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

Document Prepared By

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1	VCR APD Summing tables 2011
2	VCR Road APD analysis 2011
3	VCR Euc APD analysis 2011
4	Shape file of project boundary (Identical to shape files in Project Design Annex 6)
5	Shape file of 2002/2003 forest benchmark map (Identical to shape files in Project Design Annex 6)
6	Shape file of 2011 forest benchmark map (Identical to shape files in Project Design Annex 6)

1 PROJECT DETAILS

1.1 Summary Description of Project

The Valdivian Coastal Reserve (VCR) is located approximately 40 km southwest of Valdivia in Region XIV (formerly Region X), Chile (Figure 1.1). The VCR is situated in the Coastal Range of south-central Chile, in a section known as the Cordillera Pelada. It is located at the northern extension of the temperate rainforest ecoregion, and represents one of the last large fragments of Valdivian Temperate Forest. The area is of significant ecological value, home to numerous endemic species and globally-significant ecosystems and vegetation, such as Olivillo coastal forest (Aextoxicon punctatum) and Alerce (Fitzroya cupressoides), the latter one of the world's largest and longest-lived tree species. Significant stores of carbon are sequestered in the VCR's native forests, with stocking levels estimated at over 800 metric tons of CO2 equivalent per ha[1].

Prior to 2003, the property was owned and managed by an industrial timber company, Bosques S.A., that had been steadily converting native forest on the property to Eucalyptus plantations and coordinating with the Ministry of Public Works (MOP) and its agent the Chilean Army Corps of Engineers (CMT) on the construction of a coastal highway (Carretera Costera) traversing the property. When Bosques S.A. went bankrupt in 2003 due to financial mismanagement, the property became available for purchase, and in November 2003, The Nature Conservancy (TNC), recognizing its significant conservation value and imminent threats, acquired the property. In February 2012, TNC donated a portion of the property, consisting of approximately 9,453 ha, to the Government of Chile, to form part of Chile's new Alerce Costera National Park; as a result, the VCR is currently approximately 50,251 ha in size.

TNC's decision to purchase the property was made after extensive analysis of conservation threats and priorities in the region[2] and also after identification of the potential of carbon credits generated through forest conservation activities in the region[3] that could be explored as a revenue source to finance the acquisition and management of the property. Even after purchase of the VCR, carbon revenue remains critical to help finance the establishment of an endowment for long-term operations, and to help pay off the original acquisition costs, which were paid for through a loan from TNC's internal Land Purchase Fund, with no other immediate sources of finance to repay the entirety of the loan identified as of the project start date. Generous philanthropic donations from TNC donors, WWF and Conservation International, helped to partially offset but did not fully fund the original acquisition costs.

The acquisition of the property by TNC effectively stopped the ongoing conversion of native forest to Eucalyptus plantations, activities authorized through permits that conveyed to the new owner, and that were expected to be exercised by the most likely alternate buyer (i.e. another industrial timber company with management objectives similar to Bosques S.A.). The acquisition further leveraged the position of TNC to advocate against and ultimately contribute to stopping the construction of the coastal highway.

[1] Shoch, D. 2011 Forest biomass inventory results for the Valdivian Coastal Reserve. **ANNEX 1.**
[2] 2002 land tenure study ("Final Report: Promoting Private Lands Conservation Investments in the Valdivian Coastal Range", TNC & WWF, February 2002.)
[3] Jorge Gayoso & Bastienne Schlegel, Sept 2003, ESTUDIO DE LÍNEA DE BASE DE CARBONO: CARBONO EN BOSQUES NATIVOS, MATORRALES Y PRADERAS DE LA DÉCIMA REGIÓN DE CHILE, Universidad Austral de Chile.

The acquisition of the VCR and subsequent conservation actions by TNC, including ongoing protection and management activities, constitute two VCS-eligible Reducing Emissions from Deforestation and Degradation (REDD) activities:

1. Avoiding Planned Deforestation (APD) by stopping construction of the coastal highway
2. Avoiding Planned Degradation (APD) by stopping conversion of native forest to Eucalyptus plantations

The two activities are combined under one project, the Avoiding Planned Deforestation and Degradation in the Valdivian Coastal Reserve Project. The total eligible project area is 1,273 ha, which is a subset of the larger VCR.

The fundamental objectives of the project are:

1. Protect threatened biodiversity by avoiding the planned deforestation of native rainforest.
2. Help to sustain and improve the well-being of rural and indigenous human communities surrounding the Reserve.
3. Protect forest carbon stocks over the long term.
4. Achieve sustainable long-term financing for the Reserve (and its potential future expansion through creation of a marine protected area) through carbon credit transactions. (Funds from any transaction will be used to help pay off a loan used for the original acquisition of the Reserve, and to help establish an endowment to fund long-term operational costs, which primarily consist of salaries for park guards and other staff, and to fund additional conservation activities within the Reserve.)
5. Demonstrate a successful private sector funding strategy for climate change mitigation.
6. Widely share lessons learned during project development, in order to build climate change mitigation capacity within the Chilean government and other institutions (i.e., Universidad Austral).
7. Test scientific methodologies for quantifying emissions avoided and other impacts.
8. Improve voluntary carbon market accounting standards.
9. Influence future climate change mitigation policies and laws through the development and use of rigorous standards in the voluntary carbon market.
10. Create a reference center at a partner institution (Universidad Austral) as part of a global REDD network. The reference center will serve both as a physical repository of information and as the host of an electronic web portal for relevant documentation. The center would connect Chilean REDD+ initiatives with those in Brazil, Indonesia and Mexico.

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)

The project is not a “grouped project”.

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 1.3 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 investor relations.	Sr. Business Advisor	The Nature Conservancy Forest Carbon Team 4245 North Fairfax Drive, Suite 100 Arlington, VA 22203-1606 (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) South Andes Director* *2) Science Coordinator* *3) GIS/Data Specialist* *4) Country Representative* *5) Associate Director of Development* *6) Finance & Operations Manager*	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) Chile Conservation Manager (based in Santiago)* *2) VCR Coordinator* *3) Conservation Project Assistant* *4) 9 additional staff reporting to the Coordinator*	The Nature Conservancy Reserva Costera Valdiviana Chaihuin, Chile
Internal legal oversight and support; management of outside counsel.	*Senior Attorney*	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.

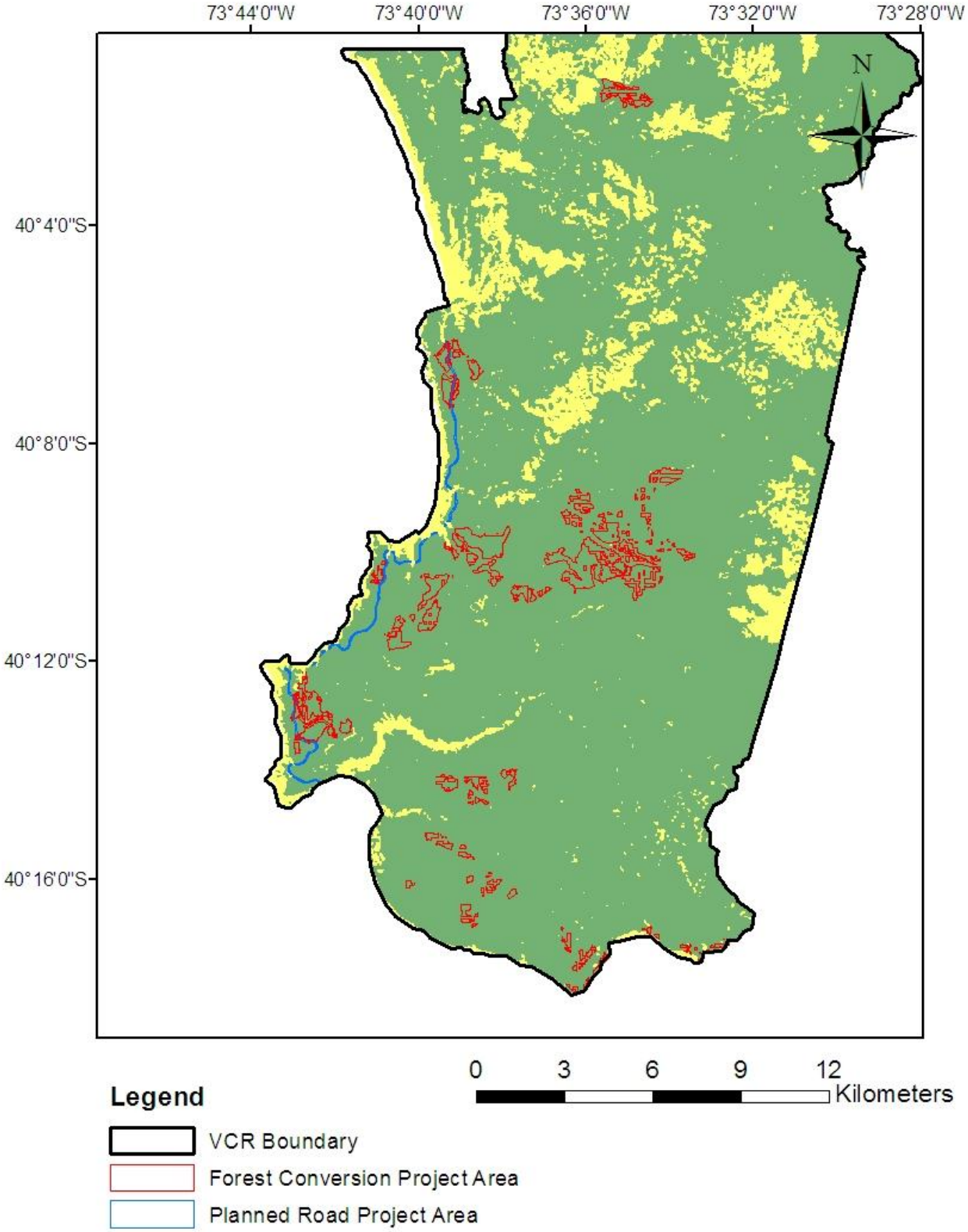
73°44'0"W
73°40'0"W
73°36'0"W
73°32'0"W
73°28'0"W
40°4'0"S
40°8'0"S
40°12'0"S
40°16'0"S
N
0
3
6
9
12
Kilometers
Legend
VCR Boundary
Forest Conversion Project Area
Planned Road Project Area

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).

Shape file of the project boundary accompanies this report as Annex 4 (or Project Design Annex 6).

1.8 Title and Reference of Methodology

REDD Methodology framework:

VM0007 REDD Methodology Module, REDD Methodology Framework (REDD-MF), version 1.3

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 1.0

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 1.1

Leakage modules:

LK-ASP "VMD0009 Estimation of emissions from activity shifting for avoided planned deforestation", version 1.1

LK-ME "VMD0011 Estimation of emissions from market-effects", version 1.0. 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 1.0.

X-UNC "VMD0017 Estimation of uncertainty for REDD project activities", version 1.0.

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 3.1

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

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The Nature Conservancy officially cancelled the legal permits to convert native forest to eucalyptus plantations by sending notice to CONAF at the end of 2004[4], definitively stopping any possibility of planned deforestation via this activity. Solicitation of new permits to convert native forest to eucalyptus plantations is no longer possible with the Native Forest Law (Law 20.283/2008) passed in 2007. In July 2012, TNC confirmed for CONAF that the permits had been voluntarily cancelled, and CONAF acknowledged receipt of the voluntary cancellation with an official stamp[5].

Since the project start date, TNC has engaged 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.

In February 2004, representatives of TNC and WWF met with the Subsecretary of Public Works[6] to advocate for the evaluation of an alternative route to the coastal highway. TNC offered to exchange expropriated land for parcels of the VCR that would allow the connection of existing construction to the alternate route, though ultimately an agreement could not be reached. However, at this time TNC refused to authorize to the Chilean Army Corps of Engineers (CMT) access to the quarry on the VCR property, as had been arranged with the previous owner of the VCR property, Bosques S.A. This action effectively cut off access to essential low cost construction materials, one of the factors that led to final cessation of road construction[7].

In August of 2004 after negotiations with the MOP broke down, the CMT resumed work on the section of Coastal Highway heading south from Chaihuín with the authorization of the MOP. This act generated extensive press coverage in the region (Diario Austral de Osorno, September 6th 2004, Diario Austral de Valdivia, September 7th 2004), as well as nationally, and condemnation from conservation groups. In 2005, negotiations were reopened and TNC and WWF offered in April of 2005 to fund an Environmental Impact Assessment and pre-feasibility studies for an alternate route connecting the constructed section of the Coastal Highway to existing public road T-470 and thereby avoiding the project area and fragile coastal Olivillo forests completely. TNC further offered to allow CMT access to the quarry on the VCR property to source construction materials for the alternative route as a concession and gesture of goodwill, and similarly to exchange parcels of land needed for the development of this alternate for lands that had already been expropriated. The alternate route was identified from a study that the organizations had requested from the Center for Agrarian and Environmental Studies[8]. The proposal was accepted by MOP in May of 2005, and the MOP stopped further lengthening of the highway.

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[4] In July 2012, TNC confirmed from CONAF that the permits had been voluntarily cancelled, and CONAF acknowledged receipt of the voluntary cancellation with an official stamp. 5 July 2012 letter from TNC to CONAF; bears CONAF stamp of receipt 10 July 2012.
[5] 5 July 2012 letter from TNC to CONAF; bears CONAF stamp of receipt 10 July 2012
[6] MOP, 2004. Acta Reunión Efectuada el 10 de Febrero 2004. Santiago, Chile.
[7] The Army clarified for TNC in the meeting that if the Army could not obtain gravel and sand from TNC, then they would have to obtain it at a much higher cost from sources further away from the Reserve, and they stated that this would mean the continued road construction would not be cost effective.
[8] Muñoz-Pedreros, A., Gil, C., Heuestein, E., Sanchez, P., Guiñez, B., Contreras, P., Sepulveda, M., Navarrete, M., Delgado, C., Farias, A., Steffen, W., Jara, C., Jaramillo, J., Woelfl, S., Arriagada, R., Godoy, M., Mera, R. 2005a. Evaluación de la biodiversidad: En las alternativas de construcción de la carretera de la costa en el tramo Chaihuín – Hueicolla. Informe Final CEA. WWF, Valdivia, Chile. 218 p

In 2005, TNC developed a conservation plan for the VCR[9]. The overarching objective of the conservation plan was to identify conservation targets of significance and to ensure the maintenance of the reserve's biodiversity. Additionally, the plan was also designed to provide "environmental assessments of proposed alternatives to the current layout of Coastal Highway project implemented by the Ministry of Public Works within the grounds of the Valdivian Coastal Reserve." The creation of the conservation plan provided the general public and other conservation advocacy organizations greater visibility into the negative impacts of the highway construction within the Reserve, which aided in galvanizing resistance by other conservation advocates to prevent the highway's further construction and the cessation of construction in 2005.

By 2006 CMT crews had left the area, though some equipment and caretakers remained at work camps[10]. Rangers at the VCR report that the last of CMT's equipment was finally removed in 2011. During this time, TNC continued to pressure the MOP by communicating with the regional authorities and closing the quarry. 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).

In 2010, TNC finalized a management plan for the VCR, that was submitted and recognized by the Chilean environmental authority (Ministerio de Medio Ambiente)[11]. TNC is currently in the process of formally submitting this plan as part of on 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 typically work ten-day shifts, with five days off for rest, and 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. 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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[9] Delgado, C., 2005. Plan de Conservación, Reserva Costera Valdiviana. The Nature Conservancy. pp173.
[10] TNC, 2007. Internal Memo from Francisco Solis to Carlos Fernandez: Situación Actual de la Carretera Costera al interior de la RCV.
[11] 2010 VCR Management Plan

2.2 Project Description Deviations

No deviations to the monitoring plan were applied.

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 for:

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.
Purpose of the data:	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.
Purpose of the data:	Detailed in PD Section 3.1.
Any comment:	

Data Unit / Parameter:	$L\text{-}D_{,i}$
Data unit:	%
Description:	Likelihood of deforestation in stratum *i*
Source of data:	
Value applied:	100%
Purpose of the data:	The likelihood of deforestation ($L\text{-}D_i$) 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
Purpose of the data:	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
Purpose of the data:	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[12], particularly in plantation grown settings as in the project area.
Any 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:	VMD0011
Value applied:	0.29
Purpose of the data:	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
Purpose of the data:	Global default
Any comment:	

Data Unit / Parameter:	*D*
Data unit:	t d.m.m^{-3}
Description:	Basic wood density of *Eucalyptus globulus*
Source of data:	IPCC 2006GL
Value applied:	0.5
Purpose of the data:	wood specific gravity of *E globulus* reported in the IPCC 2006GL
Any comment:	

[12] Gayoso, J. 2008a. Eucalyptus sp. Resultados Proyecto FONDEF D98i1076

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
Purpose of the data:	wood specific gravity of *E globulus* 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
Purpose of the data:	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
Purpose of the data:	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
Purpose of the data:	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
Purpose of the data:	Fixed for the first baseline period, derived and justified in Section 3 of PD
Any comment:	This value applies to deforestation from *area of d*eforestation 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
Purpose of the data:	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 (*Eucalyptus globulus* plantations) will be nearly identical to areas where harvest could be displaced in Chile to make up for reduction in supply of *Eucalyptus globulus* wood (i.e. other *Eucalyptus globulus* plantations).
Any comment:	This value applies to market leakage calculations for timber harvests avoided in the project case in Eucalyptus plantations

Data Unit / Parameter:	$LK_{CP\text{-}ME,c,l}$
Data unit:	Dimensionless
Description:	Leakage factor for displacement of class of planned deforestation agents
Source of data:	VM0007; LK-ASP
Value applied:	0.2
Purpose of the data:	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
Purpose of the data:	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:	
Purpose of the data:	
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:	
Purpose of the data:	
Any comment:	

3.2 Data and Parameters Monitored

Details on data and parameters monitored are provided below.

Data Unit / Parameter:	$\Delta C_{P,Def,i,t}$
Data unit:	t CO_2-e
Description:	Net carbon stock change as a result of deforestation in the project case in the project area in stratum *i* at time *t*
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	First monitoring event in 2011. Every $\leq$ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
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* at time *t*
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
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:	*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. <u>Geo-referencing:</u> 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. <u>Cloud and Shadow detection and removal:</u> Detection of clouds and shadows will be accomplished through visual inspection or combining automated cloud identification techniques and visual inspection. 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. *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. Transitions from forest to non-forest referable to anthropogenic deforestation (not natural disturbance) will be identified on the basis of auxiliary information including but not limited to high resolution satellite imagery, confirmation in the field and/or GIS layers (from which the likelihood of anthropogenic versus natural disturbance can be assessed, e.g. on the basis of remoteness or proclivity to disturbance, e.g. steep slopes).
Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Landsat or other medium resolution satellite imagery, high-resolution imagery (e.g. SPOT or Rapideye imagery) for classification, GIS coverages, remote sensing classification and GIS software, improved remote sensing data sources to be used as they become available, GPS for geo-referencing ground truth points, forest cover benchmark map from end of previous monitoring interval.
QA/QC procedures to be applied:	All data sources and analytical procedures will be documented and archived. 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) • Error of commission of each land-use category (forest and non-forest) 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%.
Calculation method:	None
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:	*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. <u>Geo-referencing:</u> 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. <u>Cloud and Shadow detection and removal:</u> Detection of clouds and shadows will be accomplished through visual inspection or combining automated cloud identification techniques and visual inspection. 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. *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. Transitions from forest to non-forest referable to natural disturbance (not anthropogenic

	deforestation) will be identified on the basis of auxiliary information including but not limited to high resolution satellite imagery, confirmation in the field and/or GIS layers (from which the likelihood of anthropogenic versus natural disturbance can be assessed, e.g. on the basis of remoteness or proclivity to disturbance, e.g. steep slopes).
Frequency of monitoring/recording:	First monitoring event in 2011. Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Landsat or other medium resolution satellite imagery, high-resolution imagery (e.g. SPOT or Rapideye imagery) for classification, GIS coverages, remote sensing classification and GIS software, GPS for geo-referencing ground truth points, improved remote sensing data sources to be used as they become available, forest cover benchmark map from end of previous monitoring interval.
QA/QC procedures to be applied:	All data sources and analytical procedures will be documented and archived. 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)

	• Error of commission of each land-use category (forest and non-forest) 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%.
Calculation method:	None
Any comment:	

Data Unit / Parameter:	$C_{BSL,i}$
Data unit:	t CO_2-e ha^{-1}
Description:	Carbon stock in all pools in the baseline case in stratum *i*
Source of data:	Estimated from forest carbon inventory
Description of measurement methods and procedures to be applied:	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.
Frequency of monitoring/recording:	Every ≤ 10 years. First measurement in 2011. Stock estimates will then be re-assessed at re-inventory on the first monitoring event subsequent to February 2021.
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	GPS Compass Flagging Rangefinder

	Wedge prisms Clinometer Diameter tape Machete Datasheets Pencils
QA/QC procedures to be applied:	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.
Calculation method:	Biomass will be estimated from diameter at breast height using allometric equations from Gayoso, J.; Guerra, J.; Alarcón, D. 2002. Contenido de carbono y funciones de biomasa en especies nativas y exóticas. Proyecto FONDEF D98I1076 Medición de la capacidad de captura de carbono en bosques de Chile y promoción en el mercado mundial. 157 p.
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:	Not measured.
Frequency of monitoring/recording:	Not measured.
Value monitored:	0
Monitoring equipment:	Not measured.
QA/QC procedures to be applied:	Not measured.
Calculation method:	None
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:	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. VCR staff patrol observations and consultations with local authorities will provide general indications on incidents and areas where illegal wood harvest (the main anticipated cause of degradation) has occurred or may be occurring in or near the project area. 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 event that any potential of illegal logging in the project area is detected, the area indicated will be delineated by GPS and calculated using GIS software ($A_{DegW,i}$).
Frequency of monitoring/recording:	Park guard surveys are continuous throughout the crediting period. Consultations with the district attorney's office conducted every $\leq$ 2 years. First consultation conducted in 2012.
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Two-way radios, motorcycles, pick-up trucks, camera traps, GPS, standardized incident forms, GIS software.
QA/QC procedures to be applied:	Incident areas of potential degradation are confirmed and delineated in the field using GPS.
Calculation method:	None
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:	Temporary sample plots will be allocated and measured in the area of potential logging ($A_{DegW,i}$). 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 of trees cut and removed 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.
Frequency of monitoring/recording:	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.
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	GPS Compass Flagging Rangefinder Diameter tape Machete Datasheets **Pencils**
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	Biomass will be estimated from diameter at

	breast height using allometric equations from Gayoso, J.; Guerra, J.; Alarcón, D. 2002. Contenido de carbono y funciones de biomasa en especies nativas y exóticas. Proyecto FONDEF D98I1076 Medición de la capacidad de captura de carbono en bosques de Chile y promoción en el mercado mundial. 157 p.
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% (minimally) of $A_{DegW,i,t}$
Description of measurement methods and procedures to be applied:	Calculated by summing the (slope corrected) area of sample plots measured in 3% sample of $A_{DegW,i,t}$.
Frequency of monitoring/recording:	Every $\leq$ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	None
QA/QC procedures to be applied:	Sample plot dimensions are measured in the field on plot establishment, and any corrections for slope made where slope exceeds 15%.
Calculation method:	Calculated by summing the (slope corrected) area of sample plots measured in 3% sample of $A_{DegW,i,t}$
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DegW,i,t}$
Data unit:	t CO_2-e
Description:	Net carbon stock changes as a result of degradation in stratum *i* in the project area at time *t*
Source of data:	Calculated
Description of measurement methods and	Not applicable

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 monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
Calculation method:	Equation 8, VMD0015 Estimates of emissions will be annualized (to produce estimates in t CO_2-e per year) by dividing the emission for the monitoring interval by the number of years in the interval.
Any comment:	

Data Unit / Parameter:	$\Delta C_{LK\text{-}AS,planned}$
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:	Not applicable
Frequency of monitoring/recording:	Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
Calculation method:	Equation 1, VMD0009
Any comment:	

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:	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. First, new road construction meeting the criteria above will be identified by consulting MOP construction records and/or current road maps. In the event that new road construction meeting the leakage criteria is identified, area of deforestation along the road construction identified above will then be determined with remotely-sensed imagery.
Frequency of monitoring/recording:	Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Medium and/or high resolution satellite imagery, GIS software, improved remote sensing data sources to be used as they become available.
QA/QC procedures to be applied:	All data sources and analytical procedures will be documented and archived.
Calculation method:	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.
Any comment:	

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:	Not applicable
Frequency of monitoring/recording:	Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
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*
Source of data:	Calculated from equation 1, VMD0006
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
Calculation method:	Equation 1, VMD0006
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:	Not applicable
Frequency of monitoring/recording:	Every ≤ 10 years
Value monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Not applicable
QA/QC procedures to be applied:	Not applicable
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. 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 remote sensing analysis.
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 monitored:	Value of parameter is monitored and expected to vary over the crediting period
Monitoring equipment:	Medium and/or high resolution satellite imagery, GIS software, improved remote sensing data sources to be used as they become available.
QA/QC procedures to be applied:	All data sources and analytical procedures will be documented and archived. Remote sensing analysis will be conducted using visual interpretation by an image analyst with knowledge of local land cover and/or with the assistance of high resolution imagery.
Calculation method:	Any areas of burns 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.
Any comment:	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.

3.3 Description of the Monitoring Plan

3.3.1 Revision of the baseline

The baseline as outlined here 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, 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 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 4.1) establishes the initial extent and location of forest and non-forest at the beginning of the crediting period and the first verification interval.

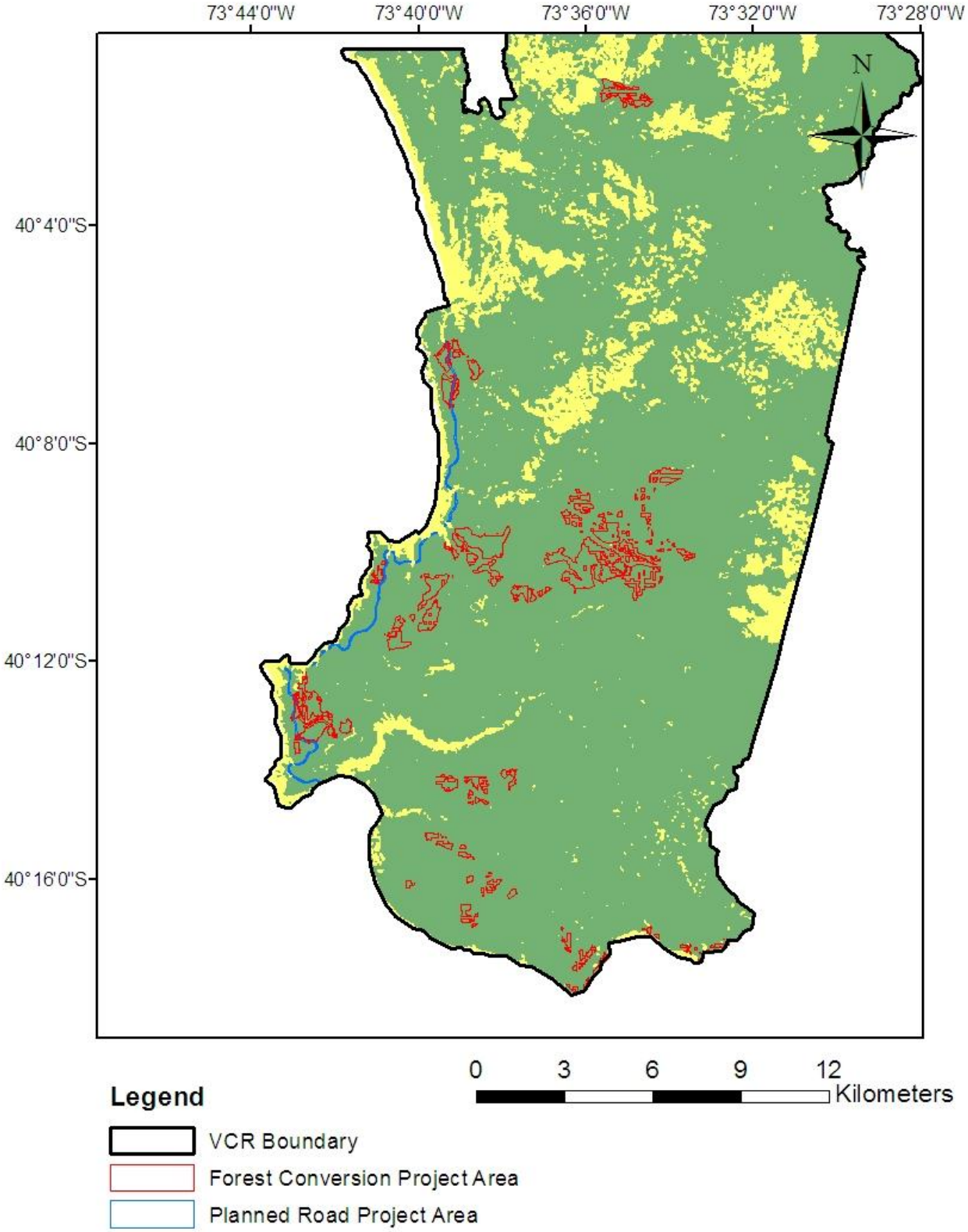

Figure 4.1. Forest cover benchmark map for project area, classified Landsat imagery 2002/2003 (forest in green, non-forest in yellow).

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)
- Error of commission of each land-use category (forest and non-forest)

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 (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:

4. 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.
5. 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.
6. 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.

7. 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 CO_2-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 4.2).

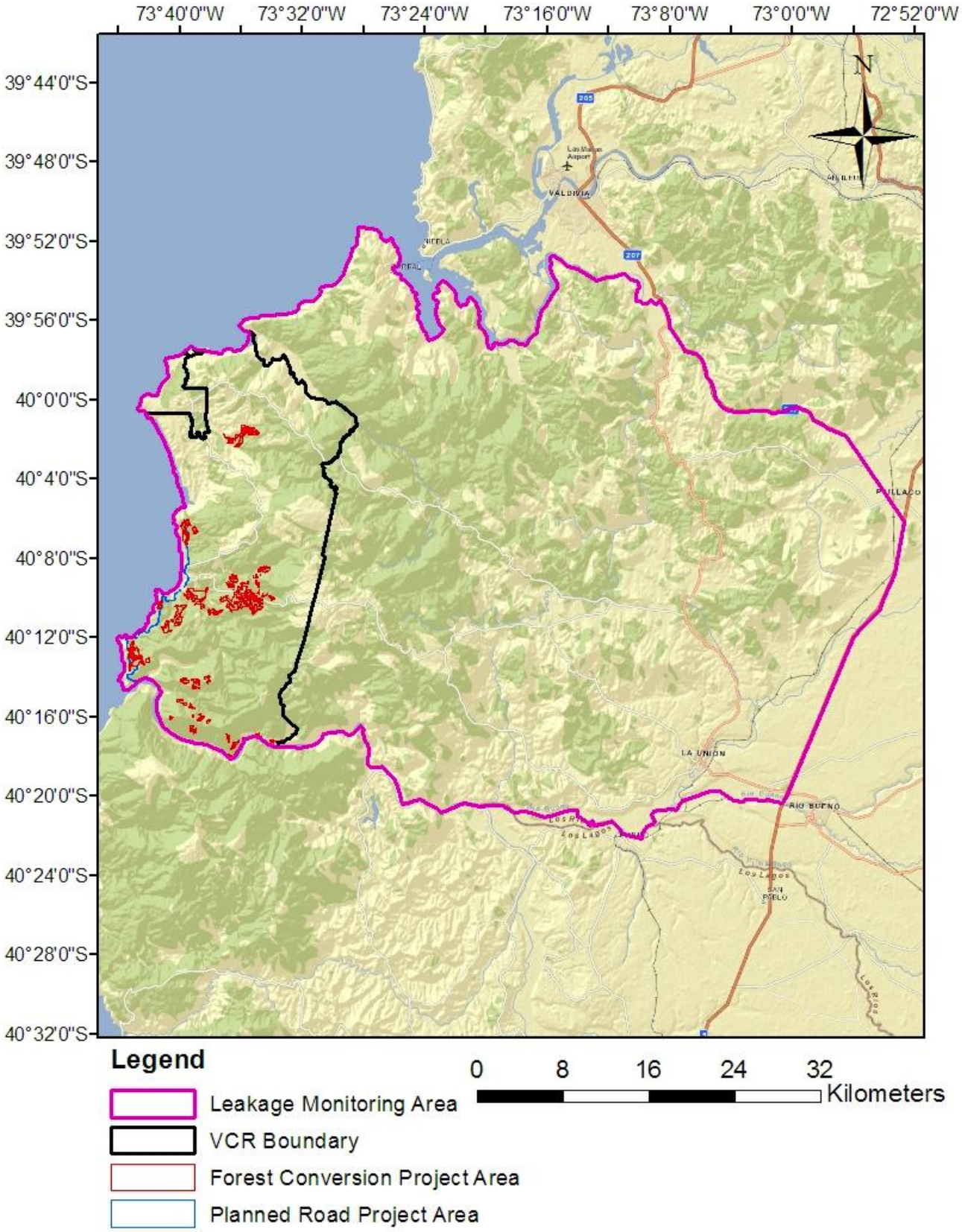
73°40'0"W
73°32'0"W
73°24'0"W
73°16'0"W
73°8'0"W
73°0'0"W
72°52'0"W
39°44'0"S
39°48'0"S
39°52'0"S
39°56'0"S
40°0'0"S
40°4'0"S
40°8'0"S
40°12'0"S
40°16'0"S
40°20'0"S
40°24'0"S
40°28'0"S
40°32'0"S
N
VALDIVIA
LA UNION
RIO BUENO
Legend
Leakage Monitoring Area
VCR Boundary
Forest Conversion Project Area
Planned Road Project Area
0
8
16
24
32
Kilometers

Figure 4.2. 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, is set to zero, thus* $LKA_{planned}$, area of activity shifting leakage, is equal to A_{defLK}.

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 d*eforestation 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).

	$\Delta C_{BSL,planned}$ tCO2e	PF	LK_{CP-ME}	$\Delta C_{LK-AS,planned}$ (t CO2)
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).

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
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 using the Table below.

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)

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO2e)	GHG credits eligible for issuance as VCUs (tCO2e)
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 1.2 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 2003 to 2011, are summed in Table 4.1 below (derived from Section 3.1 of the VCS PD).

Table 4.1. Total baseline emissions

Year	$\Delta C_{BSL,plannd\ ,\ road}$ *tCO2e*	$\Delta C_{BSL,plannd\ ,\ Euc}$ *tCO2e*	*Total* $\Delta C_{BSL,plannd}$ *tCO2e*
2004	0	130,859	130,859
2005	0	146,376	146,376
2006	13,927	43,586	57,512
2007	922	54,742	55,664
2008	6,562	36,453	43,015
2009	3,034	27,829	30,863
2010	11,841	27,829	39,670
2011	13,811	27,829	41,640

Note: Hereafter, the year refers to the year at the end of the annual interval, hence 2004 represents the year from 3 November 2003 to 2 November 2004.

4.2 Project Emissions

Monitoring areas undergoing deforestation

From analysis of forest cover change from the classified imagery, an apparent 5.3 ha of forest cover loss occurred in the project area from 2003 to 2011, detailed in the table below.

stratum	ha deforested
native forest	4.90
Euc plantation est 1990	0.05
Euc plantation est 1991	0.33

This amount is equivalent to 0.4% of the project area (equivalent to an annual deforestation rate of 0.05%), well within the classification inaccuracy (1.2%; overall accuracy of 2011 classification was 98.8%, see Section 5 below) and not unexpected in terms of classification error. In fact, on scrutiny of areas assessed as forest cover loss against high-resolution imagery, most appeared to be classification errors (Figure 4.1).

Figure 4.1. Misclassification of forest cover change from 2003-2011 (GoogleEarth imagery from Jan 1 2011).

Notwithstanding this conclusion, because it is not practical to likewise identify classification errors where actual loss of forest cover was misclassified as forest remaining forest, forest cover loss as identified through analysis of classified Landsat imagery is treated as deforestation and accounted as an emission applying module M-MON. Deforestation and natural disturbance were not distinguished, and all areas of forest cover loss were conservatively treated as deforestation with complete and instantaneous emissions of stocks.

Project emissions from deforestation are calculated as the total area deforested multiplied by the emission per unit area.

Table 4.2 Parameters used to calculate *ΔCP,DefPA,i,t*

ADefPA,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
ΔCpools,Def,u,i,t	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; t CO_2-e ha^{-1}	Calculated below

As per the monitoring plan, changes in forest cover detected for the monitoring interval (2004-2011) were annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period (8).

Table 4.3 *ADefPA,u,i,t* (ha)

	ADefPA,u,i,t (ha)			
	native forest	**Euc plantation est 1990**	**Euc plantation est 1991**	***TOTAL***
2004	0.61	0.01	0.04	0.66
2005	0.61	0.01	0.04	0.66
2006	0.61	0.01	0.04	0.66
2007	0.61	0.01	0.04	0.66
2008	0.61	0.01	0.04	0.66
2009	0.61	0.01	0.04	0.66
2010	0.61	0.01	0.04	0.66
2011	0.61	0.01	0.04	0.66
total	4.90	0.05	0.33	5.28

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

Table 4.4 Parameters used to calculate *ΔCpools,Def,u,i,t*

Parameters used to calculate *ΔCpools,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 CO2-e ha-1	Conservatively assumed to be zero	0

Table 4.5 *ΔCP,DefPA,i,t* (t CO2)

	ΔCP,DefPA,i,t **(t CO2)**			
	native forest	**Euc plantation est 1990**	**Euc plantation est 1991**	**Total *ΔCP,DefPA,i,t***
2004	517.6	2.2	18.2	537.9
2005	517.6	2.2	18.2	537.9
2006	517.6	2.2	18.2	537.9
2007	517.6	2.2	18.2	537.9
2008	517.6	2.2	18.2	537.9
2009	517.6	2.2	18.2	537.9
2010	517.6	2.2	18.2	537.9
2011	517.6	2.2	18.2	537.9
total	4,140.5	17.3	145.7	4,303.4

Monitoring biomass burning

For the period 2003-2011, the CONAF fire database was consulted to identify any records of incidence of fire in the VCR or project area. Two burns were discovered in 2008 and 2009 in VCR forests, affecting 21.7 ha of Eucalyptus plantations and matorral vegetation (right hand figure below). None of these areas were within the project area. Furthermore, in the classification process of the 2011 imagery, no evidence of fire scars was detected, nor were fires reported from park guard patrols over the 2003-2011 period. Therefore, for the current monitoring period, $A_{burn,i,t}$ was 0 and emissions from biomass burning are equal to zero.

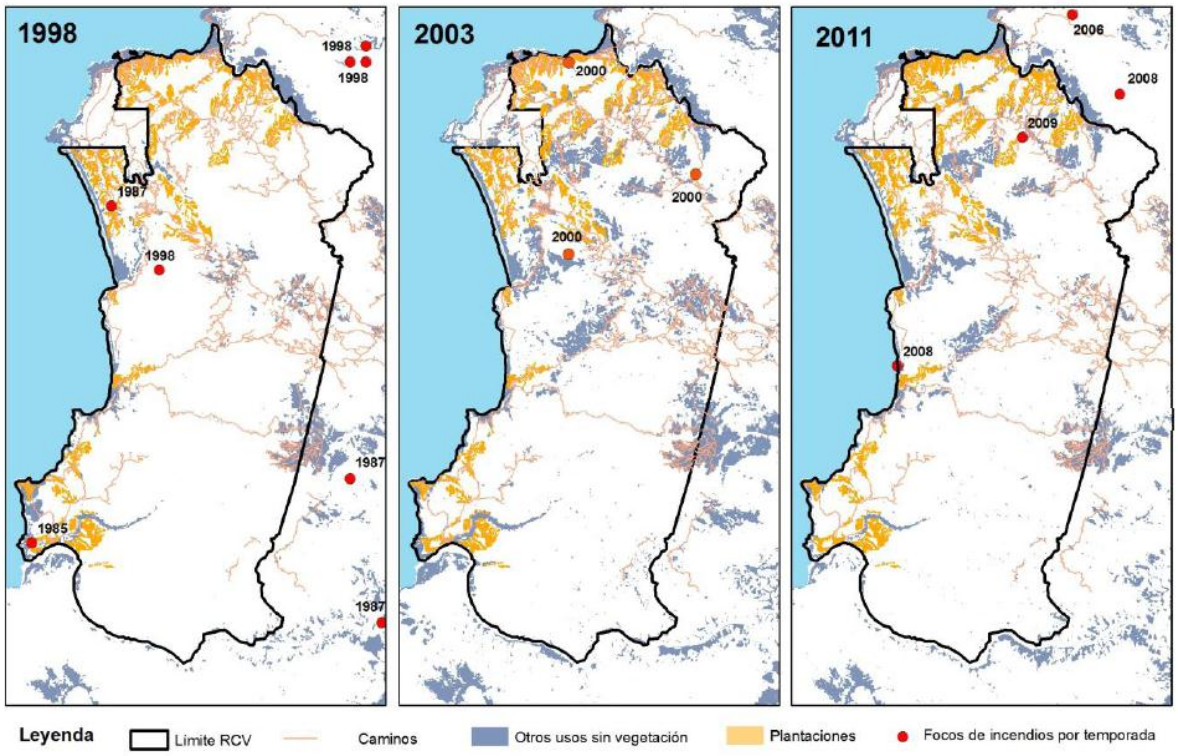

Figure: Incidence of forest fires in the VCR from the CONAF fire database. Right hand figure shows the current 2003-2011 monitoring period.

Monitoring illegal logging

Despite continuous monitoring activities in the field, no illegal logging activities have been observed in the VCR by park guards since October 2009 (and this was not in the carbon project area). Further, during three months of forest inventory field work in 2010 and 2011 throughout the VCR, no indications of recent illegal logging were observed by field crews (some >20 year old cut stumps of cipres and alerce were observed). Infractions of illegal logging in the region are rare due to remote access and difficulty of transport and strong enforcement by CONAF (personal communication, CONAF personnel, Valdivia, December 2009). The project area in particular is remote with no access by primary roads.

In 2012, records from the District Attorney's office (Fiscalia Regional) of the Ríos Region, detailing cases of illegal logging around the VCR, were obtained and reviewed, provided by Lorena Sandaña, executive director of the regional office; the District Attorney's office is where all reports of illegal logging by any enforcement body are collected. From 2005 to 2012, the office recorded 4 cases of illegal logging in and around the Reserve: three along the end of the coastal highway (km 13.3, 10 km from the border of the project area with no connection by any existing access route) and one outside the eastern border of the VCR. Only one of these incidents fell within the VCR itself (well outside the project area). These records are also confirmed by the VCR's guards. *None of these incidents occurred within the project area*.

Net project emissions within the project area calculated in table 4.2.10.

Table 4.6 *ΔCP* (t CO2-e)

	ΔCP,DefPA,i,t	*ΔCP,Deg,i,t*	*ΔCP,DistPA,i,t*	*ΔCP*
2004	537.9	0	0	537.9
2005	537.9	0	0	537.9
2006	537.9	0	0	537.9
2007	537.9	0	0	537.9
2008	537.9	0	0	537.9
2009	537.9	0	0	537.9
2010	537.9	0	0	537.9
2011	537.9	0	0	537.9
total	4,303.4	0	0	4,303.4

4.3 Leakage

Activity shifting leakage

Activity shifting leakage due to displaced road construction

No activity shifting leakage was detected from 2003 to 2011. On consultation with the MOP, no new road construction or road improvements meeting the criteria as defined in the monitoring plan occurred over the monitoring period.

The most recent meeting with the MOP on this topic occurred 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

Activity shifting leakage due to displacement of *E globulus* plantation establishment activities was assessed per Table 4.7 below (derived in Section 3 of the VCS PD) from 2003 through 2011. No activity shifting leakage occurred 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 4.7 Calculations of activity shifting leakage due to displaced forest conversion activities

	$\Delta C_{BSL,}$ *planned*	*PF*	LK_{CP-ME}	$\Delta C_{LK-AS,planned}$ *(t CO2)*

	tCO2e			
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	-

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).

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
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

Year	$V_{BSL,EX,t}$	$C_{BSL,XBT,i,t}$	$LK_{MarketEffects,timber,t}$
	m^3	t CO_2	t CO_2
2008	24.4	37.9	15.1
2009	0.1	0.2	0.1
2010	254.2	393.6	157.4
2011	19.8	30.7	12.3

Market leakage due to displaced forest conversion activities

No market leakage occurred as a result of the stop conversion to plantations activity from 2003 to 2011. 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.

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 Total leakage calculations

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	0	8,898.39	0.0	0	8,898.39
2005	0	9,953.58	0.0	0	9,953.58
2006	0	2,963.82	0.0	0	2,963.82
2007	0	3,722.46	38.9	0	3,761.40
2008	0	0	15.1	0	15.14
2009	0	0	0.1	0	0.08
2010	0	0	157.4	0	157.44
2011	0	0	12.3	0	12.29

4.4 Summary of 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	$Uncertainty_{BSL,SS}$	$Uncertainty_{BSL,RATE,}$	$Uncertainty_{BSL,t*}$	$C_{REDD_ERROR,t*}$	*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, 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 4.11 Summary of net emission reduction calculations

Years	Estimated baseline emissions or removals	Estimated project emissions or	Estimated leakage emissions (tCO2e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account	GHG credits eligible for issuance as VCUs (tCO2e)

	(tCO2e)	removals (tCO2e)			(tCO2e)	
2004	130,859	538	8,898	10.0%	13,032	108,390
2005	146,376	538	9,954	10.0%	14,584	121,301
2006	57,512	538	2,964	10.0%	5,697	48,313
2007	55,664	538	3,761	10.0%	5,513	45,852
2008	43,015	538	15	10.0%	4,248	38,214
2009	30,863	538	0	10.0%	3,032	27,292
2010	39,670	538	157	10.0%	3,913	35,061
2011	41,640	538	12	10.0%	4,110	36,979
Total	545,597	4,303	25,762		54,129	461,402

5 ADDITIONAL INFORMATION

Satellite imagery classification for monitoring date (2011)

Satellite imagery used for the 2011 forest : non-forest cover land map was Landsat Enhanced Thematic Mapper Plus (ETM+) imagery from 26 June 2011. Imagery was acquired at http://glovis.usgs.gov/ (Table 5.1). The date was selected to minimize cloud cover.

Table 5.1: Imagery used for 2011 monitoring event.

		2011
Cloud free (%)	Complete scene	66%
	Classification area (VCR)	100%
	sensor	ETM+
	Path/row	233/88
	Date	26 June 2011

Atmospheric correction was carried out prior to classification. A supervised classification applying a maximum likelihood algorithm (Keuchel *et al*. 2003) was conducted using all multispectral bands and calculated Normalized Difference Vegetation Index (NDVI). Auxiliary information from high resolution satellite imagery from GoogleEarth was used to identify training areas of homogeneous land cover for the classification. To define each training area, a minimum of 200 pixels were selected which demonstrated a high degree of separability between different types of land cover. This was demonstrated by having a transformed divergence greater than 1800 (Erdas 1999).

Minimum Mapping Unit (MMU) applied was 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m * 90m).

The following classes were distinguished:

- Forest (including native and plantation forest)
- Non-forest (including water bodies, including bare earth, pastures, matorrales, wetlands and others)

Accuracy of the resulting classification was assessed using 40 field collected ground truth points from native forest and 40 points distinguished as non-forest from high resolution satellite imagery obtained from GoogleEarth. Ground truth points of forest were obtained in the VCR forest inventory conducted in 2011. Points were well-distributed throughout the image (Figure 5.1).

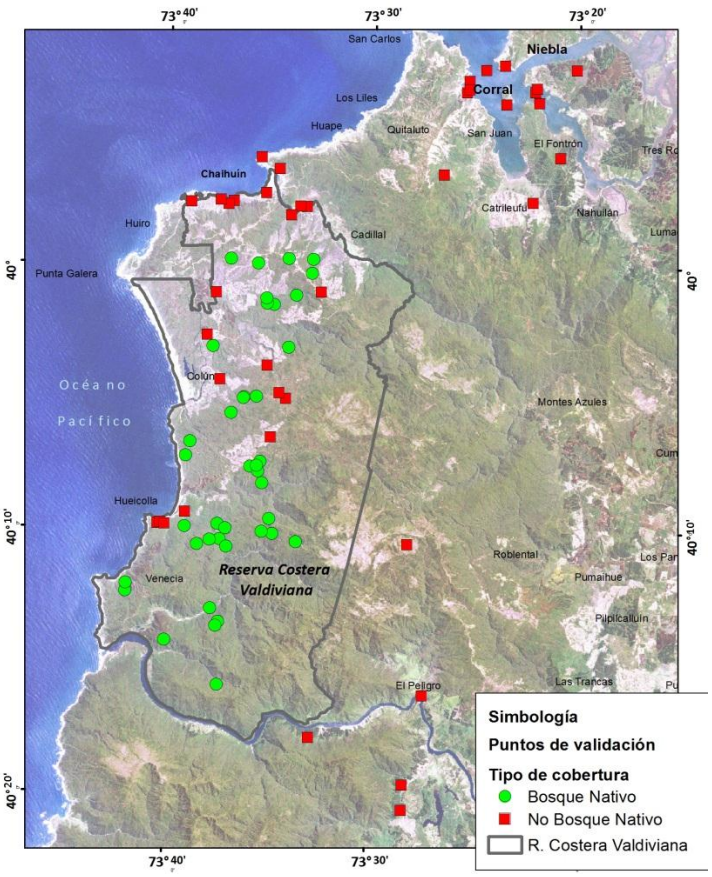

Figure 5.1 Location of points used in accuracy assessment.

Results of the accuracy assessment are presented in the matrix below (Figure 5.2).

Table 5.2 Confusion matrix for accuracy assessment of the 2011 classification.

Classification	**Observed**

	Forest	Non forest	Total	User accuracy (%)	Error of commission (%)
Forest	41	1	42	97.6	2.4
Non forest	0	38	38	100.0	0.0
Total	41	39	80		
Producer accuracy (%)	100.0	97.4			
Error de omission (%)	0.0	2.6			
Overall accuracy	98.8				

Overall accuracy of the classification, calculated as the total number of correct samples/ the total number of samples, was 98.8%.