LAGUNA SECA FOREST CARBON PROJECT MONITORING REPORT

Document Prepared By Forest Carbon Offsets LLC

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Project Title	Laguna Seca Forest Carbon Project
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project has gone forward as planned starting January 2011. FSC certification is in process and expected to be awarded in 2015. No timber has been cut so far. Patrols have occurred and the protection of the project area has been accomplished.

Monitoring of the project has been conducted per the monitoring plan. Remote sensing analysis has been conducted on the project area to detect deforestation. Remote sensing on the leakage area has been conducted to detect deforestation as a result of sugar cane agricultural development. Permanent plots have been measured throughout the project area. No deforestation due to sugarcane agriculture was detected in the leakage area.

Years	Total Avoided Emissions minus Uncertainty (Adjusted-$C_{REDD,i,t}$) (tCO_2e)
2011	229,011
2012	234,994
2013	240,977
Total	704,983

1.2 Sectoral Scope and Project Type

This project is certified as compliant with the Verified Carbon Standard Version 3.5 as an Agriculture, Forestry, or Land Use (AFOLU) Project using a strategy of Reduced Emissions from Deforestation and Degradation (REDD) and assuming a baseline of planned deforestation. This project is not a grouped project. Project type of activity is Avoided Planned Deforestation (APD).

1.3 Project Proponent

Organization name	The Forestland Group LLC
Contact person	Kaarsten Turner Dalby
Title	Vice President – Ecological Services
Address	6949 Highway 73 Suite 5 Evergreen, CO 80439 USA
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Email	kaarsten@forestlandgroup.com

1.4 Other Entities Involved in the Project

Organization name	Forest Carbon Offsets LLC
Role in the project	Project Developer
Contact person	Keister Evans
Title	CEO
Address	600 Cameron St. Alexandria, VA 22314 USA
Telephone	+1 703-795-4512
Email	info@forestcarbonoffsets.net

Organization name	Offsetters LLC
Role in the project	Technical Advisor and Data Collection
Contact person	Steve Dettman
Title	Senior Forester, Ecosystem Services
Address	1300 NW Northrup Street Portland, OR 97209
Telephone	+1 (503) 758-5320
Email	steve.dettman@offsetters.ca

Organization name	Conservation Management Institute, Virginia Tech
Role in the project	Technical Advisor and Geospatial Data
Contact person	Verl Emrick
Title	Remote Sensing Specialist
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Telephone	+1 540-231-9197
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1.5 Project Start Date

January 1, 2011

1.6 Project Crediting Period

January 1, 2011 through December 31, 2013, three calendar years.

1.7 Project Location

The Project area is located at Latitude 17°34’15.65” N and Longitude 89°03’06.30” W in the Orange Walk District, Belize 47.5 km northwest of Belmopan, Belize.

Figure 1: Project Area Location in Belize

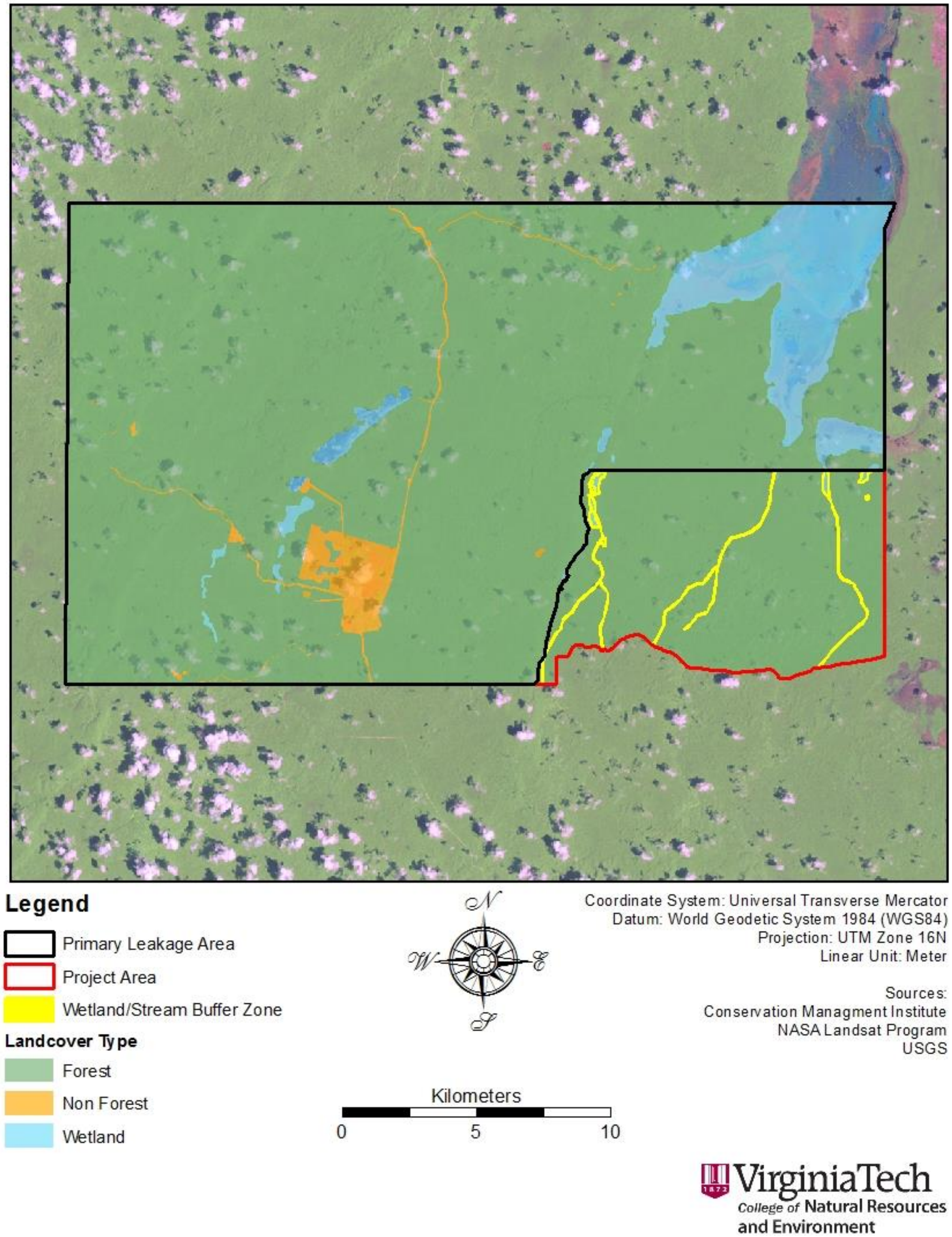

Figure 2: Project Area and Leakage Area.

1.8 Title and Reference of Methodology

This project is designed for validation under the Verified Carbon Standard Version 3.5, AFOLU Requirements Version 3.4 and utilizing methodology VM0007 REDD Methodology Modules (http://www.v-c-s.org/methodologies/redd-methodology-framework-redd-mf-v15) for planned deforestation. In particular the following methodology modules were used for this project:

Title	Version
VCS Methodology VM0007: REDD Methodology Modules (REDD-MF)	1.5
Methods for Monitoring of GHG Emissions and Removals (M-MON)	2.1
Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry, and Other Land Use (AFOLU) Project Activities (T-ADD)	3.0
Estimation of Uncertainty for REDD Project Activities (X-UNC)	2.1
Methods for Stratification of the Project Area (X-STR)	1.1
Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions From Planned Deforestation and Planned Degradation (BL-PL)	1.2
Estimation of Emissions From Activity Shifting for Avoided Planned Deforestation and Planned Degradation (LK-ASP)	1.2
Estimation of emissions from market-effects (LK-ME)	1.1
Estimation of Carbon Stocks in the Above- and Belowground Biomass in Live Tree and Nontree Pools (CP-AB)	1.1
Estimation of Carbon Stocks in the Long-Term Wood Products Pool (CP-W)	1.1
Tool for testing significance of GHG emissions in A/R CDM project activities (T-SIG): This module is used to determine if sources or activities are de minimis based on the contribution of that source or activity to the overall project.	01
Estimation of greenhouse gas emissions from biomass and peat burning (E-BPB)	1.1
AFOLU Non-Permanence Risk Tool	3.2

1.9 Other Programs

Emission Trading Programs and Other Binding Limits: Credit sales will be tracked using the APX[1] registry. Emissions reductions or removals generated by the project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions. Belize currently does not have a national, legally binding limit on greenhouse gas emissions, and there currently is no compliance emissions trading program which accepts REDD credits in Belize.

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 3rd Edition. Gold level validation is proposed based on exceptional biodiversity benefits.

Participation under Other GHG Programs: The project does not participate in any other GHG Program.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The operation of the project activity(s) during this monitoring period, including any information on events that may impact the GHG emission reductions or removals and monitoring

The project has gone forward as planned starting January 2011. FSC certification is in process and expected to be awarded in 2015. No timber has been cut so far. Patrols have occurred and monitoring of aboveground carbon stocks was completed in August 2013. No events have occurred that would impact GHG emission reductions or removals and monitoring.

Leakage and non-permanence risk factors

Leakage monitoring of land clearing for sugarcane development by the agent of deforestation (Gallon Jug Agroindustries) has occurred utilizing remote sensing. A survey of the Gallon Jug Agroindustries on site manager indicated that no fires occurred during the monitoring period. No deforestation related to sugarcane agriculture was detected.

Any other changes (e.g, to project proponent or other entities).

No changes have taken place since project validation. During the monitoring period, the ownership of the property changed from Gallon Jug Agroindustries to The Forestland Group. That change is described in detail in the project design document.

2.2 Deviations

2.2.1 Methodology Deviations

Calculation of Ex Post Emissions from Fuelwood Collection

[1] See https://vcsregistry2.apx.com/

Based on the very low number of people in the community that have access to the project area, the large area of forest available to the community, and the availability of free firewood from the local sawmill, a PRA was not conducted but rather an indisputably conservative assumption regarding the number of fuelwood users and the amount of fuelwood used (described in validated Project Design Document Section 5.4.1). The total emissions predicted using this approach was found to be de minimis and removed from further consideration.

Calculation of Ex Post Emissions from Sustainable Timber Harvest

Based on the very low merchantable volume available on the project area and in the leakage area, rather than measuring, calculating, and monitoring project emissions from selective harvest of timber, an indisputably conservative assumption was made that impacts from timber harvesting could be as much as 3x the emissions found on a nearby property harvesting similar species in a similar manner (Whitman et. al. 1997). Based on that assumption, emissions were calculated (see Project Design Document Section 5.4.1) and found to be de minimis and excluded from further consideration. No timber harvest was observed during the monitoring period. This methodology deviation directly impacts parameter $\Delta C_{P,SelLog,i,t}$.

Palm Allometric Equations

Palm biomass is significant in these systems and palm equations for the three most common palms, cohune (*Attalea cohune*), give-and-take (*Chrysophylla stauracantha*), and botan (*Sabal mauritiiformis*) are included based on equations developed at a neighboring property in 2000 (Brown 2015). This report indicates that data for 15 of each species were collected and measured to develop site specific equations for these three species. The methodology calls for a minimum of 30 individuals to qualify. Based on the close proximity and the exact species match, these equations are considered more appropriate than family level equations from elsewhere despite the low sample size. The data from the study was evaluated and qualifies as representative following the instructions in CP-AB.

Calculation vs. Measurement of Tree Heights

To validate the conservative application of the allometric equations used to predict aboveground tree biomass, tree height to a 10 cm diameter top or to the first branch must be measured. Field observations were attempted using these instructions, but the difficulty in determining first branch or seeing accurately the point of the bole where the diameter was 10 cm made the process unacceptably qualitative. An alternative method was employed by measuring the total height of each tree using a clinometer, and the DBH of each tree with a tape measure then using this information to calculate the height to a 10 cm top using a simple linear taper equation. Smalian's formula was used for calculating volume of a log and then multiplied times the wood density for comparison to the predicted volume from the allometric equation. Since tree bole forms are generally parabaloid rather than neiloid, a simple linear taper equation will underestimate the height of the tree at a 10 cm diameter (Cruz de León and Uranga-Valencia 2013). This provides a conservative estimate of height.

2.2.2 Project Description Deviations

Not applicable

2.3 Grouped Project

Not applicable

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	*Project Forest Cover Benchmark Map*
Data unit:	Ha, minimum mapping unit 1 ha.
Description:	Map showing the location of forest land within the reference region at the beginning of the project crediting period
Source of data:	Remote sensing in combination with GPS data collected during ground-reference.
Value applied:	See map graphic in Section 4.2.
Justification of choice of data or description of measurement methods and procedures applied:	Map accuracy tested and found to be 95.1%. Accuracy by class included in Appendix A. Methods described in Appendix A.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*u*
Data unit:	List of post deforestation land uses.
Description:	The intended use of land deforested either in the project area or leakage area.
Source of data:	Based on the deforestation plan for the baseline.
Value applied:	1 use: sugar cane
Justification of choice of data or description of measurement methods and procedures applied:	According to the methodology the approved baseline deforestation plan defines the post deforestation land use. That land use is the land use monitored in the leakage belt.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*i*
Data unit:	List of strata
Description:	Forest vegetation strata based on statistical analysis described in X-STR.
Source of data:	Remote sensing and inventory data.
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied:	Based on comparison of inventory data permanent plots. Two possible strata (bajo and high forest) were identified and compared, and the statistical difference was too minor to justify separate strata.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*t*
Data unit:	Years
Description:	Number of years in the project.
Source of data:	Minimum number of years required to pass risk assessment is 30 years.
Value applied:	30
Justification of choice of data or description of measurement methods and procedures applied:	Based on methodology and standard and preference of Project Proponent.
Purpose of Data:	Calculation of baseline emissions.
Comment:	Calculations for verification monitoring is based on the monitoriong period of 3 years so *t* is set to 3 for the purposes of this document.

Data Unit / Parameter:	$A_{planned,i}$
Data unit:	Ha
Description:	Total area of planned deforestation over the baseline period for stratum i
Source of data:	Validated deforestation plan.
Value applied:	8240 ha total for 10 years; 3 * 824/year or 2,472 ha for monitoring period.
Justification of choice of data or description of measurement methods and procedures applied:	Based on validated deforestation plan.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$AA_{planned,i,t}$
Data unit:	Ha
Description:	Area of planned deforestation in the project area for stratum *i* at time *t*
Source of data:	Validated deforestation plan.
Value applied:	824 ha/year for 10 years. Three years addressed in this report.
Justification of choice of data or description of measurement methods and procedures applied:	Based on validated deforestation plan.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$A_{Enh,PL,i,t}$
Data unit:	Ha
Description:	Project area in stratum *i* in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario at time *t*; ha
Source of data:	Validated deforestation plan. Three years addressed in this report.
Value applied:	824 ha/year for 10 years.
Justification of choice of data or description of measurement methods and procedures applied:	Based on validated deforestation plan.
Purpose of Data:	Calculation of project emissions.
Comment:	

Data Unit / Parameter:	$D\%_{planned,i,t}$
Data unit:	% year
Description:	Projected annual proportion of land that will be deforested in stratum *i* during year *t*
Source of data:	Validated deforestation plan.
Value applied:	10%/year
Justification of choice of data or description of measurement methods and procedures applied:	Based on validated deforestation plan.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{BSL,planned}$
Data unit:	tCO_2e
Description:	Net greenhouse gas emissions in the baseline from planned deforestation.
Source of data:	Calculated based on equations in Section 4.1.
Value applied:	803,279
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology for planned deforestation
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{BSL,i,t}$
Data unit:	tCO_2e ha-1
Description:	Carbon stock in all pools in the baseline in stratum *I* at time *t*
Source of data:	Calculated based on equations in Section 4.1.
Value applied:	Annual values provided in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology for planned deforestation
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$GHG_{BSL-E,I,t}$
Data unit:	tCO_2e ha-1
Description:	GHG emissions other than from carbon stock change in the baseline in stratum *i* at time *t*
Source of data:	Calculated based on equations in Section 4.1.
Value applied:	Annual values provided in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology for planned deforestation.
Purpose of Data:	Calculation of baseline emissions.
Comment:	Nitrogen fertilizer use and fossil fuel use are conservatively excluded pools in the baseline and project. This parameter only includes biomass burning.

Data Unit / Parameter:	$L\text{-}D_i$
Data unit:	%
Description:	Likelihood of deforestation in strata *i*
Source of data:	Validated deforestation plan.
Value applied:	100%
Justification of choice of data or description of measurement methods and procedures applied:	Based on validated sugarcane plan (Gallon Jug Agroindustries 2010), common practice review, financial additionality comparison with other feasible land use practices, and documentary evidence of planning.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$E_{BiomassBurn,i,t}$
Data unit:	tCO_2e
Description:	Non-CO_2 emissions due to biomass burning that results in deforestation in stratum *i* in year *t* (tCO2e)
Source of data:	Calculated based on equations in Section 4.1.
Value applied:	Annual values provided in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Methods are described in “Estimation of greenhouse gas emissions from biomass burning (E-BPB)”.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$B_{i,t}$
Data unit:	t d.m./ha
Description:	Average aboveground biomass stock before burning stratum *i*, year (t d.m. ha^{-1})
Source of data:	Field inventory
Value applied:	165.8
Justification of choice of data or description of measurement methods and procedures applied:	Inventory described fully elsewhere. Field methods and calculations follow CP-AB and BL-PL following techniques described in Pearson et.al. (2005).
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	GWP_g
Data unit:	tCO_2e
Description:	Global warming potential for gas *g* (tCO2/t gas g)
Source of data:	IPCC https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
Value applied:	310 for nitrous oxide and 21 for methane
Justification of choice of data or description of measurement methods and procedures applied:	Methodology instructions.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$COMF_i$
Data unit:	unitless
Description:	Combustion factor for stratum i (unitless)
Source of data:	Default values in Table 2.6 of IPCC, 2006 (Appendix 2)
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied:	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (ie, a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (ie, intensity and rate of spread). Default values must be updated whenever new guidelines are produced by the IPCC.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$G_{g,i}$
Data unit:	kg t^{-1} d.m. burnt
Description:	Emission factor for stratum i for gas g (kg t^{-1} d.m. burnt)
Source of data:	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Appendix 2: emission factors for various types of burning for CH4 and N2O)
Value applied:	6.8 for CH_4 and 0.2 for N_2O
Justification of choice of data or description	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Appendix 2: emission factors

of measurement methods and procedures applied:	for various types of burning for CH4 and N2O). Default values must be updated whenever new guidelines are produced by the IPCC.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*g*
Data unit:	unitless
Description:	List of greenhouse gases included in analysis
Source of data:	Methodology
Value applied:	CH_4 and N_2O
Justification of choice of data or description of measurement methods and procedures applied:	As indicated in methodology. CO_2 emissions from biomass burning excluded in this analysis, but included in analysis of biomass change as a result of burning.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{AB\_tree,i}$,
Data unit:	tCO_2e ha-1
Description:	Carbon stock in aboveground biomass in trees in the baseline case in stratum *i.*
Source of data:	Field measurements applied with allometric equation published in Pearson et. al. (2005)
Value applied:	Annual values presented in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Computer and spreadsheet software. Additional equipment required for field data collection.
Purpose of Data:	Calculation of baseline emissions.
Comment:	Key variable used to calculate with project carbon stocks

Data Unit / Parameter:	$C_{BB,tree,i}$,
Data unit:	tCO_2e ha-1
Description:	Carbon stock in belowground biomass in trees in the baseline case in stratum *i.*
Source of data:	Field measurements applied at plot level with root to shoot equation

Value applied:	Annual values presented in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Not measured. Calculated based on root to shoot ratio. For belowground biomass, the root-to-shoot ratios indicated in the methodology CP-AB was used which results in a ratio of .24 for plots with a mean aboveground biomass of 125 tons/ha or greater and a ratio of .2 for plots indicating a mean aboveground biomass of less than 125 tons/ha.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{AB\_non\text{-}tree,i}$,
Data unit:	tCO_2e ha-1
Description:	Carbon stock in aboveground biomass in nontrees in the baseline case in stratum *i.*
Source of data:	Dewalt and Chave (2004)
Value applied:	Annual values presented in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Methodology permits use of peer-reviewed literature that is appropriate to the species in the project area or to the geographic region, elevation and precipitation regime in the project area. Data from study areas in Costa Rica and Panama averaged.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{BB,non\text{-}tree,i}$,
Data unit:	tCO_2e ha-1
Description:	Carbon stock in belowground biomass in nontrees in the baseline case in stratum *i.*
Source of data:	Dewalt and Chave (2004)
Value applied:	Annual values presented in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Not measured. Calculated based on root to shoot ratio. For belowground biomass, the root-to-shoot ratios indicated in the methodology CP-AB was used which results in a ratio of .24 for plots with a mean aboveground biomass of 125 tons/ha or greater and a ratio of .2 for plots indicating a mean aboveground biomass of less than 125 tons/ha.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*fj(X,Y)*
Data unit:	Functions return AGB $tree^{-1}$
Description:	Allometric equation for aboveground and belowground biomass. Dry matter estimate is calculated for each tree at each plot within each strata and carried over time. Sum of dry matter estimates generate sum for plot. Mean of plots result in dry matter estimate for project.
Source of data:	Pearson et. al. (2005) and Brown (2015)
Value applied:	The equations used are: Aboveground Tree Biomass: $AGB = 0.2035 * DBH^{2.3196}$ Palm aboveground biomass (AGB) from Brown 2015: Chrysophylla stauracantha : AGB = ((0.8966 * H) – 0.37988) Attalea cohune: AGB = (302.6 * ln(H)) + 276.93) Sabal mauritiiformis: AGB = (302.6 * ln(H)) + 276.93) Belowground Biomass: If AGB is > 125 t/ha then BGB = AGB x .24 else BGB = AGB x .2
Justification of choice of data or description of measurement methods and procedures applied:	Pearson equation was an acceptable fit based on independent test as prescribed in methodology. Allometric validation conducted on equation comparing largest tree at each plot against hypothetical biomass (volume * D) and found to predict 67.5% higher than test and 32.5% lower than hypothetical biomass. Brown (2015) equations developed at contiguous site on the three species in inventory.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*R*
Data unit:	t root d.m. t -1 shoot d.m.
Description:	Root to shoot ratio appropriate to species or forest type / biome.
Source of data:	IPCC GL AFOLU per methodology
Value applied:	.24 when 125 tons/ha AGB or greater is indicated and .2 when less than 125 tons/ha.

Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$D_{,tree}$
Data unit:	g/cm^3
Description:	Density of dry wood for each species
Source of data:	Published source; Zanne et. al. 2009.
Value applied:	See database of tree measurements.
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology to test allometric equations. Must be reviewed at baseline reset.
Purpose of Data:	Calculation of baseline emissions.
Comment:	D was applied using the reference in all but 22 trees in the initial inventory. If the species was listed from Mexico or Central America (CA) that value was used. If there were multiple values, they were averaged. If values weren't available from Mexico/CA then the South America values were used, again averaging if necessary. If the species wasn't available, the Genus was averaged. If the Genus wasn't available, the Family was averaged. The decision criteria in order of precedence: 1. Species-M,CA 2. Species-SA 3. Genus-M,CA 4. Genus-SA 5. Family-M,CA 6. Family-SA Trees where D could not be determined were assigned a value of .651 based on the lower 95% confidence limit of the mean of the remaining trees that could be identified, weighted by frequency. Weighting by frequency is employed to take into account the patchy nature of tree distribution that is evident in the inventory data, and the presumption that unidentified trees are most likely to be species already identified elsewhere in the inventory.

Data Unit / Parameter:	D_{mn}
Data unit:	g/cm^3
Description:	Mean wood density of commercially harvested species.
Source of data:	Published source; Zanne et. al. (2009). Used mean of D for

	commercial species listed in sustainable forest management plan (Cho 2007) and found in inventory.
Value applied:	0.712
Justification of choice of data or description of measurement methods and procedures applied:	Required by methodology. See parameter $D_{,tree}$ for explanation of data priorities.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*CF*
Data unit:	t C t-1 d.m.
Description:	Carbon fraction of dry matter
Source of data:	
Value applied:	.47
Justification of choice of data or description of measurement methods and procedures applied:	Based on published value (IPCC 2006).
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$Ht_{,tree,i,}$
Data unit:	meters
Description:	Height of the tree from the ground based on measurements with a clinometer or other device. See monitoring plan for field methods.
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:	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.
Purpose of Data:	Calculation of baseline emissions.
Comment:	This variable is collected, but not necessary for allometric equation used. This variable is used to validate the allometric equation.

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. See procedures for measurement in the monitoring plan.
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.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$SLFt_y$
Data unit:	Fraction of wood products that will be emitted to the atmosphere within 5 years of production by class of wood product.
Description:	Winjum et. al. (1998) give the following proportions for wood products with short-term (<5 yr) uses after which they are retired and oxidized (applicable internationally). In Belize there are no markets for products other than Sawnwood therefore SLF = 0.2 as indicated.
Source of data:	CP-W 1.1 and Winjum et. al. (1998).
Value applied:	0.2
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	OF_{ty}
Data unit:	dimensionless
Description:	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product ty; dimensionless
Source of data:	CP-W 1.0 methodology
Value applied:	0.84
Justification of choice of data or description	Winjum et al. (1998) gives annual oxidation fractions for each class of wood products split by forest region (boreal, temperate and tropical).

of measurement methods and procedures applied:	This methodology projects these fractions over 95 years to give the additional proportion (OF value) that is oxidized between the 5th and 100th years after initial harvest. Based on sawnwood and tropical regions, the value provided is .84.
Purpose of Data:	Calculation of baseline emissions.
Comment:	Note that this parameter was inadvertently omitted in CP-W 1.1 and the value from CPW 1.0 is used.

Data Unit / Parameter:	*WWty*
Data unit:	WW = Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood product ty
Description:	Winjum et al. (1998) indicate that the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 19% for developed countries, 24% for developing countries. WW is therefore equal to 0.24 for Belize.
Source of data:	CP-W 1.1 and Winjum et. al. (1998).
Value applied:	.24
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*ty*
Data unit:	Class of wood product
Description:	Per CP-W methodology classes are defined as sawnwood, wood-based panels, other industrial roundwood, paper and paper board, and other.
Source of data:	CP-W 1.1
Value applied:	sawnwood
Justification of choice of data or description of measurement methods and procedures applied:	Based on inspection of the mill and sales records only one product class can be produced.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	G_{gi}
Data unit:	g kg^{-1} dry matter burnt
Description:	Emission factor for stratum *i* for gas *g*,

Source of data:	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Annex 2: emission factors for various types of burning for CH_4 and N_2O).
Value applied:	6.8 for CH_4 and .2 for N_2O
Justification of choice of data or description of measurement methods and procedures applied:	Methodology requirement.
Purpose of Data:	Calculation of baseline emissions.
Comment:	Default values shall be updated whenever new guidelines are produced by the IPCC

Data Unit / Parameter:	$C_{XB,i}$
Data unit:	tCO_2e ha-1
Description:	Mean stock of extracted biomass carbon by class of wood product ty from stratum i; tCO_2e ha-1
Source of data:	Calculated in CP-W based on merchantable volume estimated on project area from inventory.
Value applied:	10.64
Justification of choice of data or description of measurement methods and procedures applied:	Best available data is recent inventory. Merchantability standards and species based on sustainable forest management plan that is the basis for license to sell timber from property. BCEF based on methodology default. $Pcom_i$ based on commercial volume percentage of total volume.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{XB,ty,i}$
Data unit:	$tCO_2e\ ha^{-1}$
Description:	Mean stock of extracted biomass carbon by class of wood product *ty* from stratum i; $tCO_2e\ ha^{-1}$
Source of data:	Methodology default
Value applied:	10.64
Justification of choice of data or description of measurement methods and procedures applied:	Stock of extracted biomass based on inventory data, and merchantability standards in sustainable forest management plan. Presumes only one product, sawnwood, based on mill capabilities and sales records.

Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{WP,i}$
Data unit:	$tCO_2e\ ha^{-1}$
Description:	Carbon stock entering the wood products pool from stratum i; $tCO_2e\ ha^{-1}$
Source of data:	Calculated in CP-W based on merchantable volume estimated on project area from inventory.
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Best available data is recent inventory. Merchantability standards and species based on sustainable forest management plan that is the basis for license to sell timber from property. WWty based on methodology default.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{WP,i,t}$
Data unit:	$tCO_2e\ ha^{-1}$
Description:	Carbon stock entering the wood products pool from stratum i; $tCO_2e\ ha^{-1}$ in year t
Source of data:	Calculated in CP-W based on merchantable volume estimated on project area from inventory.
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Best available data is recent inventory. Merchantability standards and species based on sustainable forest management plan that is the basis for license to sell timber from property. WWty based on methodology default.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$C_{WP100,i}$
Data unit:	$tCO_2e\ ha^{-1}$

Description:	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i; $tCO_2e\ ha^{-1}$
Source of data:	Calculated in CP-W based on merchantable volume estimated on project area from inventory.
Value applied:	8.09
Justification of choice of data or description of measurement methods and procedures applied:	Best available data is recent inventory. Merchantability standards and species based on sustainable forest management plan that is the basis for license to sell timber from property. SLF_{ty} and OF_{ty} based on methodology defaults.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	*BCEF*
Data unit:	unitless
Description:	Biomass conversion and expansion factor (BCEF) for conversion of merchantable volume to total aboveground tree biomass; dimensionless
Source of data:	Methodology default
Value applied:	2.8
Justification of choice of data or description of measurement methods and procedures applied:	BCEF from IPCC 2006 is 4 (humid tropical forests with commercial volumes from 11-20 based on inventory data: 11.09 m3/ha).
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$Pcom_i$
Data unit:	dimensionless
Description:	Commercial volume as a percent of total aboveground volume in stratum i; dimensionless
Source of data:	Methodology default
Value applied:	10.42%
Justification of choice of data or description of measurement methods and	$Pcom_i$ is based on the ratio of total commercial volume to aboveground tree volume based on inventory data.

procedures applied:	
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$\Delta C_{BSL,i,t}$
Data unit:	tCO_2e ha-1
Description:	Net greenhouse gas emissions in the baseline from planned deforestation in stratum *i* in year *t* (tCO2e)
Source of data:	Calculated based on inventory data and project plan using multiple methodologies.
Value applied:	Annual values presented in Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology for planned deforestation
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$\Delta C_{pools,Def,u,i,t}$
Data unit:	tCO_2e ha-1
Description:	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; tCO2-e ha-1
Source of data:	Remote sensing and inventory data.
Value applied:	312.9
Justification of choice of data or description of measurement methods and procedures applied:	Formula and parameters provided in section 4.2.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	$C_{P,post,u,i}$
Data unit:	tCO_2e ha-1
Description:	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; tCO2-e ha-1

Source of data:	Literature
Value applied:	49.6
Justification of choice of data or description of measurement methods and procedures applied:	Formula and parameters provided in section 4.2.
Purpose of Data:	Calculation of baseline emissions.
Comment:	

Data Unit / Parameter:	$\Delta C_{P,Deg,i,t}$
Data unit:	tCO_2e ha-1
Description:	Net carbon stock change as a result of degradation in the project area in the project case in stratum i at time t; tCO_2e
Source of data:	Calculated based on indisputably conservative assumptions.
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Based on indisputably conservative assumptions, these pools are de minimis.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	$\Delta C_{P,DegW,i,t}$
Data unit:	tCO_2e ha-1
Description:	Net carbon stock change as a result of degradation through extraction of trees for illegal timber or fuelwood and charcoal in the project area in the project case in stratum i at time t; tCO_2e
Source of data:	Calculated based on indisputably conservative assumptions.
Value applied:	0 tCO_2e/ha
Justification of choice of data or description of measurement methods and procedures applied:	Based on indisputably conservative assumptions, this pool is de minimis.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	$A_{DegW,i}$
Data unit:	ha
Description:	Area potentially impacted by degradation processes in stratum i; ha
Source of data:	Conservative assumption that entire project area is available for fuelwood collection.
Value applied:	8240 ha
Justification of choice of data or description of measurement methods and procedures applied:	Indisputably conservative assumption. In fact the community has little to no access to the project area.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	A_{Pi}
Data unit:	ha
Description:	Total area of degradation sample plots in stratum i; ha.
Source of data:	This part of the analysis is based on assumptions from the literature rather than measurement.
Value applied:	0 ha
Justification of choice of data or description of measurement methods and procedures applied:	Indisputably conservative assumption.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	$\Delta C_{P,SelLog,i,t}$
Data unit:	tCO_2e
Description:	Net carbon stock change as a result of degradation through selective logging of FSC certified forest management areas in the project area in the project case in stratum i at time t; tCO_2e
Source of data:	Calculated based on indisputably conservative assumptions.
Value applied:	30,262
Justification of choice of data or description of measurement	Based on indisputably conservative assumptions, this pool is de minimis.

methods and procedures applied:	
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	$C_{LG,i,t} + C_{LR,i,t}$
Data unit:	tCO_2e
Description:	Actual (projected) net project emissions arising in the logging gap in stratum i at time t; tCO_2e plus actual (projected) net project emissions arising from logging infrastructure in stratum i at time t; tCO_2e. The difference between $C_{LG,i,t}$ and $C_{LR,i,t}$ is not easily defined in Whitman et. al. (1997) but the combination of the two can be extrapolated.
Source of data:	Total damage estimate from Whitman et. al. (1997) of 4.8% x 3 to result in indisputably conservative assumption.
Value applied:	0 tCO_2e
Justification of choice of data or description of measurement methods and procedures applied:	Based on indisputably conservative assumptions, this pool is de minimis. No harvesting occurred during the monitoring period.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	$C_{tree,I,t}$
Data unit:	tCO_2e ha-1
Description:	Total AGBtree in tCO_2e
Source of data:	Total damage estimate from Whitman et. al. (1997) of 4.8% x 3 to result in indisputably conservative assumption.
Value applied:	0 tCO_2e
Justification of choice of data or description of measurement methods and procedures applied:	This is a derivative value based on other parameters. No harvesting occurred during the monitoring period.
Purpose of Data:	Calculation of project emissions
Comment:	

Data Unit / Parameter:	*ag*
Data unit:	unitless
Description:	Number of agents of deforestation
Source of data:	Deforestation plan (Gallon Jug Agroindustries 2010)
Value applied:	1: Gallon Jug Agroindustries
Justification of choice of data or description of measurement methods and procedures applied:	Per methodology, based on deforestation plan.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	$HistHa_{i,ag}$
Data unit:	ha
Description:	Number of hectares of forest cleared by the baseline agent of the planned deforestation in the five years prior to project implementation in stratum i by agent ag within the country.
Source of data:	Remote sensing
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Based on deforestation analysis performed using remote sensing analysis described in Appendix A.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	*LDF*
Data unit:	$t\ C\ m^{-3}$
Description:	Factor for calculating the biomass of dead wood created during logging operations per cubic meter extracted
Source of data:	Default value provided
Value applied:	Default value for broadleaf and mixed forests of 0.53 $t\ C\ m^{-3}$
Justification of choice of data or description	Default value for broadleaf and mixed forests of 0.53 $t\ C\ m^{-3}$ from 774 logging gaps measured by Winrock International in Bolivia, Belize, the

of measurement methods and procedures applied:	Republic of Congo, Brazil and Indonesia.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	*LIF*
Data unit:	$t\ C\ m^{-3}$
Description:	Factor for calculating the emissions arising from the creation of logging infrastructure (roads, skid trails and decks) during logging operations per cubic meter extracted
Source of data:	Default value provided
Value applied:	Conservative default value of 0.29 $tCO_2e\ m^{-3}$
Justification of choice of data or description of measurement methods and procedures applied:	Conservative default value of 0.29 $tCO_2e\ m^{-3}$ calculated from 1,839 hectares of logging concessions analysed by Winrock International in the Republic of Congo and Brazil.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	LF_{ME}
Data unit:	dimensionless
Description:	Leakage factor for market effects calculations.
Source of data:	Default value based on the proportion of total biomass in commercial species that is merchantable (PML_{FT}) compared to mean proportion of total biomass that is merchantable in each forest type (PMP).
Value applied:	.4
Justification of choice of data or description of measurement methods and procedures applied:	LF_{ME} is .4 when PMLFT is equal to +/- 15% compared to PMP. In this case there is just one merchantable forest type since of the two forest types on the project area, the bajo type is excluded from the forest license. Therefore the comparison yields a 0% difference between PM_{LFT} and PMP.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	PML_{ft}
Data unit:	dimensionless
Description:	The mean proportion of total biomass that is merchantable for each forest type.
Source of data:	Default value based on the proportion of total biomass in commercial species that is merchantable (PML_{FT}) compared to mean proportion of

	total biomass that is merchantable in each forest type (PMP).
Value applied:	.4
Justification of choice of data or description of measurement methods and procedures applied:	LF_{ME} is .4 when PMLFT is equal to +/- 15% compared to PMP. In this case there is just one merchantable forest type since of the two forest types on the project area, the bajo type is excluded from the forest license. Therefore the comparison yields a 0% difference between PM_{LFT} and PMPi.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	LK_{MAF}
Data unit:	Leakage management adjustment factor
Description:	If the leakage management areas produce an amount equal or higher than the expected baseline production of biomass in commercial species that is merchantable, leakage shall be assumed to be zero. In order to apply this factor, project proponents need to demonstrate the production of the volume biomass in commercial species that is merchantable used to estimate this deduction, as well as evidence that such biomass has reached the relevant regional/national markets. Any increase in GHG emissions associated with the leakage management activities shall be accounted for, unless deemed de minimis or conservatively excluded.
Source of data:	No leakage management areas have been established.
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied:	Conservative default applied.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	$PRODMB_{BL,t}$
Data unit:	tons per year
Description:	Production of biomass in commercial species that is merchantable in year *t* in the baseline case (t per year)
Source of data:	Based on inventory data
Value applied:	74,076
Justification of choice of data or description of measurement methods and	Best available data from inventory and commercial criteria from Cho (2007) cutting diameter and commercial species list.

procedures applied:	
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	$PRODMB_{LMA,t}$
Data unit:	tons per year
Description:	Production biomass in commercial species that is merchantable in year t in leakage management areas (t per year).
Source of data:	Project proponent.
Value applied:	Since no leakage management areas have been established this is set to 0.
Justification of choice of data or description of measurement methods and procedures applied:	Conservative default applied.
Purpose of Data:	Calculation of leakage emissions.
Comment:	

Data Unit / Parameter:	$V_{BSL,EX,i,t}$
Data unit:	m^3
Description:	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum *i* in year *t*
Source of data:	Based on inventory data.
Value applied:	19,348
Justification of choice of data or description of measurement methods and procedures applied:	Estimates from inventory are highest priority data source if timber harvest records are unavailable.
Purpose of Data:	Calculation of leakage emissions.
Comment:	Gross AGB used.

Data Unit / Parameter:	*Species List*
Data unit:	Species
Description:	List of detected species known to occur on the site.
Source of data:	Pictures, acoustic recordings, tracks, observations by trained observers.
Value applied:	Presence/Absence
Justification of choice	Must be monitored at least every 5 years or if verification occurs on a

of data or description of measurement methods and procedures applied:	frequency of less than every 5 years examination must occur prior to any verification event.
Purpose of Data:	Used to determine biodiversity impacts.
Comment:	Species list developed by Miller and Miller (2011)

3.2 Data and Parameters Monitored

Data Unit / Parameter:	*Project Forest Cover Monitoring Map*
Data unit:	Ha: minimum mapping unit 1 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 reference.
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 reference 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, and high resolution imagery verification.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Comment:	If stratification is required in the future, then new strata will be identified using module X-STR.

Data Unit / Parameter:	$A_{DefPA,i,t}$
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	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.

applied:	
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.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Comment:	

Data Unit / Parameter:	$A_{DefLK,i,t}$
Data unit:	Ha
Description:	Area of recorded deforestation by the baseline agent of deforestation in Belize 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 (30 meter 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:	Field observations where possible. Spot check with higher resolution imagery if available.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Head's up delineation using GIS and landsat imagery (30 meter or higher resolution) using multiple images to get a cloud free image.
Comment:	

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.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Comment:	

Data Unit / Parameter:	$E_{BiomassBurn,i,t}$
Data unit:	tCO_2e
Description:	Non-CO_2 emissions due to biomass burning that results in deforestation in stratum *i* in year *t* (tCO2e)
Source of data:	Calculated based on module EBPB
Description of measurement methods and procedures to be applied:	Remote sensing. Methods described in monitoring plan. Calculations based on module "Estimation of greenhouse gas emissions from biomass burning (E-BPB)".
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.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Calculated parameter.
Comment:	

Data Unit / Parameter:	$B_{i,t}$
Data unit:	tCO_2e/ha
Description:	Average aboveground biomass stock before burning stratum i, year (t d.m. ha-1)
Source of data:	Field inventory and remote sensing.
Description of measurement methods and procedures to be	Field measurements applied with allometric equation published in Pearson et. al. (2005). Remote sensing procedures described in monitoring plan.

applied:	
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:	165.8
Monitoring equipment:	Computer and appropriate analytical software.
QA/QC procedures to be applied:	AGB is a calculated parameter. Input variables (DBH and HT) are checked by independent audit at verification events.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Inventory described fully elsewhere. Field methods and calculations follow CP-AB and BL-PL following techniques described in Pearson et.al. (2005).
Comment:	

Data Unit / Parameter:	ΔC_P
Data unit:	tCO_2e
Description:	Net greenhouse gas emissions within the project area under the project scenario; tCO_2e
Source of data:	Calculated parameter at verification described in Section 4.2
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.2
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$\Delta C_{pools,Def,u,i,t}$
Data unit:	tCO_2e ha-1
Description:	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; tCO2-e ha-1
Source of data:	Remote sensing and inventory data.
Description of measurement methods and	Calculated parameter. See equations in Section 4.2

procedures to be applied:	
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Formula and parameters provided in section 5.6.
Comment:	

Data Unit / Parameter:	$\Delta C_{P,DefPA,i,t}$
Data unit:	tCO_2e
Description:	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; tCO_2e
Source of data:	Remote Sensing
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.2
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$\Delta C_{P,DefLB,i,t}$
Data unit:	tCO_2e
Description:	Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum i at time t; tCO2-e
Source of data:	Remote Sensing and inventory plots.
Description of measurement methods and procedures to be	Calculated parameter. See equations in Section 4.2

applied:	
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$A_{DefPA,u,i,t}$
Data unit:	ha
Description:	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha
Source of data:	Remote Sensing
Description of measurement methods and procedures to be applied:	See remote sensing methods in Monitoring Plan Section 3.2.
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$A_{DefLB,u,i,t}$
Data unit:	ha
Description:	Area of recorded deforestation in the leakage belt stratum *i* converted to land use *u* at time *t*; ha.
Source of data:	Remote Sensing
Description of measurement methods and procedures to be applied:	See remote sensing methods in Monitoring Plan Section 3.2.

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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of leakage emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$\Delta C_{P,DistPA,i,t}$
Data unit:	tCO_2e
Description:	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* at time *t*; tCO_2e
Source of data:	Remote Sensing
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.2
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$GHG_{P-E,i,t}$
Data unit:	tCO_2e
Description:	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; tCO_2e
Source of data:	Remote Sensing
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.2

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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on equation in Section 4.2
Comment:	

Data Unit / Parameter:	$\Delta C_{P,Enh,i,t}$
Data unit:	tCO_2e
Description:	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in stratum *i* at time *t*; tCO_2e
Source of data:	Remote sensing and inventory data.
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.2
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:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on difference between biomass since baseline reset or previous monitoring period.
Comment:	$\Delta C_{P,Enh,i,t}$ will capture growth in biomass if evident from inventory remeasurement in future monitoring events. No emissions reductions are claimed for $\Delta C_{P,Enh,i,t}$ in this monitoring period.

Data Unit / Parameter:	$C_{P,i,t}$
Data unit:	tCO_2e
Description:	Carbon stock in all pools in the project case in stratum *i* at time *t*; tCO2-e
Source of data:	Remote sensing and inventory data.
Description of measurement	Calculated parameter. See equations in Section 4.2

methods and procedures to be applied:	
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:	49.62
Monitoring equipment:	Calculated
QA/QC procedures to be applied:	Calculated
Purpose of Data:	Calculation of project emissions.
Calculation method:	Equation and parameters described in Section 4.2
Comment:	

Data Unit / Parameter:	$A_{distPA,q,I,t}$
Data unit:	Ha
Description:	Area impacted by natural disturbance in the project stratum i converted to natural disturbance stratum q at time t; ha *(if any occurs)*
Source of data:	Remote Sensing imagery combined with ground verification or GPS coordinates. Minimum monitoring unit shall be equal to a minimum of 11 Landsat pixels or one hectare.
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. Field equipment for plot measurements and GPS for ground level confirmation.
QA/QC procedures to be applied:	Remeasurement of permanent plots.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Head's up delineation using GIS and landsat imagery (or higher resolution) using multiple images to get a cloud free image.
Comment:	

Data Unit / Parameter:	$C_{AB\_tree,i}$
Data unit:	tCO_2e 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:	See Table 4 values.
Monitoring equipment:	Computer and spreadsheet software. Additional equipment required for field data collection.
QA/QC procedures to be applied:	Independent 3rd party audit of field measurements utilizing remeasurement of a sample of plots.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Calculation method follows Pearson et. al. 2005.
Comment:	Key variable used to calculate with project carbon stocks

Data Unit / Parameter:	$C_{BB\_tree,i}$,
Data unit:	tCO_2e ha-1
Description:	Carbon stock in belowground biomass in trees in the project case in stratum *i.*
Source of data:	Field measurements applied with root to shoot equation
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:	See Table 4 for values.
Monitoring equipment:	Computer and spreadsheet software. Additional equipment required for field data collection.
QA/QC procedures to be applied:	Independent 3rd party audit of field measurements utilizing remeasurement of a sample of plots.
Purpose of Data:	Calculation of project emissions.
Calculation method:	For belowground biomass, the root-to-shoot ratios indicated in the methodology CP-AB was used which results in a ratio of .24 for plots indicating a mean aboveground biomass of 125 tons/ha or greater and a ratio of .2 for plots indicating a mean aboveground biomass of less than 125 tons/ha.
Comment:	Key variable used to calculate with project carbon stocks

Data Unit / Parameter:	A_{sp}
Data unit:	ha
Description:	Area of sample plots in ha
Source of data:	Recording and archiving of number and size of sample plots
Description of measurement methods and procedures to be applied:	Per field technique (Pearson et. al. 2005). Plot areas (diameter) are measured at each plot at each inventory. Inventory remeasurement is required at baseline renewal.
Frequency of monitoring/recording:	Verification plan calls for reinventory no less frequently than every five years. QA/QC is addressed by periodic third party verification audits.
Value applied:	40 nested plots. Each plot consists of three fixed radius plots 4 m, 14 m, and 20 m. Subplot area based on ($\pi * r^2$) is .005024 ha for the 4m plot, .061544 ha for the 14m plot, and .1256 ha for the 20 m plot.
Monitoring equipment:	Tape measure or similar device
QA/QC procedures to be applied:	Plot diameters are independently confirmed at verification audits.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Direct measurement of plot radius. Area = pi * radius^2
Comment:	

Data Unit / Parameter:	*N*
Data unit:	unitless
Description:	Number of sample points
Source of data:	Recording and archiving of number and size of sample plots
Description of measurement methods and procedures to be applied:	Direct count.
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:	40
Monitoring equipment:	None required
QA/QC procedures to be applied:	QA/QC is addressed by periodic third party verification audits. Based on the field inventory variability, the number of plots is considered adequate using module X-UNC.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Based on power analysis conducted on data from Cho (2007) by Teets et. al. (2012).
Comment:	The number and location of plots may change in the future if a plot location becomes unreachable or hazardous to field crews. Justification for any changes must be documented and explained.

Data Unit / Parameter:	$Ht_{,tree,i,}$
Data unit:	Meters
Description:	Height of the tree from the ground
Source of data:	Field measurements
Description of measurement methods and procedures to be applied:	See procedures for measurement in the monitoring plan (Section 3.2).
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:	Clinometer, tape, or equivalent
QA/QC procedures to be applied:	A subset of heights are remeasured at verification audits.
Purpose of Data:	Calculation of project emissions.
Calculation method:	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.
Comment:	This variable is collected, but not necessary for allometric equation used. This variable is used to validate the allometric equation.

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 procedures for measurement in the monitoring plan (Section 3.2).
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 baseline tree measurements.
Monitoring equipment:	Diameter tape incremented in centimeters. 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.
Purpose of Data:	Calculation of project emissions.
Calculation method:	Direct observation.

Comment:	Key variable used to calculate with project carbon stocks

Data Unit / Parameter:	$\Delta C_{LK\text{-}AS,planned,E,i,t}$
Data unit:	tCO_2e
Description:	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation; tCO_2e
Source of data:	Calculated from $LKA_{planned,i,t}$, $\Delta C_{BSL,I,}$ and $GHG_{LK,E,i,t}$ per formula in LK-ASP
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.3
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:	Remote sensing
QA/QC procedures to be applied:	Confirmation by interpretation of high resolution image such as Rapid Eye.
Purpose of Data:	Calculation of leakage emissions.
Calculation method:	Method for preprocessing, and analysis described in monitoring plan.
Comment:	

Data Unit / Parameter:	$LKA_{planned,i,t}$
Data unit:	ha
Description:	The area of activity shifting leakage in stratum i at time t; ha
Source of data:	Remote sensing.
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:	Remote sensing
QA/QC procedures to be applied:	Confirmation by interpretation of high resolution image such as Rapid Eye.
Purpose of Data:	Calculation of leakage emissions.
Calculation method:	Method for preprocessing, and analysis described in monitoring plan.
Comment:	

Data Unit / Parameter:	$GHG_{LK,E,i,t}$
Data unit:	tCO_2e
Description:	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t (tCO_2e)
Source of data:	Summation of emissions from biomass burning. Area data for biomass burning derived from remote sensing.
Description of measurement methods and procedures to be applied:	Calculated parameter. See equations in Section 4.3
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:	Remote sensing
QA/QC procedures to be applied:	Based on area and biomass estimates developed in other parameters.
Purpose of Data:	Calculation of leakage emissions.
Calculation method:	As indicated in methodology module LK-ASP.
Comment:	

Data Unit / Parameter:	*Species List*
Data unit:	Species
Description:	List of detected species known to occur on the site.
Source of data:	Pictures, acoustic recordings, tracks, observations by trained observers.
Description of measurement methods and procedures to be applied:	Observations made at CCB verification audit events using remote cameras, acoustic recordings, and transects. Anecdotal observations recorded during normal operations of project.
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:	Presence/Absence
Monitoring equipment:	Remotely triggered cameras, binoculars, camera.
QA/QC procedures to be applied:	None required.
Purpose of Data:	Monitoring biodiversity on project area.

Calculation method:	No calculation required.
Comment:	

Data Unit / Parameter:	*Contributions to Gallon Jug-Chan Chich High School Scholarship Fund*
Data unit:	BZ dollars
Description:	Documentation of donations.
Source of data:	Written receipts.
Description of measurement methods and procedures to be applied:	Recording the receipts will indicate compliance with the CCB community benefits 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:	CCB community plan is not being verified at this time.
Monitoring equipment:	None required.
QA/QC procedures to be applied:	None required.
Purpose of Data:	Monitor community benefits plan.
Calculation method:	Simple sum of contributions.
Comment:	

Data Unit / Parameter:	*Observations of biodiversity species s at time t and location l*
Data unit:	observation
Description:	Observations of biodiversity
Source of data:	Based on camera traps or anecdotal observations (visual, auditory, or tracks) by field crews.
Description of measurement methods and procedures to be applied:	Observations made at CCB verification audit events using remote cameras, acoustic recordings, and transects. Anecdotal observations recorded during normal operations of project.
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:	Presumption is that current list of animal species will continue to occur at the project throughout the life of the project.
Monitoring equipment:	Remotely triggered cameras, binoculars, camera.
QA/QC procedures to be applied:	Observations without documentary evidence should only be recorded if observer is qualified and experienced.
Purpose of Data:	To provide updates to Species List.
Calculation method:	None required.

Comment:	

3.3 Monitoring Plan

The overall objective of the monitoring plan is to detect any changes in project emissions or carbon stock enhancement. In addition, carbon stock changes must be monitored prior to baseline revision. Potential sources of leakage and other GHG emissions will also be monitored. Community and biodiversity benefits will be monitored no less frequently than every 5 years, however the intent is to monitor these benefits at each verification. The purpose of monitoring is to insure that the benefits of the project are produced as expected.

3.3.1 Monitoring of actual carbon stock changes and greenhouse gas emissions

a) *Technical description of the monitoring task.*

Monitoring of the project, all variables, will occur no less often than every 5 years. At each monitoring event M-MON and supporting methodologies will be used to determine the emissions and carbon sequestration that have occurred during the monitoring period.

At each verification, forest cover will be monitored. Monitoring is intended to detect natural and anthropomorphic impacts that would materially and significantly impact the climate benefits of the project. Above- and belowground biomass stock estimates are valid in the baseline (i.e. treated as constant) for 10 years, after which they must be re-estimated from new field measurements. For each stratum, where the re-measured estimate is within the 90% confidence interval of the t=0 estimate, the t=0 stock estimate takes precedence and is re-employed, and where the re-measured estimate is outside (i.e. greater than or less than) the 90% confidence interval of the t=0 estimate, the new stock estimate takes precedence and is used for the subsequent period.

To accomplish these objectives, 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 reference for the mapping work. Plots will be remeasured as required to support baseline revision.

Degradation related to timber harvest and fuelwood collection is expected to be de minimis during the baseline period and subsequent periods. A PRA in the community will be conducted at each monitoring interval to confirm this assumption in regards to fuelwood collection. Sales records will be retained and reviewed to confirm that timber harvest is also de minimis during the monitoring period. If these sources of emissions are determined to exceed the de minimis threshold, then the M-MON module will be employed to further document and monitor the sources.

b) *Data to be collected.*

The net carbon stock change as a result of deforestation is equal to the area deforested multiplied by the emission per unit area. The following equations and parameters will be used to determine changes in carbon stocks during a monitoring period:

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

Where:

Parameter	Description
ΔC_P	Net greenhouse gas emissions within the project area under the project scenario; tCO_2e
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; tCO_2e
$\Delta C_{P,Deg,i,t}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* at time *t*; tCO_2e: This source of emissions was found to be de minimis and will not be monitored.
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* at time *t*; tCO_2e
$GHG_{P-E,i,t}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; tCO_2e
$\Delta C_{P,Enh,i,t}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in stratum *i* at time *t*; tCO_2e
i	1, 2, 3 …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity

For the leakage belt the net greenhouse gas emissions in the project case will be equal to the sum of stock changes due to deforestation in the leakage belt. The leakage belt consists of 40,177.7 ha of forest owned by the agent of deforestation, Gallon Jug Agroindustries, at project start in 2011.

$$\Delta C_{P,LB} = \sum_{t=1}^{t} \sum_{i=1}^{M} \Delta C_{P,DefLB,i,t}$$

Parameter	Description
$\Delta C_{P,LB}$	Net greenhouse gas emissions in the leakage belt in the project case; t CO_2-e

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

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

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

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

Where:

Parameter	Description
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; tCO_2e
$\Delta C_{P,DefLB,i,t}$	Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum *i* at time *t*; t CO_2-e
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha
$A_{DefLB,u,i,t}$	Area of recorded deforestation in the leakage belt stratum *i* converted to land use *u* at time *t*; ha: note this parameter is equivalent in this case to $LKA_{planned,i,t}$ and therefore activity shifting leakage will be handled using module LK-ASP and the derived value $\Delta C_{LK\text{-}AS,planned}$.
$\Delta C_{pools,Def,u,i,t}$	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; t CO_2-e ha-1
u	*1,2,3,…U* post-deforestation land uses; in this case, only one post-deforestation land use, sugar cane agriculture.
i	1, 2, 3 …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity

The emission per unit area will be equal to the difference between the stocks before and after deforestation minus any wood products created from timber extraction in the process of deforestation:

$$\Delta C_{pools,Def,i,t} = C_{BSL,i} - C_{P,post,i} - C_{WP,i}$$

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

For each post-deforestation land use (u), the long-term carbon stock will be estimated. Carbon stocks in the selected pools (must be the same as those used in the baseline modules) must be measured and estimated using the methods given in modules CP-AB, CP-D, CP-L, and/or CP-S.

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

Parameter	Description
$C_{P,post,u,i}$	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; t CO_2-e ha-1
$C_{AB\_tree,i}$	Carbon stock in all pools in the baseline case in stratum *i*; t CO_2-e ha-1
$C_{BB\_tree,i}$	Carbon stock in belowground tree biomass in stratum *i*; t CO_2-e ha-1
$C_{AB\_non\text{-}tree,i,i}$	Carbon stock in aboveground nontree vegetation in stratum *i*; t CO_2-e ha-1; excluded from project and accounted as 0.
$C_{BB\_non\text{-}tree,i}$	Carbon stock in belowground nontree vegetation in stratum *i*; t CO_2-e ha-1;

	excluded from project and accounted as 0.
$C_{DW,i}$	Carbon stock in dead wood in stratum *i*; t CO_2-e ha-1; excluded from project and accounted as 0.
$C_{LI,i}$	Carbon stock in litter in stratum *i*; t CO_2-e ha-1; excluded from project and accounted as 0.
$C_{SOC,PD\text{-}BSL,i}$	Mean post-deforestation stock in soil organic carbon in the post deforestation stratum *i*; t CO_2-e ha-1; excluded from project and accounted as 0.
u	*1,2,3,…U* post-deforestation land uses; in this case, only one post-deforestation land use, sugar cane agriculture.
i	1, 2, 3 …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity

If carbon stock enhancement is observed based on monitoring data the following equation and parameters will be used:

$$\Delta C_{P,Enh,i,t} = \sum_{t=1}^{t}\sum_{i=1}^{M}\left(\left(C_{P,i,t} - C_{BSL,i}\right) * A_{Enh,PL,i,t}\right)$$

Where:

Parameter	Description
$\Delta C_{P,Enh,i,t}$	Net carbon stock changes as a result of forest carbon stock enhancement in stratum *i* in the project area at time *t*; t CO_2-e
$C_{P,i,t}$	Carbon stock in all pools in the project case in stratum *i* at time *t*; t CO_2-e
a $C_{BSL,i}$	Carbon stock in all pools in the baseline in stratum *i*; t CO_2-e ha-1
$A_{Enh,PL,i,t}$	Project area in stratum *i* in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario at time *t*; ha
$A_{Enh,PL,i,t} = D\%_{planned,i,t} * A_{planned,i,t}$ *i*	1, 2, 3 …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity

nd
where
:

Parameter	Description
$A_{Enh,PL,i,t}$	Project area in stratum *i* in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario at time *t*; ha

$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum *i* at time *t*; %
$A_{planned,i,}$	Total area of planned deforestation over the entire project lifetime for stratum *i*; ha
i	1, 2, 3 …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity

and where:

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

Parameter	Description
$C_{P,i,t}$	Carbon stock in all pools in the project case in stratum *i* at time *t*; t CO_2-e
$C_{AB\_tree,i}$	Carbon stock in aboveground tree biomass in the project case in stratum *i*; t CO_2-e ha-1
$C_{BB\_tree,i}$	Carbon stock in belowground tree biomass in the project case in stratum *i*; t CO_2-e ha-1
$C_{AB\_non-tree,i}$	Carbon stock in aboveground nontree vegetation in stratum *i*; t CO_2-e ha-1
$C_{BB\_non-tree,i}$	Carbon stock in belowground nontree vegetation in stratum *i*; t CO_2-e ha-1
$C_{DW,i}$	Carbon stock in dead wood in the project case in stratum *i*; t CO_2-e ha-1
$C_{LI,i}$	Carbon stock in litter in the project case in stratum *i*; t CO_2-e ha-1
$C_{SOC,i}$	Carbon stock in soil organic carbon in the project case in stratum *i*; t CO_2-e ha-1
i	1, 2, 3 …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity

Carbon pools excluded from the project, $C_{DW,}I$, $C_{LI,I}$, and $C_{SOC,I}$, will be accounted as zero.

c) *Overview of data collection procedures.*

Monitoring frequency is indicated by variable in Section 3.2. In general, data on forest cover changes and data on carbon pools will be collected at verification audit events.

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 that affect the existing stratification.

Established strata may be merged if reason for their establishing said strata have disappeared. If a change is detected that requires a strata update, additional data on carbon pools for the new strata will be collected.

Field Plot Methods

To ensure that the full range of variability was captured, a total of 40 forest inventory plots were established. 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, WGS 84 projection (Table1). These same plots will be used for monitoring.

Table 1: Locations of forestry plots used to determine aboveground biomass.

Plot ID	Plot X Coordinates	Plot Y Coordinates
1	298139	1947137
2	300164	1943314
3	300035	1946389
4	300787	1946903
5	295045	1946339
6	301676	1943013
7	292876	1945946
8	290218	1942990
9	291218	1946789
10	301524	1941719
11	301149	1944865
12	293053	1947061
13	291670	1947269
14	296245	1943174
15	289894	1942475
16	299197	1940753
17	296123	1945732
18	292084	1943271
19	295366	1942326
20	294572	1945342
21	295191	1944133
22	289843	1941189
23	297741	1942805
24	297413	1944802

25	301078	1941413
26	297901	1943645
27	293439	1942855
28	300261	1942487
29	297660	1941917
30	296073	1947246
31	296353	1941182
32	294894	1946867
33	299991	1944566
34	299723	1946948
35	299489	1945806
36	301637	1944798
37	292805	1944551
38	297513	1945842
39	298915	1943669
40	291845	1945535

Field Plot Measurements

The methods for measuring the carbon pools at Laguna Seca are based on the Sourcebook for Land Use, Land-Use Change and Forestry Projects (Pearson et al 2005). Because destructive sampling is not practical to measure aboveground carbon stocks, published allometric equations will be used to determine aboveground biomass based upon the DBH of hardwood trees and the height of palms. Allometric equations and other parameters are included in Section 3.1.

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).

Tree species, DBH and tree height will be recorded for every tree found to occur in the plot. Notes on aberrations will be included for every tree where standard measurements may be impacted. Every tree tallied will be 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.

The following equipment 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 or Pink 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 1). 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. Trees which are ≥ 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 **≥** 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 **≥** 50.0cm will be measured starting due north, and working in a clockwise direction. Figure 3 illustrates the plot design.

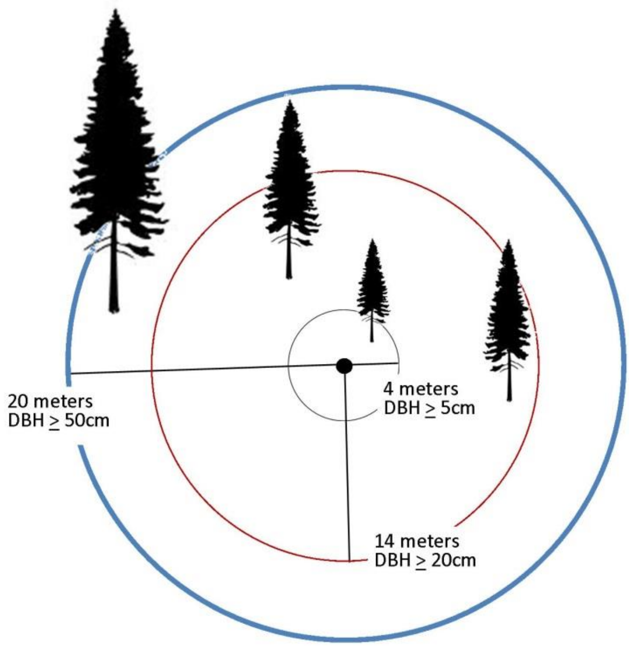

Figure 3: Nested forestry plot design. 4m radius for trees measuring ≥ 5 cm, 14m radius for trees ≥ 20cm, and 20m radius for trees ≥ 50cm dbh.

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.

Check the plot measurement data from the previous inventory to spot potential measurement errors or missed tagged trees.

Measuring Distance from Plot Center

If a tree lies partially within the plot circle diameter, the distance to the face of the tree is collected at breast height. This information will be used in conjunction with the radius of the tree to determine whether it is "in", based on calculated distance to the tree center.

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, it should 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 Laguna Seca the most common palms are the cohune, give-and-take, and sabal. Cohune palms in the early years of growth have no true trunk, just a series of palm fronds which slough off as it grows. Thus it is impossible to tag young palms for the purposes of monitoring. If the palm is considered in, the height is measured. If the height is within range for the selected allometric equations, AGB for that palm is calculated and included in the plot total.

Tree Height Measurements

All height measurements are taken either using a clinometer (percent scale) for standing trees (whether leaning or straight), or direct measurement with metric tapes for trees that are short enough to reach and measure directly or down on the ground and able to be measured by extending the tape measure along the bole. 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 4).

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.

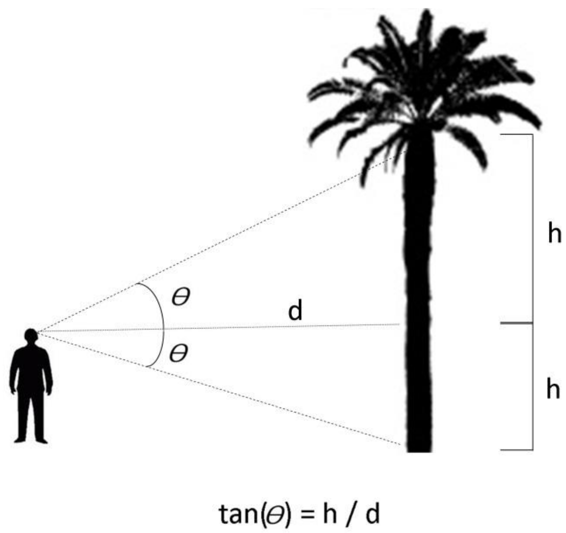

Figure 4: Measuring palm heights in the field with a clinometer.

At the end of each plot measurement, and 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.

<u>Mapping Methods</u>

Remote sensing methods will follow GOFC-GOLD Sourcebook (2014) 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 the leakage area. A classification accuracy of 90% or better will be achieved. The minimum requirements for image interpretation are: 'Geo-location accuracy < 1 pixel. Minimum mapping unit is 1 ha. A consistency assessment should be carried out' (GOFC-GOLD 2014). Detected deforested areas burned, damaged by wind, or illegally cleared will be mapped using a combination of these methods plus ground surveys with a GPS.

STEP 1. Selection and analyses of sources of land-use and land-cover (LU/LC) change data

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

The data collected and analyzed must cover the entire project area plus the potential leakage area (forest land owned by Gallon Jug Agroindustries), and data shall be available for the year in which monitoring and verification is occurring.

Preprocessing LU/LC Change Data: The remotely sensed data collected must be prepared for analysis. Minimum pre-processing involves geometric correction, geo-referencing, and cloud and shadow detection and removal. Guidance for interpretation of remote sensing imagery is given in the GOFC-GOLD 2008 Sourcebook for REDD and shall be followed as appropriate.

Post-processing assessment: Post-processing is required to:

1. Map area of change detected in the imagery.
2. Calculate the area of each category of change within the project area. For periodical revisiting of the baseline, do this also for the reference region.

   For the calculation of each category of change, at the end of each monitoring period:

   a. Calculate the area of each category within the project area.
   b. Update the Forest Cover Maps for the project area and any forest lands owned by Gallon Jug Agroindustries.

Estimating land-use and land-cover (LU/LC) change data in cloud-obscured areas: Multi-date images must be used to reduce cloud cover to no more than 10% of any image. If the areas with 10% cloud cover in either date in question do not overlap exactly, then the rate must come from areas that were cloud free in both dates in question. This must be estimated in % per year. Then, a maximum possible forest cover map must be made for the most recent time period. The historical rate in % must be multiplied by the maximum forest cover area at the start of the period for estimating the total area of deforestation during the period. The overall classification accuracy of the outcome of the previous steps must be 90% or more.

Image classification consists of seven categories: Forest, Bajo, Cropland, Grassland, Settlements, Wetland, and Other based GOFC-GOLD (2014) with a minimum mapping unit (mmu) of 1 hectare. Because the project area is relatively small, and mapping is accomplished through visual interpretation, a wall-to-wall mapping strategy will be employed as it is practical and the most suitable method for the project (GOFC-GOLD 2014).

STEP 2. Interpretation and analyses

A full visual delineation of the project area using Landsat imagery will be conducted. All digitization will be performed at an approximate scale of 1:15,000 by an experienced photo-interpreter (PI) familiar with satellite imagery applications, photo-interpretation and possessing a priori knowledge of land use/land cover in the area. The band combination of 5,4,2 (short-wave infrared, near infrared, green) will be employed.

STEP 3. Documentation

A consistent time-series of data on land use-change, and emissions and removals of CO_2 must emerge from periodic monitoring. This is only possible if a consistent methodology is applied over time. The methodological procedures used in steps 1-2 above must be documented. In particular, the following information must be provided when remotely sensed data are used:

a. Data sources and pre-processing: Type, resolution, source and acquisition date of the remotely sensed data (and other data) used; geometric, radiometric and other corrections performed, if any; spectral bands and indexes used (such as NDVI); projection and parameters used to geo-reference the images; error estimate of the geometric correction; software and software version used to perform tasks; etc.
b. Data classification: Definition of the classes and categories; classification approach and classification algorithms; coordinates and description of the ground-reference data collected for training purposes; ancillary data used in the classification, if any; software and software version used to perform the classification; additional spatial data and analysis used for post-classification analysis, including class subdivisions using non-spectral criteria, if any; etc.
c. Changes in Data sources and pre-processing / Data classification: If in subsequent periods changes will be made to the original data or use of data:
    i. Each change and its justification must be explained and recorded; and
    ii. When data from new satellites are used documentation must follow a) to c) above

Extracted Biomass and the Long Term Wood Products Pool

Although biomass change due to sustainable timber harvest is expected to be a de minimis contribution to the project, monitoring of the extracted wood products from the project will take place in the normal course of business to comply with the timber license for the project area. That data will be compiled annually and reviewed at verification and baseline reset to confirm that the impact from timber harvest continues to be a de minimis contribution to the project.

Degradation as a result of Sustainable Harvest of Fuelwood

Given the location of the project area, the small size of the community, and the availability of fuelwood from other sources, fuelwood collection at the project area is considered de minimis based on an indisputably conservative estimate of the potential impact of fuelwood collection (see Section 2.2.1 for methodology deviation). Add to that the expected elimination of any fuelwood collection resulting from patrols of the area, and the likelihood of any detectable fuelwood collection is remote.

The M-MON methodology module explicitly indicates that *"If this assessment finds no potential pressure for these activities then degradation ($\Delta C_{P,DegW,i,t}$) can be assumed to be zero and no monitoring is needed."* Since, the result of the analysis indicates that there is no potential impact from fuelwood collection i.e. the impacts are unlikely and conservatively they are de minimis if there are impacts, then no monitoring is required for degradation from fuelwood collection. However, a new PRA should be conducted every two years to determine if the potential for degradation by the community has changed. If two years has passed since the last monitoring event, then a PRA is required.

d) *Quality control and quality assurance procedure.*

Inventory: Once all of the trees have been measured and tagged, each data sheet is reviewed to ensure no data points have been forgotten (slope, azimuth, tree measurements, etc.) and recheck plot for any trees missed. At the end of each plot measurement, and the end of each day a designated team member will check that there are completely filled out data sheets for each plot inventoried. As a part of the verification process when a new inventory is required, a subset of plots will be reviewed by an independent third-party auditor, remeasured and compared to determine accuracy.

Calibration of Equipment: Monitoring equipment required, GPS, diameter tape, and measurement tape require little in the way of calibration. GPS is used to find existing permanent plots. If the plot is found the GPS is calibrated adequately.

Mapping: An accuracy assessment on all project area land cover and leakage area land cover following industry standards and applicable practices as described in Congalton (1991) and GFOI (2013) will be performed. Using the specific land cover layer, random points will be created for each cover class. Points should be created using the Create Random Points tool in ArcGIS 10.1 (or a similar tool) with the following parameters: 75 points for the forest class and 50 points each for other classes with a point separation of 250 meters. Points within 15 meters of a boundary may be removed to eliminate confusion during the accuracy assessment. For classes covering a very small percentage of the total area, 50 points may not be reached and what points that can be generated will be used for accuracy assessment. A subject matter expert (based on education, experience, and on-the-ground familiarity with the project area) will classify all points using Rapid Eye[2] high resolution imagery (or similar product) from the respective mapping year, after which the points are intersected with the land cover layer to calculate accuracy.

e) *Data archiving.*

Data archiving will be accomplished by saving data to permanent media (such as DVD) and stored in Belize at the offices of The Forestland Group in Belize. Copies will also be maintained in the United States.

[2] Rapid Eye Imagery: http://www.satimagingcorp.com/satellite-sensors/other-satellite-sensors/rapideye/

Data collection, analysis and archiving is an important aspect of the monitoring process and keeping good records for the life of the project is a key component of providing benefits over time. In general all raw and processed data will be kept for the life of the project. Paper records will be scanned and archived digitally, and the paper records will be kept as well. All records will be kept at the TFG offices in Belize, and an electronic backup archive will be kept either in the US or using cloud-based storage to prevent loss from theft or fire. 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.

Field Records

Field records can take the form of observation sheets or hand-held recorder database records. Either are acceptable, but as soon as practical a copy should be made and archived. Original records should never be taken back out into the field. Field data should be transcribed from hard copy sheets as soon as possible into spreadsheets for analysis. Entries on field sheets should be done in English and as clearly and legibly as possible avoiding the use of abbreviations or codes unless those codes are clearly delineated on the field sheet. GPS locations, pictures, observer information, date and time, and field conditions should all be recorded and archived as a component of the field records.

Remote Sensing

During verification events, and baseline reset, when remote sensing data is required to analyze the forest cover of the project and potential leakage area, the original scenes and any analytical transformations or derivative products should be saved and archived. Analysis of error rates, control points, or other ancillary data used for classification should also be archived with the images.

f) *Organization and responsibilities of the parties involved in all the above.*

TFG is responsible for all monitoring tasks. TFG may hire qualified subcontractors to perform the work as needed.

3.3.2 Monitoring of leakage

a) *Technical description of the monitoring task.*

Monitoring of activity shifting leakage (deforestation for the purpose of sugarcane agricultural production) will take place through year 2020 since that is the period in the baseline when planned deforestation was to occur. The leakage for this project will be determined using module LK-ASP and is presumed to be zero ex ante. That presumes that the original baseline deforestation agent, Gallon Jug Agroindustries, does not deforest additional acres in Belize under its control for sugarcane production. Monitoring of those forest lands under control of Gallon Jug Agroindustries will occur using the remote sensing techniques used for monitoring the project but without the use of permanent plots on Gallon Jug Agroindustries land.

Oil and gas exploration was ongoing preproject on Gallon Jug Agroindustries land and is expected to continue. Deforestation from this activity will not be monitored as leakage.

Monitoring of non-CO_2 emissions that result from burning biomass connected with deforestation in the leakage area will be monitored based on the biomass change from the deforestation activities using module E-BPB.

b) *Data to be collected.*

Data elements are described in Section 3.2. Changes due to leakage will be calculated using the following equation and parameters.

$$\Delta C_{LK} = \Delta C_{LK-AS,planned} + \Delta C_{LK-AS,unplanned} + \Delta C_{LK-AS,degrad-FW/C} + \Delta C_{LK-ME}$$

Where:

Parameter	Description
ΔC_{LK}	Net greenhouse gas emissions due to leakage; tCO_2e
$\Delta C_{LK-AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation; tCO_2e (from LK-ASP)
$\Delta C_{LK-AS,unplanned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing unplanned deforestation; tCO_2e (from LK-ASU): note this is a avoided planned deforestation and this parameter is n/a.
ΔC_{LK-ME}	Net greenhouse gas emissions due to market-effects leakage; tCO_2e (from LK-ME).
$\Delta C_{LK-AS,degrad-FW/C}$	Net greenhouse gas emissions due to activity shifting leakage for degradation caused by extraction of wood for fuel; tCO_2e (from LK-DFW). N/A in this project.

GHG emissions in the leakage area will also be monitored using the following equation and parameters:

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

Where:

Parameter	Description
$GHG_{P,E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum *i* in year *t*; tCO_2e
$E_{FC,i,t}$	Emission from fossil fuel combustion in stratum *i* within the project area in year *t*; tCO_2e. Note this is conservatively excluded from both the project and baseline scenarios, and not monitored.
$E_{biomassburn,i,t}$	Non-CO_2 emissions due to biomass burning that results in deforestation in stratum *i* in year *t* (t CO_2e)
$N_2O_{direct\text{-}N,i,t}$	Direct N2O emission as a result of nitrogen application on the alternative land use in stratum i in year t (t CO_2e). Note this is conservatively excluded from both the project and baseline scenarios, and not monitored.
i	1, 2, 3, … *M* strata (unitless)
t	*1, 2, 3 … t** time elapsed since the start of the project activity (years)

c) *Overview of data collection procedures.*

Data collection methods are the same as those described for the project area changes in carbon stocks in Section 3.3.1 with the exception that biomass inventory data will not be collected in the leakage area. Biomass levels will be extrapolated from the inventory data from the project area. The leakage area is displayed in Figure 7.

d) *Quality control and quality assurance procedure.*

Data collection methods are the same as those described for the project area changes in carbon stocks in Section 3.3.1.

e) *Data archiving.*

Data archiving methods are the same as those described for the project area changes in carbon stocks in Section 3.3.1.

f) *Organization and responsibilities of the parties involved in all the above.*

TFG is responsible for all monitoring tasks. TFG may hire qualified subcontractors to perform the work as needed.

3.3.3 Estimation of ex-post net greenhouse gas emissions from the project area.

a) *Technical description of the monitoring task.*

If a natural disaster is detected it would most likely be a catastrophic event like a hurricane and possibly a follow-on fire. A sugarcane agricultural conversion and biomass burning could be a source of GHG emissions and is hypothetically possible. In the case of biomass burning from either deforestation event, an estimate of the emissions will be made from the changes in biomass pools following module E-BPB for NO_2 and CH_4. Monitoring will occur by remote sensing and follow up ground surveys if a fire is detected on the project area that results in deforestation. CO_2 emissions will be accounted through any biomass change detected. Emissions resulting from natural disturbances, such as lightning caused fire, may be omitted if they are deemed de minimis through the use of the module T-SIG.

Fossil fuel combustion and nitrogen fertilizer use is conservatively omitted in both the project and baseline scenarios and not monitored.

Monitoring of leakage for CH_4 and N_2O from deforestation related biomass burning will take place through year 2020 since that is the period in the baseline when planned deforestation was to occur.

b) *Data to be collected.*

Parameters and equation are described in Section 4.1.7.1 for biomass burning. Emissions are estimated using the equation and parameters described in detail in Section 3.2. Calculation of $GHG_{P,E,i,t}$ can be found in Section 3.3.2b.

c) *Overview of data collection procedures.*

Monitoring of biomass burning emissions is based on biomass changes detected as a part of the deforestation monitoring effort. Procedures for monitoring biomass change are described in Section 3.3.1.

d) *Quality control and quality assurance procedure.*

Data collection methods are the same as those described for the project area changes in carbon stocks in Section 3.3.1.

e) *Data archiving.*

Data archiving methods are the same as those described for the project area changes in carbon stocks in Section 3.3.1.

f) *Organization and responsibilities of the parties involved in all the above.*

TFG is responsible for all monitoring tasks. TFG may hire qualified subcontractors to perform the work as needed

3.3.4 Revision of the Baseline

a) *Technical description of the monitoring task.*

Baselines shall be revised every 10 years. The methodological procedure used to update the baseline shall be the same as used in the first estimation. In this project that means module BL-PL will be reapplied to develop a revised baseline. Since the deforestation process is planned deforestation, and the agent of deforestation is known, changes in the baseline using BL-PL are unlikely unless revisions are made to the methodology (or methodologies that BL-

PL relies upon like CP-W for wood products) and updates are required. Baseline reset includes analysis of reference areas.

At baseline revision, forest cover must be monitored. Monitoring is intended to detect natural and anthropomorphic impacts that would materially and significantly impact the climate benefits of the project. Above- and belowground biomass stock estimates are valid in the baseline (i.e. treated as constant) for 10 years, after which they must be re-estimated from new field measurements. For each stratum, where the re-measured estimate is within the 90% confidence interval of the t=0 estimate, the t=0 stock estimate takes precedence and is re-employed, and where the re-measured estimate is outside (i.e. greater than or less than) the 90% confidence interval of the t=0 estimate, the new stock estimate takes precedence and is used for the subsequent period.

b) *Data to be collected.*

Data elements are described in section 3.1 and 3.2.

c) *Overview of data collection procedures.*

Data related to biomass on the project area will be collected by a combination of remote sensing and permanent plots as described in the monitoring plan.

d) *Quality control and quality assurance procedure.*

Quality control and quality assurance procedures are the same as those described elsewhere in the monitoring plan.

e) *Data archiving.*

Data archiving will be accomplished by saving data to permanent media (such as DVD) and stored in Belize at the offices of The Forestland Group in Orange Walk, Belize. Copies will also be maintained in the United States.

f) *Organization and responsibilities of the parties involved in all the above.*

TFG is responsible for all monitoring tasks. TFG may hire qualified subcontractors to perform the work as needed.

3.3.5 Community Benefits

a) *Technical description of the monitoring task.*

The objective of the community benefits monitoring program is to determine that the claimed community benefits, contributions to the Gallon Jug-Chan Chich High School Scholarship

Fund[3], are produced. This task is intended to gather information about these benefits and gather input from the community regarding these benefits.

b) *Data to be collected.*

Community data will be collected in the form of records of funds transfers, and records of expenditures for high school scholarships utilized by the community. Community meetings will be held to receive input regarding the success or problems with the program.

c) *Overview of data collection procedures.*

Community benefits will be monitored through community meetings and records of funds transfers to the Gallon Jug-Chan Chich High School Scholarship Fund at each verification event. Meetings will be held at each monitoring event. Funds transfer records will be archived as the funds transfers happen. Records of the spending and results from spending on high school scholarships will be recorded and included in the monitoring report. There are no known community HCVs in the project area so monitoring for community HCVs will not occur. Results of monitoring data will be made available publicly through the Climate, Community, and Biodiversity Alliance web site. Monitoring data results will also be made available to participants at community meetings at verification events.

d) *Quality control and quality assurance procedure.*

Data received from the Gallon Jug-Chan Chich High School Scholarship Fund will be considered accurate. Data will be discussed at the community meetings to confirm that the data is accurate.

e) *Data archiving.*

Data archiving will be accomplished by saving data to permanent media (such as DVD) and stored in Belize at the offices of The Forestland Group in Orange Walk, Belize. Copies will also be maintained in the United States.

f) *Organization and responsibilities of the parties involved in all the above.*

TFG is responsible for all monitoring tasks. TFG may hire qualified subcontractors to perform the work as needed.

.3.3.6 Biodiversity Benefits

a) *Technical description of the monitoring task.*

The objective of the biodiversity monitoring program is to prove that biodiversity on the site, as indicated by key trigger species, still inhabit the project area.

[3] https://sites.google.com/site/gallonjugschool/gallonjug-chanchichscholarshipfund

Biodiversity will be monitored using a combination of techniques including camera traps, and anecdotal observations of high priority species. Anecdotal observations of monkeys, highly visible and IUCN Endangered, will be recorded and archived. Results of monitoring data will be made available publicly through the Climate, Community, and Biodiversity Alliance web site. Monitoring data results will also be made available to participants at community meetings at verification events.

Harmsen et. al. (2010) determined that jaguars (*Panthera onca*) and pumas (*Puma concolor*) and typical common mammalian prey could be detected using camera traps in Belize. Davis, Kelly, and Stauffer (2010) included trap success data in their work in the Mountain Pine Ridge of Belize and most of the rare species listed in the project area are above zero. Similarly Di Bitetti et. al. (2010) found positive detection rates for felids. A detailed discussion of camera trapping and detection probabilities can be found in O'Brien (2010) and Waldon, Miller, and Miller (2011).

The forest monitoring plan is also a biodiversity monitoring plan since the forest is a key overriding habitat feature for the biodiversity of forest including the HCVs. The primary biodiversity variable used will be vertebrate species richness as indicated by the list of detected species on the project area during a monitoring period. The area to be monitored will be the accessible portions of the project area, primarily roads and permanent plots. Biodiversity monitoring will take place at verification monitoring events, no less frequently than every five years.

b) *Data to be collected.*

Data for biodiversity monitoring will consist of observations, either through camera traps or anecdotally, of species on the project area. Anecdotal observations can take the form of tracks, scat, calls, or sightings.

c) *Overview of data collection procedures.*

Biodiversity will be monitored using two methods, camera traps and anecdotal observations of IUCN endangered mammals particularly monkeys. Current biodiversity was established over many years using camera traps on, and near the project area by Miller and Miller (2011). Six stations, infrared digital cameras, will be installed on roads and run 24 hours per day for three weeks resulting in 126 potential trap nights. Presuming equipment failure or other problems with the data that should result in a minimum of 100 trap nights. Pictures from the cameras will be reviewed, catalogued, and archived by date and GPS location. Cameras should be checked weekly during the study to change batteries and confirm operational status. A species list will be developed from the data and archived with the pictures.

Anecdotal observations of IUCN Endangered mammals on the project site will be recorded by date, and location in a log book at the Yalbac mill. All observations of Baird's tapir (*Tapirus bairdii*), Yucatan black howler monkey (*Alouatta pigra*), and Geoffroy's spider monkey (*Ateles geoffroyi*) will be recorded. These observations will be archived digitally (scanned and kept with the project records). Pictures and location of tapir tracks will be recorded if found.

The three trigger species, all HCV species as well, are considered highly detectable by tracks/scat, calls, or visibility in the forest. The project will be considered effective if populations of these animals continue to be detected by monitoring. The monkey species are indicators of mature forest habitat. The Tapir is an indicator of illegal hunting.

Wildlife observations can take the form of pictures from a hand-held camera or camera trap or data recorded by a qualified observer. In every case, a GPS location, date and time, and type of observation (call, sign, animal observed) should be recorded for the observation. Observations of wildlife should be treated like other field records in transcribing and archiving.

d) *Quality control and quality assurance procedure.*

Wildlife observations from camera traps sometimes require interpretation when the animal is only partially captured or otherwise obscured. A qualified analyst with experience interpreting pictures should be utilized to analyze the camera trap data. Local guides and workers have extensive experience with observing animals on the project area, and their observations will be considered accurate for highly visible species like tapir, jaguar, or monkeys. Observations of more cryptic animals should be accompanied by either documentary evidence (e.g. picture of a track or scat), or a confirmation from a qualified observer with extensive experience in identifying animals in the neotropics.

e) *Data archiving.*

Data archiving will be accomplished by saving data to permanent media (such as DVD) and stored in Belize at the offices of The Forestland Group in Orange Walk, Belize. Copies will also be maintained in the United States.

f) *Organization and responsibilities of the parties involved in all the above.*

TFG is responsible for all monitoring tasks. TFG may hire qualified subcontractors to perform the work as needed.

3.3.7 Data Management

Data collection, analysis and archiving is an important aspect of the monitoring process and keeping good records for the life of the project is a key component of providing benefits over time. In general all raw and processed data will be kept for the life of the project. Paper records will be scanned and archived digitally, and the paper records will be kept as well. All records will be kept at the TFG offices in Belize, and an electronic backup archive will be kept either in the US or using cloud-based storage to prevent loss from theft or fire. 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.

Monitoring data will be collected periodically, 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 10 years. It is the responsibility of the landowner to conduct monitoring either utilizing contractors or in-house staff.

Field Records

Field records can take the form of observation sheets or hand-held recorder database records. Either are acceptable, but as soon as practical a copy should be made and archived. Original records should never be taken back out into the field. Field data should be transcribed from hard copy sheets as soon as possible into spreadsheets for analysis. Entries on field sheets should be done in English and as clearly and legibly as possible avoiding the use of abbreviations or codes unless those codes are clearly delineated on the field sheet. GPS locations, pictures, observer information, date and time, and field conditions should all be recorded and archived as a component of the field records.

Wildlife Observations

Wildlife observations can take the form of pictures from a hand-held camera or camera trap or data recorded by a qualified observer. In every case, a GPS location, date and time, and type of observation (call, sign, animal observed) should be recorded for the observation. Observations of wildlife should be treated like other field records in transcribing and archiving.

Remote Sensing

During verification events, and baseline reset, when remote sensing data is required to analyze the forest cover of the project and potential leakage area, the original scenes and any analytical transformations or derivative products should be saved and archived. Analysis of error rates, control points, or other ancillary data used for classification should also be archived with the images.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

This monitoring event does not include monitoring for Biodiversity and Community benefits. Monitoring for those benefits will occur at the next verification event.

4.1 Baseline Emissions

In order to estimate GHG loss und the baseline scenario the following pools and sources of emissions were analyzed:

4.1.1 Area of Forest available for Conversion and Rate of Conversion

Of the total area of the property, 8,432 ha were slated for conversion to sugarcane. In the baseline, 8240 ha would have been converted to sugarcane ($A_{planned,I}$ = 8240). A 1-chain buffer around perennial streams and wetlands was excluded to comply with directives from the Belize Forest Department accounting for 118.3 ha.

4.1.2 Biomass Baseline Carbon Stocks

Baseline biomass carbon stocks consisted of aboveground biomass and belowground biomass of the forest in the sugarcane conversion area. The mean carbon pool in 2013 was based on field measurements conducted in 2013 and independently verified. The dry tropical (900-1500mm rainfall) forest allometric equation for biomass prediction published in Pearson et. al. (2005) was used to predict aboveground biomass (Table 2). A factor of 47% was used to convert biomass to carbon.

Table 2: Equations used for calculating biomass.

<table>
<tr><th>Classification</th><th colspan="2">Equation: DBH = diameter breast height, D=wood density, H=tree height</th><th>Maximum DBH or height</th></tr>
<tr><td>Aboveground Tree Biomass: Pearson et. al. 2005 Tropical Dry (900-1500mm rainfall)</td><td colspan="2">$AGB = 0.2035 * DBH^{2.3196}$</td><td>DBH <= 63 cm</td></tr>
<tr><td rowspan="3">Palm aboveground biomass (AGB): Brown 2015</td><td>Chrysophylla stauracantha</td><td>AGB = ((0.8966 * H) – 0.37988)</td><td>H 0.45-10.0 m</td></tr>
<tr><td>Attalea cohune</td><td>AGB = (302.6 * ln(H)) + 276.93)</td><td>H 0.31-15.7 m</td></tr>
<tr><td>Sabal mauritiiformis</td><td>AGB = ((14.596 * H) + 13.54)</td><td>H 0.15-14.53 m</td></tr>
<tr><td>Belowground Biomass</td><td colspan="2">If AGB is > 125 t/ha then BGB = AGB x .24 else BGB = AGB x .2</td><td>DBH <= 63.4</td></tr>
</table>

The procedure for performing this estimate involved randomly allocating permanent plots in the forest, establishing and marking those plots, and measuring the trees and palms on those plots according to the methodology described in the monitoring plan. The number of plots was determined to capture the likely variability of the forest vegetation with adequate statistical power. The DBH and total height of trees and the height of palms were recorded in the field and transcribed to spreadsheets for calculation of biomass, carbon, and metric tons of CO_2 equivalent. Plots were mathematically averaged to produce a mean by plot. Plot means were averaged to produce a mean for the project. An error rate was produced based on the standard deviation of the plot means. The error rate was used to produce an uncertainty estimate for the inventory for each pool (aboveground biomass and belowground biomass). The combined uncertainty rate for all pools and sources of emissions was found to be 8.58%. Based on the allowable uncertainty rate of 15%, no deductions were applied for uncertainty.

Belowground biomass was estimated based on aboveground biomass using the root-to-shoot ratios indicated in the CP-AB methodology. Belowground biomass, per methodology module BL-PL, is treated as if emissions occur steadily over a 10-year period. In the baseline scenario, since 10% of the deforestation is occurring each year and only 10% of the belowground biomass is emitted each year, the emissions model accounts for each annual deforestation event separately and applies 10% of that event per year for 10 years.

Aboveground biomass attributed to palm biomass was included for three common species of palms and calculated AGB based on equations developed on a nearby study site were used to predict biomass (Brown 2015). The allometric equation used was evaluated per the methodology by reviewing the source data from which the equation was derived and confirming that the source data is representative of the species and conditions in the project and covers the range of potential sizes. The R^2 of each model is within the limit set by the methodology (R^2>.8). The range of heights is compared below:

Table 3: Palm equation range and R^2.

Species	R^2	Height range of the model	Height range of the inventory	Palms out of Range
cohune (*Attalea cohune*)	0.84	H 0.31-15.7 m	0.4-26.5 meters	2
give-and-take (*Chrysophylla stauracantha*)	0.94	H 0.45-10.0 m	1.0-8.8 meters	0
botan a.k.a sabal (*Sabal mauritiiformis*)	0.81	H 0.15-14.53 m	1.7-21.9 meters	4

To account for the four palms out of range for the botan model and the two palms out of range for the cohune model, the heights were arbitrarily, and conservatively capped at 15.7 meters for the cohune, and 14.5 meters for sabal thereby excluding those out of range palms from the calculation.

The tree biomass pool in 2013 was calculated as 285.78 tCO_2e/ha for aboveground tree biomass and 67.24 tCO_2e/ha for belowground tree biomass. Sum of the pools equals 353.02 tCO_2e/ha.

4.1.3 Rate of Deforestation and Agricultural Conversion

The likelihood of conversion to sugarcane is considered 100% based on the expected profitability of the project and the lack of barriers.

The annual rate of deforestation is derived using the following equation:

$$AA_{planned,i,t} = (A_{planned,i} * D\%_{planned,i,t}) * L\text{-}D_i$$

Where:

Parameter	Description	Result
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum i at time t; ha	824 ha/year for 3 years
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i during year t. If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; %	10%/year for 3 years
$A_{planned,i}$	Total area of planned deforestation over the baseline period for stratum i; ha	8240 ha
$L\text{-}D_i$	Likelihood of deforestation for stratum i; %	100%

According to methodology module BL-PL "Where a valid verifiable plan exists for rate at which deforestation is projected to occur, this rate shall be used." Therefore a rate of 10%/year is used for 10 years. This rate was determined to be feasible and in line with common practice.

During the monitoring period, deforestation from sugarcane production would have occurred at a rate of 10%/year or 824 ha/year * 3 years for a total of 2,472 ha.

4.1.4 Carbon stocks in agro-ecosystems and the non-tree biomass pool

To account for the non-tree biomass pool both pre-deforestation and post-deforestation, the following assumptions were made based on the literature. Equations and parameters may be found in Section 4.1. Non-tree biomass is defined as living plants that don't qualify as trees i.e. non-woody or too small to qualify for the tree inventory (DBH < 5 cm). Sugarcane is defined for this purpose as non-tree biomass, however since it is harvested annually, the average long term carbon content value is used.

The above ground nontree biomass pre-deforestation ($C_{ABnon\text{-}treebsl,i}$) is determined through the literature citing Dewalt and Chave (2004) who reported liana biomass in four neotropical forests and found that the average AGB for lianas is 13 t C (dry matter x 44/12 converts to 47.67 tCO_2e). Of the four sites reported, the sites most similar to the project site, La Selva in Costa Rica and Barro Colorado in Panama, reported 17.2 t C/ha and 8.0 t C/ha respectively. An average of the two is 12.6 t C/ha or 46.2 t CO_2e/ha for $C_{ABnon\text{-}tree,bsl,i}$. This is considered an indisputably conservative estimate for $C_{ABnon\text{-}treebsl,i}$ since it does not include trees/palms smaller than 5 cm dbh or plants other than lianas that would be allowably included in the non-tree biomass pool.

The above ground nontree biomass post-deforestation ($C_{ABnon\text{-}treepost,i}$) is calculated as the annual average AGB of sugarcane. Since it is a cyclical system, an annual average (which is defined as half the harvested aboveground wet biomass based on an expected 4 crops in every 5 years) converted to dry matter using a conversion ratio found in Bakker (2004) and confirmed in FAO (1994). Bakker (2004) recommends monitoring sugarcane until it reaches 70% moisture content as an indicator of when harvest is ready. Therefore a carbon fraction of .3 is used conservatively assuming that all remaining matter after drying is carbon.

The sugarcane plan presumes a harvest rate of 25 short tons/acre of green sugarcane. Converting that to metric tons (25 * .907185) results in 22.7 metric tons. Converting that to hectares (22.7 * 0.404686) results in 56.04 mt green biomass/ha. Converting that to dry matter (56.04 * .3) results in a harvest rate of 16.81 t C/ha. To convert t C to t CO_2e multiply 16.81 x 44/12 = 61.65 t CO_2e/ha. The annual average is used for a cyclical biomass like sugarcane based on a conservative assumption that only four crops can be produced every five years because of weather or other operational constraints so 61.65 t C is multiplied by 5/4 resulting in 38.53 t CO_2e/ha for variable $C_{ABnon\text{-}tree,post,i}$.

Below ground biomass for both the pre-deforestation and post-deforestation pools is calculated using a root-to-shoot ratio of .24 (IPCC 2006). That results in $C_{BBnon\text{-}treebsl,i}$ = 11.1 tCO_2e/ha and $C_{BBnon\text{-}treepost,I}$ = 9.2 tCO_2e/ha.

4.1.5 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 (commercially valuable and greater than or equal to 25 cm dbh based on Cho 2007) and then bulldoze and burn the remaining trees for agriculture (FCPF 2015). The aboveground and belowground tree biomass in the project area is presumed to be removed in the baseline scenario. Using module CP-W (Option 2), the long-lived wood product pool was calculated as follows:

Step 1: Calculate the biomass carbon of the volume extracted by wood product type from the project using the following equation.

$$C_{XB,i} = C_{AB\_tree,i} * \frac{1}{BCEF} * Pcom_i$$

Parameter	Description	Result
$C_{XB,i}$	Mean stock of extracted biomass carbon by class of wood product ty from stratum i; tCO_2e ha-1	10.64
$C_{AB\_tree,i}$	Mean aboveground biomass carbon stock in stratum i; tCO_2e ha-1	285.8
BCEF	Biomass conversion and expansion factor (BCEF) for conversion of merchantable volume to total aboveground tree biomass; dimensionless	2.8
$Pcom_i$	Commercial volume as a percent of total aboveground volume in stratum i; dimensionless	10.42%
i	1, 2, 3, … M strata	One strata

Step 2: Identify wood product classes. In Belize, sawnwood is the only viable product based on the lack of processing capacity for other products such as plywood, paper, or chip board. Based on common practice, the only feasible outlet for logs is to the two sawmills (one at Gallon Jug and one at Yalbac) that are only able to saw logs into boards or flitches based on direct observation of the equipment and mill records.

Step 3: Calculate the biomass carbon that enters the wood products pool at the time of deforestation utilizing the following equation:

$$C_{WP,i} = \sum_{ty=s,w,oir,p,o} C_{XB,ty,i} * (1 - WW_{ty})$$

Parameter	Description	Result
$C_{WP,i}$	Carbon stock entering the wood products pool from stratum i; tCO_2e ha^{-1}	8.09
$C_{XB,ty,i}$	Mean stock of extracted biomass carbon by class of wood product ty from stratum i; tCO_2e ha^{-1}	10.64
WW_{ty}	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product ty; dimensionless	0.24
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)	sawnwood

i	1, 2, 3, … M strata	One strata

Step 4: Calculate the amount of wood products entering the pool at the time of deforestation ($C_{WP,i}$, calculated in C-WP) that is expected to be emitted over a 100-year timeframe.

$$C_{WP100,i} = C_{WP,i} - C_{WP,i} * (1 - SLFp) * (1 - Ofp)$$

Parameter	Description	Result
$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i; $tCO_2e\ ha^{-1}$; reported by year in Table 4.	7.05
$C_{WP,i}$	Carbon stock entering wood products pool at time of deforestation from stratum i; $tCO_2e\ ha^{-1}$	8.09
SLF_{ty}	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product ty; dimensionless	0.2
OF_{ty}	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product ty; dimensionless	0.84
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)	sawnwood
i	1, 2, 3, … M strata	1

4.1.6 Baseline Emissions Calculations by Pool

Stock changes in each pool are calculated by subtracting post-deforestation carbon stocks from forest carbon stocks.

$$\Delta C_{AB_{tree},i} = C_{AB_{tree_{bsl}},i} - C_{AB_{tree_{post}},i}$$

$$\Delta C_{AB_{non-tree},i} = C_{AB_{non-tree_{bsl}},i} - C_{AB_{non-tree_{post}},i}$$

$$\Delta C_{BB\_tree,i} = C_{BB_{tree_{bsl}},i} - C_{BB_{tree_{post}},i}$$

$$\Delta C_{BB_{non-tree},i} = C_{BB_{non}-tree,bsl,i} - C_{BB_{non}-tree,post,i}$$

Where:

Parameter	Description	Result
$\Delta C_{AB\_tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum i; $tCO_2e\ ha^{-1}$	285.8
$C_{AB\_tree,bsl,i}$	Forest carbon stock in aboveground tree biomass in stratum i; $tCO_2e\ ha^{-1}$	285.8
$C_{AB\_tree,post,i}$	Post-deforestation carbon stock in aboveground tree biomass in	0

	stratum i; $tCO_2e\ ha^{-1}$	
$\Delta C_{BB\_tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum i; $tCO_2e\ ha^{-1}$	67.2
$C_{BB\_tree,bsl,i}$	Forest carbon stock in belowground tree biomass in stratum i; $tCO_2e\ ha^{-1}$	67.2
$C_{BB\_tree,post,i}$	Post-deforestation carbon stock in belowground tree biomass in stratum i; $tCO_2e\ ha^{-1}$	0
$\Delta C_{AB\_non\text{-}tree,i}$	$\Delta C_{AB\_non\text{-}tree,i}$ Baseline carbon stock change in aboveground non-tree biomass in stratum i; tCO_2-e ha-1	7.7
$C_{AB\_non\text{-}tree,bsl,i}$	$C_{AB_non\text{-}tree,bsl,}$i Forest carbon stock in aboveground non-tree biomass in stratum i; tCO_2-e ha-1	46.2
$C_{AB\_non\text{-}tree,post,i}$	$C_{AB\_non\text{-}tree,post,i}$ Post-deforestation carbon stock in aboveground non-tree biomass in stratum i; tCO_2-e ha-1	38.5
$\Delta C_{BB\_non\text{-}tree,i}$	$\Delta C_{BB_non\text{-}tree,}$i Baseline carbon stock change in belowground non-tree biomass in stratum i; tCO_2-e ha-1	1.8
$C_{BB\_non\text{-}tree,bsl,i}$	CBB_non-tree,bsl,i Forest carbon stock in belowground non-tree biomass in stratum i; tCO_2-e ha-1	11.1
$C_{BB\_non\text{-}tree,post,i}$	$C_{BB\_non\text{-}tree,post,i}$ Post-deforestation carbon stock in belowground non-tree biomass in stratum i; tCO_2-e ha-1	9.2
I	1, 2, 3, … M strata	One strata

Note that no nontree pools are included in the project so no nontree parameters are described.

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

Parameter	Description	Result
$\Delta C_{BSL,i,t}$	Sum of the baseline carbon stock change in all pools in stratum *i* at time *t,* tCO_2e ; reported by year in Table 4.	761,303
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum *i* at time *t*; ha	824 ha per year for 10 years
$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum *i*; $tCO_2e\ ha^{-1}$	7.05
$\Delta C_{AB\_tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum *i*; $tCO_2e\ ha^{-1}$	285.8
$\Delta C_{BB\_tree,i}$	Baseline carbon stock change in belowground tree biomass in	67.2

	stratum *i*; $tCO_2e\ ha^{-1}$	
$\Delta C_{AB\_non\text{-}tree,i}$	$\Delta C_{AB\_non\text{-}tree,i}$ Baseline carbon stock change in aboveground non-tree biomass in stratum i; tCO_2-e ha-1	7.7
$\Delta C_{BB\_non\text{-}tree,i}$	$\Delta C_{BB\_non\text{-}tree,i}$ Baseline carbon stock change in belowground non-tree biomass in stratum i; tCO_2-e ha-1	1.8
I	1, 2, 3, … M strata	One strata
t	1, 2, 3, … t years elapsed since the projected start of the REDD project activity	3

Note that dead wood, litter, and soil organic carbon are all conservatively excluded from the analysis.

4.1.7 Greenhouse Gas Emissions Other than Biomass Pool Change

GHG emissions are calculated based on the following equations and parameters.

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

Where:

Parameter	Description	Result
$GHG_{BSL,E}$	Greenhouse gas emissions as a result deforestation activities within the project boundary in the stratum i in year t; tCO_2e ; reported by year in Table 4.	41,977
$E_{biomassburn,i,t}$	Non-CO_2 emissions due to biomass burning that results in deforestation in stratum *i* in year *t* (tCO_2e)	41,977
$N_2O_{direct\text{-}N,i,t}$	Direct N_2O emission as a result of nitrogen application on the alternative land use in stratum i in year t (tCO_2e). Conservatively excluded pool.	0
i	1, 2, 3, … *M* strata (unitless)	one strata
t	*1, 2, 3 … t** time elapsed since the start of the project activity (years)	3 years

4.1.7.1 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-BPB)". Avoided emissions from CO_2 release are omitted because they are accounted for by biomass changes in the aboveground and belowground biomass pools. Avoided emissions attributable to CH_4 and N_2O, tCO_2e, are included based on the following equation:

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

Parameter	Description	Result

$E_{biomassburn,i,t}$	Greenhouse gas emissions due to biomass burning as part of deforestation activities in stratum i in year t of each GHG (CH_4, N_2O) (tCO2e) ; reported by year in Table 4.	41,977
$A_{burn,i,t}$	Area burnt for stratum i in year t (ha)	824 ha/year for 3 years
$B_{i,t}$	Average aboveground biomass stock before burning stratum i, year (t d.m. ha^{-1})	165.8
$COMF_i$	Combustion factor for stratum i (unitless)	0.5
$G_{g,i}$	Emission factor for stratum i for gas g (kg t^{-1} d.m. burnt)	6.8 for CH_4 and 0.2 for N_2O
GWP_g	Global warming potential for gas g (tCO2/t gas g)	21 for CH_4 and 310 for N_2O
g	1, 2, 3 ... G greenhouse gases including carbon dioxide[1], methane and nitrous oxide (unitless)	CH_4 and N_2O
i	1, 2, 3 …M strata (unitless)	1
t	1, 2, 3, … t* time elapsed since the start of the project activity (years)	Monitoring period is 3 years. Burning period is 3 years.

4.1.7.2 Avoided emissions from fertilizer application

Nitrogen fertilizer application is a conservatively excluded pool.

4.1.7.3 Avoided emissions from transportation fuel use

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

4.1.8 Baseline Emissions Summed

The baseline net GHG emissions are determined as:

$$\Delta C_{BSL,planned} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(\Delta C_{BSL,i,t} + GHG_{BSL-E,i,t} \right)$$

Parameter	Description	Result
$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation; tCO2-e ; reported by year in Table 4.	803,279
$\Delta C_{BSL,i,t}$	Net carbon stock changes in all pools in the baseline stratum *i* at time *t*; tCO2-e	Reported by year in Table 4
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum *i* during project year *t*; tCO2-e $year^{-1}$	Reported by year in Table 4
i	1, 2, 3, … *M* strata (unitless)	one strata
t	*1, 2, 3 … t** time elapsed since the start of the project activity (years)	3 years

Results by year are reported in Table 4.

Table 4a: Results of calculations for Baseline Emissions.

Year	Biomass Change AGB ($\Delta C_{AB\_tree,i}$)	Biomass Change BGB ($\Delta C_{BB\_tree,i}$)	Biomass Change AGB ($\Delta C_{AB\_non\text{-}tree,i}$)	Biomass Change BGB ($\Delta C_{BB\_non\text{-}tree,i}$)	Long Term Wood Products Pool ($C_{wp100,i,t}$)	Biomass Change ($\Delta C_{BSL,i,t}$)
2011	235,481	5,541	6,321	152	290	247,785
2012	235,481	11,081	6,321	303	581	253,768
2013	235,481	16,622	6,321	455	871	259,750

Table 4b: Results of calculations for Baseline Emissions (continued).

Year	Biomass Change ($\Delta C_{BSL,i,t}$)	Non-CO_2 Biomass Burning ($E_{biomassburn}$)	Total Baseline Emissions ($GHG_{BSL,E}$)	Total Baseline Emissions and Reductions ($\Delta C_{BSL,\ planned,I,t}$)	Total Baseline Emissions and Reductions (ΔC_{BSL})
2011	247,785	13,992	13,992	261,777	261,777
2012	253,768	13,992	13,992	267,760	267,760
2013	259,750	13,992	13,992	273,743	273,743

To determine total ΔC_{BSL}

$$\Delta C_{BSL} = \Delta C_{BSL,planned} + \Delta C_{BSL,unplanned} + \Delta C_{BSL,degrad-FW/C}$$

Where:

ΔC_{BSL}	Net greenhouse gas emissions under the baseline scenario; tCO_2-e	803,279
$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation; tCO_2-e (from BL-PL)	803,279
$\Delta C_{BSL,unplanned}$	Net greenhouse gas emissions in the baseline from unplanned deforestation; tCO_2-e (from BL-UP)	N/A
$\Delta C_{BSL,degrad\text{-}FW/C}$	Net greenhouse gas emissions in the baseline from degradation caused by fuelwood collection and charcoal making; tCO_2-e (from BL-DFW)	N/A

4.2 Project Emissions

The net carbon stock change as a result of deforestation is equal to the area deforested multiplied by the emission per unit area. Based on the remote sensing analysis, no deforestation could be detected in the project area therefore no deductions are taken. An approved methodology deviation (see Section 2.2.1) was used to determine that forest degradation from fuelwood collection and timber harvest is de minimis and set to zero.

Equations and parameters used to determine changes in carbon stocks during the monitoring period are as follows:

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

Where:

Parameter	Description	Result
ΔC_P	Net greenhouse gas emissions within the project area under the project scenario; tCO_2e ;	0
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; tCO_2e	0
$\Delta C_{P,Deg,i,t}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* at time *t*; tCO_2e: This source of emissions was found to be de minimis and will not be monitored.	0
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* at time *t*; tCO_2e	0
$GHG_{P-E,i,t}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; tCO_2e	0
$\Delta C_{P,Enh,i,t}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in stratum *i* at time *t*; tCO_2e	0
i	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

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

$$\Delta C_{P,LB} = \sum_{t=1}^{t} \sum_{i=1}^{M} \Delta C_{P,DefLB,i,t}$$

Parameter	Description	Result
$\Delta C_{P,LB}$	Net greenhouse gas emissions in the leakage belt in the project case; tCO2e	0
$\Delta C_{P,DefLB,i,t}$	Net carbon stock change as a result of deforestation in the leakage belt the project case in stratum *i* at time *t*; tCO2e	0
i	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

Since the leakage belt is equivalent to the leakage area as defined in LK-ASP, $\Delta C_{P,LB}$ will be ignored and instead leakage will be handled through LK-ASP.

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

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

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

Where:

Parameter	Description	Result
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; tCO_2e	0
$\Delta C_{P,DefLB,i,t}$	Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum *i* at time *t*; tCO2-e	0
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha	0

$A_{DefLB,u,i,t}$	Area of recorded deforestation in the leakage belt stratum *i* converted to land use *u* at time *t*; ha	0
$\Delta C_{pools,Def,u,i,t}$	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; tCO2-e ha-1	0
U	*1,2,3,…U* post-deforestation land uses; in this case, only one post-deforestation land use, sugar cane agriculture.	*1*
I	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

The emission per unit area is equal to the difference between the stocks before and after deforestation minus any wood products created from timber extraction in the process of deforestation:

$$\Delta C_{pools,Def,i,t} = C_{BSL,i} - C_{P,post,i} - C_{WP,i}$$

Parameter	Description	Result
$\Delta C_{pools,Def,u,i,t}$	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; tCO2-e ha-1	312.9
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum *i*; tCO2-e ha-1	362.5
$C_{P,post,u,i}$	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; tCO2-e ha-1	49.6
$C_{WP,i}$	Carbon stock sequestered in wood products from harvests in stratum *i*; tCO2-e ha-1	0
u	*1,2,3,…U* post-deforestation land uses; in this case, only one post-deforestation land use, sugar cane agriculture.	1
I	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

For each post-deforestation land use (u) estimate the long-term carbon stock. Carbon stocks in the selected pools (must be the same as those used in the baseline modules) must be measured and estimated using the methods given in modules CP-AB, CP-D, CP-L, and/or CP-S.

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

Parameter	Description	Result
$C_{P,post,u,i}$	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; tCO2-e ha-1	49.6
$C_{AB\_tree,i}$	Carbon stock in aboveground tree biomass in stratum *i*; tCO2-e ha-1	0
$C_{BB\_tree,i}$	Carbon stock in belowground tree biomass in stratum *i*; tCO2-e ha-1	0
$C_{AB\_non-tree,i,i}$	Carbon stock in aboveground non-tree vegetation in stratum *i*; tCO2-e ha-1; excluded from project and accounted as 0.	38.5
$C_{BB\_non-tree,i}$	Carbon stock in belowground non-tree vegetation in stratum *i*; tCO2-e ha-1; excluded from project and accounted as 0.	11.1
$C_{DW,i}$	Carbon stock in dead wood in stratum *i*; tCO2-e ha-1; excluded from project and accounted as 0.	N/A
$C_{LI,i}$	Carbon stock in litter in stratum *i*; tCO2-e ha-1; excluded from project and accounted as 0.	N/A
$C_{SOC,PD-BSL,i}$	Mean post-deforestation stock in soil organic carbon in the post deforestation stratum *i*; tCO2-e ha-1; excluded from project and accounted as 0.	N/A
u	*1,2,3,…U* post-deforestation land uses; in this case, only one post-deforestation land use, sugar cane agriculture.	1
i	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

Since the measurements used for this monitoring report also set the baseline for the project, carbon stock enhancement is not included. If carbon stock enhancement had been observed based on monitoring data the following equation and parameters would have been used:

$$\Delta C_{P,Enh,i,t} = \sum_{t=1}^{t}\sum_{i=1}^{M}\left(\left(C_{P,i,t} - C_{BSL,i}\right) * A_{Enh,PL,i,t}\right)$$

Where:

Parameter	Description	Result
$\Delta C_{P,Enh,i,t}$	Net carbon stock changes as a result of forest carbon stock	0

	enhancement in stratum *i* in the project area at time *t*; tCO2-e	
$C_{P,i,t}$	Carbon stock in all pools in the project case in stratum *i* at time *t*; tCO2-e ha-1	410.3
$C_{BSL,i}$	Carbon stock in all pools in the baseline in stratum *i*; tCO2-e ha-1	410.3
$A_{Enh,PL,i,t}$	Project area in stratum *i* in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario at time *t*; ha	824 ha/year for three years.
i	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

and where:

$$A_{Enh,PL,i,t} = D\%_{planned,i,t} * A_{planned,i,t}$$

Parameter	Description	Result
$A_{Enh,PL,i,t}$	Project area in stratum *i* in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario at time *t*; ha	824 ha/year for three years.
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum *i* at time *t*; %	10%/year for three years.
$A_{planned,i,}$	Total area of planned deforestation over the entire project lifetime for stratum *i*; ha	8240
i	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

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

Parameter	Description	Result
$C_{P,i,t}$	Carbon stock in all pools in the project case in stratum *i* at time *t*; tCO2-e	410.3
$C_{AB\_tree,i}$	Carbon stock in aboveground tree biomass in the project case in stratum *i*; tCO2-e ha-1	285.8
$C_{BB\_tree,i}$	Carbon stock in belowground tree biomass in the project case in stratum *i*; tCO2-e ha-1	67.2
$C_{AB\_non-tree,i}$	Carbon stock in aboveground non-tree vegetation in stratum *i*; tCO2-e ha-1	46.2
$C_{BB\_non-tree,i}$	Carbon stock in belowground non-tree vegetation in stratum *i*; tCO2-e ha-1	11.1
$C_{DW,i}$	Carbon stock in dead wood in the project case in stratum *i*; tCO2-e ha-1	N/A
$C_{LI,i}$	Carbon stock in litter in the project case in stratum *i*; tCO2-e ha-1	N/A
$C_{SOC,i}$	Carbon stock in soil organic carbon in the project case in stratum *i*; tCO2-e ha-1	N/A
i	1, 2, 3 …*M* strata	1
t	1, 2, 3, … *t** years elapsed since the start of the REDD project activity	3

ls excluded from the project, $C_{DW,I}$, $C_{LI,I}$, and $C_{SOC,I}$, will be accounted as zero. Herbaceous non-tree vegetation is considered to be *de minimis* in all instances.

Table 5: Project Emissions Summary by Year

Year	Project Emissions

	Biomass Change ($\Delta C_{P,Enh,i,t}$)	Long Term Wood Products Pool (C_{wp100})	Non-CO_2 Biomass Burning ($E_{biomassburn}$)	Natural Disturbance ($\Delta C_{P,DistPA,i,t}$)	Total Project Emissions (ΔC_P)
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	0	0	0	0	0

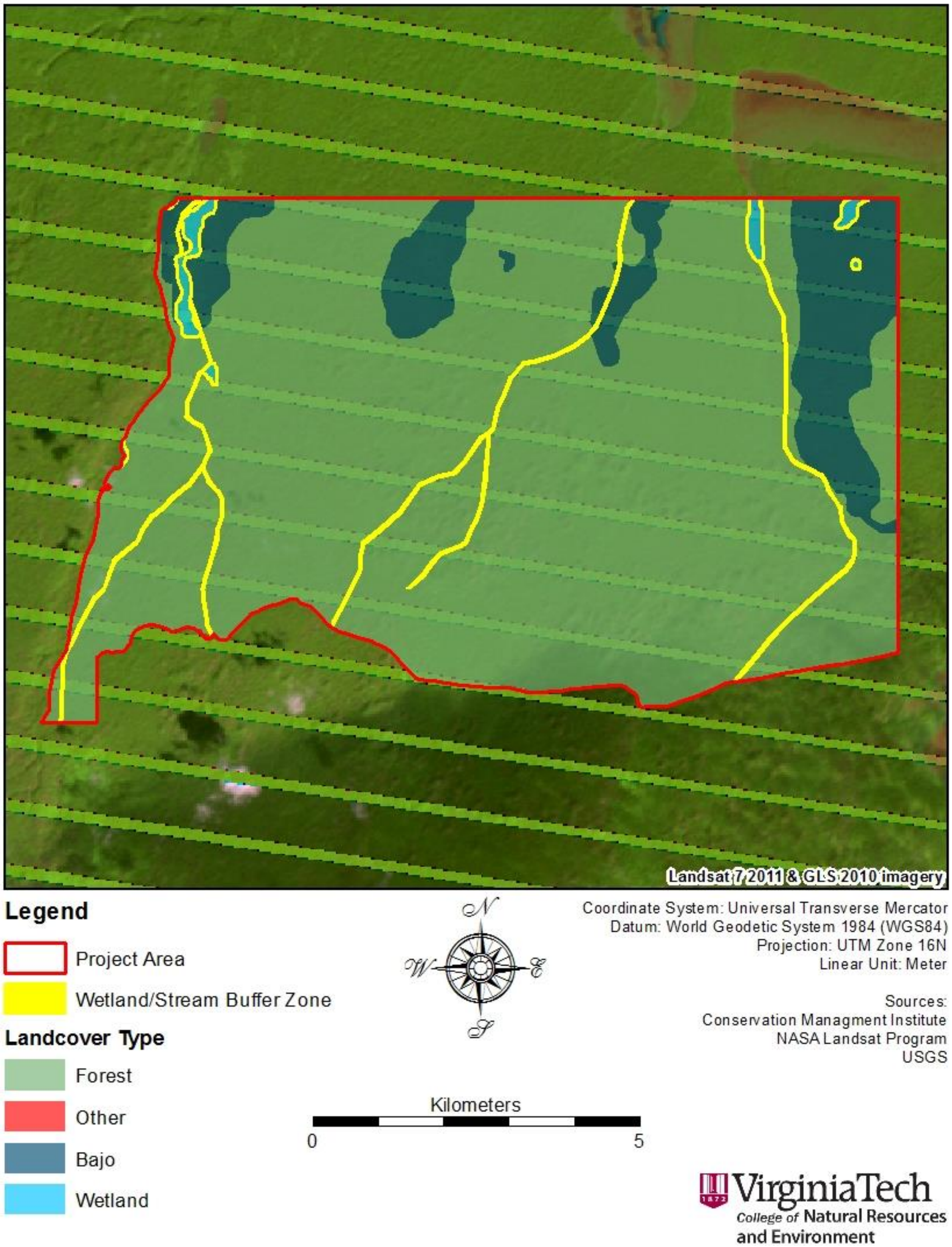

Figure 5: Project Forest Cover Benchmark Map.

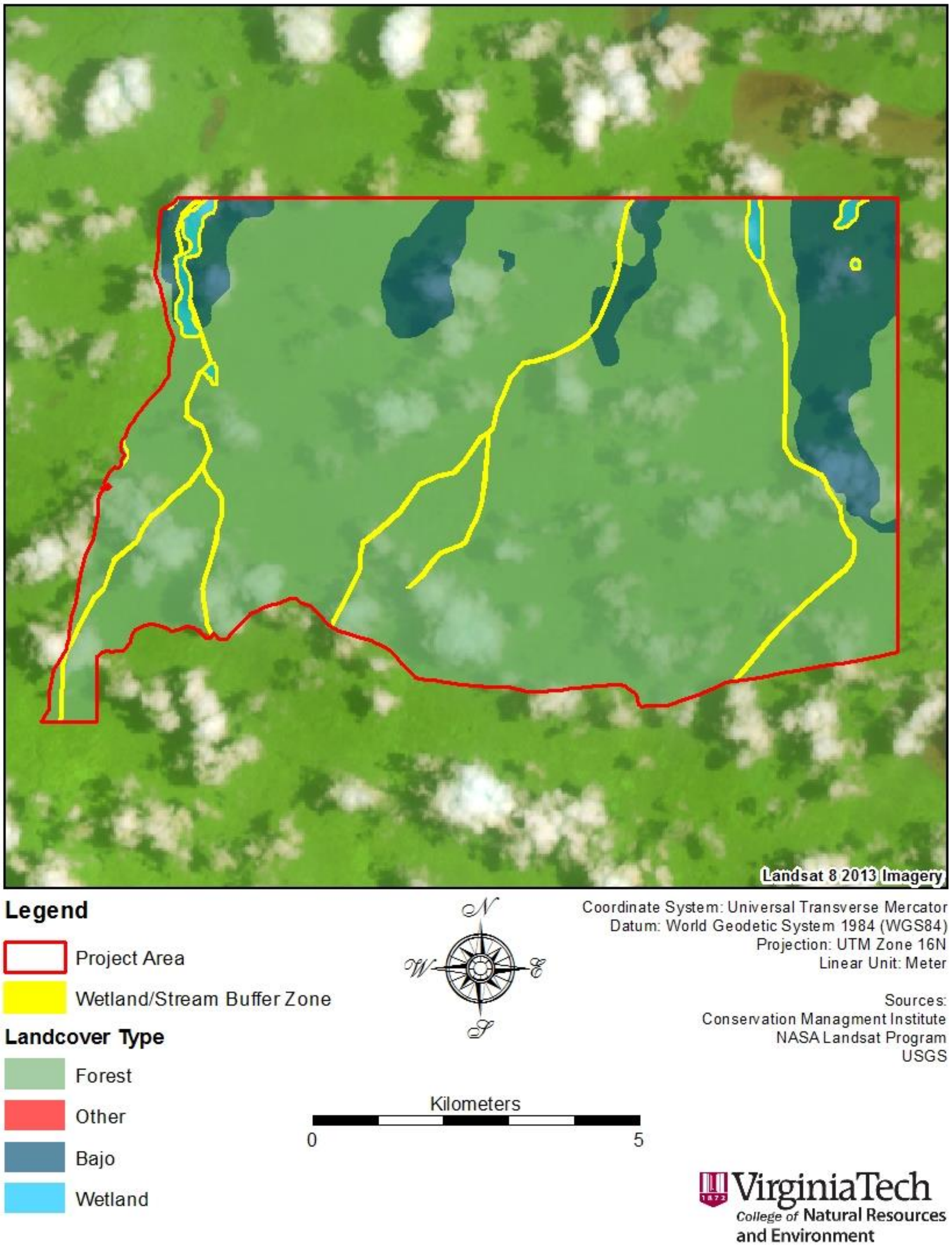

Figure 6: Project Forest Cover Monitoring Map.

4.3 Leakage

Leakage can take two forms in this case, market effects and activity shifting.

a. <u>Market Effects Leakage</u>

Market effects leakage captures possible emissions from timber harvest that could be generated when the project is removed from the available land base and additional pressure is put on surrounding landowners to provide timber to the market. Market effects leakage was calculated as a component of baseline emissions as follows:

$$\Delta C_{LK-ME} = LK_{MarketEffects,timber} + LK_{MarketEffects,FW/C}$$

Where:

Parameter	Description	Result
$\Delta C_{LK\text{-}ME}$	Net greenhouse gas emissions due to market-effects leakage (tCO2e)	98,297
$LK_{MarketEffects,timber}$	Total GHG emissions due to market-effects leakage through decreased timber harvest (tCO2e)	98,297
$LK_{MarketEffects,FW/C}$	Total GHG emissions due to market-effects leakage through decreased harvest of fuelwood and charcoal sold into regional and/or national markets (tCO2e); no commercial harvest of charcoal or fuelwood exists in the community.	0
$LK_{MarketEffects,Peat}$	Total GHG emissions due to market-effects leakage through decreased timber, fuelwood and charcoal harvest resulting in increased peatland drainage (tCO2-e); N/A	0

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

Where:

Parameter	Description	Result
$LK_{MarketEffects,timber}$	Total GHG emissions due to market-effects leakage through decreased timber harvest (tCO2e)	98,297
LF_{ME}	Leakage factor for market-effects calculations (dimensionless)	0.4
LK_{MAF}	Leakage management adjustment factor (dimensionless): conservatively set to 1 indicating no effects from leakage area management.	1
$AL_{T,i}$	Summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of the project (tCO2e)	245,741
i	1,2,3,…M strata (dimensionless)	1

$$AL_{T,i} = \sum_{t=1}^{t} (C_{BSL,XBT,i,t})$$

Parameter	Description	Result
$AL_{T,i}$	Summed emissions from timber harvest in stratum *i* in the baseline case laced through implementation of carbon project (tCO2e)	81,914
$C_{BSL,XBT,i,t}$	Carbon emission due to displaced timber harvests in the baseline scenario in stratum *i* in year *t* (tCO2e)	81,914
i	1, 2, 3, … *M* strata (unitless)	one strata
t	*1, 2, 3 … t** time elapsed since the start of the project activity (years)	3 years

$$C_{BSL,XBT,i,t} = \left(\left[V_{BSL,XE,i,t} * D_{mn} * CF\right] + \left[V_{BSL,XE,i,t} * LDF\right] + \left[V_{BSL,XE,i,t} * LIF\right]\right) * \frac{44}{12}$$

Where:

Parameter	Description	Result
$C_{BSL,XBT,i,t}$	Carbon emission due to timber harvests in the baseline scenario in stratum *i* in year *t* (tCO2e)	81,914
$V_{BSL,EX,i,t}$	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum *i* in year *t* (m^3)	19,348
D_{mn}	Mean wood density of commercially harvested species (t d.m.m^{-3})	0.712
CF	Carbon fraction of biomass for commercially harvested species *j* (t C t d.m.$^{-1}$)	0.47
LDF	Logging damage factor (t C m^{-3})	0.53
LIF	Logging infrastructure factor (t C m^{-3})	0.29
i	1, 2, 3, … *M* strata (unitless)	one strata
t	*1, 2, 3 … t** time elapsed since the start of the project activity (years)	3 years

Market effects leakage is reported by year in Table 6.

b. <u>Activity Shifting Leakage</u>

Activity shifting leakage is the potential for the agent of deforestation to deforest lands for the post-deforestation land use identified in the baseline, sugarcane. GJA forested lands, the leakage area/belt, were monitored using remote sensing and no deforestation for sugarcane was detected. The leakage belt/area consisted of 40,177.7 ha of forest and bajo area owned by the agent of deforestation, GJA, in 2011. Calculations are found in Section 4.2 for parameter $\Delta C_{P,LB}$. Activity shifting leakage is calculated using module LK-ASP using the following equations and parameters:

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t^*}\sum_{i=1}^{M}\left(\left(LKA_{planned,i,t} * \Delta C_{BSL,i}\right) + GHG_{LK,E,i,t} + LK_{peat}\right)$$

Parameter	Description	Result	Result	Result
$\Delta C_{LK-AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation; tCO2-e	0	0	0
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i at time t; ha	0	0	0
$\Delta C_{BSL,i}$	Net carbon stock changes in all pools in baseline stratum i; tCO2-e ha-1	317.7	325.0	332.2
$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoided deforestation activities in stratum i in year t; tCO2-e	0	0	0
$LK_{peat,t}$	Net greenhouse gas emissions due to leakage to peatlands as a result of implementation of a planned deforestation project at time t; tCO2-e	N/A no peat present	N/A no peat present	N/A no peat present
i	1, 2, 3, … *M* strata	1	1	
t	1, 2, 3, … *t** years elapsed since the projected start of the REDD project activity	2011	2012	2013

$$WoPR_{i,t} = \sum_{ag=1}^{ag}\frac{HistHa_{i,ag}}{5}$$

Parameter	Result	Description
$WoPR_{i,t}$	824/year	Deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t* in the absence of the project; ha: Where there is no history of deforestation and no verifiable plans for controlled lands and future-controlled lands then WoPR must be set to planned baseline rate for the project (D%planned * Aplanned from the planned deforestation baseline module).
$HistHa_{i,ag}$	0	The number of hectares of forest cleared by the baseline agent of the planned deforestation in the five years prior to project implementation in stratum i by agent ag within the country; ha
i	1	1, 2, 3, … *M* strata
ag	1	1, 2, 3, … *ag* agents of deforestation
t	2011-2013	1, 2, 3, … *t** years elapsed since the projected start of the REDD project activity

$$NewR_{i,t} = WoPR_{i,t} - \left(D\%_{planned,i,t} * A_{planned,i}\right)$$

Parameter	Result	Description
$NewR_{i,t}$	0	New calculated forest clearance in stratum *i* at time *t* by the baseline agent of the planned deforestation where no leakage is occurring; ha
$WoPR_{i,t}$	824/year	Deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t* in the absence of the project; ha
$D\%_{planned,i,t}$	10%	Projected annual proportion of land that will be deforested in stratum *i* at year *t;* %
$A_{planned,i,}$	8240	Total area of planned deforestation over the baseline period for stratum *i*; ha
i	1	1, 2, 3, … *M* strata
t	2011-2013	1, 2, 3, … *t** years elapsed since the projected start of the REDD project activity

$$LKA_{planned,i,t} = A_{defLK,i,t} - NewR_{i,t}$$

Parameter	Result	Description
$LKA_{planned,i,t}$	0	The area of activity shifting leakage in stratum i at time t; ha
$NewR_{i,t}$	0	New calculated forest clearance in stratum *i* at time *t* by the baseline agent of the planned deforestation where no leakage is occurring; ha
$A_{defLK,i,t}$	0	The total area of deforestation by the baseline agent of the planned deforestation in stratum i at time, t; ha
i	1	1, 2, 3, … *M* strata
t	2011-2013	1, 2, 3, … *t** years elapsed since the projected start of the REDD project activity

Activity shifting leakage can also take the form of biomass burning as a result of deforestation for sugarcane agriculture. The parameters, calculations and results of monitoring follow:

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

Parameter	Result	Description
$GHG_{LK,E,i,t}$	0	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum *i* in year *t* (tCO2e)
$E_{biomassburn,i,t}$	0	Non-CO_2 emissions due to biomass burning in stratum *i* in year *t* (tCO2e)
$N_2O_{direct-N,i,t}$	0	Direct N2O emission as a result of nitrogen application on the alternative land use in stratum i in year t (tCO2e); conservatively excluded pool.
i	1	1, 2, 3, … *M* strata (unitless)

t	2011-2013	*1, 2, 3 … t** time elapsed since the start of the project activity (years)

Total leakage effects are calculated as follows:

$$\Delta C_{LK} = \Delta C_{LK-AS,planned} + \Delta C_{LK-AS,unplanned} + \Delta C_{LK-AS,\deg rad-FW/C} + \Delta C_{LK-ME}$$

Where:

Parameter	Description	Result
ΔC_{LK}	Net greenhouse gas emissions due to leakage; tCO_2e; note annual reporting of parameter in Table 6.	98,297
$\Delta C_{LK-AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation; tCO_2e (from LK-ASP)	0
$\Delta C_{LK-AS,unplanned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing unplanned deforestation; tCO_2e (from LK-ASU): note this is a avoided planned deforestation and this parameter is n/a.	N/A
ΔC_{LK-ME}	Net greenhouse gas emissions due to market-effects leakage; tCO_2e (from LK-ME).	98,297
$\Delta C_{LK-AS,degrad-FW/C}$	Net greenhouse gas emissions due to activity shifting leakage for degradation caused by extraction of wood for fuel; tCO_2e (from LK-DFW).	N/A

Table 6: Leakage parameters by year.

Years (t)	ΔC_{LK-ME}	$\Delta C_{LK-AS,planned}$	Leakage emissions (tCO_2e): ΔC_{LK}
2011	32,766	0	32,766
2012	32,766	0	32,766
2013	32,766	0	32,766
Total	98,297	0	98,297

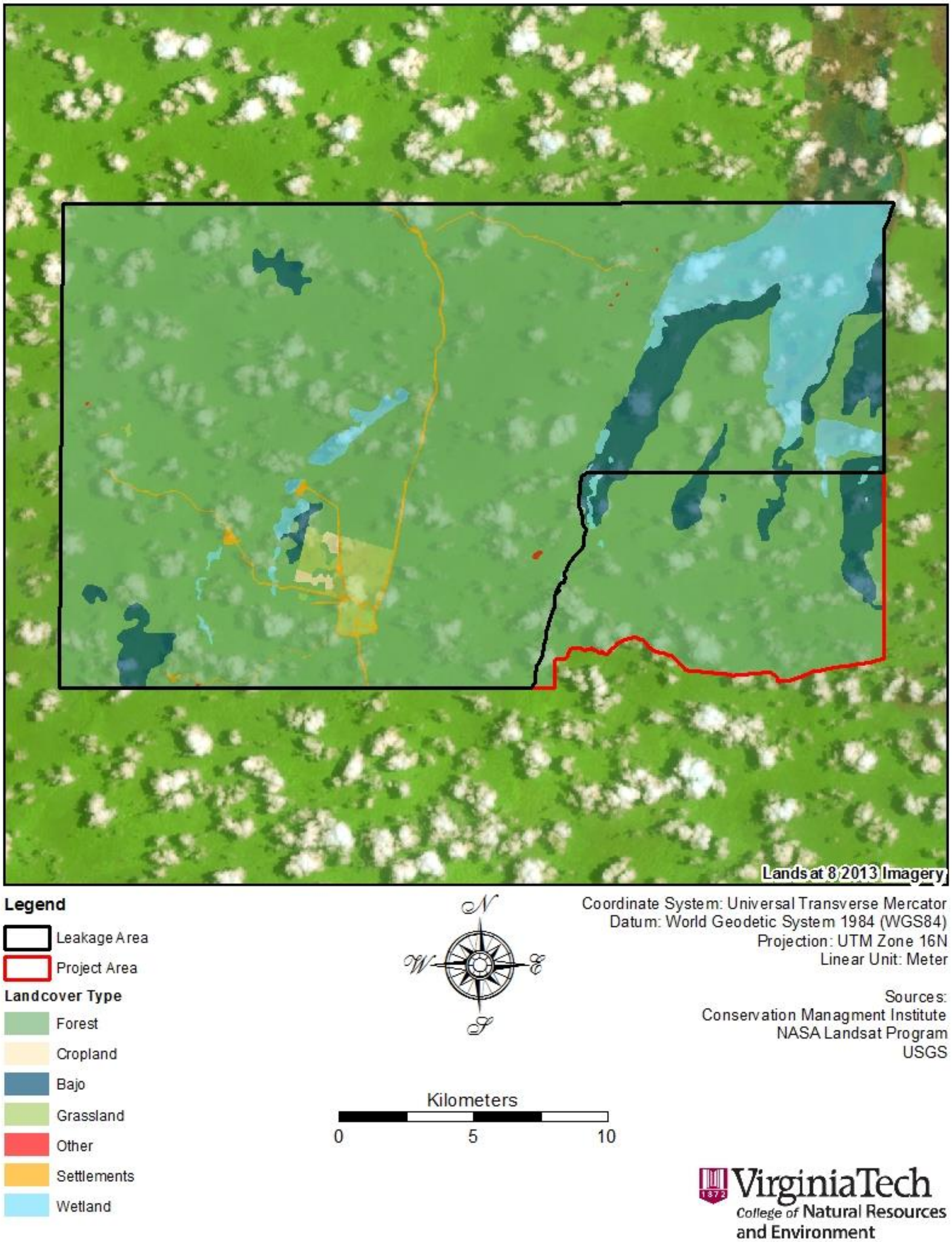

Figure 7: Leakage area monitoring map.

4.4 Net GHG Emission Reductions and Removals

The T-SIG module was utilized to determine that three pools or sources of emissions were de minimis and accounted for less than 5% of the total emissions or avoided emissions for the project.

Baseline Source/Activity	**Description**	**Total GHG emissions baseline**	**Contribution relative total decreases in carbon pools and increases in emissions**	**Contribution relative to net anthropogenic removals by sinks**
$\Delta C_{BSL,planned}$ Net greenhouse gas emissions in the baseline from planned deforestation; t CO_2-e	Biomass change from planned deforestation	761,303	84.38%	107.99%
$E_{biomassburn,i,t}$	Non-CO_2 Biomass Burning	41,977	4.65%	5.95%
$\Delta C_{LK\text{-}ME}$	Net greenhouse gas emissions due to market- effects leakage; t CO_2-e	98,297	10.89%	13.94%
Project Area Degradation ($\Delta C_{P,DegW,i,t}$)	Degradation from fuelwood collection	682	0.08%	0.10%
Project Area Degradation ($\Delta C_{P,SelLog,i,t}$)	Degradation from timber harvest	0	0.00%	0.00%
Total		902,258	100.00%	127.98%

Based on this analysis emissions from project area degradation due to timber harvest and fuelwood collection are all considered de minimis and excluded from any claims of emissions benefits for the monitoring period. Calculations for $\Delta C_{P,DegW,i,t}$ and $\Delta C_{P,SelLog,i,t}$ were made at project validation and may be found in Section 5.3 of the project design document.

The procedures for calculating the summary of emissions reductions and removals follows the equation:

$$C_{REDD,t} = \Delta C_{BSL} - \Delta C_P - \Delta C_{LK}$$

Where:

Parameter	Description	Result
$C_{REDD,t}$	Total net greenhouse emission reductions at time *t*; tCO_2e; note annual reporting of parameter in Table 7.	704,983
ΔC_{BSL}	Net greenhouse gas emissions under the baseline scenario; tCO_2e	803,279
ΔC_P	Net greenhouse gas emissions within the project area under the project scenario; tCO_2e (from M-MON)	0
ΔC_{LK}	Net greenhouse gas emissions due to leakage; tCO_2e; equivalent to $\Delta C_{P,LB}$ in this application.	98,297

Based on the use of these formulas and parameters the following summary table is provided:

Table 7: Summary of Baseline, Project, Leakage, and Total Emissions by Year

Year	Total Project Emissions (ΔC_P)	Total Baseline Emissions and Reductions (ΔC_{BSL})	Leakage Deductions (ΔC_{LK})	Total net GHG emissions ($C_{REDD,t}$)	Total Avoided Emissions minus Uncertainty (Adjusted-$C_{REDD,i,t}$)	Risk Buffer (27%)	Net Total
2011	0	261,777	32,766	229,011	229,011	70,680	158,331
2012	0	267,760	32,766	234,994	234,994	72,296	162,699
2013	0	273,743	32,766	240,977	240,977	73,911	167,066

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6 APPENDIX A: REMOTE SENSING REPORT

Develop and Update Geospatial Data to Support the Laguna Seca Forest Carbon Offset Project

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1.0 Background

As part of an ongoing effort, The Conservation Management Institute at Virginia Tech (CMIVT) was tasked with developing geospatial data and map products to support Laguna Seca forest carbon offset project in Belize. The project is being certified under Verified Carbon Standard (VCS) methodology VM0007 (2013). Geospatial analysis and map product creation followed guidelines and recommendations contained in the GOFC-GOLD Sourcebook (2014) unless otherwise noted. The following detailed information outlines the materials, methods, and parameters used to complete the mapping.

2.0 Image Acquisition and Processing

2.1 Imagery Selection

Landsat sensors were used in geospatial analysis and to create landcover maps for the project. The medium resolution imagery provided by landsat sensors is commonly used to map deforestation and estimate area change and widely recognized as a cost effective and accurate image source for mid-resolution data analysis. The primary Landsat images used were: LANDSAT 8 2013 Julian Day 219, LANDSAT 7 2013 Julian Day 83, LANDSAT 7 2011 Julian Day 14, and LANDSAT 7 GLS 2010. Ancillary Landsat images included: LANDSAT 8 2014 Julian Day 350 and LANDSAT 7 GLS 2000. All Landsat 7 ETM+, 30 meter and Landsat 8 OLI, 30 meter imagery were downloaded from the United States Geological Survey's Global Visualization Viewer (GloVis) (http://glovis.usgs.gov).

Rapideye imagery was used to assess the accuracy of the landcover maps and is considered an appropriate tool for '"ground-truthing" the interpretation of satellite imagery and for assessing the accuracy. The two Rapideye images (March 30, 2011 and March 22, 2013), both 5-band images with five meter resolution, were used to assess accuracy. Both images were obtained directly from the vendor.

2.2 Image Preprocessing

Preprocessing should include the following three steps: geometric corrections, cloud removal, and radiometric corrections. Since we employed a visual interpretation method (see below), we determined radiometric corrections would provide little additional benefit and given that '*For simple scene by scene analysis (e.g. visual interpretation), the radiometric effects of topography and atmosphere should be considered in the interpretation process but do not need to be digitally normalized' (Sourcebook 2014)*.

Thus we determined that foregoing this step would have no impact on the map products or resulting geospatial analysis. Employing visual interpretation techniques also allowed for cloud coverage to be effectively handled as part of the interpretation process. Sections 3.1 and 3.2 provide further discussion of visual interpretation methods as well as techniques used to mitigate cloud coverage.

We performed geometric corrections on all Landsat images and referenced to the Landsat GLS 2010 as a baseline. CMIVT analysts completed the georectification in ArcGIS 10.1 with the 'Georeferencing' toolbar using the '*Adjust*' transformation to resample using cubic convolution. Rectification followed all relevant industry standards described in the GEO GOFI Guidance (2014). RMSE was calculated for each image and were well within the recommended Sourcebook (2014) error of less than 1 pixel (30 meters in this case). RMSE (in meters) for each image:

Mapping Imagery:

- LANDSAT 8 2013 Julian Day 219 – RMS Forward: 4.50439
- LANDSAT 7 2013 Julian Day 83 – RMS Forward: 1.91068
- LANDSAT 7 2011 Julian Day 14 – RMS Forward: 1.91511

Historic and Ancillary Imagery:

- LANDSAT 7 GLS 2000 – RMS Forward: 2.2772
- LANDSAT 8 2014 Julian Day 350 – RMS Forward: 8.28421

Georectification Reference Image:

- LANDSAT 7 GLS 2010 (also used to map 2011 landcover)

2.3 Landcover Classification

Image classification consisted of seven categories: Forest, Bajo (i.e. wet forest), Cropland, Grassland, Settlements, Wetland, and Other based off the Sourcebook (2014), Table 1.2.1 with a MMU of 1 hectare. Because the project area was relatively small, and mapping was accomplished through visual interpretation, a wall-to-wall mapping strategy was employed as it was practical and the most suitable method for the project.

3.0 Analysis and Methods

The minimum requirements for image interpretation as described in the Sourcebook (2014) are: '*Geo-location accuracy < 1 pixel, i.e. < 30m, Minimum mapping unit should be between 1 and 6 ha, A consistency assessment should be carried out'.*

3.1 Image Interpretation

CMIVT performed a full visual delineation of the project area using Landsat. All digitization was performed at an approximate scale of 1:15,000 by an experienced photo-interpreter (PI) familiar with satellite imagery applications, photo-interpretation and possessing *a priori* knowledge of land use/land cover in the area. We used the band combination of 5,4,2 (short-wave infrared, near infrared, green). Subject Matter Experts possessing significant field experience on the Gallon Jug property also provided input and assistance during the mapping process. Upon completion of the initial map, final review and quality control was performed by senior staff per CMIVT organizational standard operating procedures before the validation and accuracy assessment step.

3.2 Approach

Because the Landsat 8 image from 2014 was the most cloud free, we used it to create an initial landcover map using photo-interpretive digitization of multi-date imagery, on-screen, using ArcGIS 10.1 software. We subsequently referenced the Landsat 7, 2011 (cloud-free, with striping due to SLC off) as well as the GLS 2010 (stripe free, to fill in Landsat 7 gaps) to create the 2011 landcover map and a record of change between 2011 and 2014.

As none of the available 2013 Landsat images were cloud free, a multi-date approach was used to identify specifically when these landcover changes occurred. By referencing each 2013 image in turn, analysts identified cloud free areas for all targeted changes in 2013 and could determine if changes were pre or post monitoring period (i.e., between 2011 and 2013 or later). In doing so, a change detection map for the project and subsequently a full 2013 landcover map were created. Thus, the 2014 land cover was ultimately no longer referenced or relevant and was eliminated from further analysis. The above approach was also applied to create the historic Forest/Non-Forest layer displayed in the Historic map with GLS 2000 imagery.

3.3 Forest Change

For this project, detection of forest change was incorporated into the original mapping process (see section 3.2). Following the Sourcebook (2014), a direct visual interpretation of images was employed as opposed to a post-hoc analysis of landcover maps

3.4 Accuracy Assessment

We conducted an accuracy assessment on all project area land cover and leakage area land cover maps following industry standards and applicable practices as described in Congalton (1991) and GFOI (2013).

Using the specific land cover layer, random points were created for each cover class. Points were created and allocated using the Create Random Points tool in ArcGIS 10.1 with the following parameters: 75 points for forest class and 50 points each for other classes with a point separation of 250 meters. Points within 15 meters of a boundary were removed to eliminate confusion during the accuracy assessment. For those classes covering a very small percentage of the total area, 50 points often could not be allocated. In these case the maximum number of points were allocated according to the parameters above.

A subject matter expert (based on education, experience, and on-the-ground familiarity with the project area) classified all points using Rapid Eye high resolution imagery from the respective mapping year, after which the points were intersected with the land cover layer to calculate accuracy.

Table A1: Project Area 2011 Accuracy Assessment

Landcover Class	Bajo	Forest	Other	Wetland	**Total**	*User Accuracy*
Bajo	28	3			31	90.3%
Forest		68			68	100.0%
Other			1		1	100.0%
Wetland	2			1	3	33.3%
Total	30	71	1	1	103	
Producer's Accuracy	93.3%	95.8%	100.0%	100.0%		95.1%

Table A2: Leakage Area 2011 Accuracy Assessment

Landcover Class	Bajo	Crop land	Forest	Grass -land	Other	Settle-ments	Wetland	**Total**	*User Accuracy*
Bajo	45							45	100.0%
Cropland		2		6				8	25.0%
Forest	2		73					75	97.3%
Grassland				12		1		13	92.3%
Other					1			1	100.0%
Settle-ments			1			7		8	87.5%
Wetland							50	50	100.0%
Total	47	2	74	18	1	8	50	200	
Producer's Accuracy	95.7%	100.0%	98.6%	66.7%	100.0%	87.5%	100.0%		95.0%

Table A3: Project Area 2013 Accuracy Assessment

Landcover Class	Bajo	Forest	Other	Wetland	Grand Total	User Accuracy
Bajo	18	4		1	23	78.3%
Forest	4	71			75	94.7%
Other			1		1	100.0%
Wetland				1	1	100.0%
Grand Total	22	75	1	2	100	
Producer Accuracy	81.8%	94.7%	100.0%	50.0%		
						Total Accuracy: 91.0%

Table A4: Leakage Area 2013 2013 Accuracy Assessment

Landcover Class	Bajo	Crop land	Forest	Grass-land	Other	Settle-ments	Wetland	**Total**	*User Accuracy*
Bajo	38		1					39	97.4%
Cropland		1		3				4	25.0%
Forest	9		73	1				83	88.0%
Grassland		1		10				11	90.9%
Other					1			1	100.0%
Settlements						5		5	100.0%
Wetland							49	49	100.0%
Grand Total	47	2	74	14	1	5	49	192	
Producer Accuracy	80.9%	50.0%	98.7%	71.44%	100.0%	100.0%	100.0%		
									Total Accuracy: 92.2%

4.0 Deliverables

The deliverables for this project include tables, geospatial data, and maps.

4.1 Tables

Land cover area for both the project area and leakage area and their associated accuracy assessments are provided in the XL workbook "*Laguna _Seca_data_Tables_20150520 version 1* " in individual worksheets.

4.2 Maps

The following maps are provided as JPEG attachments to support the Laguna Seca Forest Carbon Project (Table A3).

Table A3: Map products developed in support of the Laguna Seca Forest Carbon project.

Maps	**Descriptions**	**Validation or Verification or Both**
General Boundaries	General map displaying the Project Area, know as the Lower Wamil, and the Leakage Area within the historic Gallon Jug Property.	Both
Lower Wamil Landcover 2011	Land cover of the Project Area as of 2011 (benchmark period).	Both
Lower Wamil Landcover 2013	Land cover of the Project Area as of 2013 (monitoring period).	Verification
Leakage Area Landcover 2011	Land cover of the Leakage Area as of 2011, separated by the specified cover classes.	Both
Leakage Area Landcover 2013	Land cover of the Leakage Area as of 2013, separated by the specified cover classes.	Verification
Landcover Change	Displaying the Project Area land covers from 2011 and 2013 and that the area had remained unchanged.	Verification
Historic Landcover	Displays the Forest/Non Forest cover of the entire Historic Gallon Jug Property 10 years prior to start of the project.	Validation
Regional	Location of the Historic Gallon Jug Property in relation to the country of Belize and in Central America.	Both
Plot Points	Forest plot locations and in which land cover class they reside in the Project Area.	Both

4.3 Geospatial Data

The following geospatial data were created as to support the Laguna Seca Forest Carbon Project (Table A4).

Table A4: Map products developed in support of the Laguna Seca Forest Carbon project.

Spatial	Description	Validation or Verification or Both
Accuracy Assessment Project Area 2011	Random points created based on the 2011 Land cover layer to perform the Accuracy Assessment.	Both
Accuracy Assessment Project Area 2013	Random points created based on the 2013 Land cover layer to perform the Accuracy Assessment.	Verification
Lower Wamil Landcover 2011	Polygon layers distinguishing land cover of the Project Area in 2011 according to the specified cover classes.	Both
Lower Wamil Landcover 2013	Polygon layers distinguishing land cover of the Project Area in 2013 according to the specified cover classes.	Verification
Leakage Area Landcover 2011	Polygon layers distinguishing land cover of the Leakage Area in 2011 according to the specified cover classes.	Both
Leakage Area Landcover 2013	Polygon layers distinguishing land cover of the Leakage Area in 2013 according to the specified cover classes.	Verification
Historic Property Area	Polygon layer classifying the Forest and Non Forest areas in the Historic Gallon Jug Property a decade before the start of the project.	Both
Wetland Buffers	A single chain (66 feet) buffer surrounding all wetlands.	Both
Lower Wamil Project Area	Boundary of the Lower Wamil, henceforth known as the Project Area.	Both
Leakage Area	Part of the Historic Gallon Jug Property that is not within the Lower Wamil, and known henceforth as the Leakage Area.	Both
Plot Points	Forest plot locations where measurements were conducted within the Project Area (the Lower Wamil).	Both

Citations

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