BULL RUN OVERSEAS FOREST CARBON PROJECT: PHASE I

Project Title	Bull Run Overseas Forest Carbon Project Phase I
Version	1-6
Date of Issue	March 14, 2012
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The goal of the project is to protect the property as a carbon sink, maintain the biodiversity values of the property, and enhance the local economic environment with sustainable livelihoods. The climate objective is to avoid emissions from deforestation during the project timeframe. The project area is slated for conversion to coffee agriculture.

The project consists of protection of the property through 2038 (30 years) through patrols and placing a restrictive covenant on the property deeds for the life of the project. Bull Run Overseas Ltd. (BRO) manages the property for the ultimate land owner; The Aldebaran Company Ltd. Forest Carbon Offsets LLC (FCO) is an agent of BRO to develop the carbon finance project. The Conservation Management Institute at Virginia Tech (CMI) is a subcontractor hired to conduct technical analyses on behalf of FCO.

1.2 Sectoral Scope and Project Type

This project is certified as compliant with the Verified Carbon Standard Version 3.2 as an Agriculture, Forestry, or Land Use (AFOLU) Project using a strategy of Reduced Emissions from Deforestation and Degradation (REDD). This project is not a grouped project.

1.3 Project Proponent

The Aldebaran Company Ltd. Grand Cayman is the ultimate owner of the property. The Aldebaran Company has hired FCO to develop the strategy, implementation, and monitoring of the carbon credits generated by this project. Bull Run Overseas (BRO), wholly-owned subsidiary of The Aldebaran Company, is the project proponent and manager of the property.

FCO has hired CMI Virginia Tech to collect initial data, develop the monitoring protocol and conduct the baseline study for the monitoring program. Supporting documents are available by contacting FCO. Decisions on implementation of the project activities are the responsibility of BRO.

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1.4 Other Entities Involved in the Project

The Conservation Management Institute, Virginia Tech, Blacksburg, VA USA provided technical support for field data collection, remote sensing, GIS, and modelling.

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Conservation Management Institute
1900 Kraft Dr. Suite 250
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Email: vemrick@vt.edu

1.5 Project Start Date

Project start date is 1/1/2009. Project start date is based on the project plan and the initial discussions regarding pursuit of carbon financing with FCO.

1.6 Project Crediting Period

Project crediting period start date is January 1, 2009. Project end date is December 31, 2038. Project length is 30 years.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project	X
Mega-project	

Table 1: Estimated GHG emission reductions or removals before reductions for uncertainty or risk buffer.

Years	Estimated GHG emission reductions or removals (tCO2e)
2009	169,011
2010	169,562
2011	1,104
2012	1,104
2013	1,104
2014	1,104
2015	1,104
2016	1,104
2017	1,104
2018	1,104
2019	1,104
2020	1,104
2021	1,104
2022	1,104
2023	1,104
2024	1,104
2025	1,104

2026	1,104
2027	1,104
2028	1,104
2029	1,104
2030	1,104
2031	1,104
2032	1,104
2033	1,104
2034	1,104
2035	1,104
2036	1,104
2037	1,104
2038	1,104
Total estimated ERs	369,472
Total number of crediting years	30
Average annual ERs	12,315

1.8 Description of the Project Activity

The major project activities for Phase I are:

- control access to the site through regular patrols,
- place a restrictive covenant on the property, and
- monitor results.

The project will use carbon financing to protect the forest and avoid conversion to coffee. The primary technology employed to achieve the desired result is patrols of the property to prevent incursions and illegal logging plus monitoring of the results. The following activities will occur:

- rangers and patrols,
- monitoring
  - forest carbon data collection,
  - biodiversity data collection,
  - remote sensing
- accounting,
- personnel management,
- road maintenance, and
- restrictive covenants.

Monitoring will occur regularly with verification audits no less frequently than every 5 years.

1.9 Project Location

The Project area is located at Latitude 17°04'00.00" N and Longitude 88°47'00.00" W in the Cayo District, Belize 23.5 km east-southeast of San Ignacio, Belize. The Project boundary encompasses 4,650 ha of which 666.3 ha are available and suitable for conversion to agricultural uses in the absence of finance from a carbon trade scheme under this project document. Of the

666.3 ha planned for conversion, 567.3 ha are included in the project calculations. A one-chain buffer surrounding perennial streams is excluded from consideration. There are no regulatory constraints on land clearing for agriculture in the Project area.

1.10 Conditions Prior to Project Initiation

The property consists primarily of a tropical pine savannah with a small component of tropical mixed broadleaf forest. Historically, the property was a source of pine lumber, and was run as a private production forest. The income from the pine harvest allowed the owner to conduct wildfire suppression activities. The Government of Belize also conducted wildfire suppression on surrounding national lands until approximately 1977 (Koonce and Cabalaz-Caban 1992) when for budgetary reasons, personnel levels were dramatically reduced and fire suppression essentially ended. In 2000 to 2002, a pine bark beetle outbreak killed the majority of pine trees on the property, both removing the only source of revenue on the property and causing wildfire intensity, due to increased fuel loads, to increase dramatically in the pine areas. The result is a severely degraded system with frequent wildfires and little chance of natural pine restoration in the project period.

As a result of the reduction in income from pine harvest, the landowner investigated the conversion of the suitable component of the property to coffee. A pilot project was conducted and a plan was developed for conversion. This Phase I project addresses avoided emissions from coffee conversion. A Phase II project, probably submitted as a Clean Development Mechanism project, will address the restoration of the pine component of the property.

Illegal logging and other reversals have been inconsequential on the property historically. As the trees become larger and more valuable, and planned development of surrounding lands increases, the risk of illegal logging is expected to increase.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

BRO has a history of compliance with and currently complies with all applicable local, district, and national labor standards. BRO follows all applicable environmental laws including the Belize Environmental Protection Act Chapter 328, Revised Edition 2000. Belize has the following relevant labor laws:

- International Labour Organization Conventions Act,
- Labour Act,
- Labour (Subsidiary Laws),
- Protection Against Sexual Harassment Act,
- Protection Against Sexual Harassment Commencement Act Order,
- Public Safety Act,
- Trade Unions Act,
- Trade Unions Regulations,
- Trade Unions and Employers Organizations (Registration, Status and Recognition) Act, and
- Trade Unions and Employers Organizations (Registration, Status and Recognition) Act (Commencement) Order.

The project team conducted an exhaustive law review including:

- Belize Private Forests (Conservation) Act, Chapter 217, Revised Edition 2000.

This is a revised edition of the law, prepared by the Law Revision Commissioner under the authority of the Law Revision Act, Chapter 3 of the Laws of Belize, Revised Edition 1980 - 1990.

- Forests Act, Chapter 213, Revised Edition 2003.

This is a revised edition of the Subsidiary Laws, prepared by the Law Revision Commissioner under the authority of the Law Revision Act, Chapter 3 of the Substantive Laws of Belize, Revised Edition 2000.

- Forest Fire Protection Act, Chapter 212, Revised Edition 2000.

- Water and Sewage Act, Chapter 222.

Defines riparian protection as “that the flow of the stream does not fall below the minimum quantity necessary to secure the interest of public health and the protection of the rights of riparian and other land-owners.” (p. 46)

- Water Industry Act, Chapter 222.

- Belize Agricultural Health Authority Act, Chapter 211.

- Fisheries Act, Chapter 210.

- Timber Industry Act, Chapter 341.

- Land Utilization Act, Chapter 188.

The Minister may, for the better utilization of land, make regulations-

- to demarcate areas, water catchment areas or watersheds and prohibiting the clearing of any vegetation within those areas;
- to provide for such other measures as may be required to prevent soil erosion; restricting the construction of buildings within stipulated distances from the middle line of any road or street;
- to demarcate specific areas as special development areas and to stipulate the type of development that will be permitted within those areas;
- for the clearing of any forest or the felling of any trees; and
- to provide for all such other things as may be necessary for the better carrying out of the provisions of this Part of the Act.

Environmental Impact Assessment (Amendment) Regulations 2007.

All lands cleared over 300 acres in Belize are subject to the Environmental Impact Assessment (Amendment) Regulations 2007 law. There are no published reports[1] of environmental impact assessments (EIAs) being conducted for agricultural land clearing in and there are no published reports of EIAs being declined in Belize.

This law has clearly not been a barrier to clearing land for other activities as evidenced by the extensive land clearing that has gone on in the country since 2007 (Cherrington et. al. 2010). Given the monumental effort Belize is undergoing to support agriculture[2] and the national policy supporting the expansion of agriculture[3] including technical, financial, and international development assistance, it is unlikely that any restriction would be placed on land clearing for agriculture if an EIA or study were required. If an EIA or environmental study were required it would be conducted and approved given that no EIAs have been publicly declined.

From this analysis, it is clear that the tropical hardwood component of the BRO property could easily be converted legally to an agricultural plantation after performing the necessary EIA in accordance to generally accepted practices in Belize. The only caveat is that there should be a one-chain riparian buffer on either side of permanent streams (personal communication with the Ministry of Natural Resources and Environment, Belize). There are no property disputes within the Project area.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

The property is owned in fee simple ownership under the laws of Belize. Titles have been produced and reviewed by the auditors.

Table 2: BRO land registry information

Owner	Title	Parcel	Area (ac)	Area (ha)
East Point Farms	Grant Fiat 904 of 2000	1	139.8	56.6
Pine Tree Farms	Grant Fiat 905 of 2000	2	1,863.9	754.6
Pine Tree Farms	Grant Fiat 906 of 2000	3	759.6	307.5
MPR Farms	Transfer Certificate of Title Volume 54 Folio 147	4	2,250.8	911.3
Pine Tree Farms	Transfer Certificate of Title Volume 54 Folio 148	6	1,930.1	781.4
East Point Farms	Transfer Certificate of Title Volume 54 Folio 149	7	4,477.5	1,812.8
Total				4,624.2[4]

[1] See Belize Department of the Environment at http://www.doe.gov.bz/

[2] See Belize National Food and Agriculture Policy (2002-2020) at http://www.agriculture.gov.bz/PDF/Policy_Document.pdf.

[3] See Embassy of Belize summary of national policy at http://www.embassyofbelize.org/belize-profile/economy.html.

[4] Note that totals for parcels affected by the project are correct. Total Area of property doesn't match survey due to historic discrepancies in Minister's fiats.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable.

1.12.3 Participation under Other GHG Programs

This is the first and only application for this project to a GHG program. Indicate whether the project has been registered, or is seeking registration under any other GHG programs. Where the project has been registered under any other GHG program, provide the registration number and details.

1.12.4 Other Forms of Environmental Credit

No other environmental credit has been created by this project. The co-benefits of the project have been proposed for validation to the Climate, Community, and Biodiversity Alliance using the Climate, Community and Biodiversity Standard 2nd Edition. Gold level validation is expected based on exceptional biodiversity benefits.

1.12.5 Projects Rejected by Other GHG Programs

This is the first and only application for this project to a GHG program.

1.13 Additional Information Relevant to the Project

Leakage Management

Leakage was determined using module "Estimation of emissions from activity shifting for avoided planned deforestation (LK-ASP)". Because this is a planned deforestation project and the agent of deforestation is known, no deductions are taken for leakage. Monitoring of the landowners property will occur as indicated in LK-ASP and M-MON.

Since leakage can only occur on property owned by the project proponent in Belize, the primary leakage management strategy is to protect the rest of the property from conversion or fire damage. The project proponent is expending considerable effort in fire prevention and suppression (built and maintain a fire tower, on staff fire crew and equipment, prescribe fire and thinning regime to reduce severity of fires) and has committed to not converting any land to nonforest uses.

Commercially Sensitive Information

Land titles and economic analysis.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

This project is designed for validation under the Verified Carbon Standard Version 3.1, AFOLU Requirements Version 3.0 and utilizing methodology VM0007 REDD Methodology Modules (http://www.v-c-s.org/methodology_rmm.html). In particular the following methodology modules were used for this project:

- REDD-MF
- M-MON
- T-ADD
- T-BAR
- X-UNC
- X-STR
- BL-PL
- LK-ASP
- CP-AB
- T-SIG
- E-BB
- A/R Methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" (Version 01).

2.2 Applicability of Methodology

Based on the methodology and the reference for the methodology, VCS "Tool for AFOLU Methodological Issues", this project qualifies because of a reduction in emissions of carbon dioxide from planned deforestation in the project scenario. This methodology is applicable because:

- land in the project area qualified as forest at least 10 years before the project start date based on definition of forest land in FAO Forest Resource Assessment of 2000 (FAO 2001) and remote sensing analysis;
- no peat soils are present on the project site;
- project proponents can show ownership of the project site and ownership of the carbon rights for the project area;
- baseline deforestation in the project area falls within the category of planned deforestation (VCS category APD);
- baselines shall be renewed every 10 years after the start of the project except where triggers lead to a more frequent renewal;
- no areas registered under the CDM or any other carbon trading scheme are included within the project site; validation under the Climate, Community, and Biodiversity Alliance for co-benefits has been disclosed;
- the baseline condition is conversion of the property to a permanent deforested state of coffee agriculture;
- no reforestation is proposed for the project; and

- leakage avoidance activities do not include either agriculture lands flooded to increase production, or intensifying livestock production.

The project is considered under the category "Avoided Planned Deforestation". This project qualifies because:

- Conversion of forest lands to a deforested condition is legally permitted,
- Documentation is available to clearly demonstrate with credible evidence that the land would have been converted to non-forest use if not for the REDD project, and
- Post deforestation land use does not include reforestation.

2.3 Project Boundary

Spatial boundary has been provided in a .kml file and is represented below in Figure 1a and 1b.

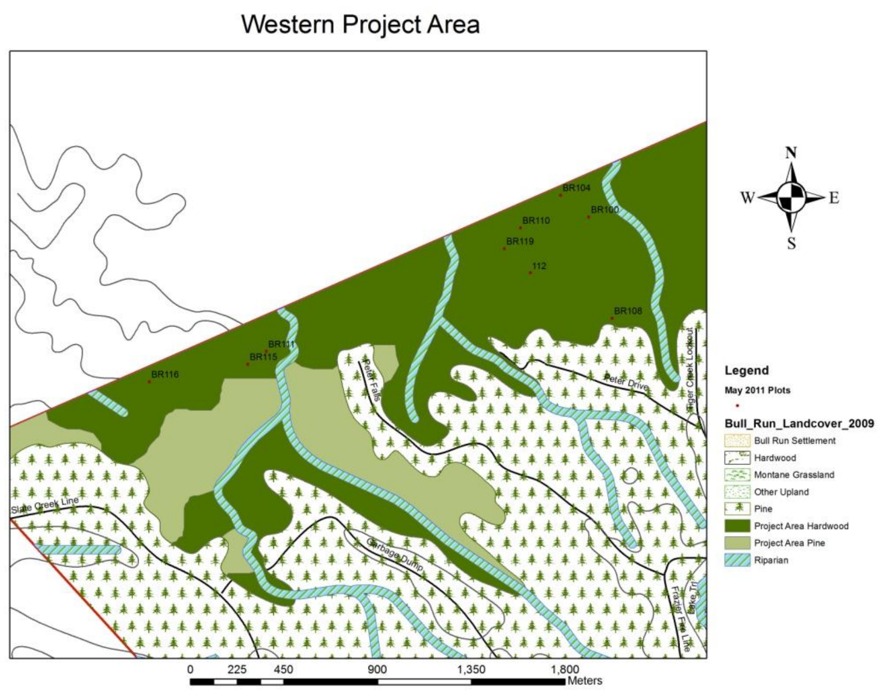

Figure 1a. Location of forest sample plots, Project Area Used for Calculations (dark green), and Project Area Omitted from Calculations (light green) at BRO Western Project Area.

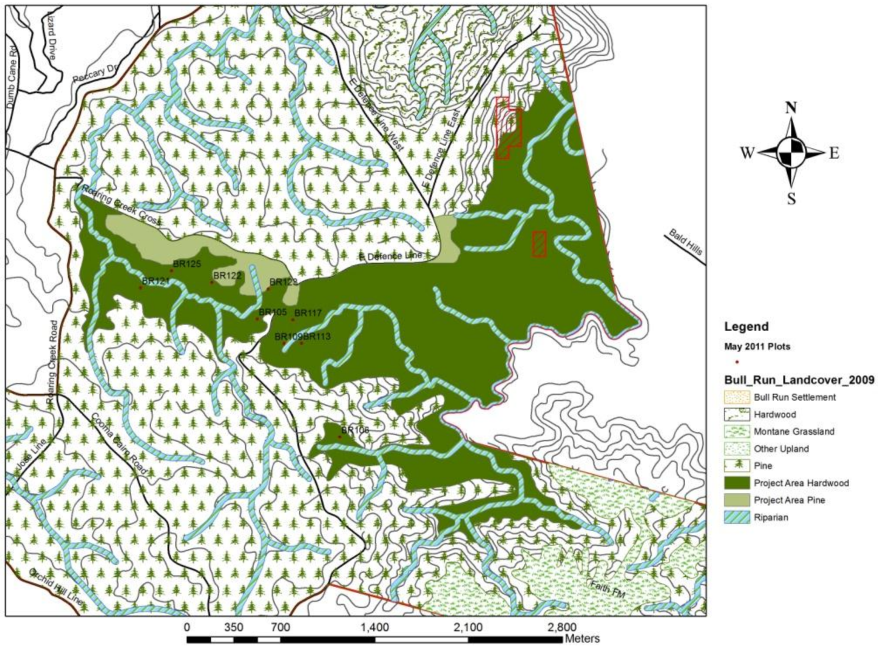

Figure 1b. Location of forest sample plots, Project Area Used for Calculations (dark green), and Project Area Omitted from Calculations (light green) at BRO Eastern Project Area.

Table 3: Sources of GHG emissions addressed for Baseline and Project.

Source		Gas	Included?	Justification/Explanation
Baseline	Aboveground tree biomass	CO_2	Yes	Required pool
		CH_4	No	
		N_2O	No	
		Other	No	
	Belowground tree biomass	CO_2	Yes	Significant pool calculated based on aboveground biomass pool.
		CH_4	No	
		N_2O	No	
		Other	No	
	Soil Carbon	CO_2	No	This pool is conservatively excluded.
		CH_4	No	
		N_2O	No	
		Other	No	
	Dead Wood	CO_2	No	This pool is conservatively excluded.
		CH_4	No	

Source		Gas	Included?	Justification/Explanation
		N_2O	No	
		Other	No	
	Harvested Wood Products	CO_2	No	The standard practice in Belize for conversion of forest to agricultural lands is to remove valuable timber species and then bulldoze and burn the remaining trees. This pool was analyzed for significance and found to be de minimis.
		CH_4	No	
		N_2O	No	
		Other	No	
	Litter	CO_2	No	Excluded to be conservative and make the monitoring cost-effective.
		CH_4	No	
		N_2O	No	
		Other	No	
	Soil organic carbon	CO_2	No	Excluded to be conservative and make the monitoring cost-effective.
		CH_4	No	
		N_2O	No	
		Other	No	
	Fuel Wood Collection	CO_2	No	No fuel wood collection was occurring prior to the project and presumably none would occur in the baseline scenario. An analysis was conducted based on local population data and found that this pool is de minimis and therefore excluded.
		CH_4	No	
		N_2O	No	
		Other	No	
	Biomass Burning	CO_2	No	CO_2 emissions are accounted for by biomass changes in the above ground and below ground biomass pools.
		CH_4	Yes	CH_4 and N_2O emissions from land clearing and burning are included in the emissions change model for the baseline. No biomass burning is proposed as a project activity.
		N_2O	Yes	
		Other	No	
	Combustion of Fossil Fuels	CO_2	No	Conservatively omitted from both the baseline and project scenarios.
		CH_4	No	
		N_2O	No	
		Other	No	
	Use of Fertilizers	CO_2	No	Conservatively omitted from both the baseline and project scenarios.
		CH_4	No	Conservatively omitted from both the baseline

Source		Gas	Included?	Justification/Explanation
				and project scenarios.
		N_2O	Yes	The baseline scenario of coffee would utilize chemical fertilizer.
		Other	No	
Project	Aboveground tree biomass	CO_2	Yes	Required pool
		CH_4	No	
		N_2O	No	
		Other	No	
	Belowground tree biomass	CO_2	Yes	Significant pool calculated based on aboveground biomass pool.
		CH_4	No	
		N_2O	No	
		Other	No	
	Project Leakage	CO_2	Yes	Activity and market shifting leakage addressed using methodology module LK-ASP.
		CH_4	Yes	
		N_2O	Yes	
		Other	No	

2.4 Baseline Scenario

In order to estimate potential carbon stock changes over the life of the project, a detailed description of a plausible and realistic baseline scenario is required. Based upon FCO analysis of alternative land use scenarios, the conversion to agriculture is the most likely land use in the baseline scenario. Of the various agricultural conversion options common in the area, coffee conversion is the most likely based on the history and plans of the property owner. The methodology provides a systematic procedure for determining the most likely baseline in module BL-PL. Where a known agent of deforestation can be identified, if a "valid and verifiable" plan for deforestation is presented, that plan becomes the most likely baseline scenario.

2.5 Additionality

The property owner has a conversion plan that has been evaluated and a pilot project conducted to convert land to coffee. The equipment and manpower required is on site. Of the 666.3 ha slated for conversion to coffee, 567.3 ha are classified as broadleaf forest and included in the calculations for avoided emissions from conversion. The remaining 99 ha of pine forest are conservatively excluded from the claim due to high uncertainty about the aboveground and below ground biomass present.

Conversion of the forest includes harvesting merchantable trees, bulldozing, piling, and burning the remaining vegetation, and planting the site to coffee. Management of the coffee includes annual application of fertilizer.

No part of the project area is currently restricted from development due to government regulation or other legal requirement.

Additionality Analysis

Per instructions from the methodology, the following analysis is conducted to determine alternative baseline scenarios according to the procedure presented in “VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities”

This tool is applicable because a) the proposed project activities will not violate any Belizean law, and b) the use of this tool results in identification of the most plausible baseline scenario of the several possible baseline scenarios identified below.

Step 1: Identification of alternative land use scenarios to the AFOLU project activity.

Some of the alternative land uses are more likely and pose a much larger deforestation threat than others. The following is a “ranking” of the most likely alternative land uses. Each alternative is considered legal in Belize.

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

1. Conversion to Agriculture

The most likely alternative land use scenario is the conversion to agriculture, and it is the most pervasive driver for deforestation and land use change in the region. The conversion of forestland in Belize to agriculture is both a national and regional trend. The FAO (2003) estimated that by 1989 about 217,241 hectares, or about 10%, of the national land area had been converted from forest to agricultural land. Furthermore, by the first half of the 1990’s 25,000 hectares of forested land were being lost yearly due to conversion to agricultural land (FAO 2003). Conversion of forest land for cattle and citrus is occurring in Belize near the project area and forest cover declined by an average of 6,479 acres/year from 1980 to 2010 in the Cayo District (Cherrington et.al. 2010) almost exclusively from agricultural development.

Suitability of soils for conversion to agriculture, particularly coffee, was evaluated on site by planting and harvesting coffee over many years in small plots. This is a planned deforestation project and the plan calls for coffee conversion. Conversion of land for agriculture is considered legal. A land clearing permit is required for clearings of over 300 acres. An environmental impact analysis (EIA) is required. Based on analysis of EIA database for Belize, the EIA process is not a barrier for the project[5]. Confirmation of the legality of conversion can be obtained by communicating with the Belize National REDD coordinator at the Belize Forest Department[6].

2. Purchase of the Land to Operate an Ecotourism Lodge

One alternative land use would be the conversion of the property for ecotourism. This strategy is employed by several lodges in the area already. A portion of the property was purchased for that very purpose many years ago, which now supports Hidden Valley Inn. To pursue this alternative would require finding a buyer with the resources to both purchase the property, protect the property, and build competitive facilities in an area that already has several tourist lodges.

3. Purchase of the Land as a Conservation Area

There are privately owned protected areas in the area and throughout Belize. Most landowners that own these properties are members of the Belize Association of Private Protected Areas (BAPPA). Landowners purchase properties for conservation for a variety of reasons. Some establish nonprofit companies to hold the property and some simply hold onto the property out of a desire to protect the biodiversity or other values of the site. There is no inherent financial income stream from owning a private protected area while there are several required expenses. The initial purchase price, annual taxes, maintenance, and protection from trespass are all expenses that can run into the millions of dollars. Landowners that pursue this strategy are required to be relatively wealthy or have outside sponsors or pursue a strategy of income generation that is consistent with conservation such as ecotourism. Purchasing land for conservation purposes is legal.

4. Continuation of the preproject land use

The project area has been in forest as far as the historical record goes back. The baseline plan calls for clearing that forest to generate income from coffee due to sustain the property owner and staff. Current income from the project area is zero due in large part to the pine bark beetle infestation that wiped out almost all of the merchantable pine. Property taxes are still a required expense, therefore continuation of the preproject land use is unsustainable.

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

This alternative land use is essentially continuation of the preproject land use with the added expenses of patrols and monitoring. Income from the project area is zero, while expenses for this scenario include property taxes, patrols, and monitoring. Therefore conducting the project without registration as a VCS AFOLU project is also unsustainable.

<u>Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory laws and regulations.</u>

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[5] See Belize Department of the Environment web site http://www.doe.gov.bz/EIAs.html.

[6] As of September 2011, the REDD Coordinator, Belize Forest Depatment, is Mr. Leon Westby (leewest6@hotmail.com).

All the alternatives presented are legal and permissible under Belizean law. Clearing of land over 300 acres is legal and permissible but requires an environmental impact statement and a permit.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

Since the project generates no financial or economic benefits other than VCS related income, simple cost analysis is selected.

Sub-step 2b. Option 1. Apply simple cost analysis.

Costs have been documented for the project and audited to demonstrate no financial benefits other than VCS related income. Proceed to step 4.

Step 4. Common Practice Analysis

Multiple private properties are listed as private protected areas in Belize through the Belize Association of Private Protected Areas. The essential distinction between the project and other lands managed as private protected areas is that the other lands are able, at least in some cases, to support the annual costs of management through outside means e.g. ecotourism, private funds, or outside donors/nongovernmental organizations. Those sources of income are not available to this landowner and therefore the project activity is additional.

2.6 Methodology Deviations

There are two slight deviations to the methodology. The first is that measurements on the plots to determine if a tree is in or out of the plot were made from the plot center to the face of the tree. While the methodology does not require the use of Pearson, Walker, and Brown (2010) field methods, the project design incorporates their methods with this one difference. The reason for the change is that face of the tree is far easier to measure positively as in or out of the plot since it can be accessed directly. Center of the tree cannot be accessed directly without cutting down the tree.

The section deviation to the methodology is a correction to the methodology tool used for determining emissions from fertilizer use “Estimation of direct nitrous oxide emission from nitrogen fertilization”. This A/R Methodological Tool is encompassed as a module within the methodology. The units described for nitrogen content (NC_{SFi} and NC_{OFj}) are listed as grams of nitrogen per 100 grams of fertilizer. This was corrected to be a unitless ratio in the calculation.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

In order to estimate GHG loss und the baseline scenario the following variables are required:

1. area of forest available for conversion,
2. baseline carbon stocks,

3. deforestation/conversion rates,
4. carbon stocks in agro-ecosystems,
5. fate of commercial timber and long-lived wood products,
6. losses of biomass attributable to fuel-wood collection,
7. avoided emissions from fertilizer use,
8. avoided emissions from biomass burning, and
9. avoided emissions from transportation fuel use.

1. Area of forest available for conversion

Of the total area of the property, 666.3 ha are slated for conversion to coffee. Of that 666.3 ha, 567.3 ha are currently in broadleaf forest and the balance, 99 ha are in pine forest. In the baseline, all 666.3 ha are converted to coffee. After analyzing the inventory from the pine component, the project proponents determined that the recent history of that part of the forest introduced a high degree of variability resulting from insect and fire effects. Therefore, to reduce the uncertainty of the pool claims and insure a conservative estimate for the claimed avoided emissions of the project, the pine component aboveground and belowground biomass has been excluded from the project claims. A 1-chain buffer around perennial streams is excluded to comply with directives from the Belize Forest Department.

2. Biomass Baseline Carbon Stocks

Baseline biomass carbon stocks consisted of above ground biomass and below ground biomass of the broadleaf component of the coffee conversion area. The mean carbon pool in 2011 was based on field measurements conducted in 2011 and independently verified. The moist forest allometric equation for biomass prediction published in Pearson et. al. (2005) was used to predict above ground biomass. A factor of 50% was used to convert biomass to carbon. A pantropic equation was chosen because higher priority equations were unavailable or unsuitable for the forest on the project area. Accuracy of the equation was validated using the procedure described in module CP-AB "Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools".

Below ground biomass was estimated based on above ground biomass using the equation found in Pearson et al (2005).

An uncertainty level of 6.4% was calculated using module "Estimation of uncertainty for REDD project activities (X-UNC)".

Aboveground and belowground biomass attributed to non-tree biomass (palms and lianas) and soil carbon were conservatively excluded.

3. Rate of Deforestation and Agricultural Conversion

Based on the plan for deforestation developed by the landowner, the rate of conversion is 50%/year. This rate was determined to be feasible and in line with common practice.

4. Carbon stocks in agro-ecosystems

The available literature on steady state C stocks for coffee bushes varies widely depending upon geographic location. Belize has one small commercial grower thus there are no published data on C stocks for coffee bushes within Belize. Polzot (2004) found that the carbon stock of open grown (without-Project scenario) coffee bushes in Costa Rica ranged from 1.4 to 3.5 t C ha-1. Thus, FCO uses a conservative figure of 5 t C ha-1 to calculate the without-Project C stocks for the coffee bushes. In addition the plan calls for leaving 10-12 trees for shade on each acre. Based on the inventory, an additional 12 tons of aboveground and belowground biomass were allocated to the coffee conversion area that was withdrawn from the hardwood component of the property.

5. Fate of Forest Resources Lost to Agricultural Conversion (Long-lived Wood Products)

The standard practice in Belize for conversion of forest to agricultural lands is to remove valuable timber species and then bulldoze and burn the remaining trees. An analysis was conducted using module CP-W "Estimation of carbon stocks in the long-term wood products pool" based on the inventory data and found that the available timber for a long-lived wood products pool was de minimis.

6. Loss of biomass attributable to fuel-wood collection

No fuel wood collection was occurring prior to the project and presumably none would occur in the baseline scenario.

7. Avoided emissions from fertilizer use

Avoided emissions from fertilizer use for the baseline was calculated using CDM A/R Methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" (Version 01). In the baseline scenario, fertilizer would be applied at the rate of 1,200 pounds of 13-13-21 and 1,200 pounds of 20-6-12 per acre per annum, based on experience of the pilot coffee project.

8. Avoided emissions from biomass burning

In the baseline scenario, land clearing would include piling and burning of biomass on the site. An analysis of emissions from biomass burning was conducted to determine CH4 and N2O using module "Estimation of greenhouse gas emissions from biomass burning (E-BB)". Avoided emissions from CO2 release are omitted because they are accounted for by biomass changes in the above ground and below ground biomass pools. Avoided emissions attributable to CH4 and N2O are included.

9. Avoided emissions from transportation fuel use

Emissions from transportation fuel use are conservatively omitted in both the baseline and project scenarios.

3.2 Project Emissions

GHG emissions and/or removals for the project are described for the same pools and variables as the baseline scenario with the addition of activity shifting leakage which only applies to the project scenario.

1. Area of forest available for conversion

Same as baseline.

2. Baseline carbon stocks

Same as baseline.

3. Deforestation/conversion rates

No reductions or removals are planned for the life of the project.

4. Carbon stocks in agro-ecosystems

N/A, no conversion is allowed in the project.

5. Fate of commercial timber and long-lived wood products

No reductions or removals are planned for the life of the project.

6. Losses of biomass attributable to fuel-wood collection

No reductions or removals are planned for the life of the project.

7. Avoided emissions from fertilizer use

No fertilization is anticipated as a project activity.

8. Avoided emissions from biomass burning

N/A, no conversion is allowed in the project. In the event of ex-post fires occurring, the REDD Methodological Module: Estimation of greenhouse gas emissions from biomass burning (E-BB) Sectoral Scope 14 will be applied.

9. Avoided emissions from transportation fuel use

Emissions from transportation fuel use are conservatively omitted in both the baseline and project scenarios.

3.3 Leakage

Leakage was determined using module "Estimation of emissions from activity shifting for avoided planned deforestation (LK-ASP)". The deforestation agent was determined to be the current landowner.

Step 1 Option 1.2 (option 1.1 is infeasible): Determine the baseline rate of forest clearance for the deforestation agent: Total area deforested by the deforestation agent over the previous 5 years is zero. WoPR is set to 666 ha.

Step 2: Estimate new projection of forest clearance by the baseline agent of deforestation with project implementation if no leakage occurring: NewR is equal to zero.

Step 3: Monitor all areas deforested by baseline agent of deforestation through the year in which planned deforestation was forecast to occur: All areas owned by the landowner in Belize are monitored for deforestation. Result is zero hectares.

Step 4: Monitor greenhouse gas emissions outside the project boundary by baseline agent of deforestation: Fertilizer use and biomass burning will be monitored on all lands owned by the landowner in Belize.

Monitoring of the landowner's property will occur as indicated in LK-ASP and M-MON using a combination of remote sensing and ground observations.

Two areas of leakage for non-CO2 gases are required for monitoring, use of nitrogen fertilizer and biomass burning. The landowner conducts prescribed fire to reduce biomass loss from wildfires. Prescribed burning has minimal year-by-year impact on emissions, and the benefits of prescribed fire to prevent catastrophic fire and subsequent loss of biomass are well documented. Records will be kept of nitrogen fertilizer use to prove that fertilizer use has not increased as a result of the project.

3.4 Summary of GHG Emission Reductions and Removals

Table 4: GHG emissions for baseline, project, and removals.

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e) after uncertainty deduction
2009	169,011	0	0	158,221
2010	169,562	0	0	158,737
2011	1,104	0	0	1,033
2012	1,104	0	0	1,033
2013	1,104	0	0	1,033
2014	1,104	0	0	1,033
2015	1,104	0	0	1,033
2016	1,104	0	0	1,033
2017	1,104	0	0	1,033
2018	1,104	0	0	1,033
2019	1,104	0	0	1,033
2020	1,104	0	0	1,033
2021	1,104	0	0	1,033
2022	1,104	0	0	1,033
2023	1,104	0	0	1,033
2024	1,104	0	0	1,033
2025	1,104	0	0	1,033
2026	1,104	0	0	1,033
2027	1,104	0	0	1,033
2028	1,104	0	0	1,033
2029	1,104	0	0	1,033
2030	1,104	0	0	1,033
2031	1,104	0	0	1,033
2032	1,104	0	0	1,033
2033	1,104	0	0	1,033
2034	1,104	0	0	1,033
2035	1,104	0	0	1,033
2036	1,104	0	0	1,033
2037	1,104	0	0	1,033
2038	1,104	0	0	1,033
Total	369,472	0	0	345,885

All equations, mathematical procedures, and net change in carbon stocks are provided in an accompanying Excel spreadsheet.

4 MONITORING

4.1 Data and Parameters Available at Validation

Data Unit / Parameter:	*Project Forest Cover Monitoring Map*
Data unit:	Ha
Description:	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Source of data:	Remote sensing in combination with GPS data collected during ground truthing
Value applied:	100%
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. The minimum map accuracy should be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy. Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Any comment:	If stratification is required in the future due to a reversal, then new strata will be identified using module X-STR.

Data Unit / Parameter:	*ADefPA,i,t*
Data unit:	Ha
Description:	Area of recorded deforestation in the project area at time *t (if any occurs)*
Source of data:	Remote sensing imagery
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image. Must be monitored at least every 5 years or if verification occurs on a frequency of

	less than every 5 years examination must occur prior to any verification event
Any comment:	This is presumed to be zero ex ante.

Data Unit / Parameter:	$A_{burn,i,t}$
Data unit:	Ha
Description:	Area burnt at time *t (if any occurs)*
Source of data:	Remote sensing imagery
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image. Areas burnt shall be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Any comment:	This is presumed to be zero ex ante.

Data Unit / Parameter:	*CAB,tree,i,*
Data unit:	t CO2-e ha-1
Description:	Carbon stock in aboveground biomass in trees in the project case in stratum *i.*
Source of data:	Field measurements applied with allometric equation published in Pearson et. al. (2005)
Value applied:	In 2009, 173.417 t CO2-e ha-1
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. See field methods section. Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Any comment:	Key variable used to calculate with project carbon stocks and year by year growth rate. Measurements conducted in 2011 and conservatively presumed to be the same in 2009.

Data Unit / Parameter:	$DBH_{,tree,i,}$
Data unit:	cm

Description:	Diameter at 1.3 meters above the ground of each tree on each plot.
Source of data:	Field measurements
Value applied:	See database of tree measurements.
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. See field methods section of monitoring plan. Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Any comment:	Key variable used to calculate with project carbon stocks and year by year growth rate.

Data Unit / Parameter:	$N_2O_{direct\text{-}N,I,t}$
Data unit:	mtCO2e
Description:	Leakage related to non CO2 emissions from increased use of nitrogen fertilizer
Source of data:	Landowner records
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. This is a source of potential leakage that monitors an increase of nitrogen fertilizer application elsewhere on the landowner's property.
Any comment:	

4.2 Data and Parameters Monitored

Data Unit / Parameter:	*Project Forest Cover Monitoring Map*
Data unit:	Ha
Description:	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Source of data:	Remote sensing in combination with GPS data collected during ground truthing
Description of measurement methods and procedures to be applied:	The minimum map accuracy should be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote

	sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy.
Frequency of monitoring/recording:	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied:	100%
Monitoring equipment:	Computer and appropriate analytical software.
QA/QC procedures to be applied:	Based on plot remeasurements.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Any comment:	If stratification is required in the future due to a reversal, then new strata will be identified using module X-STR.

Data Unit / Parameter:	*ADefPA,i,t*
Data unit:	Ha
Description:	Area of recorded deforestation in the project area at time *t (if any occurs)*
Source of data:	Remote sensing imagery
Description of measurement methods and procedures to be applied:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Frequency of monitoring/recording:	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied:	0
Monitoring equipment:	Computer and appropriate analytical software.
QA/QC procedures to be applied:	Remeasurement of permanent plots.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Any comment:	This is presumed to be zero ex ante.

Data Unit / Parameter:	$A_{burn,i,t}$

Data unit:	Ha
Description:	Area burnt at time *t (if any occurs)*
Source of data:	Remote sensing imagery
Description of measurement methods and procedures to be applied:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Frequency of monitoring/recording:	Areas burnt shall be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied:	0
Monitoring equipment:	Computer and appropriate analytical software.
QA/QC procedures to be applied:	Remeasurement of permanent plots.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Any comment:	This is presumed to be zero ex ante.

Data Unit / Parameter:	*CAB,tree,i,*
Data unit:	t CO2-e ha-1
Description:	Carbon stock in aboveground biomass in trees in the project case in stratum *i.*
Source of data:	Field measurements applied with allometric equation published in Pearson et. al. (2005)
Description of measurement methods and procedures to be applied:	See field methods section.
Frequency of monitoring/recording:	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Value applied:	In 2011, 173.417 t CO2-e ha-1. 2009 conservatively presumed to be the same.
Monitoring equipment:	Computer and spreadsheet software.
QA/QC procedures to be applied:	Independent 3rd party audit of field measurements utilizing remeasurement of a sample of plots.
Calculation method:	Calculation method follows Pearson et. al. 2005.
Any comment:	Key variable used to calculate with project carbon stocks and year by year growth rate.

Data Unit / Parameter:	$DBH_{,tree,i,}$
Data unit:	cm
Description:	Diameter at 1.3 meters above the ground of each tree on each plot.
Source of data:	Field measurements
Description of measurement methods and procedures to be applied:	See field methods section of monitoring plan.
Frequency of monitoring/recording:	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Value applied:	See database of tree measurements.
Monitoring equipment:	Diameter tape incremented in centimetres. Measuring tape to determine inclusion of trees on plots. GPS to navigate to permanent plots.
QA/QC procedures to be applied:	Independent 3rd party audit of field measurements utilizing remeasurement of a sample of plots. Field observation sheets will include DBH of each tagged tree for evaluation of reasonableness of measurement based on feasible growth rate.
Calculation method:	Direct observation.
Any comment:	Key variable used to calculate with project carbon stocks and year by year growth rate.

Data Unit / Parameter:	$N_2O_{direct\text{-}N,I,t}$
Data unit:	mtCO2e
Description:	Leakage related to non CO2 emissions from increased use of nitrogen fertilizer
Source of data:	Landowner records
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. This is a source of potential leakage that monitors an increase of nitrogen fertilizer application elsewhere on the landowner's property.
Any comment:	

4.3 Description of the Monitoring Plan

The first monitoring event will be conducted by FCO in 2011. Subsequent monitoring events will be conducted by BRO and CMI or another equally qualified contractor. FCO will be available as needed/desired by BRO for advice and consultation.

The overall objectives of the monitoring plan are to detect any reversals in forest cover for baseline renewal after 10 years. To accomplish this, a system of permanent plots has been established and remote sensing will be used to produce a forest/nonforest map. The plot data will be used as ground truth for the mapping work as well as to confirm growth rate assumptions. The map will be produced for each verification audit and the plots will be measured annually and a report of the results produced for each verification audit. There may be years when all plots are not measured due to weather or other factors that cause remeasurement to be too costly or unsafe. In that case enough plots will be measured to support the required precision goals of the methodology or the verification audit will be delayed until such time as enough plots can be remeasured to meet those guidelines.

Fuel wood collection was analyzed and considered de minimis prior to project start and is considered de minimis during the project and will not be monitored during the project.

Nitrogen fertilizer use will be monitored to detect increases of fertilizer use over preproject levels.

All data collected as part of monitoring will be archived electronically on DVD (or similar media) in Excel compatible spreadsheets or Arc/View compatible (.shp) files and kept at least for two years after the end of the project, and held by BRO at the BRO office in Belize. All of the data will be monitored if not indicated otherwise in tables below.

Monitoring data will be collected annually, except in cases where some plots are inaccessible due to high water or other factor making access unsafe, and summarized for periodic 3rd party independent audits. Audits will occur no less frequently than every 5 years. It is the responsibility of the landowner to conduct monitoring either utilizing contractors or in-house staff.

Updating of Strata

The ex-post stratification shall be updated if the following conditions occur:

- unexpected disturbances occurring during the crediting period (e.g. due to fire, pests, storms, or disease outbreaks), affecting differently various parts of an originally homogeneous stratum; and
- unplanned forest management activities (illegal reversals) that affect the existing stratification.

Established strata may be merged if reason for their establishing said strata have disappeared. Line diagrams may be used to display the GHG collection and management system.

5 ENVIRONMENTAL IMPACT

No environmental impact study is required for the project. The Project does not anticipate any negative environmental impacts within the area surrounding the Project since the project scenario consists entirely of protecting the forest as it currently exists. Offsite impacts will be positive since larger habitat and forest areas will improve the long-term viability of fauna and flora populations offsite by maintaining connectivity and avoiding fragmentation of habitats. Avoiding conversion to agriculture also avoids release of sediment and agricultural chemicals into waterways, and avoids bringing more agricultural workers into the area in general.

Socioeconomic impacts are considered positive for existing community. Jobs will be retained for maintenance, monitoring, and patrols.

If any negative impact is identified, the BRO team and the community representative will address such problems with fast and effective solutions. The issue will be discussed and mitigation actions will be designed.

The Project is not expected to have negative social impacts on the communities surrounding the Project area since the project maintains the forest as it currently exists. It is not expected that the Project will negatively impact any offsite communities. In the case of any potential negative impacts, representatives of the impacted community will bring it to the attention of the conflict resolution coordinator. No unmitigated social or economic impacts are expected from the Project.

An environmental impact statement would be required for the baseline scenario. Environmental impacts of the project are conservatively projected to be all positive for biodiversity, water quality, air quality, and climate impacts.

Project has been proposed for Gold Level certification by the Climate, Community, and Biodiversity.

6 STAKEHOLDER COMMENTS

BRO has actively engaged local stakeholders in soliciting comments on the design of the CCB Project with various onsite consultations. Local stakeholders are primarily BRO staff. BRO staff will be actively engaged in Project activities including permanent sample plot measurements, setting up remote large mammal camera traps, conducting forest patrols, and engaging in other knowledge transfer activities. Stakeholder involvement has been solicited formally and informally over a period of time so as to inform stakeholders about the BRO Project and to receive their feedback. Post CCB validation, BRO will provide an annual update in written form to all stakeholders describing Project status as a method to continue communication and consultation between stakeholders and Project managers. Furthermore, BRO will continue and improve upon its current enacted policy to proactively seek stakeholder consultation whenever possible.

Project zone stakeholder groups are:

- BRO owners and staff;
- Hidden Valley Inn owners and staff;

- Belize Forestry Department Ministry of Natural Resources including Thousand-Foot Falls National Park, Elijio Panti National Park, Mountain Pine Ridge Forest Reserve, Government of Belize Crown Lands;
- Privassion Enclave;
- Pine Lumber Company;
- British Army;
- The Peregrine Fund;
- Dr. Marcella Kelly's Jaguar Project;
- Five Sisters Lodge owners and staff;
- Pine Ridge Lodge owners and staff;
- Blancaneaux Lodge owners and staff; and
- UNFCCC Belize Focal Point and Designated National Authority.

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APPENDIX A: MONITORING PLAN

The overall objectives of the monitoring plan are to detect any reversals in forest cover for baseline renewal after 10 years. To accomplish this, a system of permanent plots has been established and remote sensing will be used to produce a forest/nonforest map. The plot data will be used as ground truth for the mapping work as well as to confirm growth rate assumptions. The map will be produced for each verification audit and the plots will be measured annually and a report of the results produced for each verification audit. There may be years when all plots are not measured due to weather or other factors that cause remeasurement to be too costly or unsafe. In that case enough plots will be measured to support the required precision goals of the methodology or the verification audit will be delayed until such time as enough plots can be remeasured to meet those guidelines.

Fuel wood collection was analyzed and considered de minimis prior to project start and is considered de minimis during the project and will not be monitored during the project.

Nitrogen fertilizer use will be monitored to detect increases of fertilizer use over preproject levels.

All data collected as part of monitoring will be archived electronically on DVD (or similar media) in Excel compatible spreadsheets or Arc/View compatible (.shp) files and kept at least for two years after the end of the project. All of the data will be monitored if not indicated otherwise in tables below.

Monitoring data will be collected annually, except in cases where some plots are inaccessible due to high water or other factor making access unsafe, and summarized for periodic 3rd party independent audits. Audits will occur no less frequently than every 5 years. It is the responsibility of the landowner to conduct monitoring either utilizing contractors or in-house staff.

Updating of Strata

The ex-post stratification shall be updated if the following conditions occur:

- unexpected disturbances occurring during the crediting period (e.g. due to fire, pests, storms, or disease outbreaks), affecting differently various parts of an originally homogeneous stratum; and
- unplanned forest management activities (illegal reversals) that affect the existing stratification.

Established strata may be merged if reason for their establishing said strata have disappeared.

Field Plot Methods

Sampling Framework

To ensure that the full range of variability was captured in the ‘Forest Land’ – the Lowland Broad Leafed Wet Forest - class on the project site, a total of 18 forest inventory plots were allocated. Plots were randomly allocated within the ‘Forest Land’ land-use and land cover (LULC) class using geographic information systems (GIS) and identified by specific XY coordinates (Table 8).

Table 5: UTM locations of forestry plots used to determine aboveground biomass (coordinates are in NAD 27)

Plot ID	Y_PROJ	X_PROJ
BR100	1888578	296402
BR104	1888683	296267
BR105	1883960	303107
BR106	1883080	303723
BR108	1888091	296514
BR109	1883778	303307
BR110	1888526	296074
BR111	1887933	294853
BR112	1888310	296123
BR113	1883780	303438
BR115	1887870	294763
BR116	1887787	294290
BR117	1883953	303374
BR119	1888427	295996
BR121	1884194	302236
BR122	1884233	302767
BR123	1884185	303187
BR125	1884320	302467

Western Project Area

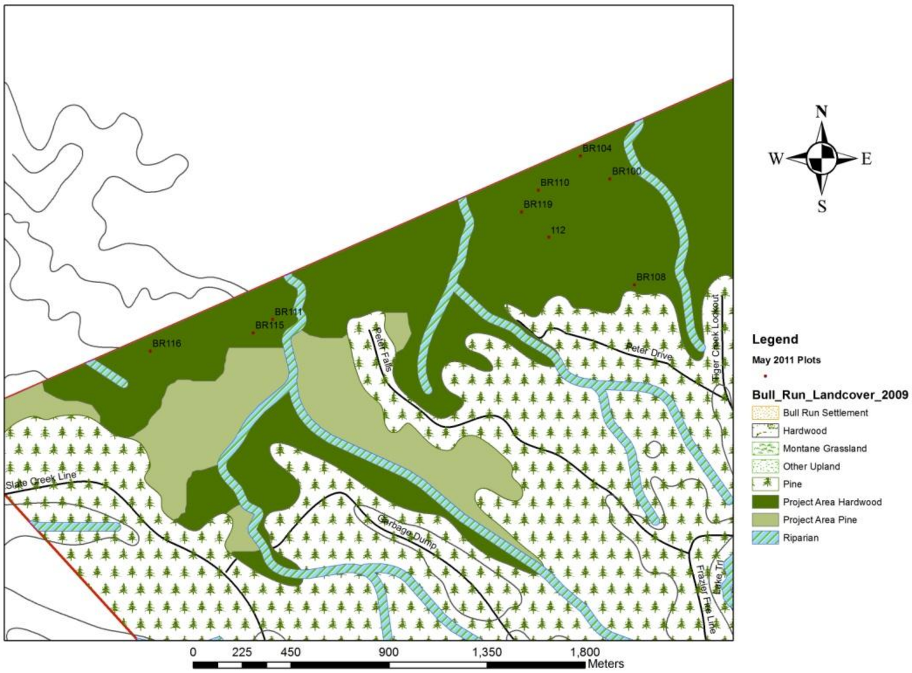

Figure 2a. Location of forest sample plots, Project Area Used for Calculations (dark green), and Project Area Omitted from Calculations (light green) at BRO Western Project Area.

Eastern Project Area

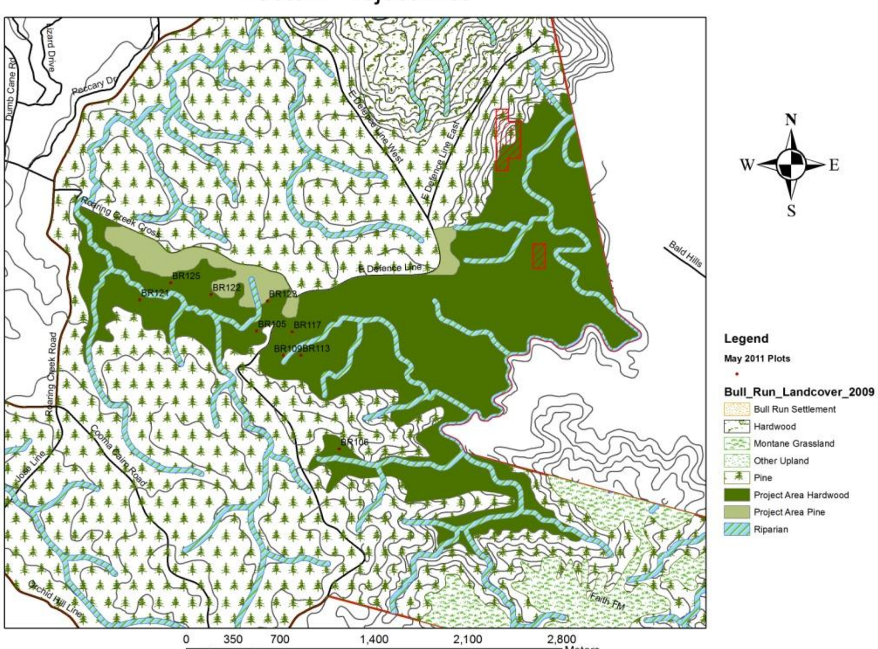

Figure 2b. Location of forest sample plots, Project Area Used for Calculations (dark green), and Project Area Omitted from Calculations (light green) at BRO Eastern Project Area.

Field Plot Measurements

The methods for measuring the carbon pools at BRO were based on the Sourcebook for Land Use, Land-Use Change and Forestry Projects (Pearson et al 2005). Because destructive sampling was not practical to measure above ground carbon stocks, published allometric equations (Table 9) were used to determine aboveground biomass based upon the DBH of hardwood trees. The following forest inventory techniques will be used to collect the appropriate data (Pearson et al 2005). All of the plots have been monumented in the field and trees within each plot tagged and numbered. Data collection is based on a nested circular plot design described in Pearson et al (2005).

All trees 5 - 20 cm DBH will be tallied within a 4 meter radius of the plot center, all trees 20 - 50 cm DBH will be tallied within a 14 meter radius of plot center and all trees > 50 cm DBH will be tallied within a 20 meter radius from plot center. If a tree splits into separate branches below breast height it is treated as multiple trees. If the tree is growing irregularly, or fallen down, it is measured at 1.3 meters above the ground. If the side branches of a fallen tree are large enough to be measured, DBH is measured from the ground. Palms are selected for height measurements based upon the same criteria. Each tree will be named to species with the help of the local guides, if possible. The DBH will be recorded and each tree will be placed into one of the following height classes:

(A) 0 - 1 meter
(B) 1 - 3 meters
(C) 3 - 6 meters
(D) 6 - 10 meters
(E) 10 - 20 meters
(F) 20 + meters.

Every tree tallied is tagged and given a unique ID number for future monitoring. If a tree is found on the plot without a tag, an effort will be made to determine if the tree lost its tag and can be identified or if it was missed in previous measurement events and should receive a new tag. Regardless, every tree will be tagged at every monitoring event and discrepancies noted in the database. Raw data will be entered in a spreadsheet for data summaries and carbon calculations.

Table 6: Equations used for calculating biomass.

Classification	Species group	Equation	Maximum DBH or height
Moist hardwood	Tropical hardwood	Biomass = $\exp(-2.289 + 2.649 \times \ln DBH - 0.021 \times \ln DBH^2)$	148 cm
Pine	Caribbean and Honduran pine	Biomass = $0.887 + ((10486 \times DBH^{2.84}) / (DBH^{2.84} + 376907))$	56.1 cm

Plot Re-measurement:

The following are detailed procedures for monitoring above ground biomass at BRO. The following supply list is recommended for re-measurement of established forest monitoring points:

GPS (using WGS 84 Datum)	Data Notebook
30 Meter Fiberglass Measuring Tape	Writing Utensils
Compass	Machete for clearing
Tree diameter at breast height (DBH) tape	1.3m pole or stick (x2)
Clinometer (percent scale)	Fluorescent Orange Flagging

The following are the basic steps necessary to consistently measure aboveground biomass in forest monitoring plots.

Step 1: Navigate to plot center using Global Positioning System (GPS), XY coordinates and appropriate datum (table 8). The plot center should be conspicuously marked with brightly-colored flagging, and a PVC or rebar center marker. Mark additional trees and plot center with brightly-colored flagging (orange or pink) to augment the remaining markings. Replace PVC as necessary.

Step 2: Fill out a data sheet by recording field crew members, date, plot number, slope, azimuth, and any additional notes on plot characteristics or vegetation.

Step 3: Starting from a due north position, begin measuring living trees within 4m of the plot center, measured to the face of the tree, with a minimum diameter of 5.0 cm at breast height (1.3m) using a DBH tape. Examine each tree making sure it is still living, it is not a liana, and checking if it has been tagged previously. Trees which are greater or equal to 5.0 cm and within 4m of the plot center will be recorded. Continue measuring and recording all trees within 4.0m of plot center in a clockwise direction around the center.

Step 4: Once all of the trees within the 4.0 m class have been measured, all trees greater than or equal to 20.0 cm will be measured and recorded within 14.0 m of the plot center, starting due north and moving in a clockwise direction.

Step 5: Once all of the 20.0cm trees have been measured within 14.0m of the plot center, any trees within 20.0 m of the plot center greater than or equal to 50.0cm will be measured starting due north, and working in a clockwise direction. Figure 3 illustrates the plot design.

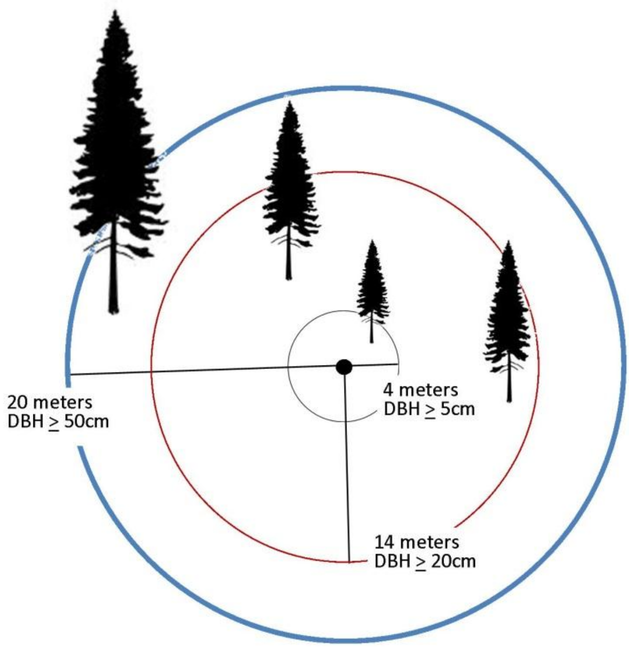

Figure 3: Nested forestry plot design. 4m radius for trees measuring 5cm to < 20cm dbh
14m radius for trees ≥ 20cm to < 50cm dbh 20m radius for trees ≥ 50cm dbh.

Plot Measurement Best Practices

Careful and consistent measurements make it possible for others to replicate identical measurements.

Measurement of DBH

When measuring DBH, set a pole/stick cut to exactly 1.3m on the ground adjacent to the tree and measure the DBH at the top of the measuring stick. When using a DBH tape insure that the tape is wrapped around the tree without any folding or kinks. Measure trees with their natural angle, if a tree is leaning wrap the tape around at the same angle. If a tree is growing straight the tape must be parallel to the ground. If a tree splits into separate branches below breast height it is treated as multiple trees, and if the branch is the appropriate size it is tagged and recorded. If a tree is on a slope, DBH will be measured from the uphill side of the slope. If the tree is growing irregularly, or fallen down, the tree will be measured where it reaches breast height. If the side branches of a fallen tree are large enough to be measured, their DBH will be measured from the ground, not 1.3m from the top of the downed tree.

In all cases the DBH tape should be directly against the bark around the entire circumference of the tree being measured. Vines growing up a tree should be pulled away from the bark, and the DBH measured underneath. If the vine cannot be manually pulled away it can be cut, or the tree diameter estimated using the reverse side of the DBH tape. It is important to leave the majority of vines intact to allow the plots to maintain similar growing conditions to surrounding stands. When applicable, measure above other natural growths at breast height, including irregular tree growths, termite nests, fungal growths, etc. If the natural growths extend out of reach measure just below growth. If the tree has buttresses which would affect the diameter at breast height, measure above the buttresses. If the buttresses extend out of reach, measure as high as possible while remaining accurate. Make a note of the buttresses which can be corrected in later calculations.

Measuring Distance from Plot Center

When measuring the distance from the plot center have one crew member stand at the plot center with the measuring tape zero set on a 1.3 m stick and pull the tape tight. Another crew member will pull the tape, allowing no bends due to trees or snags, and set the measuring end on a 1.3 m pole or stick. If any part of the tree's trunk is in at breast height the tree is considered in.

Previously Tagged Trees

Trees large enough to be recorded in each class will be inspected for previous tags. Trees which have been previously tagged will be recorded with the identification number, adjusted DBH, species (if known), and height (if applicable to the allometric equation). If the tree has not been tagged, they will be tagged with an aluminum uniquely numbered tag and aluminum nail. In this case the new identification number, DBH, species (if known), and height (if applicable to the allometric equation) are also recorded. If the tree species is unknown attempt to identify the tree using any available resources. If the tree cannot be correctly identified, the tree type will be recorded (e.g. hardwood, pine, palm, tree fern, etc.).

Palms

At BRO the most common palm is the cohune. Cohune palms in the early years of growth have no true trunk, just a series of palm fronds which slough off as the tree grows. Thus it is impossible to tag young trees for the purposes of monitoring. Thus only cohune palms old enough to have a true trunk will be measured for inclusion in the above ground biomass pool. Once the palm has aged to a point where there is a true trunk at 1.3 m, the DBH is measured and the same rules apply for inclusion in the nested plot design. If the palm is considered in, the height is measured.

Tree Height Measurements

To measure the height of a tree either use a distance range finder and follow the manufacturer's instructions, or use a clinometer. A clinometer can be used more accurately when standing further away from an object. For this reason, it is recommended that the observer stand at least 15 m from the tree being measured. From a vantage point with a clear line of sight, measure and record angle to the top of the trunk (not the leaves) and the base of the tree with a clinometer. Using a fiberglass measuring tape, measure distance from tree to the observer using the 1.3 m poles for consistent measurements. The height can be calculated using simple trigonometry, the two angles, and the distance to the tree (See Figure 5).

Once all of the trees have been measured and tagged, review data sheet to ensure no data points have been forgotten (slope, azimuth, tree measurements, etc.) and recheck plot for any trees missed. If everything is checked, and the team agrees everything has been completed, all gear is collected and the team continues to the next plot.

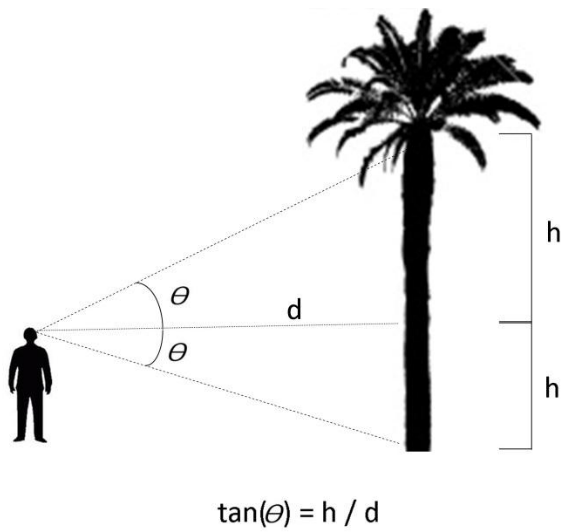

Figure 4: Measuring palm heights in the field with a clinometer.

At the end of each day a designated team member will check that there are completely filled out data sheets for each plot inventoried. Completed data sheets will be stored in a portfolio case that is not taken into the field.

Mapping Methods

Remote sensing methods will follow industry best practices using Landsat TM or higher resolution imagery. Head's up digitizing utilizing trained analysts will be employed to produce a forest/nonforest map of the project area and if necessary the leakage area. A classification accuracy of 90% or better will be achieved. Areas burned, damaged by wind, or illegally cleared will be mapped using a combination of these methods plus ground surveys with a GPS.