	C wp (t CO2-e)	ΔCTOT (t CO2-e)
2011	360.9	410.8	0.0	221,699	21,278	3,625	1,360	0	205,406
2012	353.9	466.1	0.0	237,635	22,610	7,521	2,809	0	225,355
2013	476.9	268.3	0.0	205,144	20,547	10,831	4,104	0	199,533
2014	476.6	339.5	0.0	227,845	22,502	14,524	5,529	0	225,397
2015	531.0	341.4	0.0	242,068	24,054	18,440	7,049	0	243,503
2016	471.6	334.6	0.0	225,056	22,232	22,087	8,457	0	233,368
2017	548.7	409.9	0.0	268,405	26,431	26,441	10,132	0	278,548
2018	482.6	416.8	0.0	254,087	24,800	30,575	11,708	0	271,569
2019	440.0	234.2	0.0	185,005	18,589	33,557	12,879	0	212,852
2020	556.1	242.3	0.0	216,659	22,014	37,037	14,260	0	245,941
Total	4,698.1	3,464.0	0.0	2,283,603	225,056	204,637	78,287	0	2,341,471

3.1.4.4 Estimation of the Sum of Baseline Greenhouse Gas Emissions

GHG emissions (GHGBSL,E) in the baseline are conservatively assumed to be zero. No nitrogen fertilizer application takes place in the project area in the baseline. Biomass burning is conservatively excluded from accounting in the baseline. Similarly, fossil fuel emissions are conservatively excluded from the baseline.

3.1.4.5 Calculation of Net CO_2 Equivalent Emissions

Net CO_2 emissions in the baseline for the project area and leakage belt are calculated using Equation 3.6 below.

Equation 3.6. Equation to Calculate Net Greenhouse Gas Emissions in the Baseline from Unplanned Deforestation.

$$\Delta C_{BSL,unplanned} = \Delta C_{BSL,PA,unplanned} + GHG_{BSL,E}$$

As GHG emissions in the baseline are conservatively assumed to be zero, the net CO_2 emissions in the baseline is equal to the sum of the baseline carbon stock change in all pools (ΔCBSL,unplanned = ΔCTOT).

ΔCBSL,PA,unplanned = 1,709,253 t CO_2e

ΔCBSL,LK,unplanned = 2,341,471 t CO_2e

3.2 Project Emissions

Expected project emissions are estimated ex-ante by applying module M-MON (VMD0015, Version 2.0) of Methodology VM0007. Equation 3.7 is used to calculate ex-ante project emissions. Values for individual parameters are justified in Table 3.16 or derived in Tables 3.17 and Tables 3.19.

Equation 3.7. Equation for Calculating the Net GHG emissions within the Project Area under the Project Scenario.

$$\Delta C_P = \sum_{t=1}^{t*} \sum_{i=1}^{M} \left(\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t} - \Delta C_{P,Enh,i,t} \right)$$

Table 3.16. Parameters and Values used to Calculate Annual Ex-Ante Project Emissions.

Parameter	Description	Value	Justification
ΔC_P	Net greenhouse gas emissions within the project area under the project scenario; t CO_2e	See table below for calculations.	
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum i at time t; t CO_2e	See table below for calculations.	

$\Delta C_{P,Deg,i,t}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,Deg,i,t} = 0$	Emissions resulting from degradation due to illegal logging (parameter ΔCP,DegW) will be quantified ex-post using a limited field sampling approach as there is potential for some degradation in the with-project case according to the results of community surveys carried out in March 2012, conducted in accordance with prescribed procedures per module VMD0015 of methodology VM0007. As the agent of deforestation (and degradation), have committed to no longer harvesting fuelwood and timber in forests surrounding their farms, and forest patrols with further deter degradation activities ex-ante degradation is estimated as zero. Emissions resulting from degradation due to selective logging of FSC certified areas (parameter ΔCP,SelLog,i,t) equates to zero as no selective FSC logging occurs in either the baseline or with-project case.
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,DistPA,i,t} = 0$	Forests in Acre state have a low incidence of natural disturbance outside of flooding, which does not generally result in tree death and C emissions.
$GHG_{P\text{-}E,i,t}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum i in year t; t CO_2e	$GHG_{P\text{-}E,i,t} = 0$	No GHG project emissions are expected. -As stipulated in the methodology, fossil fuel combustion in all situations is an optional emission source. -Biomass burning is not expected to occur in the with project case. Where fires do occur, it will be accounted for ex-post. -No nitrogen is applied on the alternative land use within the project boundary
$\Delta C_{P,Enh,i,t}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in stratum i at time t; t CO_2e	$\Delta C_{P,Enh,i,t} = 0$	Conservative to exclude.

Table 3.17. Data used to Calculate ΔC_P.

Year	ΔCP,DefPA,i,t (t CO2-e)	ΔCP,Deg,i,t (t CO2-e)	ΔCP,DistPA,i,t (t CO2-e)	GHGP-E,i,t (t CO2-e)	ΔCP,Enh,i,t (t CO2-e)	ΔCP (t CO2-e)
2011	37,328	0	0	0	0	37,328
2012	37,211	0	0	0	0	37,211
2013	37,094	0	0	0	0	37,094
2014	36,977	0	0	0	0	36,977
2015	36,861	0	0	0	0	36,861
2016	36,745	0	0	0	0	36,745
2017	36,630	0	0	0	0	36,630
2018	36,515	0	0	0	0	36,515
2019	36,400	0	0	0	0	36,400
2020	36,286	0	0	0	0	36,286

Deforestation in the with Project Case

Equation 3.8, Equation for Calculating the Net Carbon Stock Change as a Result of Deforestation in the Project Case.

$$\Delta C_{P,DefPA,i,t} = \sum_{u=1}^{U} \left(A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t} \right)$$

Table 3.18. Parameters and Values used to Calculate Annual Ex-Ante Deforestation Emissions.

Parameter	Description	Value	Justification
ΔCP,DefPA,i,t	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t; t CO_2e	See table below for calculations.	See table below for calculations.
ADefPA,u,i,t	Area of recorded deforestation in the project area stratum i converted to land use u at time t; ha	See table below for calculations.	See table below for calculations.
ΔCpools,Def,u,i,t	Net carbon stock changes in all pools in the project case in land use u in stratum i at time t; t CO_2e ha-1	ΔCpools,Def,u,i,t = 346.2	This value is the strata area weighted mean. See the forest inventory report for more information on the derivation of this value.

Table 3.19. Data Used to Calculate ΔCP,DefPA,i,t.

Year	ADefPA,u,i,t (ha)	ΔCpools,Def,u,i,t (t CO2-e/ha)	ΔCP,DefPA,i,t (t CO2-e)
2011	108.6	343.6	37,328
2012	108.3	343.6	37,211
2013	107.9	343.6	37,094
2014	107.6	343.6	36,977
2015	107.3	343.6	36,861
2016	106.9	343.6	36,745
2017	106.6	343.6	36,630
2018	106.3	343.6	36,515
2019	105.9	343.6	36,400
2020	105.6	343.6	36,286

ADefPA,u,i,t is derived using a value of 1.57% deforestation. Further, it is assumed a project effectiveness of 80%, resulting in an annual deforestation rate in the with project case of 0.31% deforestation.

Degradation in the with Project Case

Equation 3.9. Equation for Calculating the Net Carbon Stock Change as a Result of Degradation in the Project Area in the Project Case.

$$\Delta C_{P,Deg,i,t} = \Delta C_{P,DegW,i,t} + \Delta C_{P,SelLog,i,t}$$

Table 3.20. Parameters and Values used to Calculate Annual Ex-Ante Degradation Emissions.

Parameter	Description	Value	Justification
$\Delta C_{P,Deg,i,t}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,Deg,i,t} = 0$	

$\Delta C_{P,DegW,i,t}$	Net carbon stock change as a result of degradation through extraction of trees for illegal timber or fuelwood and charcoal in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,DegW,i,t} = 0$	Emissions resulting from degradation due to illegal logging (parameter ΔCP,DegW) will be quantified ex-post using a limited field sampling approach as there is potential for some degradation in the with-project case according to the results of community surveys carried out in March 2012, conducted in accordance with prescribed procedures per module VMD0015 of methodology VM0007. As the agent of deforestation (and degradation), have committed to no longer harvesting fuelwood and timber in forests surrounding their farms, and forest patrols with further deter degradation activities ex-ante degradation is estimated as zero.
$\Delta C_{P,SelLog,i,t}$	Net carbon stock change as a result of degradation through selective logging of FSC certified forest management areas in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,SelLog,i,t} = 0$	Emissions resulting from degradation due to selective logging of FSC certified areas (parameter ΔCP,SelLog,i,t) is equal to zero as no selective FSC logging occurs in either the baseline or with-project case.

The net carbon stock change as a result of degradation in the project area ($\Delta C_{P,Deg,i,t}$) is equal to zero for each year in the baseline period (2011-2020).

GHG Emissions

Equation 3.10. Equation for Calculating GHG Emissions as a Result of Deforestation Activities within the Project Area in the Project Case.

$$GHG_{P,E,i,t} = E_{FC,i,t} + E_{BiomassBurn,i,t} + N_2O_{direct-N,i,t}$$

Table 3.21. Parameters and Values Used to Calculate Annual Ex-Ante GHG Emissions.

Parameter	Description	Value	Justification
GHGP,E,i,t	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum i in year t; t CO_2e	GHGP,E,i,t = 0	

EFC,i,t	Emission from fossil fuel combustion in stratum i within the project area in year t; t CO_2e	EFC,i,t = 0	Not included in the project boundary
EBiomassBurn,i,t	Non-CO_2 emissions due to biomass burning in stratum i in year t; t CO_2e	EBiomassBurn,i,t = 0	Biomass burning is not expected to occur in the with project case. Where it does occur, it will be accounted for ex-post.
N2Odirect-N,i,t	Direct N_2O emission as a result of nitrogen application on the alternative land use in stratum i within the project area in year t; t CO_2e	N2Odirect-N,i,t = 0	No nitrogen is applied on the alternative land use within the project boundary

Greenhouse gas emissions as a result of deforestation activities within the project area (GHGP,E,i,t) is equal to zero for each year in the baseline period (2011-2020).

3.3 Leakage

Leakage emissions from displacement of unplanned deforestation are estimated in conformance with the VCS modular REDD methodology VM0007, specifically the LK-ASU module. This module provides for accounting for activity shifting leakage resulting from both local and immigrant deforestation agents.

Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions in the Leakage Belt

Activity shifting leakage due to displacement of unplanned deforestation was assessed using a baseline specific to the leakage belt developed following procedures detailed in the Module BL-UP. While details of the baseline are provided in Table 3.15, Table 3.22 below states the expected baseline estimates for the leakage belt.

Table 3.22. Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions in the Leakage Belt.

Year	ΔCTOT (t CO2-e)
2011	205,406
2012	225,355
2013	199,533
2014	225,397
2015	243,503
2016	233,368
2017	278,548
2018	271,569
2019	212,852
2020	245,941
Total	2,341,471

Estimation of the Proportions of Area Deforested by Immigrant and Local Deforestation Agents in the Baseline

In March 2012, 16 community surveys were carried out near the boundaries of the leakage belt and project area. While the total number of communities in the area is not known, it is thought the maximum number is approximately 45; hence about 30% of communities in the area were sampled. Results of the community surveys indicated than only 3 of the 16 families have migrated to the area within the last five years.

. $PROP_{RES}$ = the proportion of area deforested by the population that has been resident in and around the leakage belt and project area for ≥ 5 years = 0.813; and

$PROP_{IMM}$ = the proportion of area deforested by population that has migrated into the area in the last 5 years = 0.188.

Estimation of Unplanned Deforestation Displaced from the Project Area to the Leakage Belt

Ex-ante baseline emissions occurring in the leakage belt are estimated by first estimating the amount of deforestation that is thought to be displaced from the project area to the leakage belt. As people living within the project area are well settled, there appears to be little risk of them displacing much of their activities to outside the project area given project implementation measures to improve their livelihoods with expanding their agricultural land base, and therefore the leakage factor is estimated to be 0.15. Leakage is then calculated as the difference between project and baseline carbon stock changes and greenhouse gas emissions in the leakage belt, as outlined in Equation 3.11. Ex-ante estimates of the net CO_2 emissions due to unplanned deforestation displaced from the project area to the leakage belt is calculated for each year in the baseline period in Table 3.24.

Equation 3.11. Equation for Calculating Net CO_2 Emissions due to Unplanned Deforestation Displaced from the Project Area to the Leakage Belt.

$$\Delta C_{LK-ASU-LB} = \Delta C_{P,LB} - \Delta C_{BSL,LK,unplanned}$$

Table 3.23. Parameters and Values used to Calculate Annual Ex-Ante GHG Emissions in the Leakage Belt.

Parameter	Description	Value	Justification
ΔCLK-ASU-LB	Net CO_2 emissions due to unplanned deforestation displaced from the project area to the leakage belt; t CO_2e	See Table 3.24.	Calculated.
ΔCBSL,LK,unplanned	Net CO_2 emissions in the baseline from unplanned deforestation in the leakage belt; t CO_2e	See Table 3.22.	Derived in Section 3.1.

ΔCP,LB	Net greenhouse gas emissions within the leakage belt in the project case t CO_2e	See Table 3.24.	Ex-ante estimate is calculated by multiplying the estimated baseline carbon stock changes and greenhouse gas emissions for the project area by a factor < 1.0 representing the % of deforestation expected to be displaced into the leakage belt. This result is then added to the estimated baseline for the leakage belt.

Table 3.24. Estimates of the Net CO_2 Emissions due to Unplanned Deforestation Displaced from the Project Area to the Leakage Belt.

Year	ΔCBSL,PA,unplanned (t CO2-e)	Deforestation expected to be displaced from the project area	ΔCP,LB[1] (t CO2-e)	ΔCBSL,LK,unplanned (t CO2-e)	ΔCLK-ASU-LB (t CO2-e)
2011	126,240	18,936	224,342	205,406	18,936
2012	142,812	21,422	246,777	225,355	21,422
2013	137,409	20,611	220,144	199,533	20,611
2014	158,897	23,835	249,231	225,397	23,835
2015	202,300	30,345	273,848	243,503	30,345
2016	176,865	26,530	259,898	233,368	26,530
2017	185,232	27,785	306,332	278,548	27,785
2018	169,285	25,393	296,962	271,569	25,393
2019	201,212	30,182	243,033	212,852	30,182
2020	209,001	31,350	277,291	245,941	31,350
Total	1,709,253	256,388	2,597,859	2,341,471	256,388

[1]Calculated as 0.15 multiplied by ΔCBSL,PA,unplanned plus ΔCBSL,LK,unplanned

Estimation of Unplanned Deforestation Displaced from the Project Area to Outside the Leakage Belt

Deforestation at the hands of immigrant agents outside the leakage belt is calculated in this section. The first step involves calculating the total available national forest area for unplanned deforestation, using Equation 3.12 and the values found in Table 3.25. AVFOR, was calculated to be 519,522,377 ha.

Equation 3.12. Equation for Calculating the Total Available National Forest Area for Unplanned Deforestation.

$$AVFOR = TOTFOR - PROTFOR - MANFOR$$

Table 3.25. Parameters and Values used to Calculate the Total Available National Forest Area for Unplanned Deforestation.

Parameter	Description	Value	Justification/Source

AVFOR	Total available national forest area for unplanned deforestation; ha	519,522,377	
TOTFOR	Total available national forest area; ha	519,522,377	page 17, 2010 Brazil FRA
PROTFOR	Total area of fully protected forests nationally; ha	0	Conservatively set to zero
MANFOR	Total area of forests under active management nationally; ha	0	Conservatively set to zero

FAO. 2009. Global Forest Resources Assessment 2010, Brazil Country Report. Forestry Department, Food and Agriculture Organization of the United Nations, Rome.

Next, the ratio (PROPLB) of the forested area of the leakage belt (LBFOR) to the total available national forest area (AVFOR) was calculated. PROPLB = 32,128 ha / 519,522,377 ha = 0.0000618.

The area weighed mean live aboveground tree carbon stock (COLB) was calculated for Brazilian forest using data from Global Forest Resources Assessment 2010, Brazil Country Report [52] as found in Table 3.26. COLB =372 t CO2-e ha-1

Table 3.26. Live Aboveground Biomass Carbon Stocks in Amazonian Forests.

Natural Forest Biome	Area[1] (ha) in 2010	Aboveground Biomass Carbon Stock[2] M t C	AGB t C /ha	AGB t CO2/ha
Amazon	354,389,794	44,298.70	125	458
Cerrado	70,007,832	2,396.70	34	126
Caatinga	46,774,120	1,380.80	30	108
Atlantic Forest	28,818,263	3,432.10	119	437
Pantanal	8,554,246	292.27	34	125
Pampa	3,560,541	424.00	119	437
Forest Plantations	7,417,580	520.80	70	257
Total Area of Forest	519,522,377		Area weighted Average	372.3

The FAO publication Global Forest Resources Assessment 2010, Brazil Country Report was the source of information for the area of AVFOR, the forest strata, and the stocks of aboveground biomass carbon present in each strata.

The area weighted average aboveground tree carbon stock for forests available for unplanned deforestation inside the leakage belt (CLB) was calculated using data found in Section 3.1.4.

CLB = 344 t CO_2e ha-1.

The proportional difference in carbon stocks between areas of forest available for unplanned deforestation both inside and outside the leakage belt (PROPCS) was calculated as PROPCS = 372 t CO2-e ha-1 / 344 t CO_2e ha-1 = 1.082.

[52] FAO. 2009. Global Forest Resources Assessment 2010, Brazil Country Report. Forestry Department, Food and Agriculture Organization of the United Nations, Rome.

The proportional leakage for areas with immigrating populations was calculated using Equation 3.13. The values for the parameters used in this equation can be found in Table 3.27.

Equation 3.13. Equation for Calculating the Proportional Leakage for Areas with Immigrating Populations.

$$LK_{PROP} = PROP_{IMM} * (1 - PROP_{LB}) * PROP_{CS}$$

Table 3.27. Parameters and Values used to Calculate the Proportional Leakage for Areas with Immigrating Populations.

Parameter	Description	Value	Justification/Source
LKPROP	Proportional leakage for areas with immigrating populations; proportion	0.203	
PROPIMM	Estimated proportion of baseline deforestation caused by immigrating population; proportion	0.188	Estimated above
PROPLB	Area of forest available for unplanned deforestation as a proportion of the total national forest area available for unplanned deforestation; proportion	0.0000618	Calculated above
PROPCS	The proportional difference in stocks between areas of forest available for unplanned deforestation both inside and outside the Leakage Belt; proportion	1.082	Calculated above

The net leakage outside the leakage belt (ΔCLK-ASU,OLB) is calculate ex-ante using Equation 3.14. The values for the parameters used in this equation can be found in Table 3.28. Annual values for ΔCLK-ASU,OLB were calculated in Table 3.29.

Equation 3.14. Equation for Calculating the Net CO_2 Emissions due to Unplanned Deforestation Displaced Outside the Leakage Belt.

$$\Delta C_{LK-ASU,OLB} = (\Delta C_{BSL,LK,unplanned} - \Delta C_{P,LB}) * LK_{PROP}$$

Table 3.28. Parameters and Values used to Calculate the Net CO_2 Emissions due to Unplanned Deforestation Displaced Outside the Leakage Belt.

Parameter	Description	Value	Justification/Source
ΔCLK-ASU,OLB	Net CO_2 emissions due to unplanned deforestation displaced outside the leakage belt; t CO_2e	Calculated in Table 3.29, below.	
ΔCBSL,LK,unplanned	Net CO_2 equivalent emissions in the baseline from unplanned deforestation in the leakage belt; t CO_2e	See Table 3.22.	Calculated above
ΔCP,LB	Net CO_2 equivalent emissions within the leakage belt in the project case; t CO_2e	See Table 3.24.	Calculated above
LKPROP	Proportional leakage for areas with immigrating populations; proportion	0.203	Calculated above

Table 3.29. Calculation of Net CO_2 Emissions due to Unplanned Deforestation Displaced Outside the Leakage Belt.

Year	ΔCBSL,LK,unplanned (t CO2-e)	ΔCP,LB (t CO2-e)	LKPROP	ΔCLK-ASU,OLB (t CO2-e)
2011	205,406	224,342	0.203	3,842
2012	225,355	246,777	0.203	4,346
2013	199,533	220,144	0.203	4,182
2014	225,397	249,231	0.203	4,836
2015	243,503	273,848	0.203	6,157
2016	233,368	259,898	0.203	5,383
2017	278,548	306,332	0.203	5,637
2018	271,569	296,962	0.203	5,152
2019	212,852	243,033	0.203	6,123
2020	245,941	277,291	0.203	6,361

Emissions from Leakage Prevention Activities

Leakage prevention measures do not include the use of fertilizers or the burning of biomass. As such, greenhouse gas emissions as a result of leakage of avoided deforestation activities (GHGLK,E) are assumed to be zero.

Estimation of Total Leakage due to the Displacement of Unplanned Deforestation

The total leakage due to the displacement of unplanned deforestation is estimated in Table 3.31 using Equation 3.15.

Equation 3.15. Equation for Estimation of Total Leakage due to the Displacement of Unplanned Deforestation.

$$\Delta C_{LK\text{-}AS,unplanned} = \Delta C_{LK\text{-}A\ SU\text{-}LB} + \Delta C_{LK\text{-}ASU\text{-}OLB} + GHG_{LK,E}$$

Table 3.30. Parameters and Values used to Estimate Total Leakage due to the Displacement of Unplanned Deforestation.

Parameter	Description	Value	Justification
ΔCLK-AS,unplanned	Net greenhouse gas emissions due to activity shifting leakage for projects preventing unplanned deforestation Net CO_2 emissions; t CO_2e	See Table 3.31	Calculated
ΔCLK-ASU-OLB	Net CO_2 emissions due to unplanned deforestation displaced outside the leakage belt; t CO_2e	See Table 3.29.	Calculated
ΔCLK-ASU-LB	Net CO_2 emissions due to unplanned deforestation displaced from the project area to the leakage belt; t CO_2e	See Table 3.24.	Calculated.
GHGLK,E	Greenhouse gas emissions as a result of leakage of avoided deforestation activities; t CO_2e	GHGLK,E = 0	Leakage prevention measures do not include the use of fertilizers or the burning of biomass. As such, greenhouse gas emissions as a result of leakage of avoided deforestation activities (GHGLK,E) are assumed to be zero.

Table 3.31. Calculation of the Total Leakage due to the Displacement of Unplanned Deforestation.

Year	ΔCLK-ASU-OLB (t CO2-e)	ΔCLK-ASU-LB (t CO2-e)	GHGLK,E (t CO2-e)	ΔCLK-AS,unplanned (t CO2-e)
2011	3,842	18,936	0	22,778
2012	4,346	21,422	0	25,768
2013	4,182	20,611	0	24,793
2014	4,836	23,835	0	28,670
2015	6,157	30,345	0	36,502
2016	5,383	26,530	0	31,912
2017	5,637	27,785	0	33,422
2018	5,152	25,393	0	30,545
2019	6,123	30,182	0	36,305
2020	6,361	31,350	0	37,711

3.4 Summary of GHG Emission Reductions and Removals

Estimates of GHG credits eligible for issuance as VCUs were calculated in Table 3.32, below; where

Estimated GHG emission reduction credits =

Baseline emissions, fixed for 10 years at validation *minus*

Project emissions *minus*

Leakage *minus*

Non-permanence Risk Buffer withholding (calculated as a percent of net change in carbon stocks prior to deduction of leakage, see Appendix A).

Table 3.32. Ex-Ante Estimated of Net Emission Reduction Credits.

Years	Estimated baseline emissions or removals (tCO_{2e})	Estimated project emissions or removals (tCO_{2e})	Estimated leakage emissions (tCO_{2e})	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO2e)	GHG credits eligible for issuance as VCUs (tCO_{2e})
2011	126,240	37,328	22,778	10%	8,891	57,243
2012	142,812	37,211	25,768	10%	10,560	69,273
2013	137,409	37,094	24,793	10%	10,032	65,490
2014	158,897	36,977	28,670	10%	12,192	81,057
2015	202,300	36,861	36,502	10%	16,544	112,394
2016	176,865	36,745	31,912	10%	14,012	94,195
2017	185,232	36,630	33,422	10%	14,860	100,320
2018	169,285	36,515	30,545	10%	13,277	88,949
2019	201,212	36,400	36,305	10%	16,481	112,025
2020	209,001	36,286	37,711	10%	17,271	117,733

Over the first 10 year baseline period, the project area is expected to results in 1,341,205 tons t CO_2e reductions with a buffer pool contribution of 134,120 t CO_2e and a total expected emission reduction of 898,679 t CO_2e after account for leakage (308,406 t CO_2e).

Table 3.33. Emissions Reductions (t CO2-e) Expected to be Generated by the Purus Project over the 10 Year Crediting Period.

Aspect of Emission Reductions Estimate	**t CO_2e**
Net forest carbon sequestration (t CO_2) (Baseline-With project scenario)	1,341,205
Buffer pool contribution	134,120
Leakage	308,406
Total Emission Reductions	898,679

4 Monitoring

4.1 Data and Parameters Available at Validation

Data and parameters calculated during the course of project development include those listed in this section.

Data Unit / Parameter:	$\Delta C_{BSL,PA,unplanned}$
Data unit:	$t\ CO_2$-e
Description:	Net CO_2 emissions in the baseline from unplanned deforestation in the project area
Source of data:	Derived in Section 3.1 of PD
Value applied:	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied:	Derived and justified in Section 3 of PD in which baseline is set
Any comment:	

Data Unit / Parameter:	$\Delta C_{BSL,LK,unplanned}$
Data unit:	$t\ CO_2$-e
Description:	Net CO_2 emissions in the baseline from unplanned deforestation in the leakage belt
Source of data:	Derived in Section 3.1 and 3.2 of PD
Value applied:	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied:	Derived and justified in Section 3 of PD in which baseline is set
Any comment:	

Data Unit / Parameter:	*CF*
Data unit:	$t\ C\ t^{-1}$ d.m.
Description:	Carbon fraction of biomass
Source of data:	IPCC 2006GL
Value applied:	0.47
Justification of choice of data or description of measurement methods and procedures applied:	Global default
Any comment:	

Data Unit / Parameter:	C_{OLB}
Data unit:	t CO_2-e ha^{-1}
Description:	Area-weighted average aboveground tree carbon stock for forests available for unplanned deforestation outside the Leakage Belt
Source of data:	Derived from source data found in FAO. 2009. Global Forest Resources Assessment 2010, Brazil Country Report. Forestry Department, Food and Agriculture Organization of the United Nations, Rome.
Value applied:	372.3 t CO_2-e ha^{-1}
Justification of choice of data or description of measurement methods and procedures applied:	Derived above in Section 3.3 of the PD
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,LB}$
Data unit:	t CO_2-e ha^{-1}
Description:	Area weighted average aboveground tree carbon stock for forests available for unplanned deforestation inside the Leakage Belt
Source of data:	Stock estimates of strata represented in the project area were derived from measurements from the forest carbon inventory of the project area, in addition to data from Salimon et al. for one unsampled forest strata. Salimon et al. 2011. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. Forest Ecology and Management 262: 555-560.
Value applied:	351 t CO_2e ha-1
Justification of choice of data or description of measurement methods and procedures applied:	Derived above in Section 3 of the Project Description
Any comment:	

4.2 Data and Parameters Monitored

Data and parameters which will need to be monitored include those listed in this section.

Details on data and parameters monitored are provided below. Note that:

- "value applied" is left blank because all parameters in this section are monitored
- "monitoring equipment" is left blank to provide flexibility in measurement and monitoring approach, essential for any longterm MRV plan
- Where a parameter is calculated from a methodology equation (i.e. not raw data), the methodology module and equation number is specified and "Description of measurement methods and procedures to be applied" and "QA/QC procedures to be applied" are appropriately left blank
- To avoid repetition and maintain an economical use of space in the summary tables, "Description of measurement methods and procedures to be applied" and "QA/QC procedures to be applied" for monitored (not calculated) parameters reference detailed accounts of procedures provided in the monitoring plan description below.

Data Unit / Parameter:	$\Delta C_{P,Def,i,t}$
Data unit:	t CO_2-e
Description:	Net carbon stock change as a result of deforestation in the project case in the project area in stratum *i* at time *t*
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every $\leq$ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 3, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DefLB,i,t}$
Data unit:	t CO_2-e
Description:	Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum *i* at time *t*
Source of data:	Calculated

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 4, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DistPA,i,t}$
Data unit:	t CO_2-e
Description:	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum *i* at time *t*
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 20, VMD0015
Any comment:	

Data Unit / Parameter:	$A_{DefPA,u,i,t}$
Data unit:	Ha
Description:	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*
Source of data:	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	

QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DefLB,u,i,t}$
Data unit:	Ha
Description:	Area of recorded deforestation in the leakage belt stratum *i* converted to land use *u* at time *t*
Source of data:	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every $\leq$ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DistPA,q,i,t}$
Data unit:	ha
Description:	Area impacted by natural disturbance in post-natural disturbance stratum *q* in stratum *i,* at time *t*
Source of data:	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every $\leq$ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{BSL,i}$
Data unit:	t CO_2-e ha^{-1}
Description:	Carbon stock in all pools in the baseline case in stratum *i*
Source of data:	Estimated from forest carbon inventory.
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description
Frequency of monitoring/recording:	Every $\leq$ 10 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta Cpools,Def,u,i,t$
Data unit:	t CO_2-e ha^{-1}
Description:	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*
Source of data:	Post deforestation carbon stocks in continuous agriculture in included pools (aboveground and belowground live aboveground trees = $C_{AB\_tree,i}$ and $C_{BB\_tree,i}$) is zero ($C_{BSL,post,i}$ = 0).
Description of measurement methods and procedures to be applied:	None
Frequency of monitoring/recording:	Every $\leq$ 10 years.
Value applied:	0
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DegW,i,t}$
Data unit:	ha
Description:	Area potentially impacted by degradation processes in stratum *i*

Source of data:	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Repeated each time the PRA indicates a potential for degradation. PRA conducted every $\leq$ 2 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{DegW,i,t}$
Data unit:	t CO_2-e
Description:	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum *i* at time *t*
Source of data:	Estimated from diameter measurements of cut stumps in sample plots
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every $\leq$ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	AP_i
Data unit:	ha
Description:	Total area of degradation sample plots in stratum *i*

Source of data:	Calculated as 3% of $A_{DegW,i,t}$
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every $\leq$ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DegW,i,t}$
Data unit:	t CO_2-e
Description:	Net carbon stock changes as a result of degradation in stratum *i* in the project area at time *t*
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every $\leq$ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 8, VMD0015
Any comment:	

Data Unit / Parameter:	$PROP_{IMM}$
Data unit:	Proportion
Description:	Estimated proportion of baseline deforestation caused by immigrating population
Source of data:	Calculated based on results of survey of communities in the area around the project.
Description of measurement methods and	Detailed procedures provided below under

procedures to be applied:	monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$PROP_{RES}$
Data unit:	Proportion
Description:	Estimated proportion of baseline deforestation caused by population that has been resident for ≥5 years
Source of data:	Calculated based on results of survey of communities in the area around the project.
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	*TOTFOR*
Data unit:	ha
Description:	Total available national forest area
Source of data:	Official data, peer reviewed publications, remotely sensed imagery (coarse scale imagery is appropriate) or cadastral maps and other verifiable sources
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Prior to each verification event and at least every

	5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	*PROTFOR*
Data unit:	ha
Description:	Total area of fully protected forests nationally
Source of data:	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	*MANFOR*
Data unit:	ha
Description:	Total area of forests under active management nationally
Source of data:	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	

Calculation method:	
Any comment:	

Data Unit / Parameter:	*ARRL,forest,t*
Data unit:	ha
Description:	Remaining area of forest in RRL at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Calculated as the total area of the RRL minus all nonforested areas.
Any comment:	

Data Unit / Parameter:	*Aburn,q,i,t.*
Data unit:	ha
Description:	Area burnt in post-natural disturbance stratum *q* in stratum *i,* at time *t*;
Source of data:	*See parameter* $A_{DistPA,q,i,t}$
Description of measurement methods and procedures to be applied:	Monitored as part of $A_{DistPA,q,i,t}$
Frequency of monitoring/recording:	Every $\leq$ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	Aburn,q,i,t.= $A_{DistPA,q,i,t}$ for stratum where the natural disturbance included fire
Any comment:	

Data Unit / Parameter:	dbh
Data unit:	cm
Description:	diameter at breast height
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below in Appendix B
Frequency of monitoring/recording:	Every $\leq$ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	dbasal
Data unit:	cm
Description:	Basal diameter
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below in Appendix B
Frequency of monitoring/recording:	Every $\leq$ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	Dbh may be used as a conservative estimate of dbasal

Data Unit / Parameter:	H
Data unit:	m
Description:	Height of tree
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below in Appendix B

Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	Dn
Data unit:	cm
Description:	Diameter of piece n of dead wood along the transect
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below in Appendix B
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	N
Data unit:	dimensionless
Description:	Total number of wood pieces intersecting the transect
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below in Appendix B
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	L
Data unit:	m
Description:	Length of the transect
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below in Appendix B
Frequency of monitoring/recording:	Every $\leq$ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

4.3 Description of the Monitoring Plan

This monitoring plan has been developed in close conjunction with module VMD0015 of the REDD Methodological Module, “Methods for monitoring of greenhouse gas emissions and removals (M-MON).” This section focuses on establishing procedures for monitoring deforestation, illegal degradation, natural disturbance, and project emissions ex-post in the project area and leakage belt. Further, procedures for updating the forest carbon stocks and revising the baseline are also provided below.

For accounting purposes, the project conservatively assumes stable stocks and no biomass monitoring is conducted in areas undergoing carbon stock enhancement, as permitted in the methodology monitoring module VMD0015, hence $\Delta C_{P,Enh,i,t}$ is set to 0.

Further as no commercial harvest of timber (including FSC selective logging) occurs in the baseline or with project case, the degradation due to harvest of timber will not be monitored, thus parameter $\Delta C_{P,SelLog,i,t}$ is set to 0.

A separate section on quality assurance/quality control and data archiving procedures covers all monitoring tasks.

Organizations responsible for monitoring are listed below in Table 4.6. These organizations are responsible for implementing all aspects of a particular monitoring task, as described in the monitoring sub-sections below.

Monitoring Deforestation and Natural Disturbance

Forest cover change due to deforestation and natural disturbance is monitored through periodic assessment of classified satellite imagery, see below, covering the project area. Emissions ($\Delta C_{P,Def,i,t}$ and $\Delta C_{P,DistPA,i,t}$ for deforestation and natural disturbance, respectively) are estimated by the multiplying areas $A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$,, for deforestation and natural disturbance, respectively, by average forest carbon stock per unit area (conservatively assuming $\Delta C_{P,Dist,q,i,t}$ and $\Delta C_{pools,Def,u,i,t} = C_{BSL,i}$). Note that $A_{DistPA,q,i,t}$,, is limited to the area where credits have been issued and is identified as the overlap between the delineated area of the disturbance and the summed area of unplanned deforestation in the project area to the year in which the disturbance occurred. Stock estimates from the initial field inventory completed in 2011, are valid for 10 years (per VM0007). Table 4.1 shows the data and parameters monitored.

Table 4.1 Data and Parameters for Monitoring Deforestation and Natural Disturbance.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t	t CO_2e	Calculated
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i at time t	t CO_2e	Calculated

$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum i converted to land use u at time t	Ha	Monitored for each verification event
$A_{DistPA,q,i,t}$	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i, at time t	Ha	Monitored for each verification event
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum i	t CO_2e ha^{-1}	Estimated from the forest carbon inventory
ARRL,forest,t	Remaining area of forest in RRL at time t	Ha	Updated prior to each verification event

Changes in forest cover ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$) will be monitored using data provided by the State of Acre. UCEGEO, the GIS department within the Climate Change Institute, Acre State government, produces an annual dataset on the extent and spatial location of all deforestation within the state using Landsat images. Deforestation and natural disturbance will be distinguished using ancillary data which may include but is not limited to high resolution imagery, digital elevation models (to identify steep areas prone to landslides), information from local land managers, etc.

In the case, where this dataset ceases to be available, ex-post deforestation will be determined by classification of remotely sensed imagery and land use change detection procedures.

The project area (and leakage belt boundary), as set in the PD, will serve as the initial "forest cover benchmark map" against which changes in forest cover will be assessed over the interval of the first monitoring period; the entire project area has been demonstrated to meet the forest definition at the beginning of the crediting period. For subsequent monitoring periods, change in forest cover will be assessed against the preceding classified forest cover map marking the beginning of the monitoring interval. Thus, the forest benchmark map is updated at each monitoring event.

The area of remaining forest in the RRL (ARRL,forest,t) is derived by subtracting by the nonforested area within the RRL, as found in the forest benchmark map (updated at each monitoring event), from the total area of the RRL.

Monitoring Illegal Degradation

Emissions due to illegal logging will be tracked by conducting surveys in the surrounding areas every two years. Locations surveyed will include:

- Families residing on the Moura & Rosa property adjacent to the project area; and
- Nearby ranches and rural properties, along the Purus River and secondary roads approaching the project area.

Surveys will produce information on wood consumers (fuel wood and wood for construction and charcoal production) in the surroundings areas, as well as general indications on the areas where wood is sourced from and maximum depth of penetration of harvest activities from access points.

In the event that any potential of illegal logging occurring in the project area is detected from the surveys (i.e. ≥ 10% of those interviewed/surveyed believe that degradation may be occurring within the project boundary), temporary sample plots will be allocated and measured in the area of the project indicated by the surveys as a potential source area for illegally-harvested wood. The potential degradation area within the project area ($A_{DegW,i}$) will be delineated based on survey results, incorporating general area information and maximum depth of penetration. Rectangular plots 10 meters by 1 kilometer (1 ha area) will be randomly or systematically allocated in the area, sufficient to produce a 1% sample of the area, and any recently-cut stumps or other indications of illegal harvest will be noted and recorded. Diameter at breast height, or diameter at height of cut, whichever is lower, of cut stumps will be measured.

In the event that the sample plot assessment indicated that illegal logging is occurring in the area, supplemental plots will be allocated to achieve a 3% sample of the area. Biomass will be estimated from measured diameters (conservatively assuming that diameters of stumps cut below breast height are equivalent to diameter at breast height) applying the allometric equations of Brown (1997) and otherwise maintain consistency with analytical procedures applied in the original forest inventory report. Emissions due to illegal logging ($\Delta C_{P,DegW,i,t}$) are estimated by multiplying area ($A_{DegW,i}$) by average biomass carbon of trees cut and removed per unit area ($C_{DegW,i,t} / AP_i$).

The more intensive 3% sample will be carried out once every 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area to produce an estimate of emissions resulting from illegal logging ($\Delta C_{P,DegW,i}$). Estimates of emissions will be annualized (to produce estimates in t CO_2e per year) by dividing the emission for the monitoring interval by the number of years in the interval.

Table 4.2 Data and Parameters for Monitoring Illegal Degradation.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$A_{DegW,i,t}$	Area potentially impacted by degradation processes in stratum i	Ha	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
$C_{DegW,i,t}$	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t	t CO_2e	Estimated from diameter measurements of cut stumps in sample plots
AP_i	Total area of degradation sample plots in stratum i	Ha	Calculated as 3% of $A_{DegW,i,t}$

$\Delta C_{P,DegW,i,t}$	Net carbon stock changes as a result of degradation in stratum i in the project area at time t	t CO_2e	Calculated

Monitoring Project Emissions

With project emissions are calculated as the sum of emission from fossil fuel combustion (EFC,i,t) + non-CO_2 emissions due to biomass burning (EBiomassBurn,i,t) + direct N_2O emissions as a result of nitrogen application (N2Odirect-N,i,t.). As stipulated in the methodology, fossil fuel combustion in all situations is an optional emission source. Further, no nitrogen is applied on alternative land uses in the with project case and hence project emissions therefore equal EBiomassBurn and are calculated using the VMD0013, "Estimation of greenhouse gas emissions from biomass burning (E-BB)" of the AD Partners modular REDD Methodology.

Non CO2 emissions from biomass burning in the project case include emissions from burning associated with deforestation and burning associate with natural disturbance, i.e. forest fire. It will be conservatively assumed that the total area burnt during the deforestation process is equal to the area deforested, ADefPA,u,i,t. Thus, the area used when calculating E-BB is equal to Aburn,i,t. (area burnt) = Aburn,q,i,t. (area burnt in natural disturbance) + ADefPA,u,i,t (area burnt via deforestation in project ex post)."

Table 4.3 Data and Parameters for Monitoring Emissions from Biomass Burning.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
E BiomassBurn,t	Greenhouse emissions due to biomass burning as part of deforestation activities in stratum i in year t	tCO_2e of each GHG (CH_4, N_2O)	Calculated
Aburn,i,t	Area burnt for stratum i at time t	Ha	Monitored for each verification event
Bi,t	Average aboveground biomass stock before burning stratum i, time t	tonnes d. m. ha-1	Conservatively assumed to be the carbon stock in all pools in the baseline case (CBSL,i).
COMF i	Combustion factor for stratum i; dimensionless	dimensionless	0.45 for primary open tropical forest. Derived from Table 2.6 of IPCC, 2006.
Gg,i	Emission factor for stratum i for gas g	kg t-1 dry matter burnt	GCH_4 = 6.8 g kg-1 and GN_2O = 0.2 g kg-1. Derived from Table 2.5 of IPCC, 2006.
GWPg	Global warming potential for gas g	t CO_2/t gas g	Default values from IPCC SAR: CH_4 = 21; N_2O = 310).

Monitoring Leakage

Leakage by local agents of deforestation is quantified in the leakage belt. The area deforested in the leakage belt (ADefLB,i,t) is estimated in the same manner as the area deforested in the with project case ($A_{DefPA,u,i,t}$) using the procedures outlined above in the monitoring deforestation section. Activity shifting leakage within the leakage belt (ΔCLK-ASU-LB) is then calculated as the with project emissions in the leakage belt (ΔCP,LB) minus the baseline emissions in the leakage belt (ΔCBSL,LK,unplanned).

Table 4.4 Data and Parameters for Monitoring Activity Shifting Leakage.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
ΔCP,LB	Net greenhouse gas emissions within the leakage belt in the project case	t CO_2e	Calculated
ADefLB,i,t	Area of recorded deforestation in the leakage belt at time t	ha	Monitored for each verification event
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t	t CO_2e	Calculated

Immigrant leakage is calculated using a series of equations found in the LK-ASU module. Most of the data for calculating immigrant leakage has been derived for the ex-ante estimates (including ΔCBSL,LK,unplanned; AVFOR; TOTFOR; PROTFOR; MANFOR; PROPLB; LBFOR; COLB; CLB; PROPCS; and ABSL,PA,unplanned,t) or gathered in the course of monitoring activity shifting leakage within the leakage belt and deforestation in the project area (including ADefPA; ADefLB,i,t; and ΔCP,LB).

The monitoring parameters MANFOR, PROTFOR, TOTFOR will be sourced from official data, peer reviewed publications or other verifiable sources, such as the Brazil Global Forest Resources Assessment Report published by the FAO and these monitoring parameters will be updated on review of current literature at least every 5 years. Demonstration that managed and protected forests will be protected against deforestation will further be demonstrated, as stipulated in the LK-ASU module.

Monitoring immigrant leakage will therefore consist of implementing surveys in communities living within 2 kilometers of the boundaries of the leakage belt and project area to determine what proportion of the agents of deforestation have been resident in and around the leakage belt and project area for ≥ 5 years (PROPRES) and the proportion of area deforested by population that has migrated into the area in the last 5 years (PROPIMM). As it is extremely sensitive to ask explicit questions regarding responsibility for deforestation, “the proportion of area deforested by population that has migrated into the area in the last 5 years” is assumed to be equal to the percentage of recent immigrants among local population with potential access to the project area (i.e. without directly asking if they are deforestation agents). Similarly, the “proportion of baseline deforestation caused by population that has been resident for ≥5 years” is assumed to be equal to the percentage of the local population residing in the area longer than 5 years with potential access to the project area.

Table 4.5 Data and Parameters for Monitoring Immigrant Leakage.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
PROPIMM	Proportion of area deforested by immigrant agents in the leakage belt and project area	proportion	Monitored prior to each verification event and at least every 5 years
PROPRES	Proportion of baseline deforestation caused by population that has been resident for ≥5 years	proportion	Monitored prior to each verification event and at least every 5 years
TOTFOR	Total available national forest area	ha	Monitored prior to each verification event and at least every 5 years
PROTFOR	Total area of fully protected forests nationally	ha	Monitored prior to each verification event and at least every 5 years
MANFOR	Total area of forests under active management nationally	ha	Monitored prior to each verification event and at least every 5 years

Updating Forest Carbon Stocks Estimates

Forest carbon stock estimates will be derived from field measurements less than or equal to 10 years old. Sample plots will be randomly located in areas within the Purus Project and measured following standard operating procedures located in Appendix B. Biomass will be estimated applying the following allometric equations and otherwise maintain consistency with analytical procedures applied in the original inventory ("Forest biomass carbon inventory for the Purus REDD Project, Acre State, Brazil," 2011).

For live trees, biomass is calculated as a function of diameter at breast height (DBH; in cm) using the predictive model developed by Brown[53] for tropical moist forest stands. Results of this equation are conservatively adjusted downward using a calibration factor of 0.985. Application of the "moist" equation reflects the annual precipitation for the inventoried area, 2100mm.

aboveground biomass (kg) = ((42.69-12.8*(DBH)+1.242*(DBH)^2))*0.985 Equation 4.1

For palms, height and dbh (a conservative estimate of basal diameter) measurements are used to estimate the aboveground volume of a paraboloid and then mean (species level) Amazonian palm

[53]Brown, S., 1997. Estimating biomass and biomass change of tropical forests: A primer. FAO Forestry Paper: vii, 55 p.

specific gravity of 0.31 g/cm3 estimated by Baker et al (2004) will be applied. The estimate of biomass for palms is therefore to be limited to the main trunk (bole) of the palm. Thus, for palms

aboveground biomass (Mg) = 0.5*Π*(basal diameter(cm)/200)^2*height(m)*0.31 Equation 4.2

Root biomass density is estimated at the cluster sample level applying the equation developed by Cairns et al.[54] , where

Root Biomass Density (t/ha) = EXP (-1.085 + 0.925 LN(aboveground biomass density)) Equation 4.3

The volume of lying dead wood per unit area is estimated using the equation (Warren and Olsen[55]) as modified by Van Wagner[56] separately for each dead wood density class:

$$\boxed{V_{LDW} = \frac{\pi^2 * \left(\sum_{n=1}^{N} D_n^{\ 2}\right)}{8 * L}}$$

Equation 4.4

where:

V_{LDW} Volume of lying dead wood per unit area; $m^3\ ha^{-1}$

D_n Diameter of piece n of dead wood along the transect; cm

N Total number of wood pieces intersecting the transect; dimensionless

L Length of the transect; m

Length of each transect was corrected for slope. The volumes per unit area of each dead wood density class are then multiplied by their respective densities to convert to a mass per unit area.

Biomass of standing dead wood is estimated using the allometric equation for live trees in the decomposition class 1. In decomposition class 2, the estimate of biomass was limited to the main trunk (bole) of the tree, in which case the biomass was calculated converting volume to biomass using dead wood density classes. Volume was estimated as the volume of a cone, as specified in the VM0007 module, “Estimation of carbon stocks in the dead wood pool”.

Density of dead wood is determined through sampling and laboratory analysis. Discs are collected in the field and decomposition class and green volume determined as per standard protocols (see Appendix B for more details). The resulting dry weight is recorded and used to calculate dead wood density as oven-dry weight (g) / green volume (cm^3) for each sample.

[54] Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world’s upland forests. Oecologia 111, 1-11.
[55] Warren, W.G. and Olsen, P.F. (1964) A line intersect technique for assessing logging waste. Forest Science 10: 267-276.
[56] Van Wagner, C.E. (1968). The line intersect method in forest fuel sampling. Forest Science 14: 20-26.

Dry mass is converted to carbon using the default carbon fraction of 0.47 t C/t d.m. (as recommended by IPCC[57] Guidelines for National Greenhouse Gas Inventories).

Revision of the baseline

The baseline as outlined here in the Project Description is valid for 10 years, through May 23, 2021. The baseline will be revised every 10 years from the project start date.

Data collection procedures in regards to revision of the baseline will include participatory rural appraisals, interviews and collaboration with the Acre State government, UCEGEO, the GIS department within the Climate Change Institute, and municipal officials. In the case, where the Acre State government no longer produces the annual dataset on the extent and spatial location of all deforestation within the state, deforestation maps will be prepared by classifying remotely sensed imagery. Other datasets used to substantiate aspects of the baseline with be from official government sources, peer reviewed publications, or other reputable sources.

Quality Assurance/Quality Control and Data Archiving Procedures

Monitoring Deforestation, Natural Disturbance, and Leakage

To ensure consistency and quality results, spatial analysts carrying out the imagery processing, interpretation, and change detection procedures will strictly adhere to best practices and good practice guidelines, when using the alternative method for quantifying deforestation. All data sources and analytical procedures will be documented and archived (detailed under data archiving below).

Accuracy of the classification will be assessed by comparing the classification with ground-truth points or samples of high resolution imagery. Any data collected from ground-truth points will be recorded (including GPS coordinates, identified land-use class, and supporting photographic evidence) and archived. Any sample points of high resolution imagery used to assess classification accuracy will also be archived. Samples used to assess classification accuracy should be well-distributed throughout the project area (as far as is possible considering availability of high resolution imagery and/or logistics of acquiring ground-truth data), with a minimum sampling intensity of 50 points each for the forest and non-forest classes.

The classification will only be used in the forest cover change detection step if the overall classification accuracy, calculated as the total number of correct samples / the total number of samples, is equal to or exceeds 90%.

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive.

Information related to monitoring deforestation maintained in the archive will include:

- Forest / non-forest maps;

[57] IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Chapter 4 AFOLU (Agriculture, Forestry and Other Land-use).

- Documentation of software type and procedures applied (including all pre-processing steps and corrections, spectral bands used in final classifications, and classification methodologies and algorithms applied), if applicable; and
- Data used in accuracy assessment - ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) and/or sample points of high resolution imagery.

Forest Carbon Stocks and Degradation

The following steps will be taken to control for errors in field sampling and data analysis:

1. Trained field crews will carry out all field data collection and adhere to standard operating procedures. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurements. To ensure accurate measurements, the height of diameter at breast height (1.3 m) will be periodically re-assessed by personnel during the course of the inventory.
2. An opportunistic sample of plots will be re-measured to identify and correct any field measurement issues which arise during implementation of the monitoring plan and to assess measurement errors. Re-measurement for this purpose will be done by different field personnel.
3. Field measurement data will be recorded on standard field data sheets and entered into an excel database for data management and quality control. Potential errors in data entry (anomalous values) will be verified or corrected consulting the original data sheets or personnel involved in measurement. Original data sheets will be permanently archived in a dedicated long-term electronic archive. The electronic database will also archive GIS coverages detailing forest and strata boundaries and plot locations.

Quality control procedures for sampling degradation will include steps 1 and step 3, above.

Quality control procedures related to monitoring leakage include conducting a review of the current literature at least every 5 years to source information on the area of the monitoring parameters MANFOR, PROTFOR, and TOTFOR. Further, participatory rural appraisals used to assess the length of time people have been living in the project area and leakage belt will be implemented by personnel with experience conducting community surveys in rural Brazil.

Personnel involved in the revising of the baseline will have detailed knowledge in regards to spatial modeling and land use change and deep familiarity with REDD methodologies. Remote sensing data used will include officially published dataset, or classified imagery, which meets accuracy assessment requirements as laid out in the methodology.

Data Archiving

Data archived will be maintained through at least two years beyond the end of the project crediting period. Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

Organization, Responsibilities, and Monitoring Frequency

For all aspects of project monitoring, Purus Project staff will ensure that data collection, processing, analysis, management and archiving are conducted in accordance with the monitoring plan.

Table 4.6. Type of Monitoring and Party Responsible for Monitoring.

Variables to be monitored	Responsible	Frequency
Monitoring deforestation and natural disturbance	Moura & Rosa	Prior to each verification
Monitoring illegal degradation	Moura & Rosa	Every two years
Monitoring project emissions	CarbonCo	Prior to each verification
Activity shifting immigrant leakage assessment	Moura & Rosa	Prior to each verification event and at least every 5 years.
Updating forest carbon stocks estimates	CarbonCo	At least every 10 years.
Revision of the baseline	CarbonCo	At least every 10 years.

5 ENVIRONMENTAL IMPACT

Deforestation and its associated GHG emissions, is a global environmental issue but its effects locally and regionally are particularly concerning in developing countries where economies and livelihoods are more closely linked to farming and utilization of natural resources. This REDD project will result in positive environmental benefits by conserving forest land leading to less environmental degradation than would have occurred when lands are converted to pasture or cropland. The conservation of the Amazon Rainforests is vitally important to humankind and the global environment, as well as the local environment, as these forests provide a wide range of critical ecosystem services including their ability to:

- Improve local air and water quality by filtering pollutants;
- Help regulate water and nutrient cycles (e.g., phosphorous and nitrogen);
- Control flooding by minimizing runoff and soil loss;
- Provide habitat for biodiversity and nutrition for wildlife;
- Provide aesthetical, spiritual and cultural benefits to local communities;
- Produce oxygen - without which life would not be possible; and
- Absorb carbon dioxide, a greenhouse gas, to mitigate climate change.

As a conservation project, the Purus Project will ultimately have a net positive environmental impact. More specifically, the project will benefit the local communities and region overall by improved water quality and securing land for natural flood storage (i.e., lessening the effect of floods). Further, with conservation as a focal point, the Purus Project will maintain critical habitat for wildlife, including threatened and endangered species.

The International Union for Conservation of Nature (IUCN) has identified 26 species in Acre as Near Threatened, Vulnerable, Endangered, Critically Endangered and Extinct.[58] The Southwestern Amazon is also home to many endemic species. According to the World Wildlife Fund, there are approximately 42 endemic species in the Southwestern Amazon.[59]

Furthermore, a rapid assessment of the Purus Project's biodiversity was conducted by Maria José Miranda de Souza Noquelli of Tenóryo Dias and Alternativa Ambiental from August to September 2009. The vegetation sampling recorded 157 species belonging to fifty families and there was one critically endangered species and seven vulnerable species identified. The rapid assessment also identified or detected (for example, through footprints) five endangered and three vulnerable fauna species.[60]

For more details, please see the CCBS project document.

[58] IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 01 February 2012.
[59] World Wildlife Fund, "Southwest Amazon moist forests: Export Species," Available: http://www.worldwildlife.org/science/wildfinder/
[60] Maria José Miranda de Souza Noquelli, "RESPOSTAS DO QUESTIONÁRIO SOBRE A ÁREA DOS SERINGAIS PORTO CENTRAL E ITATINGA, MANUEL URBANO-AC," November 2011.

Figure 5.1. Photos of wildlife in and around the project area, including an Amazon River Dolphin, Great White Heron, Scarlet Macaw, and Squirrel Money, taken in August 2011 (Photographs by Brian McFarland).

6 STAKEHOLDER COMMENTS

A summary of project meetings and stakeholder comments have been provided below. Further information on meetings can be found in the document "Purus Project Meeting Notes" as found in the project archive.

March 9-18, 2011 - CarbonCo, Carbon Securities and TerraCarbon travelled to Acre, Brazil to conduct a preliminary assessment of the Purus Project. A few key milestones included:

- CarbonCo, Carbon Securities and TerraCarbon held initial meetings with PESACRE (Grupo de Pesquisa e Extensão em Sistemas Agroflorestais do Acre), IPAM (Instituto de Pesquisa Ambiental da Amazônia), FUNTAC (Fundacao de Tecnologia do Estado do Acre), and SISA (System of Incentives for Environmental Services) to gain an understanding of the agents and drivers of deforestation in Acre state, how forest biomass stocks vary across the state, and local REDD and forest conservation initiatives;
- CarbonCo, Carbon Securities and TerraCarbon met with Moura & Rosa and the Chico Mendes Institute on Thursday, March 17th to discuss forest conservation and payment for ecosystem services schemes, such as REDD; and
- Carbon Securities and TerraCarbon met with Acre State Officials, including Monica Julissa De Los Rios de Leal and Eufran Amaral, on Friday, March 18th.

May 9, 2011 – Moura & Rosa met with the State of Acre's General Prosecutor Patricia Rego to discuss the Purus Project. This included a general introductory discussion of the Project, the expectations of the State for the Project's area of permanent preserve (APP) being destroyed by the local coomunities and how to legalize the destruction, how to improve quality of the communities' livelihoods, how the State can help the Purus Project, how the State can offer protection for this sort of Project, and the outcomes of a successful Project.

August 9-18, 2011 - CarbonCo, Carbon Securities, and TerraCarbon visited Rio Branco and the Purus Project site during for a project implementation trip. A few key milestones included:

- CarbonCo, Carbon Securities, Moura & Rosa, TerraCarbon, and TECMAN met with Acre State officials, including Monica Julissa De Los Rios de Leal and Lucio Flavio, on Wednesday, August 3rd to discuss how to best design the forest carbon inventory to align with the State of Acre's goals and future forest inventory plans;
- CarbonCo, Carbon Securities, TerraCarbon, and Moura & Rosa visited the Purus Project area from Thursday, August 4th through Monday, August 8th.
    - Moura & Rosa, CarbonCo and Carbon Securities met with the local community to discuss the project and get feedback on how to best implement measures to reduce deforestation. The community was overall receptive of reducing deforestation in exchange for alternative income and assistance, but were nervous about monitoring for local deforestation because it appeared as a local police force.

Figure 6.1. Photo of Community Members at Community Meeting (Photograph by Brian McFarland).

- CarbonCo, Carbon Securities, Moura & Rosa, TerraCarbon, and Willian Flores met with Acre State officials, including Monica Julissa De Los Rios de Leal, Eufran Amaral and Lucio Flavio on Tuesday, August 9th to discuss how to best develop the project-level baseline; how private projects will nest with a forthcoming state level baseline; and the type of GIS data available from the State of Acre.

October 17, 2011 - Moura & Rosa and Professor Flores met EMBRAPA in Rio Branco, Acre.

During this meeting Moura & Rosa introduced the Purus Project, discussed the local communities' needs and presented ideas for mitigating deforestation pressures. Additionally, Moura & Rosa discussed the possibility of EMBRAPA sending two technicians, one a specialist in reforestation and the minimization of degradation and the other a specialist in agriculture and livestock, to the Purus Project.

November 21, 2011 – CarbonCo spoke with Shaina Brown, Project Director at the Green Technology Leadership Group and Tony Brunello, the REDD Offset Working (ROW) group's facilitator to better understand the developments in the State of California and how they relate to the State of Acre.

November 30, 2011 – Carbon Securities and CarbonCo held a call with Maria José Miranda de Souza Noquelli from Tenóryo Dias e Alternativa Ambiental to learn more about the rapid biodiversity assessment that was conducted at the Purus Project, the specific species which were identified on the Purus Project site, whether there were occurrences of globally threatened species, along with the available methodologies and approximate costs to perform regular biodiversity monitoring plans.

Early December 2011 – Moura & Rosa met with EMBRAPA to discuss what EMBRAPA needs from Moura & Rosa and EMBRAPA gave a general presentation on how they could assist Moura & Rosa. This included free-range, rotational cattle pastures, and intensified agriculture. EMBRAPA also requested an official letter from the Project Proponents.

Late December 2011 - Moura & Rosa again met EMBRAPA. This discussion focused on the timing of when EMBRAPA could help, costs of EMBRAPA's assistance, and how EMBRPA could officially sponsor the project.

February 10, 2012 – CarbonCo spoke with Natalie Unterstell, the focal point for REDD+ at Brazil's Federal Ministry of Environment. Discussions were based around:

- The role of Brazil's Federal Government in the REDD context; Progress of the Amazon Fund; How States, particularly Acre, might nest into National Government; How Brazil's domestic cap-and-trade market is shaping up; Market mechanisms and REDD as potentially eligible offset; Where to go for REDD information on Federal government updates and how to inform Government of our Project

March 9-15th, 2012 – CarbonCo, Carbon Securities and Moura & Rosa visited the Purus Project for the following tasks:

- Met with 16 communities who participated in a Participatory Rural Assessment (PRA) to better understand the activities which contribute to deforestation, the cycle of deforestation, and how far communities enter the forest to collect fuelwood;
- These same 16 communities also participated in a Basic Necessities Survey (BNS) which shall serve as a baseline for the community impact monitoring plan to ensure the communities' poverty scores, poverty index, average owned assets, and average owned assets per capita are positively impacted as a result of the Project;
- The Project proponents also surveyed these 16 communities on which agricultural extension training courses would be of most interest and which crops and agricultural techniques EMBRAPA should focus on;
- The onsite project managers Sebastião Marques da Silva and Maria Souza de Moura were officially hired;
- CarbonCo, Carbon Securities and Moura & Rosa also met with Dr. Armando Muniz Calouro, Professor at UFAC about biodiversity monitoring plans using wildlife camera traps to assess the population and distribution of medium-to-large mammals; and
- CarbonCo, Carbon Securities and Moura & Rosa also with the Vice Governor of Acre, Mr. César Correia Messias to explain the Purus Project and to ask for a Letter of Support.

March 26, 2012 – CarbonCo and TerraCarbon held a follow up call with Monica Julissa De Los Rios de Leal to discuss a variety of topics, including:

- How to register the Purus Project with the State of Acre?

Mechanisms for Ongoing Communication

CarbonCo, Carbon Securities, and Moura & Rosa are committed to meet in person at least once per year at the Purus Project property with the local community to discuss project activities, project management, and to meet with the local community to get their feedback, ideas, and provide a platform for discussion.

APPENDICES

APPENDIX A. VCS NON-PERMANENCE RISK REPORT

A1.0 INTRODUCTION

The risk analysis has been conducted in accordance with the VCS AFOLU Non-Permanence Risk Tool, dated 04 October 2012. This tool assesses a project's internal risk, external risk, natural risk and mitigation measures which help to reduce risk. The risk ratings and supporting evidence are detailed in Section A1.1, A1.2, and A1.3, below. Letters in the risk factor column correspond to the risk factor explained in the VCS AFOLU Non-Permanence Risk Tool.

A1.1 INTERNAL RISKS

Project Management		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	Not applicable. Tree planting is not a project activity for which GHG credits will be issued.	0
b)	Ongoing enforcement is required to prevent encroachment by outside actors. The Purus Project employs forest patrols to prevent encroachment by outside actors into the project area.	2
c)	Management team does not include individuals with significant experience in all skills necessary to successfully undertake all project activities.	2
d)	Local management partners are based in Rio Branco less than a day's travel from the project activity. There is a project manager living on the property and a project headquarters is being established on the property.	0
e)	Project proponents have developed other forest carbon projects and have been working in the forest carbon arena for over 5 years. Brian McFarland of CarbonCo has developed the "Tensas River National Wildlife Refuge Afforestation Project" under the VCS and the CCBS including managing the project design, implementation, and financing. The project proponents work alongside and have access to experts in carbon accounting and reporting (i.e., TerraCarbon) who have significant experience in all aspects of AFOLU project design and implementation, carbon accounting and reporting under the VCS Program. TerraCarbon has successfully validated and verified numerous projects under the VCS, including validation and verification of the VCS ARR project "Reforestation Across the Lower Mississippi Valley"	-2
f)	There is no adaptive management plan in place.	0
Total Project Management (PM) [as applicable, (a + b + c + d + e + f)] Total may be less than zero.		**2**

Financial Viability		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a-d)	Project cash flow breakeven point is between years 4 and 7. Details are provided in a cash flow analysis which can be found in the project archive.	1
e-h)	Project has secured 100% of funding needed to cover the total cash out before the project reaches breakeven. Details are provided in a cash flow analysis which can be found in the project archive.	0
i)	Project has available at least 50% of the total cash out before project reaches breakeven. Project proponents are utilizing internal, non-restricted funds as evidenced in the project archive.	-2
Total Financial Viability (FV) [as applicable, ((a, b, c or d) + (e, f, g or h) + i)] Total may not be less than zero.		0

Opportunity Cost		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a	As the majority of baseline activities over the length of the project crediting period are subsistence-driven, an NPV analysis is not required. This risk category will be revised downward, once net positive community impacts can be clearly demonstrated, such as through certification against the Climate, Community & Biodiversity Standards or results of a participatory assessment of the project activities on the local communities which demonstrates net positive community benefits.	8
b-d)	Not applicable.	0
e-f)	Not applicable.	0
g)	None of the project proponents are a non-profit organization.	0
h-i)	There is a legal contractual agreement to maintain the project area as forest for at least a 60 year period (i.e. greater than the length of the crediting period) from the project start date.	-2
Total Opportunity Cost (OC) [as applicable, (a, b, c, d, e or f) + (g or h)] Total may not be less than 0.		**6**

Project Longevity		
a)	Not applicable.	0
b)	There is a legal contractual agreement to maintain the project activities and maintain the project area as forest for at least a 60 year period from the project start date.	0

	The landowners of the property are under contractual obligations[61] which limit their development/use of the property, as stated below. "The landowner acknowledges and agrees to not execute any activity that otherwise might interfere with the [project] implementation…including but not limited to, i. Clearing forest for livestock / cattle ranches; ii. Clearing forest for agriculture; iii. Expanding old roads or constructing new roads; iv. Expanding into new forests for infrastructure (i.e., bridges, housing, electricity, etc.); v. Expanding logging operations; [and] vi. Deforestation for new mining or mineral extraction."	
Total Project Longevity (PL) May not be less than zero		0

Total Internal Risks	
Total Internal Risks (PM + FV + OC + PL) Total may not be less than zero.	**8**

A1.2. EXTERNAL RISKS

Land Tenure and Resource Access/Impacts		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	The land owners, whom are also project proponents (Moura & Rosa), own the project area outright (see Section 1.12) and have full resource access/use rights, who are not shared with anyone. The property was geo-referenced and officially registered in the cadaster (Cadastro Ambiental Rural), a process which involved on the ground assessment of all property boundaries and consultations with neighboring landowners and resolution of any existing boundary disputes.	0
b-d)	Not applicable.	0
e)	Not applicable.	0
f)	There is a legal contractual agreement to maintain the project area as forest for at least a 60 year period (i.e. greater than the length of the crediting period) from the project start date.	-2
g)	Not applicable.	0
Total Land Tenure (LT) [as applicable, ((a or b) + c + d + e+ f)] Total may not be less than zero.		0

[61] See addendum to the Tri-Party Agreement located in the project archive.

Community Engagement		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	All households living on the Moura & Rosa property directly adjacent to the project area have been consulted. MOUs with each family living within the project property have been signed and are located in the project archive.	0
b)	To their knowledge, the project proponents have contacted all families reliant on the project area.	0
c)	Not applicable.	0
Total Community Engagement (CE) [where applicable, (a+b+c)] Total may be less than zero.		0

Political Risk		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a-e)	The average governance score for 2006 through 2010 is 0.01, or between the governance score of -0.32 to less than 0.19. Details of the calculation are provided in the project archive.	2
f)	Acre, Brazil is participating in the Governors' Climate and Forest Taskforce. Further, Brazil has an established Designated National Authority under the CDM and has at least one registered CDM Afforestation/Reforestation project.[62]	-2
Total Political (PC) [as applicable ((a, b, c, d or e) + f)] Total may not be less than zero.		0

Table A1. Calculation of Brazil's average governance score.

Governance Indicator	**2006**	**2007**	**2008**	**2009**	**2010**
Voice and Accountability	0.46	0.51	0.50	0.48	0.50
Political stability	-0.25	-0.35	-0.26	0.20	0.05
Govt effectiveness	-0.13	-0.10	0.00	0.02	0.07
Regulatory quality	-0.04	-0.02	0.07	0.18	0.19
Rule of law	-0.44	-0.44	-0.37	-0.21	0.00
Control of corruption	-0.14	-0.11	-0.02	-0.10	0.06
Overall Mean					0.01

[62] Project 2569: Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil (http://cdm.unfccc.int/Projects/DB/TUEV-SUED1242052712.92/view).
Project 3887: AES Tietê Afforestation/Reforestation Project in the State of São Paulo, Brazil (http://cdm.unfccc.int/Projects/DB/SGS-UKL1280399804.71/view).

Total External Risks	
Total External Risks (LT + CE + PC) Total may not be less than zero.	0

A1.3. NATURAL RISKS

Fire	
Discussion/ Evidence	Most of the project area is un-fragmented forest, with few areas of bordering pasture/non-forest. Most forest fires that occur in the region are anthropogenic, and thus sources of fire outbreaks in the project area are limited. In a study[63] of fires in the Amazon, Cochrane and Laurance documented a relationship between fire incidence and distance from forest edge, with decreasing fire return intervals with increasing distance from edge. They also found that effects of forest fires depend on the extent and condition of fuel sources. In general, drought conditions need to be present prior to the initiation of rainforest fires. While initial fires can have a significant effect on the smaller diameter (<40 cm dbh) trees, it is only with subsequent burns, that significant losses (mortality of up to 40% of trees) of forest biomass can be expected[64]. Despite fire induced tree mortality, tree mortality itself is unlikely to result in the loss of substantial biomass due to incomplete combustion of live aboveground biomass. Biomass is merely transferred from the live biomass to dead biomass pool, which is also accounted for in this project. Further as fire is unlikely to affect the whole project area, the significance of any single fire event is likely to be minor and result in less than 25% loss in carbon stocks in the project area. The Cochrane and Laurance study[65] mentioned above, calculated a fire return intervals in another part of the Amazon as 10 to 15 years. While the agents of deforestation (and fire) are similar between region of the study (Para) and the project region (Acre), deforestation rates and likely incidences of fire are greater in Para. This fire return interval therefore is likely to represent a conservative estimate of the fire return interval in the project region with the actual interval likely being longer than 15 years.
Significance	Minor (5% to less than 25% loss of carbon stocks)

[63]Cochrane M.A.& Laurance W.F., 2002. Fire as a large-scale edge effect in Amazonian forests, Journal Of Tropical Ecology, 18:311-325.
[64]Cochrane M.A., Alencar A., Schulze M.D., Souza C.M., Nepstad D.C., Lefebvre P. & Davidson E.A., 1999. Positive feedbacks in the fire dynamic of closed canopy tropical forests, Science, 284(5421):1832-1835.
Cochrane M.A.& Schulze M.D., 1999. Fire as a recurrent event in tropical forests of the eastern Amazon: Effects on forest structure, biomass, and species composition, Biotropica, 31(1):2-16.
[65] Cochrane M.A.& Laurance W.F., 2002. Fire as a large-scale edge effect in Amazonian forests, Journal of Tropical Ecology, 18:311-325.

Likelihood	Every 10 to 25 years
Score (LS)	2
Mitigation	None

Pest and Disease	
Discussion/ evidence	The forests of the project area have a high diversity of tree species, with over 200 tree species >10 cm dbh[66], and like other diverse tropical forests, are not known to be subject to catastrophic disturbance by insect pests or forest diseases. Forest pests and diseases as a source of risk are more relevant in temperate forests or plantations, with low species diversity and consequently susceptible to extensive damage due to pest and disease outbreaks, which tend to be concentrated on single host species. Further, there is no history of catastrophic forest disturbance due to forest pests or diseases in the region.
Significance	Insignificant
Likelihood	Once every 100 years or more. Risk is not applicable to the project area
Score (LS)	0
Mitigation	None

Extreme Weather	
Discussion/ Evidence	While extreme weather events in the region include drought, flooding, and disturbance by wind, this analysis is limited to disturbance by wind as this is the only disturbance which has a direct effect on carbon stocks. As flooding within the project region is common, high water levels in the forest do not lead to a reduction in the forest carbon stocks. Drought does not have a direct effect on existing forest carbon stocks, but instead can increase the severity of forest fires and hence is covered above in the section on fire risk. In relation to disturbance by wind, the recurrence intervals for large blow down disturbances in the western Amazon have been estimated at 27,000 years.[67]
Significance	Insignificant <5% loss of carbon stocks
Likelihood	Once every 100 years or more.
Score (LS)	0
Mitigation	None

Geologic Risk

[66] For more information see the results of Purus Forest Inventory located in Annex 1.

[67] Espírito-Santo, F.D.B.; Keller, M.; Braswell, B.; Nelson, B.W.; Frolking, S.; Vicente, G. 2010. Storm intensity and old-growth forest disturbances in the Amazon region. Geophysical Research Letters. 37, L11403, doi:10.1029/2010GL043146.

Discussion/ Evidence	Neither volcanoes nor active tectonic fault lines are present within the project area. Landslides are not likely to occur within the project area because the project area is relatively level (less than 5% slope) terrain.
Significance	Minor
Likelihood	Once every 100 years or more
Score (LS)	0
Mitigation	None

Natural risk is quantified by assessing both the significance (i.e. the damage that the project would sustain if the event occurred, expressed as an estimated percentage of average carbon stocks in the project area that would be lost in a single event) and likelihood (i.e., the historical average number of times the event has occurred in the project area over the last 100 years) of the four primary types of natural risk, including the risk of fire, pest and disease, extreme weather, and geologic hazards. The significance of the risk of all natural disturbances has been assessed as "Minor" or "Insignificant" as none of the risks should they occur would lead to a loss of greater than 25% of the carbon stocks in the project area in the case of fire or greater than 5% in the case of pest and disease, extreme weather and geologic risk. The occurrence of any natural risk is unlikely to affect 50% of the project area. Where a natural risk does occur, it is unlikely to remove >50% or the carbon stocks in the project area. While it is possible for trees to be killed due to natural risks such as fire or flooding, the majority of biomass within the live biomass carbon pool would simply be transferred to the dead biomass carbon pool, also accounted for in this project and therefore not a loss of carbon.

It is at times difficult to quantify the likelihood of natural risks when these risks occur infrequently. By definition likelihood is the historical average number of times an event has occurred over the last 100 years. Another term often used when referring to the likelihood of natural risk is the return interval. The return interval is common in literature pertaining to fire and flooding (e.g., the 100 year flood). While the likelihood or return interval would also be useful for assessing pest and disease as well as geologic risk, a key feature when calculating the likelihood or return interval is that an event has occurred enough times in enough places such that there is sufficient data to calculate the return interval. A review of the literature revealed little data to support a return interval for the project area for either pest and disease or geologic risk. For this reason, we have assigned each risk a return interval of "once every 100 years or more."

Score for Each Natural Risk Applicable to the Project (Determined by (LS × M)	
Fire (F)	2
Pest and Disease Outbreaks (PD)	0
Extreme Weather (W)	0
Geological Risk (G)	0
Other natural risk (ON)	
Total Natural Risk (as applicable, F + PD + W + G + ON)	**2**

A2.0. OVERALL NON-PERMANENCE RISK RATING AND BUFFER DETERMINATION

A2.1. Overall Risk Rating

The overall risk rating calculated using the VCS AFOLU Non-Permanence Risk Tool is calculated below.

Risk Category	Rating
a) Internal Risk	8
b) External Risk	0
c) Natural Risk	2
Overall Risk Rating (a + b + c)	**10**

The Purus Project will employ a non-permanence risk deduction of 10%, as the calculated risk rating is less than the default buffer withholding.

A2.2. Calculation of Total VCUs

Ex-ante estimates, including deductions to be deposited in the AFOLU pooled buffer account, are detailed in Section 3.4 of the project document.

APPENDIX B. FOREST CARBON INVENTORY STANDARD OPERATING PROCEDURES.

B1.1 Objective and monitoring approach

The inventory objective is produce an estimate of forest biomass carbon stocks per unit area with precision of +/-15% of the mean with 95% confidence for the 35,000 ha Purus project area.

B1.2 Carbon pools

The inventory will sample and/or estimate forest carbon stocks in the following pools:

- Aboveground live tree biomass (including palms and bamboo)
- Belowground live tree biomass
- Standing dead wood
- Lying dead wood

B1.3 Sampling design

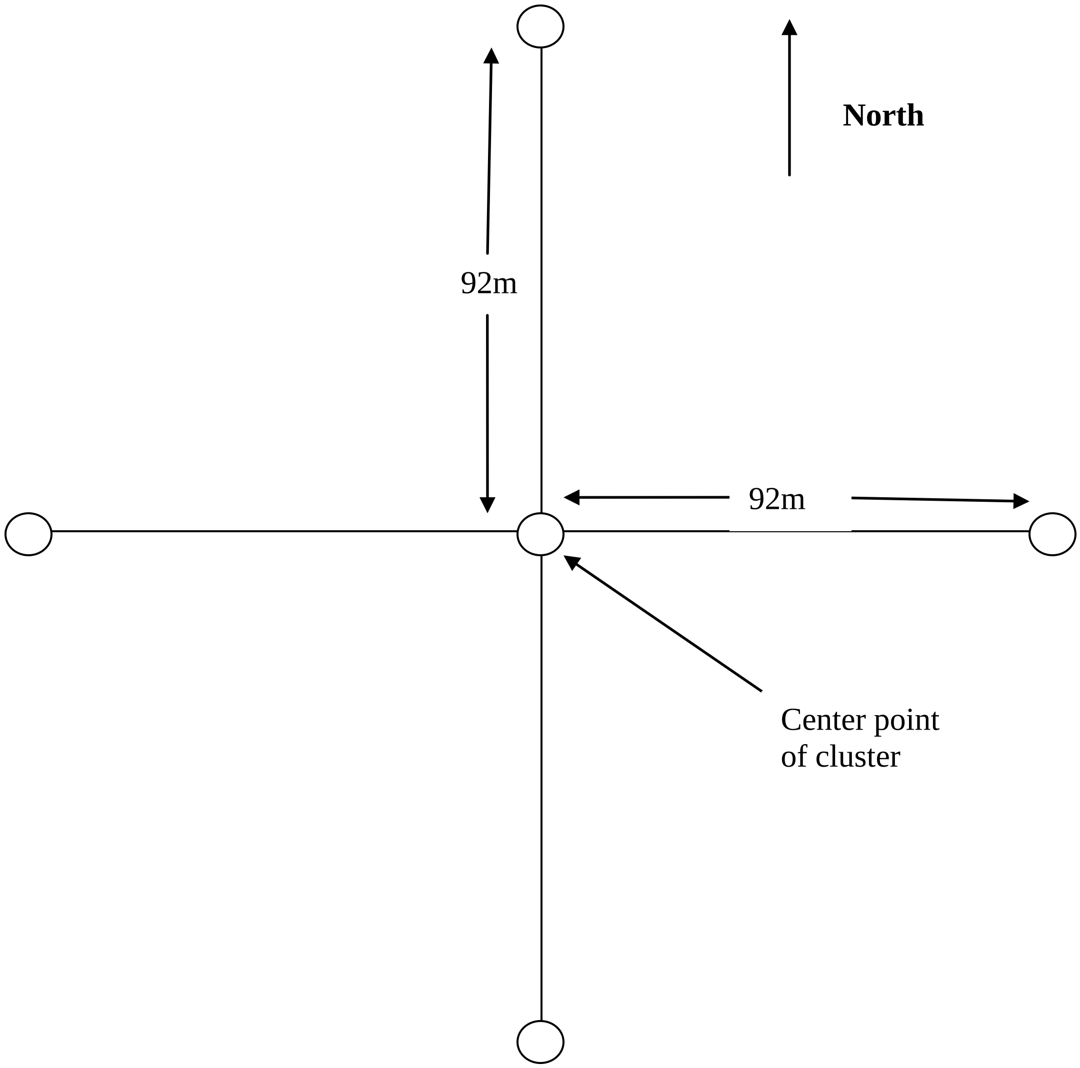
The inventory employs stratified random sampling with clusters of five 23m radius circular plots ≈ 0.83 ha (configuration of the cluster is detailed below). Two strata are delineated: (1) open forest with bamboo and palm and (2) alluvial open palm forest. Applying CV of aboveground biomass of 40% for a 0.8 ha sample area (estimated applying Freese[68] to data from Acre from Salimon et al 2011[69]), required sample size was calculated as 30 clusters.

[68] Freese, F. 1962. Elementary Forest Sampling. USDA Handbook 232. GPO Washington, DC. 91 pp.
[69] Salimon et al. 2011. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. Forest Ecology and Management 262: 555-560.

B1.4 Cluster configuration

The project employs cluster sampling, using the configuration below.

B.1. Cluster sampling configuration.



Map coordinates of sample points correspond with center point of the cluster above.

B2.0 Standard operating procedures

B2.1 Marking cluster center

Once a cluster center location is reached, the center point will be marked with a stake securely planted in the ground, to which an aluminum tag is attached. The tag is labeled with the cluster number. UTM coordinates of the cluster center will be recorded, if altered from the prescribed location.

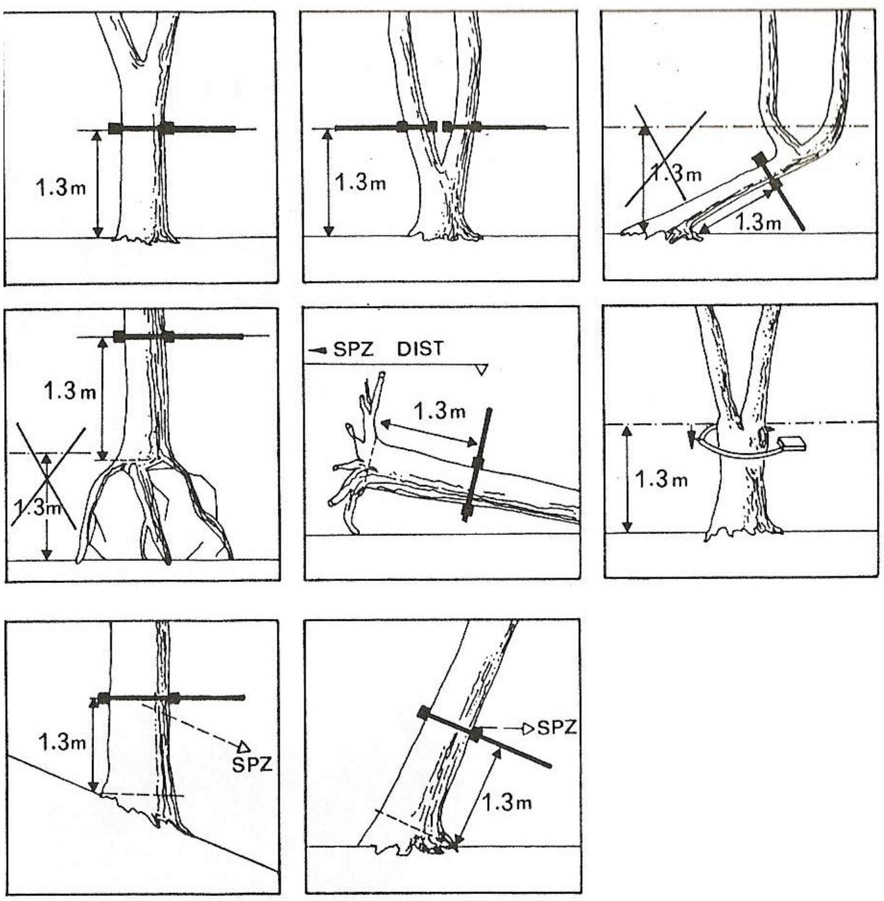
B2.2 Measuring and recording slope

Where exceeding 15%, the slope (in %) of each plot will be recorded with a clinometer. The slope will be recorded so the plot dimensions can later be adjusted to calculate the equivalent horizontal area.

B2.3 Measurement of live trees

Within each plot all stems $\geq$ 10 cm dbh will be measured and species recorded. Diameter of all trees will be measured at breast height (1.3 m above ground level, see Figure B.2). Diameter of trees with buttresses will be measured directly above the point of termination of the buttress. Species (or genera or common name) will also be recorded. Trees in the Cecropia genus will not be measured as part of the forest inventory.

Figure B.2. Point of measurement of diameter at breast height (from Pancel[70], 1993).



[70] Pancel, L., ed. 1993. Tropical forestry handbook. Berlin, Germany, Springer-Verlag. Volume 1, 738 pp.

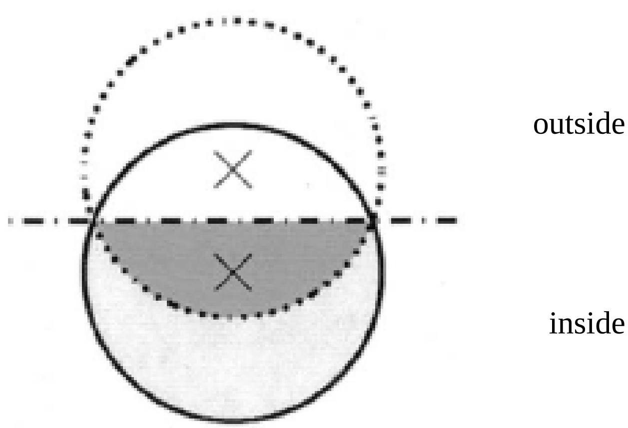
In each plot, total height of the three tallest trees will be measured with a clinometer.

Where palms are encountered that meet the minimum dbh threshold, two measurements will be taken: dbh and height to the top of the stem.

B2.4 Boundary Issues

In the event that a plot overlaps the project property boundary or strata boundary, the plot will be corrected using the mirage method[71] (Figure B.3). The solid-lined circle is the actual plot border. The portion of the circle above the horizontal line is outside of the forest strata being sampled. After sampling all the trees within the plot within the forest strata (e.g. below the line), the trees within the grey shaded area will then be registered twice on the data sheet to account for the same area which is above the horizontal line and outside the plot.

Figure B.3. Diagram of mirage method (Avery and Burkhart, 1994).



Where the 92 meter lines of transit from the cluster center cross the project or strata boundary prior to terminating, lines will be deflected from the boundary back into the project area using a “ricochet” method to complete the 92 m, where the line of transit will ricochet back into the project area to the right of the original bearing at a 45 degree angle.

B2.5 Dead wood

Dead wood measurements will be restricted to pieces of dead wood with a diameter $\geq$ 10 cm.

B2.5.1 Measurement of standing dead wood

Standing dead trees will be measured using the same plots used for live trees.

The decomposition class (not to be confused with dead wood density class) of the dead tree shall be recorded and the standing dead wood is categorized under two decomposition classes:

1) Tree with branches and twigs that resembles a live tree (except for leaves);

[71] Avery, T.E. and H.E. Burkhart. 1994. Forest Measurements. Fourth Edition. McGraw Hill, Boston, Massachusetts, USA. 408 pp.

2) Tree with signs of decomposition (other than loss of leaves) including loss of twigs, branches, or crown.

For decomposition class 1, diameter at breast height is measured and recorded as per protocols for live trees. For decomposition class 2, the following measurements/assignations are taken:

- dead wood density class (sound, intermediate or rotten)
- basal diameter
- height to the base of the crown

B2.5.2 Measurement of lying dead wood

Lying dead wood will be sampled using the line intersect method using the two 92-meter lines forming two axes of the cluster. Where exceeding 15%, the slope (in %) of each line will be recorded with a clinometer. Along the lines, the diameters of all lying dead wood ≥ 10 cm diameter intersecting the lines are measured at the point of intersection.

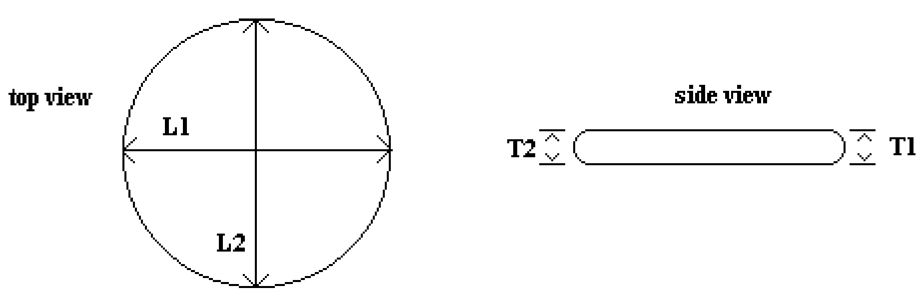
A piece of lying dead wood should only be measured if (a) more than 50% of the log is aboveground and (b) the sampling line crosses through at least 50% of the diameter of the piece (where it intersects the end of a piece).

Each piece of dead wood measured is also assigned to one of three dead wood density classes (sound, intermediate or rotten) using the ‘machete test.’

B2.6 Determining the density of dead wood

During the field inventory, a representative sample of dead wood should be collected to determine the average density for each density class. Thirty samples of dead wood should be collected for each density class, giving you a total of 90 samples. Cut a full disc of the selected piece of dead wood using a chain saw or a hand saw. Measure the diameter (L1 and L2) and thickness (T1 and T2) in cm (as shown in the figure below) to calculate green volume (cm^3). The disc is then be placed in a paper bag, and then dried in oven (80-100 ° C) in the laboratory to constant weight (g). Density is calculated as dry weight (g) per unit green volume (cm^3).

Figure B.4. Diagram for determining the density of dead wood.



B3.0 Quality control

Implementation of the monitoring plan will apply QA/QC procedures as outlined here to minimize errors in measurement and data recording. This section covers procedures for: (1) collecting reliable field measurements and (2) documenting data entry.

B3.1 Field measurements

Field crews will be fully trained in all aspects of the field data collection and adhere to field measurement protocols. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurement. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. To ensure accurate measurements, the height of diameter at breast height (1.3 m) will be periodically re-assessed by personnel during the course of the inventory. Field crews will have maps for use in the field to precisely interpret property and strata boundaries.

Throughout field monitoring events, a consistency check of an opportunistic sample of 8-12 plots (not clusters) shall be re-measured to identify and correct any field measurement issues which arise during implementation of the monitoring plan. Re-measurement for this purpose shall be done by different field personnel. These internal check cruises will also serve to quantify measurement error.

B3.2 Data entry

Data will be recorded on field sheets and then transcribed to electronic media. To minimize errors in data entry, where they are not the same, personnel involved in data entry and analysis will consult with personnel involved in measurement to clarify any anomalous values or ambiguities in transcription. A subset of the field sheets will be checked to ensure that data transcribed to electronic media is consistent with data on the field sheets. Database searches will be made following data entry to identify any anomalous values that require clarification or correction.