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CHILE

**ALTO MAIPO
HYDROELECTRIC POWER PROJECT**

CH-L1076

**ENVIRONMENTAL AND SOCIAL MANAGEMENT REPORT
(ESMR)**

SEPTEMBER 2013

ENVIRONMENTAL CATEGORY: A

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LIST OF ACRONYMS

ARD	Acid Rock Drainage
bgl	Below ground level
CADE	Electricity Development Committee (<i>Comité Asesor para el Desarrollo Eléctrico</i>)
CBI	Consensus Building Institute
CDM	Clean Development Mechanism
CIA	Cumulative Impact Assessment (<i>Evaluación de Impactos Acumulativos</i>)
CONAF	National Forestry Corporation (<i>Corporación Nacional Forestal</i>)
CONAMA	National Environment Commission (<i>Comisión Nacional del Medio Ambiente</i>)
COREMA	Regional Environmental Commission (<i>Comisión Regional del Medio Ambiente</i>)
D&B	Drilling and blasting
DFI	Development Financial Institution
DGA	General Water Authority (<i>Dirección General de Aguas</i>)
DOH	Direction of Hydraulic Works (<i>Dirección de Obras Hidráulicas</i>)
E&S	Environmental and Social
EHS	Environmental, Health and Safety
EHSQ	Environmental, Health and Safety and Quality
EIA	Environmental Impact Assessment
ERM	Environmental Resources Management, Inc.
ESDD	Environmental and Social Due Diligence
ESHS	Environmental, Social and Health and Safety
ESHSAP	Environmental and, Social, Health and Safety Action Plan
GHG	Greenhouse Gas
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IFIM	In-stream Flow Incremental Method
IPCC	United Nations Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
masl	Meters Above Sea Level
NGO	Non-Governmental Organization
OHS	Occupational Health and Safety
OP	Operational Policies
OPIC	Overseas Private Investment Corporation
PHABSIM	Physical Habitat Simulation Model
PHAM	Alto Maipo Hydroelectric Project (<i>Proyecto Hidroeléctrico Alto Maipo</i>)
PIIM	Project Induced In-Migration Plan
PRMS	Santiago Metropolitan Regulatory Plan
QMA	Annual Mean Flow
RCA	Environmental Authorization (<i>Resolución de Calificación Ambiental</i>)
SEA	Environmental Assessment Service (<i>Servicio de Evaluación Ambiental</i>)
SEIA	National System of Environmental Impact Assessment
SERNATUR	National Tourism Service
SIC	Central Interconnected System (<i>Sistema Interconectado Central</i>)
TBM	Tunnel Boring Machines
TL	Transmission Line
ToR	Terms of Reference
VEC	Valued Ecosystem Components

I INTRODUCTION

A. Summary Table

Country	Chile
Sector	Renewable Energy - Hydropower
Project Name	Alto Maipo Hydroelectric Power Project
Sponsors	AES Gener (60%) and Antofagasta PLC (40%)
Borrower	Alto Maipo SPA
Transaction Type	Project Finance
Total Project Cost	US\$ 2 billion
IDB A Loan	US\$ 200 million
Other Financial Institutions	US\$ 1 billion
Environmental Category	A

B. Executive Summary

- 1.1 The Alto Maipo Hydropower Project (PHAM or the Project) comprises the construction of two run-of-the-river hydroelectric facilities connected in series with a combined capacity of 531 MW for the purposes of providing baseload electricity to the Chilean grid. The Project will capture water through intakes located in the Upper Volcan River, Upper Yeso River and Colorado River, all in the Maipo River Basin, convey it to two powerhouses and discharge it back into the Maipo River. 90% of the Project's infrastructure will be underground. Underground facilities will include powerhouses, siphons, access tunnels and water conveyance systems, including a total of 67 km of tunnels. The total permanent surface infrastructure will occupy 85 hectare (ha) (with additional 20 ha of temporary facilities) and approximately 61 ha for the transmission line.
- 1.2 The Project has potential implications for water management in the Alto Maipo River Basin and therefore has been classified as Category A under the IDB's Environment and Safeguards Compliance Policy (OP-703). However, since the Project does not include new dams or reservoirs, does not require involuntary resettlement or construction of large scale access roads and electrical transmission facilities, does not affect indigenous communities or critical natural habitat, it presents considerable advantages from a sustainability perspective in comparison with other hydropower alternatives of equivalent generation capacity in Chile. Also significant changes have been incorporated to the Project design to address potential adverse impacts and stakeholder concerns.
- 1.3 The Project's key potential adverse impacts and risks relate to: (i) large scale construction activities in a predominantly tourist outdoor recreation area, including two protected areas below which the project will drill tunnels, raising potential issues of groundwater contamination and deterioration of attractiveness of the area for tourism activities (e.g. noise, traffic); and (ii) changes during Project's operation in hydrological conditions (including sediments) in the rivers intercepted by the Project, including the Upper Volcan River, the Upper Yeso River, the Colorado River, and indirectly some section of the Maipo River, raising

issues of water flow in the diverted reaches of those rivers, potential damages due to erosion on structures located downstream of the water discharge back into the Maipo River, and potential adverse impacts on recreational uses of the rivers in the diverted reaches.

- 1.4 Significance of those key potential impacts and risks have been carefully considered and assessed in the environmental and social due diligence process, which included completion of additional technical studies – such as a revised ecological flow study following international standards and good practices; review by expert consultants; and additional consultation activities with affected parties and concerned stakeholders. An adequate mitigation strategy has been agreed with the client, which, if properly implemented, is expected to ensure that residual adverse impacts are not significant. Some uncertainties remain on a few issues due to their inherent technical complexity, e.g. erosion impacts downstream, optimum flows for maintaining recreational uses in the Maipo River, and preserving third party water rights during initial filling of the tunnels, which will be addressed through an adaptive management framework. IDB's safeguard policies requirements are either currently being met by the Project or are expected to be met through adequate implementation of the agreed management and mitigation measures and implementation system.
- 1.5 Notwithstanding the above, certain non-governmental organizations (NGOs) and community-based organizations have voiced strong and sustained opposition to the Project, including through on-going legal challenges, on the grounds of its potential adverse environmental and social impacts, particularly on hydrology, erosion, third party water rights, and tourism activities, and alleged lack of appropriate and timely disclosure of information after issuance of the environmental permit. Despite additional consultation efforts carried out recently by the Project, including on the additional works performed during due diligence, opposition by some local stakeholders remains high. As a response, the Project has engaged a neutral third party, Consensus Building Institute (CBI), an internationally recognized not-for-profit organization dedicated to facilitating complex relationships between project owners and related stakeholders, to assist in conflict resolution. CBI's activities include an additional stakeholder mapping process, proposing dialogue mechanisms, and facilitating dialogue with a view to possible agreements between the Project and opposition stakeholders. The Project will also implement a Participatory Monitoring Program¹ on issues of concern to those stakeholders.

II PROJECT DESCRIPTION

A. Project Main Characteristics

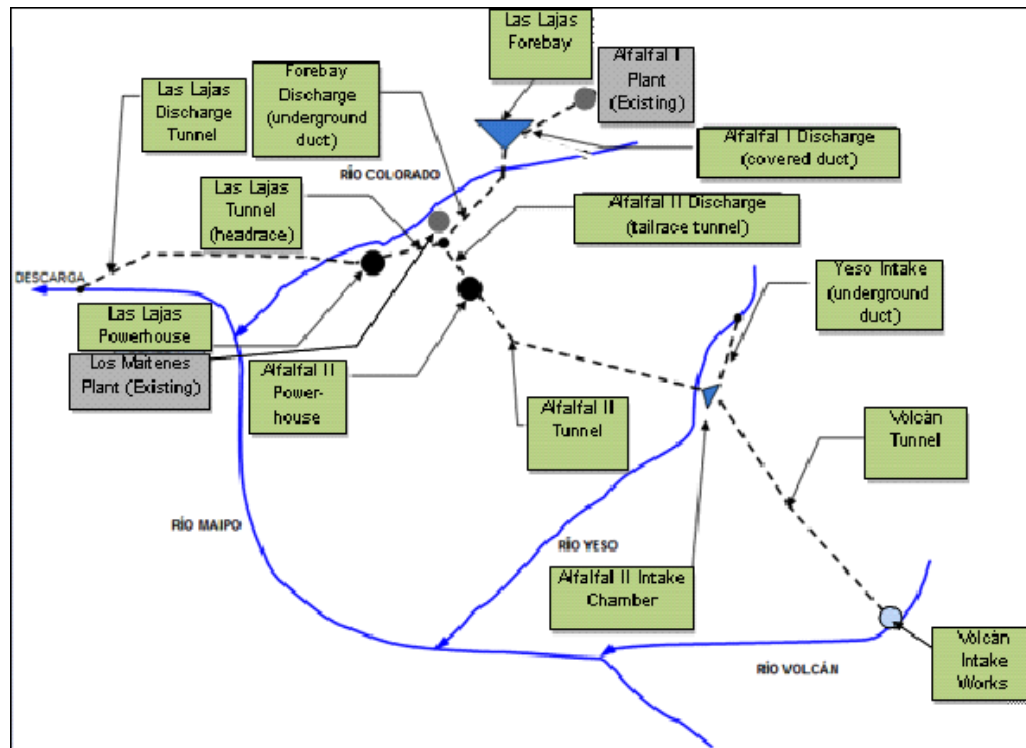
- 2.1 The Alto Maipo Hydroelectric Project (*Proyecto Hidroeléctrico Alto Maipo* – PHAM or Project) consists of the construction and operation of two run-of-the-river hydroelectric facilities with a combined capacity of 531 MW (Alfalfal II, with a capacity of 264 MW and Las Lajas, with a capacity of 267 MW) located approximately 50 km southeast of Santiago, Chile

¹ Participatory monitoring is a process through which stakeholders at various levels engage in monitoring a particular project, share control over the content, the process and the results of the monitoring activity and engage in taking or identifying corrective actions. Participatory monitoring focuses on the active engagement of primary stakeholders.

(see **Figure 1 at the end**). The two plants in series will use water of the upper basin of the Yeso and Volcán rivers, as well as the waters of the middle and lower course of the Colorado River in the Commune or Municipality of San José de Maipo.

- 2.2 The majority (90%) of the Project's infrastructure will be underground, including the two powerhouses, approximately 67 km of tunnels and four inverted siphons to cross streams. The total permanent surface infrastructure² will occupy 85 hectares (with additional 20 hectares of temporary facilities) and approximately 61.25 hectares for the transmission line. The Project will also involve construction of forebay structures and ancillary facilities, including: approximately 31 km of new access roads, four new bridges, 17 km of new transmission lines (110/220 kV), a new electrical substation and upgrades to existing roadways and electrical substation. The PHAM will not require dams or reservoirs.
- 2.3 The Project will be owned by Alto Maipo Spa (Company) a special purpose company created for the Project. Project Sponsors are AES Gener, a subsidiary of AES Corporation, with a 60% share in the Company and Antofagasta Minerales, a subsidiary of Antofagasta PLC, with a 40% share. The construction phase is targeted by the Sponsors to last approximately five years. Once operational, the Project will contribute an average annual net energy of approximately 2,300 GWh per year to the Chilean national grid (*Sistema Interconectado Central* - SIC).
- 2.4 Total Project cost is estimated today at US\$2 billion with an expected 60/40 debt to equity ratio. Funding will be provided via an Inter-American Development Bank (IDB) A loan structure (US\$ 200 million), co-financing from an International Finance Corporation (IFC) A loan structure (US\$ 150 million), Overseas Private Investment Corporation (OPIC) (US\$ 250 million) and/or 5 commercial banks (US\$ 600 million total).
- 2.5 A conceptual and simplified figure of the main Project facilities is presented in the diagram shown below. More detailed figures of the proposed Project are presented in **Figures 1 to 3**.

² Permanent surface infrastructure will include intakes, delivery canals, forebay (or head pond) structures, a new electrical substation, new bridges, access roads



2.6 The PHAM can be described in five main sections, as follows:

- (a) **El Volcán Intake Works and Tunnel:** Intake structures will be placed in each of the following four tributaries to the Volcán River upstream of its confluence with the Maipo River: La Engorda Stream, Colina Stream, Las Placas Stream, and El Morado Stream. The intakes will be connected in series (in the aforementioned order) to convey the combined flows via underground ducts to the Volcán Tunnel. The ducts will have a combined length of approximately 3.9 km and include an inverted siphon crossing the Morado Stream. The Volcán Tunnel, in turn, is a 14 km-long, approx. 4 meters in diameter pressure tunnel conveying flow to an intake chamber at the Yeso River area.
- (b) **El Yeso Intake Works and Alfalfal II Tunnel:** An intake structure will be placed on the Yeso River downstream of the existing Yeso Reservoir, which is used as a drinking water reservoir for the Santiago region and administered by Aguas Andinas⁽³⁾. Flow from the intake structure will be conveyed via a 1.35 km-long underground duct to the joint with the Volcán Tunnel, where both flows will be combined.
- (c) Flow will be conveyed via a 4.7 km-long underground pipeline to the Alfalfal II Tunnel. The pipeline includes an inverted siphon crossing the Yeso River and duct to cross the Manzanito Stream. The Alfalfal II Tunnel is a 15.7 km-long, approx. 3.4 meters in diameter pressurized headrace to convey flow from the pipeline to the Alfalfal II powerhouse.

³ The intake associated with the PHAM will receive flow discharged from the reservoir as regulated by Aguas Andinas and is not expected to impact drinking water availability or use.

- (d) **Alfalfal II Powerhouse and Discharge:** Flow from the Alfalfal II Tunnel is conducted to the Alfalfal II powerhouse via a penstock (high head pressurized tunnel). Upstream of the penstock is located the surge shaft which ends in a balancing reservoir, which will cover an area of approximately 0.25 ha. The powerhouse will be located in a cavern excavated in the rock mass and covering a surface area of 1500 m². A 2.4 km tunnel will provide access to the powerhouse, which will house two similar Pelton turbines with total installed capacity of 264 MW (each with a 13.5 m³/s design flow), a generator, and a 220/12 kV transformer.

Discharge from the Alfalfal II powerhouse will flow via a 3.4 km long and 4.5 to 5 m in diameter tailrace tunnel towards the Las Lajas headrace tunnel.

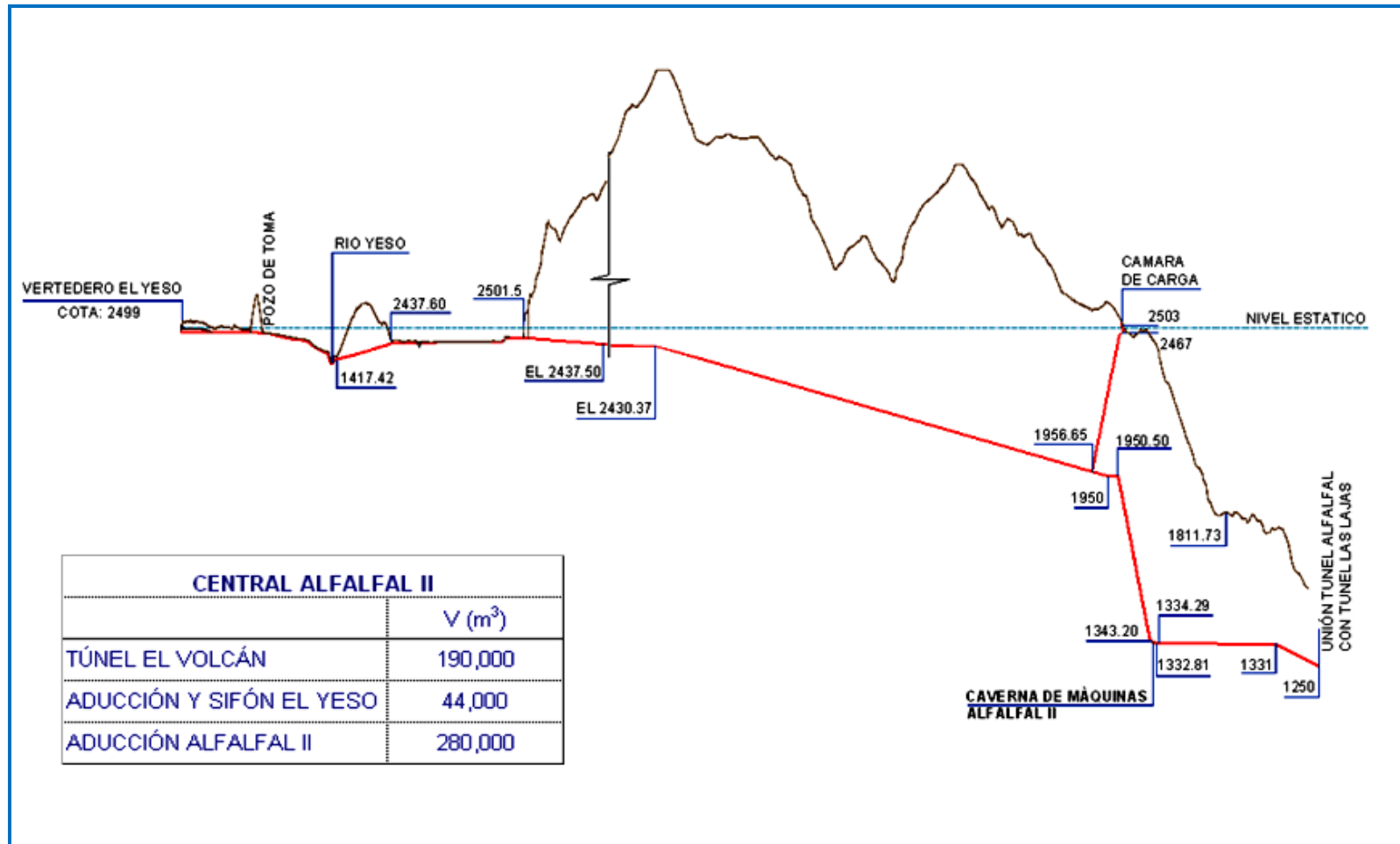
- (e) **Colorado River Works and Las Lajas Tunnel:** Discharge from the existing Alfalfal I Hydroelectric Plant, located upstream of the proposed PHAM facilities on the Colorado River, is currently partly diverted via a channel to the existing Los Maitenes Hydroelectric Plant, which is located on the bank of the Colorado River upstream of the proposed Las Lajas powerhouse. The PHAM will intercept this existing channel and convey the flow to the Las Lajas forebay via a 0.25 km-long covered duct. The forebay will also receive the remaining discharge from the Alfalfal I Plant via a 0.40 km-long extension of the existing tailrace channel that currently discharges to the Colorado River. The forebay will have a surface area of 7.5 ha and capacity of 300,000 m³. A stretch of approximately 0.82 km of the Colorado River, directly downstream of the Alfalfal I discharge, will be diverted to the southeast to allow for the formation of the Las Lajas forebay.

Discharge from the Las Lajas forebay will be conveyed to the Las Lajas Tunnel via a 1 km-long underground duct and inverted siphon crossing the Colorado River. The Las Lajas Tunnel is a 9.6 km-long headrace and conveys flow from the Las Lajas forebay as well as discharge from the Alfalfal II powerhouse to the Las Lajas powerhouse.

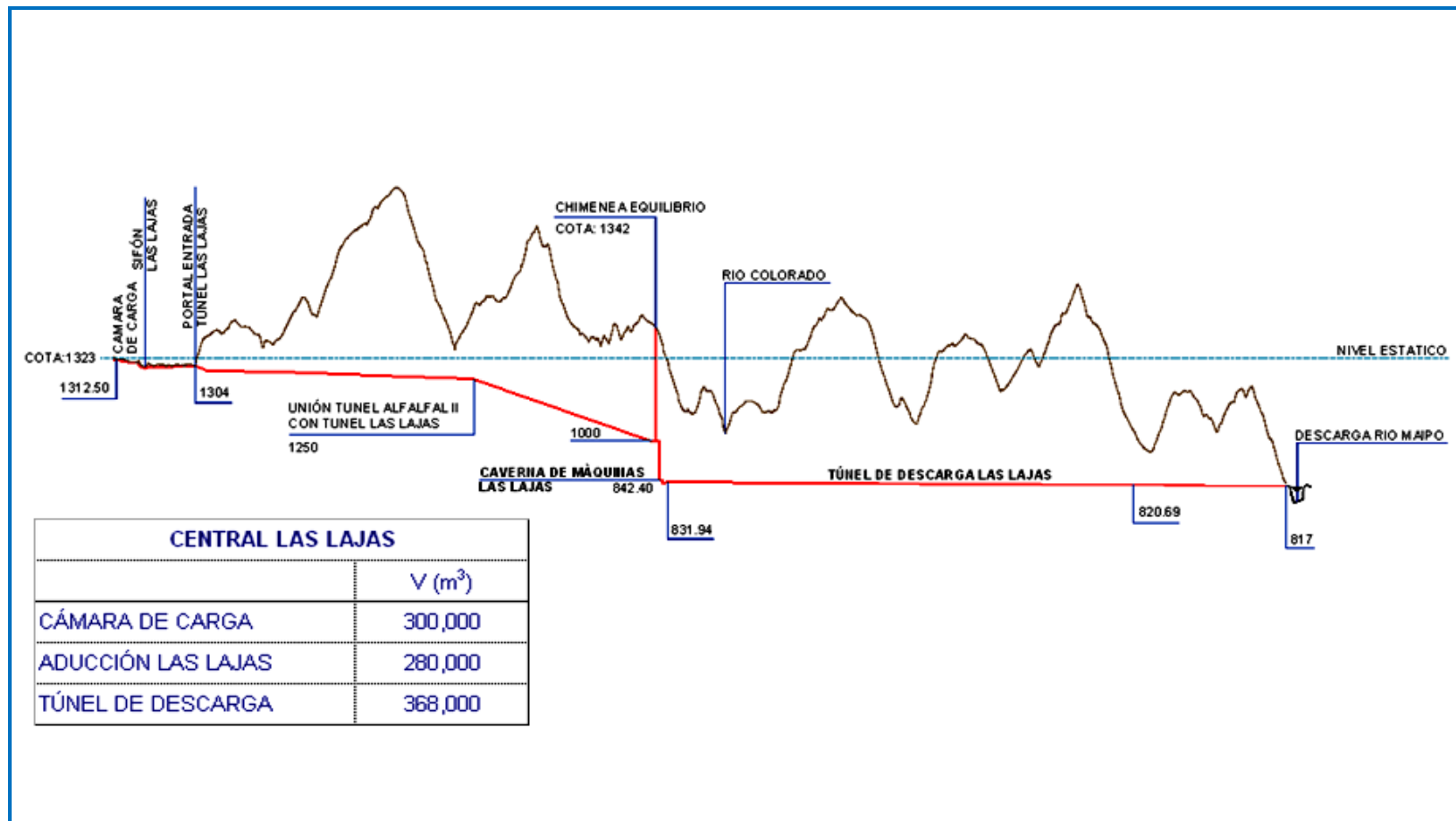
- (f) **Las Lajas Powerhouse and Discharge to Maipo River:** The Las Lajas powerhouse will be located in an underground chamber excavated in the rock mass and covering a surface area of 1700 m². A 2 km-long tunnel will provide access to the powerhouse, which will house two similar Pelton turbines with total installed capacity of 267 MW (each with a 32.5 m³/s design flow), a generator, and a 110/12 kV transformer. Discharge from the powerhouse will be conveyed via a 13.5 km-long, approx. 6.9 meters in diameter tailrace tunnel to the Maipo River downstream of the confluence of the Colorado River and approx. 1 km downstream of the confluence with El Manzano Stream.

2.7 The two following diagrams present the longitudinal profiles for the tunnels and powerhouses of Alfalfal II and Las Lajas. The net head for Alfalfal II and Las Lajas are 1154 m and 487 m, respectively, for the design flow conditions.

Longitudinal Profile for Alfalfal II Powerhouse and Tunnels



Longitudinal Profile for Las Lajas Powerhouse and Tunnels



- 2.8 Four tunnel boring machines (TBMs)⁴ will be used to drive nearly half of the total 67 km tunnel alignment under overburdens of up to 2,000 m. The remaining excavation will be completed by drilling and blasting (D&B) methods.
- 2.9 **Waste Rock Disposal Sites:** It is estimated that the construction of the tunnels will generate approximately 2.8 million m³ of waste rock materials (considering a swelling factor after excavation) and 14 waste rock disposal sites (or excavation waste heaps), ranging in size from 0.83 ha to 5.61 ha, will be sited throughout the Project area, in closing proximity of the tunnel portals. The locations of these sites were selected to place them far from settlements and houses, in zones with low visual impact, adjacent to natural elevations and in areas and sites without botanical or cultural value. The final form of each deposit site will be adapted to the surrounding topography and measures are foreseen in relation to site design and management to prevent landslides, falling rocks, or erosion due to rainwater. Where possible, materials from these deposits will be re-used during the construction of Project facilities. The Project also integrates an Environmental Management Plan for Waste Rock Disposal Sites (see **Section VI**).
- 2.10 **Ancillary Facilities:** Include approximately 31 km of new permanent access roads, four new bridges, upgrades to approximately 45 km of existing roadways (consisting solely of either resurfacing or improvement of signaling, with no widening required), one new electrical substation, 17 km of new transmission lines (110 kV/220 kV), and upgrades to existing transmission lines (25 km) and electrical substation. All of these ancillary facilities are included in the project under consideration for possible financing by the IDB.
- 2.11 **Transmission Lines and Electrical Substations:** One new electrical substation, the Alto Maipo substation, is planned as shown on **Figure 3**. This new 110 kV substation will occupy an area of approximately 0.5 ha and will mainly comprise electrical equipment and protection and control equipment, used to raise the outgoing voltage of the Alfalfal II and Las Lajas plant generators. It will be located on the East bank of the Colorado River.
- 2.12 The 17 km of new transmission lines comprise two main lines:
- (a) One 7.6 km-long, 110 kV single-circuit line between the Maitenes substation and the Alfalfal Substation, with a 30-m-wide right-of-way; and
 - (b) One 9.5 km-long, 220 kV double-circuit line between the Alfalfal II Powerhouse and the Alfalfal Substation, with a 40-m wide right-of-way.
- 2.13 The existing Alfalfal substation will be expanded considering three panels of 220 kV, one panel of 110 kV and one three-phase power transformer, of 110/220 kV. The Project will also utilize an existing line between the Alfalfal I substation and the Maitenes substation to connect the Las Lajas powerhouse. The transmission line conductors will be replaced and a new tower will be installed.

⁴ Tunnel boring machines (TBMs) are used as an alternative to drilling and blasting (D&B) methods in rock and conventional "hand mining" in soil. TBMs have the advantages of limiting the disturbance to the surrounding ground and producing a smooth tunnel wall. This significantly reduces the cost of lining the tunnel, and makes them suitable to use in heavily urbanized areas. The major disadvantage is the upfront cost. TBMs are expensive to construct, and can be difficult to transport.

- 2.14 The total disturbed area for the new transmission lines is approx. 61 ha, of which the surface occupied by physical infrastructure is around 1.9 ha, in turn comprised of 0.9 ha for the transmission structures (i.e., 61 towers) and 0.5 ha for the expansion of the existing Alfalfal substation, and 0.5 ha for the new Alto Maipo electrical substation. The new Alto Maipo sub station will be built on a closed waste rock heap that will be designed with structural considerations for this purpose. The remaining area corresponds to right-of-way for both lines, equivalent to about 60 ha. No agricultural lands or residences are present within this area; existing trees and other vegetation with the potential to impact the lines would be pruned in accordance with Chilean national standard distances.
- 2.15 **Project Schedule:** Preliminary works started in October 2012 and expected to be completed by October 2013. Construction of the main facilities (tunnels and powerhouses) is scheduled to begin in October 2013 and last for five years. Thus, commercial operation date for Las Lajas power station is scheduled for March 2018 and for Alfalfal II for October 2018. The construction start date for the transmission lines will begin in the first quarter of 2014 and construction is expected to be completed by August 2016.
- 2.16 **Worker Camp Sites:** An average of 2000 workers will be required during the construction phase of the PHAM, with a peak of 2500 midway through the construction phase. Up to 500 workers will be hired from local communities, and are not expected to require housing. The non-local workers will be housed in five worker camps with a capacity of approximately 200-400 workers in each camp, which will be set up throughout the Project area (see Figure 4). Worker camp locations were selected considering logistics and engineering requirements, as well as the environmental, social, and health and safety considerations.
- 2.17 **Operation and Maintenance (O&M):** The operation and maintenance of the facilities will be performed by AES Gener in conjunction with the operation of Alfalfal I power station and other hydroelectric power stations included in the Cordillera Complex. The Cordillera complex currently includes the Alfalfal I (located in the Colorado River; installed capacity 178 MW; operating since 1991), Maitenes (Colorado River; 31 MW; 1923), Volcan (Volcan River; 13 MW; 1944) and Queltehues (Volcan River; 49 MW; 1928) hydroelectric power facilities. AES Gener will employ a total staff of 110 personnel for O&M activities at the Cordillera Complex including the existing and new facilities. The Cordillera Complex currently has a staff of 78 and will be supplemented by an additional 32 people to provide the necessary services when Alto Maipo is in full operation.

B. Alternative Analysis

- 2.18 Over the 22-year development phase for the PHAM, five distinct Project design alternatives have been considered for the main components along with seven alternatives for the transmission line. These designs were modified over time based on various factors including economic analysis, engineering feasibility, environmental considerations and stakeholder comments. An evaluation of alternatives was not included in the original PHAM Environmental Impact Assessment (EIA) of 2008. However, following recommendations of the IDB and other Development Financial Institutions (DFIs) involved, AES Gener prepared an Alternative Analysis study⁵, which was subsequently publicly disclosed and used for consultation of the local population.

⁵ *Análisis de Alternativas para el Proyecto*, DAES Consultores (October, 2012).
Resumen Informe Gap N°7 Análisis de Alternativas, AES Gener (May 27 2013).

- 2.19 The Alternative Analysis study is aligned with IDB and the other DFIs standards and provides sufficient evidence that alternative design, location and technology options have been studied and Project design has been modified to minimize/avoid environmental, social and cultural heritage impacts, and to respond to stakeholder concerns. The study includes an economic analysis of energy alternatives, including a no-project scenario, based on a study prepared by the Electricity Development Committee (CADE). The hydropower option is a better alternative than thermal generation from the perspective of conservation of natural resources and greenhouse gases emissions. Among potential hydropower alternatives of equivalent capacity, the PHAM presents considerable advantages from a sustainability perspective: no new dam or reservoir; no resettlement or impact on indigenous communities; no seasonal storage no need to construct extensive transmission line or access road.
- 2.20 The Alternative Analysis study also includes a description of five project design alternatives that have been extensively analyzed over the past 22 years, including a discussion on important design, location, engineering and technology iterations for various components; a description of key design changes executed in response to stakeholder concerns about one of the alternatives; and a description of additional design and technology changes and operational procedures and mitigation measures incorporated to address stakeholder concerns posed during the EIA approval process.
- 2.21 Key changes incorporated to the Project design to address stakeholder concerns include:
- (a) The removal of the flow intake at Las Cortaderas Stream to protect the ecological flow in the Yeso River and the *vegas* wetlands;
 - (b) Re-routing of the crossing of Yeso River to avoid a cultural heritage finding associated to an Inca Trail (*“Camino del Inka”*);
 - (c) Removal of all projected surface infrastructure in protected areas;
 - (d) Incorporation of a recharge chamber adjacent to Colorado River with liner to serve as stabilizing pond for Las Lajas and for overflow discharge;
 - (e) Cancellation of the flow intake at Quempo Stream to protect the ecological flow in the Colorado River;
 - (f) Relocation of the Las Lajas powerhouse and surge shaft to avoid impacts on El Manzano community, thus changing the tunnel routing, access roads, waste rock disposal.
 - (g) Incorporation of the 13.5 km-long discharge tunnel from Las Lajas designed to discharge directly to the Maipo River downstream of El Manzano, in response to the concerns raised by the Community of El Manzano.
 - (h) Elimination of the Laguna Lo Encañado as a recharge chamber and inclusion of an underground chamber and surge shaft at Alto Aucayes.
 - (i) Incorporation of water deflectors in the turbine water injectors of Las Lajas power station. When activated, these devices will deflect the water from the injectors according to the magnitude of the flow-through, so that water flow does not reach the

turbines, allowing water to continue to flow through the PHAM water conveyance systems even while the power plants are shut down.

- 2.22 The report also describes seven routing alternatives for the transmission line, which have been studied throughout the years. The final design was a result of a study which considered the minimization of impacts, based on the natural characteristics of the Project area. Consequently, the line was routed along the existing and projected roadways to use right-of-ways already intervened and avoid having to create new access roads to access the towers. Also one of the most sensitive aspect associated with the analysis was to reduce the number of properties located within the proposed right-of-way. Therefore, the routing of the line prioritized the use of existing lines and minimization of private property affected.

C. Potential Project Expansion

- 2.23 Although not part of the Project being analyzed for possible financing by IDB, it should be pointed out that the Company has reported the potential incorporation of two additional water flows to the PHAM for additional power generation in the future. While the incorporation of the additional flows to PHAM will not require an expansion of the capacity of the approved PHAM infrastructure as they will maximize the generation capacity during low flow periods, they will require new infrastructure (i.e., intakes, pumps, canals, etc.) to connect the flows to the main conveyance system. It should be pointed out, however, because of their relatively small magnitude, these expansions are not expected to produce measurable or significant impacts on the river hydrology, hydrobiology or sediment dynamics.
- 2.24 The two additional water flows were obtained by AES Gener *after* the approval of the PHAM EIA and issuance of the RCA. Therefore, the use of these water rights is not yet permitted and reportedly, the Company has not started any design, studies or construction works to incorporate to the Project. The use of these additional flows will require a new EIA and a new permit (RCA) to include the new infrastructures and water uses, and would be subject to the results of due diligence from the IDB and other Lenders.
- 2.25 **Water Rights Associated with the Aguas Andinas Agreement:** AES Gener agreed to conduct up to 2.5 m³/s of water in El Manzanito stream (to the Las Lajas plant with discharge in the Maipo River) from the Laguna Negra and Laguna Lo Encañado reservoirs through an agreement with Aguas Andinas S.A. (AA Agreement) signed on June 6, 2011 and publicly disclosed in March 2013. The AA Agreement describes the parameters under which the water would be utilized and describes new infrastructure requirements, interferences between Aguas Andinas and Alto Maipo's infrastructure and how to coordinate their construction, permitting processes, legal and commercial agreements associated with the potential future use of this water in the Project. The agreement also contains provisions to protect the quality of potable water reserves, such as the requirement that AES Gener yield the flow allowing Aguas Andinas to operate the interconnection Yeso Reservoir - Laguna Negra Aqueduct under the extreme events, such as high turbidity.
- 2.26 **Water Rights from RP Global:** AES Gener acquired additional water rights for up to 2.75 m³/s (out of a total of 4.3 m³/s) from the Volcan River from RP Global Energias Renovables Chile S.A. on July 29, 2011. The Company reported that no engineering information is available yet on the design of the infrastructure to incorporate the flows to PHAM conveyance system. Furthermore, the Company reported that it is in the process of obtaining the DGA permits for the water intake and restitution points and that an additional environmental permit will also be required to construct and operate the expansion.

III COMPLIANCE STATUS AND PROJECT STANDARDS

A. EIA Review and Environmental Licensing

- 3.1. An EIA for the PHAM was completed in May 2008 by Arcadis Geotecnica Consultores, S.A., and subsequently amended with Addenda in November 2008, January 2009, and March 2009 in response to comments from a variety of the public authorities who reviewed the EIA for approval and by members of the public who commented during the public consultation period. The EIA (and revisions) include environmental and social mitigation measures as well as monitoring and management plans for the PHAM and ancillary facilities including new access roads, improvements to existing roads, new bridges, and temporary facilities such as excavation waste heaps, worker camps, and construction zones. The revised EIA for the Project was approved by the various authorities consulted with as part of the Chilean National System of Environmental Impact Assessment (SEIA) process and subsequently the Regional Environmental Commission (*Comisión Regional del Medio Ambiente – COREMA*) issued an Environmental Authorization (*Resolución de Calificación Ambiental - RCA*), RCA N°256/09, dated March 30, 2009 approving the Project.
- 3.2. The decision to grant the RCA was subsequently challenged by community groups, including the Maipo River Supervisory Board (*Junta Vigilancia del Rio Maipo*), Pirque Channel Irrigators Association, and the Maipo Rivers' Citizen Committee (*Coordinadora Ciudadana Ríos del Maipo*), mainly regarding potential impacts to drinking water from the Yeso Reservoir and downstream impacts to water quality and quantity in the Maipo River.
- 3.3. On 28 January 2010, the National Environment Commission (*Comisión Nacional del Medio Ambiente – CONAMA*) upheld the approval of the PHAM EIA (and subsequent amendments) with the Resolution N° 82/2010, which contains responses to the objections presented by community groups, including further detail on monitoring and mitigation plans that must be undertaken by the Project Sponsor to ensure that negative environmental and social impacts are minimized.⁶
- 3.4. The transmission lines proposed to connect the PHAM to the existing grid were evaluated as a separate project, titled "*Maitenes Substation—Alfalfal Substation and Alfalfal II Powerhouse—Alfalfal Substation Transmission Lines*," proposed by the Company. The EIA for this project was submitted to the environmental authorities on September 10th, 2009 and in July 2nd, 2010 obtained a favorable RCA from COREMA (Resolution N ° 443).
- 3.5. Although both the PHAM and Transmission Line projects have approvals from the environmental authority (i.e.; the RCAs), it is important to note that the RCAs contain certain commitments agreed to by the proponent, which are particularly significant given the new institutional framework soon to fully take effect. Failure to meet the commitments could result in sanctions ranging from warnings and fines to the revocation of the RCA. To this end, the Company has created a table to verify compliance with the RCA requirements and at least one internal compliance audit against the RCA was conducted on the Contractors. In addition, it

⁶ Since 2010 the Environmental Evaluation Service (*Servicio de Evaluación Ambiental – SEA*) is the authority in charge of the administration of the SEIA. The SEA replaces the former CONAMA/COREMA process by evaluating EIAs and EISs and granting the RCA. Any changes to the Project or elements that may require environmental approval will be evaluated and granted by SEA.

should be pointed out that the RCA (for the PHAM) continues to be challenged via the judicial system, with two cases outstanding.

B. Public Consultation, Opposition and Stakeholder Engagement

B.1 Public Consultations in Association with EIA Review and Environmental Licensing

- 3.6. The Alto Maipo Hydroelectric Project (PHAM) has been the subject of extensive public consultation. In accordance with Chilean EIA requirements, as well as IDB Policy Directives (OP703/B.6), AES Gener engaged public authorities, affected communities and interested civil society stakeholders throughout the preparation of the EIA and its approval process, and has begun to implement a comprehensive stakeholder strategy as part of its on-going management of the PHAM. Ensuring the PHAM's capacity to respond effectively to stakeholder pressures will continue to be a high priority during construction and operation.
- 3.7. During the preparation of the PHAM EIA, AES Gener held 40 meetings with public authorities, 70 meetings with community representatives and local citizens, as well as meetings with key civil society organizations. These meeting ranged from sessions with 2 to 3 public officials or community representatives to large public meeting with several hundred persons in attendance. The meetings included formal PowerPoint presentations, the distribution of project information and question and answer sessions. In accordance with Chilean requirements, the details regarding the content, dates, times, locations, and agendas of these meeting are recorded in the Consultation and Disclosure Report.
- 3.8. The final EIA for PHAM was submitted in May of 2008. The EIA has been disclosed for local public consultations and at the Chilean Environmental Evaluation Service (SEA) website. SEA organized 8 formal public meetings on the Project during July and August 2008 in various communities of San Jose de Maipo. During this process, over 5000 written comments on the project were submitted to SEA. As mentioned before, following this review, a revised EIA was approved by the COREMA on March 30, 2009. Several alterations in Project design have been introduced to take into account stakeholder concerns and suggestions (**see Section II B – Alternative Analysis**).
- 3.9. In addition to design changes, the Project has incorporated feedback from stakeholders and authorities in the proposed mitigation, management and compensation framework. Examples of management measures which were included at the request of affected stakeholders include:
 - (i) Ecological Flow monitoring and online, real-time reporting.
 - (ii) Refurbishment and maintenance of the El Manzano Community Aqueduct intake.
 - (iii) Hydrobiology and terrestrial biodiversity monitoring at a basin level during construction and operation;
 - (iv) Climate change studies at a basin level;
 - (v) Social indicators monitoring program;
 - (vi) Monitoring of the tourism use in the Maipo River;
 - (vii) Participatory monitoring within the Social Management System; and

- (viii) An Advanced Sediment Transport Study, monitoring and a corresponding preliminary compensation framework.
- 3.10. However, since the formal approval for the EIA and the signing of the Social Collaboration Agreement⁷, the AES Gener contacts with key stakeholder dwindled. At the beginning of the ESDD IDB and the other DFIs (IFC and OPIC) identified that the capacity of the Company to manage E&S aspects of the Project, including community relations, was very limited. Also, as described in **Section V.A (Summary of Key Impacts and Risks and ESDD Findings)**, based on the information gathered on the course of a series of meetings and interviews performed with key stakeholders during the first ESDD mission (April 2012), one of their main concerns, for even some with favorable position towards the Project, was the lack of appropriate and timely disclosure of Project information after issuance of the RCA.
- 3.11. While the ESDD found the PHAM has met Chilean and IDB OP-102 and OP-703 requirements for Public Consultation and that it has secured the support of the communities in the area of influence, several stakeholder risk factors, nevertheless, remained which are more recently starting to be managed deftly by the Company, in particular:
- i. The lack of confidence and trust in AES Gener expressed by certain stakeholders⁸, as illustrated by the continuing opposition to the Project from outside groups such as the *Coordinadora Ciudadana Ríos del Maipo*. This problem was also identified by the consultants (CBI) contracted by the Company to examine perceptions of the project and identify options for consensus building.⁹
 - ii. The lack of proper communication to interested stakeholders on specific information relative to Project design, development schedule, environmental and social impacts and proposed mitigation and management measures.¹⁰
- 3.12. The Company has performed extensive stakeholder mapping and has and has developed an environmental and social management system and specific stakeholder engagement and management plans which, if well staffed and resourced, should allow it to address these issues during the construction and operation phases of the Project. However, the intensity of the opposition to the Project from some stakeholders, such as the *Coordinadora Ciudadana Ríos del Maipo*, suggests that AES Gener and the PHAM staff might benefit from working with opposition stakeholders to secure the services of a Third Party Facilitator (other than CBI) to

⁷ In 2009, the Project executed a Social Collaboration Agreement with the Municipality of San José de Maipo, several territories contained within the municipality, and several social and labor organizations under which it committed to continue to provide support to the community. The Social Collaboration Agreement was included in the environmental permit and as a result, is also a legal compliance obligation for the Project. The agreement specifically provides funds for community programs and provides incentives for the use of local labor during construction.

⁸ The lack of confidence and alleged lack of trust in AES Gener might be associated in some aspects with lack of proper communication and transparency, as well as with the experience with other previous projects implemented and operated by AES Gener in the Maipo and Colorado River Valleys (e.g., Alfalfal I).

⁹ Consensus Building Institute(CBI): “*El Cajón del Maipo y el Proyecto Alto Maipo: Diagnóstico Preliminar Acerca de la Percepciones de la Comunidad e Ideas para una Interacción Productiva entre los Actores*” Informe Borrador, 1 agosto 2013-08-10.

¹⁰ Stakeholders interviewed recently during one of the ESDD site visits confirmed that stakeholder engagement, consultation and information disclosure between 2008 and January 2013 was mostly limited to information related to the Social Collaboration Agreement and community development activities as opposed to substantive issues regarding project design, construction schedule and impact management plans.

help conduct a dialogue aimed at identifying potential options for resolving outstanding issues. Financing and developing the Terms of Reference (ToR) for such a facilitator would have to be mutually agreed upon by opposition stakeholders and Company in order to enhance the person's credibility as an objective Third Party.

B.2 More Recent Public Consultations

- 3.13. In response to IDB and other DFIs recommendations, during 2012 and early 2013, the Company supplemented its E&S organizational structure with the incorporation of a dedicated Community Relations Manager and Department, supported by specialized personnel and reporting directly to the Project Director. The Company also established a Social Management System (January 2013), which includes a Consultation and Disclosure Strategy. The strategy establishes a five-phase approach to implement consultation and disclosure activities during each Project phase. The Consultation and Disclosure Plan is aligned with the general structural elements of the DFIs Policies and Guidelines. The Social Management System states that a detailed Phase 3 Consultation and Disclosure Plan will be established, which will include details on the implementation of the plan.
- 3.14. Between January and August 14, 2013, the Company organized and held 51 registered meetings with stakeholders involving the participation of more than 520 people. Furthermore, the various updates of the Cumulative Impact Assessment and Alternatives Analysis, and the other additional environmental impact documents produced as a result of IDB's environmental and social due diligence (ESDD) (see **Section V.A - Summary of Key Impacts and Risks and ESDD Findings**) have been made available for public consultation locally and at IDB's website. The Company also performed proper consultation activities with the local population, including meetings with key stakeholders, in relation to all additional environmental impact documents.
- 3.15. During a recent ESDD site visit, interviews and meetings were held with several stakeholder groups, including: (i) communities within the direct area of influence; (ii) *Juntas de Vecinales* (Neighborhood Committees); (iii) residents and representatives of community based organizations; (iv) local government (including the Mayor of San José de Maipo and the Municipal Council members); (v) *Unión Comunal de Juntas Vecinales de San José de Maipo* (the Community Union of Neighborhood Committees, a political structure representing the neighborhood communities in San José de Maipo); (vi) associations, organizations and groups representing recreational water users, affected land owners, irrigation committees and local business/chamber of commerce; (vii) individuals and organizations participating in the Social Collaboration Agreement grant fund; and (viii) opposition stakeholder groups.
- 3.16. Based on those interviews and meetings it has been possible to confirm that, with few exceptions, stakeholders interviewed during the site visit were generally aware of these organizational changes that were implemented, particularly since January 2013, and noted that the changes have resulted in favorable outcomes for the Company's community relations capacity. Specifically, stakeholders emphasized an improvement in the depth and frequency of communication with the Company, an increased availability of project information and more opportunities to meaningfully engage with the Company on an ongoing basis. In addition, stakeholders reported an increased responsiveness of senior Community Relations and Project staff, and initial efforts to establish a participatory monitoring program of key environmental and social indicators and potentially increase the scope of community development support through the consideration of other community economic benefits beyond the Social Collaboration Agreement or other complementary initiatives. The favorable results of the

Community Relations transition and the positive opinion many of the interviewed stakeholders now hold towards the Community Relations Department is in stark contrast to the Company's approach to community relations prior to January 2013.

B.3 Stakeholder Opposition

- 3.17. Notwithstanding the beneficial E&S impacts associated with the Project (**see Section V.F – Potential Positive E&S Impacts Associated with the Project**), and the efforts being made by the Company to improve community relations and communications, certain, well-organized non-governmental organizations (NGOs) and community-based organizations have voiced strong and sustained opposition to the Project. The primary concerns of these organizations are related to:
- i. The legality of the Project's environmental authorization (RCA) and acquisition of water rights;
 - ii. Impacts of Project operation to downstream water users (e.g., farmers who utilize community irrigation systems, kayaking/rafting users) due to changes in the availability of water and the hydrological balance in the Project area, including during initial filling of the tunnels and sudden blackout events¹¹ (i.e., a total shutdown of the plants);
 - iii. Impacts of reduced sediment transport to downstream existing structures (e.g., irrigation system intakes, bridges);
 - iv. Exacerbation of climate change impacts on water flow and local desertification in the Valley of the Maipo;
 - v. Impacts on water supply of Santiago Metropolitan region;
 - vi. The lack of appropriate and timely disclosure of Project information after issuance of the RCA; and
 - vii. The acquisition of part of the Project by Antofagasta Minerales could preclude all the energy generated by the Project from going to the grid (SIC).
- 3.18. NGO opposition has included public awareness campaigns, protests involving road closures, a strong online presence and several legal proceedings regarding these principal issues. IDB, together with the other DFIs, suggested recommendations to the Sponsors to address these stakeholder concerns.

B.4 Stakeholder Engagement

- 3.19. At the beginning of the ESDD it was identified that the capacity of the Company to manage E&S aspects of the Project, including community relations, was very limited, both in terms of resources (human and others) as well as in relation to procedures and systems. IDB, in conjunction with the other DFIs, recommended that the Company strengthen its capacity by

¹¹ A **blackout event** is a total shutdown of the plant, due to power plant or electricity grid failure, causing sudden changes in flow and water depth (drop in flow and depth in some instances, surge waves or "*golpes de agua*" in other cases) in the stream segments affected (diverted reaches and downstream of point of restitution), which could then potentially cause damage to water intakes and other structures located in those segments. It should be pointed out that the probability of a blackout event is considered low, there have been 7 blackout events in the SIC in the last 14 years, and with an average duration of less than 2 hours per event, not enough to create the conditions required for water levels to experience significant changes downstream of the point of restitution.

introducing high-level and experienced personnel and also improve its procedures and systems, particularly in view of the construction phase.

- 3.20. In response, during 2012 and early 2013, the Company supplemented its E&S organizational structure with the incorporation of a dedicated Environmental Manager and dedicated Community Relations Manager, both supported by specialized personnel and reporting directly to the Project Director, and has established a stakeholder engagement strategy and attempted to engage with opposition stakeholders.
- 3.21. In addition, the DFIs recommended that the Company develop a robust Stakeholder Engagement Plan. In response, the Company developed a Stakeholder Engagement Plan that outlines the information disclosure and public consultation activities that will be performed during all phases of the Project in terms of environmental, social, or health and safety and labor aspects. This plan also includes community communications and safety plans, participatory monitoring programs, as well as conflict and grievance prevention and management mechanisms.
- 3.22. The Company also engaged a neutral third party to assist in the process of disclosure, consultation and engagement with the community and stakeholders of the Alto Maipo Project. This neutral third, the Consensus Building Institute (CBI), is an internationally recognized not-for-profit organization dedicated to facilitating complex relationships between project owners and related stakeholders. CBI's activities includes an additional stakeholder mapping process, proposal of dialogue mechanisms, and facilitation of dialogue with a view to possible agreements between AES Gener and opposition stakeholders. CBI already presented preliminary recommendations and the Project/Company shall develop and implement an action plan to properly address these recommendations.

C. Compliance with Applicable IDB Directives and Policies

- 3.23. The following IDB Operational Policies (OP) are applicable to the Project:
 - (a) The Access to Information Policy (OP-102)
 - (b) Environment and Safeguards Compliance Policy (OP-703)
 - (c) The Disaster Risk Management Policy (OP-704)
 - (d) The Involuntary Resettlement Policy (OP-710)
 - (e) Gender Equality Policy (OP-761)
- 3.24. The following table summarizes the state of compliance with applicable IDB OPs and Directives.

Policy / Directive	Project Compliance Status (At Board Approval)	Actions required for continuous compliance
OP-102 Access to Information Policy		
	Expected to meet compliance requirements through development and implementation of a series of disclosure and consultation activities in relation to additional EIA documents and reports.	Adequate implementation of the Consultation and Disclosure Plan and Stakeholder Engagement Plan.
OP-703 Environment and Safeguard Compliance Policy		
Introduction (mitigation hierarchy)	Compliance requirements met. Key impacts identified. Mitigation, and where impacts cannot be fully mitigated, compensation strategies and measures shall be developed and implemented by the Company.	Monitoring adequate implementation of mitigation and compensation strategies and measures.
B.1, B.2 and B.3 (Bank Policies, country Laws and Regulations, Screening and Classification)	Compliance requirements met. A series of improvements in Project procedures (e.g., stakeholder engagement) and information (e.g., alternative analysis, cumulative impact analysis) have been introduced as a result of the ESDD to align the Project with IDB's applicable Policies and Guidelines. The Project is currently compliant with Chilean domestic laws and regulations and has been developed to comply with those laws and regulations throughout the construction and operation phase. The Project has been classified as a Category "A" and, as a result, the Project requires, and has completed, an Environmental Impact Assessment to properly evaluate Project impacts and risks.	Monitoring that the Project is being carried out in compliance with environmental Country Laws and Regulations, as well as with IDB applicable Policies.
B.4 Other Risk Factors	Compliance requirements met. Other risk factors, such as reputational risk and Company capacity to properly manage E&S aspects, have been adequately identified and recommendations have been provided to properly manage those risks.	Monitoring and supervision by IDB.
B.5 Environmental Assessment Requirements	Compliance requirements met. Gaps identified during ESDD have been adequately addressed by additional EIA documents.	Monitoring and adaptive management.
B.6 Consultations	Compliance requirements will be met. A series of disclosure and consultation activities are being carried out in relation to additional EIA documents and reports.	Adequate implementation of the Stakeholder Engagement Plan.
B.7 Supervision and Compliance	Compliance requirements will be met. Upon approval of the transaction and execution of the contract, IDB will monitor the Project's compliance with all safeguard requirements stipulated in the loan documents and project operating or credit regulations. In addition, applicable safeguard requirements will be incorporated into the Project contract documents.	Monitoring and supervision by IDB.
B.9 Natural Habitats and Cultural Sites	Will meet compliance requirements The Project's area of influence includes two types of Critical Natural Habitats (CNH): (i) Protected Areas (i.e. internationally recognized and legally established CNH); and (ii) other sensitive habitats, not yet legally protected (i.e. <i>vegas</i> or meadow wetlands). There will not be any significant direct or indirect impacts to protected area-type CNH. For <i>vegas</i> -type CNH, there will not be a significant conversion or degradation of	Monitoring and supervision by IDB. Adequate implementation of: Vegetation Monitoring Program and Restoration Plan for <i>Vegas</i> ; Reforestation Management Plan; and Vegetation Restoration Plan.

	<p>this type of habitat.</p> <p>The Project will affect approximately 101 ha of natural habitats, of which 31 ha are Schlerophyll-type forest and the remaining 70 ha are a mix of shrubs and grasses (of which 56 ha are of Andean shrub). This is not considered a significant degradation or conversion of these types of habitats, and the client will reforest a total of 36 ha of land with the same species that are impacted (in addition to any protected species), as well as restore approximately 75 ha – in conformity with the principle of no net loss of natural habitats (see section 5, below).</p>	
B.10 Hazardous Materials	<p>Compliance requirements met.</p> <p>The Project has adequately assessed potential risks and impacts and has established appropriate mitigation and management plans, including a Project's Emergency Response and Control Plan.</p>	Monitoring and supervision by IDB.
B.11 Pollution Prevention and Abatement	<p>Compliance requirements met.</p> <p>The Project has been designed in compliance with all applicable Chilean quantitative pollution prevention and abatement standards. Additional analysis was conducted to assess the risks and impacts from tunnel production water, groundwater contamination and waste rock leachate. In addition, appropriate control measures will have to be adopted in case of potential contamination by industrial effluents from tunneling activities.</p>	Monitoring by Company and supervision by IDB.
B.15 Co-financing Operations	<p>Compliance requirements met.</p> <p>The close collaboration and coordination that predominated throughout the preparation process between IDB and the other DFIs involved (IFC and OPIC) greatly contributed to increase the effectiveness and breadth of the ESDD. In addition, this combined, collegial and collaborative approach allowed for the harmonization of environmental assessments, disclosure and consultation, as well as other E&S requirements applicable to the Project. Furthermore, these harmonized procedures and requirements are consistent with the requirements of the OP-703 Policy. Moving ahead, the requirements of all DFIs will be captured in the loan documents.</p>	Joint supervision activities with the other DFIs as possible.
OP-704 Disaster Risk Management Policy		
	<p>Expected to meet compliance requirements</p> <p>In compliance with Disaster Risk Management Policy Directive A-2, the Project has identified and assessed natural risks associated with the Project (e.g., seismicity and landslides) and has established corresponding measures to manage such risks. As there is no dam involved and most of the PHAM structures will be</p>	Monitoring of adequate implementation of the Risk Prevention and Communications Plan and Emergency Preparedness and Response Plan.

	underground the Project has been classified as a Moderate-Risk. ¹² All PHAM plants and equipment follow national and international seismic resistant design and engineering standards. The design of the Project structures and their operation procedures have incorporated necessary safeguards to prevent damage in the eventual occurrence of a natural phenomenon such as seismic activity and landslides. A Contingencies and Risk Prevention Manual was established for the Project. In addition, as a result of the ESDD, the Project developer has been recommended to increase the specificity of disaster identification and management procedures, and improvements will be incorporated into the plans. During the operation of the Project, measures will be developed within a Risk Prevention and Communications Plan, and an Emergency Preparedness and Response Plan will be prepared outlining measures in place in the event of a plant failure, including measures to raise awareness and train communities in case such a failure could affect downstream populations.	
OP-710 Involuntary Resettlement Policy		
	Compliance requirements met. The Project has been designed to minimize land acquisition and avoid the need for physical displacement of the local population. The Project will not lead to physical displacement and will only result in limited economic displacement (two cases); iIn both cases, the Company has engaged the affected users and reached negotiated agreements.	Monitoring and supervision by IDB.
OP-761 Operational Policy on Gender Equality in Development		
	Compliance requirements met. The Project is considered to be in alignment with OP-761; the Project is not anticipated to generate direct or disproportionate impacts to women. The consultation and disclosure process has provided equal opportunity to women.	Monitoring and supervision by IDB.

IV ENVIRONMENTAL AND SOCIAL SETTING

A. Environmental Setting

A.1 Physical Setting

Climate and Meteorology

- 4.1. The area is characterized by two types of climate: Mediterranean-temperate with long dry season and a well-marked winter (lower and middle Maipo), and cold weather due to altitude (upper Maipo), where precipitation causes a permanent accumulation of snow and ice in the

¹² In general, underground structures are viewed as less sensitive to seismic shaking compared to surface structures. Usually, the intensity of the earthquake ground motion decreases from the earth surface to the location of the underground structure. Therefore, a reduction in the ground motion in underground structures is often assumed. Furthermore, the general perception of engineers is that underground structures in rock are less vulnerable to earthquakes, as tunnels and caverns are assumed to move together with the surrounding rock. Nevertheless, it has to be assumed that a strong earthquake can trigger failure of unstable rock portions of an underground structure and, therefore, the earthquake resistant design is of particular importance in geologically difficult zones.

peaks and ravines of the Andes Mountains. The annual precipitation is 536 mm/year (at San Jose de Maipo) and annual average temperatures of 14.2°C (at La Melosas).

Air Quality

- 4.2. San José de Maipo is a predominantly rural area with some populated centers that do not produce a significant source of emissions. In the area near the Project's facilities, however, some industrial activities are present including mining (non-metallic minerals) and extraction of aggregate. Impacts to air quality are mostly due to the open transportation of materials and heavy vehicle traffic on unpaved roads, which generate particulate matter. The Project will implement preventive measures and management practices for the minimization of dust generation (e.g., Dust Suppressant Application Program). No air quality monitoring is required for the Project given its nature (the Air Quality Monitoring Plan consists of weekly inspections of emission control measures during construction to ensure the implementation of dust abatement measures at each work front). However, an Emission Compensation Program is required (see **Section VI**).

Noise

- 4.3. Environmental noise measurements were made as part of the PHAM EIA baseline data collection effort. Eight measurement points in the PHAM's area of influence were established in areas likely to experience the greatest impact, near the future worksites (tunnel exits, camps), disposal material sites, buried pipes and the main roads proposed for vehicle traffic. In general, in sectors near the main road noise equivalent levels reach approximately 72 dB(A), whereas in the rest of the points they do not exceed 54 dB(A) during the day and 55 dB(A) during the night on average.

Hydrology

- 4.4. The Project will use hydrologic resources from three of the four major sub-basins of the Maipo River Basin (Volcan, Yeso and Colorado Basins):
- i. The Alto Maipo River basin, which receives input from three major tributaries that correspond to the remaining three subsystems (Volcán, Yeso and Colorado River basins). The Maipo River has an annual mean flow (QMA) of 77.8 m³/s at San Alfonso, located downstream of the confluence of the Yeso and Volcán Rivers with the Maipo River, and 111 m³/s at El Manzano, located downstream of the confluence with the Colorado River. Both the Yeso and the Colorado River natural hydrological regimes have been altered by human activity prior to their confluence with the Maipo; the former by the existence of El Yeso Reservoir and the latter due to the existing Los Maitenes, Alfalfal I and Guayacan hydroelectric facilities. Also, the Guayacan power station alters the Maipo River's flow in a 4-km stretch from the point where the station's intake is located, 5.5 km upstream from the confluence of the Colorado and Maipo rivers, to the discharge point at 1.7 km from this same confluence. The effects of the Guayacan plant on hydrology were not assessed as part of the EIA because the plant was not built at the time (2008); however, studies that include the effects of Guayacan were later conducted in the context of sediment transport regimes.
 - ii. El Volcán River basin, which can be divided into two main upper watersheds (La Engorda Stream and El Volcán River, upstream of the confluence of La Engorda Stream). The PHAM affects only the La Engorda Stream watershed, which consists of

contributions from the Colina, Las Placas, and El Morado Streams. These tributaries are snow/ glacier hydrological systems and are therefore seasonal, with the greatest flows between November and March.

- iii. The Yeso River basin, which has major lakes: Laguna Negra, Laguna Lo Encañado, and the Yeso Reservoir, all of which are drinking water reservoirs for the city of Santiago and administered by Aguas Andinas.
 - iv. The Colorado River basin is an intervened water system due to three existing hydropower projects (i.e., Alfalfal I, Maitenes and Guayacan) that utilize its flow in a run-of-river operation mode.
- 4.5. These hydrological basins are largely fed by snowmelt from glaciers and therefore have a high variability in monthly average flows, with 74% of surface runoff occurring during the snowmelt season (i.e., high flows) between November and March and a marked decrease during the winter months of June through September. The Company prepared a study in 2011 to evaluate the behavior of two glaciers, San Francisco and Mirador del Morado, located within Project area's watershed.
- 4.6. A significant amount of hydrologic data is available for the Project, including state-owned gauging stations from the DGA, the Yeso reservoir usage statistics and the operating records and statistics of the existing power plants. The hydrology analysis relied on a 56-year data set (1950 – 2006) for the Upper Volcan and Colorado and a 28-year data set (1978 – 2005) for the Yeso. The available historical hydrologic data was used to predict the flow conditions at each of the inflow points to the Project.
- 4.7. In addition, in response to a request from IDB and the other DFIs, the Company prepared a detailed inventory of water users and uses and an accompanying map showing locations¹³. This additional information includes a tabular summary of the key characteristics of each water use and water user within the intervened reaches and up to 26 km downstream of the Project discharge point, as well as a corresponding map and textual summary. The tabular summary describes the type of water right, flow requirements, duration/seasonality of use, status of use, location, type of activity supported by the water use, the name and description of each water right holder or water user.

Surface Water Quality

- 4.8. Water quality sampling campaigns were conducted in April 2005, November 2006, December 2007 and August 2008, in addition to data maintained by the DGA. However, the field baseline data needs to be interpreted with caution, given the high seasonal variability in the system.
- 4.9. Noticeable difference in water quality in the PHAM area was reported with regards to sediment load transfer and suspended solids in the PHAM EIA (2008). The Rivers Maipo and Colorado (177.6 g/m²s and 115.7-343.2 g/m²s, respectively) and La Engorda and Colina streams (102 and 101 g/m²s, respectively) presented high levels of suspended solids during the Spring, whereas the Yeso River (4.9 g/m²s) and the Aucayes, Cortaderas, Quempo and Manzanito Streams (2.9 – 6.9 g/m²s) had very low suspended particle concentration. These results would indicate that the sediment load in the systems is naturally occurring and seasonal (i.e., during the melting period), and possibly affected by the riverbed condition. The results on the Yeso

¹³ Tema 1: Identificación y evaluación de impactos potenciales sobre usos y usuarios del agua- Arcadis, 31 May 2013.

River would be expected given the existence of the Yeso Reservoir and its regulation, which affects the annual bedload movement. The sediment load in the Maipo and Colorado Rivers, which naturally increase during the summer months, allow for the development of seasonal aquatic biota.

- 4.10. With the exception of sedimentation, water quality is generally favorable in the PHAM system for the development of aquatic biota and meets national standards for irrigation which are typically less strict than the drinking water quality standards.

Geology and Hydrogeology

- 4.11. From a geologic standpoint, the Project area is characterized by outcrops of continental and marine stratified rock sequences intruded by abundant lodes, blankets, laccoliths, dikes and stocks. In general, groundwater occurs in free or semi-confined aquifers, and the permeability is a variable rate. Numerous thermal springs associated with volcanic activity are located in the area of Tupungato - San Jose. The main sources are: Colina Baths, Morales Baths, Tupungato Baths, Salinillas Baths, Azul Baths and Piuquenes Baths.
- 4.12. Locally, the PHAM area generally presents a very low occurrence of groundwater. Permeability in this area is very low or zero due to the preponderance of volcanic rock at the ground surface. These rocks are of a mixed type (e.g. ignimbrites interbedded with shale, sandstone and conglomerates), and are considered to be aquifer foundations. Consequently, these areas are considered as boundary or border zones of groundwater occurrence, and not zones of importance with regard to aquifers.
- 4.13. In response to stakeholders concerns regarding the potential for aquifer depletion and/or pollutant intrusion to aquifers due to tunneling activities, the Company commissioned an independent study that assessed nine aquifers located between the proposed intake structures and discharge points along the Maipo River. The study concluded the aquifers are not expected to be affected by the Project, the minimum river flow required to recharge the aquifers is lower than the minimum river flows in the area and below the ecological flows for the Project. These findings on permeability corroborate the experience obtained from the construction of Alfalfal I project, in the Colorado River valley.

Topography and Soils

- 4.14. The Project area is generally mountainous in character but relief varies from steep slopes and narrow valley bottoms to a gently sloping hillsides and wide valleys. Elevations range from 820 meters above sea level (masl) at the discharge point to upwards of 2,500 masl, including the mountain glaciers San Francisco (at 4,320 masl) and El Morado (at 5,060 masl). The municipality San José de Maipo generally has low quality soils, predominantly consisting of non-arable upland soils which are limited by topography, slope and a high erosion potential.

Land Use

- 4.15. Current land use of areas that will be used by the Project's above-ground infrastructure includes agriculture, cattle grazing as well evidence of unpaved roads and wooden bridges used by off-road enthusiasts, seasonal cattle herders, and mountain hikers and campers.
- 4.16. Within the Project area of indirect influence, the principal uses of the land include: i) residential (concentrated and isolated); ii) mining (gypsum and limestone in the upper basin of the Volcán,

Yeso and Colorado rivers); iii) extraction of aggregate; iv) agriculture and cattle raising (Los Maitenes, El Alfalfal, San Gabriel, El Manzano) as well as summer grazing (wetlands or “vegas” associated with the El Yeso and Lo Encañado reservoirs, El Morado, Las Placas, La Engorda and Colina streams); v) energy (Los Maitenes, El Alfalfal, Queltehues and Volcán powerhouses); vi) commerce (both sides of route G-25); vii) services and equipment (services and basic community facilities in each village); viii) tourism and recreation activities.

A.2 *Biological Setting*

Terrestrial Ecosystems

- 4.17. The Project area is predominantly located in intervened (i.e. modified) natural habitat within a relatively wide range of elevations. The least modified habitat of the Project area consists of the La Engorda canyon where four water intakes at the highest elevation of the Project will be constructed. This area is dominated by high mountain steppe vegetation which includes shrubs and grasses as well as wetlands or “vegas”. The EIA baseline discussion does not specify whether these are potentially sensitive or a critical natural habitat. Nonetheless, the project’s Environmental Management Plan sets out “restricted areas” requiring avoidance and/or special management measures due to their ecological importance, encompassing the *vegas* (see section on impacts, below).
- 4.18. The predominant vegetation at lower altitudes is dominated by Schlerophyll forests, including a mix of native and non-native species (up to 40% non-native along the Colorado River area).
- 4.19. In terms of terrestrial fauna, the Project area has a high variability of species, including amphibians, reptiles, birds (including raptors), waterfowl, and mammals. In the areas of the Colorado River, La Engorda and El Morado Streams, Laguna Lo Encañado, Manzanito Stream, the Yeso River and Reservoir, and the Aucayes Stream, the EIA reported the presence of 16 species in a Chilean conservation category, the majority of them reptiles, followed by amphibians, mammals and birds (most of them classified as “Threatened” per Chilean law but also classified under lower conservation categories by the IUCN Red List).
- 4.20. Two species in conservation status, the torrent duck (*Merganatta armata*), which is categorized as ‘Endemic to Chile’ in Chile’s National Forestry Corporation (CONAF) Red Book and as ‘Least Concern’ by the IUCN Red List, and the amphibian “*sapo arriero*” (*Alsodes nodosus*), classified by Chile’s CONAF Red Book as ‘Threatened’ and by the IUCN Red List as ‘Near Threatened’, are associated to the riverine ecosystem. Complementary baseline data to the EIA was also collected for these species in order to satisfy Lenders’ requirements.
- 4.21. The Transmission Line EIA does not mention the presence of sensitive or critical habitats at a regional and local level.

Aquatic Ecosystems

- 4.22. In regards to the parameters studied in the aquatic baseline, the PHAM EIA included phytoplankton, phytobenthos, zooplankton, zoobenthos and fish, in addition to physical-chemical parameters, water flow and vegetation. The baseline study effort was complemented with additional studies at the Lenders request during the due diligence process.
- 4.23. The additional sampling confirmed the EIA’s original findings that indicated low fish abundance and diversity in the surveyed sectors (i.e., Colorado and Yeso Rivers). Only three

fish species were ever found during all sampling studies: the rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), both non-native and introduced for recreation and sport fishing, neither of which are threatened, and the small catfish (*Trichomycterus areolatus*), which is a native and endemic species to Chile that is widely distributed across Regions III to X, with its population considered ‘vulnerable’ nationally¹⁴. *T. areolatus* is also listed as ‘Data Deficient’ in IUCN’s redlist of threatened species, which indicates that no assessment of extinction risk has been made to date.

- 4.24. The introduction of potentially invasive trout species (mainly for sport and recreational activities) has had well documented historical and current adverse effects on native fish assemblages in the country and particularly in the Upper Maipo River basin. Findings from the sampling campaigns support available literature regarding aquatic ecosystems in the area, which suggest that the ecosystems have been disturbed by anthropogenic activities mainly associated with irrigation, power generation and recreation.
- 4.25. The aquatic baseline seems to suggest that fish presence in the study area is independent of food supply (measured by abundance and richness of phytobenthic taxa), as fish were largely missing from systems with a high supply, such as the Maipo River and the Engorda Stream, and were found in sectors with reduced availability of food, such as the Colorado River and the Aucayes Stream.

Trichomycterus areolatus (small catfish)

- 4.26. Baseline results of fish diversity and abundance indicate that the populations of *T. areolatus* would appear to be small in the Project area, and found mostly in the lower slopes. Studies on habitat suitability curves indicate that *T. areolatus* prefers benthic habitats where it will actually burrow into the river gravels and pebbles between 3 and 10 cm. It prefers relatively shallow water (optimal about 0.2 to 0.6 m), high transparency, with modest currents (optimal about 0.0 to 0.7m/sec), with river gradients of about 1%. Hence, according to the findings *T. areolatus* is expected to be found at other locations on the Colorado, and other locations on the Maipo downstream of the confluence with the Yeso, if suitable river gradients are present (i.e. < 1%).

Legally Protected Areas (Critical Natural Habitats) in the Project’s Area of Influence

- 4.27. Three legally protected areas¹⁵ lie within the PHAM area of influence (see **Figure 5**), all of which are internationally recognized under an IUCN category. The Project components that overlap with the *Monumento Natural El Morado* (IUCN Category II) and the *Santuario de la Naturaleza San Francisco de Lagunillas y Quillayal* (IUCN Category IV) are entirely underground, with no expected impacts aboveground. The third protected area is the *Santuario de la Naturaleza Cascada de las Animas* (IUCN Category IV), for which there are no physical Project components within the area, with the closest component 16 km to the northeast.
- 4.28. Since 2005 the majority of the territorial area of the municipality of San José de Maipo is designated as a “priority area for conservation” according to the Strategy for the Conservation

¹⁴ Supreme Decree 51 (MINGEPRES, 2008).

¹⁵ In response to a request made by IDB and the other DFIs, the Company commissioned a supplemental study to provide a more thorough analysis of potential direct and indirect impacts to all three protected areas within the Project’s area of influence (San Francisco de Lagunillas y Quillayal Nature Sanctuary, Cascada de las Animas Nature Sanctuary, and El Morado Natural Monument) which was completed in January 2013.

of Biodiversity in the Metropolitan Region of Santiago, developed by the Chilean Ministry of Environment. Although the area primarily include modified habitats, even urban areas, the Chilean Ministry of Environment indicates that their designation is due to the presence of high altitude streams and wetland areas and due to their use as a corridor by animal species moving between Chile and Argentina, including the puma (*Puma concolor*), guanaco (*Lama guanicoe*), and Andean Parakeet (*Bolborhynchus aurifrons*). Their designation as conservation areas does not preclude development of hydropower projects or other activities as long as potentially negative impacts are prevented or mitigated according to applicable local laws, as demonstrated by the project in the EIA and accompanying environmental management programs.

B. Social Setting

- 4.29. The Alto Maipo Hydroelectric Project is located in the *Comuna* or Municipality of San José de Maipo, Province of the Cordillera, within the Santiago Metropolitan Region. The *Comuna* includes the Maipo River and its tributaries including the Volcán, Yeso, Aucayes, and Colorado rivers from which the Project will capture water for its operation. The area of influence of the Project includes San Jose de Maipo and nine other villages and settlements along the Volcán, Yeso, and Colorado Rivers (see Figure 6).¹⁶
- 4.30. The National Census of 2002, the total population of the *Comuna* is approximately 10, 753, although population growth is expected to have increased by some 8% between 2002 and 2012. Approximately, 69% of the population is urban and the remains 31% live in rural areas. The population is closely divided between males (52%) and females (48%). The vast majority of the population migrated to the area from other districts or regions, and only 2% of the population identify themselves as belonging to the Mapuche ethnic group. However, there are no indigenous communities within the Project area or indigenous groups living under distinct indigenous systems of governance and culture.
- 4.31. The area's endowment of community infrastructure is relative good in the main urban areas and along the transportation corridor between San Jose de Maipo and Santiago. Moving east toward the Andean Mountains, however, roads and community services are more limited. Road infrastructure includes route G-25, which connects the majority of the populated areas, and more limited secondary roads (G-455; G-345) which connect smaller communities. Health care and educational facilities are accessible and considered adequate for the existing population. There are 19 educational facilities throughout the municipality; adult literacy is 96% and 98 percent of the population has attended school. A hospital is located in San José de Maipo and three community clinics serve Las Vertientes, San Gabriel, and El Volcán.
- 4.32. In general access to the electricity grid, potable water and sanitation is considered good. In the Municipality of San José de Maipo, 93.6 percent of the population is connected to the national grid and 84 percent have access to potable water through either community systems or Aguas Andinas. According to the EIA, 86 %of households are served by wastewater systems. Some 16% of households in the municipality, however, are not connected to formal systems and

¹⁶ San Jose de Maipo (pop: 5615; adjacent to Maipo river between the Colorado and Yeso); El Canelo (pop: 2562 near Las Lajas discharge on Maipo); El Manzano (pop: 1022; near Las Lajas discharge on Maipo); San Gabriel (pop: 761; adjacent to access roads at Yeso river Intake points); El Alfalfal (pop: 422; close to intake points for Alfalfal II along Colorado); Los Maitenes (pop: 149; next to access road to Alfalfal II and Los Maitenes waste rock location); El Volcán (pop: 96; next to access road to Volcán river intake points); Lo Valdés (pop: 48; next to access road to Volcán river intake points); El Romeral (pop: 44; next to access road to Yeso river intake points); Baños Morales (pop: 34; next to access road to Yeso River Intake points.)

depend on water from streams, rivers and springs. The municipality has initiated a project to help communities lack public services such as water and electricity to meet government zoning and land titling prerequisites for securing these services.

- 4.33. In the Municipality of San Jose de Maipo 75% of the population was economically active, while 12 % was unemployed at the time of the EIA studies. The types of economic activity are tourism, mining, hydroelectric power generation, and agriculture. A number of so-called “traditional families” engage in traditional livestock herding and farming. A number of people also commute to work to Santiago. Mining activity primarily involves non-metallic mining: sand and gravel operations, stone quarries, gypsum and limestone. Aside from AES Gener existing Cordillera Complex, there is also another hydroelectric power plant (the Guayacán Plant) operated by another company.
- 4.34. Tourism is a growing industry, and the Municipality of San José de Maipo has made increasing local participation in the sector a high priority in its local development plans. Tourism accounts for 15% of the local economy and 22% of local employment, although only 50% of the tourist local sector workforce is local. The goal of the municipality in the *Plan de Desarrollo Turístico* is to increase local participation in the workforce to 80%. According to the overall *Plan de Desarrollo Comunal de San José de Maipo* (2010) the most popular tourism activities in San Jose de Maipo are hiking (46%), rafting (33%), horseback riding and tours (18%), fishing (2%) and kayaking (1%). There has also been an increase in the number of restaurants and lodgings, as well as the development of artisan crafts.
- 4.35. The vision of San Jose de Maipo as a predominantly tourist outdoor recreation area is reinforced by two national strategic plans: the Santiago Metropolitan Regulatory Plan (PRMS) which designates the municipality and the Alto Maipo as a protected area, and the areas designation by the Chilean National Tourism Service (SERNATUR) as a Zone of National Tourism Interest. (2002). According to the Strategic Plan for Cordillera Province the communities of San José de Maipo, San Alfonso, El Manzano, San Gabriel, El Melocotón, Las Vertientes, El Canelo, Guayacán, el Volcán, and Lo Valdés are “communities oriented toward ecotourism , nature and environment. “ The mountains, rivers and important protected nature preserves in the area all contribute to this vision of the future. Whether the PHAM and certain extractive activities in the basin are compatible with this vision is an underlying driver of external opposition to the Project.
- 4.36. The distribution and management of water rights and use within the area of influence is critical to the Project. The Maipo River basin is a fully developed water economy with privatized water rights and mature water markets characterized by increasing competition for scarce water resources. The river basin, which has a catchment area of 15,549 square kilometers serves an irrigated area of approximately 127,000 hectares, and is the source of potable water for as much as 75% of the city of Santiago and adjacent communities, as well as serving a several industrial and hydroelectric water users. AES Gener contracted a study which characterized the water users within the intervened reach of the river in May 2013.¹⁷ According to the report, there are 11 existing water rights in the intervened reach and 11 on tributaries within the direct area of influence of the Project but not affected by it. Water users within the intervened reach include livestock farmers, irrigation committees and agricultural users, hydropower projects, materials extraction operations, and recreational users. Approximately 394 individual agricultural users are members of irrigation committees and 7 families draw their supply of potable water from

¹⁷ “Caracterización de Actividades Económicas en San José de Maipo”, FDC Ciencia Social Aplicada (Mayo 2013)

the El Manzano Irrigation Canal. Other major users in the intervened area include the Canal Maurino in Maitenes and non-consumptive water rights holders such as the Guayacán hydroelectric plant, and users which do not require rights such as the 9 organized rafting and kayaking operators and 5 recreational swimming and fishing areas.

- 4.37. There are 4 water rights holders downstream of the PHAM discharge. These include the Canal San Carlos and Canal la Sirena, which are used for irrigation and managed by the Asociación de Canalistas del Río Maipo, as well as Aguas Andinas, which holds the potable water supply concession for the Santiago Metropolitan Area. Aguas Andinas also operates the el Yeso, Laguna Negra and Laguna Lo Encañada reservoirs within the Project's area of influence; community water systems for the San José de Maipo, San Gabriel and el Canelo, and the Independent Intake and treatment plants for Santiago's potable water system which is located some 5 kilometers downstream of the PHAM discharge.
- 4.38. The National Water Authority (*Dirección General de Aguas - DGA*) is responsible for overall water development planning, assigning original water rights and approving transfers, approving major hydraulic works, fixing rates for urban water and sewage companies and maintaining the Official National water Record. Actual implementation of water rights is coordinated by water users associations at the local, watershed and basin levels. The *Junta de Vigilancia de la Primera Sección del Río Maipo* administers the segment of the Maipo River in which the Project is located. The *Junta*, whose leadership is elected by the members, represents all water users in the watershed, which includes 7 irrigation associations, 7 hydroelectric operators (including AES Gener), and Aguas Andinas.

V KEY ENVIRONMENTAL AND SOCIAL IMPACTS AND RISKS AND MITIGATION

A. Summary of Key Impacts and Risks and ESDD Findings

- 5.1. IDB developed its environmental and social due diligence (ESDD) with the assistance of ERM – Environmental Resources Management (E&S Consultant). It should also be noted that close collaboration and coordination that predominated throughout the preparation process between IDB and the other DFIs involved (IFC and OPIC) greatly contributed to increase the effectiveness and breadth of the ESDD.
- 5.2. On the course of the first ESDD mission, performed in conjunction with the other DFIs, besides the technical meetings with Company personnel, consultants and contractors, and visits to all relevant Project sites, a series of meetings and interviews were performed with (i) key Project-related authorities, including the Environmental Assessment Service (SEA), General Water Authority (DGA), Direction of Hydraulic Works (DOH); (ii) local authorities, including the Municipality of San Jose de Maipo and Municipal Tourism and Economy Office of San Jose de Maipo; and (iii) other key stakeholders, such as: *Coordinadora Ciudadana Ríos del Maipo*, *Asociación de Canales del Río Maipo*, *Comunidad de Aguas El Manzano (irrigation)*, *Junta de Vigilancia del Río Maipo*, and *Directiva Unión Comunal de Juntas de Vecinos*; some of which are opposed to the Project.
- 5.3. Based on the information gathered at these meetings and interviews, it has been possible to identify the following main concerns in relation to the Project for the local authorities and other key stakeholders:

- i. Impacts of Project operation to downstream water users (e.g., farmers who utilize community irrigation systems, kayaking/rafting users) due to changes in the availability of water and the hydrological balance in the Project area, including during initial filling of the tunnels and sudden blackout events.
 - ii. Increased risks to community health and safety caused by sudden surge waves (*golpes de agua*) downstream from PHAM facilities during blackout events.
 - iii. Impacts on sediment transport and loads, leading to a reduction of sediment load downstream of the discharge point, which in turn could lead to damages to structures located downstream such as irrigation system intakes and bridges.
 - iv. Impacts on the existing sand and gravel exploitation activities (exercised by local construction workers or *areneros*, some of them illegally) downstream of the Las Lajas discharge that are currently eroding the riverbed.
 - v. Impacts on in-stream recreational uses of rivers, including kayaking, rafting, public fishing and swimming areas.
 - vi. Negative impacts on other tourism activities in the Maipo Valley (e.g., hiking, horseback riding and tours).
 - vii. Groundwater impacts associated with tunneling activities (interruption of flows).
 - viii. Changes in the local labor market and other social changes in local communities, including overload of some public services, due to the influx of non-local workers and other service providers to the area.
 - ix. Deterioration of existing roads and augmentation of the risk of road accidents associated with the increase in Project construction-related truck traffic.
 - x. Impacts on protected areas.
 - xi. Potential to exacerbate localized climate change (e.g., changes to the microclimate) caused by decreased water flow, leading to “desertification” within the dewatered reach.
 - xii. Impacts on water supply of Santiago Metropolitan Region, both in terms of quantity and quality.
 - xiii. Lack of appropriate and timely disclosure of Project information after issuance of the RCA.
 - xiv. Questions about the legality of the Project’s environmental authorization (RCA) and acquisition of water rights.
- 5.4. The Bank, jointly with the other DFIs, provided during the ESDD a series of recommendations and requests for additional documentation to the Company to better address these issues, both in terms of the information available relative to the Project, as well as in communicating proper information to local communities and other stakeholders. Furthermore, these issues were evaluated in depth with the assistance of thematic experts from the E&S Consultant (ERM), which reviewed also technical information and reports provided by key stakeholders,

particularly on the following subjects: (i) changes in surface hydrology and impacts of sudden blackout events; (ii) impacts on sediment transport and balance downstream of the discharge point; (iii) groundwater impacts associated with tunneling activities and (iv) exacerbated climate change impacts on water flow and local desertification.

5.5. Additionally, based on the results of the ESDD visits and initial document review, the Bank, jointly with the other DFIs, recommended and the Company prepared a series of complementary studies and documents intended to ensure that the scope, content, and quality of the assessment of impacts and risks is: (i) taking into proper consideration some of the key stakeholder concerns; (ii) aligned with IDB and other DFIs applicable E&S Policies and Guidelines; and (iii) consistent with international good practice. The following studies were completed by the Company between May 2012 and July 2013:

- i. Identification and assessment of potential impacts on water uses and establishment of a management/ compensation plan (including climate change analysis).
- ii. Identification and assessment of potential impacts on riverbed sediments and establishment of a management/ compensation plan.
- iii. Identification and assessment of the conversion or degradation of aquatic habitats and establishment of an ecological flow management strategy.
- iv. Identification and assessment of impacts from land and right of way acquisition and establishment of a land and right of way acquisition report.
- v. Identification and assessment of impacts to legally protected and internationally recognized areas.
- vi. Preparation of cumulative impact assessment report.
- vii. Preparation of an alternative analysis report.

5.6. These activities required the Company to conduct a series of studies complementary to the original EIA, including in some cases collection and analysis of additional environmental and social information. These studies were developed in close consultation with the independent consultants, and representatives from IDB and other DFIs.

5.7. Furthermore, as mentioned before, at the beginning of the ESDD it was identified that the capacity of the Company to manage E&S aspects of the Project, including community relations, was very limited, both in terms of resources (human and others) as well as in relation to procedures and systems. Based on the recommendation by IDB, in conjunction with the other DFIs, the Company strengthened its capacity and has developed a robust Stakeholder Engagement Plan.

B. Potential Negative E&S Impacts and Risks Associated with Construction Phase

5.8. The main potential negative environmental and social impacts associated with the construction of the Project include: alteration of air quality resulting from transportation and construction activities; noise and vibrations from excavation; temporary alteration of water quality and flow; impacts on aquatic fauna; waste rock disposal; alteration of local hydrogeology (groundwater); stormwater runoff; risk of soil contamination from waste and hazardous substances; soil

erosion and compaction; loss of vegetation and forest cover; risk of landslides; greenhouse gas emissions; alteration of the natural landscape; social changes and overload of some public services due to the influx of non-local people; changes in the local labor market; health and safety risks to workers; disruption of tourism activities; traffic and road use.

- 5.9. However, this section focus on the E&S impacts and risks that were considered to be the key ones based on the stakeholder concerns and technical analyses performed during the ESDD.

B.1 Groundwater Impacts Associated with Tunneling Activities

- 5.10. Stakeholder concerns were raised in regards to the potential localized impacts on the groundwater hydrology (interruption of groundwater/aquifers) due to the tunneling activities during the construction of the PHAM. The independent consultants assisting in the Bank in its technical and E&S due diligence conducted an in-depth technical review of the documentation provided by stakeholders as well as that prepared by the Company regarding this issue.
- 5.11. In response to the DFIs request, the Company commissioned a review conducted by a specialized consultant on the Potential for Contamination of Water from Tunneling Activities and Rock Disposal in Waste Heaps. The hydrogeological review concluded that the potential impacts to local hydrogeology have been adequately addressed through technical documentation, supporting evidence, and proposed management and mitigation measures. In addition, as described in the next **section (B.2)**, management measures are in place to mitigate the potential impacts associated with waste rock disposal sites.
- 5.12. The rock permeability for the Project areas has been assessed based on tests executed on drill holes. The hydrogeology studies performed for the EIA conclude that the probability of finding aquifers below 250 m below ground level is minimal. Another study conducted by another specialized engineering firm (“Analysis of Potential Impacts to Aquifers in the PHAM Area of Influence”, March 2008) concluded that nine aquifers located between the proposed intake structures and discharge points in the Maipo River are not expected to be affected by the Project. The study also concludes that the Volcán and Colorado area aquifer systems would be expected to have similar results.
- 5.13. Further, the experience obtained from the construction of more than 35 km of tunnels at the existing Alfalfal I generation facility, in the Colorado River valley, constitutes the most important background information to estimate the expected permeability during the tunneling activities in the Project. During the construction of the Alfalfal I project, more than 95 percent of the excavated tunnels were dry to humid; the remaining less than 5 percent of the tunnels showed higher infiltrations, which were effectively sealed with grouting.
- 5.14. Nevertheless, as a precautionary measure in the PHAM, although the possibilities of encountering an aquifer have been assessed as low by the hydrogeological studies, the tunneling procedures have further taken provision and control measures to avoid an impact on these. First, the tunnel excavation includes a procedure for systematic exploratory drilling 20-25 m ahead of the face, before each next blast round takes place to provide advanced information on rock mass conditions and water infiltration ahead of the face. Second, the tunnel excavation also includes a water sealing technique called grouting. The rock mass is a significant barrier by itself; however, in shallow depths it can be a discontinuous material which is sometimes highly water conductive but PHAM tunnels and underground works are several hundred meters deep mitigating this issue. Reducing the permeability of the rock mass by pre-grouting (injection of cement, cement-bentonite slurry, polyurethane or others) is

important in tunneling and underground excavation to avoid hindrance to the tunneling activities and impacts to groundwater or aquifer, the surroundings and the flora and fauna.

B.2 Impacts on Water Supply of Santiago Metropolitan Region

- 5.15. The risks of contamination of water sources that can potentially affect the water quality of the water supply system of Santiago, operated by Aguas Andinas, is also of concern to opposing stakeholders, given the Project's location directly upstream from the intake for the potable water system.
- 5.16. Aguas Andinas is the concession holder for the provision of potable water and sewerage services in the Metropolitan Region of Santiago. Aguas Andinas operates the following facilities within the PHAM Project area of influence and vicinity: (i) el Yeso Reservoir; (ii) Laguna Negra and Laguna Lo Encañado Reservoirs and Laguna Negra aqueduct (iii) the Independent Intake (*Bocatoma Independiente*), which is the primary source of potable water for the Santiago Metropolitan Region and located approximately 5 km downstream from the PHAM discharge point;¹⁸ and (iv) potable water and sewage systems in the Metropolitan Region of Santiago; and (v) community water systems in the municipal center of San Jose de Maipo, San Gabriel and El Canelo.
- 5.17. Three main sources of impacts to water quality identified in the EIA include: (i) construction works in the river channel; (ii) domestic effluents from wastewater treatment plants; and (iii) industrial effluent from tunneling activities.
- 5.18. *Construction Works:* Prevention and control measures are in place to minimize the impacts due to civil works in streambeds. These measures include: (a) minimizing the intervention of riverbed and river channel for bridge construction; (b) scheduling works in river channels at the end of the summer and beginning of the fall, when the flow is lowest, to ensure maximum riverbed exposure; (c) minimizing the duration of riverbed intervention; (d) ensuring that construction material and machinery do not creep into the riverbanks; (e) supervision of adequate use; (f) preventing spills of oil by prohibiting stockpiling drums of lubricants or parking machinery on the riverbed; and (g) restriction of access to Laguna Negra and Laguna Lo Encañado to workers in coordination with Aguas Andinas for use of the access road.
- 5.19. *Domestic Effluents:* Sewage wastewater from camps and work fronts will be treated in temporary modular plants according to local regulations and discharged into surface water courses at five selected discharge points.
- 5.20. *Industrial Effluent from Tunneling Activities* The production water from tunnels will be monitored and if necessary, treated prior to its discharge onto surface water. The treatment system will be capable of retaining production water that may contain high pH, to undergo treatment. Contractors will be required to monitor water quality at discharge points associated with runoff from tunnel construction sites and establish control measures in cases of exceeding allowable limits.
- 5.21. *Waste Rock Disposal Sites:* Other possible sources of water contamination are the 14 waste rock disposal sites or excavation waste heaps that will be located throughout the Project area, in close proximity to the tunnel portals (selection of locations for the waste sites has taken into

¹⁸Water from the "Independent Intake is channeled to the *Las Vizcachas* Potable Water Production Plant, where the water is purified and stored for use in Aguas Andinas potable water distribution system.

consideration avoidance of areas of natural risk, i.e., avalanche, landslide, as well as avoidance of inundation plains or aquifers). Depending on the chemical make-up of this waste rock, stormwater and snowmelt leachate from the heaps could negatively impact the surrounding soils, groundwater and potentially surface water. Based on the geological assessments conducted mineral or acidic contents in the geological alignment have not been detected, and thus the potential for acid rock drainage is considered low. Nevertheless, contractors will be required to conduct geological sampling 20 m – 25 m in advance of tunnel extraction operations to identify hydrogeological characteristics that could generate impacts to water quality (see **Environmental Management Plan for Waste Rock Disposal Sites in Section VI**). In case of encountering levels of acidity or alkalinity over regulated limits, the Company is required, per the RCA, to implement contingency measures such as installation of a soil impermeabilization system (i.e., liner), runoff and drainage management, and water treatment/neutralization prior to discharge of surface or subsurface runoff.

- 5.22. In order to address residual risk, the Company will develop and implement the following plans:
- i. Plan for managing tunnel production wastewater, including a complete list of chemical substances that will be used, handled and stored in tunnels; expected flow of production water in each tunnel section; capacity of wastewater treatment plants, the operating system and expected pollutants to be treated (i.e., high pH, high sediment load, oil and grease, other pollutants). The assessment should account for potential excess water production from fractured rock (i.e., “*bolsones de agua*”) and include regular monitoring to ensure compliance with receiving water quality standards.
 - ii. Complement the existing Contingency Plan for Acid Rocks with specific mitigation measures to be implemented in the event of encountering acid rock, including measures to prevent acid drainage from entering the water courses.
 - iii. Comprehensive plan for stormwater management, to include estimation of stormwater to be generated, mitigation and control measures, and regular monitoring to ensure compliance with receiving water quality standards.
 - iv. Integrate Participatory Monitoring Program in the Water Quality Monitoring Plan.

B.3 Impacts on Biodiversity

- 5.23. Project-related biodiversity impacts can largely be summarized in terms of Natural (*including* modified) Habitats and Critical Natural Habitats, and are as follows: (i) direct impacts to terrestrial flora due to the project’s footprint, primarily during construction; and (ii) indirect impacts to critical natural habitats (i.e. legally protected and internationally recognized areas).

Impacts on Terrestrial Natural and Critical Natural Habitats

- 5.24. Overall, the project’s footprint will impact approximately 31 ha of natural Schlerophyll forests along the Colorado and Volcan Rivers and 70 ha of shrubs and grasses, which includes 56 ha of Andean steppe vegetation in the upper reach of the La Engorda area. These habitats pertain to the ‘Natural Habitats’ definition for the purposes of OP-703 (Directive B.09). The analysis of Project documentation indicates that the foreseen direct impacts will not result in a significant conversion or degradation of such habitats. In the case of Schlerophyll forest, some of the

constituent vegetation includes up to five species of trees listed locally as ‘vulnerable’¹⁹, but which have not yet had their status assessed by the IUCN.

- 5.25. The upland, intermittent type of wet meadows (wetlands) known locally as “*vegas*” are considered ‘Critical Natural Habitat’ for the purposes of OP-703 (B.09), mainly because of its key ecosystem functions in terms of provisioning services for water, animal grazing and a variety of other biological processes associated with seasonal glacier melting flows²⁰. The project will directly affect approximately 7.3 ha of “*vegas*” habitat during construction, of which 6.3 ha are in the La Engorda area in Upper Volcan. However, this is not considered a significant conversion or degradation, and the Project has a requirement of revegetating and promoting the restoration of at least 50% of the intervened surface (i.e. diversion tunnel and working fronts).
- 5.26. Furthermore, the Project’s Environmental Management Plan defines a series of management actions to prevent or minimize impacts on terrestrial flora and fauna. These measures include the definition of “restricted areas” requiring avoidance and/or special management measures due to their ecological sensitivity, including the following: (i) *vegas* and wetlands in the Lo Encañado – Yeso River area and upstream of the intake area along the Volcan River, (ii) areas where flora species under conservations status are present, and (iii) officially protected areas (see below). In addition, per Chilean regulations, all protected vegetation species require a sectorial permit prior to clear cutting. Permits are issued for individual trees and need to be reforested based on the authority’s requirement (i.e., 1:1, 1:5 or 1:10 depending on the conservation status). Similarly, a fauna capture and relocation plan is in place prior to entering new areas and specific specialist supervision is required in areas of ecological sensitivity. In addition, the Project integrates a Reforestation Management Plan and a Vegetation Restoration Plan (see **Section VI**).

Impacts on Protected Areas (Legally Recognized Critical Natural Habitats)

- 5.27. The Project includes developing underground works within the El Morado Natural Monument and the San Francisco de Lagunillas y Quillayal Nature Sanctuary borders (see **Figure 5**). An approximately 3.3 km stretch of the Volcán Tunnel will traverse the El Morado Natural Monument between 550 and over 1,500 m below ground level (bgl). Similarly, approximately 5.5 km of the Alfalfal II Tunnel will traverse underneath the San Francisco de Lagunillas y Quillayal Nature Sanctuary between 400 and 450 m bgl. The Cascada de las Animas Nature Sanctuary is located 16 km away from the closest surface or sub-surface infrastructure associated with the Project.
- 5.28. Per the Environmental Authorization (RCA), tunnel boring machines will be used to avoid the use of explosives during the construction of the tunnel beneath the San Francisco de Lagunillas y Quillayal Nature Sanctuary. In addition, the EIA concluded that, in the areas in which the tunnel beneath the El Morado Natural Monument is planned to be excavated with the traditional D&B method, the depth of the tunnel (i.e., between 550 and 1,500 m bgl) is such that no vibrations effects are expected on the surface.

¹⁹ Conservation category status is derived from the official Chilean classification system (*Reglamento de Clasificación de Especies Silvestres (RCE)* known as the “CONAF (Chilean) Red Book” (<http://www.mma.gob.cl/clasificacionespecies/index2.htm>))

²⁰ For these reasons this type of habitat enjoys formal, legal protection in Chile where it occurs in regions I and II (but no such legal protection in region V, where the Project is located).

- 5.29. Following the EIA, and in response to a request made by IDB and the other DFIs, based on preliminary due diligence findings, the Company commissioned a supplemental study²¹ to provide a more thorough analysis of potential direct and indirect impacts to all three protected areas within the Project's area of influence (San Francisco de Lagunillas y Quillayal Nature Sanctuary, Cascada de las Animas Nature Sanctuary, and El Morado Natural Monument). This study, was presented in July 2012, updated in October 2012 and completed in January 2013, included a description of the protected areas and their use; a field survey of flora, fauna and habitats; and an analysis of potential impacts from the project on the transportation network, noise levels (during construction), visual resources, and hydrology of the Maipo River abutting the Cascada de las Animas Nature Sanctuary area. An analysis of the potential impacts indicates that the Project will not result in any significant direct or indirect impacts to protected area-type Critical Natural Habitats.
- 5.30. Regarding possible effects of reduced flow on the Maipo River and its potential indirect impacts on the Cascada de las Animas Nature Sanctuary during operations, the October 2012 study concluded that the expected decrease in minimum monthly flow of the Maipo River abutting the Nature Sanctuary area would fall within the range of natural variation of flow in the river. The study therefore concludes that the impacts of Project operation in the hydrology of the Maipo River are not expected to cause significant indirect impacts to the riparian habitat of the Nature Sanctuary.
- 5.31. The potential increase in noise levels within the protected areas from D&B explosives to be used in the initial sections of the tunnels was modeled and shown to be of highest significance in the San Francisco de Lagunillas y Quillayal Nature Sanctuary. Furthermore, the modeling work concluded that the overall analysis of range of noise levels likely to be experienced in the protected areas is adequate, and falls below limits established in standards, such as those set by the U.S. Code of Federal Regulations Part 816 - Permanent Program Performance Standards - Surface Mining Activities.
- 5.32. As with noise, the impact to visual resources and the transportation network is most likely to be more significant during construction activities. The supplemental study requested by IDB and the other DFIs also analyzed potential impacts to visual resources from the main access roads to and within the protected areas and, in the case of the El Morado Natural Monument, a main hiking path. The study concluded that the surface works would not have an impact to visual resources within these areas.
- 5.33. With regard to impacts to the transportation network, the study uses data from the PHAM Transportation Network Impact Monitoring Program, which is currently underway and which includes monitoring of traffic flows on routes G-25 and G-345 (the main access routes to all three protected areas). The study concluded that, given the current capacity and flow of traffic on the routes, the Project is not expected to have a significant impact on access to the protected areas due to increased traffic.
- 5.34. Nevertheless, precautionary measures will be implemented, which include instructing contractors on paying attention to sensitive receptors in protected areas. In addition, the Company will provide written notification to landowners prior to the execution of construction

²¹ *Analisis Ambiental de los Efectos del PHAM Sobre las Áreas Protegidas Presentes en su Área de Influencia: Monumento Natural el Morado, Santuario de la Naturaleza San Francisco de Lagunillas y Quillayal, y Santuario de la Naturaleza Cascada de las Animas* (October 2012).

works, as well as carry out informational talks with the owners of the properties that constitute the San Francisco de Lagunillas y Quillayal Sanctuary.

B.4 Project Related Road Traffic and Deterioration of Existing Roads and Increased Risks of Accidents

- 5.35. The Project will require the construction of 31 km of new permanent access roads in the Volcán, Yeso, Aucayes, Colorado River and Las Lajas construction areas. Access roads will be 10 m wide gravel roads. The Project will also utilize existing public roads, including at least 12 key intersections throughout the areas of influence.
- 5.36. A Traffic Impact Assessment was conducted as part of the original EIA to assess traffic-related impacts. The assessment methodology characterized road supply and demand and assessed related impacts. Issues related to community health and safety were also indirectly addressed in the methodology (i.e. increased traffic causes increased dust, noise and risk of accidents). According to this study, construction activities will result in a temporary increase in vehicular traffic on public roads associated with the delivery and transport of materials, equipment, machinery and staff to Project construction sites. However, the simulation models used suggest that the expected increase in traffic will not exceed the capacity of affected roads; any traffic impacts will be temporary delays associated with construction activities rather than a significant increase in the volume of traffic. A comparison of traffic volume for a baseline year (2010) and the projected construction phase traffic volumes indicates that the projected traffic volumes will not represent significant increases over baseline conditions (overall increase around 10%).
- 5.37. Nevertheless, the Project has committed to the following road use and traffic-related design parameters and mitigation measures: (i) Dust Suppression Program; and (ii) Roadway Improvement Program. With the implementation of these mitigation measures, traffic and road use impacts are considered to be minor negative impacts. Community health and safety impacts, particularly the risk of pedestrian and vehicular accidents will be managed through the application of driver safety training and driver safety guidelines. In addition, control measures to reduce traffic impacts and road degradation will include enforcement of maximum weight restrictions (45 tons) for all Project vehicle and suspension of vehicular traffic (greater than 4 tons) on holidays and weekends (Saturday 14:00h – Monday 8:30h).
- 5.38. Furthermore, the Roadway Improvement Program to be implemented by the Company foresees that a 22-km segment of route G-25 and a 21-km segment of Route G-455 to the Yeso Reservoir will be improved during the PHAM construction phase. Road improvements will include re-leveling, resurfacing with dust suppressant compounds, installation of drainage channels, and placement of traffic signs, signals and safety barriers. None of the road improvements will affect urban areas. With the implementation of the proposed mitigation and management measures, physical impacts to roads and traffic volumes are expected to be minor.
- 5.39. In addition, it should be noted that under the RCA, the following requirements were established, in compliance with the Municipal Regulation of San Jose de Maipo: (i) Prioritize surface construction works during daytime (8:00h – 21:00h); (ii) Construction works in El Alfalfal, and any other area with sensitive receptors in close proximity, can only be conducted between 8:00h and 21:00h; (iii) During construction, trucks and worker vehicles can only occur between 8:30h and 17:30h (Mon – Fri) and between 9:30h and 14:00h (Saturday). In addition, transportation of workers and that of loads shall be conducted at different times.

B.5 Greenhouse Gas Emissions

- 5.40. During construction, the Project will use a power line from the operating *Los Maitenes* hydropower plant, therefore replacing the potential use of fossil fuel-based energy alternatives. However, other fuel-based sources that could generate GHG emissions will be used during construction (i.e., fuel burning for machinery and vehicles, etc.) and the construction of PHAM facilities will involve clearing of forest cover for transmission lines and surface installations.
- 5.41. A quantification of GHG emissions during the construction phase of the Project was not conducted as part of the PHAM or Transmission Line EIAs. However, a GHG emissions inventory and estimations were prepared in response to IDB and other DFIs request during the ESDD.²²
- 5.42. The report provides a quantification of direct and indirect emissions during construction and operations phases of the Project, corresponding to Scope 1 and selected Scope 3 emission factors, stemming from machinery and equipment (fuel burning), loss of vegetation, and sewage treatment. The estimations also take into account reforestation and the carbon capture associated to it. For construction phase, estimations were made for the years 2011 – 2016. The report includes a quantification of CO₂, N₂O, and CH₄ emitted and references the methodology developed by the GHG Protocol Initiative (GHG Protocol Corporate Standard) and the United Nations Intergovernmental Panel on Climate Change (IPCC), which are internationally accepted. The calculations used detailed information from the Project design and description (e.g., number of trucks per day for transportation of waste rock).
- 5.43. The report estimates that the annual CO₂-equivalent emissions of the Project during the construction phase will range from 141.5 tons of CO₂e/year in 2011 to 8,442 tons of CO₂e/year in 2014.

B.6 Influx of Non-Local Workers and Changes in the Local Labor Market and other Social Changes in Local Communities

- 5.44. The Project construction phase will require an average of 2,000 employees, reaching a peak of 2,500 employees in the third year of construction. An estimated 30-40 percent of employment opportunities will be filled by non-skilled laborers. According to the EIA (2008), labor demand generated by the Project is not expected to significantly alter the local job market. However, the addition of up to 2,500 employment opportunities would represent a 67% increase over the current number of economically active residents in the entire municipality of San Jose de Maipo. Rapid increases in direct employment are likely lead to temporary increases in indirect employment in commerce, transportation and related industries, resulting in temporary, but potentially significant, changes in the local job market. The creation of local job opportunities may also decrease the extent to which local residents commute to Santiago to seek work. The impact of these changes will likely consist of short-term economic opportunities which will increase the rate of urbanization and cultural change in San Jose de Maipo, followed by another restructuring of the local job market upon completion of the construction phase.
- 5.45. Control measures will include the establishment and monitoring of local employment quotas applicable to all Contractors, in accordance with the Social Collaboration Agreement which includes a Local Employment Development Program, as well as communication and disclosure of employment opportunities and application procedures in the Project area of influence.

²² *Memoria de cálculo del inventario de emisiones de gases de efecto invernadero en las etapas de construcción y operación, Proyecto Hidroeléctrico Alto Maipo* (Medioambiente Gestion, July 2012)

Contractors will be required to fill at least 15 percent of job opportunities with local laborers. Incentives will be applied to encourage contractors to employ up to 25 percent local laborers and fines will be applied to those employing less than 15 percent local laborers. Workers will be housed at 5 worker camps in close proximity to construction sites (see **Figure 4**). Transportation services will be provided by the Company to facilitate transportation between the worker camps and work sites as well as between the worker camps and residential areas in order to minimize traffic and influx to the area. The Project community relations and corporate social responsibility programs have also incorporated initiatives related to local employment, skills development and sustainable development, although these are not considered mitigation or management measures and will be administered by the *Fundación AES Gener*.²³

- 5.46. In general, in large infrastructure projects it is possible that community exposure to disease may result from worker-community interactions at worker housing sites (including the potential transmission of communicable diseases, respiratory and sexually transmitted infections resulting from influx of project labor), as well as household and community level changes to the social determinants of health (e.g., drug, alcohol, gender violence, and other psychosocial effects) associated with the rapid influx of labor during construction.
- 5.47. However, in the case of the PHAM, the rules governing workers residing at Project camps are considered appropriate for minimizing these associated health risks to neighboring communities. Negative impacts usually associated with increased presence of construction workers will be discouraged through the enforcement of the employee Code of Conduct for all staff and contractors (Community Relations Regulation for Contractors, March 2011). The Code of Conduct will promote respect for the local community, as well as E&S and H&S training, communication procedures to document and monitor environmental matters noted during work activities, penalties and incentives related to Occupational Health and Safety (OHS). Other preventive measures included are the following: location of worker camps away from villages and houses, provision of dedicated transportation services between worker camps and construction sites to avoid encounters in local communities, access to worker camps will be restricted, regulations on the prohibition of drugs, alcohol, weapons, and pets at all work sites and camps; health screening and education; and training on communicable diseases. Population change and influx will be monitored via the Social Indicators Monitoring Program to be implemented throughout the construction phase.

B.7 Negative Impacts on Tourism Activities

- 5.48. According to the PHAM EIA (2008), no direct impacts to tourism sites or tourism service providers are expected during the construction phase of the PHAM. However, indirect impacts may include disruption/delay of traffic and visual impacts which detract from the serenity and natural landscape of the two primary tourism zones in proximity to Project work sites: the Yeso Reservoir and the Alto Volcán sector. The Volcán Tunnel will pass underneath the Monumento Natural El Morado and the Alfalfal Tunnel will pass underneath the Santuario de la Naturaleza San Francisco at a depth of 1,000 m and 450 m, respectively. Therefore, tunneling activities at such depths are not anticipated to generate impacts to tourism or protected areas. Assessment of potential impacts to river-based recreation activities in the intervened reach is presented in the section associated with Project operation.

²³ The *Fundación AES Gener* is a non-profit foundation established in 1993 by AES Gener to implement the Company's Corporate Social Responsibility initiatives. The Foundation has focused on educational activities, leadership training and environmental education since it was founded.

- 5.49. Control measures presented in the EIA to reduce negative impacts to identified tourism and tourism sites in the Yeso Reservoir and Alto Volcán sectors include: Project design parameters to avoid construction activities in priority tourism areas; compliance with all transit and traffic laws; and suspension of Project traffic during holidays and weekends (Saturday 14:00h – Monday 8:30h).
- 5.50. In addition to impact control measures, the Company has implemented a Tourism Development Program in partnership with the Municipality of San Jose de Maipo to compensate for any interference of tourism activities caused by the PHAM. The Tourism Development Program includes three primary activities: (i) training of tourism monitors through support to local educational facilities; (ii) design and publishing of a San Jose de Maipo Tourism Guidebook, including printing 5,000 example copies; and (iii) design and establishment of a tourism website for the Municipality of San Jose de Maipo.
- 5.51. The Company will also support local tourism service providers through a grant fund administered by the *Fundación AES Gener*. The Company will designate an annual grant fund for use in support of tourism service providers, tourism business creation, and other activities which increase employment in the tourism sector. Proposals from local stakeholders and tourism providers will be accepted by the *Fundación AES Gener*, which will judge the proposals and provide funding to selected initiatives.

C. Potential Negative E&S Impacts and Risks Associated with Operation Phase

- 5.52. The main potential negative environmental and social impacts associated with the Project operation phase include: changes in the water flow regime; changes in water quality; alteration of sediment transport and load in the Maipo River; impacts to aquatic life; potential impacts to water users in the diverted reach and downstream from the Project discharge; impacts on community water intake structures downstream from the Project discharge; visual impacts and instream recreational river use impacts (e.g., kayaking/rafting).
- 5.53. However, this section focus on the E&S impacts and risks that were considered to be the key ones based on the stakeholder concerns and technical analyses performed during the ESDD.

C.1 Impacts of Project Operation on Downstream Water Users – Routine, Initial Filling and Blackout Events

- 5.54. Stakeholders located downstream of the point of restitution, particularly the operators of irrigation associations and/or systems located within a 5-km stretch downstream of the point of restitution²⁴, have also expressed significant concerns about potential violations of their water rights, especially those that could occur prior to plant start-up, during the filling of Project water conveyance structures, and during electric grid blackout events, which would require the Company to conduct a temporarily, emergency, shut down one or both plants.
- 5.55. In other words, key stakeholder concerns related to changes in surface hydrology caused by the operation of Project include:

²⁴ The Aguas Andinas “Independent Intake” is located approximately 5 km downstream of the PHAM discharge. From this point on downstream the flow of the Maipo River is significantly reduced due to existing intake structures for the Aguas Andinas water system and two irrigation association irrigation intake structures. As such, any downstream effects generated by the PHAM would be restricted primarily to the 5 km immediately downstream of the PHAM discharge. For this reason, the Project area of influence has been adequately established to include 5 km downstream of the PHAM discharge.

- i. Fluctuations in downstream water flows and levels under routine operation;
- ii. Insufficient stream flow during tunnel filling and blackout events to meet required water flow for all existing water right holders;
- iii. Decreased stream flow during tunnel filling and blackout events rendering existing intake structures for irrigation and potable water systems unusable/inadequate; and
- iv. Increased risks to community health and safety caused by sudden surge waves (*golpes de agua*) downstream from PHAM facilities during blackout scenarios.

C.1.1 Routine Operation

- 5.56. In response to a request from IDB and the other DFIs, the Company developed a specific study for the identification and assessment of potential impacts on water uses and establishment of a management/ compensation plan (including climate change analysis).²⁵
- 5.57. Additional field data collection of water users and uses was conducted, including a review of public record and field interviews. An inventory of water diversion infrastructure as well as recreational uses was prepared. The hydrologic models were also refined to assess the effects of climate change on future water availability, considering an average and critical scenarios. The studies concluded that the Projects effects on downstream water users would not be measurable and that third party water rights would not be affected by Project operation.

C.1.2 Initial Filling of Tunnels

- 5.58. The Project's Operating Plan concludes that the only alteration of the natural regime of Maipo River at the discharge point of Las Lajas station occurs with the first filling of the forebay of Las Lajas station, for which 300,000 m³ will be required. Since the Project has been licensed as a pure run-of-river scheme without any consumptive water rights, as specified in the EIA, the PHAM will purchase water from owners of consumptive water rights in order to fill the Las Lajas forebay), unless of course the filling is done during the high water flow season in which case the Maipo River's water volume would exceed the allocated water rights.
- 5.59. A specific study²⁶ prepared by the Company describes how initial forebay and tunnel filling for the Las Lajas and Alfalfal II stations will occur. The process is planned to start during high streamflow season (wet) to avoid affecting third party water rights. The Company based its rights for forebay and tunnel filling processes on Chilean legislation (Art. 23 DGA No. 1800), which does not require consumptive water rights for reservoir filling. The Company will begin operating the Las Lajas station followed by Alfalfal II station six months later. The study describes times, volumes, and operating flow rates projected to maintain unaltered natural streamflow of the Maipo River at the downstream point. The result of this process is the normal operation of both power plants, with both forebays at their normal operating level. The Operating Plan prepared by the Company concludes that the only alteration of the natural regime of Maipo River at the discharge point of Las Lajas station will occur with the first filling of the forebay of Las Lajas station, for which 300,000 m³ will be required. However,

²⁵ Tema 1: Identificación y evaluación de impactos potenciales sobre usos y usuarios del agua)(Arcadis, 31 May 2013).

²⁶AES Gener. PHAM Minute: Tunnel Filling for Alfalfal II and Las Lajas Plants (*PHAM Minuta: Puesta en agua de las centrales Alfalfal II y Las Lajas*), dated July 2012.

Chilean legislation establishes that consumptive water rights are not required for filling reservoirs.

- 5.60. Nevertheless, the Company has stated that to prevent the event that the initial filling of the Las Lajas forebay represents an infringement of downstream water rights, the Company plans to obtain, via lease or purchase, the corresponding temporary consumptive water rights. Since the Project has been licensed as a pure run-of-river scheme without any consumptive water rights, as specified in the EIA, the PHAM will purchase water from owners of consumptive water rights in order to fill the Las Lajas forebay, unless of course the filling is done during the high water flow season in which case the Maipo River's water volume would exceed the allocated water rights.

C.1.3 Operation in the Event of Sudden Shut Down or Blackout Event

- 5.61. This type of events would potentially discontinue the flow of water out of the point of restitution, redirecting the water that would be entering the intake points into their natural river courses. The main concern expressed by some stakeholders is that the shut-down could result in a delay in discharge on the Maipo River downstream of Las Lajas by a total of about 7 hours (assuming an extended blackout), during which time stream flows may be insufficient to meet required water flow for all existing water right holders downstream from the project. Unexpected drops in water levels could also cause physical damage to intake structures for irrigation and potable water systems downstream.
- 5.62. It should be pointed out, however, that the probability of a blackout event is considered low. There have been 7 blackout events in the SIC in the last 14 years, and with an average duration of less than 2 hours per event, not enough to create the conditions required for water levels to experience significant changes downstream of the point of restitution.
- 5.63. Nevertheless, the Company has incorporated blackout events mitigation measures through alternatives in the equipment design and operational procedures, as follows:
- i. *Project design modification:* The Company modified the design of the Project to incorporate water deflectors in the turbine water injectors of Las Lajas power station. When activated, these devices will deflect the water from the injectors according to the magnitude of the flow-through, so that water flow does not reach the turbines, allowing water to continue to flow through the PHAM water conveyance systems even while the power plants are shut down.
 - ii. *Operational procedures for sequential up and down ramping of the system:* The Project operational sequence in the event of a shut-down or blackout event foresees the use of the Las Lajas discharge tunnel as a compensation system. Discharge from the Las Lajas powerhouse will be conveyed via a 13.5 km-long, approx. 6.9 meters in diameter tailrace tunnel that has a structure with two sector gates to permit flow regulation in the discharge tunnel, using the tailrace tunnel's capacity to compensate the retentions made upstream.
 - iii. The combination of the two measures above will ensure continuity of flow in the Maipo River and avoidance or minimization of surge waves (*golpes de agua*) downstream from the discharge point.
- 5.64. Overall, based on the documentation reviewed, the probability of a blackout event is low and the effects on downstream users are mitigated with the proposed design, measures and

operational procedures in place. The modeling results conducted by the Company and the opposing stakeholders differ only by a few (14) minutes, which is not considered a significant difference.

- 5.65. The stakeholders suggested extra mitigation measures that include the construction of flow regulation tanks/reservoir at all intake structures and the installation of continuous electronic flow devices in the Las Lajas forebay and in the restitution tunnel (between Las Lajas power plant and the PHAM discharge point). In response of the stakeholders' review, the Company has already considered some of these suggestions and planned to implement them as mitigation measures, such as installing continuous electronic flow devices with registered data to be available on real time at DGA's website.
- 5.66. One of the main stakeholder concerns is where restoring water volumes will be pumped from without affecting other existing water rights. The stakeholders mention that the Company needs to present a Contingency Plan to explain how restoration volumes will be obtained without affecting third parties when blackout events occur (during and after).
- 5.67. Therefore, to better address this issue on a timely basis, i.e., well ahead of the operation phase, it is recommended that the Company complement or develop the following additional plans:
- i. Include the operation scenario in the event of a blackout event, with specific steps to be taken, including a communication and warning system for communities downstream as part of its comprehensive Emergency Response Plan.
 - ii. In addition, gaps with regards to the risk and impacts on community health and safety from surge waves (*golpes de agua*) should be addressed in a Compensation Plan, in the event of affecting infrastructure, and a comprehensive Emergency Response Plan, in coordination with stakeholders.

C.2 Impacts on sediment transport and loads, particularly downstream of the discharge

- 5.68. The reduced flow during operation of the Project could potentially impact the river system's capacity to transport sediments downstream. This impact could exacerbate the effects of the existing sand and gravel exploitation activities (exercised by construction workers or *areneros*, some of them illegally) downstream of the Las Lajas discharge that are currently eroding the riverbed, and could in turn affect the stabilization and/or functionality of infrastructure associated with the river through failing of road and railroad bridge structures over the Maipo River; irrigation infrastructure (i.e., intake structure and canals); and community-based potable water intake structures. In addition, it could directly impact the ecosystem services provided by the river for sand and gravel extraction activities.
- 5.69. In response to these impacts, the Company sponsored a Sedimentology Study, conducted by the Department of Civil Engineering at the University of Chile in March 2007 ("*Estudio Sedimentológico en el Río Maipo.*" *Grupo de Investigación en Procesos de Transporte y Flujos Ambientales, Departamento de Ingeniería Civil.*) The study concluded that the operation of the PHAM could reduce sediment load downstream of the project by as much as 22% (approximately three million tons of sand each year). The Company suggests that because the study was a high-level evaluation and did not incorporate detailed project design, the actual reduction in sediment load is likely to be much lower than the estimates in the original study.
- 5.70. The RCA that approved the Project states that "*Both the decrease in the expected average contribution of sediments to the Maipo River from its tributaries and the abrupt increase of*

*the flow downstream of El Colorado could cause a sediment imbalance and therefore the degradation of the bed in that area of the Maipo River*²⁷. The RCA further required the Company, among others, to (i) develop an Advanced Sediment Study of the Maipo River, as a complementary technical study, to identify the potential effects, measures and mitigation works that could be required to counteract those unforeseen effects; and (ii) prepare and implement a monitoring program to assist in the identification of the potential unforeseen impacts, as well as define and implement potential mitigation and/or compensation and follow-up measures and works deemed necessary for the project to anticipate and/or resolve potential unforeseen environmental impacts.

- 5.71. The Advanced Sediment Transport Study comprises a six-stage sediment transport study, which includes increased areal coverage and additional sampling of sediments; it also includes updated structural, flow, and operational details of the PHAM. The six phases involve the following activities:
 - i. *Phase 1: Compilation and Analysis of Background Information and Cadaster.*
 - ii. *Phase 2: Complementary Fieldwork and Basic Studies.*
 - iii. *Phase 3: Analysis of Phenomenon and Effects of Degradations Downstream of the Intakes in Tributaries.* This phase will include impact assessments downstream of intakes located at the Colorado River, Yeso River, Colina Stream, La Engorda Stream, Las Placas Stream and El Morado Stream that may occur due to flow reductions. These assessments will be based on simulating different river/stream hydraulic-mechanical and sediment transport patterns.
 - iv. *Phase 4: Analysis of Phenomenon and Effects of Degradation Downstream and Local Erosion of the Discharge Structure on the Maipo River-Las Lajas Area.* In this phase, impacts downstream of the PHAM discharge will be evaluated including an analysis of hydraulic-mechanical and sediment transport patterns of the Maipo River and degradation/scouring impacts.
 - v. *Phase 5: Proposal for Mitigation Measures and Monitoring Plan.*
 - vi. *Phase 6: Final Report.* This phase will include a final report prepared by a consulting firm to the Company.
- 5.72. The first two phases (Phase 1 and 2) of the Advanced Sediment Transport Study are complete. Phases 3-6 are still underway as of July 2013.
- 5.73. In addition, in response to an IDB and other DFIs request the Company developed specific studies for the Identification and Assessment of Potential Impacts on Riverbed Sediments and Establishment of a Management/Compensation Plan.²⁸. The documents provide an identification and description of the structures in the river and a more detailed schedule for the ongoing Advanced Sediment Transport Study.

²⁷ COREMA. Environmental Permit RCA No256/2009. Section 8.11.

²⁸ *Topic 2: Identification and Evaluation of Potential Impacts in Sediments- Preliminary Report* (Arcadis, January 2013) and *Resumen* (AES Gener, June 2013).

- 5.74. The inventory includes the location, existing conditions, photos, google-earth images, diagrams, owners and users of the structures. The list of inventoried structures includes bridges, intakes, discharges and areas for aggregate extraction (*areneros*). The reports provide a summary of the river sediment material extraction (“*areneros*”) issue at the PHAM discharge point (restitution) and downstream of that location. The Company highlights two (2) of the seventeen (17) inventoried intake structures located downstream of the PHAM discharge point: (i) “*Bocatoma Independiente*”, owned by Aguas Andinas and (ii) “*Bocatoma del Canal de Riego San Carlos*”, owned by *Sociedad de Canalistas del Maipo*. The Company states that these two intake structures, located approximately 5 km downstream of the PHAM restitution point, pump approximately 78.5% of the Maipo River flow, and are therefore responsible for disturbing the river’s natural conditions downstream from that point; this assessment justifies why the effects of PHAM can only be assessed upstream of these points.
- 5.75. Furthermore, the reports use the existing Alfafal I Plant as an example to show that the operation of Alfafal I has not produced impacts in structures or streamflows for the last 20 years. The PHAM operation will be similar to Alfafal I, retaining and releasing the sediment, which is in itself, an operational mitigation measure that will minimize the impacts on sediment transport/ scour and therefore not expected to cause significant impacts. However, no further detailed information has been presented regarding the assessment of impacts to sediment/scour. It is expected that the final Advanced Sediment Transport Study will provide a clear understanding of the nature and magnitude (significance) of the Project’s impacts on sediment transport/scour in the study area.
- 5.76. In summary, the documents available to date provide an identification and description of the structures in the river, a more detailed schedule for the ongoing Advanced Sediment Transport Study, and a commitment to establishing a plan for management, mitigation and compensation measures. However, besides the impact assessment presented in the EIA, which estimated up to 22% reduction in sediment transport capacity, based on a qualitative analysis, no further detailed information has been presented regarding the assessment of impacts to sediment/scour or the corresponding management, mitigation, and compensation plans. This information is expected to be developed within and, immediately after, some of the phases of the Advanced Sediment Study underway and, therefore, is pending review until these phases of the Study are complete.
- 5.77. Therefore, to better address this issue on a timely basis, i.e., well ahead of the operation phase, the Company will develop the following additional mitigation measures:
- i. Present a general statement on the mitigation/compensation strategy that the Company intends to pursue in the event that significant impacts are identified in association with the Project and related to sediment load and transport.
 - ii. Use the results of the impact assessment within the Advanced Sediment Transport Study to design and implement a comprehensive plan that includes impact mitigation strategies to address all key adverse impacts and risks, as well as management, monitoring and compensation measures.
 - iii. Demonstrate a commitment and capacity to implement the mitigation strategy and the Management, Mitigation, and/or Compensation Plan.

- iv. Disclose the Advanced Sediment Transport Study, particularly the impact assessment and mitigation, management and compensation measures to the potentially affected stakeholders for proper consultation and feedback in a timely manner.
- v. The Management, Mitigation, and/or Compensation Plan should be presented to Lenders and for their comments and approval.
- vi. Develop and implement an Ecosystem Services Management Program to address the cumulative impacts on ecosystem services arising from impacts on sediment transport in the Project area and up to 5 km downstream of the discharge at Las Lajas.

C.3 Identification and assessment of potential conversion or degradation of aquatic habitats and establishment of an ecological flow management strategy.

5.78. Although the Project is designed to operate in a run-of-river mode and provide the respective ecological flows, the Project will result in flow reductions in the deviated reaches, downstream of the respective intake structures. Therefore, a first Ecological Flow Study of PHAM was developed during the year 2008 and as a result specific flows were recommended at each intake location, which were determined to be sufficient to sustain the aquatic habitats directly impacted by the Project. These ecological flows were approved by the Environmental Authorities in the RCA issued in 2009. Nevertheless, the National Water Authority is the DGA and through the application of the DGA method (i.e., 10% of the mean annual flow), higher ecological flow requirements were imposed on the Project, thus requiring even more conservative measures for aquatic habitats and anthropogenic activities in rivers. As indicated in **Table 5.1** below, based on the DGA ecological flow requirements, all the values were higher than those recommended in the Study, except for one which was the same value at Colina Stream.

Table 5.1 Summary of Ecological Flow Approvals

Stream/ River	RCA N°256/09 Ecological Flow (m3/s)	DGA RMS N° 102, 103, 104, 105, 111, 112/ 2010 Ecological Flow (m3/s)	Minimum Mean Monthly Flow (m3/s)	Mean Annual Flow (m3/s)	Occurrence of fish species *
La Engorda Stream	0.15	0.20	0.32	0.99	No
El Morado Stream	0.17	0.24	0.56	1.71	No
Las Placas Stream	0.10	0.14	0.13	0.47	No
Colina Stream	0.37	0.37	0.89	3.24	No
Yeso River	0.46	0.82	0.74	7.91	<i>Salmo trutta</i>
Colorado River	0.66	2.51	1.49	16.05	<i>T. areolatus + Oncorhynchus mykiss</i>)
Central El Volcan	0.30	N/A	1.59	N/A	No

Sources: RCA N256 from March 2009 and DGA approvals, January 2010.

* *Oncorhynchus mykiss* = rainbow trout; *Salmo trutta* = brown trout; *Trichomycterus Areolatus*= small catfish.

5.79. The EIA and RCA state that the Project will maintain ecological flows “which meet the actual requirements of the aquatic system.” The RCA also includes specific requirements for adaptive management and revisions to the proposed ecological flows if deemed necessary in the future,

based on monitoring information obtained. Effectively, the RCA requires on-going monitoring and real-time disclosure of flow data to continuously confirm that ecological flows are sufficient to meet environmental and socio-economic water uses throughout the life of the Project. In the event that water flow is not sufficient to maintain the approved ecological flow, the RCA requires mitigation, remediation and/or compensation measures to be implemented as established by an integrated ecological flow management plan. Therefore, an Integrated Management Plan for Small Catfish (*Trichomycterus Areolatus*) Populations and an Adaptive Management Plan for Ecological Flow are included in the Ecological Flow Study.

- 5.80. Nevertheless, in response to requests from IDB and other DFIs, to bring the Project's environmental impact assessments in line with the Bank's E&S Policies and Guidelines, as well as with international best practice, the Company performed additional ecological flow analyses.²⁹ These additional analyses included: (i) additional hydrology, topobathymetry, hydrobiology and limnology field data collection; (ii) re-analysis of the hydrologic models; and (iii) technical review by expert consultants. Results show that the proposed ecological flow would not significantly convert or degrade the aquatic habitat.
- 5.81. The updated information was assessed in the context of three areas: (i) accuracy and validity of hydraulic and hydrologic models using HEC-RAS; (ii) impacts on hydrobiology and biodiversity based on the application of the IFIM/PHABSIM models and habitat suitability curves and (iii) impacts on recreational users of the waterways affected by the project. The accuracy of the hydrologic and hydraulic models were deemed acceptable to meet best practice and the hydrobiology data confirmed the hypothesis based on available literature in terms of habitat requirements for the fish species (with particular focus on the endemic Small Catfish - *Trichomycterus Areolatus* - and macro-invertebrates), basically concluding that the depth and velocity requirements of the fish would not be threatened by the Project operation and the proposed ecological flows.
- 5.82. In addition to the required ecological flows, the Company developed and is beginning to implement an Integrated Ecological Flow Management Plan for the Small catfish (*Trichomycterus areolatus*) consisting of an in-depth study of the distribution, abundance and habitat characteristics of the species (including details of habitat preference). The Company is further incorporating protected species Torrent duck (*Merganatta armata*), and the amphibian "Sapo Arriero" (*Alsodes nodosus*) into the on-going habitat surveys. This management plan incorporates monitoring and mitigation measures following a mitigation hierarchy to protect biodiversity and includes an adaptive management of Project operations in the event that it is determined that the Project causes significant impacts to the aquatic habitats.
- 5.83. Going forward, as a complement to the Ecological Flow Management Plan, the PHAM will continue to gather baseline information on fish species, macro invertebrates, and other non-fish species as well as hydrological information with monitoring and sampling campaigns, to be performed during construction and operation, which will provide detailed information on the pattern of habitat use of small catfish in the specific Maipo basin area and help better understand the distribution and abundance of the species in the Project area, as well as the habitat preferences locally. In addition, the plan was expanded to include unaffected tributaries to understand the species distribution in the basin.

²⁹ Informe Tecnico-Caudal Ecologico del Proyecto Hidroelectrico Alto Maipo) Centro de Ecologia Aplicada (CEA), Agosto 2013.

- 5.84. The PHAM will further complement the Ecological Flow Management Plan with specific mitigation measures for habitat conservation, compensation, and adaptive management measures, if applicable. In addition to the adaptive management requirements set forth in the RCA, mitigation measures for the protection of the Small Catfish shall consider, among other mitigation measures, adjustment of flows and biodiversity offsets, in case these are deemed necessary, in order to maintain or improve their population in rivers affected by the Project.
- 5.85. Based on the studies conducted from 2008 through 2013, the ecological flow was determined taking into consideration the hydrological, ecological and anthropic conditions of the river, including the low flow season (i.e., minimum monthly flow with 85% probability of exceedance) at each intake location and at the areas of environmental importance. Moreover, based on the more stringent DGA requirements, the actual required ecological flows that the Project will release are higher (and only in one case equal) than the ecological flows determined by the modeling efforts. Therefore, the release of ecological flows is considered to be sufficient and adequate to maintain the ecological and hydrologic conditions in the river system.
- 5.86. Regarding possible effects of reduced flow on the Maipo River and its potential indirect impacts on the Cascada de las Animas Nature Sanctuary (Critical Natural Habitat) during operations, the October 2012 supplemental (protected areas) study³⁰ concluded that the expected decrease in minimum monthly flow of the Maipo River abutting the Nature Sanctuary area would fall within the range of natural variation of flow in the river. The study therefore concludes that the impacts of Project operation in the hydrology of the Maipo River are not expected to cause significant indirect impacts to the riparian habitat of the Nature Sanctuary.
- 5.87. As explained in the following **Section C.4** (Impacts on instream recreational uses of the rivers in the diverted reach), the recreational flow requirements still need to be researched based on surveys with recreational users (mainly rafting) to confirm the adequacy of the flow. If warranted, additional mitigation/compensation measures including, if necessary, additional releases during specific times will be considered by the Company within the scope of the adaptive management plan.
- 5.88. To expand the knowledge on this issue and be better prepared to address it during Project operation, the Company will develop the following additional actions or plans on a timely basis, i.e., well ahead of the operation phase:
- i. Initiate the hydrobiology monitoring described in the Integrated Management Plan for Small Catfish as soon as possible
 - ii. Use the monitoring data collected during construction to prepare site-specific habitat suitability curves for the Small Catfish (*Trichomycterus areolatus*).
 - iii. Refine the Adaptive Management Plan for Ecological Flow, described within the Integrated Management Plan for Small Catfish and including recreational uses, with more specific details regarding the schedule for implementation, roles and responsibilities, resources, specific on the monitoring programs and specific commitments to revise the flow needs and consider

³⁰ *Análisis Ambiental de los Efectos del PHAM Sobre las Áreas Protegidas Presentes en su Área de Influencia: Monumento Natural el Morado, Santuario de la Naturaleza San Francisco de Lagunillas y Quillayal, y Santuario de la Naturaleza Cascada de las Animas* (October 2012).

additional voluntary and/or Lenders' recommended mitigation/compensation measures including, if necessary, additional releases within the scope of the adaptive management plan .

C.4 Impacts on instream recreational uses of the rivers in the diverted reach

- 5.89. The original PHAM EIA social baseline did not identify water users involved in recreational uses (e.g., kayaking, rafting, public fishing and swimming areas.) as a potentially affected stakeholder group, although these users were considered in the ecological flow study performed in 2008 for the PHAM EIA. However, the Maipo River is used for recreational boating , mainly rafting.³¹
- 5.90. However, as a result of the additional impact assessment studies performed by the Company to respond to IDB and other DFIs request, the Company identified multiple water users within the diverted reach which do not require water rights, including tourism operators (kayaking and rafting) and public fishing areas. A total of 9 organized boating/rafting operators and 5 recreational use areas (including fishing areas) were identified. No individual or informal recreational uses were reported beyond the Maipo River (i.e. kayaking in the Colorado, Yeso and Volcán Rivers).
- 5.91. The Company conducted a preliminary consultation meeting with recreational water users on May 15th, 2013, which identified multiple concerns from that group of stakeholders. As an outcome of the meeting, the Company agreed to engage in a process of information gathering, a site visit to affected areas utilized by kayakers and rafters and follow-up meetings to address stakeholder concerns.
- 5.92. It should be noted that, based on the flow studies performed to date, the operation of the Project would maintain navigation flow levels but may reduce the “recreational experience” for rafters during a few critical months of the year. Commercial rafting Company revenue is based on the ability to sell customers a quality whitewater experience. Similarly, non-commercial kayakers and rafters select recreation opportunities based on the quality of the experience. Reducing instream flows below preferred levels to minimum transportation flows could affect the quality of the experience and potentially diminish visitation.
- 5.93. Furthermore, in the previous studies, the instream flow needs for recreation uses focused solely on a section of the Maipo River used for commercial rafting (between the confluence of Yeso and Maipo Rivers and the town of San Jose de Maipo) and overlooked other river segments that may support non-commercial recreation use. The Rivers of Chile website³² describes whitewater kayak runs for the Rio Colorado, Yeso, Volcán (upper and lower runs) and the Rio Maipo (upper and lower runs), but gives no indication of the use levels. These uses will be further investigated.
- 5.94. Therefore, to better address this issue on a timely basis, i.e., well ahead of the operation phase, the Company will develop the following additional studies or mitigation measures:
- i. Consult with recreational users to quantify the extent and level of recreational use in these rivers based on the quality of the recreation experience, as opposed to minimum

³¹ According to the overall *Plan de Desarrollo Comunal de San José de Maipo* (2010) the most popular recreational activities in San Jose de Maipo are hiking (46%), rafting (33%), horseback riding and tours (18%), fishing (2%) and kayaking (1%).

³² (<http://riversofchile.com/category/santiago-metropolitan-region>)

flows for navigational purposes. Instream flow preferences should be developed through a combination of structured interviews with river users, electronic and intercept surveys, and direct observations. The study can be performed during the construction period prior to flow diversion and adaptively managed post-construction to monitor recreation use patterns and effectiveness of flows to meet recreation needs.

- ii. Identify the range of optimum flows for respective watercraft that will allow identifying the annual number of days recreation opportunities are available hydrologically with Project operation. If warranted, the Company should consider mitigation measures that would allow for an appropriate level and number of recreational activities, including, if necessary, additional voluntary and/or Lenders' recommended flow releases. These measures should be considered within an Adaptive Management Plan.

C.5 Potential to exacerbate localized climate change impacts

5.95. A key stakeholder concern, identified at the beginning of the ESDD, was centered on the potential of the Project to exacerbate climate change impacts. Stakeholders raised concerns about whether the PHAM adequately accounted for the potential effects of climate change as described in two stakeholder specific documents.³³ The primary stakeholder concerns with respect to climate change issues were the following:

- i. An alleged existing deficit in water flow required to maintain all water rights in the Alto Maipo River, based on DGA water rights data;
- ii. The potential reduction in water flow as a result of climate change (in general) leading to a further deficit in water flow; and
- iii. The Project's potential to exacerbate localized climate change (e.g., changes to the microclimate), caused by decreased water flows, leading to the "desertification" within the diverted reach.

5.96. In response to a request from IDB and the other DFIs, the Company developed a specific study to evaluate the effects of climate change on streamflows and identification and assessment of potential impacts on water uses. Additional field data collection of water users and uses was conducted, including a review of public record and field interviews. An inventory of water diversion infrastructure as well as recreational uses was prepared. The hydrologic models were also refined to assess the effects of climate change on future water availability, considering an average and critical scenarios.

5.97. Based on the most recent Final Report³⁴ submitted in May 2013, the Company has adequately assessed the potential effects of climate change on streamflow of the Maipo and Colorado systems and, resulting implications for the Project's design and environmental impacts.

³³ (1) An April 2012 document presented by the *Coordinadora Ciudadana Ríos del Maipo*, and

(2) A more detailed supporting study specifically on climate change implications for the Maipo river watershed and water rights regime, commissioned by the organization *Chile Sustentable* ("*Gestión de Cuencas y Cambio Climático: El Caso del Maipo*" by Rodrigo García Palmo (16 April 2012).

³⁴ UNTEC, 2013. *Cambio climático y su impacto en la disponibilidad de recursos hídricos del proyecto Alto Maipo. Informe Final*. MG Medioambiente & Gestión S.A. Fundación para la transferencia tecnológica (UNTEC)

Furthermore, the studies concluded that the Project's effects on downstream water users would not be measurable and that third party water rights would not be affected by Project operation.

- 5.98. Effectively, results from the Final Report show a reduction of average annual streamflow at the seven gauge stations of 9% and 3.4% for the Alto Maipo System for the 2040-2070 timeframe as a result of climate change. In the case of the 2011-2040 timeframe, the Final Report states a decrease of 8.5% and 5.9% for the Alto Maipo system compared to the simulated observed streamflow calculated for the baseline. The report also states that the Colorado system is more vulnerable to global warming than the Maipo system. However, when shrinking glaciers (approximately 1% per year) are considered, these negative percentages of streamflow are lower than without shrinking glaciers because runoff will be increased, particularly during the winter months.
- 5.99. In addition, to better address this issue on a timely basis, i.e., well ahead of the operation phase, the Company will develop the following additional mitigation actions or measures:
- i. Actively participate in and sponsor vulnerability and adaptation climate change studies and groups like the “*Vulnerabilidad y Adaptación Cuenca del Rio Maipo en Chile Central*” project described in the “*Tema 1: Identificación y evaluación de impactos potenciales sobre usos y usuarios del agua*” report.
 - ii. Design and apply the monitoring plan that the Company promotes in the “*Tema 1: Identificación y evaluación de impactos potenciales sobre usos y usuarios del agua*” report to establish a mitigation and compensation plan.
 - iii. Present the findings of all of the above to stakeholders and directly respond to their concerns about the implications of climate change for the Maipo river watershed, future water availability, commitment to maintaining ecological flow in the event of over-scarcity to meet human consumption allocations, and Project environmental impacts at local and regional levels.

C.6 Impacts on water supply of Santiago Metropolitan Region

- 5.100. As mentioned before, stakeholder demonstrate great concern in terms of possible contamination of water sources that can potentially affect the water quality of the water supply system of Santiago, operated by Aguas Andinas, given the Project's location 5 km upstream from the intake for the potable water system. However, the principal factor for potential water quality alteration during operation of the Project will be associated with a change in sediment load.
- 5.101. As discussed in **Section C.2** (Impacts on sediment transport and loads, particularly downstream of the discharge), the operation of the Project is expected to reduce the sediment load in the Maipo River downstream from the discharge point; if confirmed to be significant, this reduction can contribute to an improvement in water quality for potable water uses, by lowering the turbidity and aiding the treatment process at the treatment plant, but the magnitude is uncertain. It is expected that the final Advanced Sediment Transport Study will provide a clear understanding of the nature and magnitude (significance) of the Project's impacts on sediment transport and water quality in the study area.
- 5.102. Therefore, to better address this issue on a timely basis i.e., well ahead of the operation phase, besides the mitigation measures already mentioned in **Section C.2** (Impacts on sediment

transport and loads, particularly downstream of the discharge), the Company will develop the following additional mitigation actions or measures:

- i. Integrate Participatory Monitoring Program in the Water Quality Monitoring Plan for the operation phase.

D. Potential Negative E&S Cumulative Impacts

- 5.103. The PHAM EIA (2008) considered the existing operations as part of the environmental and social baseline in the Project area of influence (e.g., Los Maitenes and Alfalfal I plants operated by AES Gener). However, the EIA did not assess the potential cumulative impacts of the Project with existing and with future planned projects in the area of influence.
- 5.104. Therefore, to bring the Project's environmental impact assessments in line with IDB's and the other DFIs' E&S Policies and Guidelines, as well as with international best practice, at the request of the DFIs the Company prepared a Cumulative Impact Assessment (CIA) of the PHAM, with the information available to date. This study will be updated for any future expansions of PHAM when more detailed information becomes available.³⁵
- 5.105. The CIA report follows a methodology that is internationally accepted and, most importantly, includes an analysis –qualitative and quantitative– of the cumulative impacts, taking into consideration issues raised by stakeholders as well as the recommendations in preliminary ESDD reports. The CIA is comprehensive and describes the process and assumptions used in the analysis.
- 5.106. The Cumulative Impact Assessment (CIA) prepared during the ESDD, includes the entire diverted reach of the hydrologic system, from the intakes on the Volcan, Yeso and Colorado basins to the Project discharge on the Maipo River and up to 5 km downstream, as well as areas of cumulative impacts (i.e., roads, transmission line, etc.). The CIA also depicts specific maps for each Valued Ecosystem Component (VEC).
- 5.107. Furthermore, the CIA identifies existing activities that could accumulate impacts with the Project as well as expected future activities that could happen within the same general timeframe as the Project. These projects were grouped into four categories: (i) hydropower projects; (ii) potable water projects; (iii) mining exploration projects , and (iv) transmission lines, separate from those of the PHAM.³⁶ The effects that these activities (plus climate change) might have on surface hydrology, sediment dynamics, landscape, and the socio-economic and cultural conditions of local communities were identified and assessed.
- 5.108. The following seven key cumulative effects were identified: (i) impacts on water uses for human consumption, irrigation and recreation; (ii) sand and gravel extraction from the Maipo River; (iii) erosion processes; (iv) tourism; (v) traffic safety; (vi) basic services; and (vii) cultural changes.

³⁵ *Proyecto Hidroeléctrico Alto Maipo, Evaluación de Efectos Acumulativos* (Cumulative Impact Assessment - CIA), prepared by DAES Consultores with participation and review of MSc Juan David Quinteros, dated June 14, 2013.

³⁶ Examples of existing activities include: AES Gener's Cordillera Complex; Guayacan Hydro Plant; Aguas Andinas' El Yeso Reservoir; non-mineral mining activities; existing transmission lines. Examples of know project: Maitenes-Alfalfal and Alfalfal II transmission lines and substations; El Yeso Reservoir-Laguna Negra Aqueduct Interconnection; G-25 roadway improvements. Reasonably expected projects included: Los Piches and El Condor mining Exploration Projects; El Canel Hydro Project; arid extraction projects in el Volcan-San Jose del Maipo.

- 5.109. The report provides also a list of stakeholders groups affected by cumulative impacts, including:
- i. Communities in the area of influence (the localities of El Canelo, El Manzano, Los Maitenes, El Alfalfal, San Gabriel, El Romeral, El Volcán, Baños Morales and Lo Valdés, as well as the cattle drivers and herders and other users of the summer highland pastures);
 - ii. Rafters and kayakers in the Maipo River;
 - iii. Trekking groups;
 - iv. Restaurants and lodging enterprises, including campgrounds;
 - v. Sport fishing activities;
 - vi. Sand and gravel extraction workers along the Maipo river (*areneros*);
 - vii. Irrigators and their associate groups (irrigation committees and surveillance committees, etc.).
- 5.110. This list of stakeholders also includes the companies operating in the area, such as AES Gener S.A. and Coyanco S.A.; however, only the *areneros* and irrigation committees are considered vulnerable due to their dependence on natural resources that could be affected by the Project.
- 5.111. A brief review of the potential impacts the cumulative effect of the PHAM project on the reduction of surface water flow will not be significant and will not have an effect on the provision of potable water, the flow of water to water rights holders, or to recreational users. Climate change will reduce river flows, however, over the 2011-2070 in amounts varying from 3-9% according to the CIA Study and an updated UNTEC Climate change Study (May 2013). The level of impact on sediment transport and on water infrastructure could not be definitively established in the CIA, however, and must await the results of the Advanced Sediment Transport Study that is now underway as a result of the ESDD process.
- 5.112. The CIA takes a positive view of the potential for social impacts. It concludes that the Project will not generate significant effects on tourism because of increased traffic or the visual impact of project facilities (90% of which will be constructed underground), and that the addition of other projects to the area will have a negligible effect. The CIA also supported the conclusion of the EIA's traffic flow and safety study that the Project impact on traffic would be of minor negative significance and easily managed with known traffic management techniques. The CIA does recommend careful monitoring of the traffic situation during construction and operation. Finally, CIA study, as well as the EIA conclude that the increased work force brought about by the PHAM, and other projects that might coincide with its construction such as the Yeso-Laguna Negra Aqueduct and the Maitenes-Alfalfal transmission lines will disturb the local community or place a burden on the provision of social services. Any potentially disruptive effects of worker in-migration must be adequately managed by worker camp management procedures, codes of conduct, and human resources policies.
- 5.113. The assessment determined that the incremental impacts of PHAM on the Valued Ecosystem Components (VEC) were not significant. Furthermore, the CIA confirms the appropriateness of

many of the existing and proposed mitigation, management, monitoring and compensation measures already included in the PHAM as part of the EIA approval process, including specific measures and monitoring commitments including a description of how PHAM will minimize cumulative impacts and contribute, at a regional level, to improve certain conditions (e.g., capacity building for local employment). It further explains the adaptive management approach by which the Company will monitor on an ongoing basis potential cumulative impacts and implement additional prevention and mitigation measures as applicable.

- 5.114. The ESDD findings point out, however, that neither the EIA nor the CIA provide any quantifiable data to support the conclusion that Project Induced In-migration will not constitute a risk. The arrival of from 1500-2000 new workers, assuming that some 500 will be hired locally, may very well induce family members and other job seekers to move to San Juan de Maipo. This in turn will have an effect on the local housing market, the price of basic goods, and the demand for social services. More detailed baseline information is needed to monitor these potential effects, and the PHAM should consider conducting a Project Induced In-migration Study to determine their potential scale. Such a study would include the potential effects of the drop off in the work force once operations begin.
- 5.115. The CIA has some areas for improvement with regard to environmental as well as social issues. These include:
 - i. Detailed assessment of the effects of future project expansions (i.e., 2.5 m³/s from Laguna Negra and Laguna Lo Encañado; 2.75 m³/s (from total 4.5 m³/s) from Volcan River) as well as the 'known' and 'reasonably expected' future projects described in the CIA. The assessment should be conducted particularly on the hydrology, downstream water users (i.e., irrigation and recreational); sediment transport and scouring and riverine infrastructure, with the conceptual information available and update the assessment when more detailed information becomes available. However, because of their relatively small magnitude, these expansions are not expected to produce measurable or significant impacts on the river hydrology, hydrobiology or sediment dynamics;
 - ii. Develop and implement an Ecosystem Services Management Program to address the cumulative impacts in the direct and indirect area of influence on surface hydrology, water users (recreational and irrigation); sediment dynamics and scouring and riverine infrastructure, in coordination with other organizations operating in the Project area;
 - iii. The consultation and disclosure activities should be complemented with the Participatory Monitoring Program, specifically on those impacts that have a cumulative nature and that will require joint regional approaches with key stakeholders.

E. Other Potential Relevant E&S Risks Associated with the Project

- 5.116. The Bank's assessment performed during the ESDD identified the following risk factors as potentially relevant:
 - i. *Reputational Risk* - The Project has been subject to continuous, organized and strong opposition from environmental NGO's and civil society organizations, some of which have taken legal action against the Project. Therefore, any institution involved in financing the Project will potentially be a target and exposed to the opposition's arguments and actions. As mentioned in **Section III B.4 (Stakeholder Engagement)**,

to help address this type of risk the Bank recommended that the Company strengthen its capacity and systems to manage stakeholder engagement activities.

Association with the Mining Industry: Antofagasta Minerales acquisition of a minority stake in Alto Maipo SpA could negatively affect the reputation of the Alto Maipo Project and those involved in its financing. Antofagasta Minerales SA entered into a binding agreement with AES Gener to acquire 40% of Alto Maipo SpA. As part of this transaction, Antofagasta Minerals signed one 20-year power purchase agreement (PPA) with the PHAM that will secure the provision of up to 110 MW of energy for the Los Pelambres mining project, which is 60%-owned by Antofagasta Minerals.

The Pelambres mine, which began production in 2000, has been subjected to public scrutiny due to the construction and operation of the El Mauro tailings dam, located close to the Pelambres mine. The tailings dam was completed and began operation in 2008, but has been the subject of multiple lawsuits related to alleged and potential water contamination and risk of dam collapse. One of these claims, originally denied by lower courts was appealed to the Chilean Supreme Court, which granted an injunction filed by the community of Caimanes, located immediately downstream of the tailings dam. The injunction does not affect project operation, but requires Antofagasta Minerales to evaluate the seismic risk associated with the El Mauro tailings dam implement a corresponding safety plan, and requests that Onemi, the National Office of Emergency, should investigate evacuation plans for Caimanes.

- ii. *Company Capacity to Properly Manage E&S Aspects* – As mentioned before (see **Section III B.4 – Stakeholder Engagement**), At the beginning of the ESDD, IDB, in conjunction with the other DFIs, recommended that the Company strengthen its capacity to manage E&S aspects related to the Project. Moving forward to the construction phase, there will be a series of different contractors and subcontractors working simultaneously in different fronts, sometimes under not so favorable conditions (e.g., high altitude, steep slopes, cold weather, deep underground), and the potential for accidents and unexpected incidents is accrued. The Company will have to be well prepared to manage E&S and health and safety matters under routine activities, as well as in face of unexpected events. Supervision by the Bank will be key to monitor adequate and effective compliance with E&S requirements and provisions during Project implementation.
- iii. *Vulnerability to Natural Disasters* - The following natural risks have been identified as of relevance to the Project: avalanches; landslides; rockfalls; debris flow; flooding; and earthquakes. These risks are discussed in the Disaster Risk Management Policy (OP-704) evaluation of compliance section (see **Section III.C. Compliance with Applicable IDB Directives and Policies**). The Company has introduced in the design and implementation of the Project measures to address those types of risks.

F. Potential Positive E&S Impacts Associated with the Project

- 5.117. *Generation of Renewable Energy:* The Project represents the largest utility-scale run-of-river hydroelectric development project in Chile which has obtained environmental permitting. The Project is expected to provide clean renewable energy generation for the Chilean National Grid -in the region with the highest demand (Santiago Metropolitan Area) - and displace energy generated by the burning of fossil fuels. An estimate indicates that its operation can avert around 1 million ton of CO₂e per year nationally, due to displacement of fossil fuel based

power generation from non-renewable grid suppliers. The Project sought in the past carbon credits through the Clean Development Mechanism (CDM) of the United Nations Organization (Project Design Document dated Dec/19/2012); however, in view of market uncertainties, it has discontinued the registration process, but may attempt alternative registration in the future.

- 5.118. *Direct Employment Opportunities:* The PHAM construction phase will require an average of approximately 2,000 employees, reaching a peak of 2,500 employees in the third year of construction. An estimated 30 to 40 percent of employment opportunities will be for non-skilled laborers. All contractors will be required to fill 15 percent of job opportunities with local laborers; incentives will be applied for contractors employing up to 25 percent local laborers while contractors that do not meet the quota will be fined. Operation phase employment will consist of a maximum of 32 additional individuals to maintain and operate the electrical plants.
- 5.119. *Local Community Development (Social Collaboration Agreement):* As described in **Section III.B**, AES Gener has signed a Social Collaboration Agreement with the municipality of San José de Maipo and 16 of the 28 communities represented by the *Unión Comunal de Juntas de Vecinos* de San Jose de Maipo (March 2009). The Agreement, which was developed through a broad participatory process, is a legally binding commitment which has been incorporated into the Project's Environmental Authorization (RCA). The Agreement focuses on two major programs. The first is the local employment program designed to assure that 500 job opportunities are fulfilled by local workers. The program is designed to monitor and enforce contractor compliance, and enhance the disclosure and communication of employment opportunities and access to the application process. The second initiative establishes a Social Program Grant fund to support projects proposed by local stakeholders and approved by a nine member oversight board representing the community of San Jose de Maipo and Company representatives.
- 5.120. As currently agreed upon, the fund will consider projects in four priority areas: (i) education (35%); (ii) social development and infrastructure (30%); (iii) local development and job creation (15%) and (iv) sports and recreation. Funded at the rate of \$200,000 per year for a 30 year period the program, which will be administered by AES Gener's *Fundación AES Gener* has already supported a number of projects including educational scholarships and a yearly outdoor training program for guides under its Tourism Development activities. The Social Collaboration Agreement provides the framework for a broader set of public private partnerships which could engage other actors and sources of funding.
- 5.121. *Other Community Benefits:* Nevertheless, the Company should consider other community economic benefits beyond the Social Collaboration Agreement to account for the increase in the expected cost of the Project since 2008, the concerns regarding other members of the community that did not participate in the signing of the initial agreement, and in consideration of stakeholder concerns regarding equitable distribution of Project benefits.
- 5.122. *Investment and Tax Revenue:* The total estimated Project cost for the PHAM is USD \$2 billion. Companies resident or domiciled in Chile are subject to a 20% corporate tax. Foreign investors are liable for an additional tax on profit remittances. Municipal governments may also require municipal business licenses subject to a municipal tax/fee paid through the respective municipal license (*patente municipal*). The rate to be applied for the municipal license is calculated on the basis of net tax equity at rate established by the municipality, typically ranging between 0.25% and 0.5%. Municipal licenses are granted by the municipality where a

business is domiciled, which does not necessarily correspond to the municipality in which a project or company operates.

The Company is currently registered in the Municipality of Las Condes. As a result, the direct financial benefit to the Municipality of San Jose de Maipo from the construction and operation of the PHAM will be limited. According to the Mayor of San Jose de Maipo, if the Company were to register the PHAM project operator within the Municipality of San Jose de Maipo the applicable municipal license fee would be less than what the Company currently pays to the Municipality of Las Condes. Such a change would increase the budgeted income of the Municipality of San Jose de Maipo and would represent tangible local benefits associated with the construction and operation of the PHAM.

The Company informed that it is an AES Gener policy to register its projects in the municipality where they are located and that it intends to register with the Municipality of San Jose de Maipo once construction is initiated. While not required by Lenders' standards, it is recommended that the Company investigate the legal, financial, and local social benefit implications of registering in the Municipality of San Jose de Maipo rather than Las Condes. Share the findings of this investigation with local stakeholders and explore ways to ensure San Jose de Maipo is benefiting from the project (either via direct license fees or via other community investment activities).

- 5.123. *Contribution to Advancement of Knowledge on Species:* Through the development and implementation of the Integrated Management Plan for Small Catfish, the Project will contribute significantly to the advancement of knowledge of basic life history information of an important native species of fish, which is playing an increasing role in environmental monitoring programs focusing on detecting the responses of river fish communities to habitat changes resulting from hydroelectric power plants, and more recently also on impacts of industrial effluents.

G. IDB Additionality

- 5.124. Through the ESDD process, IDB and the other DFIs involved (IFC and OPIC) have contributed to enhance the Project/Company capacity to more effectively manage E&S aspects related to the Project in several important ways; some of which are outlined below:
- i. *Improved management of ecological flows:* the Ecological Flow Management Plan has strengthened the baseline information on fish species, macro invertebrates, and other non-fish species as well as hydrological information with monitoring and sampling campaigns, which provide detailed information on the pattern of habitat use of small catfish in the specific Maipo basin area.³⁷
 - ii. *Improved management of ecosystem services:* the Ecosystems Services Management Program will address identified cumulative impacts on ecosystem services in the project direct and indirect area of influence (diverted reach and up to 5 km downstream of the point of restitution).

³⁷ Gustavo Chiang, Kelly R. Munkittrick, M. Fernanda Saavedra, Felipe Tucca, Mark E. McMaster, Roberto Urrutia, Gerald Tetreault & Ricardo Barra (2011): Seasonal changes in reproductive endpoints in *Trichomycterus areolatus* (Siluriformes: Trichomycteridae) and *Percilia gillissi* (Perciformes, Perciliidae), and the consequences for environmental monitoring, *Studies on Neotropical Fauna and Environment*, 46:3, 185-196.
<http://dx.doi.org/10.1080/01650521.2011.598296>

- iii. *Improved Community Relations Capacity:* by working closely with AES Gener to develop and refine their Community Relations (CR) team and functions as an integral part of the overall project management system. This involved the development of an increasingly refined Stakeholder Engagement Plan, and Consultation and Disclosure Plan based on stakeholder mapping and participation. Building the capacity of the CR staff and assuring it adequate resources throughout construction and operations will be a high priority.
 - iv. *Improved Stakeholder Engagement:* working with the Project and stakeholders to develop detailed information on a series of concerns of high priority to local stakeholders the IDB and other DFIs helped the Project gather and analyze critical information that will set the basis for discussions and negotiations with key stakeholder groups about options for resolving these critical issues. Continuing to support the Project stakeholder management capacity will be a high priority for the IDB during its supervision of the project during construction, particularly, and later during operation.
- 5.125. Moving forward, the Bank will monitor the environmental, social, health and safety aspects in the Loan Agreement; this supervision by IDB will contribute to ensure that the Project/Company maintains adequate capacity to properly manage the E&S and H&S aspects related to the Project.

VI MANAGEMENT AND MONITORING OF ENVIRONMENTAL, SOCIAL, HEALTH AND SAFETY AND LABOR IMPACTS AND RISKS

A. General Programs and Plans in the EIA

- 6.1. As part of the EIA (2008), several environmental and social management plans were developed to address the impacts and risks identified. The plans were developed as terms of reference, including some level of detail with respect to the design and construction measures as well as, in some cases, additional detail on the control measures, guidance for the contents of the plans and applicable legislation. Technical environmental specifications were further developed as contractual requirements for the construction contractors to develop more detailed Environmental Management Plans. The management plans included in the EIA and Addenda are listed in **Table 6.1**.

Table 6.1: Environmental and Social Management Plans in the EIA

Environmental and Social Management Plans
Air Quality Monitoring Plan
Dust Suppressant Application Program
Emission Compensation Program
Environmental Management Plan for Waste Rock Disposal Sites
Reforestation Management Plan
Vegetation Restoration Plan
Waste Management Plan for Work Fronts and Camps
Access Roads Improvement Program
Contingency and Emergency Response Plans
General Operation and Closure Standards for Work Fronts and Camps
Fauna Rescue and Relocation Plan
Integrated Management Plan for Populations of Small Catfish in Alto Maipo

Environmental and Social Management Plans

Petroleum and Hazardous Substances Management Plan
Explosives Management Plan

- 6.2. *Emission Compensation Program:* As mentioned before, given the non-significant atmospheric emissions, no air quality monitoring was required for the Project (the Air Quality Monitoring Plan consists of weekly inspections of emission control measures during construction to ensure the implementation of dust abatement measures at each work front). However, an Emission Compensation Program is required. The Metropolitan Region of Santiago was declared as “Saturated Zone” for four air pollutants (particulate matter, total suspended particulates, carbon monoxide and ozone) and “Latent Zone” for nitrogen dioxide, on August 1, 1996, leading to the development of a Plan for the Prevention and Decontamination of Atmosphere (*Plan de Prevencion y Desccontaminacion Atmosférica - PPDA*)³⁸. As a result, an emissions compensation program (for particulate matter) was introduced to reduce emissions to air coming from industrial stationary sources. As San José de Maipo is part of the Metropolitan Region of Santiago, the Project is subject to this emission compensation program. For the Project, a compensation of 150% of emissions of particulate matter (PM10) is required per the RCA. Compensation measures include the improvement of 23 km of Route G-455, between Route G -25 and the Yeso Reservoir, and 23 km of Route G-25, between the Yeso Bridge and the Project work sites. The road improvements consist of rebuilding the roadbed (using a leveled granular pavement fill) and damping of the road with water and dust suppressant (magnesium chloride - bischofite).
- 6.3. *Environmental Management Plan for Waste Rock Disposal Sites:* This plan aims to provide background data on the location of 14 waste rock or excavation waste disposal sites; related activities of construction and operation; assessment and identification of impacts; control, mitigation and restoration measures; and the monitoring plan. Preferable disposal sites include environmentally degraded areas such as abandoned borrow pits or zones with large depressions; areas with low soil productivity and disruption of surface water streams have been avoided; and zones of low visual impacts. Additionally, sites are in areas that are not exposed to flooding or geomorphologic risks.
- 6.4. *Reforestation Management Plan:* This plan aims to compensate for the tree clearing that will be required in the areas where the Project will be built. The *Sclerophyllous* forest type and a *Eucalyptus globulus* plantation will be impacted by the Project. It is proposed that area should have a reforestation density of 1000 trees per hectare which is 60%t higher than the average current density. A total of 30,110 specimens of *Kagencekia angustifolia*, 5940 specimens of *Porlieria chilensis*, and 550 specimens of *Eriosyce (Neoporteria) curvispina* would be replanted.
- 6.5. *Vegetation Restoration Plan:* The plan aims to restore the 78 hectares of vegetation in all non-forested area to pre-existing conditions in order to control soil erosion and mitigate visual impacts and restore animal habitats. The restoration plan includes vegetation micro routing; nursery production of species for restoration; and vegetation of disposal sites, camps, embankments and tunnel access platforms. Re-vegetation plans stabilize slopes and embankments after construction and restores vegetation that existed before the Project.

³⁸ *Esfuerzos para controlar la contaminación del aire en Chile.* Pan American Health Organization (PAHO). January 2005. http://www.bvsde.paho.org/cursoa_orientacion/lecc3/lecc3_6.html

B. Description of Management Systems and Plans

- 6.6. *Construction phase* management plans were developed at a high level for the EIA. In addition, the Project adopted AES Gener's Integrated Environmental, Health, Safety and Quality (EHSQ) Policy, as well as several AES Corp policies covering ethics and compliance, community liaison and networks, and management of contractors and subcontractors. The Corporate policies and corresponding guidelines for project-level management systems are consistent with ISO 14001 and 9001 and OHSAS 18001 standards. The Company is currently in the process of developing the EHSQ Management System specific to the PHAM project, in line with these policies and guidelines. An environmental and social management system to supervise and monitor performance of contractors, subcontractors and Company staff will be in place prior to commencement of construction activities.
- 6.7. The Preliminary Works Environmental Management Plans developed by CONPAX (preliminary works contractor) were reviewed and considered adequate for the corresponding stage of the Project. Contractor's ESHS and Labor requirements were included in the main contracts and Contractor's are required to develop the detailed EHS Management Plans and adhere to the Company's policy and management system. The following management plans will be prepared/ updated by the Company:
- i. Develop and implement an Owner's EHS Management Plan, approved by the Lenders;
 - ii. More detailed EHS Management Plans need to be developed by the Contractors and submitted to the Lenders for review;
 - iii. Develop and implement a detailed OHS Manual and Program, specifically identifying and addressing the risks of tunnel construction and the specific natural risks in the Project area;
 - iv. Develop and implement an Integrated Wastewater Management Plan to manage stormwater runoff, tunnel production water and waste rock drainage, including appropriate infrastructure for water treatment and discharge; and
 - v. More detailed Vegetation Monitoring Program and the Restoration Plan for *Vegas*, including the participation of experienced professionals in the restoration design and implementation and an action plan in case of no success of restoration be developed.
- 6.8. AES Gener has an Integrated Environmental, Health and Safety and Quality (ESHQ) System which cover all its operations. The EHSQ System is being adapted to the specific requirements of the PHAM according to requirements of the RCA and the EIA. The PHAM has a dedicated Construction Management Team supported by external consultants for environmental supervision, Owners engineering and Technical Inspection. During 2012 and 2013, as a result of the ESDD process and requests from IDB and other DFIs, the Company added an Environmental Manager and Community Relations Manager to the Construction management organization. Both of these new managers report to the Project Director.
- 6.9. The current environmental and social management functions fit within the overall Construction Management organization. The Environmental Manager is supported by 3 Environmental Engineers dedicated to the implementation of the EHSQ Management System and to overseeing compliance with RCA conditions for the development of the Project. During the

preliminary work stage involving the construction of access roads , electric infrastructure etc., the environmental Engineers were supported by an external consultant with some 20 environmental supervisors overseeing the implementation of environmental plans and procedures on the part of contractors and sub-contractors.

Social Management System.

- 6.10. The Community Relations Manager is supported by a team of seven professionals covering community relations, communications, and community projects. In addition, Contract Monitoring personnel are assigned to ensure compliance with ESHQ requirements. The Project maintains a community relations office staffed by an assistant in San Jose de Maipo.
- 6.11. AES Gener also provides support to the team from its Chile headquarters. AES will further define the organizational structure for the management of EHSQ issues during the project's operational phase. It is expected that the organizational structure will include a dedicated ESHQ Manager supported by the required environmental, social and OHS staff.
- 6.12. Given the diversity of stakeholders potentially effected the Project, the existing stakeholder opposition movement, and the dynamic nature of the community engagement process, it will be especially important that the Community Relations team is adequately staffed and budgeted for both the construction and operations period and that there is clear internal company alignment regarding objectives and requirements of the stakeholder engagement strategy that the PHAM is pursuing.
- 6.13. The Project has developed a number of plans to address critical social issues. These include the Stakeholder Engagement Plan, a Grievance Mechanism, Community Health Safety and Security, Occupational Health and Safety, and Emergency Preparedness and Response.
- 6.14. Stakeholder Engagement Plan: Completed in August 2012 and recently updated, the Stakeholder Engagement Strategy has the following main objectives: 1) create and maintain positive relations with all key directors of the Project's environmental and social performance; and 2) contribute to local development initiatives according to the needs and interests of the Project and local communities. The plan lays out a number of activities to these ends: publication of a monthly newsletter; maintenance of a project website with up-to-date information on status, activities, monitoring results, grievances etc.; annual sustainability report; activities of the Social Collaboration Agreement and the Participatory Monitoring Program, which will be discussed in the Monitoring and supervision section of this ESMR.. Recently, the plan was updated to include an extensive program for discussion and disclosure of the key issues papers which address water rights, water use, ecological flow, sedimentation and climate change. This process envisions holding broad community meetings about project information and activities, as well as thematic workshops to address specific issues with interested stakeholders. It is expected that these activities and communications programs will become regular, routine activities throughout the life of the Project.
- 6.15. Grievance Mechanism: A formal Grievance Mechanism was established as part of the project in August 2012 as part of the Stakeholder Engagement Plan. Designed to meet international performance standards, the mechanisms consists of five steps which will be managed by the Community Relations office: 1) receipt and registration of the grievance; 2) grievance verification; 3) establishment of the proposed resolution strategy; 4) implementation of the proposed resolution; 5) monitoring and documentation. Contractors also will be required to establish and manage a grievance process, as part of their obligations under Community

Relations Regulations for Contractors dated 14 December 2010. The Project holds final responsibility for the grievance process and will periodically audit the performance of contractors' grievance mechanisms.

- 6.16. Social Collaboration Agreement: As noted, a Social Collaboration Agreement signed by AES Gener, the municipality of San José de Maipo and 16 of the 28 members of the *Unión Comunal de Juntas de Vecinos of San José de Maipo* is a key mechanism for meeting the local labor goals of the project as well as supporting locally agreed upon educational and enterprise development projects in the area of influence. AES Gener will provide the equivalent to US\$200 thousand a year for 30 years to the community development fund created by the Agreement. While the Agreement is aimed at local development rather than the mitigation of specific project impacts, it establishes a potentially fruitful mechanism for building community confidence and expanding cooperation in the future.
- 6.17. Emergency Preparedness and Response : The Project has developed emergency preparedness and response plans (EPRP) for the construction and operational phases of the project based on the initial identification of potential hazard and risks in the Project's EIA and plans currently adopted by AES GENER's Cordillera Complex. The EPRPs, which are mainly applicable to the construction phase of the Project, cover events such as avalanches, lahars, landslides and rock falls, flooding, earthquakes, explosions, drainage from waste rock, traffic accidents, hazardous substance spills, damages to cultural sites, work site fires, groundwater damage, and falls from heights. Some of these are covered in the annex to the EIA entitled Contingencies and Risk Prevention Manual. Separate from these plans, the Project has developed a plan to respond to electricity grid "blackouts", relatively rare events involving potential interruptions, reductions or surges in the flow of water downstream of the project which are of special concern to some stakeholders. In the future, the Project will integrate and harmonize the existing EPRPs plans into a comprehensive EPRP document (PHAM Prevention and Contingency the roles of the Project, local authorities, and potentially affected communities in emergency situations.
- 6.18. Labor and Occupational Health and Safety: The combination of Chilean national labor legislation and AES Gener labor and occupational health and safety requirements obligate the Project to provide for the protection of the lives and health of workers, maintain safe and healthy conditions, and provide the necessary tools to prevent occupational accidents and diseases. Chilean legislation also protects the rights of migratory workers and their families by regulating sub-contractor and temporary worker contracts. AES maintains policies governing company labor relations, including selection, hiring and relocation of personnel, business ethics and compliance, health and safety requirements, codes of conducts and requirements for compliance with national laws. AES Gener follows parent company policies for Environment, Security and Occupational Health and Safety. In addition, during construction of the Project, all contractors will be required to develop and apply their OHS policies. The principal contractors Strabag and Hochtief have globally recognized health and safety policies and procedures. The PHAM now requires that all legal contracts with contractors cover among other things: leanders ESHS requirements; compliance with local laws and Lender requirements regarding labor and working conditions; requirements for Community Relations Management Plans; requirements for Community Health and Safety Management Plans; adequate organizational and staff capacity to meet ESHS requirements; Worker camp Management Plan requirements; and obligations to respond to Owner's audits, including stop work orders to address imminent risks. PHAM will ensure adequate monitoring of the implementation of these obligations.

- 6.19. Community Health Safety and Security : The Project is designed to minimize potential impacts to community health , safety and security. The Project does not entail construction of dams or storage facilities or physical infrastructure that would pose a risk to communities in the are of influence. Construction activities will adhere to international best practice and construction camps have been established with residential facilities in order to minimize the need for daily transport of workers from local towns. The Project will implement a Traffic Safety signaling Program on routes G-25 and G-455 and the risk of transporting explosives will be addressed in a required Explosives management Plan.
- 6.20. The Project has not developed a Project Induced In-Migration Plan (PIIM) to address the potential attraction the construction of the project may have to workers families, outside job seekers, and the impacts of the interactions of the projected work force on the existing communities in the area of influence. While the EIA did not consider the potential of induced in-migration to be significant no evidence was shown to support this conclusion. It would be advisable to prepare a preliminary plan to address the issue and begin to gather the baseline data that will allow for monitoring potential impacts.

C. Monitoring and Supervision

- 6.21. The Bank will monitor the environmental, social, health and safety aspects in the Loan Agreement via internal Bank supervision actions (e.g., site visits, review of documentation). Particularly, IDB will supervise the Project/Company compliance with the requirements established in the Environmental, Health and Safety Action Plan (EHSAP). In addition, the following monitoring plans will be developed and implemented by the Company.

C.1 Environmental

- 6.22. *Ecological Flow Management Plan*: the Ecological Flow Management Plan will be complemented with specific mitigation measures for habitat conservation, compensation, and adaptive management measures. In addition to the adaptive management requirements set forth in the Environmental Authorization, the mitigation measures for the protection of the Small Catfish may include adjustment of flows and development of biodiversity offsets, in case these are deemed necessary, in order to maintain or improve their population in rivers affected by the project.
- 6.23. *Ecosystem Services Management Program*: the program includes the following main elements: (i) plans for outreach and engagement with relevant stakeholders to discuss joint regional approaches for the management of identified impacts on hydrology and sediment transport from the Participatory Monitoring Program (see below), including impacts potentially associated with climate change (including continuation of AES's participation and sponsorship of the study "*Vulnerabilidad y Adaptación a la Variabilidad y al Cambio Climático en la cuenca del río Maipo en Chile Central*"; (ii) operational change management procedures to address those aspects that the company is able to influence independently or in collaboration with other stakeholders; (iii) compensation plans with clear commitments to address impacts to key stakeholders; and (iv) specific commitments to complete the Advanced Sediment Transport Study and to develop and implement specific management, mitigation, and compensation measures to address impacts from the Project in collaboration with affected stakeholders.

C.2 Social

- 6.24. The Social Management System includes three formal monitoring programs addressing the social performance of the Project. These are: 1) a social indicators monitoring program required

by the RCA approving the EIA for the Project; 2) a recreational water-users monitoring program; and 3) the Participatory Monitoring Program included in the Social Collaboration Agreement. In addition, it should be noted that the Project's design and use of its internal management system will enhance its capacity to monitor its performance.

- 6.25. The *social indicators monitoring program* required by Chilean Supreme decree 95 (Article 8) covers a series of prescribed geographical, demographic, socio economic, anthropological and basic welfare dimensions. The monitoring covers qualitative and quantitative analysis of the indicators set forth below(VI,C- Indicators) . Qualitative data is developed through semi-structure interviews with some 30 key stakeholders; quantitative data is derived from household surveys in the area of influence (415 houses), and secondary data from government agencies and civil society organization is included in the monitoring study. The social indicators monitoring program is conducted each semester in the communities of 11 communities in the area of influence.³⁹ Three monitoring exercises have been conducted beginning in August 2012, November 2012 and March 2013.
- 6.26. The *recreational water users monitoring program*: After the first two social monitoring campaigns, the Company identified the need to conduct additional monitoring related to recreational water uses in the Project area of influence. The Company agreed, in consultation with representatives of the local rafting providers, to establish twice-monthly monitoring of recreational uses of the Alto Maipo River to be potentially affected by the Project. The monitoring proposed to record the number of rafts/kayaks and number of boaters using the river over a 12 hour period every two weeks during peak use, as well as interviews with recreational users. Although there has been an informational meeting with recreational users, no monitoring data has been developed. It is important that the Project engage recreational water users in the context of the discussion and disclosure of additional environmental impact documentation regarding recreational flow requirements and establish a collaborative water management agreement to address their concerns.
- 6.27. The *Participatory Monitoring Program* is being developed. The program will be conducted by a Monitoring Committee consisting of the Project's Community Relations Director, the Project's Environmental Manager, three community representatives, and one representative from the *Unión Comunal de Juntas de Vecinos*, the local school system, and the Municipality of San José de Maipo, respectively. The intent is to conduct a monitoring inspection every four months throughout the project cycle aligned with the RCA requirements and to carry out a yearly survey to verify that the monitoring panel and other participants are satisfied with the monitoring activities. The Participatory monitoring Program has not yet begun.
- 6.28. The social monitoring programs are aligned with the requirements of Chilean law. However, they offer an opportunity for collaborative design of a set of indicators that address other stakeholder concerns (sediment transport, ecological flow, irrigation uses, etc.), as well as opening up a space for other stakeholders to actively engage in monitoring the potential impacts of the project on the area of influence. Needless to say, these opportunities for constructive engagement will help create confidence in the Project.
- 6.29. Along with these external monitoring activities, the Project should establish an internal information management system that will allow it to identify key occurrences and trends that

³⁹ El canelo, El Manzano, El alfalfal, Los Maitenes, San Gabriel, Romeral, El Volcán, Baños Morales, Sector Camino Rio Yeso, Lo Valdés, and San José de Maipo

may require management responses. Routine reporting on the Grievance Mechanism, the results of community meetings, continuous stakeholder communications, etc., should be made a routine part of risk assessment and strategy adjustment at regular management meetings.

VII REQUIREMENTS TO BE INCLUDED IN THE LOAN AGREEMENT

- 7.1 IDB will require as part of the Loan Agreement that the Company and all portions of the Project shall, at all times during the life of the Loan Agreement, comply with each of the following:
1. All applicable environmental, health and safety Chilean regulatory requirements and all applicable IDB's environmental and social policy and requirements.
 2. All requirements associated with any environmental, health and safety related permits, authorizations, or licenses that apply to the Project or the Company.
 3. All environmental, health and safety requirements of the Project contracts, and any subsequent modifications.
 4. All aspects and components of all of the Project environmental, health and safety documents.
 5. Applicable aspects of the International Finance Corporation Performance Standards on Environmental and Social Sustainability and Environmental Guidelines for Occupational Health and Safety.
 6. Consult with IDB before approving or implementing any and all substantive changes to the Project or its timetable that could potentially have negative environmental, social, or health and safety effects.
 7. Send written notice to IDB of any and all non-compliances with any environmental, social or health and safety requirement of the Loan Agreement and any significant environmental, social, or health and safety accident, impact, event, claim or material complaint.
 8. Ensure that all companies contracted for construction and operation activities comply with the applicable environmental, social and health and safety requirements of the Loan Agreement.
 9. Implement ongoing information disclosure and consultation activities related to environmental, social, and health and safety aspects of the Project, including, if applicable, information from environmental and social, health and safety monitoring reports prepared by external consultants, in compliance to Bank's OP-102 Access to Information Policy.
 10. Implement and/or maintain Environmental and Social, and Health and Safety Management Systems that are consistent with the principles of ISO 14001 and OHSAS 18001.
- 7.2 Prior to Financial Closure the Company shall submit an Environmental and Social, Health and Safety Action Plan (ESHSAP), in form and substance satisfactory to IDB, properly addressing the environmental, social, health and safety improvement recommendations, as well as any

relevant pending non-compliance and/or liability associated with the Project or the Company. A suggested Draft ESHSAP is presented in **Annex 1**.

- 7.3 Prior to each disbursement, the Company shall certify compliance with all environmental social, and health and safety requirements in the Loan Agreement, in particular with the following conditions:
1. The Bank has received, in form and substance satisfactory to IDB, the applicable documents, reports, or plans required by the ESHSAP that are applicable up to the date of the relevant Disbursement.
 2. IDB has received certifications from the Borrower and the Environmental and Social Consultant, as needed, confirming environment and social compliance with the Environmental and Social Requirements and Provisions in the Loan Agreement, including those in the ESHSAP.
 3. Any additional requirement which may arise from the IDB Environmental & Social Due Diligence and internal reviews.
- 7.4 During the life of the Loan Agreement, the Company shall present, in form and substance satisfactory to IDB, the applicable documents, reports and plans indicated in the EHSAP, and prepare and submit Environmental and Social Compliance Reports (ESCR), in form, substance and frequency satisfactory to IDB.
- 7.5 The Bank will monitor the environmental, social, health and safety aspects in the Loan Agreement via internal Bank supervision actions (e.g., site visits, review of documentation) and will contract an external independent Environmental and Social Consultant to perform more detailed supervision/monitoring actions during the life of the Loan Agreement. In addition, the Bank will have the right, as part of the Loan Agreement, to contract for the performance of independent environmental, health, and safety audits, if needed.

FIGURE 1: LOCATION AND MAIN COMPONENTS OF ALTO MAIPO PROJECT

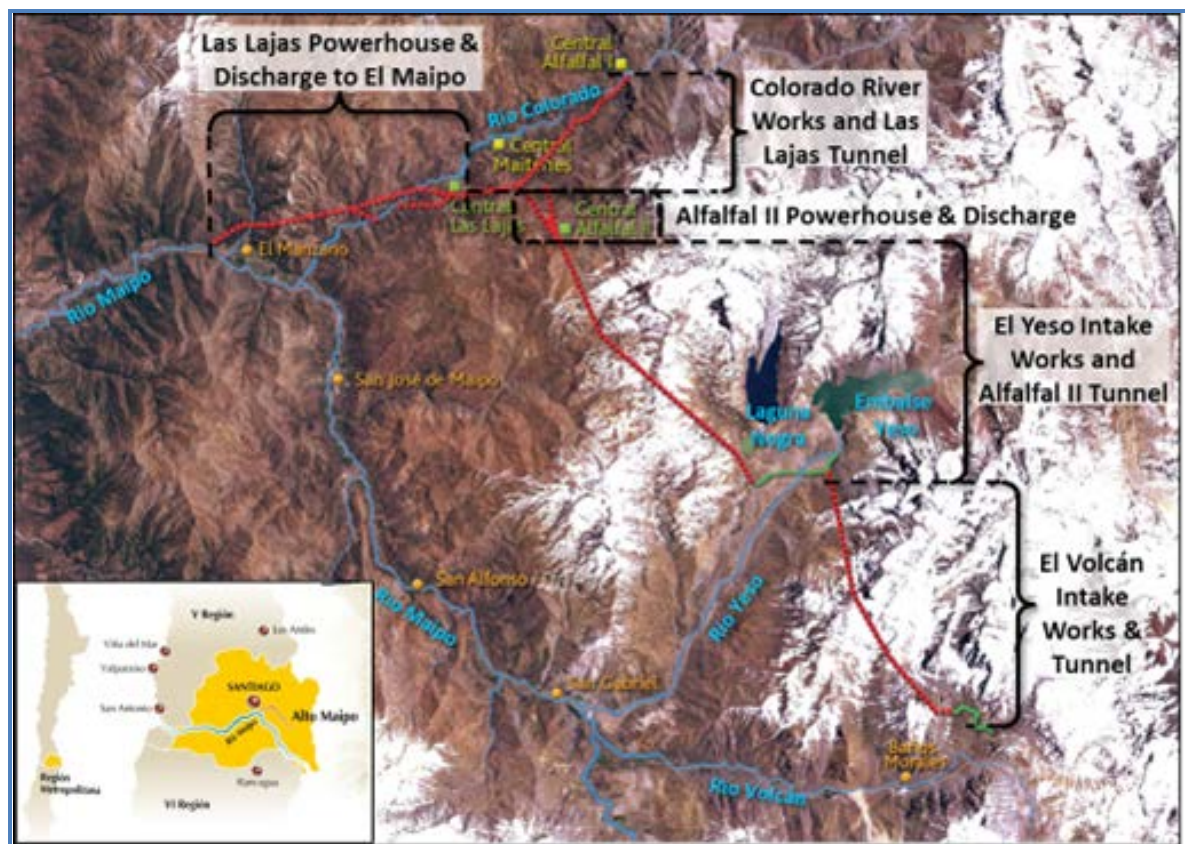
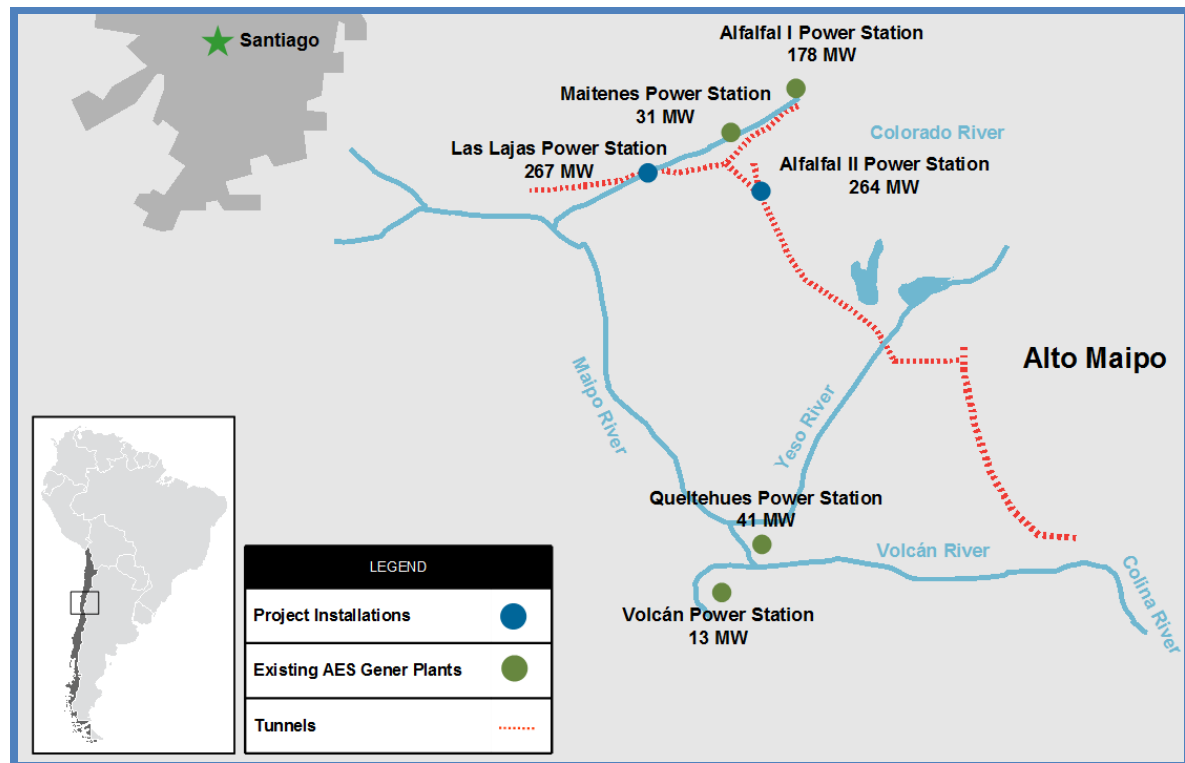


FIGURE 2: LOCATION OF TUNNELS

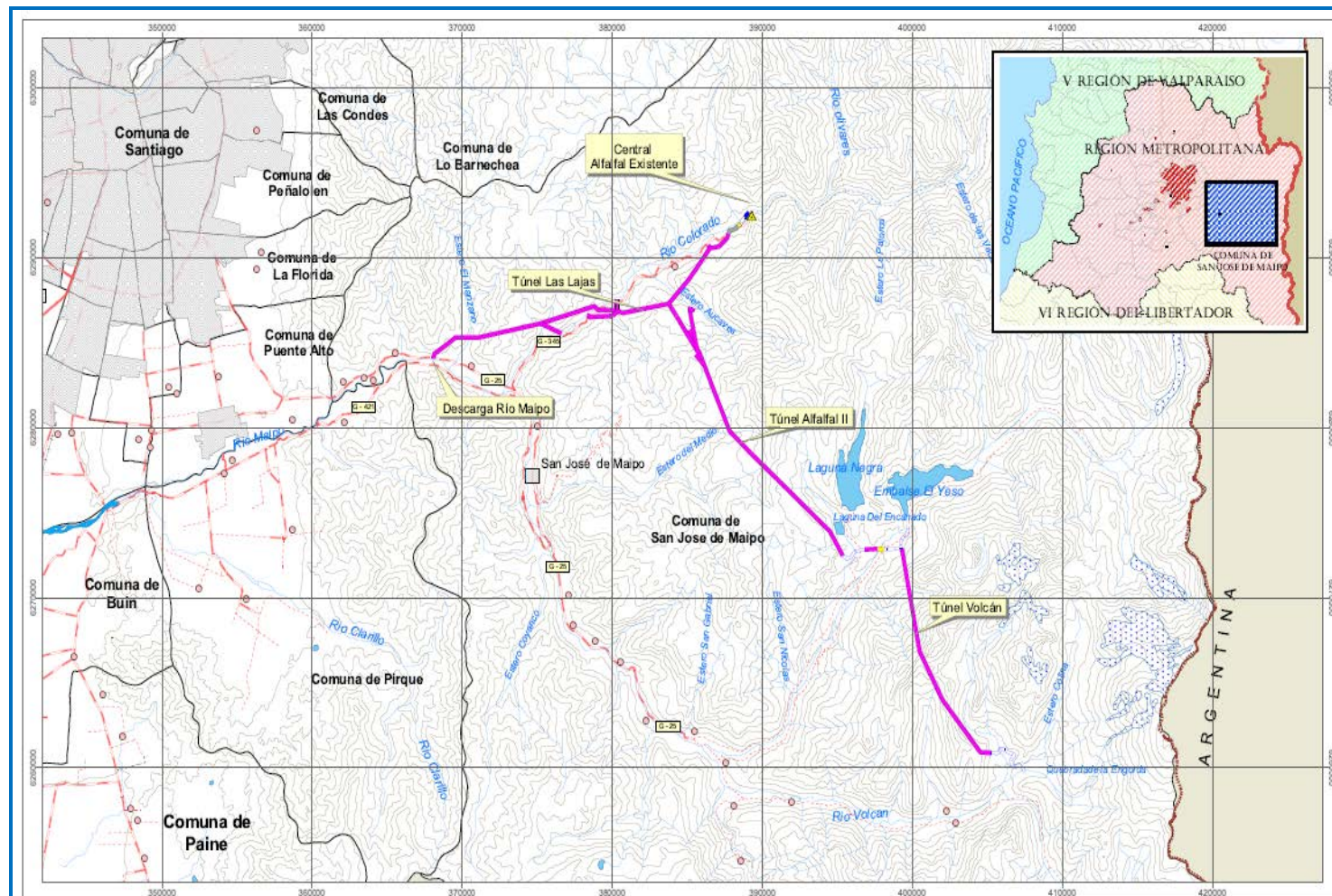


FIGURE 3: LOCATION OF TRANSMISSION LINES

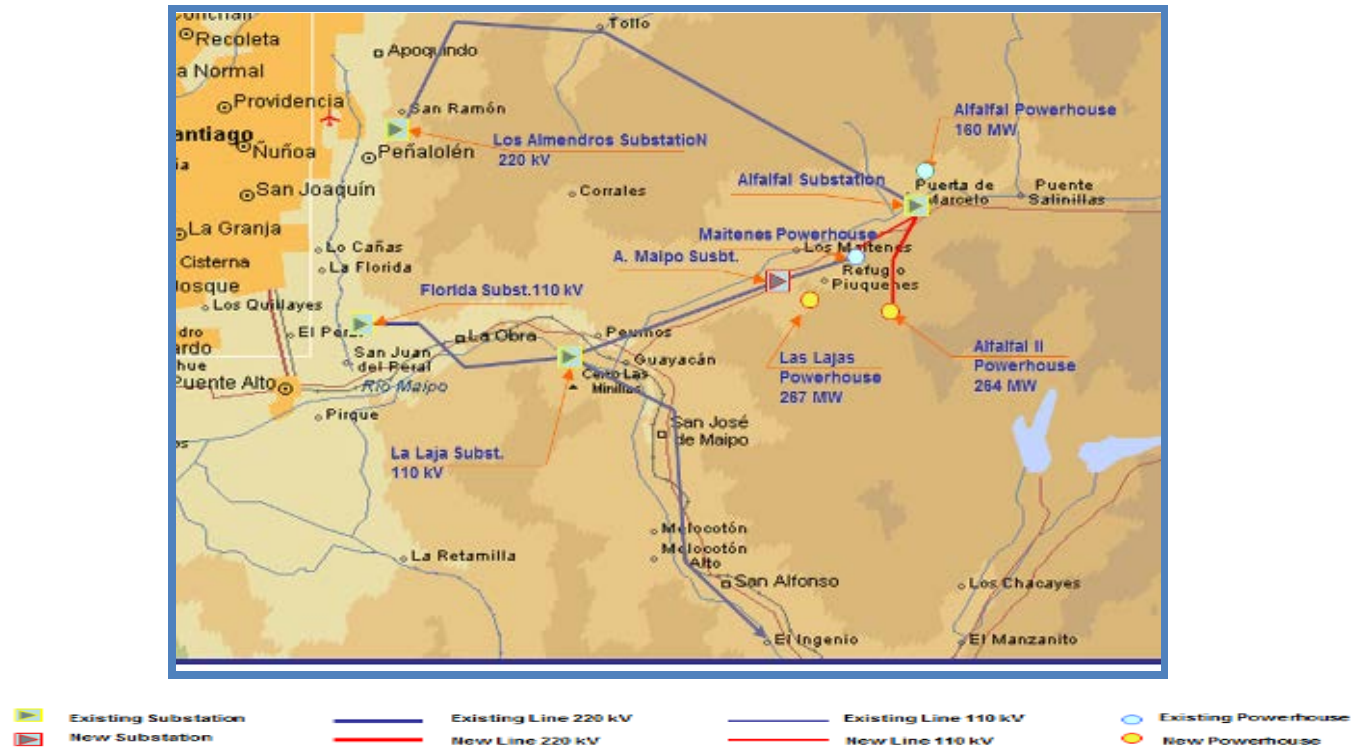


FIGURE 4 : LOCATION OF WORKER CAMPS



FIGURE 5: PROTECTED AREAS LOCATED IN THE PROJECT AREA OF INFLUENCE

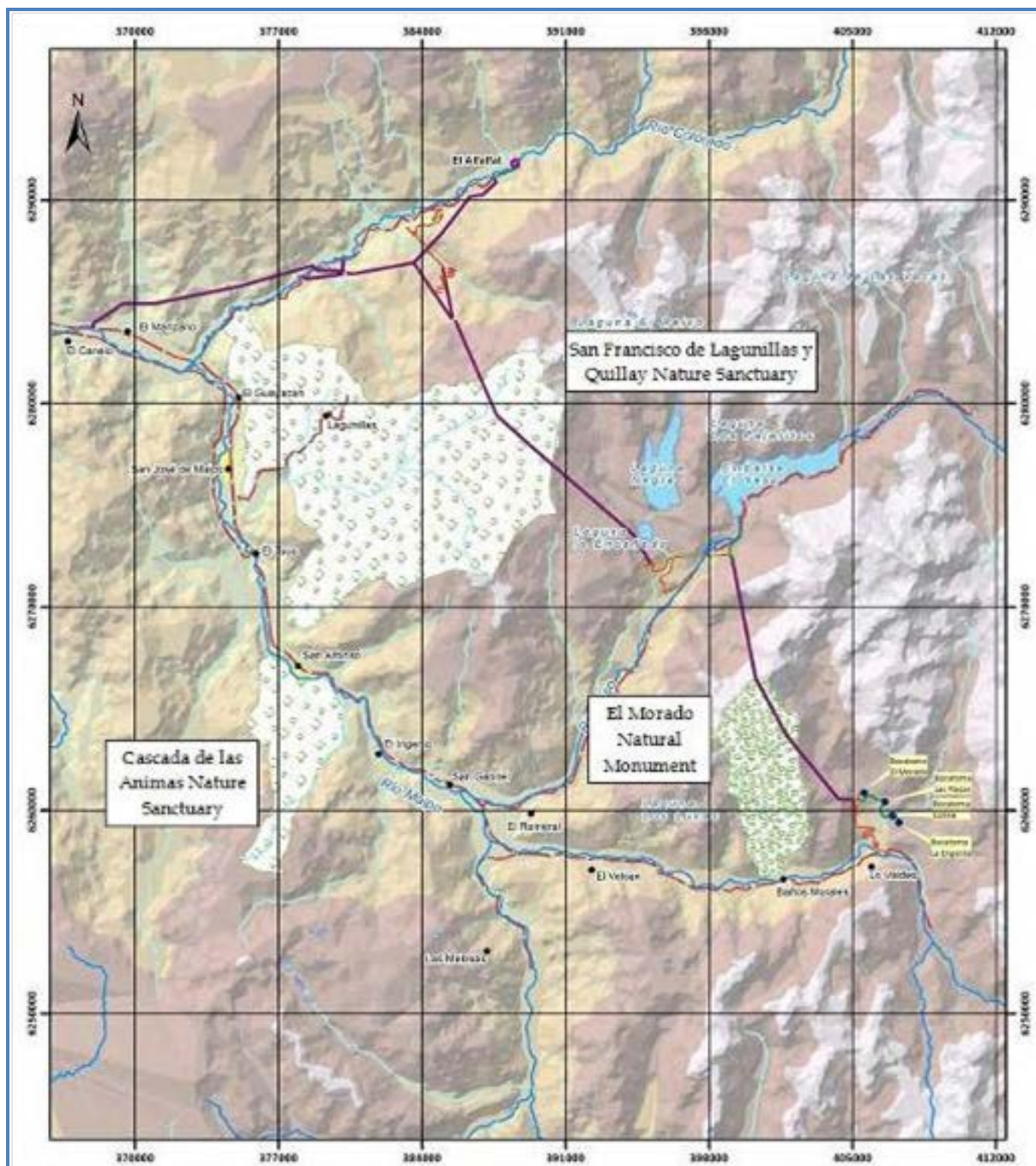
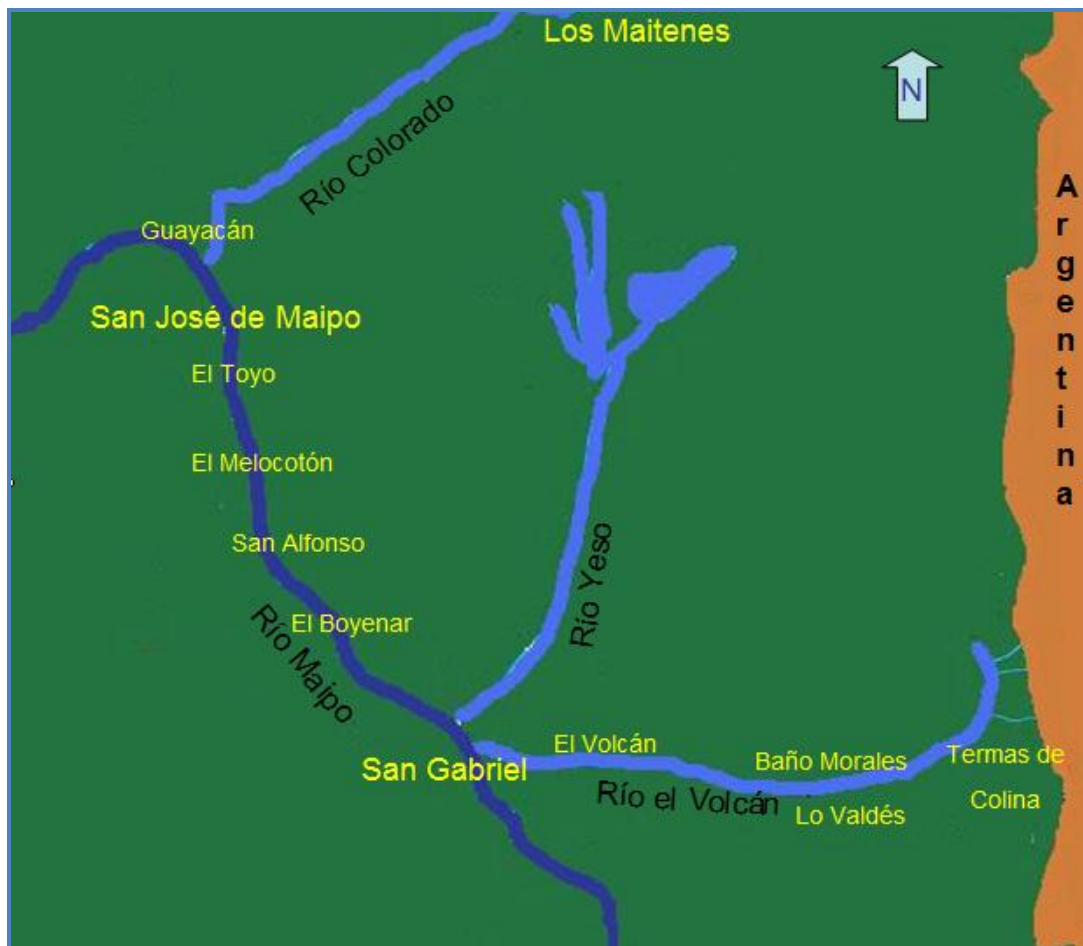


FIGURE 6: MAIN VILLAGES LOCATED IN THE AREA



ANNEX 1: ALTO MAIPO DRAFT ENVIRONMENTAL AND SOCIAL, HEALTH AND SAFETY ACTION PLAN (ESHSAP)⁴⁰

Ref #	Issue	Action	Deliverable	Deadline
1.	Permitting	Establish and maintain a registry of required permits and monitor its compliance, to ensure that the Contractors and the Company obtain the necessary permits prior to initiating activities.	Registry of required permits established and maintained.	December 31, 2013.
2.	Cumulative Impact Assessment	<p>Perform a detailed assessment of the cumulative effects of future project expansions and PHAM as more detailed information is generated (i.e., hydrology, downstream water users, sediment transport and riverine infrastructure).</p> <p>Implement specific measures to distinguish Project construction vehicles from other projects and ensure a transparent grievance mechanism. Develop and implement an Ecosystem Services Management Program to address the cumulative effects (see detailed recommendations under Ecosystem Services).</p> <p>Implement the consultation and disclosure activities planned, including the disclosure of the CIA and summary document prepared for disclosure.</p>	<p>Assessment of potential cumulative impacts from future project expansions</p> <p>Evidence of measures to distinguish Project traffic from other traffic sources and development of grievance mechanism</p> <p>Evidence of consultation and disclosure activities</p>	<p>Prior to Project expansions or changes in project design (when enough information is known to conduct the assessment), as required by local laws.</p> <p>March 31, 2014.</p> <p>September 16, 2013.</p>
3.	ESHS Management System	Complete and implement the Project-level ESHS management system. The management system shall include all the mitigation measures, management plans and programs, and monitoring plans developed for the Project and ensure adequate implementation and record keeping, as well as a review and continuous improvement process. The management system shall embed the Lenders' requirements and ensure that relevant information and reports are provided to Lenders in a timely manner.	Evidence that the ESHS Management System has been developed and implemented and that the Lender's requirements are embedded in the system.	<p>Document Framework December 31, 2013.</p> <p>Document Management Procedure March 31, 2014.</p>
4.	Owner's Management Plan	Develop an Owner's Management Plan for the Construction Phase. Ensure that the Company's ESHS team has sufficient authority and decision-making capacity to stop work under critical environmental, social or health and safety situations until such situation is corrected by the contractor. This should be described in the Owner's ESHS Management Plan.	Owner's Management Plan for the Construction Phase.	<p>Document Framework December, 31 2013.</p> <p>Document Management Procedure March 31, 2014.</p>

⁴⁰ Suggested plan shown. Definite actions, deliverables and deadlines to be determined upon discussions among Lenders and with Project/Company.

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Ref #	Issue	Action	Deliverable	Deadline
5.	Construction Phase Organizational Capacity and Competency	Define organization structure for the management of ESHS issues during the construction phase (including ToR's for ESHS Manager and environmental and social and OHS coordinators). As with the Environmental Team, permanently assess the capacity of the Health and Safety Team to determine the need for additional supervisors as the construction work fronts advance and occur in parallel.	Documented construction management plans and procedures and evidence of hiring new positions for construction phase. Evidence of implementation of construction management plan/procedures	December, 31 2013. At start of construction. [45 days after Notice to Proceed]
6.	Contractors Management System	Ensure that the contractors management systems incorporate the Lenders' requirements (i.e., Lenders' Environmental and Social requirements; requirements for community relations; comprehensive treatment of all community health and safety, security, and labor and workers' rights issues relating to contractors; specific requirements for adequate organizational capacity and reporting structure). Complement the ESHS Manual for Contractor's with air quality, workplace noise, general health risks, medical exams, training, and record keeping and reporting Ensure that construction contracts incorporate, Lenders' Environmental and Social and Health and Safety requirements.	Evidence within documented management system of contractor monitoring (including scope and frequency) Documented information within ESHS Contractor's Manual Documented construction contract with all required elements	December 31, 2013. December 31, 2013. December 31, 2013.
7.	Project Induced In-Migration Plan (PIIM)	Develop a Project Induced In-Migration Plan (PIIM) to address the potential attraction the construction of the project may have to workers families, outside job seekers, and the potential impacts of the interactions of the projected work force on the existing communities in the area of influence.	Present Preliminary Plan Present Final Plan	December 31, 2013. March 31, 2014.
8.	Closure Plan and Management	Develop a conceptual decommissioning and closure plan for the project outlining the key elements to be included in the eventual full plan (to be fleshed out in greater detail once the project is operational) and including a clear commitment to continue to monitor and manage any ongoing potential impacts resulting from the project, particularly acid rock drainage (ARD) from waste rock piles.	Conceptual Decommissioning and Closure Plan	Prior to the start of operations.
9.	Operational Phase Organizational Capacity and Competency	Define organization structure for the management of ESHS issues during the operational phase (including ToRs for ESHS Manager and environmental, OHS and social coordinators) As with the Environmental Team, permanently assess the capacity of the Health and Safety Team to determine the need for additional supervisors as the construction work fronts advance and occur in parallel.	Defined organization structure, including ToRs for management roles Evidence of hiring new positions for operation phase	September 30, 2017 60 days prior to start of operations
10.	Operational Phase Management	Complement the general operational management programs described in the environmental and social impact study (ESIA) and existing management plans with detailed operational phase environmental and social, and health and safety (ESHS) management plans specific to the Alto Maipo Hydropower Project, including a Community Health and	Documented operational management plans and procedures Evidence of implementation of	September, 30 2017. At start of operations.

Ref #	Issue	Action	Deliverable	Deadline
		Safety Management Plan. A complete Health and Safety Program should be available for review at least one year prior to starting operations and a final program should be available at least 6 months prior to starting operations.	operational management plan/procedures	
11.	Emergency Preparedness and Response Plans	<p>Compile and synchronize the existing EPRP plans into a discrete, comprehensive, EPRP document (a PHAM Prevention and Contingency Plan) specifically focusing on emergency situations and categorizing applicable risks by probability, severity, and magnitude, using up to date risk information, including mapping of natural hazards.</p> <p>Tailor the existing Cordillera Complex Emergency Plans (including the Spillage Prevention Plan) to the specifics of the PHAM project's <u>construction and operational</u> phases.</p> <p>Ensure that the PHAM Prevention and Contingency Plan includes contingencies for all aspects related to plant operations, including filling of tunnels prior to start up and the event of a shutdown resulting from a electricity grid blackout including, but not limited to: unforeseen infringement of water rights during filling of the tunnels; sudden changes in stream flow affecting intake structures for irrigation and potable water systems; and risks to communities health and safety caused by the unlikely event of surge waves.</p>	<p>Documented PHAM-specific EPRP Plan and management procedure for construction phase</p> <p>Evidence of implementation of PHAM-specific EPRP Plan and management procedure for construction phase</p> <p>Framework PHAM-specific EPRP Plan for operational phase</p> <p>Evidence of documented management procedure for operational phase</p> <p>Evidence of implementation of management procedure for operational phase</p> <p>Capacity assessment of third party emergency responders</p>	<p>November 30, 2013</p> <p>December 31, 2013</p> <p>December 31, 2015</p> <p>September 30, 2017</p> <p>Prior to start of operations</p> <p>March 31, 2014</p>
12.	Reporting	<p>Report on the water quality monitoring; tunnel production, industrial and domestic wastewater monitoring, vegetation monitoring, rescue and relocation program, traffic monitoring, social indicator monitoring, among others in the periodic environmental reports, including the preliminary construction works stage. Include detailed information of the species captured and relocated.</p> <p>Prepare and present, in form and substance satisfactory to Lenders, periodic Environmental and Social Compliance Reports (ESCRs).</p>	<p>Environmental monitoring incorporated in periodic environmental reports in accordance with loan agreement.</p> <p>Periodic ESCR</p>	<p>September 30, 2017</p> <p>In accordance with loan agreement.</p>
13.	Internal Auditing	Systematize internal auditing and inspections so that they occur regularly, and link the process to project supervision and monitoring so that deficiencies/ corrective actions are followed up on and continuous improvement takes place.	Systemization of internal audits within the management system	December 31, 2013
14.	Community Relations	<p>Develop and implement an action plan to properly address the recommendations from CBI's survey and analysis (August/2013).</p> <p>Update and implement the Consultation and Dialogue Plan and</p>	<p>Presentation of action plan.</p> <p>Implementation of action plan</p>	<p>November 30, 2013</p> <p>According to schedule</p>

Ref #	Issue	Action	Deliverable	Deadline
		<p>implement the proposed Project-wide Stakeholder Engagement Plan to disclose information related to key issues described in this report in a way that is culturally appropriate and understandable to key opposition stakeholders.</p> <p>As applicable, increase capacity within the Community Relations team, ensuring to incorporate additional professionals with relevant experience and expertise in the implementation of stakeholder engagement strategies.</p>	<p>Documented implementation of the Consultation and Dialogue Plan and Stakeholder Engagement Plan</p> <p>Evidence of enhanced CR Team, as necessary</p>	<p>presented in the action plan and approved by IDB</p> <p>December 31, 2013</p> <p>Prior to start of construction</p>
15.	Participatory Monitoring Program	<p>Increase the specificity of socio-economic data through the collection of ongoing social indicators monitoring data which is specifically relevant to potential project impacts.</p> <p>As an extension of the currently planned multi-stakeholder process to implement the social monitoring program, prepare and implement detailed participative monitoring programs to monitor, in cooperation with recognized representatives of potentially affected stakeholders and other interested parties, potential impacts related to:</p> <ul style="list-style-type: none"> • Changes in water flow regimes along the diverted reach and up to 5 km downstream of the point of restitution during start up, normal operation, and potential emergency shutdown during “blackouts”, including access to real time water flow information in locations agreed upon with potentially affected stakeholders; • Changes in streambed sediment transport and any potential effects on the structural integrity of irrigation water intake and potable water intakes, along the diverted reach and up to 5 km downstream of the point of restitution; • Potential impacts to groundwater or surface water bodies as a result of tunneling activities. 	<p>For Construction Phase:</p> <p>Document framework</p> <p>Evidence of documented participatory monitoring program and procedures developed in cooperation with potentially affected stakeholders</p> <p>For Operation Phase:</p> <p>Document framework</p> <p>Evidence of implementation of monitoring program and procedures developed in cooperation with potentially affected stakeholders (which would include updated socio-economic data)</p>	<p>December 31, 2013</p> <p>March 31, 2014</p> <p>December 31, 2015</p> <p>Prior to start of operations</p>
16.	Sharing of Economic Benefits with Community	<p>Company should consider additional mechanisms to share the Project’s economic benefits with the community, in consideration of increase in Project cost and stakeholder concerns regarding equitable distribution of Project benefits. This assessment should include legal, financial, and local social benefit implications of registering the Company in the Municipality of San Jose de Maipo.</p>	<p>Presentation of an action plan.</p> <p>Implementation of the action plan</p>	<p>March 31, 2014</p> <p>In accordance with schedule presented in the action plan and approved by IDB</p>
17.	Stakeholder Grievance Mechanism	<p>Develop and implement a stakeholder grievance mechanism, which includes community and employees and other stakeholders, consistent with Lenders’ requirements and national labor laws.</p> <p>The Grievance Mechanism will be applicable and disseminated to both contractors and employees.</p>	<p>Completed stakeholder grievance mechanism</p> <p>Evidence of disclosure and retention of mechanism to all employees (including contractors)</p>	<p>December 31, 2013</p>

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Ref #	Issue	Action	Deliverable	Deadline
18.	Human Resource (Labor) Policy	Develop and implement a human resources policy consistent with Lenders' requirements and national labor laws. The HR Policy will be disseminated among all employees.	Completed HR (Labor) Policy in accordance with requirements of Lenders Evidence of disclosure and retention of Policy to all employees	December 31, 2013
19.	Occupational Health and Safety	Site-specific occupational health and safety hazards should be evaluated based on detail job safety analysis or comprehensive hazard or risk assessment using established methodologies such as a hazard identification study (HAZID), hazard and operability study (HAZOP), or a quantitative risk assessment (QRA)), or equivalent international methodologies.	Site-specific OHS Hazard Assessment	March 31, 2014
20.	Stormwater Management	Develop and implement a comprehensive plan for stormwater management, to include estimation of stormwater to be generated, mitigation and control measures, and regular monitoring to ensure compliance with receiving water quality standards.	Documented stormwater plan and relevant procedures Evidence of implementation of stormwater plan and relevant procedures	March 31, 2014 March 31, 2014
21.	Tunnel Production Water Management	Develop and implement a plan for managing tunnel production wastewater, including a complete list of chemical substances that will be used, handled and stored in tunnels; expected flow of production water in each tunnel section; capacity of wastewater treatment plants, the operating system and expected pollutants to be treated (i.e., high pH, high sediment load, oil and grease, other pollutants). The plan should account for potential excess water production from fractured rock (i.e., " <i>bolsones de agua</i> ") and include regular monitoring to ensure compliance with receiving water quality standards.	Documented tunnel production wastewater plan and relevant procedures Evidence of implementation of tunnel production wastewater plan and relevant procedures	March 31, 2014 March 31, 2014
22.	Waste Rock Drainage Management	Complement the existing Contingency Plan for Acid Rocks with specific mitigation measures to be implemented in the event of encountering acid rock, including measures to prevent acid drainage from entering the water courses. Implement groundwater monitoring in areas of waste rock heaps to control potential impacts from seepage, even under non-contingency situations. Develop a detailed closure and restoration plan for the waste rock heaps. Maintain monitoring of waste rock heaps leachate on surface and groundwater during closure and post-closure, for at least 3 years after restoration.	Documented mitigation measures to complement the Contingency Plan for Acid Rocks Evidence of groundwater monitoring in areas of waste rock heaps Detailed closure and restoration plan for waste rock heaps	March 31, 2014 (To be determined based on updated construction plan). (To be determined based on updated construction plan).
23.	Alteration of local hydrogeology	Ensure that pre-grouting and grouting requirements are explicitly specified in the Contractor's ESHS Requirements and Management Plans and that supervision and monitoring of this measure is included in the program.	Documentation of grouting requirements within Contractor's plans	March 31, 2014

Ref #	Issue	Action	Deliverable	Deadline
24.	Noise and Vibration	Complement the existing Noise and Vibration Monitoring Program to include a clear notification protocol to alert potentially affected communities when blasting will occur and, if necessary, assist in preparing communities at risk to respond to any emergencies caused by blasting (e.g., landslides, avalanches). Expand the Noise and Vibration Monitoring Program to include households and sensitive receptors located in close proximity to roads where heavy traffic will occur due to the Project.	Documented notification protocol Evidence that Noise and Vibration Monitoring Program includes sensitive receptors along heavy traffic routes	December 31, 2013 March 31, 2014
25.	Climate Change	Extend the GHG emission estimation beyond 2021 to account for years where no revegetation or reforestation occurs Actively participate in and sponsor vulnerability and adaptation climate change studies and groups like the “ <i>Vulnerabilidad y Adaptacion Cuenca del Rio Maipo en Chile Central</i> ” project described in the “ <i>Tema 1: Identificacion y evaluacion de impactos potenciales sobre usos y usuarios del agua</i> ” report. Design and apply the monitoring plan that the Company promotes in the “ <i>Tema 1: Identificacion y evaluacion de impactos potenciales sobre usos y usuarios del agua</i> ” report to establish a mitigation and compensation plan.	Evidence of GHG accounting Climate change mitigation and compensation plan Evidence of application of monitoring plan.	December 31, 2013 In accordance with delivery of reports of climate change study “ <i>Vulnerabilidad y Adaptacion Cuenca del Rio Maipo en Chile Central</i> ” September 30, 2014
26.	Traffic Monitoring	Expand the traffic monitoring to include measures to minimize potential impacts to community health and safety (i.e., traffic accidents, awareness raising, etc.) and implement an effective grievance mechanism to tackle traffic potential impacts to communities. Traffic monitoring should be extended to continue, at least, on a bi-monthly basis for the first three years of construction.	Evidence of expanded traffic monitoring program Results of monitoring in ESCRs	December 31, 2013 Ongoing during construction
27.	Community, Health and Safety Risk Assessment	Prepare a comprehensive community health and safety risk assessment specific to the Project’s operation and maintenance phase and incorporate the identification of risks and prevention and mitigation measures into the Emergency Response Plan.	Operational phase community health and safety assessment and mitigation measures	September 30, 2017
28.	Monitoring and Evaluation of Land Acquisition Process	Monitor and evaluate (M&E) any additional land acquired subsequent to preparation of Land and Right of Way Acquisition Report dated January 31, 2013 to ensure adequate compensation to affected land owners and avoidance of damages to properties not acquired by the Project.	Documentation of compensation for additional acquired land and M&E of potential damages to properties or affected residents	On-going, as applicable, until adequate compensation can be confirmed
29.	Sensitive Habitats	Confirm that the “restricted areas” noted in the PHAM’s Environmental Management Plan are inclusive of all areas that would require additional restrictions per international standards, due to sensitive habitat or its potential to be “critical”, including those areas around the Transmission Line. Develop management measures consistent with international standards should “critical habitat” be identified.	Documentation that “restricted areas” have been reviewed in the context of project changes and their potential to be considered “critical habitat” Development of management measures consistent with international standards should “critical habitat” be identified	March 31, 2014 Immediately after identification, if applicable

Ref #	Issue	Action	Deliverable	Deadline
30.	Vegetation Monitoring Program	Provide additional detail on the methodology, scope, key biodiversity indicators and outputs expected for the Vegetation Monitoring Program. Ensure that an expert in these types of ecosystems is engaged to design and implement the program. Monitor the effects of the reduction in local drainage and runoff on the <i>vegas</i> wetland in the Cordillera Alta in the context of the Veranada Vegetation Monitoring Plan at La Engorda.	Documentation of improvements to Vegetation Monitoring Program Evidence of monitoring of the <i>vegas</i> wetland in the Cordillera Alta	March 31, 2014 December 31, 2013 for initial monitoring then ongoing
31.	Vegas and Restoration Program	Develop a detailed Restoration Plan for <i>Vegas</i> . Ensure that qualified and expert professionals, with experience in the restoration of <i>vegas</i> are involved in the design of the plan and supervision of its implementation. Strengthen the reporting indicators for restoration success beyond aerial photographs to include field monitoring. Develop an action plan that delineates the steps to take in case of no success of restoration.	Detailed <i>Vegas</i> Restoration Plan with strengthened reporting indicators and action plan to address inadequate restoration techniques.	March 31, 2014
32.	Ecological Flow and Adaptive Management Plans	Through the Integrated Management Plan for Populations of Small Catfish, continue to gather information on aquatic biota and habitat requirements (quarterly during construction and the first three years of operations) and determine site-specific habitat suitability curves for <i>T. areolatus</i> . Refine the Adaptive Management Plan described within the Integrated Management Plan for Populations of Small Catfish, with more specific details regarding the schedule for implementation, roles and responsibilities, resources, specific on the monitoring programs and specific commitments to revise the flow needs and consider additional voluntary and/or Lenders' recommended mitigation/compensation measures including, if necessary, additional releases within the scope of the adaptive management plan	Documentation within Plan the monitoring results and proposal for site-specific habitat suitability curves Documented Adaptive Management Plan describing the necessary elements	December 31, 2013 March 31, 2014
33.	Recreational Water Use Management Program	In consultation with commercial and private recreational boaters and other stakeholders, quantify the level of recreational use in affected rivers, the flow requirements for a quality recreation experience (including preferred river segments, time of year, and minimum and maximum flows for recreational uses in any of the bypass reach segments), and propose complementary mitigation and management measures, if required within the scope of the adaptive management plan.	Quantification of recreational use and flow requirements Documentation of mitigation and management measures, if required.	March 31, 2014 Prior to start of operations
34.	Protected Areas	Maintain timely and relevant information disclosure with the owners of the properties that constitute the protected areas regarding the most recent studies and potential impact assessments as well as the construction activities and schedule that may be of relevance to them.	Documentation of stakeholder engagement relevant to protected areas	December 31, 2013
35.	Ecosystem Services Management Program	Develop and implement an ecosystem services management program to address identified cumulative impacts on ecosystem services in the project direct and indirect area of influence (diverted reach and up to 5km downstream of the point of restitution). The program shall include the following main elements:		

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Ref #	Issue	Action	Deliverable	Deadline
		<ul style="list-style-type: none"> • Present a general statement on the mitigation/compensation strategy that the Company intends to pursue in the event that significant impacts are identified in association with the Project and related to sediment load and transport. • Plans for outreach and engagement with relevant stakeholders including but not limited to: relevant public agencies, community associations and business groups, irrigation associations, and other business operations (i.e. hydropower and mining) to discuss joint regional approaches for the management of identified impacts on hydrology and sediment transport from the Participatory Monitoring Program, including impacts potentially associated with climate change; • Engagement on stakeholder perception of potential visual impacts to the rivers and potential impacts on local tourism sector • Operational change management procedures to address those aspects that the company is able to influence independently on in collaboration with other stakeholders. • Compensation plans with clear commitments to address potential impacts to key stakeholders including but not limited to: commercial whitewater rafting operators along a section of the diverted reach in the Maipo River; irrigation canal water intakes (from changes in riverbed sediments or water fluctuations); • Specific commitments to complete the Advanced Sediment Transport Study and to develop and implement specific management, mitigation, and compensation measures to address potential impacts from the Project in collaboration with affected stakeholders. 	<p>Statement from the Company</p> <p>Plans for stakeholder engagement regarding regional approaches for the management of hydrology and sediment transport from the Participatory Monitoring Program</p> <p>Documented change management procedures (to incorporate stakeholder input) for operation phase</p> <p>Documented compensation plans to address key impacts to stakeholders</p> <p>Completed Advanced Sediment Transport Study and corresponding mitigation, management and compensation plan based on results</p>	<p>November 30, 2013</p> <p>March 31, 2014 (Evidence of documented plans and disclosure to potentially affected stakeholders)</p> <p>Prior to start of operations (Evidence of implementation of management and compensation plans)</p> <p>November 30, 2013 (Completed Advanced Sediment Transport Study, as committed to by the Company)</p>