

AVOIDING PLANNED DEFORESTATION AND DEGRADATION IN THE VALDIVIAN COASTAL RESERVE, CHILE

Document Prepared By
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Table of Contents

1 PROJECT DETAILS	3
1.1 Summary Description of the Implementation Status of the Project	3
1.2 Sectoral Scope and Project Type	3
1.3 Project Proponent	3
1.4 Other Entities Involved in the Project	4
1.5 Project Start Date	5
1.6 Project Crediting Period	5
1.7 Project Location	5
1.8 Title and Reference of Methodology	8
1.9 Other Programs	8
2 IMPLEMENTATION STATUS	10
2.1 Implementation Status of the Project Activity	10
2.2 Deviations	10
2.3 Grouped Project	11
3 DATA AND PARAMETERS	12
3.1 Data and Parameters Available at Validation	12
3.2 Data and Parameters Monitored	18
3.3 Monitoring Plan	27
4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS	43
4.1 Baseline Emissions	43
4.2 Project Emissions	44
4.3 Leakage	47
4.4 Net GHG Emission Reductions and Removals	48
5 ADDITIONAL INFORMATION	50

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

TNC granted a conservation easement on the Valdivian Coastal Reserve to FORECOS, recorded on 23 May 2014, in order to protect the ecological values at the Reserve for future generations, even if the property title were to change in the future.

Table 1.1. Project activities implemented during the current monitoring period

Project activity	Date	Notes
VCS validation and first verification of the project	2013	Verification interval 2003-2011
VCS registration of the project	2013	
Servidumbre established	23 May 2014	

During the monitoring period, no new deforestation, degradation or natural disturbances took place in the project area, confirmed through classification of Landsat imagery and from close surveillance of the reserve by park guards and CONAF. Total GHG emission reductions or removals generated in this monitoring period were 80,288 t CO₂e (72,252 t CO₂e after VCS AFOLU risk buffer contribution).

1.2 Sectoral Scope and Project Type

Project Scope 14: Agriculture, Forest and other Land Use (AFOLU)

Project Category: Reduction Emission from Deforestation and Degradation (REDD)

Type of Activity: Avoided Planned Deforestation (APD)

1.3 Project Proponent

The project will be financed and implemented by The Nature Conservancy. Roles and responsibilities of project proponents are elaborated in Table 1.2 below. All project proponents are listed in Table 1.2; and no other implementation partners exist.

Table 1.2. List of project proponents

Roles and Responsibility	Position/Personnel	Contact Details
Manage project validation, verification and registration, including hiring of contractors to assist in PD development, validation and verification; offset sales support and	Sr. Business Advisor	The Nature Conservancy Forest Carbon Team 4245 North Fairfax Drive, Suite 100 Arlington, VA 22203-1606

Roles and Responsibility	Position/Personnel	Contact Details
investor relations.		(703) 841-4533
General management and oversight for the TNC program in Chile is based in Santiago. Core staff providing GIS, Science, Financial, Marketing, and Government Affairs support for the VCR are also based in Santiago.	1) <i>South Andes Director</i> 2) <i>Science Coordinator</i> 3) <i>GIS/Data Specialist</i> 4) <i>Country Representative</i> 5) <i>Associate Director of Development</i> 6) <i>Finance & Operations Manager</i>	The Nature Conservancy Marchant Pereira 367, Of 801 Providencia, Santiago, Chile
Day to day management of the VCR, including hiring of all staff, implementation of strategic plan, outreach to surrounding communities, tourism/education programs, park security and biological and carbon stock monitoring.	1) <i>Chile Conservation Manager (based in Santiago)</i> 2) <i>VCR Coordinator</i> 3) <i>Conservation Project Assistant</i> 4) <i>9 additional staff reporting to the Coordinator</i>	The Nature Conservancy Reserva Costera Valdiviana Chaihuin, Chile
Internal legal oversight and support; management of outside counsel.	<i>Senior Attorney</i>	The Nature Conservancy Rio de Janeiro, Brazil Tel via USA: (703) 841-5375

1.4 Other Entities Involved in the Project

Entity	Consultants based at Universidad de Austral, Chile
Role	1) Primary research and author of sections relating to biological and stakeholder impacts of the project. 2) Technical advisor and economic research. 3) Technical advisor and GIS/mapping.
Responsible	1) Trevor Walter 2) Miguel Carcamo 3) Aldo Farias
Address	Universidad de Austral, Valdivia, Chile
Contact	1) ecologue@gmail.com 2) miguelcarcamo@uach.cl 3) Aldo.farias@gmail.com

Entity	TerraCarbon LLC
Role	Technical lead on development of VCS PD
Responsible	David Shoch
Address	5901 N. Sheridan Road, Peoria, Illinois 61614 USA
Contact	David.shoch@terracarbon.com

Entity	SERVAL, Ltda. (Raul Troncozo)
Role	Implementation of 2011 biomass inventory, including management of field crews
Responsible	Nestor Juarez and Marcos Contreras
Address	Chile
Contact	nestorjuarez_60@yahoo.es mcontrerast@gmail.com

1.5 Project Start Date

The project start date is 4 November 2003, the date when The Nature Conservancy acquired the Valdivian Coastal Reserve property, which encompasses the project area.

1.6 Project Crediting Period

The project has a crediting period of 20 years. The start date of the crediting period is 4 November 2003 and the end date of the crediting period is 3 November 2023.

1.7 Project Location

The project area of 1,273 ha is located within the larger VCR property (Figure 1.1), in Region XIV, Chile, south of the city of Valdivia.

Figure 1.1. Location of the Valdivian Coastal Reserve, within which the VCS project area is located.

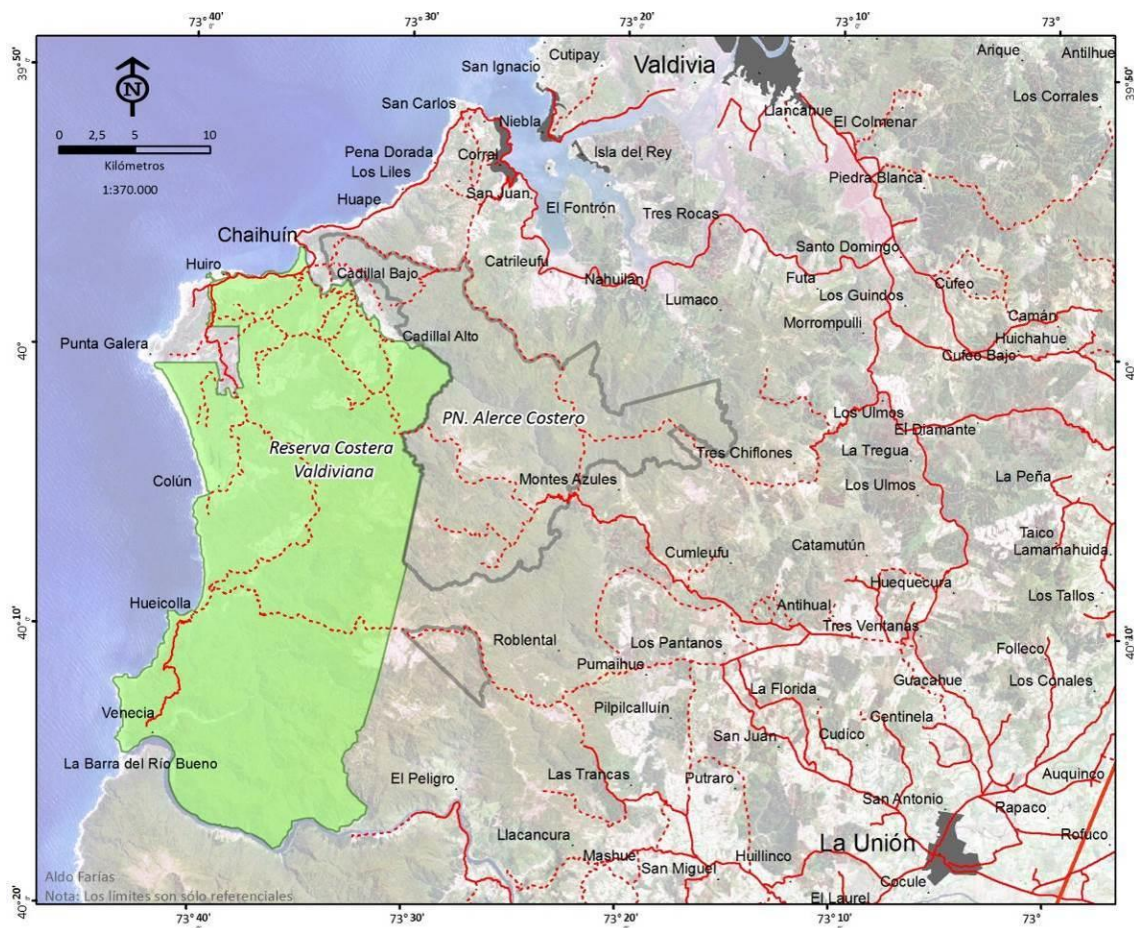
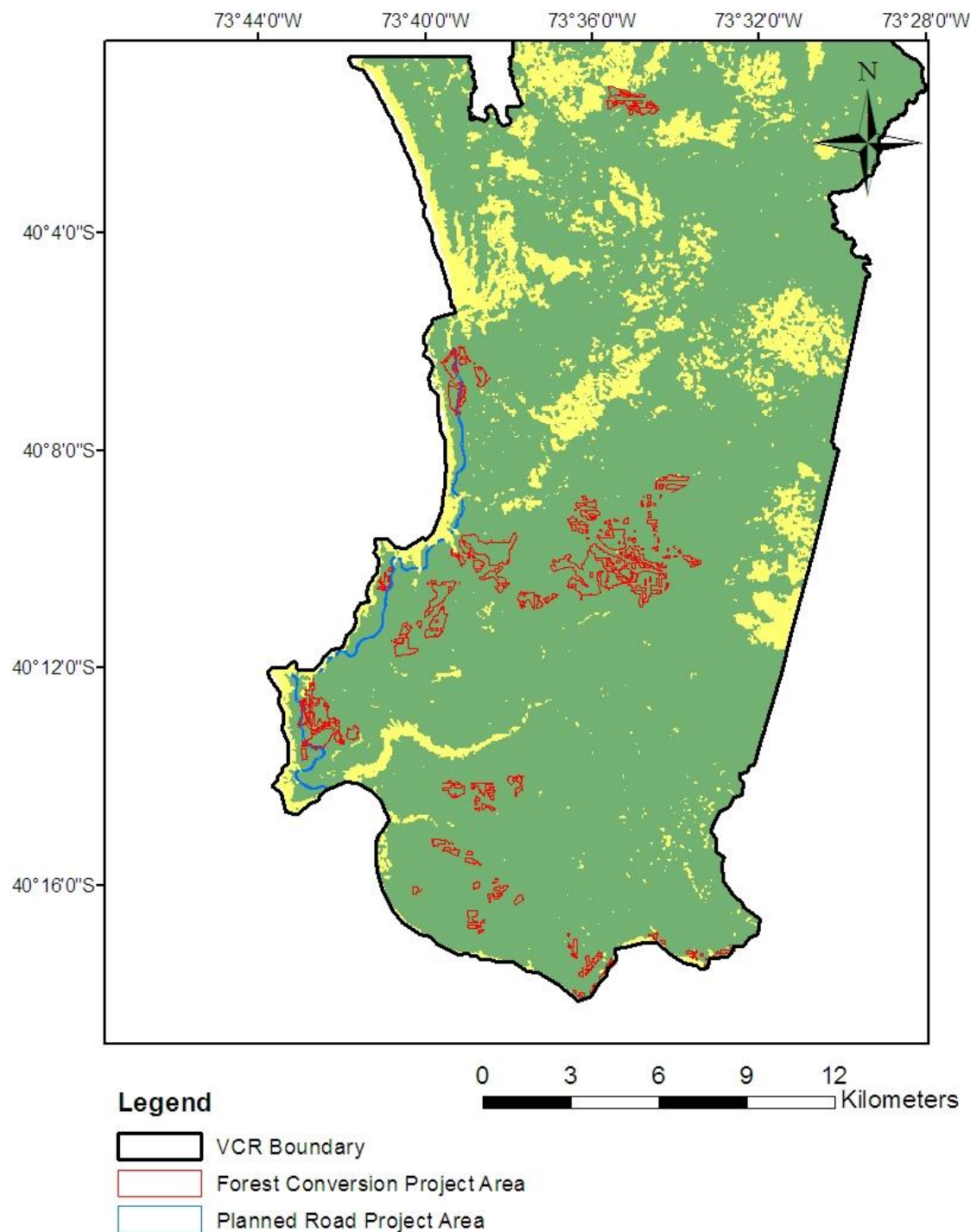


Figure 1.2. Project area within the VCR (blue outline for stop road construction activity, red outline for stop forest conversion to plantation activity) overlaid on classified 2002/2003 Landsat imagery (forest in green, non-forest in yellow).



1.8 Title and Reference of Methodology

REDD Methodology framework:

VM0007 REDD Methodology Module, REDD Methodology Framework (REDD-MF), version 1.5

This project uses the following modules and tools:

Carbon pool modules:

CP-AB “VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools”, version 1.1

CP-D “VMD0002 Estimation of carbon stocks in the dead-wood pool”, version 1.0

CP-W “VMD0005 Estimation of carbon stocks in the long-term wood products pool”, version 1.1

Baseline module:

BL-PL “VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation”, version 1.2

Leakage modules:

LK-ASP “VMD0009 Estimation of emissions from activity shifting for avoided planned deforestation”, version 1.2

LK-ME “VMD0011 Estimation of emissions from market-effects”, version 1.1. Mandatory where the process of deforestation involves timber harvesting for commercial markets

Monitoring module:

M-MON “VMD0015 Methods for monitoring of greenhouse gas emissions and removals”, version 2.1

Other modules:

X -STR “VMD0016 Methods for stratification of the project area”, version 1.1.

X-UNC “VMD0017 Estimation of uncertainty for REDD project activities”, version 2.1.

Tools:

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

“AFOLU Non-permanence Risk Tool”, version 3.2.

T-SIG “Tool for testing significance of GHG emissions in A/R CDM project activities” – latest CDM-EB approved version

1.9 Other Programs

Emission Trading Programs and Other Binding Limits

No emission reductions generated by the Valdivian Coastal Reserve Project are part of an emissions trading program. Further, Chile does not currently have a national, legally binding limit on greenhouse gas

(GHG) emissions nor is there currently a compliance emissions trading program which accepts REDD credits.

Other Forms of Environmental Credit

The Valdivian Coastal Reserve Project has not nor intends to create non-VCS GHG emission reductions or any another form of environmental credit. This includes, but is not limited to, biodiversity credits, species banking, water certificates, and nutrient certificates. The project is being submitted for certification under the Climate, Community and Biodiversity Alliance Standard, however this standard does not issue credits in any form.

Participation under Other GHG Programs

The Valdivian Coastal Reserve Project has not been registered, nor is seeking registration, under any other GHG programs. The Valdivian Coastal Reserve Project is seeking registration under the Climate, Community and Biodiversity Alliance Standard.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

In July 2012, TNC confirmed for CONAF that the legal permits to convert native forest to eucalyptus plantations had been voluntarily cancelled, and CONAF acknowledged receipt of the voluntary cancellation with an official stamp¹.

TNC has continued to engage through the monitoring period with the MOP and regional authorities and through the forum of the Technical and Legal Coordination Committee (CCTL), the collaborative multilateral body advising on the Coastal Highway, to advocate for re-routing the Coastal Highway. Ongoing communication with the MOP's regional office also has resulted in the MOP refocusing its resources on developing the route connecting Corral to La Unión rather than on the Coastal Highway (Alfredo Almonacid, RCV, Pers. Com., 2012). We are developing an impact study for this proposed alternative road development for the Ministry of Public Works.

In 2010, TNC finalized a management plan for the VCR, that was submitted and recognized by the Chilean environmental authority (Ministerio de Medio Ambiente)². TNC is currently updating the management plan and in the process of formally submitting this plan as part of an environmental impact study and seek formal government approval (*Resolución de Calificación Ambiental*) so that future owners of the Reserve will have to comply with this plan, and most importantly, potential conflicting infrastructure projects should respect this environmental authorization. TNC will submit the environmental impact study for formal government approval, as well as submit the Conservation Management Plan for approval under the Native Forest Law and its bylaw.

The Reserve's six park rangers continue patrols of the reserve, typically working ten-day shifts, with five days off for rest, with support from the coordinator and manager of community development. The VCR administrator has met annually with the ranger team to develop annual work plans based on the VCR management plan. Rangers' responsibilities included control and monitoring, forest fire prevention, environmental education, monitoring threats, wildlife monitoring, and community development. The primary operations center for the park rangers is in Chaihuin, and a new base was established in 2013 in Hueicolla, allowing the rangers to more easily and frequently monitor activities in the southern portion of the Reserve. All daily activities conducted by VCR rangers and maintenance staff are recorded in a log; Reserve vehicles also have logs for recording activities undertaken (administrative, maintenance, monitoring, etc.)

A seasonal contract with a local fire brigade for Prevention and Combat of Forest Fires is established each summer season for a period of at least two months to supplement the Reserve's park guard staff in their fire prevention activities. This brigade consists of 12 firefighters, headquartered in Colún. This program is coordinated with the National Forest Corporation's (CONAF) Fire Control Program.

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¹ 5 July 2012 letter from TNC to CONAF; bears CONAF stamp of receipt 10 July 2012

² 2010 VCR Management Plan

2.2 Deviations

2.2.1 Methodology Deviations

The following deviations to the methodology are applied.

For monitoring potential for illegal degradation, module M-MON is employed. Because it is extremely sensitive to ask of community members explicit questions regarding timber harvest activities, instead of the participatory rural appraisal approach specified in module M-MON, involving direct interviews in communities surrounding the project area to evaluate potential for illegal degradation, an alternative approach was pursued involving consultation with local authorities responsible for tracking these activities (elaborated in Section 4 of the PD).

2.2.2 Project Description Deviations

There are no deviations to the project description.

2.3 Grouped Project

The project is not a grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Details on data and parameters available at validation are provided below.

Data Unit / Parameter:	$A_{planned,i}$
Data unit:	Ha
Description:	Total area of planned deforestation over the fixed baseline period for stratum i
Source of data:	Forest permits and engineering plans. Area determination detailed in PD Section 3.1.
Value applied:	Detailed in PD Section 3.1.
Justification of choice of data or description of measurement methods and procedures applied:	Detailed in PD Section 3.1.
Any comment:	

Data Unit / Parameter:	$D\%_{planned,i,t}$
Data unit:	% year ⁻¹
Description:	Projected annual proportion of land that will be deforested in stratum i at year t
Source of data:	Forest permits, engineering plans and remote sensing data. Rate determination detailed in PD Section 3.1.
Value applied:	Detailed in PD Section 3.1.
Justification of choice of data or description of measurement methods and procedures applied:	Detailed in PD Section 3.1.
Any comment:	

Data Unit / Parameter:	$L-D_i$
Data unit:	%
Description:	Likelihood of deforestation in stratum i
Source of data:	
Value applied:	100%

Justification of choice of data or description of measurement methods and procedures applied:	The likelihood of deforestation ($L-D_i$) is set to 100% as the project area is not “both under government control and zoned for deforestation” (per module BL-PL).
Any comment:	

Data Unit / Parameter:	$\Delta C_{BSL,planned}$
Data unit:	t CO ₂ -e
Description:	Net CO ₂ emissions in the baseline from planned deforestation
Source of data:	Derived in Section 3.1 of PD
Value applied:	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied:	Derived and justified in Section 3 of PD in which baseline is set
Any comment:	

Data Unit / Parameter:	LDF
Data unit:	t C m ⁻³
Description:	Logging damage factor for logging stratum z , in stratum i
Source of data:	VMD0011
Value applied:	0.25
Justification of choice of data or description of measurement methods and procedures applied:	Default value for coniferous forests from module VMD0011. Although Eucalypts are not conifers, their growth form is closer to conifers than deciduous or hardwood species, with a predominant stem (with bark) component representing 71% of aboveground biomass ³ , particularly in plantation grown settings as in the project area.
Any comment:	

Data Unit / Parameter:	LIF
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³ Gayoso, J. 2008a. Eucalyptus sp. Resultados Proyecto FONDEF D98i1076

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:	VMD0011
Value applied:	0.29
Justification of choice of data or description of measurement methods and procedures applied:	Default value from methodology VM0007
Any comment:	

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

Data Unit / Parameter:	D
Data unit:	t d.m.m ⁻³
Description:	Basic wood density of <i>Eucalyptus globulus</i>
Source of data:	IPCC 2006GL
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied:	wood specific gravity of <i>E globulus</i> reported in the IPCC 2006GL
Any comment:	

Data Unit / Parameter:	D _{mn}
Data unit:	t d.m.m ⁻³
Description:	Mean wood density of commercially harvested species

Source of data:	IPCC 2006GL
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied:	wood specific gravity of <i>E globulus</i> reported in the IPCC 2006GL – only one species harvested in the project area
Any comment:	

Data Unit / Parameter:	WW_s
Data unit:	Dimension- less
Description:	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product s
Source of data:	VMD005
Value applied:	0.19
Justification of choice of data or description of measurement methods and procedures applied:	Default value from VMD005
Any comment:	

Data Unit / Parameter:	SLF_s
Data unit:	Dimensionless
Description:	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product s
Source of data:	VMD005
Value applied:	0.4
Justification of choice of data or description of measurement methods and procedures applied:	Default value from VMD005
Any comment:	

Data Unit / Parameter:	Ofs
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 s

Source of data:	VMD005
Value applied:	0.6
Justification of choice of data or description of measurement methods and procedures applied:	Default value from VMD005
Any comment:	

Data Unit / Parameter:	$NewR_{i,t}$
Data unit:	Ha
Description:	New calculated forest clearance in stratum i at time t by the baseline agent of the planned deforestation where no leakage is occurring
Source of data:	derived in Section 3 of PD
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Fixed for the first baseline period, derived and justified in Section 3 of PD
Any comment:	This value applies to deforestation from <i>area of deforestation</i> from any highways constructed or improved in Region XIV, within the leakage zone, which is defined as the area bounded by 1) the coast on the west, 2) the existing north-south highway Rt. 5 on the east, 3) the coastline from the town of Corral to Rt 207 on the north, and 4) the Rio Bueno on the south (representing the southernmost border of the Reserve), by the MOP after the project start date.

Data Unit / Parameter:	LF_{ME}
Data unit:	Dimensionless
Description:	Leakage factor for market effects calculations
Source of data:	VM0007; LK-ME
Value applied:	0.4
Justification of choice of data or description of measurement methods and procedures applied:	Default value where mean merchantable biomass as a proportion of total aboveground tree biomass in forests to which harvest would be displaced is equal to merchantable biomass as a proportion of total aboveground tree biomass within the project boundary. This value is justified

	because the commercial component of aboveground tree structure in the project area (<i>Eucalyptus globulus</i> plantations) will be nearly identical to areas where harvest could be displaced in Chile to make up for reduction in supply of <i>Eucalyptus globulus</i> wood (i.e. other <i>Eucalyptus globulus</i> plantations).
Any comment:	This value applies to market leakage calculations for timber harvests avoided in the project case in <i>Eucalyptus</i> plantations

Data Unit / Parameter:	$LK_{CP-ME,c,I}$
Data unit:	Dimensionless
Description:	Leakage factor for displacement of class of planned deforestation agents
Source of data:	VM0007; LK-ASP
Value applied:	0.2
Justification of choice of data or description of measurement methods and procedures applied:	Default value where average productivity of alternative lands is >15% more than the relevant strata in the project area. Justified in Section 3.
Any comment:	This value applies to activity shifting calculations for native forest to plantation conversion activities avoided in the project case

Data Unit / Parameter:	PF_c
Data unit:	Dimensionless
Description:	Proportion of available area for production of commodity c that is currently forested
Source of data:	Instituto Nacional de Estadísticas (INE). 2007. Censo Agropecuario 2007.
Value applied:	0.34
Justification of choice of data or description of measurement methods and procedures applied:	Justified in Section 3.
Any comment:	This value applies to activity shifting calculations for native forest to plantation conversion activities avoided in the project case

Data Unit / Parameter:	$COMF_i$
Data unit:	dimensionless
Description:	combustion factor for stratum i (vegetation type)
Source of data:	default values in Table 2.6 of IPCC, 2006 (Annex 2)
Value applied:	
Justification of choice of data or description of measurement methods and procedures applied:	
Any 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 in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (Annex 2: emission factors for various types of burning for CH_4 and N_2O).
Value applied:	
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

3.2 Data and Parameters Monitored

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

- “Value applied” is left blank because all parameters in this section are monitored
- “Monitoring equipment” is left blank to provide flexibility in measurement and monitoring approach, essential for any long-term MRV plan

- Where a parameter is calculated from a methodology equation (i.e. not raw data), the methodology module and equation number is specified and “Description of measurement methods and procedures to be applied” and “QA/QC procedures to be applied” are appropriately left blank
- To avoid repetition and maintain an economical use of space in the summary tables, “Description of measurement methods and procedures to be applied” and “QA/QC procedures to be applied” for monitored (not calculated) parameters reference detailed accounts of procedures provided in the monitoring plan description below.

Data Unit / Parameter:	$\Delta C_{P,Def,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of deforestation in the project case in the project area in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value applied:	0 t CO ₂ -e for the period 2012-2014
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 3, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DistPA,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value applied:	0 t CO ₂ -e for the period 2012-2014
Monitoring equipment:	
QA/QC procedures to be applied:	

Calculation method:	Equation 20, VMD0015
Any comment:	

Data Unit / Parameter:	$A_{DefPA,u,i,t}$
Data unit:	Ha
Description:	Area of recorded deforestation in the project area stratum i converted to land use u at time t
Source of data:	Monitored at each monitoring/verification event through analysis of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description. Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m * 90m), providing close conformance to 0.5 ha Chile DNA forest definition.
Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value applied:	0 ha for the period 2012-2014
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DistPA,q,i,t}$
Data unit:	ha
Description:	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i , at time t
Source of data:	Monitored at each monitoring/verification event through analysis of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description. Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m * 90m), providing close conformance to 0.5 ha Chile DNA forest definition.

Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value applied:	0 ha for the period 2012-2014
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{BSL,i}$																				
Data unit:	t CO ₂ -e ha ⁻¹																				
Description:	Carbon stock in all pools in the baseline case in stratum <i>i</i>																				
Source of data:	Estimated from forest carbon inventory																				
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description																				
Frequency of monitoring/recording:	Every ≤ 10 years. First measurement in 2011.																				
Value applied:	<table><tr><th>Strata</th><th>average AGB t CO2/ha</th><th>average BGB t CO2/ha</th><th>average dead wood t CO2/ha</th></tr><tr><td>Native forest</td><td>610.5</td><td>175.2</td><td>59.3</td></tr><tr><td><i>E globulus</i> plantation est 1990</td><td>284.1</td><td>61.3</td><td>0</td></tr><tr><td><i>E globulus</i> plantation est 1991</td><td>363.0</td><td>78.4</td><td>0</td></tr><tr><td><i>E globulus</i> plantation est 1992</td><td>434.7</td><td>93.8</td><td>0</td></tr></table> AGB = aboveground biomass BGB = belowground biomass	Strata	average AGB t CO2/ha	average BGB t CO2/ha	average dead wood t CO2/ha	Native forest	610.5	175.2	59.3	<i>E globulus</i> plantation est 1990	284.1	61.3	0	<i>E globulus</i> plantation est 1991	363.0	78.4	0	<i>E globulus</i> plantation est 1992	434.7	93.8	0
Strata	average AGB t CO2/ha	average BGB t CO2/ha	average dead wood t CO2/ha																		
Native forest	610.5	175.2	59.3																		
<i>E globulus</i> plantation est 1990	284.1	61.3	0																		
<i>E globulus</i> plantation est 1991	363.0	78.4	0																		
<i>E globulus</i> plantation est 1992	434.7	93.8	0																		

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

Data Unit / Parameter:	$C_{P,Dist,q,i}$
Data unit:	t CO ₂ -e ha ⁻¹
Description:	Carbon stock in pools in post-natural disturbance strata q in stratum i
Source of data:	Conservatively assumed to be zero
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	0 t CO ₂ -e ha ⁻¹
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DegW,i,t}$
Data unit:	ha
Description:	Area potentially impacted by degradation processes in stratum i
Source of data:	Delineated based on observations by VCR guard staff and consultation with the District Attorney's office (Fiscalia Regional) of the Ríos Region.
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Consultations conducted every ≤ 2 years. First consultation conducted in 2012.
Value applied:	0 ha
Monitoring equipment:	
QA/QC procedures to be applied:	

Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{DegW,i,t}$
Data unit:	t CO ₂ -e
Description:	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t
Source of data:	Estimated from diameter measurements of cut stumps in sample plots
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	N/A
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	AP_i
Data unit:	ha
Description:	Total area of degradation sample plots in stratum i
Source of data:	Calculated as 3% of $A_{DegW,i,t}$
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	N/A
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.

Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DegW,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock changes as a result of degradation in stratum <i>i</i> in the project area at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	N/A
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 8, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{LK-AS,planned}$
Data unit:	t CO ₂ -e
Description:	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	0 t CO ₂ -e
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 1, VMD0009

Any comment:	
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Data Unit / Parameter:	$A_{defLK,i,t}$
Data unit:	ha
Description:	The total area of deforestation by the baseline agent of the planned deforestation in stratum i at time, t
Source of data:	Monitored through investigation of MOP construction records or current road maps and remote imagery.
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	0 ha for the period 2012-2014
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	The area of this parameter is restricted to deforestation from any highways constructed or improved in Region XIV, within the leakage zone, which is defined as the area bounded by 1) the coast on the west, 2) the existing north-south highway Rt. 5 on the east, 3) the coastline from the town of Corral to Rt 207 on the north, and 4) the Rio Bueno on the south (representing the southernmost border of the Reserve), by the MOP after the project start date.

Data Unit / Parameter:	$LKA_{planned,i,t}$
Data unit:	ha
Description:	The area of activity shifting leakage in stratum i at time t
Source of data:	Calculated as $NewR_{i,t} - A_{defLK,i,t}$
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 10 years

Value applied:	0 ha
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 5, VMD0009
Any comment:	

Data Unit / Parameter:	$\Delta C_{BSL,i}$
Data unit:	t CO ₂ -e ha ⁻¹
Description:	Net carbon stock changes in all pools in baseline stratum <i>i</i>
Source of data:	Sourced from mean forest carbon stock estimates from forest carbon inventories of project area for equivalent strata in area of activity shifting leakage
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Stock estimates updated every ≤ 10 years
Value applied:	Calculated in the VCS Project Document for project years 2004-2013 and in baseline revision below for years 2014-2023
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$LK_{MarketEffects,timber}$
Data unit:	t CO ₂
Description:	Total GHG emissions due to market- effects leakage through decreased timber harvest sold into domestic markets
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	66.7 t CO ₂ for the period 2012-2014
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 2, VMD0011
Any comment:	

Data Unit / Parameter:	$A_{burn,i,t}$
Data unit:	ha
Description:	Area burnt in stratum i at time t
Source of data:	CONAF fire database and analysis of remote sensing data
Description of measurement methods and procedures to be applied:	Consultation of CONAF fire database identifying incidence of fire followed by remote sensing analysis to delineate and quantify area, detailed below under monitoring plan description
Frequency of monitoring/recording:	Areas burnt shall be monitored at least every five 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 ha
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

3.3 Monitoring Plan

3.3.1 Revision of the baseline

The baseline as outlined in the Project Description is valid for 10 years from the project start date, through November 3, 2013, and will be revised on the first monitoring event subsequent to this date.

Because the entire project area is deforested in the first 10-year baseline period, the deforestation rate in the baseline for all subsequent baseline periods will be equal to zero.

3.3.2 Monitoring of actual carbon stock changes and greenhouse gas emissions

The project area is made up of mostly mature temperate rainforest either at steady state or accruing biomass at very slow rates (i.e. unlikely to be significant within the timeframe of the project crediting period). For accounting purposes the project assumes stable stocks and no measurement or accounting of growth is conducted, as permitted in the methodology monitoring module VMD0015, hence $\Delta C_{P,Enh,i,t}$ is set to 0.

Monitoring of actual emissions in the project area focuses on:

- Emissions due to deforestation and natural disturbance
- Emissions due to biomass burning
- Emissions due to illegal degradation

Procedures and responsibilities for monitoring each of the above sources of emissions are detailed below.

Emissions due to deforestation and natural disturbance

Forest cover change due to deforestation and natural disturbance is monitored through periodic assessment of classified satellite imagery covering the project area. Emissions ($\Delta C_{P,Def,i,t}$ and $\Delta C_{P,DistPA,i,t}$ for deforestation and natural disturbance, respectively) are estimated by multiplying area of forest loss detected ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$, for deforestation and natural disturbance, respectively) by average forest carbon stock per unit area (conservatively assuming $\Delta C_{P,Dist,q,i,t}$ and $\Delta C_{Pools,Def,u,i,t} = C_{BSL,i}$). Stock estimates from the initial field inventory completed in 2011, are valid for 10 years (per VM0007), minimally through 2021. Stock estimates will be re-assessed at re-inventory on the first monitoring event subsequent to February 2021.

Monitoring changes in forest cover

The project boundary, as set in the PD, will serve as the initial “forest cover benchmark map” against which changes in forest cover will be assessed over the interval of the first monitoring period; the entire project area has been demonstrated to meet the forest definition at the beginning of the crediting period. For subsequent monitoring periods, change in forest cover will be assessed against the preceding classified forest cover map marking the beginning of the monitoring interval.

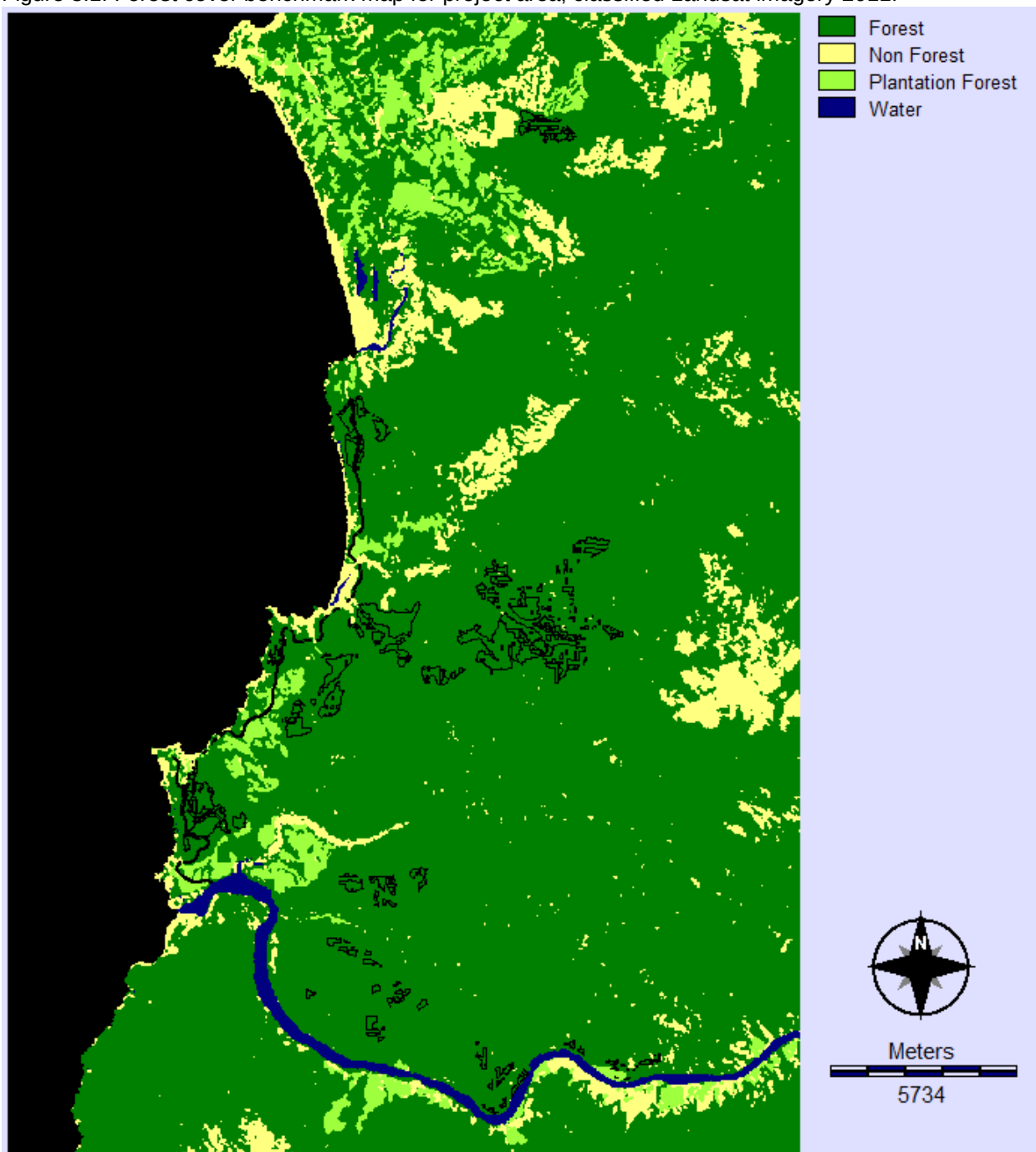
Data collection and analysis to determine forest cover change at each monitoring event will follow the procedures detailed below. The resulting classified image is compared with the preceding classified image (forest cover benchmark map marking the start of the monitoring interval) to detect forest cover change over the monitoring interval, and subsequently becomes the updated forest cover benchmark map for the next monitoring interval. Thus, the forest benchmark map is updated at each monitoring event. All changes in forest cover detected for the monitoring interval will be annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period.

For each monitoring/verification date, satellite imagery for that year will be acquired and interpreted to produce a classified forest cover map in which forest and non-forest are distinguished. Consistent with

the original 2002/2003 imagery from which the eligible project area was set, a Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m by 90m) will be used throughout the duration of the project crediting period.

The forest cover benchmark map (Figure 3.1) establishes the extent and location of forest and non-forest at the beginning of the current monitoring period.

Figure 3.1. Forest cover benchmark map for project area, classified Landsat imagery 2011.



Data acquisition

To estimate the change of forest cover within the project area, the benchmark map generated at the previous monitoring event (or at project start November 2003 for the first monitoring event) will be compared with a newly-generated classified forest cover map for the monitoring date. The new forest cover map for the project area will comply with the following requirements.

Base satellite imagery will cover the entire project area and will be from a single year, though it may include a mosaic of scenes over several months.

Imagery will be 90% cloud free. To achieve 90% classified area, multiple scenes or portions of multiple scenes may be mosaicked. Where possible, areas that are continually clouded will be classified on the basis of other data sources (e.g. ground surveys in the year of interest, radar, over-flights or classified imagery from a year subsequent to the monitored year).

Pre-processing

Collected imagery will be prepared for processing and analysis to ensure that the imagery displays and overlays accurately. The following pre-processing tasks will be conducted and are detailed below: geo-referencing, cloud and shadow removal. Each scene will be pre-processed and classified separately, eliminating need for radiometric corrections or topographic normalization where scenes must be mosaicked together.

Geo-referencing

For this procedure the November 2003 benchmark map will be used as a reference image from which all subsequent images will be geo-referenced. At least 7 control points will be established for the geo-reference procedure and the average geo-location error will not exceed 1 pixel. In the case that multiple images are mosaicked, a final image may be geo-referenced to ensure accurate location. In the case that imagery is obtained with geo-rectification conducted by the image producer or provider, secondary geo-referencing is not necessary.

Cloud and Shadow detection and removal

Detection of clouds and shadows will be accomplished through visual inspection or combining automated cloud identification techniques and visual inspection.

Interpretation and classification

In this step, the scenes are interpreted by applying a classification algorithm to identify forest and non-forest categories. A land use map with 2 categories (forest and non-forest) will be created to assess forest loss against the previous benchmark map. As mentioned above, each scene will be classified separately.

The following guidelines will be taken into consideration for the imagery classification process:

Each scene will be classified separately using a hard classification method. The geospatial analyst performing the classification will take into consideration the variety of features in the scene and reference training sites representing a range of categories (from within forest and non-forest) sufficient to facilitate the identification of forested locations from locations with no forest. Where necessary, corrections to the

classification will be made from visual interpretation of imagery. Once the classified map is produced, categories will be merged into two categories for change assessment: forest and non-forest.

Following classification, classified scenes will then be joined to produce a final map that will be compared against the benchmark map.

Change detection

Post-classification change detection techniques will be implemented for identifying forest cover change.

Basic cross-tabulation techniques will be used to identify changes from forest to non-forest. Area data from the two maps (benchmark map at beginning of monitoring interval and newly-generated map for current monitoring year) will be cross-tabulated to identify locations that change from forest to non-forest during the monitoring period, which represent deforestation in the actual with-project case.

Quality Assurance/Quality Control

To ensure consistency and quality results, spatial analysts carrying out the imagery processing, interpretation, and change detection procedures will strictly adhere to the steps detailed above. All data sources and analytical procedures will be documented and archived (detailed under data archiving below).

Accuracy of the classification will be assessed by comparing the classification with ground truth points or samples of high-resolution imagery (e.g. SPOT or Rapideye imagery). Any data collected from ground-truth points will be recorded (including GPS coordinates, identified land-use class) and archived. Any sample points of high resolution imagery used to assess classification accuracy will also be archived. Samples used to assess classification accuracy should be well-distributed throughout the project area (as far as is possible considering availability of high resolution imagery and/or logistics of acquiring ground truth data).

Results of the accuracy assessment will be presented and analyzed in a matrix in the format elaborated in the example below, such that the following errors are presented:

- Overall classification accuracy;
- Error of omission of each land-use category (forest and non-forest); and
- Error of commission of each land-use category (forest and non-forest).

Table 3.1. Accuracy assessment.

Land-use class as determined from ground-truth points	Classification		Total	Accuracy (%) <i>User's accuracy</i> (# correct/ row total)	Error of Commission (%)
	Forest	Non-forest			
Forest (100)	95	5	100	95.0	5.0

Non-forest (100)	9	91	100	91.0	9.0
Total	104	96	200		
Accuracy (%) Producer's accuracy (# correct/ column total)	91.3	94.8			
Error of Omission (%)	8.7	5.2			

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

Data Archiving

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by TNC at its office in Chaihuin, with a backup file at its office in Valdivia.

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

- Base (raw) imagery used (specifying type, source, resolution, imagery date, acquisition date)
- Any cartographic data used to geo-reference the image (source, base data)
- Data used for training classification, if supervised
- Definition of land cover classes assessed
- Documentation of software type and procedures applied (including all pre-processing steps and corrections, spectral bands used in final classifications, and classification methodologies and algorithms applied)
- Classified images
- Data used in accuracy assessment - ground-truth points (including GPS coordinates, identified land-use class) and/or sample points of high resolution imagery
- Accuracy assessment matrix with minimally the following errors presented: overall classification accuracy, error of omission of each land-use category (forest and non-forest), and error of commission of each land-use category (forest and non-forest)

Data archived will be maintained through at least two years beyond the end of the project crediting period, through November 2025. Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

Updating forest carbon stock estimates

Forest carbon stock estimates used to calculate emissions from deforestation and natural disturbance will use estimates derived from field measurements less than or equal to 10 years old. In the event that any deforestation is discovered in the project area, forest carbon stock estimates older than 10 years will be updated where deforestation is detected. Initial above- and belowground biomass and dead wood stock estimates from the 2011 inventory are valid and treated as constant through 2021, after which they will be re-estimated from new field measurements. Stock estimates will be re-assessed at re-inventory on the first monitoring event subsequent to February 2021.

To re-assess forest carbon stocks, fifty (50) point samples (ten clusters of five points) will be randomly located in the project area and basal area measured (following field protocols in Annex 15) in 2021. Biomass will be estimated from basal area applying a Biomass:Basal Area Ratio (BBAR) of 2.87 (derived for the VCR in the 2011 inventory, Annex 1). Where the re-measured estimate of live above- and belowground forest biomass carbon is within the 90% confidence interval of the 2011 estimate, the 2011 stock estimate will continue to be used in the next 10 year period. If the re-measured estimate is outside (i.e., greater than or less than) the 90% confidence interval of the 2011 estimate, then the new stock estimate will be used in the next 10-year period.

Quality Assurance /Quality Control and Data Archiving Procedures

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

1. Field crews will be fully trained in all aspects of the field data collection prior to conducting formal sampling and measurements and adhere to field measurement protocols outlined in standard field operating procedures. Pilot sample points will be used for field training prior to initiating formal measurements to appraise field crews and identify and correct any errors in field measurements. Detailed standard procedures for all aspects of field measurement activities are provided in Annex 15: "PROTOCOLOS DE CAMPO PARA LA MEDICIÓN Y MONITOREO DE LA BIOMASA FORESTAL EN LA RESERVA COSTERA VALDIVIANA." Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurement. Prism calibration will be verified prior to use. All borderline trees will be measured and assessed against prism plot radius factor, which will be standardized as distance to the center of the tree: diameter at breast height. To ensure accurate measurements, the height of diameter at breast height (1.3 m) will be periodically re-assessed by personnel during the course of the inventory. Field crews will have fine scale forest strata maps for use in the field to precisely interpret strata/forest boundaries and identify potential areas of plot overlap.
2. Following measurement, a consistency check of an opportunistic sample of 5 points will be re-measured to determine measurement error. Re-measurement for this purpose will be done by a different field crew. Measurement error will be assessed as 1/2 of the mean (absolute) percent difference between re-measured plot level biomass estimates (a valid assumption where teams

are equally experienced and there are no systematic errors in measurement, which will also be appraised from the re-measurement results). Target measurement error is < 5%. During the course of implementation, field crews will be periodically apprised of measurement errors to assess progress.

3. Field measurement data will be recorded on standard field data sheets included in “PROTOCOLOS DE CAMPO PARA LA MEDICIÓN Y MONITOREO DE LA BIOMASA FORESTAL EN LA RESERVA COSTERA VALDIVIANA.” Data will be entered from field sheets to an electronic database. Checks will be run for unusual (high or low) values to identify and correct any errors in recorded field data or transcription. Personnel involved in data analysis will consult with personnel involved in measurement to clarify any ambiguities in recorded field data.
4. Data archiving: On each return from the field, field data sheets will be photocopied and originals archived with the TNC office in Chaihuin, with duplicate copies stored at the TNC office in Valdivia. The electronic database of all field measurements will be housed in the dedicated long-term electronic archive maintained on the TNC server at its office in Valdivia. The electronic database will also archive GIS coverages detailing forest and strata boundaries and plot locations.

Emissions due to biomass burning

Incidence of burned areas in the project area will be monitored consulting the CONAF fire database. Where points of fire incidence are discovered, the area subject to fire will be delineated and quantified using the same remote sensing analysis detailed above, using visual interpretation by an image analyst with knowledge of the land cover and/or with the assistance of high resolution imagery. Burned areas will be maintained as a separate category to calculate parameter $A_{burn,i,t}$ and for estimation of biomass burning emissions using the module E-BB – calculated emissions from biomass burning will be incorporated in project accounting only where they are not determined to be insignificant applying T-SIG.

Emissions due to illegal degradation

Because it is extremely sensitive to ask of community members explicit questions regarding timber harvest activities, precluding direct interviews with communities potentially carrying out these activities, potential for illegal degradation will instead be monitored via periodic patrols throughout the VCR area, including the project area, by six TNC park rangers and through periodic consultation the District Attorney’s office (Fiscalia Regional) of the Ríos Region; the District Attorney’s office is where all reports of illegal logging by any enforcement body are collected. Consultations will be conducted at least every 2 years, starting in 2012. VCR staff patrol observations and consultations with local authorities will provide general indications on incidents and areas where illegal wood harvest has occurred or may be occurring in or near the project area.

Rangers typically work ten-day shifts, with five days off for rest, with the exception of the coordinator and manager of community development work Monday through Friday. The VCR administrator meets annually with the ranger team to develop annual work plan based on the VCR management plan. The coordinator, according to the annual work plan provides that each ranger activities must meet during their shift and ensures that these are met. Rangers’ responsibilities include control and monitoring, forest fire prevention, environmental education, monitoring threats, wildlife monitoring, and community development. The primary operations center for the park rangers is in Chaihuin, but a new base will be

established in the upcoming summer, in Hueicolla, allowing the rangers to more easily and frequently monitor activities in the southern portion of the Reserve. Patrols prioritize key access points/areas of activity, particularly in the areas of Colun, Chaihuin and the route from Hueicolla to La Union (Rts 470 and 80), the latter area in coordination with CONAF personnel posted at a permanent guard station at the national park near the reserve entrance. Notwithstanding the priority areas identified above, guard patrols are deployed according to continuous re-assessments of threats, which may change in nature and location seasonally. Monthly meetings of park guards are held to assess current threats and using a planning grid of the reserve, select priority 100 ha grid areas for patrols on the basis of accessibility and threats. Monthly, 4 grids, covering an area of 400 ha, are investigated. Guards carry out patrols on foot, on motorcycles and in pickup trucks. Twenty camera traps are also deployed in priority areas to aid in monitoring threats. When incidents are encountered, guards will record details regarding the incident on standardized forms, including the location using GPS. In the case of illegal logging encountered, guards will specify the species and volume (cubic meters) extracted, and whether there was any contact with the persons involved. While in the field, guards maintain radio contact with the reserve administration office in Chaihuin, to which incidents are also relayed immediately by radio.

In the event that any potential of illegal logging in the project area is detected, the area indicated will be delineated ($A_{DegW,i}$) and temporary sample plots will be allocated and measured in the area. Rectangular plots 10 meters by 1 kilometer (1 ha area) will be randomly or systematically allocated in the area, sufficient to produce a 1% sample of the area, and any recently-cut stumps or other indications of illegal harvest will be noted and recorded. Diameter at breast height, or diameter at height of cut, whichever is lower, of cut stumps will be measured. Where potential emissions as determined through this assessment are determined to be insignificant using tool T-SIG, no further monitoring will be conducted and emissions from illegal logging will be assumed to be zero.

In the event that the sample plot assessment indicated that illegal logging is occurring in the area and is potentially significant, supplemental plots will be allocated systematically to achieve a 3% sample of the area. Biomass will be estimated from measured diameters (conservatively assuming that diameters of stumps cut below breast height are equivalent to diameter at breast height) applying allometric equations of Gayoso et al., (2002) and otherwise maintain consistency with analytical procedures applied in the original 2011 inventory. Emissions due to illegal logging ($\Delta C_{P,DegW,i,t}$) are estimated by multiplying area ($A_{DegW,i}$) by average biomass carbon of trees cut and removed per unit area ($C_{DegW,i,t} / AP_i$).

The more intensive 3% sample will be carried out once every 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area to produce an estimate of emissions resulting from illegal logging ($\Delta C_{P,DegW,i}$). Estimates of emissions will be annualized (to produce estimates in t CO₂-e per year) by dividing the emission for the monitoring interval by the number of years in the interval.

3.3.3 Monitoring of leakage carbon stock changes and greenhouse gas emissions

Two sources of leakage will be monitored: activity shifting leakage and market leakage.

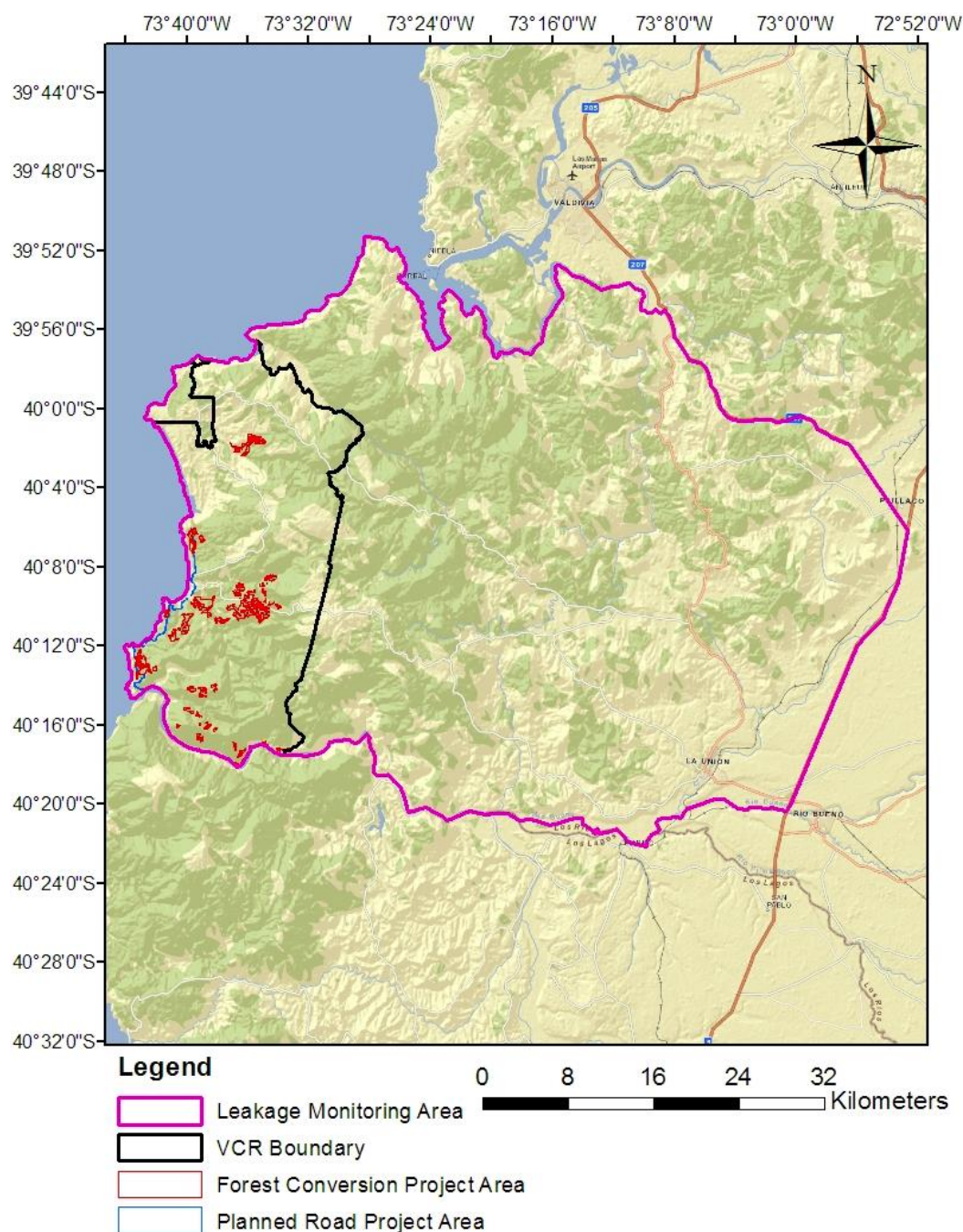
Activity-shifting leakage

Activity shifting leakage due to displaced road construction

Activity shifting leakage due to road construction by the MOP will be monitored in a defined north-south corridor, thus capturing any alternative routes to the Carretera Costera. The effective baseline rate for this corridor is set to zero, and hence any deforestation resulting from road construction meeting the criteria defined below will be treated as leakage.

The parameter *NewR*, new calculated planned forest clearance by the baseline agent where no leakage is occurring, is set to zero. The Carretera Costera was intended to be a major highway for scenic and commercial purposes, generally running from north to south through the Reserve, though with some east-west variation in direction, to account for topography and connection of existing points of habitation and local roads. As such, the defined leakage zone is intended to capture deforestation resulting within an area where an alternative highway could be constructed after the project start date. Parameter *NewR*, and parameter *A_{defLK}*, monitored area of planned deforestation by the baseline agent, are further specified to refer to deforestation from any highways in Region XIV within the leakage zone, which is defined as the area bounded by 1) the coast on the west, 2) the existing north-south highway Rt. 5 on the east, 3) the coastline from the town of Corral to Rt 207 on the north, and 4) the Rio Bueno on the south (representing the southernmost border of the Reserve), by the MOP after the project start date. (Figure 3.2).

Figure 3.2. Leakage zone in which deforestation resulting from new road construction/improvement by the MOP is monitored.



New road construction meeting the criteria detailed above will be identified by consulting MOP construction records and/or current road maps.

Area of deforestation along the road construction identified above will be determined with remotely-sensed imagery. When using remotely-sensed imagery, imagery that is freely available and accessible

using Google Earth will be used preferentially when it is available. When it is unavailable, other remotely sensed imagery will be acquired for analysis.

Any activity shifting leakage identified for the monitoring interval will be annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period.

Activity shifting due to displaced road construction will be tracked and calculated using the table below. For monitoring, because $NewR_i$ is set to zero, thus $LKA_{planned,i}$, area of activity shifting leakage, is equal to A_{defLK} .

Table 3.2. Estimate of activity shifting leakage due to road construction.

Year	$NewR_{i,t}$ (ha) *	$A_{defLK,i,t}$ (ha) *	$LKA_{planned,i,t}$ (ha) *
2004	0		
2005	0		
2006	0		
2007	0		
2008	0		
2009	0		
2010	0		
2011	0		
2012	0		
2013	0		

* area of deforestation from any highways constructed or improved by the MOP after the project start date within the leakage zone, which is defined as the area bounded by 1) the coast on the west, 2) the existing north-south highway Rt. 5 on the east, 3) the coastline from the town of Corral to Rt 207 on the north, and 4) the Rio Bueno on the south (representing the southernmost border of the Reserve).

Activity shifting leakage due to displaced forest conversion activities

Activity shifting leakage due to displacement of *E globulus* plantation establishment activities will be assessed per the table below (derived in Section 3) from project start date through 2007. No activity shifting leakage occurs after project year 2007 (Nov 2006 to Nov 2007), due to the new Native Forest Law going into effect at the end of 2007; Native Forest Law (Law 20.283/2008).

Table 3.3. Estimate of activity shifting leakage due to displacement *E globulus* plantations.

	ΔC_{BSL}	PF	LK_{CP-ME}	$\Delta C_{LK-AS,planned}$

	<i>planned</i> <i>tCO₂e</i>			(t CO ₂)
2004	130,858.7	0.3	0.2	8,898.4
2005	146,376.1	0.3	0.2	9,953.6
2006	43,585.5	0.3	0.2	2,963.8
2007	54,742.0	0.3	0.2	3,722.5
2008	0.0	0.0	0.0	-
2009	0.0	0.0	0.0	-
2010	0.0	0.0	0.0	-
2011	0.0	0.0	0.0	-
2012	0.0	0.0	0.0	-
2013	0.0	0.0	0.0	-

Market leakage

Market leakage from displaced timber production within the road clearance area will be assessed per the table below (derived in Section 3).

Table 3.4. Estimate of market shifting leakage.

Year	$V_{BSL,EX,t}$	$C_{BSL,XBT,i,t}$	$LK_{MarketEffects,timber,t}$
	m ³	t CO ₂	t CO ₂
2004	0.0	0	0.0
2005	0.0	0.0	0.0
2006	0.0	0.0	0.0
2007	62.9	97.4	38.9
2008	24.4	37.9	15.1
2009	0.1	0.2	0.1

Year	$V_{BSL,EX,t}$	$C_{BSL,XBT,i,t}$	$LK_{MarketEffects,timber,t}$
	m^3	$t\ CO_2$	$t\ CO_2$
2010	254.2	393.6	157.4
2011	19.8	30.7	12.3
2012	107.7	166.8	66.7
2013	0.0	0.0	0.0
		$AL_T = 726.5$	$LK_{MarketEffects,timber} = 290.6$

No market leakage occurs as a result of the stop conversion to plantations activity until 2019, the year of the first commercial wood harvest potentially displaced by the project. Market leakage for this component will be estimated (for subsequent accounting in monitoring dates from 2019 to 2023) at baseline renewal in 2013.

Total leakage for the project as a whole, including both activities (stopping conversion of native forest to Eucalyptus plantations and stopping highway construction) will be summed in Table 3.5 below.

Table 3.5. Estimate of total leakage.

Year	$\Delta C_{LK-AS,planned,road}$	$\Delta C_{LK-AS,planned,Euc}$	$\Delta C_{LK-ME,road}$	$\Delta C_{LK-ME,Euc}$	ΔC_{LK}
2004		8,898.39	0.0	0.0	
2005		9,953.58	0.0	0.0	
2006		2,963.82	0.0	0.0	
2007		3,722.46	38.9	0.0	
2008		-	15.1	0.0	
2009		-	0.1	0.0	
2010		-	157.4	0.0	
2011		-	12.3	0.0	

2012		-	66.7	0.0	
2013		-	0.0	0.0	

3.4.4 Estimation of ex-post net carbon stock changes and greenhouse gas emissions.

Estimates of GHG credits eligible for issuance as VCU's for the project as a whole, including both activities (stopping conversion of native forest to Eucalyptus plantations and stopping highway construction), will be calculated entering data into the table format below, where

Estimated GHG emission reduction credits =

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

Project emissions *minus*

Leakage *minus*

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

Table 3.6. Estimate of Net Emission Reduction Credits.

Years	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO ₂ e)	GHG credits eligible for issuance as VCUs (tCO ₂ e)
2004	130,859			10%		
2005	146,376			10%		
2006	57,512			10%		
2007	55,664			10%		
2008	43,015			10%		
2009	30,863			10%		
2010	39,670			10%		
2011	41,640			10%		
2012	30,309			10%		
2013	31,463			10%		

3.4.5 Organization and Responsibilities

Responsibility for carrying out future monitoring resides within TNC's Chile chapter, lead by the S. Andes Director, though implementation of monitoring activities will be delegated to staff within the Reserve. TNC Chile staff have expertise in the areas of biological monitoring, forest engineering and Geographic Information Systems, but will contract with external experts as required, in the area of forest biometrics, remote sensing, and the like. Biomass inventory may be contracted to external experts and field crews, should this be required. See Table 1.1 for more detail.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions for the project activities (stopping conversion of native forest to Eucalyptus plantations and stopping highway construction) for project years 2012 to 2014, are summed in Table 4.2 below (derived from Section 3.1 of the VCS PD through 2013, and from updated baseline detailed in the PD Appendix 1).

Table 4.2. Total baseline emissions.

Year	$\Delta C_{BSL,plannd, road}$ tCO ₂ e	$\Delta C_{BSL,plannd, Euc}$ tCO ₂ e	Total $\Delta C_{BSL,plannd}$ tCO ₂ e
4 Nov. 2011 – 3 Nov. 2012	2,480	27,829	30,309
4 Nov. 2012 – 3 Nov. 2013	3,634	27,829	31,463
4 Nov. 2013 – 3 Nov. 2014	1,899	16,683	18,583
Total	8,014	72,341	80,354

4.2 Project Emissions

Monitoring areas undergoing deforestation

From analysis of forest cover change from the classified imagery no forest cover loss occurred in the project area from 2011 to 2014. Project emissions from deforestation are calculated as the total area deforested multiplied by the emission per unit area.

Table 4.3 Parameters used to calculate $\Delta CP, DefPA, i, t$

$A_{DefPA, u, i, t}$ (ha)	Area of recorded deforestation in the project area stratum i converted to land use u at time t ; ha	Calculated in imagery analysis
$\Delta C_{pools, Def, u, i, t}$	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	Calculated below

As per the monitoring plan, changes in forest cover detected for the monitoring interval (2011-2014) were annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period (3).

Table 4.4 $A_{DefPA,u,i,t}$ (ha)

	$A_{DefPA,u,i,t}$ (ha)			
	Native Forest	Euc plantation est 1990	Euc plantation est 1991	TOTAL
4 Nov. 2011 – 3 Nov. 2012	0.0	0.0	0.0	0.0
4 Nov. 2012 – 3 Nov. 2013	0.0	0.0	0.0	0.0
4 Nov. 2013 – 3 Nov. 2014	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0

Calculation of emission per unit area is equal to the difference between the stocks before and after deforestation.

Table 4.5 Parameters used to calculate $\Delta C_{pools,Def,u,i,t}$

Parameters used to calculate $\Delta C_{pools,Def,u,i,t}$			
Parameter	Description		value
CBSL _i	Carbon stock in all pools in the baseline case in stratum	Calculated from forest inventory results (PD section 3)	Variable depending on stratum
CP _{post,u,i}	Carbon stock in all pools in post-deforestation land use u in stratum i; t CO ₂ -e ha ⁻¹	Conservatively assumed to be zero	0

Table 4.6 $\Delta CP, DefPA, i, t$ (t CO₂)

	$\Delta CP, DefPA, i, t$ (t CO ₂)			
	Native Forest	Euc plantation est 1990	Euc plantation est 1991	Total $\Delta CP, DefPA, i, t$
4 Nov. 2011 – 3 Nov. 2012	0.0	0.0	0.0	0.0
4 Nov. 2012 – 3 Nov. 2013	0.0	0.0	0.0	0.0
4 Nov. 2013 – 3 Nov. 2014	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0

Monitoring biomass burning

A meeting was held with Mauricio Gomez of CONAF on 21 April 2015 in Valdivia. For the period November 2011 to November 2014, the CONAF fire database confirms that no fires (> 0.1 ha) occurred within the project area. One fire occurred in the reserve near the coast in Chaihuin, however this was outside the project area. The reserve, including the project area, is a priority area for CONAF's fire prevention and control activities, and is routinely patrolled, in close coordination with reserve guardaparques, and monitored from a fire observation tower near Chaihuin close to the project area.

Furthermore, in the classification process of the 2014 imagery, no evidence of fire scars was detected, nor were fires reported from the project area by park guard patrols over the 2011-2014 period; outside the project area during the period, two small fires of ~0.5 ha each were identified by park guards, in Chaihuin near the coast (the same fire reported to CONAF) and the other along the coastal highway margin (confirmed in a meeting with park guards Danilo Gonzalez and Erwin Ovando held in Chaihuin on 22 April 2015). Therefore, for the current monitoring period, $A_{burn, i, t}$ was 0 and emissions from biomass burning are equal to zero.

Monitoring illegal logging

Continuous monitoring activities in the field by park guards through the monitoring period identified no illegal logging activities in the project area, confirmed in a meeting with park guards Danilo Gonzalez and Erwin Ovando held in Chaihuin on 22 April 2015. One illegal harvest was identified by park guards in the reserve in 2013/2014 resulting in the cutting of less than 10 trees, however this was located in the road right of way near Galera/Huiro, outside of the project area.

Likewise, CONAF provincial director Rodrigo Pedraza confirmed that there were no illegal cuts reported in the reserve from 2011 to 2014 (meeting held in Valdivia, 21 April 2015). In 2013 there were 3 CONAF reports of infractions related to authorized harvest activities carried out by local cooperatives in Eucalyptus stands in the reserve, however these were not in the project area.

Infractions of illegal logging in the region are rare due to remote access and difficulty of transport and strong enforcement by CONAF. The project area in particular is remote with no access by primary roads.

Net project emissions within the project area calculated in Table 4.7.

Table 4.7 ΔCP (t CO₂-e)

	$\Delta CP, DefPA, i, t$	$\Delta CP, Deg, i, t$	$\Delta CP, DistPA, i, t$	ΔCP
4 Nov. 2011 – 3 Nov. 2012	0.0	0.0	0.0	0.0
4 Nov. 2012 – 3 Nov. 2013	0.0	0.0	0.0	0.0
4 Nov. 2013 – 3 Nov. 2014	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0

4.3 Leakage

Activity shifting leakage

Activity shifting leakage due to displaced road construction

No activity shifting leakage was detected from 2011 to 2014. Daniel Bifani, Regional Director of Planning, Rivers Region, MOP, in a meeting held in Valdivia on 21 April 2015, confirmed that no new road construction meeting the criteria as defined in the monitoring plan occurred over the monitoring period. Some road improvements were carried out from 2011-2013 in the activity shifting leakage area, however none of these improvements resulted in any loss of forest cover.

A previous meeting, confirming the same as the above, was also conducted with the MOP on August 17, 2012 in the Multipurpose Room of the Ministry of Public Works, Yungay 621, Valdivia. Attendees included: Ana Maria Henriquez (Tax Inspector, Department of Roads Central level, MOP), Daniel Bifani (Regional Director of Planning, Rivers Region, MOP), Erwin Ovando (Ranger Valdivian Coastal Reserve, TNC), Liliana Pezoa (Assistant Conservation Projects, TNC), Gaston Perez (Mayor of Corral), Carlos Garcia (Councilmember, City of Corral), Ruben Perez (Councillor, City of Corral), Oscar Droguett (Provincial Chief CONAF Rivers), and Patricio Contreras (Administrator, Alerce Costero National Park).

Activity shifting leakage due to displaced forest conversion activities

No native forest conversion to plantations takes place in the baseline after 2008, thus activity shifting leakage from this source is equal to zero. Even any delayed displacement of these activities is precluded, due to the Native Forest Law in effect through the monitoring period; the Native Forest Law (Law 20.283/2008) prohibits conversion of native forests to non-native plantations.

Market leakage

Market leakage due displaced timber production within the road clearance area

Market leakage from displaced timber production within the road clearance area was assessed per Table 4.8 below (derived in Section 3 of the VCS PD). Note that the last Eucalyptus harvest in the road clearance area in the baseline takes place in project year 2012, thus there is no market leakage from this source in project years 2013 on.

Table 4.8 Calculations of market leakage due displaced timber production within the road clearance area.

Year	$V_{BSL,EX,t}$	$C_{BSL,XBT,i,t}$	$LK_{MarketEffects,timber,t}$
	m ³	t CO ₂	t CO ₂
4 Nov. 2011 – 3 Nov. 2012	107.7	166.8	66.7
4 Nov. 2012 – 3 Nov. 2013	0.0	0.0	0.0
4 Nov. 2013 – 3 Nov. 2014	0.0	0.0	0.0

Market leakage due to displaced forest conversion activities

No market leakage occurred as a result of the stop conversion to plantations activity during the monitoring period. In the baseline, plantations established are managed on 15 year rotations, and the first commercial wood harvest potentially displaced by the project take place in 2019, as explained in the VCS Project Document.

Total leakage for the project as a whole, including both activities (stopping conversion of native forest to Eucalyptus plantations and stopping highway construction) was summed in Table 4.9 below.

Table 4.9. Calculation of total leakage.

Year	$\Delta C_{LK-AS,planned,road}$	$\Delta C_{LK-AS,planned,Euc}$	$\Delta C_{LK-ME,road}$	$\Delta C_{LK-ME,Euc}$	ΔC_{LK}
4 Nov. 2011 – 3 Nov. 2012	0.0	0.0	66.7	0.0	66.7
4 Nov. 2012 – 3 Nov. 2013	0.0	0.0	0.0	0.0	0.0
4 Nov. 2013 – 3 Nov. 2014	0.0	0.0	0.0	0.0	0.0
Total	0	0	66.7	0.0	66.7

4.4 Net GHG Emission Reductions and Removals

Uncertainty

Uncertainty was assessed applying module X-UNC.

Uncertainty in the baseline rate, parameter $Uncertainty_{BSL,RATE}$, is equal to zero. Per X-UNC, “Where an uncertainty value is not known or cannot be simply calculated, then a project must justify that it is using an indisputably conservative number and an uncertainty of 0% may be used for this component.”

Uncertainty of 0% is applied to the rate of deforestation associated with road construction in the baseline, which cannot be calculated and has been clearly demonstrated to be conservative (VCS PD Section 3.1).

Uncertainty in the baseline rate of deforestation associated with the conversion of native forest to plantations is also assumed to be zero “where the planned deforestation rate is based on actual deforestation plans” (per X-UNC), as it is for this component of the baseline, based on CONAF permits and management plans.

Total uncertainty in carbon stocks in native forest (parameter $Uncertainty_{BSL,SS}$) is equal to combined uncertainty of forest carbon pool stock estimates, calculated using propagation of errors (equation 4 of VM0007 module X-UNC). Parameter $Uncertainty_{BSL,SS}$ is thus calculated to be 8% at the 95% confidence level (calculations detailed in VCS PD Annex 1 2011 Forest Biomass Inventory Results for Valdivia Coastal Reserve).

Results of overall uncertainty calculations are presented in Table 4.10.

Table 4.10. Summary of uncertainty calculations.

X-UNC eq #	5	3	6	10	11
Parameter	$Uncertainty_{BSL,S}$ S	$Uncertainty_{BSL,R}$ $ATE,$	$Uncertainty_{BSL,t^*}$	C_{REDD_ERROR,t^*}	$Adjustment$ $factor\ applied\ to$ C_{REDD,t^*}
value	8%	0%	8%	8%	100%

Summary of net emission reduction calculations

Estimates of GHG credits eligible for issuance as VCU's for the project as a whole, including both activities (stopping conversion of native forest to Eucalyptus plantations and stopping highway construction), were calculated entering data into Table 4.11 below, where

Estimated GHG emission reduction credits =

Baseline emissions *minus*

Project emissions *minus*

Leakage *minus*

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

Table 4.11. Summary of net emission reduction calculations.

Years	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO ₂ e)	GHG credits eligible for issuance as VCUs (tCO ₂ e)
4 Nov. 2011 – 3 Nov. 2012	30,309	0	67	10.0%	3,031	27,211
4 Nov. 2012 – 3 Nov. 2013	31,463	0	0	10.0%	3,146	28,317
4 Nov. 2013 – 3 Nov. 2014	18,583	0	0	10.0%	1,858	16,724
Total	80,354	0	67		8,035	72,252

5 ADDITIONAL INFORMATION

Interpretation and classification of imagery for monitoring date (2014)

Landsat imagery

The Landsat program has provided the longest temporal archive of moderate resolution satellite imagery available, and as of 2008 USGS made all of this data freely available to all users. The combination of frequent data capture, moderate resolution (30m) and accessibility have made Landsat data the most widely used satellite platform for land cover change analysis. Satellite imagery used for the 2014 image classification was acquired from Landsat 8 and was acquired on October 24, 2014 (Landsat scene ID LC82330882014297LGN00).

Imagery was acquired at <http://glovis.usgs.gov/> (Table 5.1). The date was selected to minimize cloud cover and to coincide as closely as possible with the date marking the end of the monitoring interval (November 3 2014).

Table 5.1: Imagery used for 2014 monitoring event.

		2014
Cloud free (%)	Complete scene	72%
	Classification area (VCR)	100%
sensor		OLI
Path/row		233/88
		24
		October
Date		2014

All image processing was conducted in Idrisi software TerrSet release.

Pre-processing

Pre-processing of multispectral bands carried out prior to classification. Multispectral bands were converted to reflectances and corrected for atmospheric distortion using the solar elevation angle parameter defined in the metadata and the DN Haze parameter which is calculated from the raw imagery using the AtmosC module.

When using Landsat 8 data, imagery can be obtained from EROS (Earth Resource Observation Systems) with multiple pre-processing steps completed. These processing steps are summarized below and more detail information can be found from NASA <http://landsathandbook.gsfc.nasa.gov/level/>.

The 1G product available to users is both radiometrically and geometrically corrected. The correction algorithms employed model the spacecraft and sensor using data generated by onboard computers during imaging events and ground control points and a digital elevation model are also used to improve the overall geometric fidelity. The geometric correction process utilizes both ground control points (GCP) and digital elevation models (DEM) to attain absolute geodetic accuracy. The WGS84 ellipsoid is employed as the Earth model for the Universal Transverse Mercator (UTM) coordinate transformation. Associated with the UTM projection is a unique set of projection parameters that flow from the USGS General Cartographic Transformation Package. The end result is a geometrically rectified product free from distortions related to the sensor (e.g. jitter, view angle effects), satellite (e.g. attitude deviations from nominal), and Earth (e.g. rotation, curvature, relief).

When using Level 1G processed imagery, geometric accuracy should be confirmed, but extra geo-referencing steps are unnecessary.

Processing

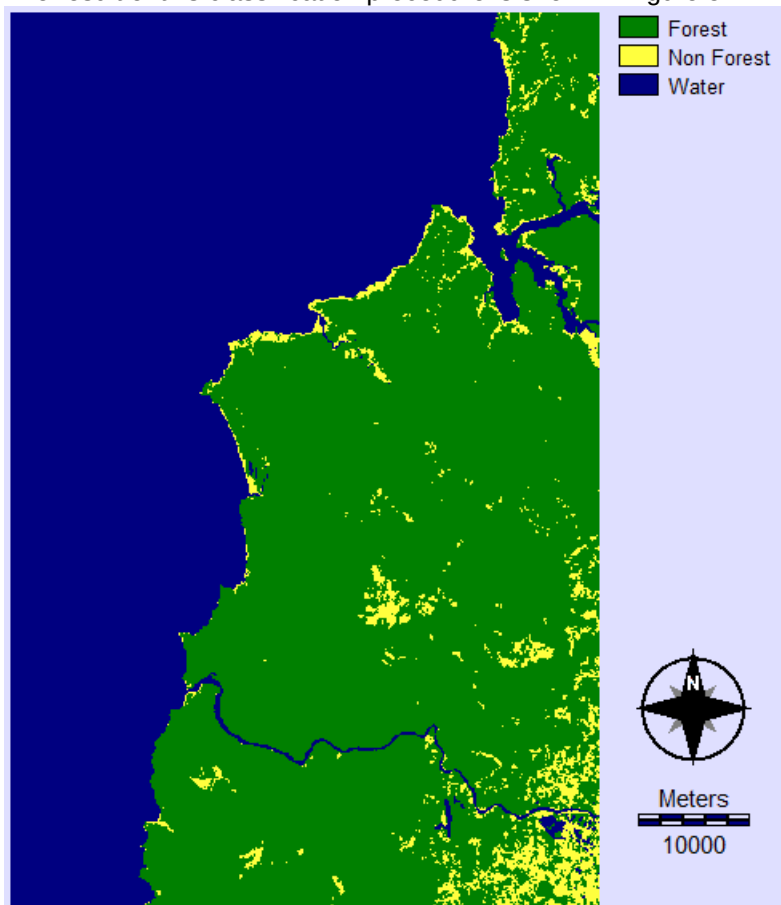
Imagery was processed using a hard classification technique. Using a clustering technique all useable data were identified. Through this process, pixels are grouped according to their spectral similarities and are then identified to land cover classes. All data is processed to identify all forest and non-forest clusters. Using known areas of forest, these cluster groups are identified and combined. The same process is conducted for non-forest clusters. The following classes were distinguished:

- Forest (including native and plantation forest)
- Non-forest (including bare earth, pastures, matorrales, wetlands, urban areas, roads and others)
- Water was identified separately (including rivers, shallow & deep water)

Post- processing

After the initial classification procedure and identification of forest, non-forest, and water classes was completed, a mode filtering procedure was used to align the classification as closely as possible with the Chilean DNA forest definition. A 3 pixel by 3 pixel filter was used which increases the minimum mapping unit to 0.81 ha. (90m by 90m).

The result of this classification procedure is shown in figure 5.2.



Quality Assurance/Quality Control

To ensure consistency and quality results, all data sources and analytical procedures are documented and archived (detailed under data archiving in monitoring plan Section 3 above).

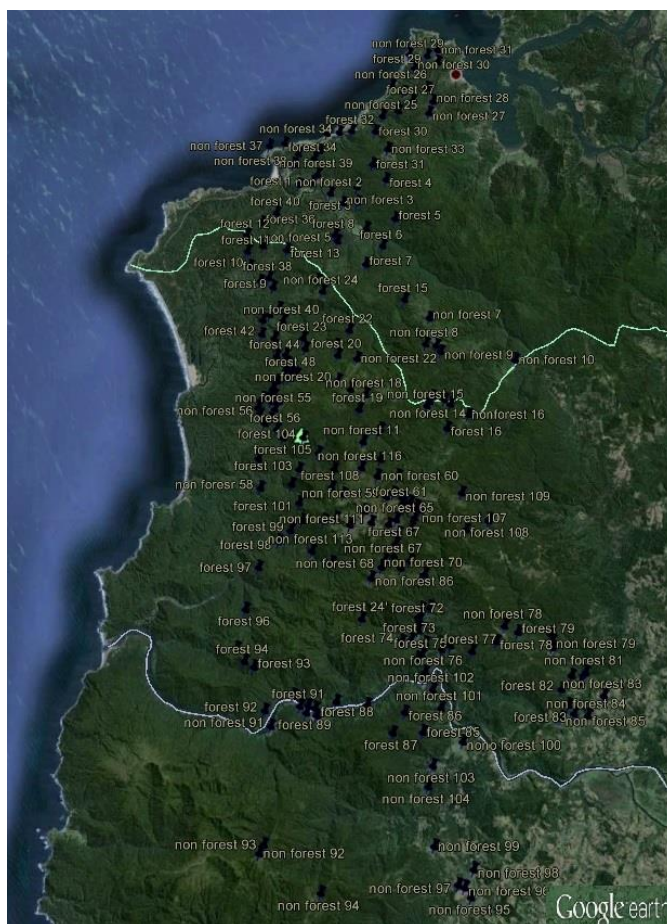
Accuracy of the classification was assessed by comparing the classification with ground truth points and samples of high resolution imagery (Quickbird imagery/ Astirum~ 5m resolution available on Google Earth). All data collected from ground-truth points are recorded (GIS files of all data points and tables of with identified land-use class) and archived. Any sample points of high resolution imagery used to assess classification accuracy are also archived. Samples used to assess classification accuracy are well-distributed throughout the project area (as far as is possible considering availability of high resolution imagery and/or logistics of acquiring ground truth data), with a minimum sampling intensity of 100 points each for the forest and non-forest classes. Distribution of all points is shown in figure 5.2

Overall classification accuracy was 93.2%. Results of the accuracy assessment are in table 5.2.

Table 5.2 Classification accuracy assessment 2014

Land-use class as determined from ground-truth points	Classification		Total	Accuracy (%)	Error of Commission (%)
	Forest	Non-forest		User's accuracy (# correct/ row total)	
Forest	105	4	109	96.3%	3.7%
Non-forest	11	101	112	90.2%	9.8%
Total	116	105	221		
Accuracy (%)				Overall classification accuracy (correct/ total points)	
Producer's accuracy (# correct/ column total)	90.5%	96.2%			
Error of Omission (%)	9.5%	3.8%		93.2%	

Figure 5.2: Accuracy assessment points



Final Forest Plantation Assignment

Following all classification and accuracy assessment steps, areas of agreement in forest classes between 2014 and the previous image classification from 2011 were defined. Areas that were previously classified as plantation forest in 2011 and remained as forest in 2014 were identified as remaining in Plantation. This map is shown in Figure 5.3.

