ANNEX 5
EMISSIONS COMPENSATION PROGRAM

1 INTRODUCTION

This Emissions Compensation Program was requested within the framework of the environmental impact assessment developed for the Alto Maipo Hydroelectric Project (PHAM), as required by the system of environmental impact assessment, SEIA. The structure of the program was agreed to with staff from CONAMA's Metropolitan Region Atmospheric Decontamination Department.

The Emissions Compensation Program (PCE) describes the measures to be adopted by the PHAM to compensate for the emissions produced during the construction phase. In addition to a detailed description of these measures, the Program specifies the areas where the measures will be applied, and the period of time assigned to the activities in the Project Schedule (see Annex 2). Actions to monitor compliance with the Program are also included.

The PCE will be adapted to the construction programs developed by the different contractors.

The PCE was developed based on the PHAM Emissions Study (see Annex 4), and the Road Improvement Program (see Annex 19).

2 EMISSIONS-GENERATING ACTIVITIES

Development of the PHAM will involve the construction of four conveyance tunnels: El Volcán, Yeso, Alfalfal and Las Lajas. The PHAM also includes the construction of permanent and temporary facilities.

All the construction works to be undertaken as part of the PHAM are described in detail in Annexes 1 and 11.

Construction works will involve the use of heavy equipment, and earth-moving activities. The main activities associated with the generation of PM-10 and gas emissions are as follows:

a) Site preparation for road works;
b) Drilling and blasting;
c) Truck loading;
d) Truck traffic;
e) Truck unloading;
f) Loading of material disposal train wagons and conveyor belt;
g) Unloading of material disposal train wagons and conveyor belt;
h) Truck engines;
i) Equipment engines;
j) Erosion in muck disposal site active zones;
k) Construction of worker camps and other facilities.

The above activities will be concentrated mainly at the work fronts.

All the activities listed above generate PM-10 emissions. In addition, activities h) and i) also release CO, HC and NO_X.

The construction phase of the PHAM will take place in different work areas, where different volumes of material will be moved, and different muck disposal sites set up. There are eight such sites:

1. Volcán
2. El Yeso
3. Aucayes Alto
4. Alfalfal
5. Aucayes Bajo
6. Ventana Las Lajas
7. Ventana Las Puertas
8. Maipo River Discharge

According to the Project Schedule (see Annex 2), the construction phase will begin as soon as COREMA issues the Environmental Qualification Resolution approving the PHAM. The details and duration of the works to be undertaken as part of the Project are shown in the following table:

Table 2.1
Work Areas, Activities and Duration

WORK AREA	ACTIVITIES	YEAR OF CONSTRUCTION					
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
El Volcán	Installment and operation of camp		Jan-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Mar
	Installment and operation of temporary facilities	Oct-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Mar
	Operation of MDS Nº 1	Oct-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Jul	
	Construction of service roads	Oct-Dec	Jan-Mar				
	Improvement of Route G -25 (Lo Valdés - Puente Colina)	Oct-Dec	Jan-Mar				
	El Volcán Tunnel Front		Apr-Dec	Jan-Dec	Jan-Dec	Jan-May	
	External civil works front		Oct-Dec	Jan-Apr / Oct-Dec	Jan-Apr / Oct-Dec	Jan-Apr	
El Yeso	Installment and operation of camp		Jan-Dec	Jan-Dec	Jan-Dec	Jan-Jun	
	Installment and operation of temporary facilities	Oct-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Jun	
	Operation of MDS Nº 2		Apr-Dec	Jan-Dec	Jan-Dec	Jan-Feb	
	Operation of MDS Nº 3			Oct-Dec	Jan-Dec	Jan-May	
	Operation of MDS Nº 4		Apr-Dec	Jan-Dec	Jan-May		
	Preparatory works	Oct-Dec	Jan-Mar				
	Improvement Route G-455 to El Yeso reservoir	Oct-Dec	Jan-Mar				
	El Volcán Tunnel Front		Apr-Dec	Jan-Dec	Jan-Dec	Jan-Jun	
	Alfalfal II Tunnel Front .		Apr-Dec	Jan-Dec	Jan-May		
	Lo Encañado internal works front			Apr-Oct			
	Suelo Norte Tunnel Front			Nov-Dec	Jan-Dec	Jan-May	
	Suelo Sur Tunnel Front				Jul-Dec	Jan-Mar	
	External civil works front		Oct-Dec	Jan-Apr / Oct-Dec	Jan-Apr / Oct-Dec	Jan-Apr	
Aucayes Alto	Installment and operation of camp		Apr-Dec	Jan-Dec	Jan-Dec	Jan-Jul	
	Installment and operation of temporary facilities		Apr-Dec	Jan-Dec	Jan-Dec	Jan-Jul	
	Operation of MDS Nº 5		Apr-Dec	Jan-Dec	Jan-Nov		
	Operation of MDS Nº 6	Oct-Dec	Jan-Mar				
	Preparatory works	Oct-Dec	Jan-Mar				
	Alfalfal II Tunnel Front		Apr-Dec	Jan-May / Nov-Dec	Jan-Nov		
	Bulkhead and shielding assembly					Jan-Jul	
Alfalfal	Installment and operation of temporary facilities		Mar-Dec	Jan-Dec	Jan-Dec	Jan-Mar	
	Operation of MDS Nº 7		Apr-Dec	Jan-Dec	Jan-Dec	Jan-Mar	
	Operation of MDS Nº 8		Apr-Dec	Jan-Mar			
	Preparatory works	Apr-Nov	Jan				
	Alfalfal II Access Tunnel		Mar-Dec	Jan-Mar			
	Alfalfal II Cavern & Others			Apr-Dec			
	Alfalfal II Cavern Civil Works				Jan-Aug		
	Equipment Installation				Jun-Dec	Jan-Mar	
	Shaft Excavation			Apr-Sep			
	Alfalfal II Discharge Tunnel				Jan-Jun		
	Forebay Area		Apr-Dec	Jan-Mar			
	External civil works front			Oct-Dec	Jan-Dec	Jan-Mar	
Aucayes Bajo	Installment and operation of camp	Jul-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Mar	
	Installment and operation of temporary facilities	Jul-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Mar	
	Operation of MDS Nº 9	Apr-Dec	Jan-Dec	Jan-Dec	Jan-Jun		
	Preparatory works	Jul-Dec					
	Ventana		Jan-Jun				
	Alfalfal II Discharge Tunnel		Jul-Dec	Jan-Dec	Jan-Feb		
	Las Lajas Upstream Adduction		Jul-Dec	Jan-Dec	Jan-Feb		
	Las Lajas Downstream Adduction			Apr-Dec	Jan-May		
Ventana Las Lajas	Installment and operation of camp		Jan-Dec	Jan-Dec	Jan-Dec		
	Installment and operation of temporary facilities		Jan-Dec	Jan-Dec	Jan-Dec		
	Operation of MDS Nº 10		Mar-Sep				
	Operation of MDS Nº 13	Apr-Dec	Jan-Dec	Jan-Sep			
	Operation of MDS Nº 11	Apr-Dec	Jan-Sep				
	Las Lajas Upstream Adduction		Oct-Dec	Jan-Sep			
	Surge Tank			Jan-Jul			
	Shielding Assembly			Oct-Dec	Jan-Mar		
Las Puertas	Operation of MDS Nº 14	Oct-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Feb	
	Preparatory works	Apr-Sep					
	Las Lajas Access Tunnel		Jan-Dec				
	Las Lajas Cavern & Others			Jan-Sep			
	Las Lajas Cavern Civil Works			Oct-Dec	Jan-May		
	Equipment Installation				Mar-Dec		
	Pressure Shaft Excavation			Mar-Aug			
	Las Lajas Discharge Tunnel			Oct-Dec	Jan-Dec		
Maipo	Installment and operation of temporary facilities	Apr-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Aug	
	Operation of MDS Nº 12	Apr-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Feb	
	Preparatory works	Apr-Dec					
	Las Lajas Discharge Tunnel		Jan-Dec				
	Alfalfal II Tunnel Front			Mar-Dec	Jan-Dec	Jan-Feb	
	Discharge to Maipo River					Mar-Aug	

External work fronts include all surface civil works, i.e. intakes, delivery canals, siphons, bridges, etc.

Emissions are estimated for each work front, based on the corresponding works and/or activities indicated in Table 2.1 above. The emissions from activities associated with the installment and operation of temporary facilities, limited mainly to truck traffic emissions, are also considered in the calculation.

3 PROPOSAL FOR EMISSION COMPENSATION MEASURES

According to the results of the emissions study (see Annex 4), the highest level of PM-10 emissions, 284.6 tons per year, will occur in 2010, as indicated in Table 4-54 of Annex 4.

Pursuant to Article 51 of the Atmospheric Prevention and Decontamination Plan (PPDA) for the Metropolitan Region, new activities or projects or modifications of existing projects or activities that emit more than 10 tons per year of PM-10 are required to compensate their emissions by 150%.

During the year of maximum emissions, Project-related activities exceed by almost 275 tons the emissions limit set by the PPDA. It is therefore necessary to put in place an Emissions Compensation Program, describing the actions that will be taken to compensate 150% of the emissions generated by the PHAM. Considering that the highest level of Project-related emissions is 284.6 tons per year, the compensation of emissions should be in the order of 426.9 tons.

In view of the above, following is a compensation proposal intended to ensure that total Project-related emissions do not exceed the limits set by the PPDA.

The compensation proposal consists of improvements to existing roads used to access the Project area: 22 km of Route G-455, between Route G-25 and the El Yeso Reservoir, and 21 km of Route G-25, between Baños Morales and the PHAM work area. The improvements will include restoring road surfaces with a well-graded granular layer, and spraying with bischofite, a dust suppressant.

Installing road signs on specific road segments is also contemplated.

These roads are currently used by heavy-duty trucks accessing the mining sites located in the upper Yeso, Volcán and Colorado river valleys.

The average daily traffic of 2-axle and plus trucks (baseline) is 154 trucks for Route G-25 (between San Gabriel and El Volcán), and 5 trucks for Route G-455. These flows were calculated using the methodology described in Annex 14.

Current air emissions from truck traffic in the area are mitigated only by rainfall.

The upgrading of Routes G-25 and G-455 contemplated by the PHAM is expected to substantially reduce baseline air emissions, representing one of the Project's emission compensation measures.

Table 3.1 below summarizes the road upgrading activities proposed to be carried out by the PHAM, and which represent the emission compensation measures set forth in Annex 19.

Table 3.1
Emission Compensation Measures

General Measures	Specific Measures	Description	Area	Duration
Improvement El Volcán Route G-25	Restoring road surface with a granular layer	CBR $\geq$ 60 %, 7 m wide and 15 cm thick	From km 13.8 to km 20	October Year 1 to March Year 2
	Installing road signs	Approximately 50 road signs and 60 vertical delineators are expected to be installed	From km 12 to km 23.3	October Year 1 to March Year 2
	Installing road protection barriers	On sections with curves, low visibility or risk of vehicles going over the edge and falling from great heights	From km 12 to km 23.3 (estimated total of 200 m)	October Year 1 to March Year 2
	Installing corrugated tube type masonry structures	Diameter d=0.80 m	In sector where road surface is restored	October Year 1 to March Year 2
	Annual spraying with bischofite	Dust suppression system. Annual spraying activities are expected to take place along the entire road, including the road segment to be paved by the Ministry of Public Works	From km 0 (Puente Yeso) to km 23	October Year 1 to March Year 2 October-December Years 2, 3, 4 and 5

Measures	Activities	Description	Area	Duration
Improvement Yeso Route G-455	Installing road signs	Approximately 100 signs and 50 vertical delineators are expected to be installed	Along the entire road; from km 0 (Puente Yeso) to km 22	October Year 1 to March Year 2
	Installing road protection barriers	On sections with curves, low visibility or risk of vehicles going over the edge and falling great distances	From km 10 to km 19 (estimated total of 200 m)	October Year 1 to March Year 2
	Installing corrugated tube type masonry structures	Diameter d=0.80 m	In the km 6 area, where a water outlet for tank trucks is located	October Year 1 to March Year 2
	Restoring road surface with granular layer	CBR > 60 % from km 17.8 to km 18.3, 7 m wide and 15 cm thick	From km 17.8 to km 18.3	October Year 1 to March Year 2
	Building road gutters	Building of two natural rock gutters	km 18 area	October Year 1 to March Year 2
	Building masonry wall	One-meter wall to delimit edge and contain spills to allow for manual or machine removal	Km 3.6 (40 m); km 4.2 (80 m); from km 17.8 to km 18.8 (300 m)	October Year 1 to March Year 2
	Extending sewers	Three box sewers extended from 4 m to 7 m	Aucayes Stream	October Year 1 to March Year 2
	Annual spraying with bischofite	Dust suppression system. Annual spraying activities are expected to take place along the entire road.	From km 0 (intersection with Route G-25) to km 22	October Year 1 to March Year 2 October-December Years 2, 3, 4 and 5

In addition to the compensation measures proposed to ensure that Project-related emissions stay below the maximum limits set by the PPDA, the Project Owner has considered the following particulate matter reduction measures, as indicated in Section 6.4.1.1 of the EIA.

Table 3.2
Emissions Mitigation Measures

Measures	Description	Area
Transportation of loads of loose material covered with a canvas	Trucks carrying material out of the work fronts will cover their loads with a canvas to prevent the loads from dropping	Service roads and Routes G-25, G-455 and G-345
Surface moistening	Work site internal surfaces will be moistened	Inside camps and work fronts
Debris and/or material dump piles covered with a canvas	Debris and/or material dumps will be covered with a plastic or fabric cover, or kept in closed containers	Inside camps and work fronts
Access roads kept free of debris	Service and access roads will be kept clean (free of debris, mud, dirt and construction materials)	Service roads and Routes G-25, G-455 and G-345
Engine shut off	Contractors will be instructed to shut off truck engines when vehicles are parked for an extended period of time	Inside camps and work fronts
Prohibition of open burning of waste and burnable debris	The open burning of waste and burnable debris (wood, paper, leaves, excess plant material and any other debris from the construction phase) is prohibited. Food must be cooked or heated with gas or electric devices.	Inside camps and work fronts

4 EMISSIONS ESTIMATION

4.1 EMISSIONS ESTIMATION IN THE CURRENT SITUATION WITHOUT THE PROJECT

The current conditions of the road segments to be improved, together with the traffic of heavy-duty vehicles accessing the mining sites, constitute the main source of particulate matter emissions in the area. The upgrading of the roads will immediately impact the emissions from this source.

In order to conservatively estimate the reduction of emissions resulting from the emissions compensation proposal, only the reduction of emissions due to road improvement activities was considered. For this, a comparison was made between the current emissions and the emissions projected after road improvement. The comparison was based on the following:

- A traffic count, targeting light vehicles, 2-axle and larger trucks, and buses, carried out on 15 November 2007. Three observation points were set up to record traffic, one on Route G-455, one on Route G-25, before the turnoff to Baños Morales, and a third point on Route G-25, at the turnoff to Baños Morales. The traffic count at points 1 and 3 were considered representative.

- Confirmation through inspections that the roadways are sprayed with water, at least twice a day, using another company's water tank truck. According to the estimates, this reduces the dust emissions by approximately 50% (Area for Road Impact Assessment dated 23 November 2006).

- Data from the Queltehues weather station, showing an average of 34 rainy days per year for the area.

Finally, the emissions compensation proposal includes the use of bischofite[1] as a dust suppressant (see Annex 19 for details). The effectiveness of bischofite as a dust suppressant is 85% (see Annex 4, Appendices 1, 2 and 3).

Regarding bischofite's effectiveness as a dust suppressant, according to a 2004 study conducted by Universidad Católica's Scientific and Technological Research Department (DICTUC) on the use of this product on unpaved roads (*Metodología de Aplicación del Cloruro de Magnesio como supresor de polvo en caminos no pavimentados*), bischofite can reduce dust emissions by 83% to 96% (see Annex 4).

In proximity to the PHAM area, the La Perla mining company has been using bischofite in the Colorado River area since 2003. According to their reports, filed with CONAMA RM, dust emissions have been reduced by 90%.

A comparative analysis conducted by the Road Administration Department of Region VII (*Análisis Comparativo de la Eficiencia de Supresores de Polvo Mediante el Uso de Equipo Dustmate y el Efecto Económico para la Conservación Rutinaria y Periódica de Carpetas Granulares*, 2006), revealed that bischofite was the most effective of the three dust suppressants included in the study, reducing dust emissions by 96% (Annex 4, Appendix 1).

The emissions for each of the road segments included in the emissions reduction proposal are estimated below. The methodology details, emission factors and equations used for PM-10, CO, HC and NO_x are discussed in Annex 4.

The estimation of current emissions is based on the traffic flow data collected on 15 November 2007. These are summarized in Table 4.1.1 below.

Table 4.1.1
Traffic Count on Route G-455[2]

Route	Distance (km)	Nº of Vehicles by Type			
		Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses
G-455	22	34	3	8	0
G-25	21	73	43	277	1

Source: Ambitrans Traffic Count, 15 November 2007.

Table 4.1.2 below shows the mean weight and emission factor considered for each vehicle type. The emission factor is for unpaved roads, as defined in Annex 4. As in the case of the estimation of Project-related emissions, 10% material silt content was considered.

[1] Thenoux, G. and S. Vera, 2003. Guía para la aplicación de Roadmag como supresor de polvo en caminos no pavimentados. ROADMAG. Centro de Ingeniería e Investigación Vial. Dirección de Investigación Científica y Tecnológica, Universidad Católica.
[2] Traffic count carried out on 23 November 2007, at the intersection of Routes G-455 and G-12. Point 13 of the Baseline Report. Baseline Report.

Table 4.1.2
Vehicle Mean Weights and Emission Factors

Route	Mean Weight by Vehicle Type (t)				Emission Factors by Vehicle Type (kg/VKT)			
	Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses	Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses
G-455	2	45	45	30	0.3300	1.3395	1.3395	1.1161
G-25	2	45	45	30	0.3300	1.3395	1.3395	1.1161

Table 4.1.3 below shows the total distances traveled by vehicle type and the associated emissions. The effectiveness of water spraying was estimated at 50%, and annual emissions were based on a 331-day year, in order to exclude the 34 rainy days without emissions.

Table 4.1.3
Total Distances Traveled by Vehicle Type and Associated Emissions

Route	Total Distances Traveled				Emissions Generated (kg/day)				Total Emissions (t/yr)
	Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses	Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses	
G-455	748	66	176	0	123	44	118	0	94
G-25	1,533	903	5,817	21	253	605	3,896	12	1,577
							TOTAL		**1,672**

Based on the current traffic flows on the segments of Routes G-455 and G-25, 1,672 tons of PM-10 is released to the air each year.

4.2 EMISSIONS ESTIMATION AFTER ROAD IMPROVEMENTS

Improvements to Routes G-455 and G-25, consisting in the restoration of road surfaces with a well-graded granular layer, and the spraying with bischofite, are expected to reduce dust emissions by 85%.

Table 4.2.1 below shows the emissions associated with the vehicle traffic on Routes G-455 and G-25 after improvements. The same parameters defined in Tables 4.1.1 and 4.1.2.5 were used to estimate emissions.

Table 4.2.1
Vehicle Emissions Considering Bischofite Application

Route	Total Distances Traveled (km)				Emissions Generated (kg/day)				Total Emissions (t/yr)
	Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses	Light Vehicles	2-axle Trucks	2-axle+ Trucks	Buses & Taxibuses	
G-455	748	66	176	0	37	13	35	0	28
G-25	1,533	903	5,817	21	76	181	1,169	4	473
							TOTAL		**502**

When comparing the results of Tables 4.1.3 and 4.2.1 above, it is clear that spraying with bischofite reduced PM-10 emissions from 1,672 to 502 tons per year. This represents an annual reduction of 1,170 tons in PM-10 emissions, which clearly exceeds the 426.9 tons of Project-related emissions to be compensated.

5 MONITORING

Compliance with the emissions compensation measures will be monitored as summarized below:

Table 5.1
Monitoring of Emissions Compensation Measures

Measures	Monitoring Activities	Frequency
Restoring road surface with a granular layer	Visual verification of road segments subject to improvements, following the dust measuring protocol developed by Universidad Católica's DICTUC. A DustMate instrument is used to objectively measure dust emissions, thus determining the effectiveness of the dust suppressing treatments.	March - April of each calendar year
Annual spraying with bischofite		August - September of each calendar year
Installing road signs	Visual verification of the existence and conditions of the road signs installed on the road segments subject to improvement	April – May of each calendar year
Installing road protection barriers	Visual verification of the conditions of the road protection barriers installed in road segments with curves, low visibility or risk of vehicles going over the edge and falling from great heights	April – May of each calendar year
Installing corrugated tube type masonry structures	Visual verification of the progress of the works in the segments of Routes G-25 and G-455 (km 6) where the road surface is being restored.	April – May of each calendar year
Building road gutters	Visual verification of the conditions of the gutters at the 18 km point of Route G-455	April – May of each calendar year
Building masonry wall	Visual verification of the state of the wall at the 3.6, 4.2, and 17.8 to 18.8 km points of Route G-455.	April – May of each calendar year
Extending sewers	Visual verification of the state of the sewers of Route G-455	April – May of each calendar year

Based on the results of the monitoring activities described above, a progress report will be developed and submitted to the Environmental Authority, on a six-monthly basis.

6 CONCLUSIONS

During the construction phase of the PHAM, CO, HC and NOx emissions will remain below the limits established in the Atmospheric Prevention and Decontamination Plan for the Metropolitan Region.

According to the results of this study, the PM-10 emissions from Project activities will exceed the PPDA permissible limits by a maximum of 275 tons per year (considering a maximum of 284.6 tons per year for the Project). To compensate for the excess emissions, the Project proposes to make improvements to a segment of Route G-455 (between Route G-25 and the El Yeso Reservoir), and a segment of Route G-25 (between Baños Morales and the work area). The details of the proposal are included in Annex 19.

Current PM-10 emissions for the road segments already mentioned will fall by 1,170 tons per year as a result of road improvement activities. This reduction will meet the 150% emissions compensation requirement provided for in the PPDA for the Metropolitan Region.

The emissions compensation proposal was developed based on the calculations and criteria recommended by CONAMA, and is expected to be approved by the competent authorities.

385000 390000 395000 400000 405000 410000

6265000 6260000 6255000

N

San Sebastian
Quebrada El Agua
San Gabriel
Quebrada Los Colorados
Los Chacayes
Quebrada Los Chacayes
El Manzanito
Quebrada LAs Cortaderas
Co. San Francisco
Co. Morado
Co. Punta Balcón
Co. Las Placas
Estero Colina
Co. San Gabriel
G - 455
Co. San Nicolas
El Rodeo de Los Bueyes
Quebrada Rodeo de Los Bueyes
Panamávida
Estero el Morado
Estero Las Placas
El Bollenar
San Gabriel
Puente Yeso
RÍO YESO
Laguna Morales
Co. Ruhillas
Laguna Los Lunes
A San José de Maipo
Co. La Colorada
Quebrada Colorada
Estero Colina
La Engorda
Romeral
Los Piuches
G - 25
Co. Blanco
Quebrada Los Lunes
Co. Los Chacayes
Quebrada Morales
CAJÓN RUHILLAS
RÍO VOLCÁN
Puente Colina
Yeseras del Volcán
Qda. Las Amarillas
Los Queltehues
Los Arboles
Villa del Valle
G - 25
El Volcán
Quebrada Chacayes
Baños Morales
CAJÓN D
Chacritas
Lo Valdes
La Cueva de la Bruja
Ref. Los Condores
Ref. Verbo Divino
Quebrada El Salto
Los Chacayes
Co. Catedral
El Chancho
Co. San Simón
Qda. Rosales
Qda. Sonámbulo
San Simón
Quebrada El Cobre
Quebrada Los Amarillas
RÍO VOLCÁN
Ojos de Agua
Baños de Colina
Quebrada el Chiquero
Co. El Salto
Quebrada El Yesillo
Quebrada El Durazno
Los Chacayes
Quebrada Carrefito
Pocitos Azul

DETALLE MEDIDAS DE COMPENSACIÓN DE EMISIONES

Codigo	Descripción
RAB	Riego Anual de Bischofita
IOATC	Instalación de Obra de Arte Tipo Tubo Corrugado
IDC	Instalación de Defensas Camineras
ISC	Instalación de Señales Camineras
RCRG	Reposición Carpeta de Rodado Granular

Simbología

Localidad
- Localidad

Curva de Nivel
- Curva índice
- Curva glaciar
- Curva secundaria

Hidrografía
- Río
- Estero
- Quebrada permanente
- Canal existente

Vialidad Existente
- Camino pavimentado
- Camino ripio

Medida Compensación
- RAB + IDC + ISC + RCRG + IOATC
- RAB + IDC - ISC
- RAB
- RAB + ISC

Vialidad Proyectada
- Camino de servicio proyectado

Obras Proyecto PHAM
- Bocatoma
- Túnel
- Canal conducción

1000 0 1000 2000 3000 4000 mt

Escala 1:75.0000
Coordenadas UTM en Metros
Datum PSAD 56 - Huso 19
Elipsoide Internacional de 1924

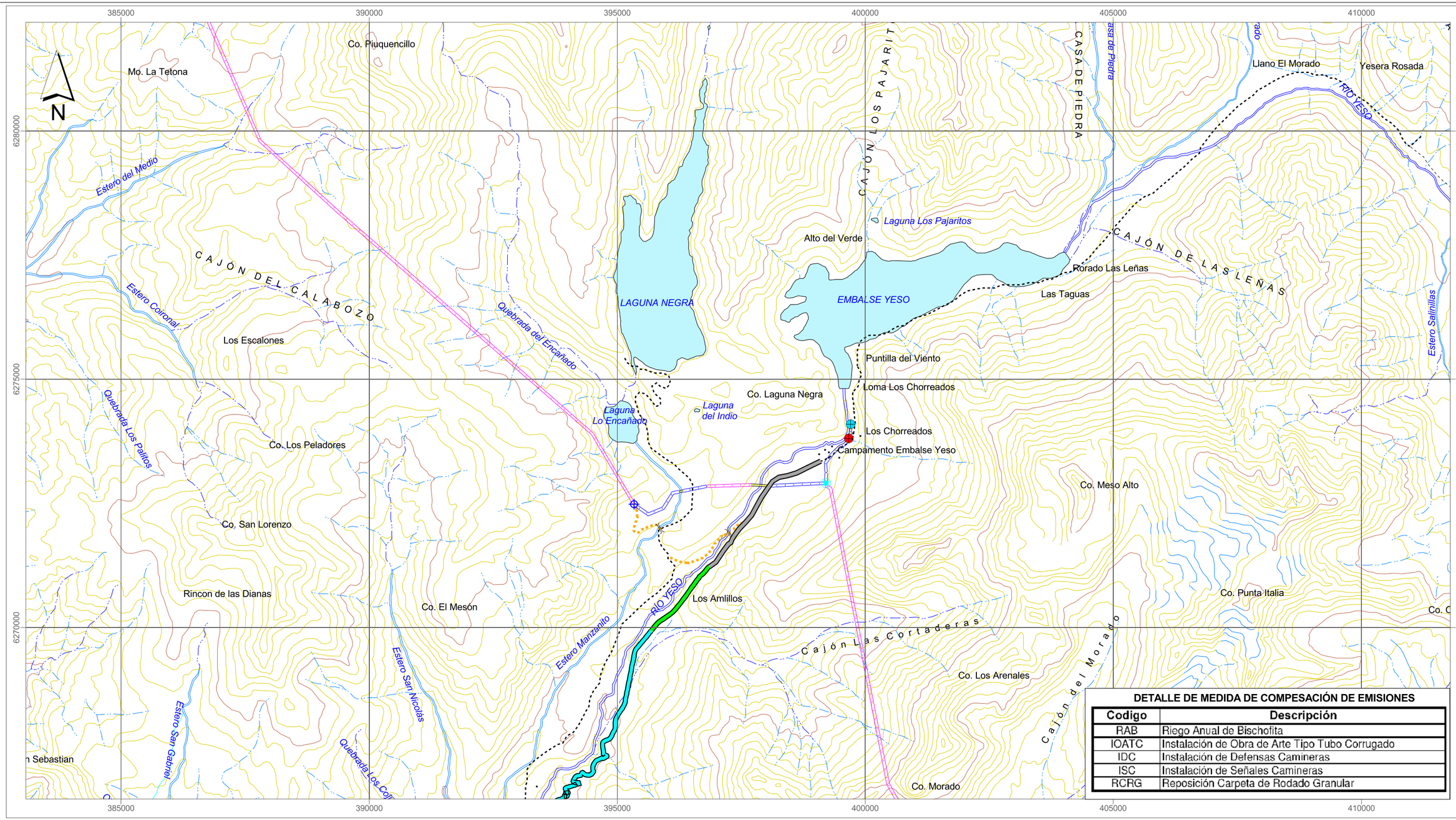
FUENTE MAPA BASE: Cartografia Digital IGM, Escala 1:50.000, "Farellones", "Volcán San José", "Río Yeso", "El Ingenio", "Río Olivares", "Embalse Yeso", "El Volcán"

ESTUDIO DE IMPACTO AMBIENTAL
PROYECTO HIDROELÉCTRICO ALTO MAIPO

TÍTULO: **MEDIDAS DE COMPENSACIÓN DE EMISIONES EN RUTA G-25 y G-455**

ESCALA:	FECHA:	LÁMINA:	REV:
1:75.000	MAYO 2008	1	0

PREPARADO POR: ARCADIS GEOTECNICA
PREPARADO PARA: Gener una empresa AES



DETALLE DE MEDIDA DE COMPESACIÓN DE EMISIONES

Codigo	Descripción
RAB	Riego Anual de Bischofita
IOATC	Instalación de Obra de Arte Tipo Tubo Corrugado
IDC	Instalación de Defensas Camineras
ISC	Instalación de Señales Camineras
RCRG	Reposición Carpeta de Rodado Granular

Simbología

Localidades
- Localidades

Curva de Nivel
- Curva nivel índice
- Curva glaciar
- Curva secundaria

Hidrografía
- Río
- Estero
- Quebrada intermitente

Obras Proyecto PHAM
- Bocatoma
- Captación
- Descarga
- Ventana
- Pozo
- Puente
- Sifón
- Túnel
- Ducto Proyectado

Vialidad Existente
- Camino ripio

Vialidad Proyectada
- Camino servicio proyectado

Medidas de Compensación
- RAB + IDC + ISC
- RAB + ISC
- RAB + IDC + ISC + RCRG + IOATC

2000 0 2000 4000 mt

Escala 1:75.000
Coordenadas UTM en Metros
Datum PSAD 56 - Huso 19
Elipsoide Internacional de 1924

ESTUDIO DE IMPACTO AMBIENTAL
PROYECTO HIDROELÉCTRICO ALTO MAIPO

TÍTULO
MEDIDAS COMPENSACIÓN DE EMISIÓN EN RUTA G-455

ESCALA:	FECHA:	LÁMINA:	REV:
1:75.000	MAYO 2008	2	0

PREPARADO POR: ARCADIS GEOTECNICA

PREPARADO PARA: Gener, una empresa AES

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