Boden Creek Ecological Preserve
Forest Carbon Project
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Cover Photo: Station #6 Boden Creek Trail, April 3, 3008 03:47h, jaguar likely pair (Miller and Miller 2008).

1.0 Project Description

1.1 Project title

Boden Creek Ecological Preserve (BCEP) Forest Carbon Project (the "project").

1.2 Type and Category of Project

AFOLU: Reduced Emissions from Deforestation and Degradation

1.3 Estimated Emission reductions over the crediting period

The total predicted avoided emissions over 25 years exceeds 1.4 million mtCO2e

1.4 A brief description of the project

BCEP is located on 5,213 hectares of which 3,980 ha are considered the project area. The goal of the project is to develop the project as a carbon sink by means of conserving and protecting the property which will maintain the biodiversity values of the property and enhance the local economic environment with sustainable livelihoods through private-sector eco-tourism. The climate objective is to avoid emissions from deforestation during the project timeframe.

The project consists of protection of the property for the timeframe of the project through patrols, outreach with and job creation for the local villages, and placing a restrictive covenant on the property deeds for the life of the project. Belize Lodge and Excursions (BLE) is the contractor charged with running an ecotourism operation on the property. BCEP is the entity that owns the property and the entity charged with managing the property. BLE has an ecotourism contract for use of the property from BCEP. Forest Carbon Offsets LLC (FCO) is an agent of BCEP to develop BCEP as a carbon finance project. Conservation Management Institute at Virginia Tech (CMI) is a subcontractor hired to conduct technical analysis on behalf of FCO.

1.5 Project location

The property boundary consists of 5,213 ha of which 3,980 ha are considered the project area. The project area is completely available for aquaculture, industrial logging and commercial agriculture (with the exception of a one-chain buffer around perennial streams) according to Belize's national plans for agriculture[1] and aquaculture development[2] in the absence of finance from any carbon financing mechanism. The project is situated at Latitude 16^{0}17'37" North and Longitude 88^{0}48'47" West in the Toledo District, Belize 23 km north of Punta Gorda, Belize (Figure 1: General location of Boden Creek Ecological Preserve). The project's boundaries are defined by the 931 ha Pine Hill Mennonite Community, the 7,516 ha Seven Hills Estate, the 2,192 ha Manatee Creek Parcel, the 3,866 ha Golden Stream Parcel, and Indian Creek Village.

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[1] National Food and Agriculture Policy (2002-2020). Available at http://www.agriculture.gov.bz/PDF/Policy_Document.pdf accessed 1/21/2010.

[2] National Aquaculture Zoning Plan for Belize: Schedule I (DRAFT). Available at http://www.coastalzonebelize.org/reports/draft_nationa_aquaculture_policy.pdf accessed 1/21/2010.

Figure 1: General location of Boden Creek Ecological Preserve[3]

[3]Source: CIA World Factbook via the University of Texas (http://www.lib.utexas.edu/maps/belize.html

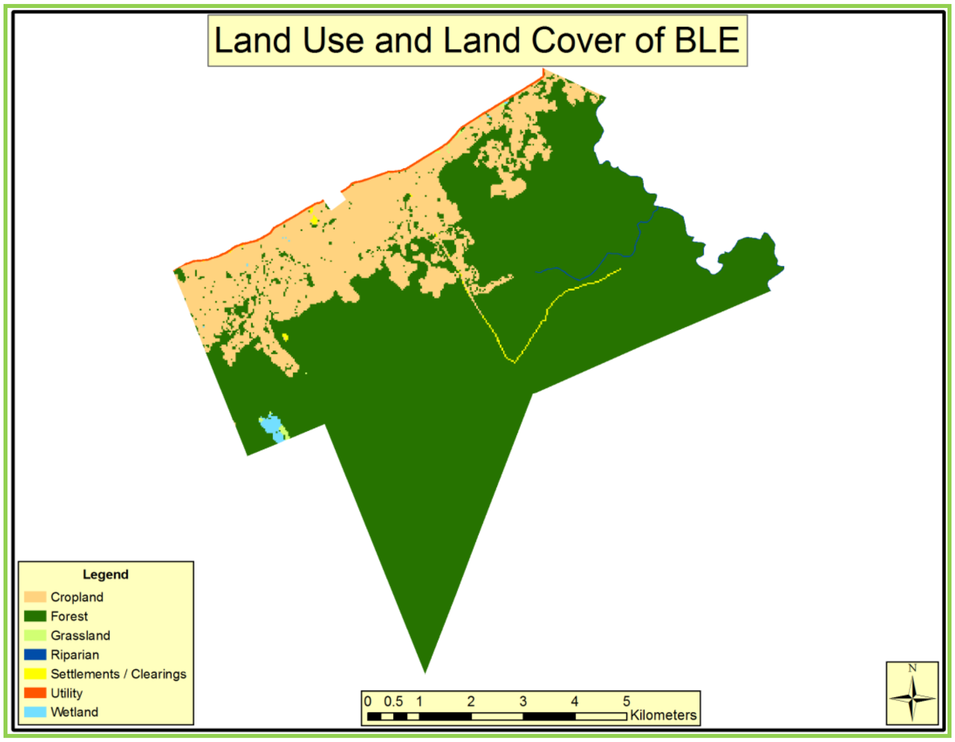

Figure 2: Project Area: Forest vs. Non-Forest Map

1.6 Duration of the project activity/crediting period

- Historical reference period January 1995 through December 2004
- Funding secured for carbon project and developer signed September 2009.
- Start of project 1/1/2005
- Crediting period 2005 to 2029.
- Baseline reset 2015 and 2025.
- Project end date is December 31, 2029.

1.7 Conditions prior to project initiation

The property was purchased from the previous owner who was in the process of converting the property to a mix of agriculture (bananas and citrus primarily). The evidence on the ground of this history is self-evident as a part of the property was cleared and remnant banana and orange trees are still visible. The project started when the property was purchased (2000-2004). The previous landowner received and seriously considered at least one other offer of purchase for conversion so the agent of deforestation was determined to be a class of deforestation agent.

In 2001, a hurricane damaged the biomass on the property. In the period 2004 to 2008, the property owner protected the property with investor funds and sought outside support for a carbon financing project. In 2008/2009, FCO was contracted as an agent of the landowner to perform the due diligence required, collect and analyze the data, and prepare the documentation for the REDD project.

1.8 Project description

The major project activities are:

- Partner with BLE to conduct ecotourism activities at the site to generate jobs for local people,
- Control access to the site through regular patrols,
- Continue to conduct outreach with the local communities,
- Place a restrictive covenant on the property, and
- Monitor results.

The project will use carbon financing to avoid the threat of conversion to citrus, pasture, and/or aquaculture. A successful and financially stable BCEP will provide livelihoods both through management of the property and through the ecotourism operations conducted by BLE. These livelihoods are badly needed in the local communities. Financial stability means that the taxes can be paid, and all the other activities necessary to maintain and protect the property are sustainable. The primary activity for management of the property is patrols and interaction with local communities. These activities ensure the long term protection of the climate and biodiversity values of the project by preventing illegal hunting and harvesting of timber. A substantial monitoring program will be undertaken by BCEP.

1.9 Project technologies, products, services and the expected level of activity

The primary technology employed to achieve the desired results is patrols of the property to prevent incursions and illegal removal of biomass. The following activities will occur:

- Rangers and patrols,
- Assisting forest carbon data collection,
- Assisting biodiversity data collection,
- Ecotourism services,
- Accounting,
- Personnel management,
- Maintenance, and
- Restrictive covenants.

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

1.10 Compliance with relevant local laws and regulations related to the project

BCEP complies with all applicable local, district, and national labor standards. BCEP follows all applicable environmental laws including the Belize Environmental Protection Act Chapter 328, Revised Edition 2000.[4] Belize has the following relevant labor laws:

- International Labour Organization Conventions Act,
- Labour Act,
- Labour (Subsidiary Laws),
- Protection Against Sexual Harassment Act,

[4] See www.belizelaw.org.

- 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 for the PDD:

- 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.
- Citrus (Processing and Production) Act, Chapter 277.

From this analysis and based on personal communication with the Ministry of Natural Resources and the Environment and the Belize Forest Department, it is clear that the BCEP property could easily be converted legally to a citrus plantation. The only caveat is that there should be a one-chain riparian buffer on either side of Golden Stream and Boden Creek (personal communication with the Ministry of Natural Resources and Environment, Belize), even though this one-chain buffer is not required by law. There are no property disputes within the project area per personal communication with the Belize

Forestry Department and the legal resources assisting with the claims of the 38 Mayan villages of southern Belize.

1.11 Identification of risks

Political Risk

Risks to the project from instability in the Government or a change in leadership at BCEP or BLE are considered minimal. In any case, BCEP has agreed to a restrictive covenant for the life of the project to ensure permanence once carbon finance becomes available. The restrictive covenant is envisioned as a commitment by the landowner on the title to comply with the project plan over the life of the project. The purpose of this restrictive covenant is (in the unlikely event that the land changes hands) to bind any new owners to compliance with the CCB and VCS project plans e.g. no removal of forest, regular monitoring, patrols, and outreach to the local communities.

Risk from Oil and Gas Development

To the best of FCO's knowledge no oil or mineral resources occur on the project site and exploration for mineral resources is not occurring nor is it expected to occur. If oil or gas is discovered on the site, it would belong to the Government of Belize. Similar sites in Belize where oil extraction is taking place have minimal above ground disturbance. Section 26 paragraph 6 of the National Petroleum Act states:

> "(6) Subject to this Act, where, in the course of conducting petroleum operations pursuant to a contract, the rights of the owner or lawful occupier of any land are disturbed or damage to any crops, trees, buildings, stock, works or other property thereon is caused, the contractor is liable to pay the owner or lawful occupier fair and reasonable compensation in respect of the disturbance or damage according to the respective rights or interests of the owner or lawful occupier concerned. The amount of compensation payable shall be determined by agreement between the parties or if the parties are unable to reach agreement or the agreed compensation is not paid, the matter may be treated in accordance with the Arbitration Act."

Based on this, the contractor for the Government extracting the oil would be responsible for compensating the owner of the credits for any reversals suffered as a result of the oil extraction process.

Natural Risk

The greatest natural risk to the project is a direct hit by a hurricane. Hurricane Iris struck the project site in 2001 resulting in a blow down of trees. Therefore, this area is currently in a state of ecological regeneration as is much of the Toledo District likewise impacted in this natural cycle.

Leakage Risk

Since the risk to the forest is determined to be a class of deforestation agents that convert land in Belize to agricultural uses, and the most conservative agricultural use, from a carbon sequestration standpoint is citrus development, a market leakage analysis was conducted following methodology module "Estimation of emissions from activity shifting for avoided planned deforestation (LK-ASP)". A reduction in claimed avoided emissions was made to account for leakage risk.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions

No GHG emissions have been created by this project. The objective of this project is to avoid emissions.

1.13 Other forms of environmental credit

No other environmental credit has been created by this project. The co-benefits of the project have been validated to the Climate, Community, and Biodiversity 2nd Edition Gold Standard at the project level by SCS July 14, 2010.[5]

1.14 Project rejected under other GHG programs

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

1.15 Project proponents roles and responsibilities

BCEP is the project proponent. BCEP has hired FCO to develop the strategy, implementation, and monitoring of the carbon credits generated by this project. 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. BLE is the partner actually conducting the ecotourism enterprise. Decisions on implementation of the project activities are the responsibility of the BCEP board. FCO will be a member of the BCEP board at least through 2014.

1.16 List of commercially sensitive information

Land titles, economic analysis, and inventory data.

[5] CCB Website: http://www.climate-standards.org/projects/index.html

2.0 VCS Methodology

2.1 VCS methodology applied

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) with correction for percentage of nitrogen in applied fertilizer (NC_{SFi})

2.2 Justification of the choice of the 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,
- 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 citrus 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 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project

The approach to measuring carbon stock in the project was based upon the "Sourcebook for Land Use, Land-Use Change and Forestry Projects" (Pearson et al 2005). These methods comply with the Intergovernmental Panel on Climate Change's 2006 Guidelines for National GHG Inventories for Agriculture, Forestry and Other Land Use.

Emrick and Dorr (2008) identified 10 general cover types at BCEP and created a preliminary vegetation map using a 2003 Quickbird image that covered approximately 50% of BCEP. Two of the 10 types, Wet Tropical Broadleaf Forest and Mixed Cohune/Tropical Broadleaf Forest, accounted for over 95% of the forested area at BCEP. Observations during subsequent field visits indicated that these boundaries corresponded poorly to the forested vegetation types. As a result FCO concluded that accurately mapping separate forest types in a young forest recovering from a series of disturbances would be difficult if not impossible. Therefore FCO classified the entire forested area at BCEP as *Lowland Broad Leafed Wet Forest* (Meerman and Sabido 2001).

Thus, for the purposes of assessing carbon stocks at BCEP, FCO classified the landscape into one of the six Land Use Land Cover classes (Forest Land, Crop Land, Grass Land, Wetlands, Settlements and Other Land) defined by IPCC (2006).

<u>Carbon Pools</u>

The carbon pools selected for measurements were the above ground tree (> 5cm diameter at breast height) and below-ground biomass. Non-tree above ground and below ground biomass were either not measured (lianas), or measured and set aside for a future revision of the project (palms and cecropias). Down or standing dead wood and leaf litter were also not measured. Omitting these potential carbon pools resulted in a conservative estimation of carbon stocks. It was determined that some existing trees may be harvested in the baseline scenario. These few trees were analyzed from the inventory data and found to be insignificant. In the baseline scenario, emissions attributable to biomass burning were analyzed and included, as were avoided emissions from fertilizer use.

Table 1: Carbon Pools and Sources of Emissions

Carbon pools	**Included / excluded**	**Justification / explanation of choice**
Above ground	Included	Recovering secondary tropical forests have high growth / carbon accumulation rates and rapidly fix key nutrients in the above and below ground biomass (Vitousek and Stanford 1986, Vitousek 1991, Guariguata and Ostertag 2001, Hughes et al 1999).
Below ground	Included	Recovering secondary tropical forests have high growth / carbon accumulation rates and rapidly fix key nutrients in the above and below ground biomass (Vitousek and Stanford 1986, Vitousek 1991, Guariguata and Ostertag 2001, Hughes et al 1999).
Dead-wood	Excluded	Excluded to be conservative and make the monitoring cost-effective.
Harvested wood products	Excluded	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.
Litter	Excluded	Excluded to be conservative and make the monitoring cost-effective.
Soil organic carbon	Excluded	Excluded to be conservative and make the monitoring cost-effective.
Fuel Wood Collection	Excluded	While some fuel wood collection was occurring prior to the project and would presumably 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.

Sources	**Gas**	**Included / excluded**	**Justification / explanation**
Biomass burning	CO_2	Excluded	CO_2 emissions are accounted for by biomass changes in the above ground and below ground biomass pools.
	CH_4	Included	CH_4 emissions from land clearing and burning are included in the stock change model for the baseline. No biomass burning is proposed as a project activity.
	N_2O	Included	N_2O emissions from land clearing and burning are included in the stock change model for the baseline. No biomass burning is proposed as a project activity.
Combustion of fossil fuels	CO_2	Excluded	Conservatively omitted from both the baseline and project scenarios.
	CH_4	Excluded	Conservatively omitted from both the baseline and project scenarios.
	N_2O	Excluded	Conservatively omitted from both the baseline and project scenarios.
Use of fertilizers	CO_2	Excluded	Conservatively omitted from both the baseline and project scenarios.

	CH_4	Excluded	Conservatively omitted from both the baseline and project scenarios.
	N_2O	Included.	The baseline scenario of citrus agriculture would utilize chemical fertilizer.

2.4 Description of the identified baseline scenario

Prior to the start of the project, the previous owner was in the process of removing timber and converting the property to a banana plantation. The baseline scenario therefore is considered to be a continuation of that process of conversion. As far as is known, no written plan was produced for this process by the previous landowner so proxy areas were analyzed to support a rate of conversion consistent with current practice in the area.

Carbon financing will stabilize the protection and maintenance budget which includes patrols, monitoring, outreach to local communities, road maintenance, trail maintenance, and other activities.

Additionality Analysis

Per instructions from the methodology, the following analysis is offered of 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.

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 three most likely alternative land uses. Each alternative is considered legal in Belize.

1. Conversion to Agriculture (continuation of the preproject land use)

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 project area. Agricultural products could include cattle, citrus, bananas, aquaculture, cacao, rice, and other products. 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).

Suitability of soils for conversion to agriculture, particularly citrus were evaluated using the literature. According to Baillie (1993) soils throughout the Project Area are derived from mudstones, sandstones limestone deposits. Soils are moderately shallow clays that are fairly well drained. The soils are underlain by flat-bedded mudstones with some minor sandstones and limestones. Most soils are clay and well-drained while calcium and magnesium are present. The soils are moderately acidic.

Citrus soils need 1) to be moderately acidic, 2) well-drained, and 3) without a deficiency of calcium and magnesium and soils in the project area meet all necessary criteria (Baillie 1993).

BCEP is bordered and in close proximity to several farms involved in the production of banana, citrus, and cattle. The owner has indicated that some of these landowners expressed an interest in buying portions of BCEP in order to expand their operations. Furthermore, the previous owners of BCEP operated a citrus, banana and cattle operation on the project site which ceased only after the current owner purchased the property (Bowen-Jones 2001).

2. Purchase of the Land to Operate Ecotourism Lodges

One alternative land use would be the purchase of BCEP by a different owner to operate the ecotourism lodges. The economics of the current operation, running the lodge system and supporting protection of a large conservation area, is not sufficient, and it would be unlikely to change appreciably to allow a different landowner to succeed.

Commercializing the value of the avoided CO_2 emissions will provide the capital required to support the management of the property as a conservation area independent of the ecotourism operation. There are no other ecotourism operations in Belize with a large conservation area and no other outside sources of income either through agriculture or external donors.

3. Purchase of the Land as a Conservation Area

There are privately owned protected areas in the area and throughout Belize. Most landowners, and the landowner at BCEP, 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.

Analysis of Alternatives

The ecotourism operation is a separate entity. No financial resources are planned for transfer from the ecotourism operation to the carbon project. At present the ecotourism operation is negative. No income is expected from the carbon project. Simple financial analysis would indicate that without the carbon income the financial situation will be negative. The baseline scenario of agriculture and particular citrus is considered positive since it was underway at the time of the purchase of the project (Bowen-Jones 2001) and the citrus industry is a healthy part of the Belizean economy (Tzul 2010). Therefore at least one of the baseline scenarios is more profitable than the project scenario excluding the carbon project income.

Financial plans for both the ecotourism operation and the carbon project will be made available to the auditors.

Common Practice Analysis

- The practice of converting land to industrial agriculture is commonplace in the region as indicated in Tzul 2010, FCO's land cover analysis, and observations on the ground.
- Two other nearby properties owned by nonprofits are of similar size and are managed as protected areas.
- Both nearby properties are supported by an international donor base not available for the project site making the situations quite dissimilar. The essential difference between this project site and others is that this project site has no external funding source on which to draw in the absence of carbon financing.

2.4 Strategy for reduction of GHG in the baseline scenario

The climate objective is to avoid emissions from deforestation during the project timeframe. The major project activities are:

- Partner with BLE to conduct ecotourism activities at the site to generate income for expenses of maintaining and managing the property,
- Control access to the project site through regular patrols,
- Continue to interact with the local communities,
- Place a restrictive covenant on the titles, and
- Monitor results.

The project will use carbon financing to avoid the threat of conversion to agriculture. A successful and financially stable BCEP will provide livelihoods both for management of the property and through the ecotourism operations conducted by BLE. These livelihoods are badly needed in the local communities. Financial stability means that taxes can be paid, and all the other activities necessary to maintain and protect the property are sustainable.

The primary activity for management of the property is patrols and interaction with local communities. These activities ensure the long term protection of the climate and biodiversity values of the project by preventing illegal hunting and harvesting of timber. Employment within local communities makes local communities stakeholders in protecting the property.

A substantial monitoring program will be undertaken by BCEP. The monitoring protocol and baseline study are being designed and initially conducted by staff of CMI and FCO. CMI conducted the initial studies at BCEP and both FCO and CMI have significant field experience in Belize.

3.0 Monitoring

3.1 VCS methodology applied to the project activity:
REDD Methodology Modules (http://www.v-c-s.org/methodology_rmm.html) particularly modules M-MON and LK-ASP.

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches

Purpose of Monitoring

The purpose of monitoring is to:

- Revise the baseline in year 10 of the project,
- Detect carbon stock changes and greenhouse gas emissions,
- Describe leakage of carbon stocks and greenhouse gas emissions attributable to leakage, and
- Estimate ex-post net carbon stock changes and greenhouse gas emissions.

Types of Data and Information to be Reported, Including Units of Measurement

The types of data and information to be reported are reproduced from the methodology in Appendix A.

Origin of the Data

The origin of the data will be from field observations made on an annual basis and verified by a 3rd party auditor at least every 5 years.

Monitoring, Including Estimation, Modelling, Measurement or Calculation Approaches

The monitoring plan is reproduced in Appendix A.

Monitoring Times and Periods, Considering the Needs of Intended Users

The monitoring times will be during the dry season, typically December through April of each year. Each permanent plot will ideally be remeasured each year, but at least in the year prior to the verification event. Monitoring reports will be produced for use by the 3rd party auditors at each verification event.

Monitoring Roles and Responsibilities

BCEP has responsibility for monitoring and has budgeted personnel and funds for this purpose.

Managing Data Quality

The data quality will be assessed at each verification event. The monitoring protocol is available for review and includes a QA/QC component.

3.4 Data and parameters monitored

The monitoring protocol is reproduced in Appendix A.

3.5 Description of the monitoring plan

The monitoring protocol is reproduced in Appendix A. The overall plan is that staff from BCEP will be trained by the Conservation Management Institute to measure each permanent plot each year. At periodic intervals, no less frequently than every 5 years, the data will be summarized, written up within a monitoring report, and verified by a 3rd party auditor.

4.0 GHG Emission Reductions

4.1 Explanation of methodological choice

This REDD Methodology Framework is applicable to project activities that fall within the AFOLU project category "REDD" as defined in the VCS AFOLU Guidance document. By choosing the appropriate modules on the basis of the applicability conditions mentioned in each of the modules, a project-specific methodology can be constructed. Prior to project initiation, the project site was being deforested. This project avoids planned deforestation by means of the purchase of the property for the purpose of protecting it.

4.2 Quantifying GHG emissions and/or removals for the 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, citrus conversion is used as a likely, and most conservative from a biomass perspective, choice for performing the calculations necessary to describe the scenario.

<u>Estimate of Greenhouse Gas (GHG) Loss in the Baseline Scenario</u>

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. Forest growth/biomass/carbon accumulation annual rates,
4. Maximum carbon stocks for secondary tropical forest in Belize,
5. Deforestation/conversion rates,
6. Allocation of deforestation among agro-ecosystems,
7. Carbon stocks in agro-ecosystems,
8. Fate of commercial timber and long-lived wood products,
9. Losses of biomass attributable to fuel-wood collection,
10. Avoided emissions from fertilizer use,
11. Avoided emissions from biomass burning, and
12. Avoided emissions from transportation fuel use.

1. Area of forest available for conversion

Of the total area of the property, 5,213 ha, 3,980 ha is available for the project. A reduction of 1,233 ha was made to account for land that was not forested at least 10 years prior to the start of the project plus land that is within a 1 chain buffer of perennial streams. This figure is based upon Landsat TM data and represents the total forest areas minus a one-chain buffer along perennial streams. An additional 228 ha of forest was conservatively removed from the project (from the forest class) to account for the discrepancy between the title acreage and the GIS boundary file.

2. Baseline Carbon Stocks

Baseline carbon stocks consisted of above ground biomass and below ground biomass. The mean carbon pool in 2011 was based on field measurements conducted in 2009 and 2011 and independently verified. The allometric equation for biomass prediction published in Chave et. al. (2005) for wet forest stands (without Height) was used to predict above ground biomass. A factor of 50% was used to convert biomass to carbon. The Chave et. al. equation requires the use of specific gravity for each species of tree (Zanne 2009). All trees were not identified to species as is commonly reported in the literature (Chave et. al. 2005) so a weighted average specific gravity for the site was developed based on the specific gravity for known trees on all plots. That weighted average (.6253) was used for all trees that were not identifiable to species.

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

An uncertainty level of 25.33% was calculated using module “Estimation of uncertainty for REDD project activities (X-UNC)”.

3. Forest Growth / Biomass/Carbon Accumulation Annual Rates

A critical factor in calculating changes in carbon pools under the baseline scenario is the recovery of the forest from the impact of Hurricane Iris. Recovering secondary tropical forests have long been recognized to have high growth/carbon accumulation rates and rapidly fix key nutrients in the above and below ground biomass (Vitousek and Stanford 1986, Vitousek 1991, Guariguata and Ostertag 2001). Published rates of carbon accumulation and/or growth rates for young secondary *Lowland Broad Leafed Wet Forest* specifically for Belize are not available. However, Guariguata and Ostertag (2001) in a review of neotropical forest succession studies, reported above ground biomass accumulation rates of up to 100 t/ha over a 15 year period or a 6.7% accumulation rate /year.

Hughes et al. (1999) in a study conducted in the Los Tuxtlas region of Mexico, calculated mean yearly above ground biomass accumulation for a series of different aged secondary tropical forests. This study is particularly pertinent to carbon accumulation rates at BCEP because:

- The general vegetation composition of the communities is similar to those of BCEP.
- The ages of the forest stands used in their study encompass the age distribution of the forest at BCEP over the entire project (i.e. space for time substitution).
- Environmental variables (soils, bedrock geology, and climate) and land use history are similar to BCEP.

Using the data from Hughes et al (1999) the average annual above ground biomass accumulation rate for secondary tropical forests of all ages was 6.3%/year. Because southern Belize has substantially higher rainfall compared to the Los Tuxtlas region of Mexico the 6.3% rate was determined to be an appropriate and conservative figure to estimate biomass accumulation within the project area.

4. Maximum Carbon Stocks for Secondary Tropical Forest in Belize

The published steady state maximum for carbon stocks in tropical forest in southern Belize is 318 C tons/ha (Gibbs et al 2007).

5. Rate of Deforestation and Agricultural Conversion

Based on FCO analysis of proxy areas, the deforestation rate for the baseline scenario is considered to be 10.8% Six proxy areas were selected using the methodology described in "REDD Methodological Module: Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation (BL-PL)". An uncertainty level of 7.43% was calculated using module "Estimation of uncertainty for REDD project activities (X-UNC)".

6. Allocation of Deforestation/Conversion among Agro-Ecosystems

Under the baseline scenario, forest cover at BCEP would be converted to mixed agricultural uses. The conversion of tropical forest to mixed agriculture (i.e. citrus / banana plantations, pasture) does not result in a complete loss of carbon from the ecosystem. Each new agro-ecosystem will fix carbon albeit at a much lower rate compared to tropical forest. The one exception would be aquaculture where carbon fixation would be minimal. As opposed to citrus plantations, conversion to aquaculture will result in a 100% loss of carbon from the ecosystem.

7. Carbon stocks in agro-ecosystems

Of the terrestrial agro-ecosystems citrus plantations fix the most carbon, so citrus conversion was chosen as the most conservative assumption. Based on the best available literature, we determined an undeniably conservative estimate is 50% above the average found in Morgan et. al. (2006) or 141 kg/tree dry weight. Converting that weight to tons C/ha requires a presumption of tree density which is provided in Spreen et. al. (2010) as 107 trees/acre at year 20. That estimate then works out to 37 tons C/ha. Based on the literature, the other terrestrial agro-ecosystems had substantially lower maximum carbon stocks.

8. 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 based on the inventory data and found that the available timber for a long-lived wood products pool was de minimis.

9. Loss of biomass attributable to fuel-wood collection

According to Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation (BL-PL), if pre-project, unsustainable fuel wood collection was occurring within the project boundaries, modules BL-DFW and LK-DFW shall be used to determine potential leakage. BCEP pre-project, limited fuel wood extraction was occurring on the portion of the property that is excluded from the above-ground biomass carbon pool. Given the estimated 1997 populations of the two villages pre-project at 751 (Toledo Maya Cultural Council 1997) individuals, and after applying Tool for testing significance of GHG emissions in A/R CDM project activities (Version 01) (T-SIG), the impact on this carbon pool was determined to be de minimis. Therefore emissions from fuel wood collection are not included in the baseline scenario, and monitoring leakage from fuel wood collection is not included in the monitoring plan.

10. 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). A low rate recommended by the Belize Citrus Growers Association (Tzul 2011) is 3.3 lbs of fertilizer (19-9-19)/tree-year. This rate was determined to be indisputably conservative and was used to calculate an annual application of .21 metric tons fertilizer/ha-year application rate in the baseline scenario.

11. 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 CH_4 and N_2O 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.

12. Avoided emissions from transportation fuel use

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

4.3 Quantifying GHG emissions and/or removals for the project

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 starting point as baseline.

3. Forest growth/biomass/carbon accumulation annual rates

Since the forest is recovering from a hurricane event, a growth multiplier (6.3% per year) is used on an annual basis to estimate ex ante C stocks based on the literature (Hughes et al 1999). Given the phase of growth that the forest is experiencing right now and for the life of the project, a more sophisticated sigmoidal growth model is not warranted.

4. Maximum carbon stocks for secondary tropical forest in Belize

Same as baseline, 318 tons C/ha.

5. Deforestation/conversion rates

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

6. Allocation of deforestation among agro-ecosystems

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

7. Carbon stocks in agro-ecosystems

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

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

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

9. Losses of biomass attributable to fuel-wood collection

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

10. Avoided emissions from fertilizer use

No fertilization is anticipated as a project activity.

11. 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.

12. Avoided emissions from transportation fuel use

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

13. Activity shifting leakage

Leakage was determined using module "Estimation of emissions from activity shifting for avoided planned deforestation (LK-ASP)".

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project

Total uncertainty was calculated according to module "Estimation of uncertainty for REDD project activities (X-UNC)" for the above ground biomass pool and the proxy area analysis to determine deforestation rate by summing the uncertainty of each pool and subtracting 15% resulting in a combined project uncertainty of 21.58%. This percentage of the claimed avoided emissions was removed. The other pools and calculations were determined from the literature and considered to be undeniably conservative.

Table 2: Annual avoided emissions 2005 to 2029 in mtCO2e

Year	Project Emissions	Baseline Emissions					Total Avoided Emissions	Risk Buffer (15%)	Net Total
	Leakage	Biomass Change	Fertilizer Use	Non-CO2 Biomass Burning	Uncertainty Deduction	Total Baseline Emissions			
2005	236	8,480	76	1,863	2,248	8,171	7,935	1,190	6,745
2006	485	17,449	152	1,988	4,227	15,362	14,876	2,231	12,645
2007	760	27,321	228	2,121	6,403	23,269	22,509	3,376	19,132
2008	1,062	38,180	304	2,264	8,793	31,956	30,894	4,634	26,260
2009	1,394	50,112	381	2,416	11,417	41,492	40,098	6,015	34,083
2010	1,758	63,213	457	2,579	14,295	51,953	50,195	7,529	42,665
2011	2,158	77,585	533	2,752	17,450	63,420	61,262	9,189	52,073
2012	2,503	90,002	609	2,926	20,184	73,353	70,850	10,627	60,222
2013	2,947	105,940	685	3,110	23,679	86,056	83,109	12,466	70,643
2014	2,217	79,706	706	910	17,548	63,775	61,557	9,234	52,324
2015	1,924	69,170	706	0	15,078	54,798	52,874	7,931	44,943
2016	2,045	73,528	706	0	16,018	58,216	56,170	8,426	47,745
2017	2,174	78,160	706	0	17,018	61,848	59,674	8,951	50,723
2018	2,311	83,084	706	0	18,081	65,710	63,399	9,510	53,889
2019	2,457	88,319	706	0	19,210	69,815	67,358	10,104	57,254
2020	2,611	93,883	706	0	20,411	74,178	71,567	10,735	60,832
2021	2,776	99,797	706	0	21,687	78,816	76,041	11,406	64,634
2022	2,951	106,085	706	0	23,044	83,747	80,796	12,119	68,677
2023	3,137	112,768	706	0	24,486	88,988	85,851	12,878	72,974
2024	3,334	119,872	706	0	26,019	94,560	91,225	13,684	77,541
2025	3,544	127,424	706	0	27,648	100,482	96,938	14,541	82,397
2026	3,768	135,452	706	0	29,381	106,777	103,010	15,451	87,558
2027	4,005	143,986	706	0	31,222	113,470	109,464	16,420	93,045
2028	4,257	153,057	706	0	33,179	120,583	116,326	17,449	98,877
2029	4,526	162,699	706	0	35,260	128,145	123,620	18,543	105,077
Total	61,341	2,205,273	14,722	22,929	483,985	1,758,938	1,697,597	254,640	1,442,957

5.0 Environmental Impact

The Project does not anticipate any negative biodiversity impacts within the area surrounding the Project. Offsite impacts will be positive since larger habitat and forest areas will improve the long-term viability of fauna and flora populations offsite. Avoiding conversion to agriculture also avoids release of sediment and agricultural chemicals into waterways and the Port Honduras Marine Sanctuary. If any negative impact is identified, the BCEP 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. It is not expected that the Project will negatively impact any of 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.

According to personal interviews and official correspondence, Indian Creek Village has never traditionally used the BCEP property for hunting, medicinal plant collecting, or other activities. All hunting has traditional occurred west and north of the village (Toledo Maya Cultural Council 1997).

According to personal interviews and official correspondence, Golden Stream Village has never used the BCEP property for hunting, medicinal plant collecting, or other activities (Toledo Maya Cultural Council 1997).

The Pine Hill Mennonite Community, a Kleine Gemeinde Mennonite community, is reclusive and interacts minimally with others from outside their community. They have no record of using the BCEP property for hunting or other activities. Currently, they receive from BCEP road access to their property through BCEP property.

Project has been awarded Gold Level certification by the Cilmate, Community, and Biodiversity Alliance.

An environmental impact statement is not required for the project. Environmental impacts of the project are conservatively projected to be all positive for biodiversity, water quality, air quality, and climate impacts.

6.0 Stakeholders' Comments

BCEP has actively engaged local stakeholders in designing the project with various onsite consultations. Members of the local communities are the primary employees of BCEP participating in permanent sample plot measuring, setting up remote large mammal camera traps, setting up acoustic recording devices, conducting forest patrols, educating other local community members about forest protection, and engaging in other knowledge transfer activities. Stakeholder involvement has been solicited formally and informally since early 2010 so as to inform stakeholders about the project, to receive their feedback, and to publicize the project for public comment.

- Information posted on the website (http://www.belizelodge.com/home.html) since late February 2010.

- Direct email and phone contact with economist Dr. Jim Bass.
- Direct email and phone contact with Belize ecology specialists Dr. Miller and Mrs. Miller.
- Held meeting with management representatives from TIDE, YCT, and Golden Stream Corridor and Alcaldes and representatives from Indian Creek and Golden Stream March 17, 2010, 5pm to 8pm.
- Direct email and phone contact culminating in meeting with the Belize Association for Private Protected Areas (BAPPA) on March 19, 2010 in Belize City, Belize.
- Visited Indian Creek Village, and sharing the CCB Project PDD with the Indian Creek Village and hosted public meetings at Indian Creek Village and Golden Stream Village, April 10th, 2010. Indian Creek Village meeting had 31 attendees with formal representation from the Indian Creek Village Parent Teacher Association, primary school, water board, Chairman, Secretary, Vice President, and Alcalde. Golden Stream Village meeting had 9 attendees with formal representation including the Alcalde, Chairmen, and others.
- Displayed for all clients of BLE at Indian Creek eco-lodge entrance point since late February.
- Displayed and shared with all BLE employees and their community members through printed materials and presentations with staff stakeholder meeting attended by 7 local women and 16 local men and local men and local women in managerial positions on Wednesday March 17th, 2010 at 5pm.
- The PDD was made available on the CCBA webpage and open to public comments (http://www.climate-standards.org/projects/index.html) beginning February 12, 2010.
- Public meetings held at Indian Creek Village and Golden Stream Village, April 10th, 2010.
- Direct personal meetings with the Alcalde, Chairman, Secretary, and Vice President from the villages of Indian Creek and Golden Stream.
- Notification of Embassy of Belize, Ambassador A. Joy Grant, Mission to the European Comission and to the World Trade Organization, in person and via email.

The plan for continuing involvement by the local communities includes regular public meetings held in the villages by a staff member of BCEP hired for that role. Public comments are available on the CCBA web site.

7.0 Schedule

The project began in 2004 with the title transfer of the last parcel. The crediting timeframe of the project extends from 2009 through 2029 (Table 3: BCEP Project Timeline) and final verification will take place the year after the project ends in 2029.

Table 3: BCEP Project Timeline

Milestone	2004-2009	2010	2011	2015	2020	2025	2029	2030
BCEP Formed, Project Start								
Survey Work Conducted								
Project Start								
CCBA Project Validation								
VCS Project Validation								
Initial financing								
Restrictive covenant								

Second Verification								
Third Verification								
Fourth Verification								
Project End								
Fifth Verification								

8.0 Ownership

8.1 Proof of title

Forest Carbon Offsets, LLC has a legally binding agreement with the landowner which transfers management of the environmental service rights of the property. The agreement also sets out the obligations and responsibilities placed on the landowners for the duration of the project. BCEP follows all applicable environmental laws including the Belize Environmental Protection Act Chapter 328, Revised Edition 2000.[6] Belize ratified the Kyoto Protocol September 26, 2003. BCEP title proof is available if requested from the Department of Land and Surveys, Market Square, Belmopan, Belize (Table 4: BCEP land registry information).

Table 4: BCEP land registry information

Title	Ha	Registry	Date Recorded	Title Search Completed
Block 131A	213	Surveyors Plan Book No. 7, Folio 75	November 28, 2000	August 5, 2009
Block 131	2,882	Surveyors Plan Book No. 4, Folio 54	November 28, 2000	August 5, 2009
Whitney block	2,118	Entry No. 10573, Register 15	February 19, 2004. December 31, 2008. Deed of Conveyance on file.	August 5, 2009
Total ha	5,213			

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program

Not applicable.

9.1 Tool for AFOLU non-permanence risk analysis and buffer determination

Population Surrounding the Project Area

The population density in the surrounding area is very low. It is < 50 people / km2. The Project's boundaries are defined by the 931 ha Pine Hill Mennonite Community, the 7,516 ha Seven Hills Estate, the 2,192 ha Manatee Creek Parcel, the 3,866 ha Golden Stream Parcel, and Indian Creek Village for a total of 14,505 ha. There are three communities located in the Project Zone. The communities are Indian

[6] See www.belizelaw.org.

Creek Village, Golden Stream Village, and Pine Hill Mennonite Community. The population of three communities is roughly 1,250 individual (Table 5: Population surrounding the Project area 2008 midyear population estimates). Population density is roughly 8.6 individuals per km2. Population density in the surrounding area is very low risk.

Table 5: Population surrounding the Project area 2008 midyear population estimates

	Total	Male	Female	% Toledo District rural population
Indian Creek Village	447 (1997 estimate)	(no data available)	(no data available)	~2%
Golden Stream Village	304 (1997 estimate)	(no data available)	(no data available)	~1%
Pine Hill Mennonite Community	500 (2010 estimate, pers. communication)	(no data available)	(no data available)	~2%

Fire

This ecosystem is a wet tropical system with a range of 90 mm/month in the dry season to 750 mm/month in the wet season. Fires in this system are rare events. A superb discussion of fire (Meerman and Sabido 2001) in Belize may be viewed at http://biological-diversity.info/fire.htm. The project area is in the lowest fire risk category.

The best practices for fire prevention in Belize are primarily excluding humans from the property through patrols as is proposed in the project plan.

Hurricanes

The southern region of Belize has one of the lowest frequencies of hurricane landfall in the Caribbean with an average of one landfall every 23 years (Lugo et al. 2000). Since the forest is recovering from Hurricane Iris in 2001, and the trees are smaller and less prone to breakage, the risk of reversal as a result of hurricanes is low for the life of the project.

Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination

The version of the tool used is dated 18 November 2008.

Table 6: Generic AFOLU project risk factors

Project risk	**BCEP risk**
Risk of unclear land tenure and potential for disputes: Independent third-party title search has confirmed title is held by BCEP with no liens. See section 8.0 Ownership.	Low
Risk of financial failure: BLE has proven track record of repaying loans to Conservation International, The Nature Conservancy and the Ecologic Development Fund. Project proponent manages eco-tourism business that is dependent on protected forest for tourism income.	Low
Risk of technical failure: FCO and CMI have proven long-term track record of	Low

designing, implementing, and monitoring high quality ecosystem management projects and forest carbon projects.	
Risk of management failure: FCO and CMI have proven long-term track record of designing, implementing, and monitoring high quality ecosystem management projects and forest carbon projects.	Low
Economic risk	
Risk of rising land opportunity costs that cause reversal of sequestration and/or protection: Project proponent manages eco-tourism business that is dependent on protected forest for tourism income.	Low
Regulatory and social risk	
Risk of political instability: Belize has low regional political instability. The project area does not include local communities. Local communities are not reliant upon the project area for essential food, fuel, fodder, medicines or building materials where such resources are not readily available elsewhere, or where the project area includes areas of cultural, ecological, economic or religious significance.	Low
Risk of social instability: Belize has low regional social instability. The project area does not include local communities. Local communities are not reliant upon the project area for essential food, fuel, fodder, medicines or building materials where such resources are not readily available elsewhere, or where the project area includes areas of cultural, ecological, economic or religious significance.	
Natural disturbance risk	
Risk of devastating fire: BCEP has no recorded history of devastating fire.	Very low
Risk of pest and disease attacks: BCEP has no recorded history of pest and disease attacks.	Very low
Risk of extreme weather events (e.g. floods, drought, winds): BCEP has hurricane occurrence recorded roughly every 50 to 100 years.	Low
Geological risk (e.g. volcanoes, earthquakes, landslides): BCEP has no recorded history of geological risk.	Very low

Table 7: BCEP specific risks

Risk factor	BCEP risk
Land ownership / land management type	
Land owned by private conservation organization, BCEP, with a good track record in forest conservation activities and able to obtain and enforce nationally recognized legal protection of the land.	Very low
Technical capability of project developer	
BCEP, CMI, and FCO have proven capacity to design and successfully implement activities that are likely to ensure the longevity of carbon benefits (e.g., effectively managing protected areas).	Very low
Net revenues/financial returns from the project to all relevant stakeholders	
Higher to pre-project or similar to alternative land-uses. Land owned by private conservation organization, BCEP, with a good track record in forest conservation activities and able to obtain and enforce nationally recognized	Very low

legal protection of the land.	
Infrastructure and natural resources	
Low likelihood of new road(s)/rails being built near the BCEP project boundary. BCEP is bordered on two sides with protected areas. Land owned by private conservation organization, BCEP, with a good track record in forest conservation activities and able to obtain and enforce nationally recognized legal protection of the land.	Very low
No high-value non-forest related natural resources (oil, minerals, etc.) known to exist within BCEP project area. Land owned by private conservation organization, BCEP, with a good track record in forest conservation activities and able to obtain and enforce nationally recognized legal protection of the land.	Low
No hydroelectric potential within BCEP project area. Land owned by private conservation organization, BCEP, with a good track record in forest conservation activities and able to obtain and enforce nationally recognized legal protection of the land.	Low
Population surrounding the project area	
Decreasing or increasing, but with low population density (e.g., <50 people/km^2). BCEP project area population is estimated to be less than <50 people/km^2.	Very low
Incidence of crop failure on surrounding lands from severe droughts, flooding and/or pests/diseases	
Frequent (>1 in 10 years)	Low
Project financial plan	
Credible long-term financial strategy in place (e.g., endowment, annuity-paying investments, and the like). Funding BCEP will fund investment trust with annuity payment with guaranteed income for employees of BCEP for lifetime of project.	Low
BCEP has legal easement for ongoing protection tied to land title in place.	Very low

Overall Risk Rating

Overall risk rating is low, or 15%.

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Appendix A: Monitoring Plan

The overall objectives of the monitoring plan are to detect any reversals in forest cover and to update the growth rate assumption (Guariguata and Ostertag 2001, and Hughes et al. 1999) 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.

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.

Data and Parameters Monitored

The following parameters will be monitored during the project activity. These estimates shall be based on measured or existing published data where possible and the project participants will retain a conservative approach: that is, if different values for a parameter are equally plausible, a value that does not lead to over-estimation of net anthropogenic GHG removals by sinks will be selected. Field measurements will be conducted by revisiting the permanent plots.

Procedures for calculating the impacts of changes in these parameters, selection of external data sources (e.g. remote sensing data), post-processing and accuracy assessment, and documentation will follow approved VCS module VMD0015 Version 1.0 “Methods for monitoring of greenhouse gas emissions and removals (M-MON)”.

Data / 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
Measurement procedures (if any):	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.
Measurement Frequency	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC Procedures	Based on plot remeasurements.
Any comment:	If stratification is required in the future due to a reversal, then new strata will be identified using module X-STR.

Data / 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
Measurement procedures (if any):	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Measurement Frequency	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC Procedures	Remeasurement of permanent plots.
Any comment:	This is presumed to be zero ex ante.

Data / parameter:	$A_{burn,i,t}$
Data unit:	Ha
Description:	Area burnt at time *t (if any occurs)*
Source of data:	Remote sensing imagery
Measurement procedures (if any):	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Measurement Frequency	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
QA/QC Procedures	Remeasurement of permanent plots.
Any comment:	This is presumed to be zero ex ante.

Data / parameter:	*ADefLK,i,t*
Data unit:	Ha
Description:	The total area of deforestation by the class of agent of the planned deforestation at time t
Source of data:	Remote sensing imagery
Measurement procedures (if any):	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image or published data.
Measurement Frequency	Must be reexamined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC Procedures	Groundtruthing using GPS if necessary.
Any comment:	Ex ante, project proponents shall determine and justify the likelihood of leakage based on characteristics of the class of deforestation agent.

Data / parameter:	*CAB,tree,i,*
Data unit:	t CO2-e ha-1
Source of data:	Field measurements applied with allometric equation published in Chave et. al. (2005)
Description:	Carbon stock in aboveground biomass in trees in the project case in stratum *i*
Measurement procedures (if any):	See field methods section.

Measurement Frequency	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC Procedures:	Independent 3rd party audit of field measurements utilizing remeasurement of a sample of plots.
Any comment:	Key variable used to calculate with project carbon stocks and year by year growth rate.

Data / parameter:	$DBH_{,tree,i,}$
Data unit:	cm
Source of data:	Field measurements
Description:	Diameter at 1.3 meters above the ground of each tree on each plot
Measurement procedures (if any):	See field methods section.
Measurement Frequency	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC Procedures:	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.
Any comment:	Key variable used to calculate with project carbon stocks and year by year growth rate.

Data / parameter:	$species_{,tree,i,}$
Data unit:	unitless
Source of data:	Field observations
Description:	Identify each tree to species or species group whenever possible.
Measurement procedures (if any):	See field methods section.
Measurement Frequency	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC Procedures:	Independent 3rd party audit of field measurements utilizing remeasurement of a sample of plots. Field observations sheets will

	include species of each tree tagged for reconfirmation in the field.
Any comment:	Key variable used to determine specific gravity to calculate with project carbon stocks and year by year growth rate.

<u>Variables Used but not Monitored for Boden Creek Ecological Preserve Carbon Project</u>

Variable	Source of Data
Carbon fraction of dry matter in t C t-1 d.m:	Common practice 50% (Pearson et. al. 2005)
Average annual aboveground biomass accumulation rate for secondary tropical forests of all ages was 6.3%/year.	Using the data from Hughes et al (1999) the average annual aboveground biomass accumulation rate for secondary tropical forests of all ages was 6.3%/year.
Combustion factor for stratum i (vegetation type)	Default values in Table 2.6 of IPCC, 2006 (Annex 2).
Combustion Emission factor for stratum i for gas g - source of data	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Annex 2: emission factors for various types of burning for CH4 and N2O).
Total area of stratum	GIS coverages, ground survey data and/or remote imagery (satellite or aerial photographs).
Emission Factor for emissions from N inputs	Updated country-specific data when available. In the meantime, IPCC.
The fraction that volatilizes as NH3 and NOX for synthetic fertilizers	IPCC default
Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH3 and NOX	Published rates from Belize Citrus Growers Association
Nitrogen content of synthetic fertilizer type I applied	Producers of synthetic fertilizer purchased and used as recommended by the Belize Citrus Growers Association
Proportion of available area for production of commodity that is currently forested	GIS analysis plus consultation with experts
Total area of planned deforestation over the fixed baseline period	GPS coordinates and/or Remote Sensing data and/or legal parcel records.
Leakage factor for displacement of class of planned deforestation agents	GIS analysis

Field Plot Methods

Sampling Framework

The sample size required to achieve the desired precision and confidence is 20 forest inventory plots. However, 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 31 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 8: UTM locations of forestry plots used to determine aboveground biomass (coordinates are in WGS 84 zone 16)

Plot ID	X coordinate	Y coordinate
1	307223	1801041
2	310014	1804373
3	306734	1805336
4	309546	1799665
5	310373	1803894
6	305126	1800216
7	307018	1803584
8	307918	1805047
9	307806	1804326
10	306569	1801938
11	307239	1800066
12	310192	1803071
13	307140	1801838
14	308038	1805429
15	305784	1800156
16	307517	1805715
17	309332	1802438
18	308703	1805334
19	307561	1806108
20	307594	1799864
21	304106	1800663
22	304949	1800058
23	308801	1804441
24	311735	1803043
25	312012	1803278

26	312003	1802413
27	303676	1801725
28	304951	1799165
29	302985	1801203
30	306658	1799374
31	307121	1798628

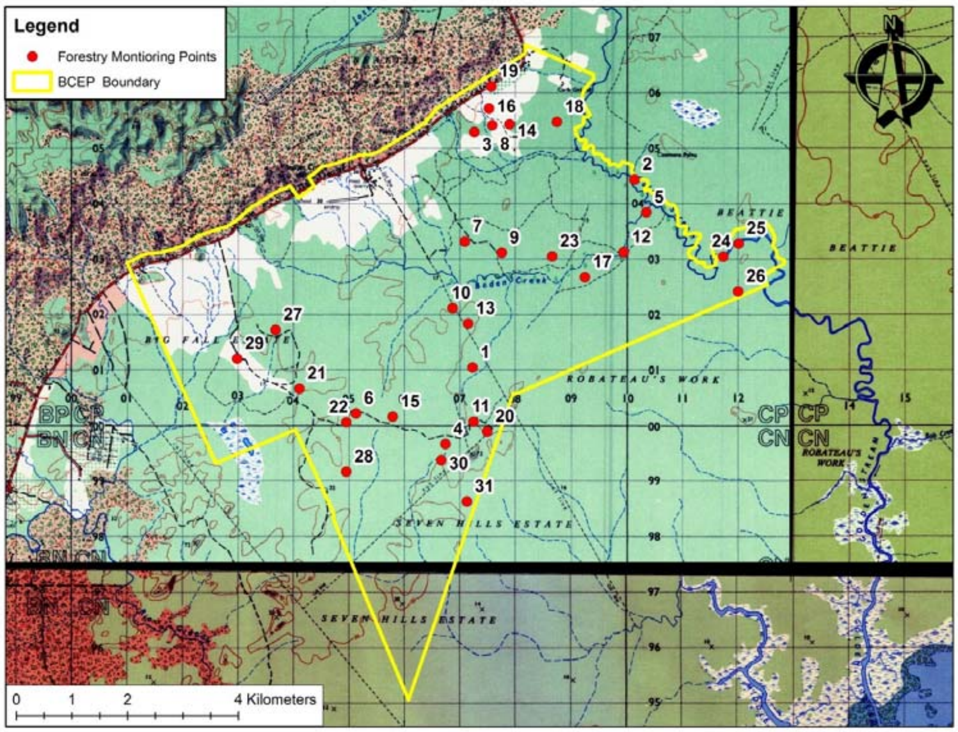

Figure 3. Location of forest sample plots at BCEP.

<u>Field Plot Measurements</u>

The methods for measuring the carbon pools at BCEP 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 were used to determine aboveground biomass based upon the DBH of hardwood trees and the height of palms. The following forest inventory techniques will be used to collect the appropriate data (Pearson et al 2005). All of the 31 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.

<u>Plot Re-measurement:</u>

The following are detailed procedures for monitoring above ground biomass at BCEP. 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 bright 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 or calipers. 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 illustrates the plot design.

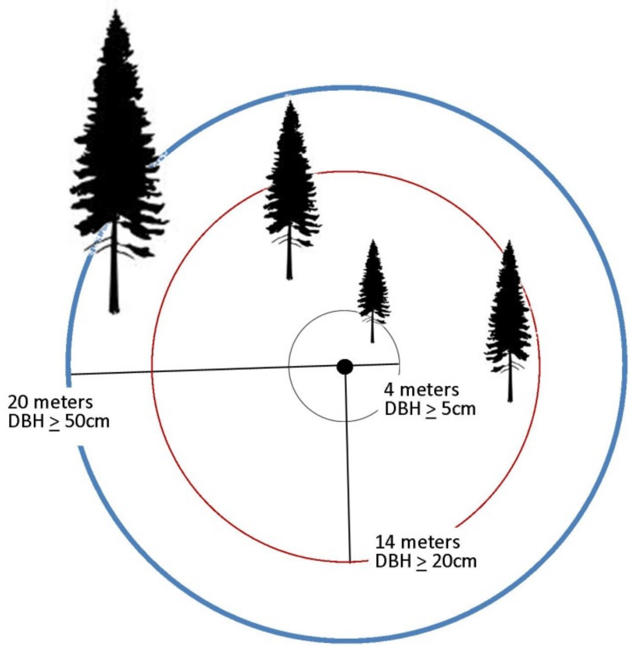

Figure 4. Nested forestry plot design. 4m radius for trees measuring 5cm to < 20cm dbh 14m radius for trees ≥ 20cm to < 50cm dbh 20m radius for trees ≥ 50cm dbh.

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 BCEP 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.

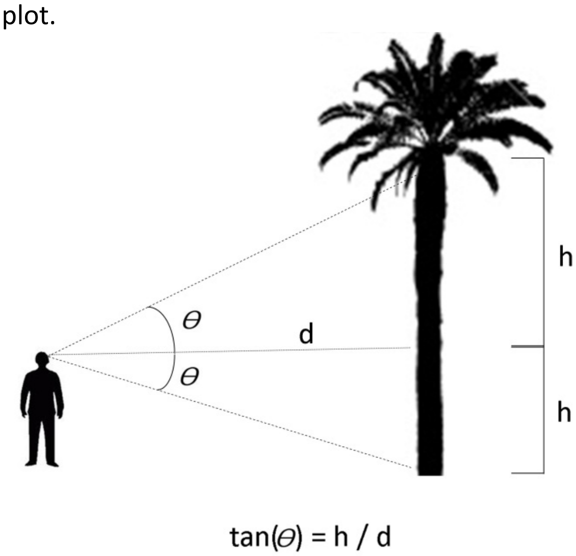

Figure 5. Measuring palm heights in the field with a clinometer.

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.