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SANTO ANTÔNIO HYDROELECTRIC – BRAZIL

Figure 01: General picture of Santo Antonio hydroelectric plant.
Sources: Santo Antônio Energia

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Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective project design or implementation.

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1. PROJECT DESCRIPTION & LOCATION

Santo Antônio is considered one of the largest hydroelectric plants in the Legal Amazon area, as it takes great advantage of the Madeira River hydropower potential to generate more than 3000 MW. The Santo Antônio hydroelectric plant is located in the Northern Region of Brazil's Legal Amazon in the state of Rondônia at 7 km from Porto Velho, the state's capital. The amount of construction materials used for the plant, especially concrete and steel are enough to build 40 Maracanã Stadiums and 18 Eiffel Towers.[1] According to the operation license and Brazilian environmental impact regulations the project has a high impact level on ecosystems[2]. Most of the project impacts to ecosystems are mainly related with permanent flooding, interruptions to ecological connectivity and changes in the Madeira river runoff. It is noteworthy to point out the proximity to the urban area of Port Velho, which has contributed to the progressive disturbance of regional ecosystems due to exploitative uses of the river and land for productive activities such as fishing, agriculture and cattle ranching.

At the country level, this project is considered strategic, as it is part of the Brazilian Federal Government's Growth Acceleration Program (PAC), providing a significant influx of sustainable energy to Brazil. At the regional level it aims to develop northern Brazil by creating jobs and commercial activity with a positive impact in the economic development of the region. Brazil is one of the top five countries in renewable energy production. In 2008 the Brazilian Government already in the first version of its National Plan on Climate Change included the goal to keep a high share of renewables in the primary energy sources and to increase hydropower generation. In the plan the project and other hydropower plants are referenced as cumulatively reducing 184 million tCO2e.[3]. Besides, the hydroelectric plant will allocate 600MW of the energy generated to the state of Rondônia. By 2016, it is expected to operate at full power, allowing the gradual disconnection of the fossil fuel powered thermoelectric plants of the region, thus reducing costs and air pollution. Moreover, the project is a Clean Development Mechanism (CDM) estimated to reduce 4,015,196 CO2e/year, according to the CDM project registration.

Santo Antônio will have 50 turbines distributed among four powerhouses. At the Madeira River left bank are found powerhouses 2 and 3, with 12 turbines each; at the right bank is located powerhouse 1, with 8 turbines and the first to start operating; and at the center of the river bed is located the powerhouse 4 with 18 turbines. The plant allows for water volumes of up to

[1] SAE, accessed in 2014 http://www.santoantonioenergia.com.br/en/empresa/usina-em-numeros/.
[2] In the impact level or 'grau de impacto' (GI) scale from 0 to 0.5%, this hydroelectric is considered to have a high impact of 0.5%.
[3] Clean Development Mechanism Project Design Document Form (CDM-PDD). Version 03 - in effect as of: 28 July 2006. 3

84,000 m3 to pass per second, excess water is handled with two spillways containing a total of 18 floodgates or openings. As part of the project innovative fishways were installed; the Fish Transposition System is considered to be an advanced system that reproduces fish natural habitat, guaranteeing reproduction as migratory species can go up the river during spawning season.

The project is located in the transnational basin of the Madeira River, which is also shared with Peru and Bolivia. The Madeira River is the largest tributary of the Amazon River counting with a total catchment area of 1,420,000 km², according to the Brazilian National Water Agency (ANA), distributed in territories of Brazil, Bolivia and Peru. Counting with an area of approximately 1.47 million km2, the Madeira River basin is 23% of the Amazon River basin, which is twice the size of any other tributary basin, and partly covers the territory of Bolivia (40%), Brazil (50%) and Peru (10%). It is considered to carry about half of Amazon's sediment and nutrient load downstream. The Madeira River has a total length of about 3,240 km, of which about 1,425 km in Brazilian territory.

The community living along the banks of the Madeira River is a rural population made of small producers developing economic activities for family subsistence, that include fishing on the larger extent. In terms of agriculture, the main production from the temporary crops is from cassava, corn, watermelon, pineapple, pepper, and bay beans. In the area of permanent crops, the main products are banana, açai and orange to a lesser extent.[4] From the main agricultural activities in the region, poultry, swine and cattle, which has been growing since 1991. This trend of deforestation identified in the region, correlates to with the increasing occupation of the Amazon by livestock.

About compensations to the Porto Velho region and its people, Santo Antonio Energia S.A. is investing $766 millions USD for the 28 programs listed in the Environmental and Social Program Report (PBA), which is a higher value than that regulatory agencies stipulated.[5] In addition, once the hydroelectric is in full operation by November 2016, Santo Antonio hydroelectric will pay about $37.02 million USD (R$100 million) per year in royalties for the use of the Madeira River waters. These royalties, according to the Brazilian Electricity Regulatory Agency (ANEEL) will be distributed to states and municipalities and can be applied in health, education and security, among other sectors. Of this total, 45% will be allocated to Porto Velho, a further 45 % to Rondônia and the remainder to the Brazilian Federal Government. The Public Authority will therefore receive an increase in the volume of available resources, which may be directed to expanding public projects and services to benefit the population.

[4] Santo Antonio Energia (2015), hereafter cited as SAE
[5] SAE

The evaluation of San Antonio Hydroelectric plant presented below was conducted between September and December of 2014. At the start of the evaluation, the project was partially operating with 32 turbines, generating 2286,08 MW of total power, equivalent to 64% of its total capacity. After the evaluation, in December of that year, the project had approximately more than 60% of progress in its construction. According to the schedule of the project's activities, the plant is expected to operate full power by mid 2016.

2. APPLICATION OF THE ENVISION RATING SYSTEM

The Envision™ system is a set of guidelines that aid in optimizing the sustainability of an infrastructure project during the planning and preliminary design phases, as well as a means to quantify the relative sustainability of the project. In this case study, the infrastructure to be assessed is the Santo Antônio Hydroelectric, Brazil.

Envision consists of 60 credits grouped into five categories: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk. Each credit pertains to a specific indicator of sustainability such as reducing energy use, preserving natural habitat, or reducing greenhouse gas emissions. Those credits are rated on a five-point scale referred to as a 'level of achievement': 'improved', 'enhanced', 'superior', 'conserving', and 'restorative'. Evaluation criteria are provided to determine if the qualifications for each level of achievement have been met for a particular credit. In each of the five categories there is a specific credit called "Innovate or exceed credit requirements". This is an opportunity to reward exceptional performance that applies innovative methods within the subjects that Envision evaluates.

The criteria for the levels of achievement vary from credit to credit, but generally an 'improved' level of achievement is awarded for performance that slightly exceeds regulatory requirements. 'Enhanced' and 'superior' levels indicate additional gradual improvement, while 'conserving' often indicates performance that achieves a net-zero or neutral impact. 'Restorative' is the highest level and is typically reserved for projects that produce an overall net positive impact. The Envision system weighs the relative value of each credit and level of achievement by assigning points. Credit criteria are documented in the Envision Guidance Manual, which is available to the public on the ISI[6] and Zofnass Program[7] websites.

3. QUALITY OF LIFE CATEGORY

Envision's first category, Quality of Life, pertains to potential project impacts on surrounding

[6] www.sustainableinfrastructure.org
[7] www.zofnass.org

communities and their respective wellbeing. More specifically, it distinguishes infrastructure projects that are in line with community goals, clearly established as parts of existing community networks, as well as consider the long-term community benefits and aspirations. Quality of Life incorporates guidance related to community capacity building and promotes infrastructure users and local members as important stakeholders in the decision making process. The category is further divided into three sub-categories: Purpose, Wellbeing, and Community.

Purpose

The purpose subcategory evaluates if the project is the right one for the community. It looks into what are the project's impacts in community growth, development, job creation, and the general improvement of quality of life. In terms of improving the quality of life, the Santo Antonio hydroelectric performed well as it reaches large scale progress by providing a significant influx of sustainable energy to Brazil, diversifying its energy source matrix, as well as enhancing the competitiveness of Rondonia state and to its capital the city of Porto Velho. The Santo Antônio Hydroelectric Plant is strategic infrastructure in stimulating local development, especially as it provides an expanded supply and increase in quality and reliable electrical energy. Once it operates at full power, it will allocate up to an average of 600 megawatts to the state of Rondônia by 2016, allowing the gradual disconnection of traditional thermoelectric plants. Improvements to local productivity are expected due to the provision of electrical energy, and advances in integration with other localities, which are factors of sustainable economic development because of its capacity to promote new businesses and attract capital to develop industry, commerce and local services. In addition to the energy input, there will be an increase of available public resources due to royalties that Santo Antônio hydroelectric will pay for using the Madeira River.

Although the Madeira River is in a transnational basin, the area considered for impact mitigation was strictly limited to what the Brazilian Institute of Environment and Renewable Resources (IBAMA) references as the Area of Direct Influence (AID) delimitation for hydroelectric projects. The area considered is the flooded area at the maximum level of the reservoir plus the Area of Permanent Preservation (APP), the continuous areas of ecological relevance, and the areas located downstream to the dam. Within this area there were many riverine communities that were displaced. Although there is a compromise with the quality of life of the existing communities, the scale of the population relocation is considered an adverse impact of the project, which the project team is trying to mitigate by implementing several measures. Due to relocations of the directly impacted riverfront communities, compensations and new housing were constructed for 540 families, which accounts for a group of about 2,044 persons. According to the project's team, quality of life is likely to improve since available

monitoring studies show that in many cases family income increased over time. Most efforts are directed to mitigate the immediate negative impacts on communities facing relocation from the riverfront without considering a long-term vision. Addressing that population resettlement is a complex on going process that could last many years, more substantive efforts are needed to assess, review and incorporate community needs, goals and issues after the relocation is completed.

Since the early phases of the project, all stakeholders and their households were considered to be actively involved in the relocation process; the compensations and resettlement conditions have been agreed in consultation with the people affected by the project. In general, the relocations were approved by most of the resettled families, as they have acquired an area with the possibility of generating income, basic infrastructure services, and the benefit of regularized tenure of land ownership. Considering the scale of the relocation, a more participatory process of home substitution rebuilding should be encouraged to take into consideration the riverine lifestyle and culture, as well as, the possibility of relocating the original structures and the production of new housing models that resemble the openness to nature that was present in the original housing typologies.

The Santo Antonio hydroelectric stimulates sustainable growth and development of the local community. During construction this project created new jobs for the area, and in its peak phase the hydroelectric power plant created approximately 20,000 jobs, from which residents of the local Porto Velho region filled 80% of the positions. The project team asserted that the Acreditar program gave training to more than 40,000 people from the community, in addition to the project introducing technical innovative solutions to the area.

In terms of community participation, approximately 2,000 people contributed to the 64 public meetings held for the approval of the power plant project. However, it is not clear to what extent the affected communities were meaningfully engaged in the plant design process. Santo Antônio Energia assures that the hydropower has not affected indigenous populations because it is not located in indigenous lands. It is worth noting that no indigenous lands were flooded for the implementation of the hydroelectric reservoir.[8] Nonetheless, there have been terms of cooperation executed in conjunction with the Brazilian FUNAI[9] for the indigenous communities of Karitiana, Karipuna and Cassupã, located outside the reservoir of the dam, in the areas of education, health, infrastructure and security. In addition, the project team developed several

[8] SAE.

[9] Fundação Nacional do Índio - FUNAI, which has in Brazil the determination to follow and protect the interests of indigenous peoples

environmental and social programs.

The project performed best in developing local skills and capabilities. Long-term competitiveness is developed in the Rondonia region where the project's area of influence is located. Although the construction of the project entailed the relocation of many communities, the project team seems to have considered community needs and to have focused on the indigenous communities indirectly affected by the project. It is noteworthy that in the early years of construction, the rate of women working in the construction site reached 10% of the total number of members. In addition, women also participated in the continuing education program offered by the company called Acreditar (Believe), responsible for the qualification of the local workforce.

In addition, in the periodical report monitoring the activities related to the action plan based on Equator Principles[10], numerous programs are listed in relation to the relocated communities and local skills building. This monitoring and inspection done by external procedures demanded by the official organs have generated recommendations and findings in relation to the implementation of the project activities that are important to follow in relation to the development of local skills and capabilities.

Community

The community subcategory looks into how the integral parts of the community are addressed by infrastructure projects to improve comfort, public health and mobility. The project does a great job at enhancing public health and safety; during construction there has been an overall trend of reduction in the frequency rate of injuries and accidents according to the indexes of health and safety.

In public health development, Santo Antônio Energia has improved their own health and safety standards above that which is required by regulations. Santo Antônio Energia won the 6th Medical Services Innovation Award, in the Tropical Medicine category, because of actions already implemented and availability of measurable results against vector-borne diseases such as malaria, which are usually associated with the water held in a hydroelectric plant. Medical Services Innovation Award is an initiative of Sanofi[11] and Medical Services portal[12], which aims

[10] The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. Equator Principles, accessed in 2014, http://www.equator-principles.com/index.php/ep3/38-about/about/195

[11] Sanofi is one of the largest pharmaceutical groups in the world with large presence in Europe and in emerging countries. Sanofi, accessed in 2015, http://www.sanofi.com.br/l/br/pt/layout.jsp?scat=5BC3219D-D71C-4893-89B8-90B77AC27C9B.

to enhance, encourage and disseminate innovative work to bring improvements in public health.[13]

In addition, SAE has placed special attention on the needs of the indigenous communities as accorded in the Term of Mutual Cooperation for the implementation of the Comprehensive Plan for Indigenous Health, which will benefit the Karitiana, Karipuna, and Cassupá communities.

In minimizing noise and vibrations, the project performed low as all strategies were directed to the construction phase and not during the operational phase. Management strategies include the monitoring of environmental noise related to the activities of the construction site and monitoring of air emissions. The company monitored these impacts during the construction phase, but as the SAE team considers it, the construction impacts cease to exist during the operation phase, therefore no additional monitoring has been conducted.[14]

In some aspects the Santo Antonio hydroelectric needs to provide supporting documentation to score better, such as confirming or performing an overall assessment of lighting needs in order to eliminate any unnecessary lighting to minimize light pollution, which can be detrimental to certain ecosystems. Considering the scale and location of the project, it would be noteworthy to implement lighting needs assessments, as this aspect is usually not considered in environmental impact assessments for hydroelectric projects.

In mobility and access, the hydroelectric performed best by supporting and investing in the mobility plan of Porto Velho Urban Mobility Plan (PMob). The PMob emphasizes public transportation service, road traffic data, infrastructure, and accessibility for people with special needs, integration of public transport with private, non-motorized transport, major generators of travel centers, public areas, and private parking and transportation loads. This investment is part of an agreement signed with the city of Porto Velho to integrate the Social Compensation Program with the implementation of the Santo Antônio hydroelectric. As the Madeira River has a fundamental role in regional transportation between communities using private boats to move around, it will be important to know how this system will integrate with the proposed terrestrial rapid transit buses.

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[12] Medical Services portal offers healthcare professionals a permanent channel of dialogue and updated, which combines medical education, scientific updates, tools and differentiated services. Medical Services, accessed in 2015, https://www.medicalservices.com.br/sobre-o-medical-services.aspx.
[13] Medical Services, accessed in 2015, https://www.medicalservices.com.br/premio-medical-services.aspx.
[14] SAE.

Providing alternatives modes of transportation performed well but to a lesser extent, since it is not clear if the PMob will promote pedestrian pathways, bikeways and water transportation integration to the public mass transit. There are guidelines that support the process of analyzing strategic alternatives necessary to: implement the rapid bus corridor system; propose a new methodology for tariff calculation; propose a methodology for the location of the interstate highway in the city; establish subsidies for the implementation of a transportation operations control center; and propose a regulatory framework for taxi service.

Efforts to improve site accessibility, safety and wayfinding are done by providing onsite wayfinding following the guidance and requirements of the Brazilian Association of Technical Standards (ABNT).

Wellbeing

The wellbeing subcategory is about ensuring that the project uses context-sensitive design that respects, maintains or improves its surroundings.

The Santo Antonio hydroelectric project has taken several steps to identify, preserve or restore cultural resources according to the programs created related to the archaeological, prehistoric and historic heritage of the area, and in compliance with Brazilian regulations. In terms of identification of potential sites for historic or cultural preservation the following field reports were carried out: prospecting on the construction site and reservoir area; delimitation and rescue of archaeological sites highlighted in prospecting; technical training in archeology; curation and laboratory analysis; dissemination of results; and seminars.

In total, 58 archaeological sites were found, of which 43 are pre-colonial sites and 15 are historic sites. In addition, 157 archaeological occurrences (isolated or discrete) that are not archaeological sites were also identified. Paleontological monitoring was also performed, rescuing the first Palaeobotanical Amazon site presenting different types of plant fossils, such as seeds, leaves and logs, which display dates older than 46,000 BCE. Regarding education and sharing knowledge with the community, exhibitions of works produced in partnership with educational institutions are being planned, but formal commitments should be defined.

In terms of natural heritage sites, the project performed at a lesser extent. Several natural features such as the Santo Antônio and Teotônio waterfalls, necessary for hydroelectric use, have succumbed to the construction of the plant, displacing the neighboring communities as well. Notwithstanding, the installation of the power plant will not cause the inundation of part

of the historic Madeira Mamoré Railway.[15] In fact, restoration works were done and delivered following the executive project from Brazilian National Institute of Historic and Artistic Heritage (IPHAN).[16] Further restoration is needed as the historic flood from 2014 buried this project under a meter of sand and mud.

Views and local character were not preserved adequately. In the relocation of displaced communities, moderate efforts have been made to respect the principal characteristics of those communities. However, the siting of the project is on top of two culturally important waterfalls, Santo Antônio and Teotônio, does not support the preservation of views and local character of the area.

According to the Environmental Impact Assessment, the total course of the Madeira River can be divided into three distinct sections: the High Madeira- consisting almost of source rivers; the stretch of waterfalls among Guarajá Mirim and Santo Antônio waterfalls; and the Low Madeira. The most visually impacted area would be the Madeira's waterfall stretch, which begins just downstream of the city of Mirim Guarajá and ends upstream of Porto Velho, at Santo Antônio waterfalls. This stretch total length of approximately 360 km has a total fall of 70 m, along which features 18 waterfalls or rapids that might disappear with the construction of the hydroelectric.

In enhancing the public space, Santo Antonio obtained the highest score possible; the team has prioritized the improvement of existing public space, creating parks, tourist venues, sport facilities, cultural centers and wildlife viewing areas. Among the enhancement projects are the improvements to the Porto Velho Natural Park, the urban betterment of the surroundings of the Santo Antonio chapel, and the revitalization of the Madeira Mamoré Railway Complex, which are all important tourist sites. SAE has also created public spaces such as a park, an artificial beach, and a soccer field in the Jacy-Paraná district. In addition the project team has built the Indigenous Cultural Center.

4. LEADERSHIP CATEGORY

Leadership evaluates project team initiatives that establish communication and collaboration strategies early on, with the ultimate objective of achieving sustainable performance. Envision rewards stakeholder engagement as well as encompassing a holistic, long-term view of the project's life cycle. Leadership is distributed into three sub-categories: Collaboration,

[15] SAE.
[16] Ibid.

Management, and Planning.

Collaboration

The Collaboration subcategory focuses on how the project aims to emphasize sustainable practices throughout its working network. The Santo Antônio Energia (SAE) is providing effective leadership and commitment to improve sustainable performance by adopting the Equator Principles. The Equator Principles are defined as a financial industry benchmark for determining, assessing and managing environmental and social risk in projects. The SAE, for instance, in order to comply with the principles, prepared environmental and social studies as well as disseminated the action plans designed for the affected communities. This commitment is audited periodically to verify that the criteria are being met.

The Santo Antonio hydroelectric project falls into Equator Principles Category A, for which assessment documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the project. The adoption of these criteria is above and beyond governmental regulation as it is not required for receiving an environmental license.

The sustainability management system listed in the basic environmental project aims to prevent and control direct impacts generated by the works and deployment activities of Santo Antonio hydroelectric. The management system prioritizes avoiding processes that can trigger environmental degradation in the area of direct Influence. Besides, it provides environmental criteria and procedures found in the agreements with construction companies and services that contribute to the implementation of the project, including its subcontractors.

Among the 28 environmental mitigation programs that comprise the Basic Environmental Project (PBA), two are intended for sustainable management: the Environmental Management System and the Environmental Program for Construction. The Brazilian Institute of Environment and Renewable Resources (IBAMA) approves programs, and is both the licensing and inspecting body. The Environmental Management programs help to ensure that the sustainability criteria and procedures are respected and verified.

The sustainability management plan seeks to achieve a continuous pursuit of its objectives, goals and strategic directions, such as compliance with legal requirements, adapting to local expectations, minimization of impacts, encouraging sustainable development and use of renewable natural sources, protecting human health, and protecting cultural properties and biodiversity, among others.

Appropriate roles and responsibilities are assigned within SAE's sustainability leadership based mainly in Porto Velho and in Sao Paulo. The sustainability board of directors' team, according to their responsibilities, is listed as follow: a director, a manager, a socioeconomic coordinator, a cartographer engineer, three environmental analysts, a relocation coordinator, a social communication analyst, and administrative staff.

The hydroelectric performed well in terms of teamwork, consultation and communication with stakeholders. Participation by affected parties is fostered in the development, revision and implementation of the project. The project team has also established a goal to reduce impacts on nearby indigenous communities. Nonetheless, there is room for improvement in assuring meaningful participation by integrating more the communities' input during the project's decision-making process.

Outstanding performance from SAE is achieved by providing for comprehensive stakeholder involvement. Due to the large scale of the hydroelectric project's area of influence, the SAE project team has been able to build good relationships with the directly affected communities. Even after the project approvals were obtained, the project team held a participatory process, which attracted more than 2,000 people to 64 meetings and six public hearings. The SAE project team's effort to identify key stakeholders and establish communication was done according to the federal environmental permitting regulations as identified in the environmental impact studies, which are updated periodically. The identification of stakeholders went beyond the communities that are directly impacted by the project to include communities of nearby areas, indigenous communities that are located in areas outside the reservoir of the dam, opinion leaders from the city of Porto Velho and region, as well as leaders and the press.

The project team started stakeholder engagement at the initial stages of the project as they introduced a publication strategy to disclose the environmental impact assessment for the Madeira River hydroelectric power complex with the local society, and debate the results before the official public hearings started.

The environmental impact assessment was developed in conjunction with local universities, considering the research previously published of the Madeira River project. This helped identify the main stakeholder groups, which became the key factor of the participative process. The stakeholder groups identified were classified as follows: a) the riparian population in the power station area and the resident population downstream of the projects; and safety; b) Indigenous people; c) urban population of Porto Velho – target audience for the opinion poll: the academic

community, students and university students, industrial and commercial business people, representatives from worker entities/unions; d) government constituents; and e) communication and press agencies. Appropriate communication and outreach were place for these stakeholder groups.

As an example of the participative process are the first meetings with the riparian population and communities downstream from the project. These meetings were held in order to become acquainted with the communities that included different types of dynamics such as a theater piece made by the residents, technically called an socioeconomic act, and also to explain what would happen to the region as a result of the construction of the power stations.

Management

The Management subcategory looks for a broader comprehensive understanding that allows the team to see and pursue synergies between systems and greater integration. This can lead to a new way of managing that understands the project as q whole and is able to project cost and sustainability efficiencies. In this case, the project performed well in improving infrastructure integration, although it can perform better at pursuing by-product synergy opportunities.

There is a program for pursuing opportunities to reuse unwanted by-products in order to reduce waste, improve the project's performance and reduce costs. More broad and aggressive strategies for the pursuit of by-product synergy opportunities can help reduce further waste, improve project performance and reduce costs. It is important to try to identify more by-product resources and capture more synergy opportunities for energy generation at nearby facilities such as generating power from waste by filtrating Porto Velho's wastewater effluents that are mostly discharged directly into the Madeira River.

Infrastructure integration is better achieved by the project at various levels such as national, regional and local scale. The Santo Antônio hydroelectric project improves infrastructure integration by taking into account the operational relationships with the community and providing energy to the northern region of Brazil. It is estimated that the 3568 MW will give power to around 45 million people. The SAE team identified the community assets in the natural and built environment. The project was designed and planned to integrate community infrastructure assets as well as restore them.

Planning

In the Planning subcategory a long-term view is encouraged in terms of the sustainability of the project. This includes understanding the regulatory environment and future growth trends to

avoid pitfalls and plan effectively for the project's future.

A comprehensive maintenance and monitoring plan has been prepared in advance to the project's completion. Santo Antônio hydroelectric plant has a concession period of 35 years for operation, granted by the Brazilian Federal Government. Sufficient financial resources have been put in place to cover the monitoring and maintenance plans. There is opportunity in planning and identifying resources for long term monitoring and maintenance beyond the 35 years of concession.

There is room for improvement when addressing conflicting regulation and policies that may unintentionally create barriers to sustainable practices. The SAE team must work with officials and stakeholders to try to identify and address laws, standards, regulations or policies that create unintentional barriers to the implementation of sustainable infrastructure.

A better performance can be achieved in extending the useful life of the project. The project team incorporates useful life cycle thinking in improving the durability, flexibility and resilience of the project over its projected lifespan. The hydroelectric plant has a projected useful life of 100 years, due to the historic lifespan allocated to hydroelectric projects in Brazil. Due to the estimations on intensification of land use around the reservoir as well as the increase of meteorological and climate effects, this number has been decreased to 92 years. The Santo Antonio hydroelectric plant, in order to expand the useful life to the required 100 years, developed a hydrosedimentological monitoring program, which according to the predicted parameters in the environmental impact studies will extend the lifespan for 100 years. Sediments monitoring is crucial in the lifetime of a hydroelectric and makes part of a requirements of ANEEL in reference to the Guide for the Evaluation of Reservoir Sedimentation.

Although, there aren't many cases of hydropower plant projects decommissioning in Brazil, once the project concession of 35 years is complete, then the project is transferred to the Brazilian federal government. According to the ANEEL, the concession contract stipulates the federal government to be responsible for decommissioning the hydroelectric plant.

The project team can extend further the boundaries of useful life and perform a more aggressive full life cycle thinking that can be incorporated into the design and planning of the project, which could lead to improve the durability, flexibility and resilience of the hydroelectric to uncertain future threats.

5. RESOURCE ALLOCATION CATEGORY

Resource allocation deals with material, energy, and water requirements during the construction and operation phases of infrastructure projects. The quantity and source of these elements, as well as their impact on overall sustainability, is investigated throughout this section of the Envision rating system. Envision guides teams to choose less toxic materials and promotes renewable energy resources. Resource Allocation is divided into three subcategories: Materials, Energy, and Water.

Materials

The subcategory of Materials encourages minimizing the total amount of material used in a project in order to reduce pressure on natural resources extraction and processing. The overall performance of the Santo Antonio hydroelectric plant in this subcategory was low indicating the need to identify and reduce use of material.

There is a need to identify and reduce the net embodied energy of the Santo Antonio hydroelectric plant. As there is no indication that a life cycle energy assessment over the project life has been done. In order to achieve a better performance, a life cycle energy assessment must be done for the hydropower plant.

For supporting sustainable procurement practices there is a basic sustainable sourcing, but lack of tracking and monitoring suppliers. In terms of obtaining materials and equipment, Envision looks for procurement practices that implement sustainable practices. The manual of integrated management system (MSGI) purpose is to outline the integrated management system of the hydroelectric plant sustainability board and it is structured to meet the requirements such as the Equator Principles, the International Finance Corporation Performance Standards, ISO 9000, among other Brazilian requirements.

The project performed low in the procurement of recycled and regional materials. A better performance can be obtained when the use of recyclable materials is a project driver. This will help reduce the use of virgin materials and avoid sending useful materials to landfills. There is no indication of the use of recycled materials for the structures of the hydropower plant, but only in the reuse of the vegetative material that was removed for construction. The vegetative material was mostly wood salvaged and sold in the market, or reused in the fencing of the permanent protected areas, or sent to the Santo Antonio sponsored herbaria and nursery. In terms of volume 116,066.51 cubic meters of logs were commercialized. However, it is not established within the documentation what percentage of the total material this constitutes. Implementing a tracking system will help indicate and quantify the project's impacts from a wider sustainability perspective in order to manage and minimize them.

There is a need to record and make inventories of materials use, such as regional materials used for building the hydroelectric. According to the project owners, the acquisition of construction materials is made locally in the region, but it is difficult to know to what extent they used regional materials without inventories with costs and extraction locations.

The project performed better in diverting waste from landfills. The project team indicated that waste generated in the construction of the Hydroelectric has proper disposal, recycling, composting or to the landfill. At least 75% of the waste stream is recycled, reused or diverted from landfills. In fact, the team asserts that 88% of the waste generated at the construction site is intended for recycling. Their goal is to raise this percentage to 90% by the end of year 2014.

SAE was able to achieve an efficient waste management during construction against the lack of public waste infrastructure and management in the neighboring communities. In terms of diverting community waste from landfills, there is a lack of waste infrastructure in the area as waste collection and management are in serious need. The waste produced by residents of the right bank of the Madeira River is almost either taken by public service or burned. The project team can help delineate a waste management plan that can include community waste management that can continue beyond the construction period.

Although there are guidelines for excavated materials, it is not clear what is the percentage of material that has been retained on site, which has lowered the project performance in this aspect. In order for the hydroelectric to perform better, at least 30% of the excavated material must be retained on site. The project team asserts that most excavated material is reused in the construction site itself.

Reducing excavated materials taken of site was also a complex issue since during the excavation works on the Madeira Riverbed; the presence of mercury needs to be monitored. Upon sampling, all extracted materials are tested to check how to dispose of them, materials with mercury need to be landfilled, materials with below permitted mercury levels will be disposed as deposit surplus material.

Providing for deconstruction and recycling performed low. The intent is to encourage future recycling, up cycling and reuse of infrastructure by designing for ease and efficiency in project disassembly or deconstruction the end of the useful life of the project. There is no documentation on the percentage of components that can be easily separated for disassembly or deconstruction. No evidence was found on how the project infrastructure will adapt to future environmental conditions.

Energy

The energy subcategory goals are to reduce overall energy use, particularly from non-renewable fossil fuel sources. Saving energy is a topic often times overlooked by energy generation projects such as the Santo Antonio hydroelectric plant.

Energy consumption from operations can represent a significant amount of energy that can be used elsewhere. Reducing energy consumption should be encouraged in order to conserve energy and have a better performance. This can be achieved by reducing overall operation and maintenance energy consumption throughout the project lifecycle.

The best performance observed is in the use of renewable energy, as the credit looks into how projects meet energy needs through renewable sources. Santo Antonio hydroelectric main goal is to be a net positive renewable energy generation in the region. The project generates a significant net positive amount of renewable energy capable to give power to 45 million people with its installed capacity of 3568 MW once the construction is completed. According to Envision, hydropower is considered renewable energy along with solar, wind, biomass, among others. The hydroelectric project is generating clean and renewable energy source, however, for its implementation conventional sources are used. There are synergy opportunities for more renewable energy generation and input into the national grid if other infrastructure projects are bundled, such as a waste to energy projects.

To get a higher achievement and proper functioning of the energy systems and extend the useful life, the project must specify commissioning and monitoring of its energy systems performance. According to the project team, the project was scaled to the conscious and rational use of electrical equipment and mechanical systems, while respecting the specificities of its scope defined in your auction and cannot be changed. Third party commissioning of the electrical or mechanical systems is recommended at least once during the useful life of the project. Long-term strategies are needed to back up these requirements, which help enable a more efficient hydroelectric plant.

Water

The Water subcategory seeks to reduce overall water use particularly potable water sources. Protecting fresh water availability should be an important goal for infrastructure projects, especially for hydroelectric projects. Infrastructure projects performance can assesse higher if there is negative net impact on freshwater availability, quantity, and quality. Also it looks to how much water the project needs and if the project is designed to protect water sources.

Santo Antonio hydroelectric performed well in protecting fresh water availability by having

total water management. Since the project is a hydroelectric plant, it utilizes directly the water flow of the river Madeira. The project team has taken especial care in monitoring pollutants in the water. For example, the water quality is monitored trimonthly considering over 60 physical, chemical and biological parameters, as well as samples from multiple sites that are reviewed periodically.[17] It is expected that such monitoring to be extended to the end of the grant of hydropower. According to the project team the Brazilian National Water Agency (ANA) exempted the need for granting water for the project because of the low rate of consumption and the low amount of funding. IBAMA also regulates the river water use by asking for royalty payments for water use with the purpose of energy generation.

In reducing potable water consumption there is no indication of how the project reduces consumption and encourages the use of greywater, recycled water and storm water to meet water needs. To be able to evaluate water use reductions, calculations on the estimated water consumption over the life of the project, as well as an inventory of measures taken to reduce potable water use during operations are needed.

Currently, the water supply that is connected to the public grid in Porto Velho, meets only 30.6% of the urban and rural population of the municipality (the national average is 90%). On the outskirts of the urban centers of Porto Velho, most families depend on ponds wells (also known as Amazonian wells), of 10-15 meters depth, from where each family takes on its own drinking water. Porto Velho is one of the Brazilian national capitals with the lowest rate of available infrastructure for basic services. The project can achieve the highest level if the project has net zero impact and recycles water. Further water recycling can include treating the community sewage to clean water that replenishes the Madeira River. Considering the lack of infrastructure in the area this can be a synergy worth pursuing.

In terms of monitoring water systems, there was a medium performance as there are operations monitoring in place, but not done through a third party. All monitoring in the project is responsibility from the project sponsor, not from an independent authority.

6. NATURAL WORLD CATEGORY

Natural World focuses on how infrastructure projects may impact natural systems and promotes opportunities for positive synergistic effects. Envision encourages strategies for conservation and distinguishes projects with a focus on enhancing surrounding natural systems.

[17] SAE.

Natural World is further divided into three sub-categories: Siting, Land and Water, and Biodiversity.

Siting

The Siting subcategory is about assessing how projects should be sited to avoid direct and indirect impacts on ecological areas of importance.

Avoiding development in areas of high ecological value is difficult to achieve when building a hydroelectric in the Amazon. According to IBAMA, the management of natural resources in the Amazon should be based on profound scientific knowledge about the functioning of ecosystems, due to the high biodiversity and complexity of the interactions of organisms with one another and with the physical environment. The low availability of scientific knowledge about the habitats in the area has been a challenge in identifying the Madeira River area as prime habitat. In this sense, the exploration of these areas has helped to document local species, an endeavor considered to be a contribution for the natural sciences.

The project performance in preserving prime habitat is low, since development on the Madeira River was not avoided. The impacts of Santo Antonio hydroelectric on the native flora cannot be disregarded despite its relatively reduced flooding area when compared to other Amazonian hydroelectric projects. The building of this infrastructure will inevitably promote deforestation of forest areas for deployment of infrastructure and civil works. The creation of Santo Antonio hydroelectric reservoir is expected to remove 10,448 ha of open rainforests and low alluvial land to clean the flood areas. A positive aspect about the deforestation for construction in this area is that it will provide access and opportunity to collect large number of botanical samples of great scientific value, which can be considered a small compensation considering the magnitude of the loss.

Performance in preserving wetlands and surface water was also low. The Santo Antonio hydroelectric does not avoid development on wetlands, shorelines, and water bodies, as it is located inside the Madeira River. Impacts on these areas are inevitable and irreversible, due to the permanent flooding. All riparian habitats along the water body stretch between Santo Antonio waterfall and river confluence of the Abuna, should be affected due to changes in the hydrological regime caused by the Madeira river. The areas closest to the dam should suffer greater impacts due to the increased flooding, more than stretches downstream of the reservoirs. The disappearance of most plant communities adapted to the flood pulse of the Madeira River would prevent the implementation of programs in situ conservation for species that occur in these environments, as is recommended by IBAMA.

Despite not having soils designated as prime farmland of national importance, performance in preserving farmland was low. There is agricultural activity in the area that is done by the riverine communities in soil not officially allocated or zoned for agriculture, which were flooded for the project implementation. Technical assistance, land and monetary compensations were given directly to the resettlement families who had lost their plots for agriculture.[18]

The hydroelectric performed better in avoiding adverse geology. The siting of the project offers protection and risk management as it takes advantage of the rocky outcrops of the Sao Antonio falls to construct the dam. According to the documentation, there is no evidence that the Santo Antônio reservoir may induce earthquakes. However, due to the relative proximity of the Andes, a recognized high seismic activity area, and considering the history of natural regional earthquakes, possibly some associated with geological structures and the occurrence of a recent natural earthquake of magnitude 4.2 on the Richter scale located about 200 km from the dam axis, it was recommended to implement a seismological monitoring program.

Efforts done by the project team to avoid floodplains or maintain predevelopment floodplain functions performed better, but still in the lower end. Preserving floodplain functions is usually achieved by limiting development and development impacts to maintain management capacities and capabilities. In the case of the Santo Antonio hydroelectric, the floodplain functions were drastically modified to accommodate for the reservoir and the hydropower generating facilities such as the turbines and powerhouses. The project modified the topography to raise the water level to 70.5m to create the minimum level for the reservoir, and the maximum at 71.31m. This changed the average annual river runoff predevelopment volume from 594.4 billions of m3 to 587.4 billions of m3. Although the project does alter the floodplain functions, the project team tried to mitigate impacts with various compensatory programs. The infrastructure design also helps to mitigate the impacts because the hydroelectric plant does not have a reservoir for water retention, reducing the flooded area.

Avoid unsuitable development on steep slopes also scored in the lower end. Amongst the adverse impacts from the hydroelectric implementation, there are: solids retention in the reservoir changing the water quality, and increased erosion potential of the Madeira River. The project team follows best management practices to manage erosion and prevent landslides by delineating mitigation in the hydrosedimentological monitoring program.

According to documentation the hydroelectric is located in what is mostly considered a greenfield although its location is not remote, as it is 7 km from Porto Velho, the capital of

[18] SAE.

Rondonia. Within the site some areas are classified as were previously developed with about 2,000 people living in there, mostly in the southern bank of the river. In order to restore this greyfields into greenfields, most of the communities living in the river margins and within the buffer zones will be displaced. The land use map shows that in the direct influence area includes a contour of 70 m, which delimits the reservoir size, there are anthropic areas, different types of forests and shrubland. Roughly, the map indicates that at least 25 % of the site is located on a greyfield, due to the anthropic areas, previously developed mostly on the right bank of the Madeira River.

Land & water

The Land and Water subcategory stipulates that infrastructure projects should have minimal impact on existing hydrologic and nutrient cycles. The evaluations of land and water are threefold: To manage stormwater, reduce pesticides and fertilizer impacts, and prevent surface and groundwater contamination.

This is achieved by managing stormwater that can carry contamination. The hydroelectric performed low in managing stormwater. Considering that the location of the hydroelectric project is in a rain forest, the amount of rain that hits the ground is extreme. According to the project team, the water that passes through hydroelectric is not stored, including rain, thus not having need of treatment. There are water quality monitoring programs conducted by the project in the Madeira River. In terms of quantity, it is not clear if the hydroelectric works will reduced or increased the storage capacity of the basin. Since the hydroelectric is a run-of-the-river model, water is not exactly stored to increase storage capacity for storm water.

In reducing pesticides ad fertilizers impacts there was a better performance. There is intent in reducing pesticides and fertilizer impacts with application management practice. According to the zoning developed for the direct area of influence, the diverse use zone consists of areas that are currently being developed for agriculture, fishing, agroforestry and forest use activities, with a predominance of an accelerated deforestation process of occupation and conversion into agricultural land.

For surface and groundwater contamination prevention was assessed the highest in this subcategory. The project team has implemented several environmental programs that include long term monitoring of surface and groundwater quality, in order to reduce the impacts caused by the project construction and operation. In order to prevent contamination of the water the team has put in place the following comprehensive monitoring programs from which stand out: the environmental program of construction the environmental management system, the monitoring program of the water table, the hydrosedimentological monitoring program,

hydro biogeochemical monitoring program, and the limnology and aquatic macrophytes monitoring program.

Biodiversity

The Biodiversity subcategory encourages infrastructure projects to minimize negative effects on natural species and habitats located in or nearby the site.

Biodiversity protection is achieved by preserving and restoring habitats. This represents the highest performance achieved by the project in the Natural World category. The hydroelectric will have a big impact into the biodiversity of the river, but at the same time can preserve them through comprehensive mitigation strategies during construction and post-construction of the dam. Western Amazon is considered to be one of the regions with the highest biodiversity in the world, due to high precipitation rate throughout the year and the presence of fertile soil. Because of the diversity of river streams and the heterogeneity of landscape, where in some instances two distinct landscape habitat or ecotones intertwine may have important ecological significance.

Since August 2008, several teams have monitored the movement of animals that inhabited places of the Amazon forest and farms located in the construction site where the dam and reservoir are located. During the implementation of the Santo Antônio, there is intense work of rescuing the animals that inhabited the reservoir areas were done to ensure their conservation and avoid impact on the local fauna. Several mitigation and monitoring programs have been instituted in the project, which include fish in the ichthyofauna conservation program and wildlife protection in the wildlife rescue program.

In controlling invasive species the project performed well. The use of appropriate non-invasive species and control is helpful when eliminating invasive species. There is no documentation supporting that the control of exotic species is done in the area of the project implementation. In terms of using locally appropriate plants, Santo Antonio Energia conducted a forest inventory and obtained a list of native species to be used in reforestation.

Controlling invasive species is limited to the Permanent Protection Area (APP) located around the reservoir. The project team works with state and local agencies to identify and use locally appropriate plant species. During the deforestation of the areas where the hydroelectric and reservoir would be implemented, plant nurseries were established to be able to reinstate them in the APP area.

In terms of restoring disturbed soils the project performed much better. There are various

programs to restore soils disturbed during the construction of the hydroelectric, in order to bring back ecological and hydrological functions. The project team will embark on the restoration of all soils disturbed in the construction of the site's disturbed area.

For maintaining wetland and surface water functions, the project performed well. In terms of ecosystem functions that are maintained and restored, three functions are clearly addressed in the mitigation and monitoring programs: hydrologic connection, water quality, and habitat. In order to maintain wetlands and surface water functions of the Madeira River, streams and riparian areas, the project team developed certain mitigation and monitoring programs, such as the monitoring program of the water table, the hydrosedimentological monitoring program, hydro biogeochemical monitoring program, and the limnology and aquatic macrophytes monitoring program. The project maintains the hydrologic connection of the Madeira River by utilizing a run-of-the-river hydroelectric, which disrupts the water flow to a lower extent than other types of development. In terms of habitat maintenance, the proposed strategies to mitigate obstructions to habitat connectivity for spawning fish are significant. The installed mechanism at the Santo Antonio hydropower plant is the Fish Transposition System or fish ladder.

Innovation credit

There are innovations in preserving species biodiversity with numerous programs designed for monitoring, wildlife rescue and habitat restoration within the basic environmental program (PBA) that exceed industry norms and requirements. Many of the subprograms are considered advances in the industry and innovation to the science fields.

With the species rich environment of the Amazon, where even new species were found while implementing the infrastructure, innovative approaches to preservation and leaving a knowledge legacy in the area are highly necessary. For example, just for the fish fauna were identified 459 fish species belonging to 245 genera, 44 families and 11 orders. For the herpetofauna group was recorded 110 species, 65 of amphibians and 45 reptiles (21 species of lizards and 16 snakes, alligators four and three turtles). There was also the record of 24 possible new species of amphibians.

In terms of innovations in the industry, there are structural systems for mitigation and biodiversity preservation, the log interceptor program, and the fish transposition system. The Fish Transposition System is a corridor, which reproduces the river characteristics, with rapids, natural barriers and a compatible opening, allowing the fish to get used to this new system and follow their natural cycle. The system started operating progressively since December 2011 and

successfully completed its first spawning season with the hydroelectric plant already in operation. The project sponsor via radio telemetry technology has monitored the efficiency of the system. Over 200 fish received radio transmitters to show their location in the river. Another technology instituted for the fish transposition is the use of sonar, which forms images and shows the fish trajectory, even within the muddy waters of the Madeira River.

The development of activities under these programs, therefore, contributes to the knowledge of a region of great flora and fauna diversity of the world. It is intended to mitigate environmental damage, and contribute to the depth of knowledge about the local botanical specimens. This important scientific work will interact with the regional scientific community, thus contributing to the strengthening of the structures of important Amazonian research institutions. It will also enable the implementation of relevant botanical and ecological studies, the improvement of researchers from collaborating institutions and the training of qualified staff, undergraduate and graduate, in a region still lacks human resources in the environmental area. In addition to scientific publications, dissertations, theses and graduate monographs, there will also be publications for dissemination to society in general, with high quality informative content.

7. CLIMATE & RISK CATEGORY

Envision aims to promote infrastructure development that are sensitive to long-term climate disturbances. Climate and Risk focuses on avoiding direct and indirect contributions to greenhouse gas emissions, as well as promotes mitigation and adaptation actions to ensure short and long term resilience to hazards. Climate and Risk is further divided into two sub-categories: Emissions and Resilience.

Emission

The Emissions subcategory goal is to understand and to reduce dangerous emissions that include greenhouse gas emissions as well as other dangerous pollutants during all stages of a project's life cycle. These emissions can increase both short and long-term risk to the project.

The Santo Antonio hydroelectric is considered to generate low emissions electricity that will be delivered to the national power grid; thereby displacing CO2 emissions from fossil fueled grid-generated electricity. According to the Clean Development Mechanism Project Design Document Form (CDM-PPD), the estimated annual emission reductions in metric tons of CO2 provided by the project participants of the Santo Antonio hydroelectric project are 5,146,403

tons per year. The estimations of the emissions reductions during the project's concession are 51,464,028 tons using 3,150.4 MW as the installed capacity per year.

The Santo Antônio plant produces 8.5 megawatts per km²de reservoir, which is twice the minimum energy efficiency to generate carbon credits. With the use of the bulb turbine that generates power using river flow, the reservoir area is three times lower than that of conventional plants using turbines. The reservoir is 421,56 km² area, is slightly larger than the area occupied naturally by the river in the rainy season.

Through their air pollutant emissions mitigation strategies, the Environmental Construction Program (PAC) and the Environmental Management System (SGA), help position the project as having negligible air quality impact. The PAC aims to prevent and control the direct impacts generated by the construction and implementation activities, to avoid any process that can trigger environmental degradation of their direct influence area. It provides environmental criteria and procedures to be included in the agreements with the construction companies and services that contribute to the implementation of the project, including its subcontractors.

Resilience

Resilience includes the ability to withstand short-term risks, such as flooding or fires, and the ability to adapt to changing long-term conditions, such as changes in weather patterns, sea level rise, or changes in climate. Understanding the types of risks and probability of risks allows the project team to deliver and informed project design that anticipates and withstands or adapts to these risks, minimizing its overall vulnerability.

In assessing climate threat, having a comprehensive climate impact assessment and adaptation plan helps achieve a better performance. Santo Antonio hydroelectric does not count with such plan, but the project team has taken steps to prepare for climate variation and natural hazards by monitoring climate and creating a database that can serve to create an impact assessment and adaptation plan. A meteorological monitoring program has been implemented by installing a network of stations that produce local data, supplementing existing data from other nearby stations, data for the Santo Antonio hydroelectric and other projects and activities in the region. Monitoring the weather will be permanently held during the lifetime of the Santo Antônio hydroelectric plant.

Flow rates of Madeira are influenced by the local rainfall and melt water from the Andean slopes, which with climate change could be subject to flooding threats or low flow, which would translate into less energy production capacity. The creation of monitoring stations and

database over the life of the project will be useful for developing a plan that surveys the important and potential impacts of climate change that can inform project design adaptations or future projects.

The project performed low in the long-term adaptability preparedness. Plans and designs need to have be created and implemented to prepare for long-term climate change including the effects of increased intensity and frequency of extreme weather events. Monitoring programs instituted by the project's team can serve to prepare the hydroelectric to be resilient to the consequences of long-term climate change, be able to perform adequately under altered climate conditions, or to adapt to other long-term change scenarios.

In preparing for short-term hazards the project performed somewhat well. The team has considered the types of natural and man-made hazards that are possible in the region such as floods and earthquakes, and have installed numerous environmental monitoring programs that will shed light on how to deal with short-term hazards as well as long-term ones.

For instance, in terms of public health hazards, the project team invested in preventing the occurrence of diseases and conditions that lead to the need for hospitalization and increased pressure on scarce hospital services. Reforestation efforts can also serve to deal with hazards that can lead to erosion and water quality and environmental issues that can increase vulnerabilities against climate change.

There is potential to manage heat island effects in the project, as the performance of the project in this aspect is negligible. Minimizing surfaces with a low solar reflectance index (SRI) will contribute to reduce localized heat accumulation that can alter microclimates that can affect the ecologies in the area of direct influence as well as in the resettlement areas.

8. SUMMARY AND CONCLUSION

The location of the Santo Antonio hydroelectric is complex as it is located both in the Amazon rainforest as well as next to Porto Velho, an urban area with a population of about 600,000. Porto Velho is the Rondônia state capital and is just 7 km from the hydroelectric. It rates as one of the Brazilian national capitals with the lowest rate of available infrastructure for basic services. Besides, the area presents an incremental deforestation trend in the use of land for agriculture and cattle, which is considered detrimental to the Amazonian ecosystems.

The **Quality of Life** category is the second best performing category in the Envision assessment. Within the three subcategories, Wellbeing and Community are the best achieved, while Purpose made a good performance. In the Purpose subcategory there is a good overall performance that highlights the improvements to the community quality of life, as well as how the project stimulates sustainable growth and development by providing jobs and increasing productivity and renewable energy capacity in Northern Brazil.

At the national scale it provides solutions for the electric energy market and enhances the competitiveness of the Amazon region. It will allocate up to an average of 600 megawatts to Rondônia by 2016, allowing the gradual disconnection of traditional thermoelectric plants. At the regional and national scale, quality of life will not only be improved with an influx of clean power, but also with an increment of available public resources due to royalties that Santo Antônio hydroelectric will pay for using the Madeira River.

Although the Madeira River is in a transnational basin, the area considered for impacts mitigation was strictly limited to IBAMA's terms of reference for the Area of Direct Influence (AID) delimitation for hydroelectric projects. The area considered is the flooded area at the maximum level of the reservoir plus the Area of Permanent Preservation (APP) displacing many riverine communities to a count of more than 2,000 persons that have been relocated.

In the Community subcategory, improvements to public health development are outstanding. The project team has health and safety standards above any of required regulations. In fact, these initiatives have won a prestigious award in the Tropical Medicine for actions with measurable results against vector-borne diseases such as malaria, usually associated with the water held in a hydroelectric plant. Special attention has been placed on the needs of the indigenous neighboring communities, as are the Karitiana, Karipuna, and Cassupá communities.

In mobility and access, the hydroelectric performed best by supporting and investing in the mobility plan of Porto Velho Urban Mobility Plan (PMob). The PMob emphasizes public transportation service, road traffic data, infrastructure, and accessibility for people with special needs, integration of public transport with private, non-motorized transport, major generators of travel centers, public areas, and private parking and transportation loads.

The subcategory of Wellbeing had a good performance as well as room for improvement. The Santo Antonio hydroelectric project has taken several steps to identify, preserve or restore cultural resources according to the programs created related to the archaeological, prehistoric and historic heritage of the area, and in compliance with Brazilian regulations. In total, 58 archaeological sites were found, of which 43 are pre-colonial sites and 15 are historic sites.

In terms of natural heritage sites, the project had a lesser performance by not protecting natural and cultural features such as the Santo Antônio and Teotônio waterfalls. These waterfalls have succumbed due to the construction of the plant in order to allow for hydroelectric use, displacing neighboring communities as well. Despite this impact, the project team contributed to the preservation of local heritage sites, such as the historic Madeira Mamoré Railway.

In enhancing the public space, Santo Antonio obtained the highest score, as the team has prioritized the improvement of existing public space, creating parks, tourist venues, sport facilities, cultural centers and wildlife viewing areas.

The best achieving category is **Leadership**, which presented an overall good balance between its three subcategories. In the Collaboration category, the Santo Antônio Energia (SAE) is providing effective leadership and commitment to improve sustainable performance by adopting the Equator Principles. Among the 28 environmental mitigation programs that comprise the Basic Environmental Project (PAC), two are intended for sustainable management: the Environmental Management System and the Environmental Program for Construction. Appropriate roles and responsibilities are assigned within SAE's sustainability leadership based mainly in Porto Velho and in Sao Paulo.

The hydroelectric performed well in terms of teamwork, consultation and communication with stakeholders. Participation by affected parties is fostered in the development, revision and implementation of the project. The project team has also established a goal to reduce impacts on indigenous communities.

Outstanding performance from SAE is achieved by providing for comprehensive stakeholder involvement. Due to the large scale of the hydroelectric project's area of influence, the SAE project team has been able to build good relationships with the directly affected communities.

In the Management subcategory, SAE achieved another outstanding performance improving infrastructure integration by taking into account the operational relationships with the community and providing energy to the northern region of Brazil. But in relation with synergies opportunities more broad and aggressive strategies for the pursuit of by-product synergy opportunities should be considered, which can help reduce further waste, improve project performance and reduce costs.

In relation with planning, a comprehensive maintenance and monitoring plan has been prepared in advance to the project's completion. Santo Antônio hydroelectric plant has a concession period of 35 years for operation, granted by the Brazilian Federal Government. Sufficient financial resources have been put in place to cover the monitoring and maintenance plans. There is opportunity in planning and identifying resources for long term monitoring and maintenance beyond the 35 years of concession, as the project life is required to be 100 years according to Brazilian regulations for hydroelectric plants.

The project team can extend further the boundaries of useful life and perform more aggressive full life cycle thinking that can be incorporated into the design and planning of the project, which could lead to improve the durability, flexibility and resilience of the hydroelectric to uncertain future threats.

The **Resource Allocation** category has the lowest performance, and presents the most potential for improvement. The Materials subcategory proves to be the one with the lowest scores in the whole assessment. Use of recycled, reused and regional materials are areas that can be improved and can be addressed by the hydroelectric project team by inventorying all materials used by the project by weight, cost or location. Within Materials, diverting waste from landfills performed somewhat well but presents opportunities for performing better. According to the team 88% of the waste stream generated at the construction site is intended for recycling, diverting it from landfills. Another highlight of the Materials subcategory is obtaining materials and equipment from suppliers that follow procurement practices that implement sustainable practices.

The Energy subcategory presents the best Resource Allocation performance. The most outstanding area is the rocketing of net positive renewables through the generation of renewable energy due to the typology of project, a large-scale hydroelectric plant with capacity to power 45 million people. Still there is room for improvement in saving energy, usually overlooked by large-scale energy generation projects such as the Santo Antonio hydroelectric plant.

The Water subcategory had a good performance in protecting fresh water availability. There is room for improvement in reducing potable water consumption, and in increasing water system monitoring by third parties.

The **Natural World** category is the fourth best achieved by the project. Despite the lower-end performance, the Biodiversity subcategory presented good achievements. The project achieved outstanding in goals of preserving species biodiversity, which extended to an innovation credit

by having multiple strategies in monitoring, wildlife rescue, restoring habitat, as well as documenting knowledge to further science. The Fish Transposition System is an innovative strategy that tries to maintain hydrological connections for spawning fish, especially for the piramutaba and dourada (golden). About 200 fish were geotagged and monitored to know their where about in the muddy Madeira River waters and test the efficacy of the system. Another assistances of the project to science is the support and collaboration to create the UNITE herbarium, and contributions to the regional INPA Herbarium, Goeldi Museum and other Amazonian and national collections contributing to the activities of teaching and research in botany systematics, phytogeography, genetics, etc.

Madeira River is located in Western Amazon, one of the regions with the highest biodiversity in the world, mostly due to high precipitation rate throughout the year and the presence of fertile soil. For example, in the environmental impact assessment about 459 species of fish were found, as well as 64 species of amphibians, 24 possible new species, 766 species of birds, 83 species of mammals. From these around 59 species are endangered.

Lower achieving subcategories such as Land and Water, need attention from the project team. There is no stormwater management plan, nor specifics about the plan for reducing pesticide and fertilizer impacts. In preventing surface and groundwater contamination a better performance is observed as the project counts with several water monitoring programs such as the monitoring program of the water table, the hydrosedimentological monitoring program, hydro biogeochemical monitoring program, and the limnology and aquatic macrophytes monitoring program.

In the lowest end performance of the assessment is the Siting subcategory, which deals about locating a hydroelectric plant into the Madeira River. Avoiding development in areas of high ecological value is difficult to achieve when building a hydroelectric in the Amazon, as siting does not help in preserving prime habitat, wetlands and surface water, or prime farmland. In terms of preventing adverse geology, avoiding steep slopes performed regularly well. This better performance indicates precautions taken by the project team to avoid erosion. For instance, more data on seismic activity due to the relative proximity of the Andes can help to prepare the dam for future scenarios. Currently, there is no evidence that the Santo Antônio reservoir may induce earthquakes, through the seismological monitoring program data gathered can indicate issues that require more attention or shed more light on what developing large scale infrastructure in the Amazon means.

The **Climate and Risk** category performed well, making it the third best category overall. The Emissions subcategory is the best achieved presenting the highest performance in the category.

Emissions subcategory performed outstandingly due to the project nomination as a Clean Development Mechanism. The Santo Antonio hydroelectric is considered to help displace CO2 emissions from fossil fueled grid-generated electricity. According to the documentation, the estimated emissions reduction during the project's concession is 51,464,028 tons, if using 3,150.4 MW as the installed capacity per year.

In addition, the energy density achieved by Santo Antônio hydroelectric is about 8.5 megawatts per km²de reservoir, which is twice the minimum energy efficiency to generate carbon credits. With the use of the bulb turbines power will be generated by using the river flow. In terms of design and technology, the reservoir area is three times lower than that of conventional plants using turbines. The reservoir is 421,56 km² area, slightly larger than the area occupied naturally by the river in the rainy season.

The Resilience subcategory needs to get better attention by the project team as not having a plan to face climate change threats puts the hydroelectric and the Porto Velho communities in disadvantage. Nonetheless, the project team has been implementing 28 monitoring programs with subprograms that help mitigate the adverse effects that the hydroelectric places in the environment. The plethora of data that most of the monitoring programs capture can give the Santo Antonio team great advantage to have an overall overview of the project within its context and be able to project future scenarios of operations.

APPENDIX:
APPENDIX A: PROJECT PICTURES AND DRAWINGS

Figure 01: General picture of the project
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 87.

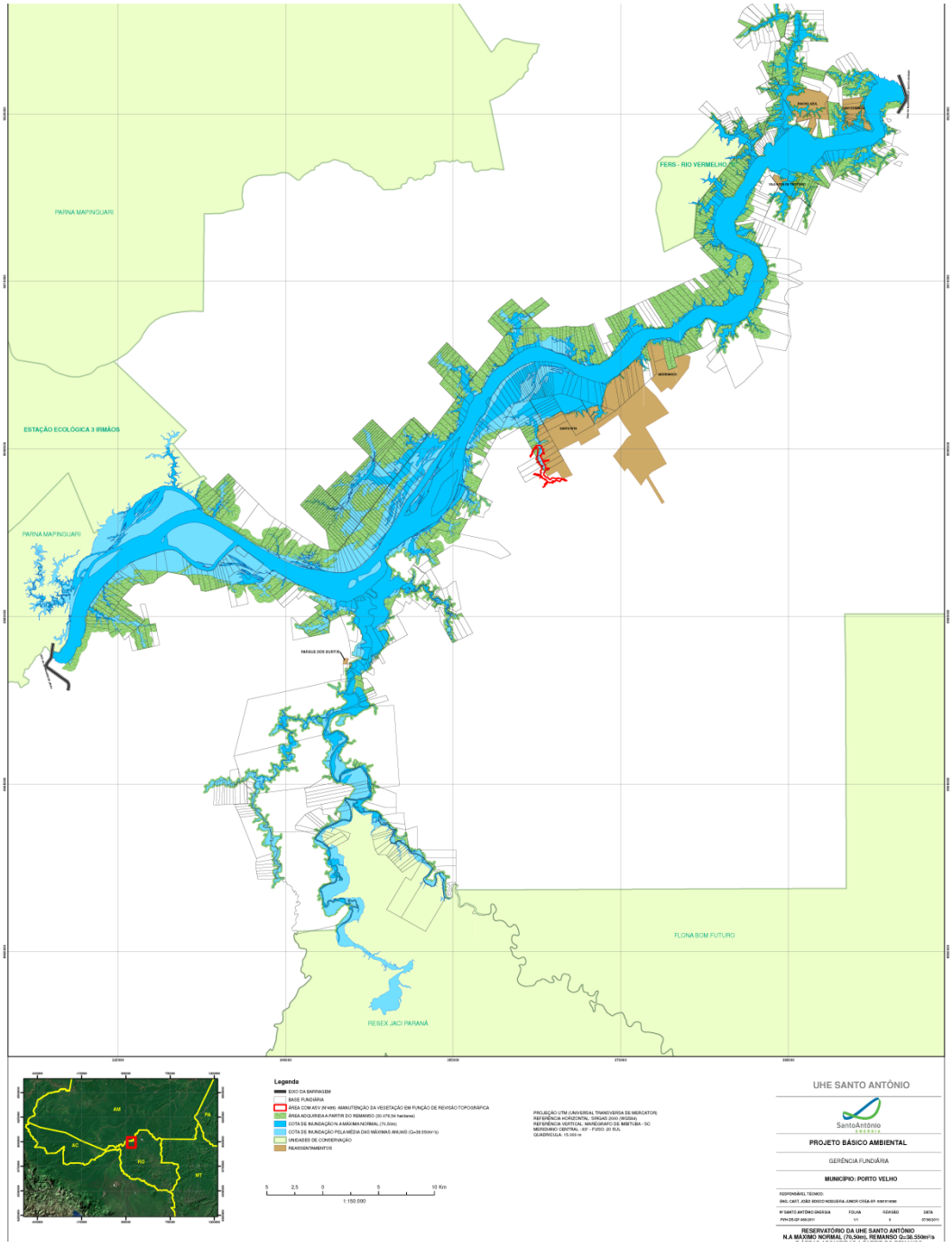
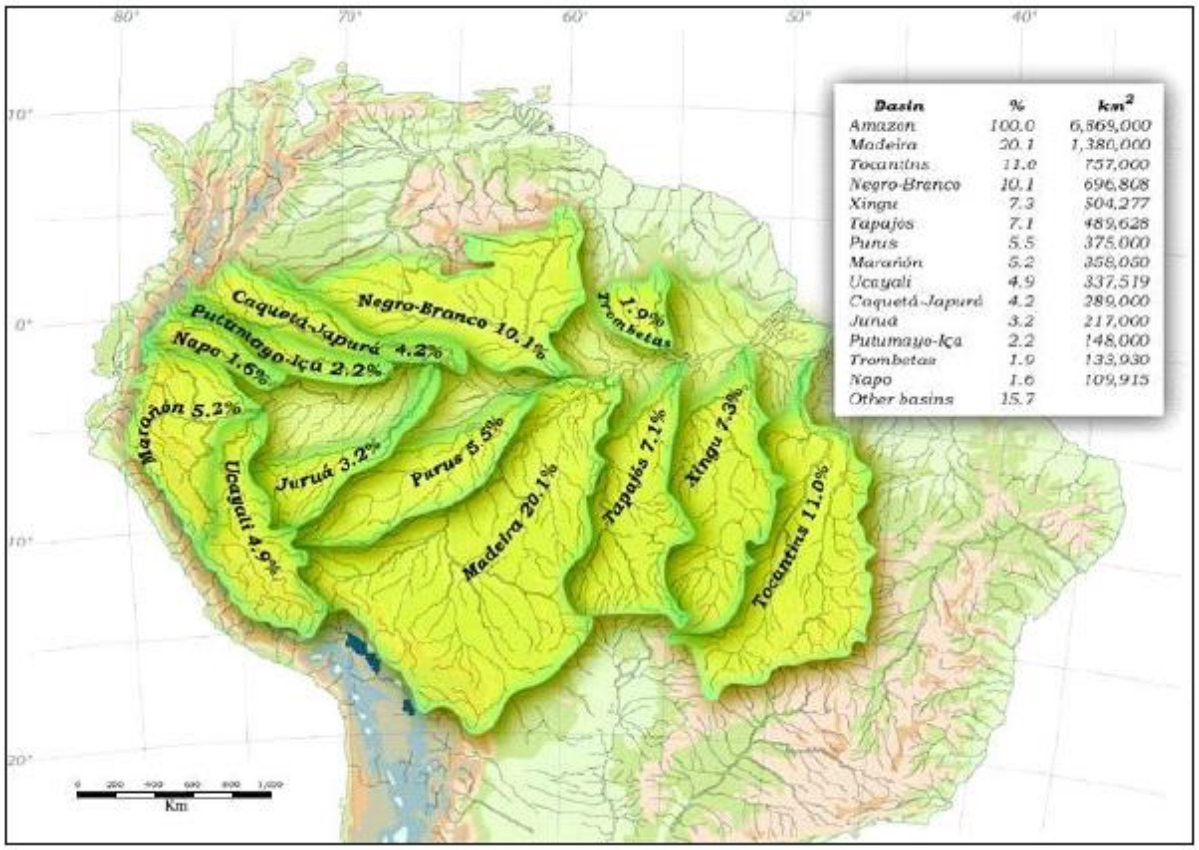


Figure 02: Location map showing reservoir
Sources: Santo Antonio Energia



Basin	%	km²
Amazon	100.0	6,869,000
Madeira	20.1	1,380,000
Tocantins	11.0	757,000
Negro-Branco	10.1	696,808
Xingu	7.3	504,277
Tapajós	7.1	489,628
Purus	5.5	375,000
Marañón	5.2	358,050
Ucayali	4.9	337,519
Caquetá-Japurá	4.2	289,000
Juruá	3.2	217,000
Putumayo-Içá	2.2	148,000
Trombetas	1.9	133,930
Napo	1.6	109,915
Other basins	15.7	

Figure 03: Madeira River one of main tributary of the Amazon River.
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

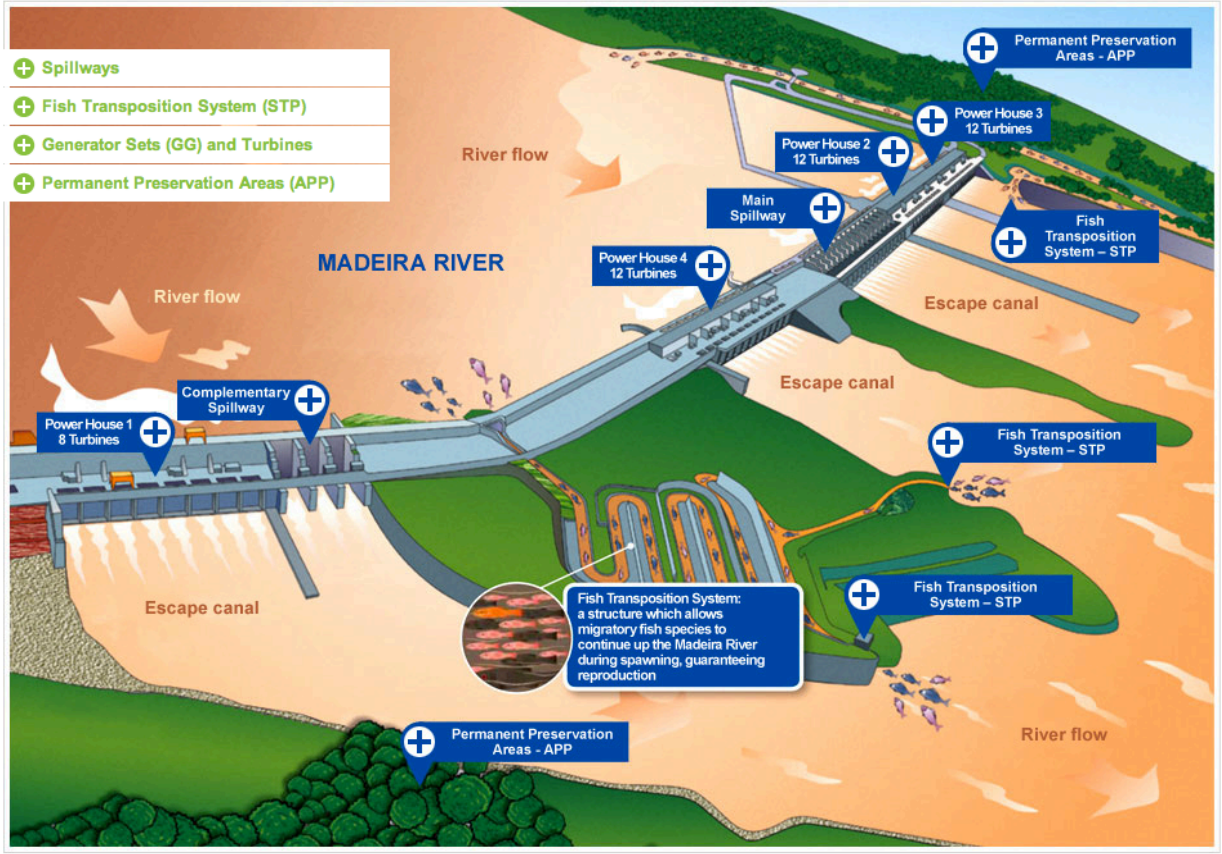


Figure 04: Infographic of the Santo Antônio hydroelectric plant.
Sources: Santo Antônio Energia, acessed in 2014, http://www.santoantonioenergia.com.br/en/tecnologia/infografico/#info

Figure 05: Fish Transposition System
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

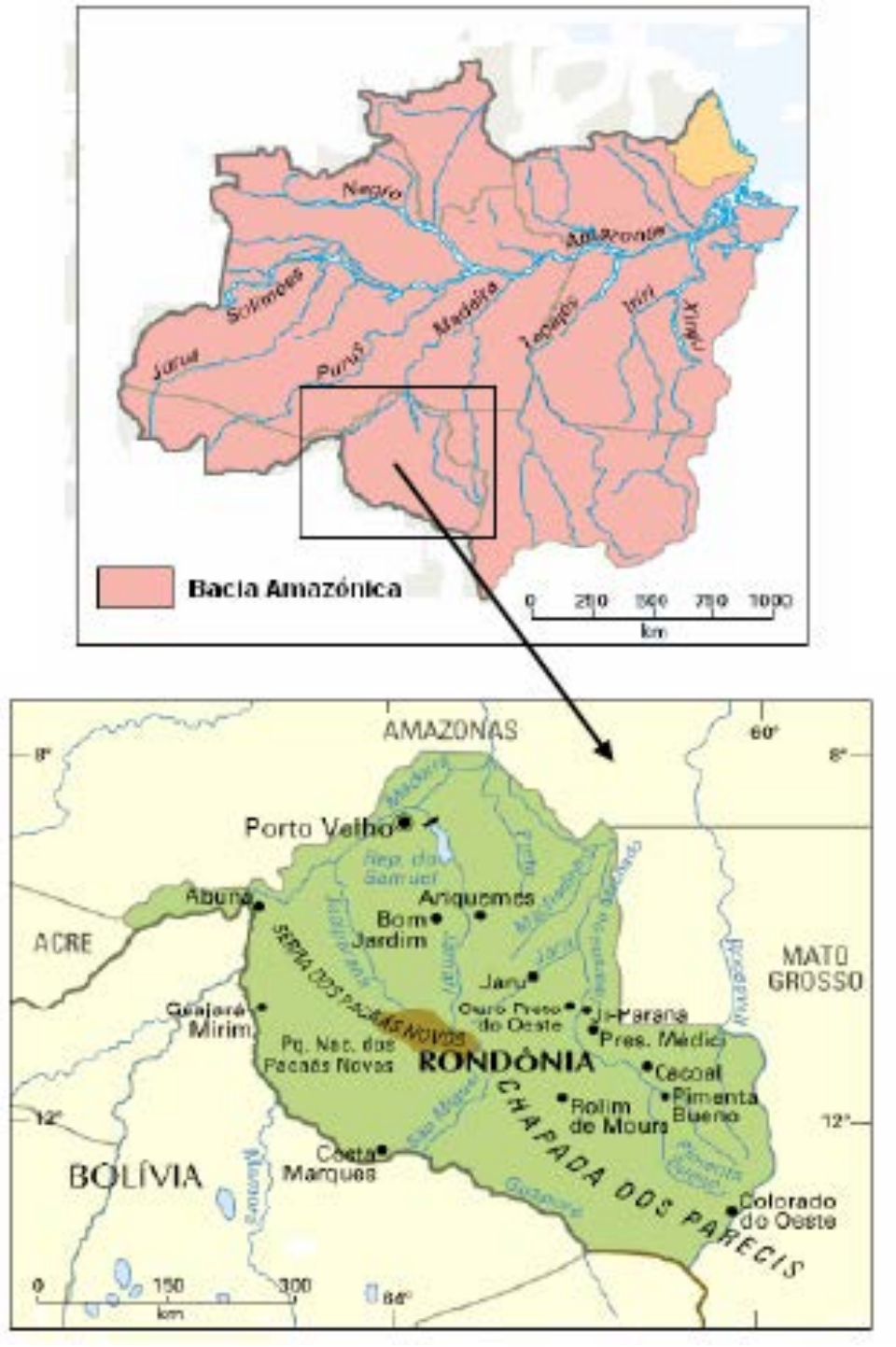


Figure 06: Transboundary location
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

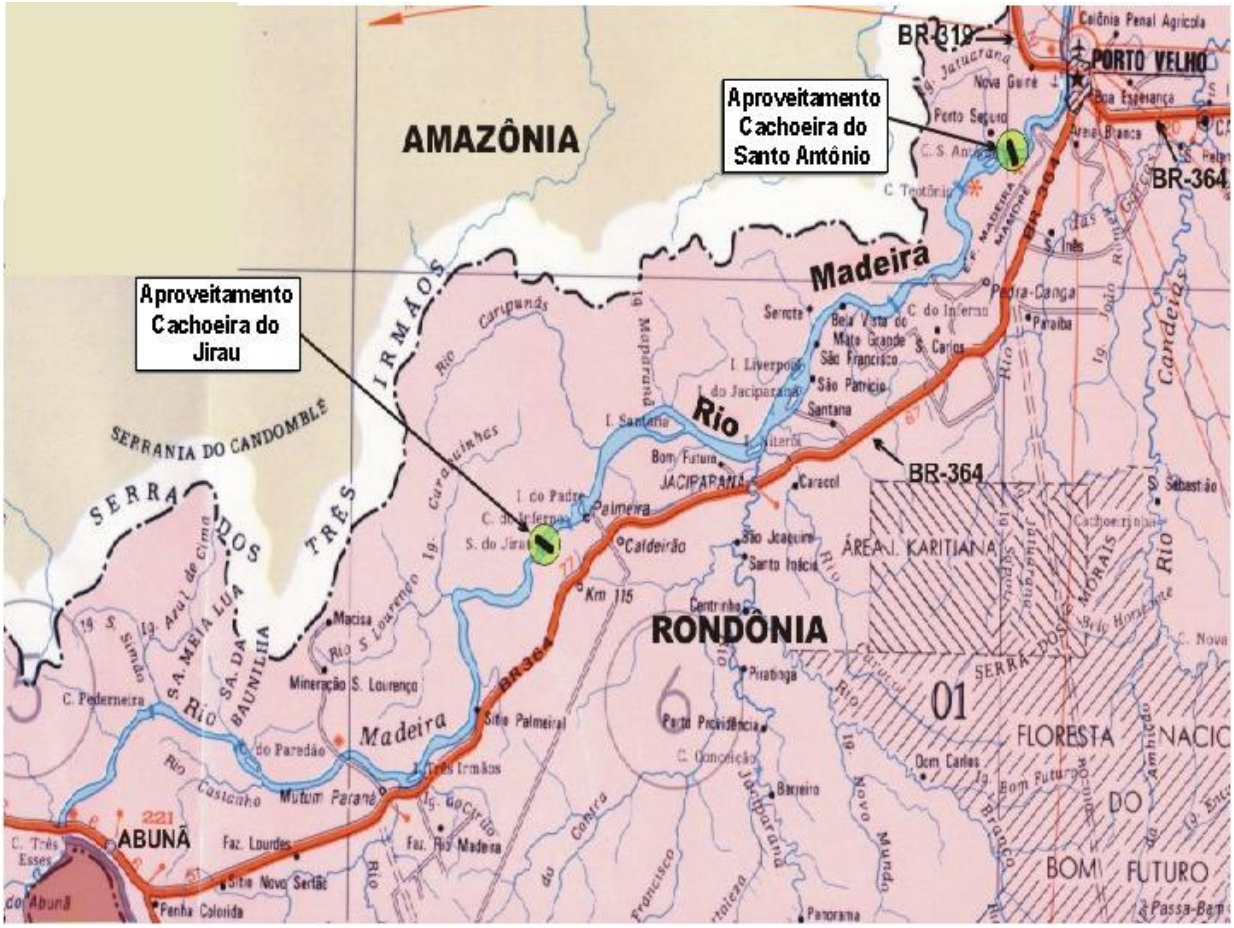


Figure 07: Location of waterfalls used for the hydroelectric location
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

Figure 08: Typical structures on the water
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

Figure 09: Typical structure of riverine community before relocation
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

Figure 10: Gold mining in the river
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

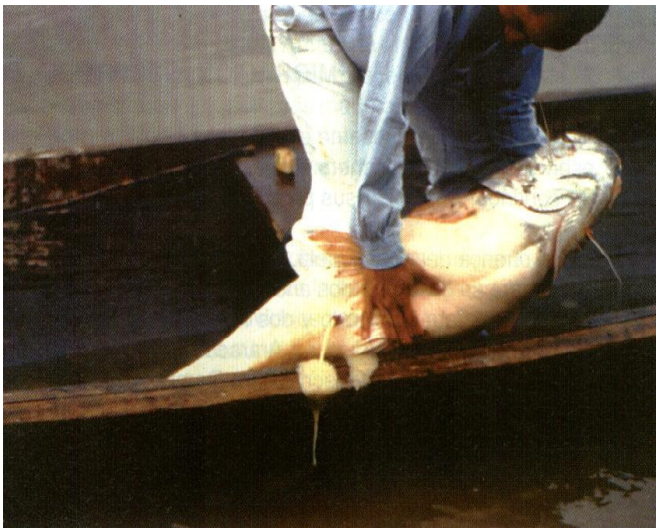


Figure 11: Female dourada (golden) spawning
Sources: Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008).

Figure 12: Agricultural uses in resettlements
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

Figure 13: Resettled neighbor with his banana crop
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).

Figure 14:Reforestation in the permanent protection area (APP)
Sources: Santo Antônio Energia

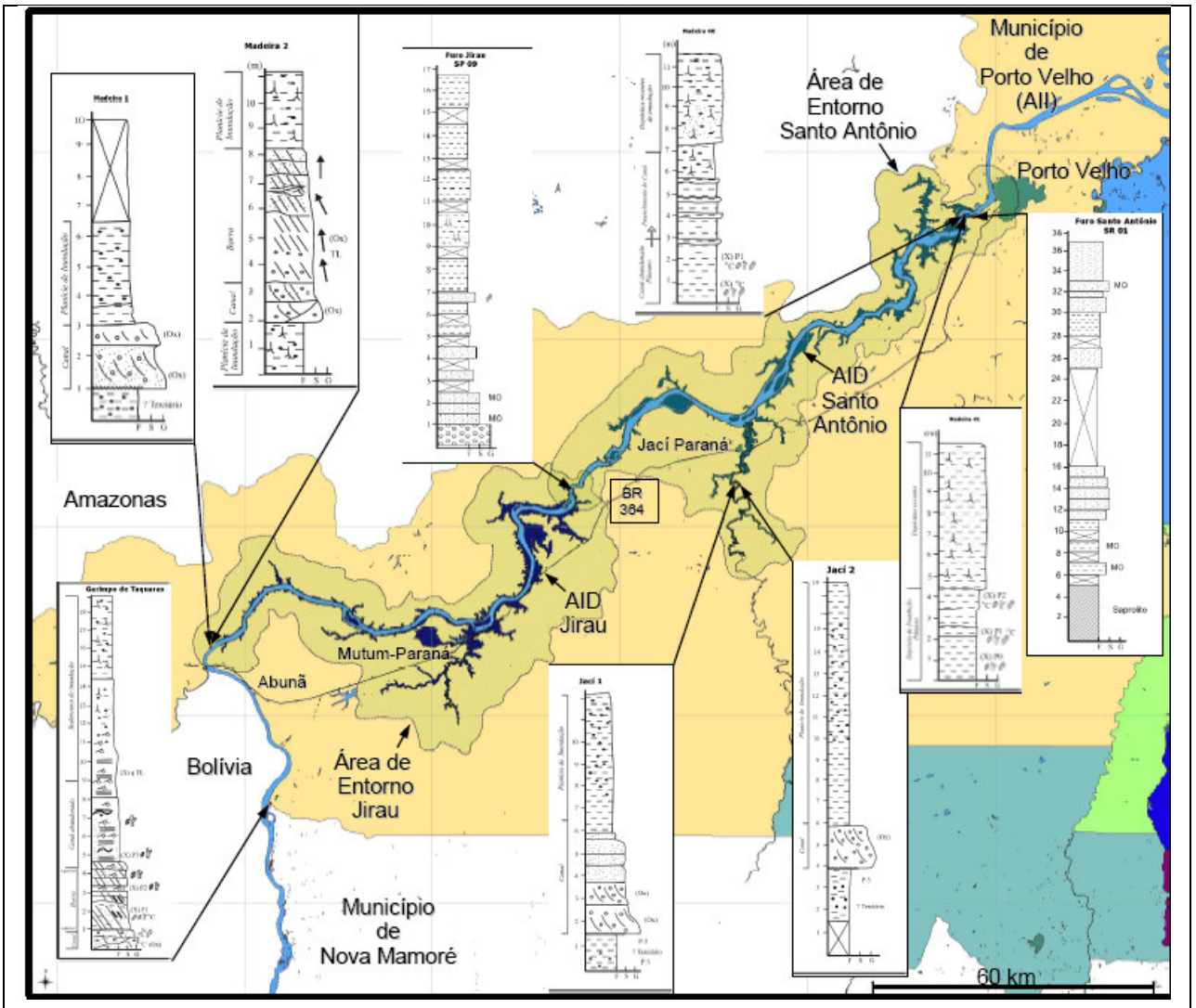


Figure 15: Geology of the area of direct influence
Sources: Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008).

Figure 15: Location of hydroelectric and isolated Indegenous Cassupa/Salamanti
Sources: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 27.

APPENDIX B: ENVISION POINTS TABLE

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve community quality of life	2	5	10	**20**	**25**
2			QL1.2 Stimulate sustainable growth and development	1	2	5	13	**16**
3			QL1.3 Develop local skills and capabilities	1	2	5	12	**15**
4		COMMUNITY	QL2.1 Enhance public health and safety	2			**16**	
5			QL2.2 Minimize noise and vibration	1			8	**11**
6			QL2.3 Minimize light pollution	1	2	4	8	**11**
7			QL2.4 Improve community mobility and access	1	4	7	**14**	
8			QL2.5 Encourage alternative modes of transportation	1	3	6	12	**15**
9			QL2.6 Improve site accessibility, safety and wayfinding		3	6	12	**15**
10		WELLBEING	QL3.1 Preserve historic and cultural resources	1		7	**13**	**16**
11			QL3.2 Preserve views and local character	1	3	6	11	**14**
12			QL3.3 Enhance public space	1	3	6	11	**13**
						Maximum points possible:		**181**
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	2	4	9	**17**	
14			LD1.2 Establish a sustainability management system	1	4	7	**14**	
15			LD1.3 Foster collaboration and teamwork	1	4	8	**15**	
16			LD1.4 Provide for stakeholder involvement	1	5	9	**14**	
17		MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	3	6	12	**15**
18			LD2.2 Improve infrastructure integration	1	3	7	13	**16**
19		PLANNING	LD3.1 Plan for long-term monitoring and maintenance	1	3		**10**	
20			LD3.2 Address conflicting regulations and policies	1	2	4	**8**	
21			LD3.3 Extend useful life	1	3	6	**12**	
						Maximum points possible:		**121**
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce net embodied energy	2	6	12	**18**	
23			RA1.2 Support sustainable procurement practices	2	3	6	**9**	
24			RA1.3 Use recycled materials	2	5	11	**14**	
25			RA1.4 Use regional materials	3	6	9	**10**	
26			RA1.5 Divert waste from landfills	3	6	8	**11**	
27			RA1.6 Reduce excavated materials taken off site	2	4	5	**6**	
28			RA1.7 Provide for deconstruction and recycling	1	4	8	**12**	
29		ENERGY	RA2.1 Reduce energy consumption	3	7	12	**18**	
30			RA2.2 Use renewable energy	4	6	13	16	**20**
31			RA2.3 Commission and monitor energy systems		3		**11**	
32		WATER	RA3.1 Protect fresh water availability	2	4	9	17	**21**
33			RA3.2 Reduce potable water consumption	4	9	13	17	**21**
34			RA3.3 Monitor water systems	1	3	6	**11**	
						Maximum points possible:		**182**
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat			9	14	**18**
36			NW1.2 Protect wetlands and surface water	1	4	9	14	**18**
37			NW1.3 Preserve prime farmland			6	12	**15**
38			NW1.4 Avoid adverse geology	1	2	3	**5**	
39			NW1.5 Preserve floodplain functions	2	5	8	**14**	
40			NW1.6 Avoid unsuitable development on steep slopes	1		4	**6**	
41			NW1.7 Preserve greenfields	3	6	10	15	**23**
42		LAND & WATER	NW2.1 Manage stormwater		4	9	17	**21**
43			NW2.2 Reduce pesticide and fertilizer impacts	1	2	5	**9**	
44			NW2.3 Prevent surface and groundwater contamination	1	4	9	14	**18**
45		BIODIVERSITY	NW3.1 Preserve species biodiversity	2			13	**16**
46			NW3.2 Control invasive species			5	9	**11**
47			NW3.3 Restore disturbed soils				8	**10**
48			NW3.4 Maintain wetland and surface water functions	3	6	9	15	**19**
						Maximum points possible:		**203**
49	CLIMATE & RISK	EMISSIONS	CR1.1 Reduce greenhouse gas emissions	4	7	13	18	**25**
50			CR1.2 Reduce air pollutant emissions	2	6		12	**15**
51		RESILIENCE	CR2.1 Assess climate threat				**15**	
52			CR2.2 Avoid traps and vulnerabilities	2	6	12	16	**20**
53			CR2.3 Prepare for long-term adaptability				16	**20**
54			CR2.4 Prepare for short-term hazards	3		10	17	**21**
55			CR2.5 Manage heat islands effects	1	2	4	**6**	
						Maximum points possible:		**116**
								803

**The five innovation credits are bonus points and not included in total point tallies*

APPENDIX C: GRAPHS

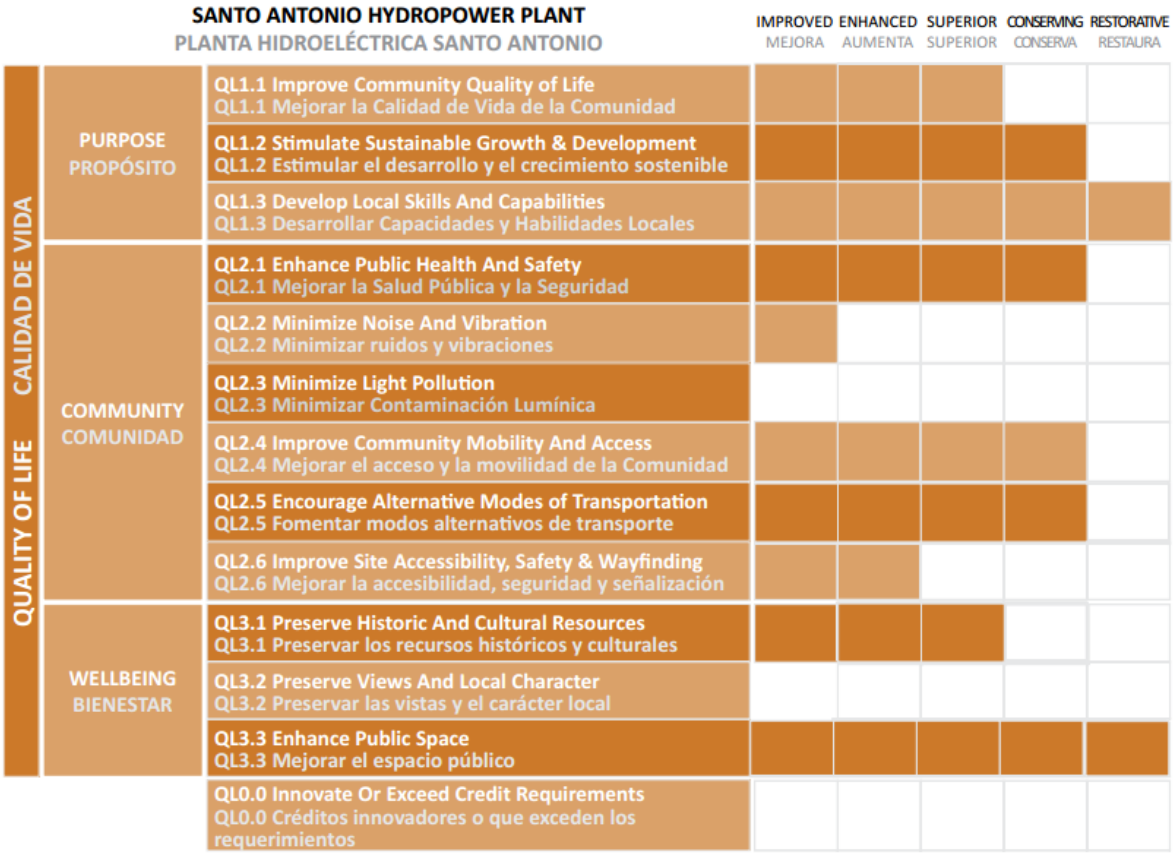


Figure 16: Quality of Life category_ Summary of results

Santo Antônio Hydroelectric, Brazil

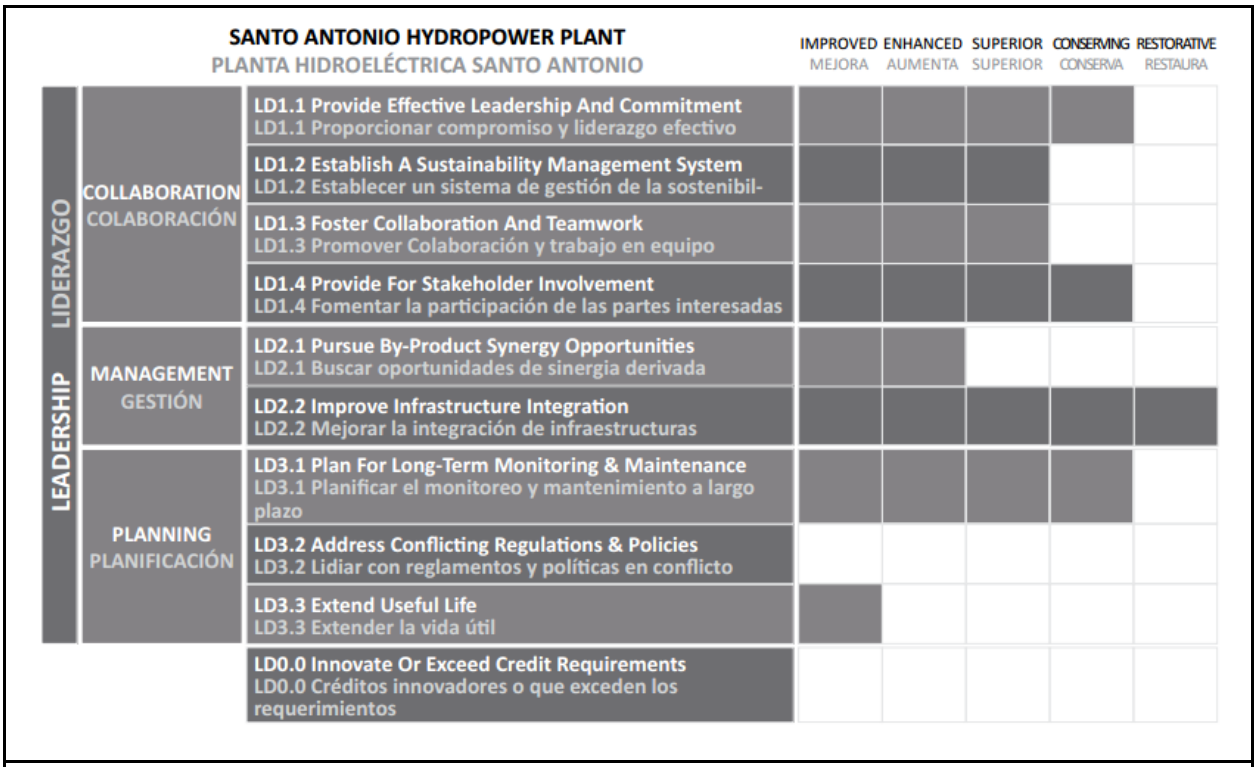


Figure 17: Leadership category_ Summary of results

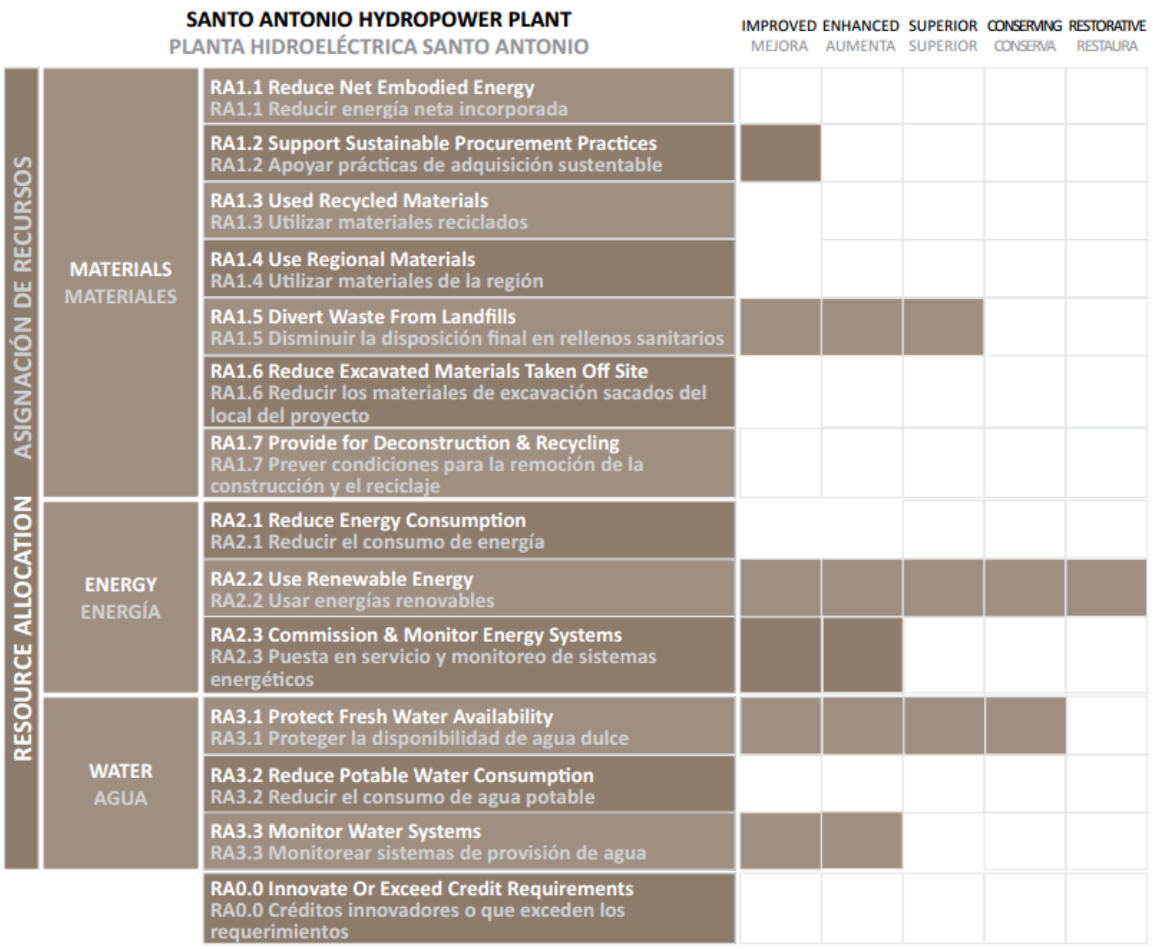


Figure 18:Resource Allocation category_ Summary of results

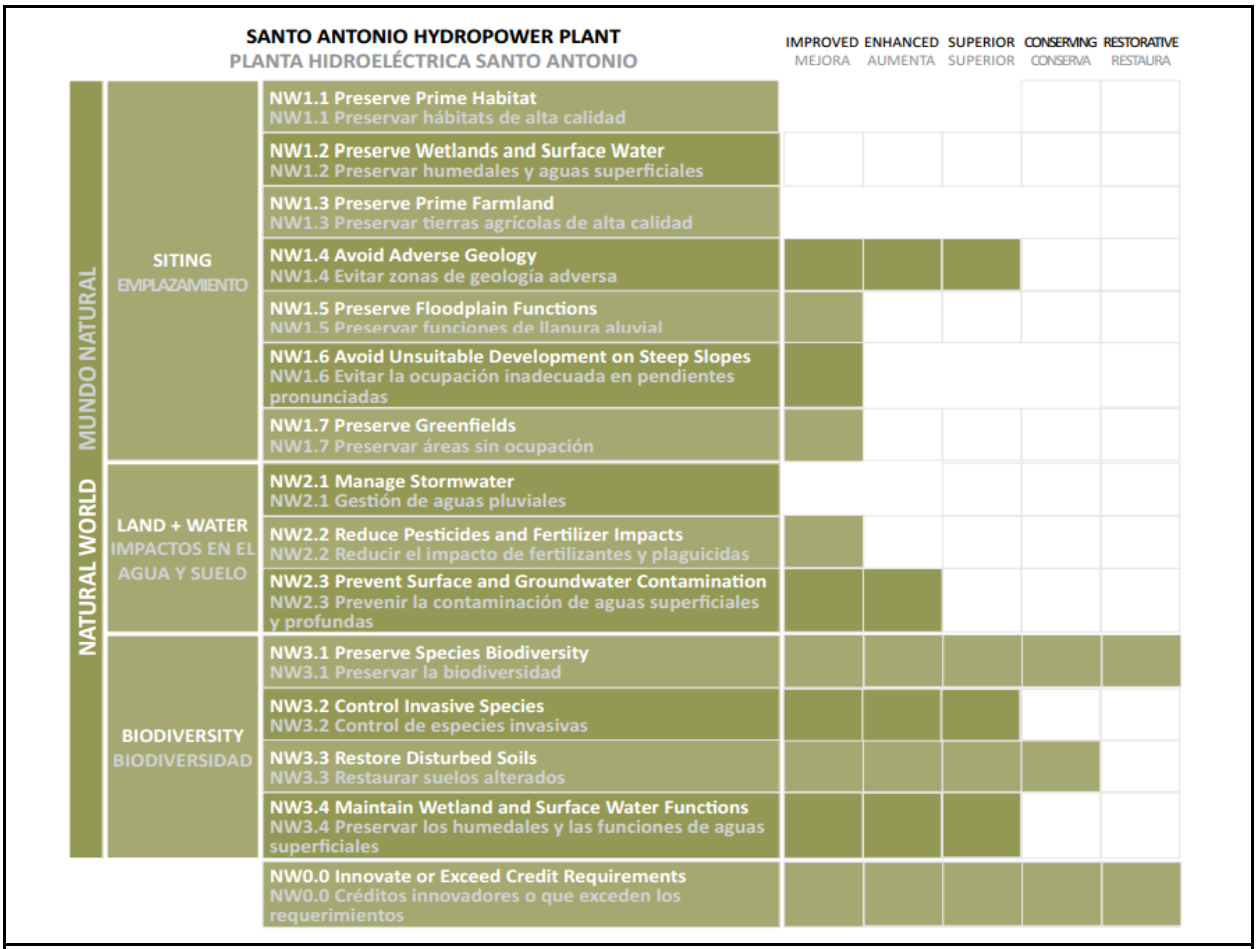


Figure 19: Natural World category_ Summary of results

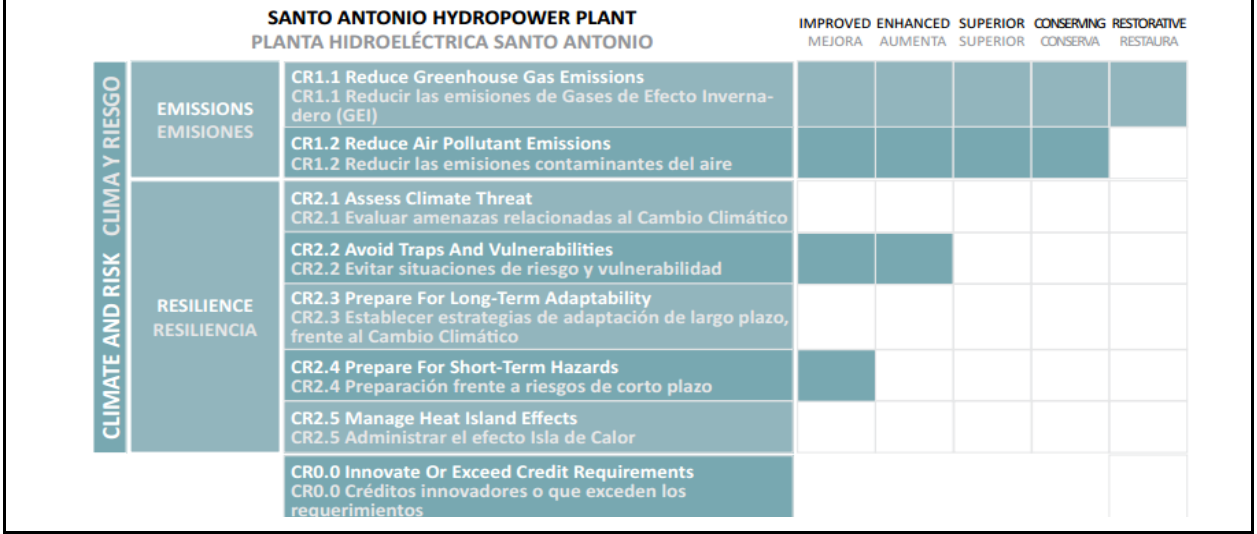


Figure 20: Climate & Risk category_ Summary of results

Figure 21: People & Leadership award Summary of results

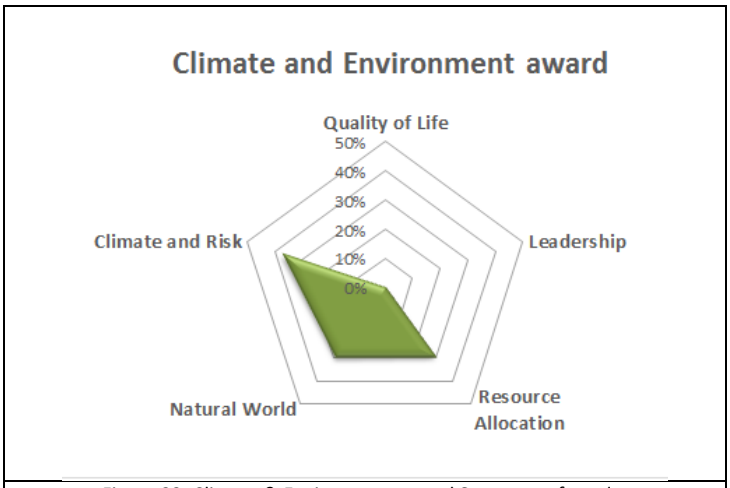


Figure 22: Climate & Environment award Summary of results

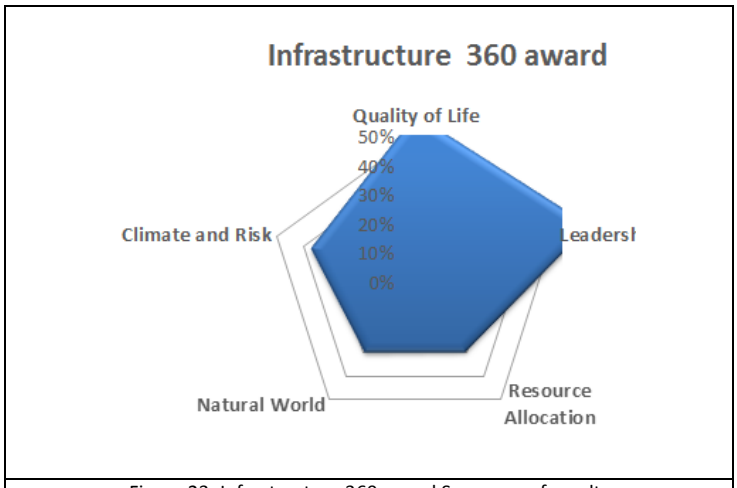


Figure 23: Infrastructure 360 award Summary of results

SANTO ANTONIO HYDROELECTRIC PLANT, BRAZIL	PT.	Performance

1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve Community Quality of Life	10	Superior
2			QL1.2 Stimulate Sustainable Growth & Development	13	Conserving
3			QL1.3 Develop Local Skills And Capabilities	15	Restorative
4		COMMUNITY	QL2.1 Enhance Public Health And Safety	16	Conserving
5			QL2.2 Minimize Noise And Vibration	1	Improved
6			QL2.3 Minimize Light Pollution	0	No Score
7			QL2.4 Improve Community Mobility And Access	14	Conserving
8			QL2.5 Encourage Alternative Modes of Transportation	12	Conserving
9			QL2.6 Improve Site Accessibility, Safety & Wayfinding	3	Enhanced
10		WELLBEING	QL3.1 Preserve Historic And Cultural Resources	7	Superior
11			QL3.2 Preserve Views And Local Character	0	No Score
12			QL3.3 Enhance Public Space	13	Restorative
			QL0.0 Innovate Or Exceed Credit Requirements	0	0
			QL	104	

SANTO ANTONIO HYDROELECTRIC PLANT, BRAZIL				PT.	Performance
13	LEADERSHIP	COLLABORATION	LD1.1 Provide Effective Leadership And Commitment	17	Conserving
14			LD1.2 Establish A Sustainability Management System	7	Superior
15			LD1.3 Foster Collaboration And Teamwork	8	Superior
16			LD1.4 Provide For Stakeholder Involvement	14	Conserving
17		MNGMT.	LD2.1 Pursue By-Product Synergy Opportunities	3	Enhanced
18			LD2.2 Improve Infrastructure Integration	16	Restorative
19		PLANNING	LD3.1 Plan For Long-Term Monitoring & Maintenance	10	Conserving
20			LD3.2 Address Conflicting Regulations & Policies	0	No Score
21			LD3.3 Extend Useful Life	1	Improved
			LD0.0 Innovate Or Exceed Credit Requirements	0	N/A
			LD	76	

SANTO ANTONIO HYDROELECTRIC PLANT, BRAZIL				PT.	Performance
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce Net Embodied Energy	0	No Score
23			RA1.2 Support Sustainable Procurement Practices	2	Improved
24			RA1.3 Used Recycled Materials	0	No Score
25			RA1.4 Use Regional Materials	0	No Score
26			RA1.5 Divert Waste From Landfills	8	Superior
27			RA1.6 Reduce Excavated Materials Taken Off Site	0	No Score
28			RA1.7 Provide for Deconstruction & Recycling	0	No Score
29		ENERGY	RA2.1 Reduce Energy Consumption	0	No Score
30			RA2.2 Reduce Pesticide and Fertilizer Impacts	20	Restorative
31			RA2.3 Commission & Monitor Energy Systems	3	Enhanced
32		WATER	RA3.1 Protect Fresh Water Availability	17	Conserving
33			RA3.2 Reduce Potable Water Consumption	0	No Score
34			RA3.3 Monitor Water Systems	3	Enhanced
			RA0.0 Innovate Or Exceed Credit Requirements	0	N/A
			RA	**53**	

SANTO ANTONIO HYDROELECTRIC PLANT, BRAZIL				PT.	Performance
35	NATURAL WORLD	SITING	NW1.1 Preserve Prime Habitat	0	No Score
36			NW1.2 Preserve Wetlands and Surface Water	0	No Score
37			NW1.3 Preserve Prime Farmland	0	No Score

38			NW1.4 Avoid Adverse Geology	3	Superior
39			NW1.5 Preserve Floodplain Functions	2	Improved
40			NW1.6 Avoid Unsuitable Development on Steep Slopes	1	Improved
41			NW1.7 Preserve Greenfields	3	Improved
42		L & W	NW2.1 Manage Stormwater	0	No Score
43			NW2.2 Reduce Pesticides and Fertilizer Impacts	1	Improved
44			NW2.3 Prevent Surface and Groundwater Contamination	4	Enhanced
45		BIODIVERSITY	NW3.1 Preserve Species Biodiversity	16	Restorative
46			NW3.2 Control Invasive Species	5	Superior
47			NW3.3 Restore Disturbed Soils	8	Conserving
48			NW3.4 Maintain Wetland and Surface Water Functions	9	Superior
			NW0.0 Innovate or Exceed Credit Requirements	8	
			NW	60	
SANTO ANTONIO HYDROELECTRIC PLANT, BRAZIL				**PT.**	**Performance**
49	CLIMATE	EMISSION	CR1.1 Reduce Greenhouse Gas Emissions	25	Restorative
50			CR1.2 Reduce Air Pollutant Emissions	12	Conserving
51		RESILENCE	CR2.1 Assess Climate Threat	0	No Score
52			CR2.2 Avoid Traps And Vulnerabilities	6	Enhanced
53			CR2.3 Prepare For Long-Term Adaptability	0	No Score
54			CR2.4 Prepare For Short-Term Hazards	3	Improved
55			CR2.5 Manage Heat Island Effects	0	No Score
			CR0.0 Innovate Or Exceed Credit Requirements	0	N/A
			CR	46	
			Total points	**339**	**0**

APPENDIX D: CREDIT DETAIL

SAN ANTONIO HYDROELECTRIC PLANT: CREDIT SPREADSHEET WITH DETAILS

CATEGORY I, PEOPLE AND LEADERSHIP		
SUB CATEGORY: QUALITY OF LIFE		
	Score	**SAN ANTONIO HYDROELECTRIC PLANT**
QL1.1 Improve Community Quality of Life	**10**	**Superior** This project improves community quality of life at different scales. At the national scale it provides solutions for the electric energy market and enhances the competitiveness of the Amazon region. At the regional and national scale, quality of life will not only be improved with an influx of clean power, but also with an increase of available public resources due to royalties that Santo Antônio hydroelectric will pay for using the Madeira River. Starting in November 2016, they will pay the total of about $37.02 million USD (R$100 million) per year, of which 45% will be allocated to Porto Velho, a further 45 % to Rondônia and 10% to the Brazilian Federal Government. Although the Madeira River is in a transnational basin, the area considered for impacts mitigation was strictly delimited in accordance with IBAMA's terms of reference. IBAMA defines the area of direct influence (AID) for hydroelectric projects as the flooded area at the maximum level of the reservoir plus the area of permanent preservation (APP), the continuous areas of ecological relevance and the areas located downstream to the dam. For the socioeconomic studies, was considered the municipality of Porto Velho and other areas located downstream to the dam, considering the impacts in the local communities. When it comes to physical improvements in quality of life, more substantive efforts are needed to assess, review and incorporate community needs, goals and issues. Most efforts are directed at mitigating negative impacts on communities facing relocation from the riverfront. The mitigation strategies employed are the ones established by Brazilian environmental legislation, which requires that the seven resettlements be provided with services such as health infrastructure, schools, and waste water treatment. Although there is a compromise with the quality of life of the existing communities, the scale of the relocations are considered adverse impacts, which the team is trying to mitigate. Due to relocations of the directly impacted riverfront communities, indemnisations and new construction were created with 620 million Brazilian Reais for 540 families, which accounts for about 2,044 persons. According to the project team, quality of life is likely to improve since there are monitoring studies that show that in many cases family incomes increased. All stakeholders and their households are considered to have been actively involved in the relocation process, the compensations and resettlement conditions have been agreed in consultation with the people affected by the project. Where no resettlement was needed, affected people received an indemnity. In addition, technical assistance for the reorganization of productive agricultural activities was implemented in order to minimize the impacts and to benefit local people. Although the process was comprehensive, the relocation

		represents a drastic change of property and riverfront lifestyle as houses located on the river were relocated into track of lands into what appears to be the same model of housing. In general, the relocations were approved by most of the resettled families, as they have acquired an area with the possibility of generating income, basic infrastructure services, and the benefit of regularization and owning the land. Santo Antônio Energia assures that the hydropower has not affected indigenous populations because it is not located in indigenous lands. Nonetheless, there have been terms of cooperation executed in conjunction with the Brazilian FUNAI for the indigenous communities of Karitiana, Karipuna and Cassupã in the areas of education, health, infrastructure and security. In addition, the project team developed several environmental and social programs presented in the basic environmental project for the indigenous communities, such as: Indigenous program for production and sustainability; Strengthening ethnic and cultural enhancement; Territorial protection; Indigenous articulation program, among others. Approximately 2,000 people contributed to the 64 public meetings held for the approval of the power plant project. However, it is not clear to what extent the affected communities were meaningfully engaged in the plant design process.
		Source: Plenu's Soluçoes em Gestão LTDA, Relatório Semestral de Monitoramento: Santa Rita January- June 2014 (2014), 1-2. *Santo Antonio Energia, Termo de Cooperaçao com a Associaçao Indígena Abycutu Apoika do Povo Kaipiruna (2013).* *Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 4-6, 26-28, 141-145, 163-164.*
		RECOMMENDATIONS: A higher score hinges on having minimal adverse impacts, which is not the case for Santo Antonio hydroelectric although these are addressed in the mitigation efforts. The project could provide more explicit documentation that highlights the solutions that enhance community values, as well as social and environmental actions to achieve a higher score. In addition, results from the recommended actions in the Support Programme for Indigenous Communities will be helpful to understand improvements in their quality of life. The relocation process efforts are a complicated endeavor as it requires all parties to agree. Considering the scale of the relocation, a more participatory process of home substitution rebuilding should be encouraged to take into consideration the lifestyle as well as location of the original structure in the production of the new housing models that seem not to resemble the original structure openness to nature.
QL1.2 Stimulate Sustainable Growth & Development	**13**	**Conserving**
		The Santo Antônio Hydroelectric Plant is strategic in stimulating local development, especially as it provides an expanded supply and increase in quality and reliable electrical energy. Once it operates at full power, it will allocate up to an average of 600 megawatts to Rondônia by 2016, allowing the gradual disconnection of traditional thermoelectric plants. Improvements to local productivity are expected due to the provision of electrical energy, and advances in integration with other localities are factors of sustainable economic development because of its capacity to promote new businesses and attract capital to develop industry, commerce and local services. During construction this project injected the area with jobs, and in its peak phase the hydroelectric power plant created approximately 20,000 jobs, from which 80% of the positions were filled by residents of the local Porto Velho region.

		The project team asserted that the Acreditar program gave training to more than 40,000 people from the community, in addition to the project introducing technical innovative solutions to the area. In addition, reports done by Santo Antônio Energia indicate the evidence in the improvement in quality of life of families, demonstrated by the indicators reported in the monitoring, mainly regarding the evolution of family income, welfare, access to essential public services, attendance and academic performance, among others. According to SAE reports, the Relocation Program for Affected Populations has given appropriate support to relocated families by training them for different production systems and the incorporation of appropriate techniques for cultivation and skills of families. Good results have been seen with the systems of vegetable production, irrigated horticulture, orchards and fertigation integrated with the the creation of pirarucus and introducing projects for dairy cattle assai palms. Additionally, the resettled communities have been able to produce and sell their agricultural products directly to consumers at the monthly "Taste of Country" farmer's market in the parking lot of the Administrative Policy Centre (CPA). *Source: UHE Santo Antônio, 11º Relatório Socioambiental Periódico (2014), 61 - 69, hereafter referred as RSAP.* *RECOMMENDATIONS:* Higher scores can be achieved by providing documentation evidencing the rehabilitation or restoration of natural or built assets in tandem with efforts for the betterment of the communities affected by the project.
QL1.3 Develop Local Skills and Capabilities	**15**	**Restorative** Long term competitiveness is developed in the Rondonia region where the project areas of influence are located. Although the construction of the project entailed the relocation of many communities, the project team seems to have considered community needs and to have focused on the indigenous communities affected by the project. Local hiring has been emphasized during construction; it created approximately 20,000 jobs at its peak, from which 80% of the positions were filled by residents of Porto Velho region. The more visible and immediate benefits to the region are absorption of labor and payment of royalties to the state of Rondônia, the municipality of Porto Velho and the Federal Government. A total of 420 staff members have been directly contracted for development and approximately 800 have been hired for specific projects, such as biologists, archaeologists, sociologists, and environmental and forest engineers. It is noteworthy that in the early years of construction, the rate of women working in the construction site reached 10% of the total number of members. In addition, women also participated in the continuing education program offered by the company called Acreditar (Believe), responsible for the qualification of the local workforce. In fact, the number of Acreditar trainees increased from 2009 to 2012 according to the project owner statistics. In addition to these efforts, the project team developed training courses for construction, targeted for women living in a state of social

		vulnerability. The Economic Brazil Journal has published an article with the title 'Hydroelectric of Opportunities', which highlights the investments for qualification and use of local labor and suppliers of Porto Velho. In addition, in the periodical report monitoring the activities related to the action plan based on Equator Principles, numerous programs are listed in relation to the relocated communities and local skills building. This monitoring and inspection done by external procedures demanded by the official organs have generated recommendations and findings in relation to the implementation of the project activities that are important to follow in relation to the development of local skills and capabilities.
		Source: RSAP. *Ibid, 28.* *Equator Principles, The Equator Principles June 2013 (2013).* *Santo Antônio Energia, Statistics in Programa Acreditar.*
		RECOMMENDATIONS: F urther documentation attesting how the project team identified community employment, and how their proposed skills training programs, such as Acreditar, will continue or lead to jobs during the operational phase will be beneficial for maintaining a restorative score.
QL2.1 Enhance Public Health And Safety	**16**	**Conserving** There has been an overall trend of reduction in the frequency rate of injuries and accidents according to the indexes of health and safety. Santo Antônio Energia (SAE) has used the values of health and safety from Odebrecht as a reference, which have been subsequently validated by the board of directors of the company. According to Brazilian law calculations of injury rates, from 2012 to 2013 there was a reduction of the fees related to injuries, with a 40% decrease in the rate of total injuries, 25% decrease in accidents and a 40% decrease for severity rates. This decreasing trend has continued into 2014. The Santo Antônio Energia is restructuring the work related to the management of business processes on HSE (Health, Safety and Environment), implementing the Integrated Management System (IMS), which has reference to the International Standard ISO 14001 (environmental System) and OHSAS 18001 (health and safety). Santo Antônio Energia has improved their own health and safety standards above that which is required by regulations. Santo Antônio Energia won the 6th Medical Services Innovation Award, in the Tropical Medicine category, because of actions already implemented and measurable results against vector-borne diseases such as malaria, which are usually associated with the water held in a hydroelectric plant. Medical Services is a cultural competition that aims to enhance, encourage and disseminate innovative work to bring improvements in public health. In addition, SAE has placed special attention on the needs of the Indigenous communities as accorded in the Term of Mutual Cooperation for the implementation of the Comprehensive Plan for Indigenous Health, which will benefit the Karitiana, Karipuna, and Cassupá communities. This agreement was signed by the Special Indigenous Sanitary District (DSEI) in Porto Velho and Santo Antônio Energia. The Comprehensive Plan was prepared by the DSEI with the holdings of the District Council of Indigenous Health and Santo Antônio Energia. This partnership aims to implement actions that will provide improvements in the health infrastructure of indigenous

		communities. *Source: RSAP, 30, 29, 203-205.* *RECOMMENDATIONS:* It is recommended to keep systematic documentation of significant risks identified, changes instituted and appropriate sign-offs on all the health and safety measures that have been adopted from Odebrecht. In addition, it will be beneficial for SAE to keep track of the implementation of the Comprehensive Plan for Indigenous Health to know how effective the health and safety measures have been for these communities.
QL2.2 Minimize Noise And Vibration	**1**	**Improved** Higher levels of noise are expected during the construction of the hydropower plant. Changes in air quality due to the movement of vehicles and equipment are anticipated in the official list of expected impacts, for which management strategies and associated programs have been recommended. Noise and changes in air quality alterations are considered localized, fully reversible, short-term and temporary. Management strategies include the monitoring of environmental noise related to the activities of the construction site and monitoring of air emissions. Minimizing noise and vibration dust is mentioned in the Environmental Construction Program (PAC) and in the Social Communication Program in the Environmental Management System (SGA). According to the Social and Environmental Periodic Report (RSAP), five quantitative evaluations of noise have been done so far. SAE has made predictions of noise created from equipment, blasting, transportation, and crushing. Brazilian environmental legislation demands the measuring of noise levels annually, and more frequently with anticipated activities that may produce noise. Besides monitoring, according to the documentation submitted, it is not clear if there is a comprehensive proposal for noise and vibration reduction not only for the construction, but also during the operational phase. *Source: RSAP, 79, 162.* *RECOMMENDATIONS:* Proposals for ambient noise and vibration mitigation would be needed for creating quieter communities. In addition, the results of the studies and assessments of noise and vibration levels in relation to the target noise levels as defined by IBAMA or the local municipality will be useful in understanding the hydropower impact and assessing the mitigation strategies.
QL2.3 Minimize Light Pollution	**0**	**No Score** Documentation was not found supporting a light pollution minimization assessment or a mitigation strategy. This credit intends to evaluate strategies that prevent excessive glare, light at night, and light directed skyward to conserve energy and reduce obtrusive lighting and excessive glare. *Source:* *RECOMMENDATIONS*: Perform and document an overall assessment of lighting needs to establish appropriate lighting zones established for the project. The benchmark for the hydropower project would be to meet its lighting standards for safety but to prevent spillover beyond the site boundaries, and to avoid intrusive and disruptive glare to communities or ecosystems.
QL2.4 Improve Community	**14**	**Conserving** In terms of improving community mobility and access, SAE has supported and invested in the Porto Velho Urban Mobility Plan (PMob), which must ensure the execution of Brazilian federal regulations for cities as it is the capital of the state of Rondônia. The

Mobility And Access		PMob emphasizes public transportation service, road traffic data, infrastructure, accessibility for people with special needs, integration of public transport with private, non-motorized transport, major generators of travel centers, public areas, and private parking and transportation loads. The investment is part of an agreement signed with the city of Porto Velho to integrate the Social Compensation Program with the implementation of the Santo Antônio hydroelectric. Studies and projects have been developed by a company to elaborate the plan. In addition, the capital of Rondônia is one of the few municipalities can seek federal budgetary resources for urban mobility, benefiting all citizens. According to the documentation, the plan will deal with the most important issues that related to urban macro-drainage of Porto Velho, urban mobility in the city, municipal development, environmental zoning of the municipality and urban impacts related the construction of the project. The circulation system and transport of the area surrounding the Santo Antonio reservoir consists of small stretches of roads, unpaved, that on the right bank, is linked to the interstate highway BR-364, which runs parallel to Madeira River. The Madeira River has a fundamental role in regional transportation, as the river circulates between communities where the local population uses private boats to move around. Surrounding the Santo Antônio reservoir the local families predominantly move by boat, and in the villages of Teotônio and the urban center of Jaci-Paraná there is pedestrian activity.
		Source: Madeira Energia S.A., "Programa De Compensação Social" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 49-50.
		RECOMMENDATIONS: The project team should provide a detailed inventory of the community improvements they have supported. In addition, it is important to disclose all the specific efforts that SAE has done in the relocation of the affected communities by the project, as they probably have improved the communities' access and mobility. It is not clear how the river navigability will be affected by the dam and if it will be possible for the community to move by boat.
QL2.5 Encourage Alternative Modes of Transportation	**12**	**Conserving**
		Santo Antônio Energia invested in the PMob as part of an agreement signed with the city of Porto Velho to integrate the Social Compensation Program with the hydroelectric plant implementation. Studies and projects have been developed by the contractor, Via Urban Projects and Consulting, which featured a team of various experts from around the country, including international experience in elaboration of plan mobility. According to the project team, the Porto Velho Urban Mobility Plan (PMob) will encourage alternative modes of transportation. The PMob emphasizes providing service for public transportation, road traffic data, infrastructure, accessibility for people with special needs, integrating public transportation with private, non-motorized transport, major generators of travel centers, areas public and private parking lots and cargo transportation. The PMob encourages public mass transit with various strategic plans that establish guidelines for the adequacy of the Porto Velho's public transport system. The guidelines support the process of analyzing strategic alternatives necessary to: implement the rapid bus corridor system; propose a new methodology for tariff calculation; propose a methodology for the location of the interstate highway in the city; establish subsidies for the implementation of a transportation operations control center; and propose a regulatory framework for the

		taxi service.
		Source: Santo Antônio Energia, "Mobilidade Urbana trará melhorias a portovelhenses," accessed in 2014, http://www.santoantonioenergia.com.br/mobilidade-urbana-trara-melhorias-a-portovelhenses/ *Prefeitura Municipal de Porto Velho, Santo Antônio Energia, Via Urbana Projetos e Consultoria Ltda., "Serviços de Transportes Públicos de Porto Velho" in Plano de Mobilidade Urbana de Porto Velho (2011).*
		RECOMMENDATIONS: Inclusion of the PMob design documents as evidence will help estimate the degree to which the project has increased walkability, public transit use, and non-motorized options. For a higher score it would be necessary to know about the substantial upgrades that have been designed and specified beyond Porto Velho's requirements for the social compensation program.
QL2.6 Improve Site Accessibility, Safety & Wayfinding	**3**	**Enhanced**
		According to the documentation, the project strives to have onsite wayfinding following the guidance and requirements of the Brazilian Association of Technical Standards (ABNT). Founded in 1940, ABNT is responsible for technical standardization in the country, providing the necessary base for Brazilian technological development. In addition, site accessibility, safety and wayfinding are supported by the development of a plan that acts in accordance to the regulatory frameworks in Brazil. For instance, the plan is being developed under the regulations established by ANEEL, the Brazilian Electricity Regulatory Agency. ANEEL's mission is to provide favorable conditions for the electric power market to develop a balance between the agents and the benefit of society.
		Source: Brazilian Association of Technical Standards, accessed in 2014, http://www.abnt.org.br/m3.asp?cod_pagina=929. *Brazilian Electricity Regulatory Agency, accessed in 2014, http://www.aneel.gov.br/area.cfm?idArea=640&idPerfil=9.*
		RECOMMENDATIONS Additional information documenting the efforts to improve site accessibility, safety and wayfinding that go beyond existing regulations are necessary to be considered for a higher score.
QL3.1 Preserve Historic and Cultural Resources	**7**	**Superior**
		The Santo Antonio hydroelectric project, complying with Brazilian regulations, have taken several steps to identify, preserve or restore cultural resources according to the programs created related to the archaeological, prehistoric and historic heritage of the area. According to the documentation, several proactive efforts have been taken and there are various subprograms to identify and rescue heritage resources. The implementation of preventive archaeological protection measures in the direct Influence of the hydroelectric plant aimed to meet the requirements of national legislation to protect archaeological heritage. Based on archaeological evidence on record and the high archaeological potential of the region it has been essential to develop systematic archaeological work in the project that can be installed, developed and validated by Institute of National Historical and Artistic Heritage (IPHAN). In terms of identification of potential sites for historic or cultural preservation the following field reports were carried out: prospecting on the construction site and reservoir area; delimitation and rescue of archaeological sites highlighted in prospecting; technical training in archeology; curation and laboratory analysis; dissemination of results; and seminars.

		In total, 58 archaeological sites were found, of which 43 are pre-colonial sites and 15 are historic sites. In addition, 157 archaeological occurrences (isolated or discrete) that are not archaeological sites were also identified. Paleontological monitoring was also performed, rescuing the first Palaeobotanical Amazon site presenting different types of plant fossils, such as seeds, leaves and logs, which display dates older than 46,000 BCE. Regarding education and sharing knowledge with the community, exhibitions of works produced in partnership with educational institutions are being planned. Although there have been efforts to preserve archaeological and paleontological sites, several natural features such as the Santo Antônio and Teotônio waterfalls have succumbed to the construction of the plant, displacing the neighboring communities as well. Additionally, the installation of the power plant will cause the inundation of part of the historic Madeira Mamoré Railway. The actions for the rescue of the archaeological heritage have been executed by MESA independently. Despite the environmental impact that the hydroelectric plant may produce, studies suggest the positive effects on the region's economy must be observed, as well as the possibility of preserving the cultural heritage for posterity.
		Source: Santo Antônio Energia, Relatório Final para LO: Programa de Preservação do Patrimônio Paleontológico – UHE Santo Antônio, 1-10. *Santo Antônio Energia, Relatório Final para LO: Programas Relacionados ao Patrimônio Arqueológico, Pré-Histórico e Histórico, 1-10.* *SVS Advisory and Projects ltda, Reference Document for the Elaboration of Projects to be Executed in the Part of Madeira Mamore Railway that is Officially Proclaimed as a Historical Landmark, 1-10.* *UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 61.*
		RECOMMENDATIONS More aggressive efforts are needed to preserve and restore significant historical and cultural sites, especially the ones that define the character of the community. Increasing the scope of identification, analysis and interests will benefit preservation. Efforts such as exhibiting and educating about finding the first Palaeobotanical Amazon site should be encouraged.
QL3.2 Preserve Views and Local Character	**0**	**No Score**
		In the relocation of displaced communities, moderate efforts have been made to respect the principal characteristics of those communities. However, the siting of the project is on top of 2 culturally important waterfalls of Santo Antônio, and Teotônio does not support the preservation of views and local character of the area. A basic feasibility analysis could have avoided construction in such natural heritage. The construction of the hydroelectric plant has significantly changed the views and local character of the area. This drastic change in the natural features of the river make the preservation of views unattainable. According to the Environmental Impact Assessment, the total course of the Madeira River can be divided into three distinct sections: the High Madeira- consisting almost of source rivers; the stretch of waterfalls among Guarajá Mirim and Santo Antônio waterfalls; and the Low Madeira. The most visually impacted area would be the Madeira's waterfall stretch, which begins just downstream of the city of Mirim Guarajá and ends upstream of Porto Velho, at Santo Antônio waterfalls. This stretch total length of approximately 360 km, has a total fall of 70 m, along which features 18 waterfalls or rapids which might not be visible with the construction of the hydroelectric.
		Source: Madeira Energia S.A., Projeto Básico Ambiental: AHE Santo Antônio (2008), 1-5. *UHE Santo Antônio, Projeto Básico Ambiental: Reservatório Da Uhe Santo Antônio N.A*

		Máximo Normal (70,50M), Remanso Q=38.550M³/S E Áreas Adquiridas A Partir Do Remanso (2011). *Leme Engenharia Ltda., "Área De Influência Indireta dos Aproveitamentos Hidrelétricos Jirau e Santo Antônio" in Sumário dos Estudos de Impacto Ambiental (2005), 52-53.*
		RECOMMENDATIONS: Evidence of a feasibility analysis proving that the siting of the project on top of the waterfalls was unavoidable could demonstrate some proactive efforts from the project owners. In addition, compensation measures in exchange for changing the natural features of the area would also help legitimize any efforts taken to avoid such modification.
QL3.3 Enhance Public Space	**13**	**Restorative**
		The Santo Antonio project team has prioritized the improvement of existing public space, creating parks, tourist venues, sport facilities, cultural centers and wildlife viewing areas. The plans to preserve, conserve and enhance defining elements of the public space are based on the project's compensation measures as defined in the social and environmental programs, but SAE's commitment goes beyond the regulations, as efforts are channeled into the creation of substantial restoration. Among the enhancement projects are the improvement to the Porto Velho Natural Park, the urbanistic betterment of the surroundings of the Santo Antonio chapel, and the revitalization of the Madeira Mamoré Railway Complex, which are all important tourist sites. SAE have also created public spaces such as a park, an artificial beach, and a soccer field in the Jacy-Paraná district. In addition the Indigenous Cultural Center has been built by the project team.
		Source: Santo Antônio Energia, "Programa e Apoio às Atividades de Lazer e Turismo" in Plano de Desenvolvimento do Lazer e do Turismo Integrado Sustentável do Distrito de Jaci-Paraná (2014).
		RECOMMENDATIONS: Additional documentation on the efforts to include or improve the public spaces designed for the relocated population settlements will help support further this score.
QL0.0 Innovate Or Exceed Credit Requirements		
	104	

SUB CATEGORY:LEADERSHIP		
	Score	**SAN ANTONIO HYDROELECTRIC PLANT**
LD1.1 Provide Effective Leadership And Commitment	**17**	**Conserving**
		The Santo Antônio Energia (SAE) is providing effective leadership and commitment to improve sustainable performance by adopting the Equator Principles. The Equator Principles are defined as a financial industry benchmark for determining, assessing and managing environmental and social risk in projects. The SAE, for instance, in order to comply with the principles, prepared environmental and social studies as well as disseminated the action plans designed for the affected communities. This commitment is audited periodically to verify that the criteria are being met. The use of the Equator Principles reflects that sustainability makes part of the core values for the project.. The Santo Antonio hydroelectric project falls into Equator

		Principles Category A, for which assessment documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the project. The adoption of these criteria is above and beyond governmental regulation as it is not required for receiving an environmental license. Since the hydroelectric project is funded by financial institutions signatory of the Equator Principles, having received Project-Related Corporate Loans and Bridge Loans, the project must comply with all 10 principles. According to the Equator Principles, the project must seek the following: Review and Categorization; Environmental and Social Assessment; Applicable Environmental and Social Standards; Environmental and Social Management System and Equator Principles Action Plan; Stakeholder Engagement; Grievance Mechanisms; Independent Review; Covenants; independent Monitoring and Reporting; and finally Reporting and Transparency.
		Source: Equator Principles, The Equator Principles: A financial industry benchmark for determining, assessing and managing environmental and social risk in projects (2013), 1-13. *UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 70-116.*
		RECOMMENDATIONS: Further examples of past or ongoing actions to improve sustainability performance would be beneficial to achieve a higher score. In addition, to support this score, it is necessary to provide documentation demonstrating that all 10 Equator Principles were and continue to be followed by the project.
LD1.2 Establish A Sustainability Management System	**7**	**Superior**
		Among the 28 environmental mitigation programs that comprise the Basic Environmental Project (PAC), two are intended for sustainable management: the Environmental Management System and the Environmental Program for Construction. Both are approved by the Brazilian Institute of Environment and Renewable Resources (IBAMA), which is the Brazilian federal government licensing and inspecting body. The Environmental Management programs help to ensure that the sustainability criteria and procedures are respected and verified. The sustainability management system listed in the basic environmental project aims to prevent and control direct impacts generated by the works and deployment activities of Santo Antonio hydroelectric. The management system prioritizes avoiding processes that can trigger environmental degradation in the area of direct Influence. It provides environmental criteria and procedures found in the agreements with construction companies and services that contribute to the implementation of the project, including its subcontractors. The sustainability management plan seeks to achieve a continuous pursuit of its objectives, goals and strategic directions, such as compliance with legal requirements, adapting to local expectations, minimization of impacts, encouraging sustainable development and use of renewable natural sources, protecting human health, and protecting cultural properties and biodiversity, among others. Appropriate roles and responsibilities are assigned within SAE's sustainability leadership based mainly in Porto Velho and in Sao Paulo. The sustainability board of directors team, according to responsibilities, are listed as follow: a director, a manager, a socioeconomic coordinator, a cartographer engineer, three environmental analysts, a relocation coordinator, a social communication analyst, and administrative staff.

		Source: Santo Antônio Energia, Macroestrutura (2014) 37. Madeira Energia S.A., "Sistema de Gestão Ambiental" in Projeto Básico Ambiental: AHE Santo Antônio (2008) 47-52.
		RECOMMENDATIONS: Further documentation supporting the fact that goals and objectives take changing conditions into account will be helpful to achieve a higher score. The project could also provide evidence that the sustainability plan is robust enough to deal with extreme changes.
LD1.3 Foster Collaboration And Teamwork	**8**	**Superior**
		The sustainability management system includes several goals that foster collaboration and teamwork. For instance, they strive for the full observance of the principles of the environmental policy and the mission of Madeira Energia for the continuous pursuit of the targets set out in the objectives, goals and strategies. It is also encouraged for the project to adapt to the expectations of shareholders, employees, local community and society at large in order to minimize the maximum effects and impacts associated with implementation and operation of the project. In terms of teamwork, consultation and communication with stakeholders is fostered, as is participation by affected parties in the development, revision and implementation of the project. The project team has also established a goal to reduce impacts on indigenous communities. Madeira Energia has established the goal of having a proactive stance in pursuit of continual improvement of the environmental conditions of all involved and affected by the project. Another project goal is to meet the expectations of the partners in terms of time and cost of implementation on the construction site.
		Source: Madeira Energia S.A., "Sistema de Gestão Ambiental" in Projeto Básico Ambiental: AHE Santo Antônio (2008) 47-52.
		RECOMMENDATIONS: Achieving a higher score is possible if sufficient proof is established on the project's whole systems design and delivery. In the case of displaced population is key to provide information to ensure that their collaboration was considered as part of the decision making process.
LD1.4 Provide For Stakeholder Involvement	**14**	**Conserving**
		Due to the large scale of the hydroelectric project's area of influence, the SAE project team has been able to build good relationships with the directly affected communities. The SAE project team's effort to identify key stakeholders and establish communication was done according to the federal environmental permitting regulations as identified in the environmental impact studies, which are updated periodically. The identification of stakeholders went beyond the communities that are directly impacted by the project to include communities of nearby areas, indigenous communities that are located in areas outside the reservoir of the dam, opinion leaders from the city of Porto Velho and region, as well as leaders and the press. Even after the project approvals were obtained, the project team held a participatory process, which attracted more than 2,000 people to 64 meetings and six public hearings. Several communication channels were established so that all participants could send feedback to the company. There are also communication campaigns and polls to lead ombudsmen, in addition to communication through radio, newspapers, brochures, flyers, field actions, and especially the permanent presence of a team of

		communicators who make personal contact with each affected family from the resettlement program, as well as nearby communities. According to the documentation, the project team also provided for stakeholder engagement at the initial stages of the project as they introduced a publication strategy to disclose the environmental impact assessment for the Madeira River hydroelectric power complex with the local society, and debate the results before the official public hearings. There are no legal or infra-legal requirements stating that any meetings should be held before the official public hearings. This started discussions with society to begin answer questions such as: do we have a good project?; does the project correspond to a clear social requirement?; is the project is feasible from an economic perspective?; there are people interested in its installation who are willing to finance it?; have the impacts related to its installation and operation been identified, and can they be avoided, alleviated or compensated?; are the mitigation and compensation measures acceptable to society?; yes or no? The environmental impact assessment was developed in conjunction with local universities, on the research previously published of the Madeira River project. This helped identify the main stakeholder groups, which became the key factor of the participative process. The stakeholder groups identified were classified as follows: a) the riparian population in the power station area and the resident population downstream of the projects; and safety; b) Indigenous people; c) urban population of Porto Velho – target audience for the opinion poll: the academic community, students and university students, industrial and commercial business people, representatives from worker entities/unions; d) government constituents; and e) communication and press agencies. Appropriate communication and outreach were place for these stakeholder groups. According to the project team and as an example of the participative process are the first meetings with the riparian population and communities downstream from the project. These meetings were held in order to become acquainted with the communities that included dynamics such as a theater piece made by the residents, technically called an socioeconomic act, and also to explain what would happen to the region as a result of the construction of the power stations, which areas would be flooded, what would happen to the fish, the wetlands, and beaches, so that the residents could offer their opinion, and the conclusions from the environmental impact study.
		Source: *Madeira Energia S.A., Meeting Record: Presentation of the Affected Population Relocation Program Joana D'Arc. III- Riverine (2013).* *Madeira Energia S.A., "Sistema de Gestão Ambiental" in Projeto Básico Ambiental: AHE Santo Antônio (2008) 47-52.* *Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 31-33.*
		RECOMMENDATIONS: Keep an inventory of the stakeholders and evidence of a planned or ongoing stakeholder programs for the project. It will be useful to evaluate what strategies of the stakeholder engagement process were the most successful and which ones have room for improvement. This assessment will be valuable for future practices in order to reproduce success in new projects or help inform other large infrastructure projects on how to engage affected populations.
LD2.1 Pursue	**3**	**Enhanced**
		There is a program for pursuing opportunities to reuse unwanted by-products in order

By-Product Synergy Opportunities		to reduce waste, improve project performance and reduce costs. The project team states that metal, plastic, cardboard, wood, and glass are directed to companies that recycle these products. Food leftovers are composted and are reused in degraded areas as established in the Hydropower Program for Recovery of Degraded Areas. The project team has kept an inventory of the unwanted by-products and the reuse destination sorted by types of waste.
		Source: Santo Antônio Energia, Tabela de Resíduos. *Madeira Energia S.A., "Programa Ambiental para a Construção" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 19-25.*
		RECOMMENDATIONS: More broad and aggressive strategies for the pursuit of by-product synergy opportunities can help reduce further waste, improve project performance and reduce costs. It is important to try to identify more by-product resources and capture more synergy opportunities at nearby facilities. Since wastewater effluents from Porto Velho pollute the Madeira River because of direct untreated discharges, it will be useful to find a synergy between wastewater synergy opportunities between filtration and energy generation.
LD2.2 Improve Infrastructure Integration	**16**	**Restorative**
		The Santo Antônio hydroelectric project improves infrastructure integration by taking into account the operational relationships with the community and providing energy to the northern region of Brazil. The project improves infrastructure integration in the larger scale, considering the regional and national level, by injecting energy to the power grid. It is estimated that the 3568 MW will give power to around 45 million people. The SAE team identified the community assets in the natural and built environment. The project was designed and planned to integrate community infrastructure assets as well as restore them. In addition, the location of the hydroelectric plant in a rural area of the municipality, 7 km from Porto Velho, requires that all public utilities of water, sewage and waste are handled at the project site itself, eliminating overhead costs for the city. Even so, within the letter of intent signed by the mayor, the hydropower is responsible for the preparation of the Environmental Impact Statement of Landfill Porto Velho. The same protocol provides more than $200 million USD in projects that benefit health, education, infrastructure and public safety.
		Source: UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 256.
		RECOMMENDATIONS
LD3.1 Plan For Long-Term Monitoring & Maintenance	**10**	**Conserving**
		A comprehensive maintenance and monitoring plan has been prepared in advance to the project's completion. Santo Antônio hydroelectric plant has a concession period of 35 years for operation, granted by the Brazilian Federal Government. During this period, monitoring is effective in all areas and there are permanent environmental programs, such as monitoring water quality and seismological monitoring, among others. Sufficient financial resources have been put in place to cover the monitoring and maintenance plans. Resources for maintenance and monitoring of the project have been provided in the stage auction for the concession of the construction of the hydroelectric plant.

		In terms of monitoring tools, there is an average compliance of 85% of subjects, but the scaffold team exhibited a low performance of 55%. The SAE recommended that the contractor identify and present a classification of critical items in each.
		Source: Brazilian Electricity Regulatory Agency, Segundo Aditivo do Contrato de Concessão (2008).
		RECOMMENDATIONS: Plan and identify resources for long term monitoring and maintenance beyond the 35 years of concession, even if another company takes over the project. Develop a comprehensive long term plan with stakeholders goals in mind that can be integrate into the next party responsible to operate the hydroelectric.
LD3.2 Address Conflicting Regulations & Policies	**0**	**No Score**
		The SAE team must work with officials and stakeholders to try to identify and address laws, standards, regulations or policies that create unintentional barriers to the implementation of sustainable infrastructure. The concession period of Hydroelectric is 35 years and during this period the Santo Antônio Energia provides for the monitoring and maintenance of the enterprise infrastructure. The lifespan of hydroelectric, according to the feasibility study, is a hundred years.
		Source: Santo Antônio Energia, Ficha Técnica.
		RECOMMENDATIONS: Join efforts with the stakeholders to identify and change laws, standards, regulations or policies that may unintentionally create barriers to the implementation of sustainable infrastructure. Save evidence of activities to find conflicting regulations and policies.
LD3.3 Extend Useful Life	**1**	**Improved**
		The project team incorporates useful life cycle thinking in improving the durability, flexibility and resilience of the project over its projected lifespan. The hydroelectric plant has a projected useful life of 100 years, due to the historic lifespan allocated to hydroelectric projects in Brazil. Due to the estimations on intensification of land use around the reservoir as well as the increase of meteorological and climate effects, this number has been decreased to 92 years. The Santo Antonio hydroelectric plant, in order to expand the useful life to the required 100 years, developed a hydrosdimentological monitoring program, which according to the predicted parameters in the environmental impact studies will extend the lifespan for 100 years. Sediments monitoring is crucial in the lifetime of a hydroelectric and makes part of a requirements of ANEEL in reference to the Guide for the Evaluation of Reservoir Sedimentation. After the project's concession (35 years), the project is transferred to the federal government and, therefore, all necessary arrangements for the project decommissioning are the Brazilian government responsibility. The project sponsor is confident that Brazilian government will take all necessary procedures for the project decommissioning.

		Although, there aren't many cases of hydropower plant projects decommissioning in Brazil, once the project concession of 35 years is complete, then the project is transferred to Brazilian federal government hands. According to the ANEEL Concession contract nr. 001/200, the federal government then will be responsible for decommissioning the hydroelectric.
		Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 104-105.
		RECOMMENDATIONS: Perform more aggressive full life cycle thinking that can be incorporated into the design and planning of the project, which could lead to improve the durability, flexibility and resilience of the hydroelectric to uncertain future threats.
LD0.0 Innovate Or Exceed Credit Requirements		*N/A*
	76	

CATEGORY II: CLIMATE AND ENVIRONMENT		
RESOURCE ALLOCATION		
	Score	**SAN ANTONIO HYDROELECTRIC PLANT**
RA1.1 Reduce Net Embodied Energy	**0**	**No Score**
		This credit looks at efforts to conserve energy by reducing the net energy embodied in the project's materials. Within the provided documentation for the Santo Antonio hydroelectric, there is no indication that a life cycle energy assessment over the project life has been done.
		Source: Madeira Energia S.A., "Sistema de Gestão Ambiental" in Projeto Básico Ambiental: AHE Santo Antônio (2008).
		RECOMMENDATIONS: In order to achieve a better performance, documentation with an estimate of the net embodied energy of project materials is required. This estimation must include materials not only used in the construction, but in the operation and maintenance of the hydropower plant.
RA1.2	**2**	**Improved**

Support Sustainable Procurement Practices		In terms of obtaining materials and equipment, Envision looks for procurement practices that implement sustainable practices. According to the project team, all construction consortium contractors and subcontractors preferably should follow the ISO 9000 guidelines for quality certification of products and services. The ISO 9000 guidelines help organizations seeking confidence from their suppliers that their product requirements will be satisfied. The manual of integrated management system (MSGI) mentions the use of ISO 9000 and ISO-14000 for its development, but the documentation submitted does not offer any more detail on the sustainable procurement practices of suppliers and manufacturers. The manual of integrated management system (MSGI) purpose is to outline the integrated management system (quality / environmental) of the hydroelectric plant sustainability board and it is structured to meet the requirements of the Equator Principles, the International Finance Corporation Performance Standards, NBR-ISO-9000, NBR-ISO-14000, and the requirements for obtaining the Operating License from IBAMA and Legal Requirements No 825/2011. The Madeira Energia S/A adopts management methodology known as "PDCA" (Plan, Do, Check and Act), and establishes the macro planning cycle as a basis for defining and monitoring the goals of the environmental management system for the construction site. The construction companies responsible for building the hydroelectric on the construction site and perform specialized functions in environmental management will have their skills ensured by operational training and for serving the specific requirements of experience and education defined in procedure. Eligibility requirements established in the qualification, environmental approval and evaluation of suppliers (PI-Pre-15) and specific environmental clearance must be met by the subcontractors. Through the EMS, the project team makes sure requirements are met, but it also provides several mechanisms awareness of members and service providers in the construction site, among which are: campaigns, newsletters, ads for the management of cadres, meeting area and daily safety training. In addition the SAE project team asserts that they look for health, safety and environmental practices when hiring a company. Monitoring of the criteria is done periodically through specific audits and in the case of non-compliance recommendations, notifications and filings are made.
		Source: Manual de Saúde e Segurança do Trabalho e Meio Ambiente, item 1.1 - p. 2. *ISO, accessed in 2014, http://www.iso.org/iso/catalogue_detail?csnumber=42180.* *Santo Antonio Energia, Manual on Integrated Management System (2012)* *Madeira Energia S.A., "Sistema de Gestão Ambiental" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 2-3, 8-10.*
		RECOMMENDATIONS: It is recommended to reduce negative environmental impacts by implementing an environmental management system consistent with ISO 14001 or equivalent. Higher scores hinge on having more sustainable suppliers and purchases. Keep track and make inventories of the sustainable suppliers and purchases that have been used for building and operating the hydroelectric.
RA1.3 Used	**0**	**No Score**

Recycled Materials		The intent of this this credit is to evaluate reductions in the use of virgin materials and avoid sending useful materials to landfills by specifying reused materials for structures, and material with recycled content. There is no indication of the use of recycled materials for the structures of the hydropower plant, but only in the reuse of the vegetative material that was removed for construction. This material was mostly wood salvaged resold in the market, and reused in the fencing of the protected areas, or sent to the Santo Antonio sponsored herbaria. In terms of volume of salvaged wood, 116,066.51 cubic meters of logs were commercialized. However, it is not established within the documentation what percentage of the total material this constitutes.
		Source: "Destinação de Madeira" in 6º Relatório de Acompanhamento dos Programas Ambientais Após Emissão de Licença de Operação (2014). Santo Antônio Energia, Gráficos de Resíduos Recicláveis e Não Recicláveis (2014).
		RECOMMENDATIONS: More information regarding the volume of recycled materials used in the construction and operation of the hydroelectric plant are essential to know their percentage in relation to the total amount of materials.
RA1.4 Use Regional Materials	**0**	**No Score**
		In order to minimize transportation costs and impacts, the use of regional materials is encouraged. According to the project owners, the acquisition of construction materials is made locally in the region. For shopping and service, wherever possible, the company prioritizes local negotiations.
		Source: Madeira Energia S.A., "Projeto Ambiental para a Construçao" in Projeto Básico Ambiental AHE Santo Antônio (2008).
		RECOMMENDATIONS: It is recommended that the team make an inventory of materials, plants, aggregates and soils for construction sourced near the site to know to what extent they used regional materials. The inventory should include the total cost of materials and distance to location from which they were extracted or produced. It is recommended to get soils and aggregate from a 50 miles radius; plants from 250 miles radius, and all other materials within a 500 miles radius. To achieve a the minimum 'Improved' score at least 30% of materials should be locally sourced
RA1.5 Divert	**8**	**Superior**

Waste From Landfills		The project team indicated that waste generated in the construction of the Hydroelectric has proper disposal, recycling, composting or to the landfill. At least 75% of the waste stream is recycled, reused or diverted from landfills. In fact, the team asserts that 88% of the waste generated at the construction site is intended for recycling. Their goal is to raise this percentage to 90% by the end of year 2014. During construction, there are specific teams developing the Environmental Program of Construction (PAC) which provides the correct disposal of waste produced at the construction site. The team has developed a waste management program, delineated in the PAC. In areas where waste is generated, they record their volume and type of waste as collection points and containers will be set to their packaging to ensure proper segregation. The waste collection must meet the different forms of packing, adjusted to the amount and type of waste generated per area. There will be containers that are referred to as unique containers intended for packaging only a certain type of waste, and mixture of waste is not allowed. The unique containers are correctly identified them according to the material that is deposited using the color standard established in CONAMA resolution. There is an exhaustive list numbering the different types of waste material handled in the waste management plan including hazardous and nonhazardous materials collected according to the different types of waste collection: selective collection-separated by type, differentiated collection for debris and large objects, and special collection for medical waste and hazardous waste. For the economic exploitation of the raw material of commercial value the project team follow the requirements of IBAMA in the State of Rondonia, requests authorization to use forest raw material (AUMPF). This is the case for the vegetative material resulting from the needed deforestation to make way for the reservoir. In terms of diverting community waste from landfills, there is a lack of waste infrastructure in the area as waste collection and management are in serious need. The waste produced by residents of the right bank of the Madeira River is almost either taken by public service or burned. Only the inhabitants of Porto Velho, in the urban and rural areas, have access to public waste collection and public cleaning service. In other communities, garbage is often burned; the second most adopted option by most people is to dump waste in vacant lots or directly on the Madeira River, followed by the option of burrying it in the ground or dumping in streams. In the left bank, none of the communities, including urban, have waste collection and public cleaning service. In communities either urban or rural, tend to burn the waste or dump directly on the Madeira River, in a vacant lot, in the woods or yard. The residents of the urban core of San Carlos use a room intended for that purpose, called "Community dump".
		Source: Santo Antônio Energia, Gráficos de Resíduos Recicláveis e Não Recicláveis (2014). Madeira Energia S.A., "Projeto Ambiental para a Construçao" in Projeto Básico Ambiental AHE Santo Antônio (2008), 19-22. Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 73.
		RECOMMENDATIONS: Higher scores represent recycling and reusing 100% of the waste. Most of the waste will be generated during construction, it is necessary to have more information about the waste management during the operation of the hydroelectric. SAE was able to achieve an efficient waste management during construction against the lack of public waste infrastructure and management in the

		neighboring communities. The project team can help delineate a waste management plan that can include community waste management that can continue beyond the construction period.
RA1.6 Reduce Excavated Materials Taken Off Site	**0**	**No Score**
		In terms of excavated materials taken off site, the project team asserts that most excavated material is reused in the construction site itself. The amount of excavated material not used in the construction is intended to the send away (bota fora) area which are later mandatorily reforested within the Degraded Areas Recovery Program. According to the technical record, the main volumes of general excavation materials is 30,408,470 m3, and 16,652,570 m3 of exposed rock. Considering the large amount of excavated material these constitute, it is important to have a design and management plan that minimizes the movement of soils and exposed rock off site. During the excavation works on the Madeira Riverbed, the presence of mercury needs to be monitored. Upon sampling, all extracted materials are tested to check how to dispose of them, materials with mercury need to be landfilled, materials with below permitted mercury levels will be disposed as deposit surplus material. As samples of material removed and analyzed, a safe storage area must be provided. Appropriate signage will be used to inform that the material should not be removed or held without prior authorization of the environmental management work. There are guidelines for the contractor to follow regarding excavation, such as preserving the local topography and replenish degraded areas with plants coverage to ensure that the filled slopes maintain the original slope of the land as well as observing the provisions for the recovery procedure of degraded areas.
		Source: Madeira Energia S.A., "Cuidados Ambientais nas Operaçoes do Construtor" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 185. UHE Santo Antônio, “Procedimentos Internos de Supervisão e Assurance Ambiental e de Saúde e Segurança” in11º Relatório Socioambiental Periódico RSAP (2014), 279-282. Santo Antônio Energia, Ficha Técnica.
		RECOMMENDATIONS: Although there are guidelines for excavation materials, it is not clear what is the percentage of material that has been retained on site. In order to score in this credit, at least 30% of the excavated material must be retained on site. The following documentation can help delineate this uncertainty: design documents showing the estimations of excavated material that was taken off site, and documentation of how the design reduced the volume of excavated materials or a balance of cut and fill.
RA1.7 Provide	**0**	**No Score**

for Deconstruction & Recycling		The intent of this credit is to encourage future recycling, upcycling and reuse of infrastructure by designing for ease and efficiency in project disassembly or deconstruction the end of the useful life of the project. There is no documentation on the percentage of components that can be easily separated for disassembly or deconstruction. Nor evidence of how the project will adapt to future environmental conditions. The deconstruction of the structure was not meant for easy removal due to the about 3,000,000 m3 of concrete that was poured to make the structure of the hydroelectric. The lifespan of the project is calculated to be 100 years. Many dams removal projects require to dynamite its parts to be able to deconstruct them, instead of disassembling them. The 100 years lifetime is due to the historic lifespan of hydroelectric projects in Brazil of 100 years. This number has been decreasing to 92 years due to the estimations on intensification of land use around the reservoir as well as the increase of meteorological and climate effects. In the case of the Santo Antonio hydroelectric, according to the predicted parameters in the environmental impact studies a hydrosedimentological monitoring program is implemented in order to keep the project performance for 100 years.
		Source: Santo Antônio Energia, Ficha Técnica. Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 105.
		RECOMMENDATIONS: An inventory of the parts of the components that could be disassembled such as the 50 bulb-type turbines can help decipher what is the percentage of components that can be easily separated. This is the minimum consideration for providing for deconstruction and recycling. In order to score, at least 15% of the components must be easily separated for reuse.
RA2.1 Reduce Energy Consumption	**0**	**No Score**
		Reducing energy consumption is encouraged in order to conserve energy. This can be achieved by reducing overall operation and maintenance energy consumption throughout the project lifecycle. According to the project team, the specifics of the project did not allowed to implement features to reduce power consumption. No documentation was found regarding energy reduction in the project. Reduction in energy consumption can be achieved by conducting feasibility and cost analysis to determine effective methods, in initiatives that can go from changing lightbulbs to doing structural changes.
		Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 105.
		RECOMMENDATIONS: Saving energy is a topic often times overlooked by energy generation projects. Energy consumption from operations can represent a significant amount of energy that can be used elsewhere. Consider establishing energy reduction practices in the operation of the hydroelectric plant. Inventory of energy saving methods as well as feasibility studies, can serve as documentation that can establish the percentage of reductions achieved.
RA2.2 Use	**20**	**Restorative**

Renewable Energy		The 'use renewable energy' credit looks into how projects meet energy needs through renewable sources. Santo Antonio hydroelectric main goal is to be a net positive renewable energy generation in the region. The project generates a significant net positive amount of renewable energy capable to give power to 45 million people with its installed capacity of 3568 MW once the construction is completed. According to Envision, hydropower is considered renewable energy along with solar, wind, biomass, among others. The hydroelectric project is generating clean and renewable energy source, however, for its implementation conventional sources are used.
		Source: Santo Antônio Energia, Ficha Técnica. *IBAMA, Licença de Operação nº 1044/2011 (2011).* *Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 73.*
		RECOMMENDATIONS:More renewable energy can be generated and input into the national grid if other infrastructure projects are bundled, such as a waste to energy project. For example, the team can try to capture synergies between waste generated in the region and energy production, as waste and sewage most times burned or dump directly into the river.
RA 2.3 Commission & Monitor Energy Systems	**3**	**Enhanced**
		To ensure proper functioning of the energy systems and extend the useful life, the project must specify commissioning and monitoring of the energy systems performance. According to the project team, the project was scaled to the conscious and rational use of electrical equipment and mechanical systems, while respecting the specificities of its scope defined in your auction and can not be changed. Third party commissioning of the electrical or mechanical systems is recommended at least once during the useful life of the project. Long term strategies backed up with documentation stating this requirements can help enable more efficient hydro plant. According to the implementation diagram, there have been a few commissionings of the energy system, especially for the hydraulic generator, turbines, and electromechanical assembly among others. The Brazilian Power Regulatory Agency (ANEEL) created the decree nr. 2,335/1997, which one of its responsibilities was to supervise the operation and maintenance of electric installations and services. ANEEL visits power plants to guarantee their correct operation. The Santo Antonio hydroelectric visit was conducted from 20th to 22nd August, 2013. However, all equipment maintenance is the project sponsor responsibility. Santo Antonio Energia S.A prepared the Integrated Management System (from the Portuguese Sistema de Gestão Integrada, SGI), which includes procedures for Santo Antonio dam operation, maintenance and emergency. All procedures follow the equipment manufacturers and is composed by 12 (twelve) volumes. The SGI manual was structured to meet the requirements of the Equator Principles, the International Finance Corporation Performance Standards, NBR-ISO-9000 , NBR-ISO-14000, Determinants of Operating License nº1044 / 2011 / IBAMA and Legal Requirements No 825/2011 / IBAMA. The project must comply with the Equator Principles and ensure ongoing monitoring and reporting after the financial close and over the life of the loan requires the appointment of an independent environmental and social consultant.

		Source: Santo Antônio Energia, Ficha Técnica. *UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 127.* *Madeira Energia S.A., "Sistema de Gestão Ambiental" in Projeto Básico Ambiental: AHE Santo Antônio (2008).* *Santo Antonio Energia, Manual on Integrated Management System (2012).* *Equator Principles, The Equator Principles: A financial industry benchmark for determining, assessing and managing environmental and social risk in projects (2013), 11.*
		RECOMMENDATIONS: More documentation supporting the monitoring and commissioning of the energy systems can help support a higher score. Furthermore, there must be evidence that a third party commissioner is independent of the design and the construction team.
RA3.1 Protect Fresh Water Availability	**17**	**Conserving** This credit looks into how the project reduces the negative net impact on freshwater availability, quantity, and quality. Also it looks to how much water the project needs and if the project is designed to protect water sources. Since the project is a hydroelectric plant, it utilizes directly the water flow of the river Madeira. According to the project team the Brazilian National Water Agency (ANA) exempted the need for granting water for the project because of the low rate of consumption and the low amount of funding. IBAMA also regulates the river water use by putting law and policy, such as the nr. 7,990 that establishes royalties' payments for water use/exploration with the purpose of energy generation. The project team has taken especial care in monitoring pollutants in the water. For example, the water quality is monitored bimonthly over 60 physical, chemical and biological parameters, as well as samples from multiple sites that are reviewed periodically. It is expected that such monitoring extend to the end of the grant of Hydropower. There is a mention to the WCD Report (2000), which states that "hydropower has been perceived and promoted as a comparatively clean, low-cost, renewable source of energy that relies on proven technology. Except for reservoir evaporation, it is a non-consumptive use of water". Therefore, hydropower plants contribute to efficient water use generating renewable electricity for the grid. According to the program for limnological monitoring, the water classification in the Amazon reflects the differences between alluvial waters chemically rich in high areas of recent geological origin (white water), and those with low content of suspended matter and low concentrations of dissolved ions, sunken and ancient geological origin (black and clear water). In addition to these, transitional types occur throughout the Amazon. However, in all the rivers of this region is the key feature pronounced and predictable fluctuation of water levels, with a monomodal discharge pattern, especially in large rivers. In terms of protecting water quality, the project team will monitor changes resulting from the implementation of the reservoir in the aquatic plants communities in the Madeira River and associated aquatic ecosystems, such as herbaceous plants, emerging, floating or underwater.

		Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 77. *National Water Agency, Oficio 851 (2014).* *Madeira Energia S.A., "Programa de Monitoramento Limnológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008)., 6-7.* *Madeira Energia S.A., "Programa de Monitoramento de Macrófitas Aquáticas" in Projeto Básico Ambiental: AHE Santo Antônio (2008)., 6-7.*
		RECOMMENDATIONS: The hydroelectric impact to the water quality of the Madeira River can be reduced further by providing documentation that proves that the project also helps in the replenishment of Madeira's water, as well as the extent to which the project uses freshwater sources.
RA3.2 Reduce Potable Water Consumption	**0**	**No Score**
		There is no indication of how the project reduces potable water consumption and encourage the use of greywater, recycled water and stormwater to meet water need. According to the hydroelectric licensing process the project must meet the criteria set by IBAMA. It has implemented of a series of mitigation programs that indicate that Santo Antonio contributes to efficient water resource management. In addition, the project sponsor informs the Brazilian National Institution of Environment and Renewable Natural Resources (IBAMA) periodically to ensure the validity of the licenses. In terms of water use in the Amazon hydrographic region, most of the water use is destined for urban human consumption (36.6%), irrigation (21.8%), watering livestock (24.6%), industry (9.8%), and rural human consumption (7.2%). The water supply system in the city of Porto Velho is the responsibility of the Water and Sewage Company of Rondônia (CAERD) joint stock company with majority equity belonging to the state government. The water supply of the city comes from, among others, the intake San Antonio water collection point on the Madeira River, from which is extracted daily 85 million liters of water a day. Porto Velho is one of the Brazilian national capitals with the lowest rate of available infrastructure for basic services. Currently, the water supply, connected to the public grid, meets only 30.6% of the urban and rural population of the municipality (the national average is 90%). On the outskirts of the urban centers of Porto Velho, most families depend on ponds wells (also known as Amazonian wells), 10-15 meters deep, where each family takes on its own drinking water. This practice can contaminate the water table, due to poor hygiene conditions when handling the collection instruments and the direct contact of the population with water from wells.
		Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 80, 113.
		RECOMMENDATIONS:An estimation of the percentage of reduction in water use is needed of at least 25% in order to be able to score in this credit. Provide calculations of the estimated water consumption over the life of the project, as well as an inventory of measures taken to reduce potable water use during operations. The project can achieve the highest level if the project has net zero impact and recycles water. Further water recycling can include treating the community sewage to clean water that replenishes the Madeira River. Considering the lack of infrastructure in the area this can be a synergy worth pursuing.

RA3.3 Monitor Water Systems	**3**	**Enhanced** The intent of this credit is to assess and monitor water systems performance during operations and their impacts to receiving waters. According to the project team, because the typology of the hydroelectric is run-of-the-river, the water used for hydroelectric power generation inside the turbines comes out the same way it enters, not suffering changes in its composition. All monitoring in the project is responsibility from the project sponsor, not from an independent authority. Turbines, generators, ancillary systems and overflow devices shall be monitored according to the ONS grid procedures. Santo Antonio hydroelectric also complies with the Brazilian National Policy on Safety of Dams (PNSB) established by the Brazilian Government. Monitoring of other equipment shall be made following the manufacturer's manual or by demand. The water that is used for administrative buildings going directly to, the onsite sewage treatment plant, which is handled within the parameters allowed by Brazilian law. Treatment of sewage generated at the construction site of UHE Santo Antonio is being conducted in two treatment plants - STPs, located on the left bank and right bank.
		Source: UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 264-269. *Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 87-88.*
		RECOMMENDATIONS Considering the scale and scope of this project, having an independent monitoring authority will help better to keep track of the hydroelectric equipment and their impact to the riverine environment. The use of a third party can help in getting a higher score.
RA 0.0 Innovate Or Exceed Credit Requirements		*N/A*
	53	

NATURAL WORLD		
	Score	**SAN ANTONIO HYDROELECTRIC PLANT**
NW1.1	**0**	**No Score**

Preserve Prime Habitat		Avoiding development in areas of high ecological value is difficult to achieve when building a hydroelectric in the Amazon. According to IBAMA, the management of natural resources in the Amazon should be based on profound scientific knowledge about the functioning of ecosystems, due to the high biodiversity and complexity of the interactions of organisms with one another and with the physical environment. The low availability of scientific knowledge about the habitats in the area, has been a challenge in identifying the Madeira River area as prime habitat. In this sense, the exploration of these areas has helped document local species, an endeavor considered to be a contribution for the natural sciences. The impacts of Santo Antonio hydroelectric on the native flora can not be disregarded despite its relatively reduced flooding area when compared to other Amazonian hydroelectric projects. The building of this infrastructure will inevitably promote deforestation of forest areas for deployment of infrastructure and civil works. The creation of Santo Antonio hydroelectric reservoir is expected to remove 10,448 ha of open rainforests and low alluvial land to clean the flood areas. According to the zoning programs in Rondônia, this region is considered to have the highest rates of environmental change in the Amazon, stemming mainly from deforestation and to a lesser extent, from mining and construction of hydropower. In addition, the nearby indigenous lands, such as the Karitiana Indigenous Land, show a high degree of vulnerability to development impacts such as actions done by loggers, miners, and prospectors. The project team, according to IBAMA's regulations stipulated in the basic environmental program, have developed a program for the conservation of flora that consists of a subprogram for the rescue of flora, and a subprogram for monitoring of succession of vegetation margins of reservoirs. The development of the conservation of flora program will help contribute to the knowledge of a region with one of the greatest floristic diversity of the world. A positive aspect about the deforestation for construction in this area, is that it will provide access and opportunity to collect large number of botanical samples of great scientific value. Botanical identification is not only dedicated to trees, as there would be access to a large number of species such as epiphytes, lianas and hemiepiphytes, which are usually difficult to collect and to study. The feasibility of large-scale botanical collections in these areas will strengthen the local botanical collections. The hydroelectric project will support the creation of UNITE herbarium, and contributions to the regional INPA Herbarium, Goeldi Museum and other Amazonian and national collections contributing to the activities of teaching and research in botany systematics, phytogeography, genetics, etc. It should be noted that the hydroelectric plant has planned for a program for recovery of degraded areas (PRAD), and a permanent preservation area of 1,987 hectares around the reservoir, as stipulated in the environmental commitment term (TCO), for which 644 hectares have been planted for this purpose.
		Source: Leme Engenharia Ltda., "Área De Influência Indireta dos Aproveitamentos Hidrelétricos Jirau e Santo Antônio" in Sumário dos Estudos de Impacto Ambiental (2005), 100, 138-140, 142-145, 302-305. *Madeira Energia S.A., "Programa de Conservação da Flora" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 5-7.* *Santo Antônio Energia, Termo de Compromisso Ambiental (2014).*

		RECOMMENDATIONS: The fact that the Madeira River is considered the river with the most biodiversity in the world, makes it a prime habitat or an area of high ecological value. To understand better if the official zoning designation of the hydropower site as non prime habitat, it is necessary to provide with such documentation. In addition, considering the efforts in designing a smaller footprint, plans or documents that can explain better the planned reduction of the area of Santo Antonio's reservoir could help argue for a better score in this credit.
NW1.2 Preserve Wetlands and Surface Water	**0**	**No Score** The Santo Antonio hydroelectric does not avoid development on wetlands, shorelines, and water bodies as it is located inside the Madeira River. The creation of the reservoir in the Madeira River is expected to remove 10,448 ha of open rainforests and low alluvial land to clean the flood areas. Impacts on these areas are inevitable and irreversible, due to the permanent flooding. All riparian habitats along the water body stretch between Santo Antonio waterfall and river confluence of the Abuna, should be affected due to changes in the hydrological regime caused by the Madeira river. The areas closest to the dam should suffer greater impacts due to the increased flooding, more than stretches downstream of the reservoirs. The disappearance of most plant communities adapted to the flood pulse of the Madeira River would prevent the implementation of programs in situ conservation for species that occur in these environments, as is recommended by IBAMA. The operation license granted by IBAMA requires the project team to comply with the Basic Environmental Program (PBA) that specifies numerous programs for the reconstitution of eroded areas by planting native trees, and for the reconstitution of riparian forests in water bodies. The development of the PBA, maintains alignment with the planning of the studies presented in the EIA, in addition to meet the competency requirements, by incorporating institutions with extensive knowledge of the specifics of the Amazon region, the state of Rondônia and the municipality Porto Velho. The permanent preservation area (APP) of 1,987 hectares around the reservoir serves as a buffer as stipulated in the environmental commitment term (TCO), and in the program for recovery of degraded areas (PRAD). In the case of Santo Antonio a buffer or APP was created around the reservoir that exceeds the Brazilian forestry law requirements, exceeding 600 meters at most areas, which is equivalent to around 1968 feet, surpassing also the Envision criteria of 300 feet buffer or vegetation and soil protection zone (VSPZ). The Brazilian forestry law article 2 considers an area of permanent preservation the forests and other forms of natural vegetation located: along rivers or any water course from its highest level; a width of 500 meters for water courses which have a width exceeding 600 meters; around the ponds, lakes or natural or artificial reservoirs. The removal of vegetation in permanent preservation areas can only be allowed in cases of public utility or social interest properly characterized and motivated by an administrative procedure as is the case of Santo Antonio, when there is no better technical or location alternative for the proposed development. Regarding water quality, the project team pointed out that there is a lack of sanitation in the urban areas, including Porto Velho, which discharge pollution loads directly into the Madeira River. This impact is considered negligible due to the dilution capacity and flow of the Madeira river, but represents potential use conflicts location. The collection of sewage treatment system is administered by CAERD and, according to

		the diagnosis of the Water and Sewage Services conducted in 2005 by the National Sanitation Information System (SNIS), only 2.2% of households have system sewage. Of these, 43% are benefited by sewage collection, but there is no treatment system for the collected sewage, as waste is dumped directly into the river, woods or its tributaries. It is included in PAC that the Legal Amazon has a major investment in sanitation, water supply and urban settlements in Porto Velho.
		Source: Leme Engenharia Ltda., "Área de Influência Indireta dos Aproveitamentos Hidroelétricos Jirau e Santo Antônio" in Sumário dos Estudos de Impacto Ambiental (2005), 100 - 148. *IBAMA, Licença de Operação nº 1044/2011 (2011).* *Santo Antônio Energia, Termo de Compromisso Ambiental (2014).* *Madeira Energia S.A., "Programa de Conservação da Flora" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 7-8.*
		RECOMMENDATIONS: Since the hydroelectric dam is located inside the river, it does not meet the criteria of avoiding development on water bodies. Although the project team has designed a buffer area that exceeds requirements widths, the area was modified first by deforesting for development and then restored. A higher score would require documentation about the restoration of a degraded land areas that have been restored by the project and incorporated into the buffer zone or vegetation and soil protection zone (VSPZ).
NW1.3	**0**	**No Score**

Preserve Prime Farmland		According to the project team and the documentation no soils designated as prime farmland of national importance were flooded for the project implementation.There is agricultural activity in the the area that is done by the riverine communities in soil not officially allocated or zoned for agriculture. The sediments carried by the waters of the Madeira River are rich in nutrients. After flooding periods the nutrients remain in the lowland soils as natural fertilizer favoring agricultural activities. For instance, on the banks of the Madeira River, pastures for cattle cover approximately 10.35% of the area to be flooded by the Santo Antônio reservoir. The statement of environmental compensation assigned the amount of about US $17,281,316 to be paid by hydroelectric to compensate 3 protected areas that were flooded. The main land use patterns are the following, according to the environmental impact assessment: natural forest (65%), natural pasture (10%), artificial pasture (7%), productive land (unused, 6%), temporary crops (4%), permanent crops (3%), temporary farming (in break period, 3%), and unproductive lands (3%). In the resettlements indemnisations plots of lands were given to them. Conditions of climate, topography and geology allowed the formation of the following classes of soil in the stretch of the Madeira River basin, corresponding to the area of the hydroelectric under consideration: Gley Dystrophic and red-yellow Dystrophic (not recommended for agriculture), Cambisols, Podzolic red-yellow and yellow, Podzolic dark-red, Quartz sands and Leptosols. The Cambisols and the Leptosols are the only soils that can be used for agriculture and pasture. Cambisols Dystrophic have extension 947 km2 in the region of Jaci-Paraná and near the axis of the AHE Santo Antonio, on the left bank of the Rio Madeira. These soils have potential for development of crop activities. Consequently, the agricultural capability demonstrates that much of the soil from the right and left bank of the Madeira River has operating conditions, with climatically adapted crops, and a management system developed with high use of technology and capital. The main production in the temporary crops are cassava, rice and sugarcane; in the area of permanent crops, the main products are banana and orange. Indemnisations were given directly to the resettlement families who had lost their plots for agriculture, for a monthly amount of $4720.71 USD (R$ 12,550.00) for a period of ten months. This financial assistance was renewed for an equal period until the establishment of the results of agricultural production activities. Santo Antonio Energia S.A. still provides support regarding the productive activities to the resettled families through the transfer of materials and supplies for the increase of agricultural production.
		Source: IBAMA, Licença de Operação nº 1044/2011 (2011), 6. *Leme Engenharia Ltda., "Área de Influência Indireta dos Aproveitamentos Hidrelétricos Jirau e Santo Antônio" in Sumário dos Estudos de Impacto Ambiental (2005), 61-64.* *Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 6-7, 29-30.* *Furnas, Odebrecht and Leme, "Sumario" in Premissas Adotadas para a Elaboração dos Estudos Ambientais.*
		RECOMMENDATIONS: Provide additional documentation showing the areas of temporary crops from the resettled community and their new land allocations, and if any farmland was restored into agricultural prime land. Any documentation attesting to how the community is adapting to a new lifestyle further from the river can help understand the scope of mitigation efforts.

NW1.4 Avoid Adverse Geology	**3**	**Superior** Envision encourages to avoid development in adverse geologic formations and safeguard aquifers to reduce natural hazards risk and preserve high quality groundwater resources. The siting of the project offers protection and risk management as it took advantage of the rocky outcrops of the Sao Antonio falls to construct the dam. The area was mapped to identify and delineate the fault lines. The area of the project, in geomorphological terms, is inserted in macro-compartments of peripheral and marginal depressions. According to experts involved in the developing of the basic environmental project, the dam is located in a geological area presenting in its full scope reliefs of medium and large hills with tops and convex slopes, as well as isolated residual hills. In the case of the AHE Santo Antônio, the geomorphological unit corresponds to Guajará Mirim - Porto Velho. In most outcrops, sediments rest over rocks at Sao Antonio and Teotônio and granite suite of Rondônia. To build the hydroelectric power plant large rocks were dismantled with dynamite to remove them. Experts observed that the Santo Antônio reservoir with a volume of 3.9 x 109 m3 and depth of up to 45 m is not framed to what could be a higher probability of induced earthquakes by Seismicity Triggered by Reservoirs (SIR). SIR is influenced by the size and weight of the reservoir; pre existing tectonic forces; geological conditions and specific hydro area; constructive interaction between the orientation of the earthquake tectonic forces; dynamics of change in the water level of the lake and the additional load caused by the reservoir. According to the documentation, there is no evidence that the Santo Antônio reservoir may induce earthquakes. However, due to the relative proximity of the Andes, a recognized high seismic activity area, and considering the history of natural regional earthquakes, possibly some associated with geological structures and the occurrence of a recent natural earthquake of magnitude 4.2 on the Richter scale located about 200 km from the dam axis, it was recommended to implement a seismological monitoring program. A part of the environmental impacts from the Santo Antonio hydroelectric implementation, is the Increased erosion potential to the Madeira river. The case of the Madeira River is exceptional, unlike common erosions and landslides on stream banks, in this Amazon region there is a natural phenomenon called "desbarrancamento", "terras caidas" or fallen lands along river margins, where the water flow collapses accumulated sand, trees and riparian vegetation. This is a typical phenomenon of the Madeira River, results in large and abrupt changes in the volume and flow of water. There have been negative press surrounding the impacts of "desbarrancamento" that got worse from not just the Santo Antonio hydroelectric, but also from the Jirau hydroelectric upstream, which together with 2 more dams belong the Madeira River Complex. The public prosecutor of Rondônia has placed the responsibility of the floods to the Santo Antonio and Jirau hydro plants. The civil defense, at first, explained that the opening of the floodgates of hydropower has caused floods and the banks of the Madeira River suffer landslides due to force of the water released from dams. There has been controversy around the floods and the "desbarrancamento" to the point that the president of Brazil, Dilma Rousseff, made statements about the floods volumes to be coming from Bolivia and not caused by the hydroelectrics. The protected areas around the reservoir can serve as some protection against adverse

		geology. From 2010 to 2014 have been planted 400,000 seedlings of 170 species of trees native to the Amazon region in 1244 hectares. The planting prevents damage to land as erosion processes.
		Source: UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 31-33. *Santo Antônio Energia, Termo de Compromisso Ambiental (2014), 1-4.* *Santo Antônio Energia, Saiba Mais Rio Madeira.* *Furnas, Odebrecht and Leme, "Sumario" in Premissas Adotadas para a Elaboração dos Estudos Ambientais.* *Mesa Madeira Energia SA, Entenda o Desmonte de Rochas.* *Madeira Energia S.A., "Programa de Monitoramento Sismológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 5-6.*
		RECOMMENDATIONS: Provide documentation that can illustrate more specifically the sitting strategies to avoid damage to sensitive geology. Higher score requires proof that the site has completely avoided adverse geology and that is located in a safe area with no adverse effects on aquifers.
NW1.5 Preserve Floodplain Functions	**2**	**Improved**
		Efforts to avoid floodplains or maintain predevelopment floodplain functions are regarded in this credit. Preserving floodplain functions is usually achieved by limiting development and development impacts to maintain management capacities and capabilities. In the case of the Santo Antonio hydroelectric, the floodplain functions were drastically modified to accommodate for the reservoir and the hydro power generating facilities such as the turbines and power houses, but overall the development in the floodplain was limited by using the run-of-the-river typology, which requires reduced flooded areas. The project modified the topography to raise the water level to 70.5m to create the minimum level for the reservoir, and the maximum at 71.31 m. The average annual river runoff predevelopment volume from 1931-2005 was 594.4 billions of m3, and after development in 2012 the runoff decreased to 587.4 billions of m3. Although the project does alter the floodplain functions, the project team tried to mitigate impacts with various monitoring programs. The design also helps in the mitigation, the hydroelectric plant does not have a reservoir for water retention. Its design provides the water flow to reach the plant and follow the course of the river. This means that the interference in the natural cycle in reduced. There are various programs within the basic environmental project (PBA) that look for water quality and macrophytes to enhance the vegetation and soil protection areas. The limnological monitoring program monitors physical, chemical and biological variables that characterize the quality of water of the Madeira River and its major tributaries and lakes, and which are located in the area of influence of the hydroelectric. In terms of sediment transport, sediments are transported by the waters rich in nutrients, and after the rainy season when the river returns to its normal bed, sediments remain in the soil favoring fertilization needed to agricultural activities. There is a requirement of ANEEL, the Brazilian Electricity Regulatory Agency that all

		hydropower projects develop PAE - Emergency Action Plan that guides needed for emergency activities. The Santo Antônio Energia is developing the plan that will be implemented in the future. To enhance connectivity, the riparian habitat will be maintained with the restoration of the Permanent Preservation Areas and degraded riparian areas. As for the aquatic habitat, hydropower has two environmental programs toward this end: the program for water quality and macrophytes monitoring . In addition to these measures, the hydroelectric built a fish transfer system, which allows the passage of migratory species through the dam, thus ensuring its survival. The water quality and macrophytes monitoring programs look for communities of aquatic and marsh weeds in the Madeira River, as well as the major tributaries and lakes located in the area of influence. This monitoring will start before the construction and will last until the operation phase, in order to detect and take action to mitigate any environmental impacts of the project.
		Source: Santo Antônio Energia, Termo de Compromisso Ambiental (2014). *Madeira Energia S.A., "Programa de Monitoramento de Macrófitas Aquáticas" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 2.* *Madeira Energia S.A., "Programa de Monitoramento Limnológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008).* *Plano Básico Ambiental, Volume II, Seção 10 , Seção 11 e Seção 16 (p. 39-49).*
		RECOMMENDATIONS: Provide with documentation that can support that the project enhance connectivity and sediment transport, as well as mitigate floodplain functions.
NW1.6 Avoid Unsuitable Development on Steep Slopes	**1**	**Improved** In order to avoid unsuitable development on steep slopes, the project team must plan development avoiding hillsides, exposure and risks to erosion, landslides and other natural hazards. Amongst the adverse impacts from the hydroelectric implementation, there are: solids retention in the reservoir; changing in the water quality; Increased erosion potential of the Madeira River; vegetation removal; disruption of migratory routes of fish; Increasing in the cases of malaria; resettlement of part of the population; changing in the fishing activities at the reservoir area; reduce employment and income of fishermen and miners. All plans and programs have been implemented in order to mitigate the project impacts. The project follow best management practices to manage erosion and prevent landslides as it is delineated in the hydrosedimentological monitoring program. The program looks for increasing knowledge of the sedimentological behavior of the Madeira River in the past and current conditions, monitor the evolution of

		hydrosedimentological behavior of the reservoir and the Madeira River throughout the spurt affected by the implementation thereof, during the construction phase and for a period of 5 years after the operation input of the power plant. It also intends to subsidize erosion estimates and deposition downstream of the hydropower facilities, and monitor morphological changes in river channel and banks of the Madeira river. Another goal of the program is to evaluate the prognostic siltation and life of reservoirs, and the effects upstream and downstream of dams after a period of five years of operation input of the plants.
		Source: Madeira Energia S.A., "Programa de Monitoramento Hidrossedimentológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008).
		RECOMMENDATIONS: Provide documentation showing that the siting of the project avoid steep slopes and favored optimal project siting in order to achieve a higher score. Also any documentation to assert the design process behind avoiding high risk hillsides.
NW1.7 Preserve Greenfields	**3**	**Improved** This credit looks for efforts in preserving greenfields by locating projects on greyfields- previously developed land or the use and cleanup of brownfields- contaminated sites. According to documentation provided the hydroelectric is located in what is mostly considered a greenfield although its location is not remote, as it is 7 km from Porto Velho, the capital of Rondonia. Within the site some areas are classified as were previously developed with about 2,000 people living in there, mostly in the southern bank of the river. Besides, the area presents agricultural activity and towns, as well as gold mining in the river, which is highly contaminant. The land use map shows that in the direct influence area around the contour 70 m, which delimits the reservoir size, there are anthropic areas, different types of forests and shrubland. Roughly, the map indicates that at least 25 % of the site is located on a greyfield, due to the anthropic areas, previously developed mostly on the right bank of the Madeira River. The anthropic areas are composed of residential areas (housing groups), urban area of mixed use (residential, institutional, commercial, services), housing groupings with residential, institutional, commercial and service, industrial area (small, medium or large), rural property headquarters: (main house of the property, dependencies and associated infrastructure), agriculture (permanent or temporary crops, extensive or not, fruit and vegetable horticulture), pastures (ctive fields, covered by grasses for cattle foraging), and anthropic fields (Areas covered by grasses without any cattle use). In terms of Indigenous lands protection, there is an increased pressure on indigenous lands development with the implementation of the hydroelectric. On the other side, the implementation can help strengthen the instruments for the supervision of indigenous lands that are susceptible to illegal loggers. For greenfields restoration, the project team defined a buffer area around the reservoir that at certain areas is 500 m wide, to 30 m wide in some areas that are closer to the urban center. This area accounts for 271.3 km2 of the reservoir defined for the Environmental Conservation Program. APP with 100 meters around the

reservoir 10,972 ha; APP with 500 meters around the reservoir 41,090; and the proposal for APP reservoir 24,153. In the case, the proposed APP reservoir has wide ranging between 30, 100 and 500 meters, all consistent with the parameters and settings of CONAMA Resolution 302/02 (see item 4.6 of this program).

The 2,500 meters delimitation surrounding the Santo Antônio reservoir will be set for planning guidelines and proposals in order to manage the multiple use of water, conservation, recovery and the use and occupation of around the reservoir, with the operating standards of the enterprise, according to Resolution CONAMA 302/02 and conditionality 2:20 LP No 251/2007.

Extensive data collection and mapping of this area was done by the project team including the deforestation trends of the area. Following institutional consistency with the Master Plan of the Municipality of Porto Velho, the Santo Antônio team proposed the following guidelines for zoning the area: to divide the area into six zones to provide for the conservation of natural resources, restoration, agricultural activity, generation of electricity, and maintenance. The zones as they appear in map 8 are designated into the following: Diversified Use Zone, Use Zone with Diverse Vegetation Cover Prevalence, Special Use Zone, Wildlife Protection Zone, Zone- Integral Protection Conservation Unit, and Zone - Sustainable Use Conservation Unit. In addition to these six zones, other designations such as the Environmental Recovery Zone and the Tourism-Recreation Use Zone should be identified.

For economic and social development of the area these following guides in monitoring and controlling were created: land use and natural resources for conservation and improvement of environmental quality around the reservoir; existing activities in the area, in order to enable the conservation of environmental areas concurrently with plant operation and maintenance of the reservoir.

Along the Madeira River, its islands and tributaries, especially in the Jaci-Paraná river, the lands are occupied by a population dependent on fishing, exploitation and family farming. Towns of Jaci-Paraná, Amazons and Teotônio communities will be completely flooded by the reservoir. Teotônio is a fishing community, whose houses are built on the rocks, located on the right bank of the Madeira River, along the waterfall of Teotônio. As Teotônio, the Amazon community is also made up of fishermen, whose houses are built on the left bank of stones, near the waterfall Teotônio that will be flooded as well.

In areas of less than 10 hectares, located on the banks of rivers and streams, with no permanent preservation area, land use consists of subsistence agriculture with generation of small marketable surpluses. According to the documentation the agricultural activities developed by these populations served in the past as an important subsidy to supply the urban center of Porto Velho. However, after the construction of the interstate highway BR-364, the supply of the city of Porto Velho is now done by products from South-Central Region leaving only the manioc flour as the only commercially important product.

Despite the difficulties faced by small coastal producers, an entire existing secular structure on the banks of the Madeira River has not disappeared, mainly syringe plantations, chestnut, açaí, peach palm, banana, cupuaçu, mango, hog plum, cashew, orange, guava, biribá, jackfruit, genipap, among other perennials, and large areas of poultry used in rotating systems in the planting of cassava for the production, and flour

		among other products. The low lying areas of the banks of the Madeira River are sedimentary land, and potentially productive in relation to the "dry areas" of the properties upland. The lowland agriculture, although not full intensely cultivated areas and large productivity, is practiced along the Madeira River, including in the section corresponding to where the Santo Antônio reservoir is located. The areas of the gorge of the rivers are used, for example, for the production of vegetables, green beans and watermelon during the dry season when the river waters fall, exposing the banks of the river and creating sandbars.
		Source: Furnas, Odebrecht and Leme, "Sumario" in Premissas Adotadas para a Elaboração dos Estudos Ambientais. *Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 1-87, 97, 107.*
		RECOMMENDATIONS: Higher scores on preserving greenfields depend on the percentage of the site area that is a greyfield or brownfield. As the permanent protection were defined various settlements were displaced, it is not clear in the documentation if the new settlements for the relocated communities are located in a greenfield.
NW2.1	**0**	**No Score**

Manage Stormwater		Stormwater management looks into minimizing the impact of stormwater runoff quantity and quality. Considering that the location of the hydroelectric project is in a rain forest, the amount of rain that hits the ground is extreme. The average annual rainfall observed in Abunã is 1,595 mm in Palmeiral is 1,700 mm and in Porto Velho is 2,200 mm; the rainy season is between the months of November and April, with a rainier period covering the months of December to March; the drought period begins in May and extends to October with the driest months happening from June to August. According to the project team, the water that passes through hydroelectric is not stored, including rain,thus not having need of treatment. There are water quality monitoring programs conducted by the project in the Madeira River. In terms of quantity, it is not clear if the hydroelectric works reduced or increased the storage capacity of the basin. Since the hydroelectric is a run-of -the-rivre model, water is not exactly stored to increase storage capacity for storm water. The topography was modified to accommodate the water level to 70.5m to create the reservoir with a maximum level of 71.31 m. The average annual river runoff predevelopment volume has decreased from 1931-2005 was 594.4 billions of m3, and after development in 2012 the runoff decreased to 587.4 billions of m3. The need to generate meteorological data surrounding the basin's is to monitor the evolution of the climate to support the operation of the hydroelectric. In addition, during operation of the system, warn of possible climate fluctuations against the floods and prolonged droughts, besides the formation of a database that will be a permanent source of information for the expansion, modernization and improvement of future conditions of the Madeira River watershed. The meteorological data gathering is in accordance to Law 9433- the Water Law- and Resolution no. 396 of December 4, 1998 by ANEEL, whose program objective is to monitor the development of local meteorological parameters before, during and after the implementation of hydroelectrics, whose reservoir will result in the formation of a reflecting pool of 271 km² and establish an appropriate management model for the information system and its modernization in monitoring the development of local climate in the area of the basin.
		Source: Madeira Energia S.A., "Programa de Monitoramento Climatológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008). Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 9
		RECOMMENDATIONS:
NW2.2 Reduce Pesticides and Fertilizer Impacts	**1**	**Improved**
		There is intent in reducing pesticides and fertilizer impacts with application management practices. According to the zoning developed for the direct area of influence, the diverse use zone consists of areas that are currently being developed for agriculture, fishing, agroforestry and forest use activities, with a predominance of accelerated process of occupation and conversion of forested areas. As part of the zoning guidelines is the monitoring and combating pollution and contamination of soil and water mainly by the reducing the use of agrochemicals (pesticides and pesticides). There is no specification on the type of pesticide, herbicide or fertilizer selection or more details on the programs to control and reduce fertilizer use. The objectives for this zoning are to increase in sustainable agricultural and fishing activities and services in areas previously converted, with land tenure regularization.

		The Diversified Use Zone are those areas outside the permanent protection area that are currently intended for agricultural use, fishing, agroforestry and forestry, as shown in the map 8 titled 'Land Use and Vegetation Cover.'
		Source: Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 88.
		RECOMMENDATIONS:Have runoff controls installed to minimize contamination of ground and surface water in the reservoir. Specify the types and controls to reduce fertilizer use, such as increased use of compost. Identify documentation that establishes the operational policies for applying fertilizers and pesticides. For higher scores it is recommended to eliminate the use of pesticide or fertilizers use completely.
NW2.3 Prevent Surface and Groundwater Contamination	**4**	**Enhanced**
		The project team has implemented several environmental programs that include long term monitoring of surface and groundwater quality, in order to reduce the impacts caused by the project construction and operation. In order to prevent contamination of the water the team has put in place the following comprehensive monitoring programs from which stand out: the environmental program of construction the environmental management system, the monitoring program of the water table, the hydrosedimentological monitoring program, hydro biogeochemical monitoring program, and the limnology and aquatic macrophytes monitoring program. An extensive study of the Madeira River Basin was conducted to identify possible contaminants. One of the most significant contaminants is the exploration of gold mining in the Madeira River and tributaries, which has decreased in the past decades, but still created significant financial resources in the region. Gold is found as metal deposits that occur in the alluvial deposits of the Madeira River. It is extracted with the use of dredging barges in the river course and margins, then gold is transported to the surface as sludge, which is then separated by the use of mercury, which is highly contaminant. Another significant water contamination emissions comes from the lack of waste management, as there is no water treatment facility that can filter the raw sewage that goes directly into the river and ground waters. This is a challenge of the region that needs to find sustainable solutions for waste water and garbage that is also dumped directly into the river. There is contamination prevention within the implementation of Santo Antonio that counts with the design of a smaller reservoir of 354.40km2 from which 164.00 km² are the river course area just gives a smaller increased flooded area of 190.40 km². Through this design strategy the environmental impacts that can affect water quality were considerably diminished. In addition, because the hydroelectric is a run-of-river typology that simulates the natural flow regime in the Madeira River, the environmental impacts caused by the

		construction and operation of the project are reduced. However, the project team implemented some programs with actions to minimize the impacts, such as water table monitoring program; hydrosedimentological monitoring program; hydrobiogeochemical monitoring program; mining rights and prospecting activity monitoring program; limnological monitoring program; aquatic macrophytes monitoring program; ichthyofauna preservation program. According to Brazilian Law 9,433 that establishes the Brazilian National Regulations for Water Resources: "the authorization for the water resources use shall conserve the multiple use of the river". The multiple use of Madeira River water is encouraged by preventing pollution since Santo Antonio hydroelectric has the authorization to exploit the hydropower potential of the river, it must also respect other uses.
		Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 109-110. Madeira Energia S.A., "Programa Ambiental para a Construção" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 19-25.
		RECOMMENDATIONS: Beyond the mitigation and monitoring programs, the project should try to remediate existing contamination found in the river, and propose a solution for the raw sewage that goes into the Madeira River and tributaries. Spill and leak prevention and response plans should be instituted not only on the projects grounds, but also as regulations to the old mining industry that contaminates water with mercury. Provide documentation on plans to clean up contaminated areas or proposed land use controls will help achieve a higher score.
NW3.1 Preserve Species Biodiversity	**16**	**Restorative**
		Biodiversity protection is achieved by preserving and restoring habitats. The hydroelectric will have a big impact into the biodiversity of the river, notwithstanding this fact, the project team made a great effort to preserve it through comprehensive mitigation strategies during construction and post-construction of the dam. Western Amazon is considered to be one of the regions with the highest biodiversity in the world, due to high precipitation rate throughout the year and the presence of fertile soil. Because of the diversity of river streams and the heterogeneity of landscape, where in some instances two distinct landscape habitat or ecotones intertwine may have important ecological significance. In Amazon Biome and Cerrado in Brazil. In fact, many species and subspecies of birds and other vertebrates are remarkably different on opposite sides of the large rivers of the Amazon and the Madeira river correspond to one of these barriers, separating species east and west. There is high richness of species, attested by bird surveys, and in water, where there are endemic, ornamental and migratory species of large areas, but this complex water and ecotone ecosystems

		still lack scientific studies. In addition to the conservation importance, there is natural resource importance as it is used in extractive activities and livelihoods of coastal communities. Since August 2008, several teams have monitored the movement of animals that inhabited places of the Amazon forest and farms located in the construction site where the dam and reservoir are located. During the implementation of the Santo Antônio, there is intense work of rescuing the animals that inhabited the reservoir areas were done to ensure their conservation and avoid impact on the local fauna and flora. Several mitigation and monitoring programs have been instituted in the project, which include fish in the ichthyofauna conservation program and wildlife protection in the wildlife rescue program. Within this work Screening Center of Wild Animals (Cetas) was built and prepared to shelter temporarily animals who were frail or unable to get around. The Cetas was built within the Federal University of Rondônia campus so that in future, when it is delivered to IBAMA, it can be administered in partnership with the institution. More than 126,000 animals were rescued and returned to nature during the process of vegetation removal and filling of the reservoir of the plant. With the restoration of more than 30 000 hectares of Permanent Preservation Area movement of animals will be guaranteed with the formation of ecological corridors.
		Source: Madeira Energia S.A., "Programa de Conservação da Flora" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 12-78. *Santo Antônio Energia, Saiba Mais Rio Madeira.* *Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).* *UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 84-120.* *Madeira Energia S.A., "Programa de Conservação da Ictiofauna" in Projeto Básico Ambiental: AHE Santo Antônio (2008) 5-9, 39-40, 54-58.* *Santo Antônio Energia, Peixes do Rio Madeira (São Paulo, 2013).*
		RECOMMENDATIONS: Provide documentation that can attest to the degree of habitat protection that the hydroelectric has provided and what if there have been important updates to the subprograms of the mitigation programs. Expand the species scope of the ichthyofauna conservation program beyond the commercially valuable fish. Shift from protecting existing habitats into upgrading and creating habitats for species biodiversity. Document the strategies and locations for habitat expansion efforts.
NW 3.2	**5**	**Superior**

Control Invasive Species		The use of appropriate non-invasive species and control is helpful when eliminating invasive species. There is no documentation supporting that the control of exotic species is done in the area of the project implementation. In terms of using locally appropriate plants, Santo Antonio Energia conducted a forest inventory and obtained a list of native species to be used in reforestation. The MMA, through the Project Conservation and Sustainable Use of Brazilian Biological Diversity - PROBIO, coordinated between 1997 and 2002 the project "Evaluation and identification of priority actions for the conservation, sustainable use and benefit sharing in the Brazilian Amazon," and had the scope the assessment of biological diversity of the Amazon forest biome based on the legal Amazon. The definition of the relevant areas was based on the available information on biodiversity and human pressure, and the experience of researchers from public and private institutions. The priority of each area has been defined by its biological richness, importance for traditional communities and indigenous peoples and their vulnerability. For each area listed as a priority have been proposed emergency actions aimed at their conservation. The main suggested actions were: creation of protected areas of different categories, implementation of corridors to connect fragments, biological inventories, environmental education, tourism planning, restoration of riparian forests, maintenance lotic stretches of rivers and streams, control of exotic species invasive, encouraging environmentally sustainable economic practices and activities, among others. Controlling invasive species is limited to the permanent protection area (APP) located around the reservoir. The project team works with state and local agencies to identify and use locally appropriate plant species. During the deforestation of the areas where the hydroelectric and reservoir would be implemented, plant nurseries were established to be able to reinstate them in the APP area. According to CONAMA resolution 369/06 there are chances of public interest that can lead to intervention and changes in the APP. In the APP, activities that protect plantations with native species, for example: 1) activities essential to protect the integrity of native vegetation, such as prevention, combat and fire control, erosion control, eradication of invasive and protection plantations with native species, as; 2) sustainable agroforestry activities practiced in the small property or rural family ownership, not damage vegetation cover and does not impair the environmental function of the area; 3) other works, plans, activities or projects defined in Resolution CONAMA
		Source: Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 28, 56-59.
		RECOMMENDATIONS: In accordance to the state and local agencies, invasive species must be identified and prevented. In regard to invasive species control, the development of a locally appropriate and non-invasive plan can help eliminate them. Beyond the use of native species, it is not clear in the documentation submitted how the project will deal with invasive species. Invasive species elimination from the site area constitutes a higher score in this credit.
NW3.3	**8**	**Conserving**

Restore Disturbed Soils		There are various programs to restore soils disturbed during the construction of the hydroelectric, in order to bring back ecological and hydrological functions. The project team will embark on the restoration of all soils disturbed in the construction of the site's disturbed area. According to the project team, the subprogram of revegetation of areas of permanent preservation is part of the flora conservation program and has as main objective the restoration and conservation of areas acquired by hydroelectric, specifically the Permanent Preservation Areas (APP) around the reservoir of the project. The areas acquired by the hydroelectric include soils disturbed by previous development and well as soils disturbed by the construction of the hydroelectric and the reservoir. The program favors in situ conservation, which means conserving species in their habitat, as a priority, because it is more effective and lower-cost, especially when deployed on public lands. AS apart of this program an inventory of the local vegetation with solid scientific basis was done in hand with the restoration. In terms of restoration, the project team is already in its third phase from the program of recovery of degraded areas, which will total 1200 hectares of the APP. For 2014, it is planned to plant 600 hectares on the right bank of the Madeira River (pasture, secondary enrichment and regeneration) with 97,750 seedlings of 54 native species on 600 hectares in the permanent preservation area.
		Source: UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 94. Madeira Energia S.A., "Programa de Conservação da Flora" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 1-5.
		RECOMMENDATIONS: Documentation regarding efforts for restoring areas outside the responsibility of SAO and outside the APP will prove helpful in understanding the scope of the disturbed soils restoration endeavor. Provide documentation of calculations and percentages to show that the restoration inside the APP included areas disturbed from previous development and areas disturbed by the hydroelectric construction
NW3.4	**9**	**Superior**

Maintain wetland and surface water functions.		In terms of ecosystem functions that are maintained and restored, 3 functions are clearly addressed in the mitigation and monitoring programs for hydrologic connection, water quality, and habitat. In order to maintain wetlands and surface water functions of the Madeira River, streams and riparian areas, the project team developed certain mitigation and monitoring programs, such as the monitoring program of the water table, the hydrosedimentological monitoring program, hydro biogeochemical monitoring program, and the limnology and aquatic macrophytes monitoring program. The project maintains the hydrologic connection of the Madeira River by utilizing a run-of-the-river hydroelectric which disrupt the water flow to a lower extent than other types of development. Run-of-river plants produce electricity according to the flow of water in the river it has been built in. Water is stored at low head and channeled through bulb-type turbines using the natural force of the river flow. Hydrologic connection, water quality and habitat are maintained by allowing the river to flow. .Maintaining the river flow and guaranteeing minimum river flow downstream is one of the measures taken to maintain ecosystems, habitats, as well as, productive fisheries and other aqua-cultures downstream and upstream. In terms of habitat maintenance, the proposed strategies to mitigate obstructions to habitat connectivity for spawning fish are significant. The installed mechanism at the Santo Antonio hydropower plant is the Fish Transposition System or fish ladder. This mechanism aims to ensure the continuity of the process of migration and reproduction, downstream to upstream of the dam. The system was studied for two years in an experimental canal built in the river itself and planned on a real scale to test the fish behavior in conditions similar to those where the definitive system is located on Presídio Island. The implementation of Santo Antonio is considered to not have caused a decrease in the water quality because the monitoring program showed that there was no change in the water quality upstream and downstream to the dam. It is not clear if the project helps maintaining the sediment transport in the water. Due to the large amount of solids carried by the Madeira river, there is a need to conduct appropriate studies on backwater and siltation of reservoirs and the downstream effects of planned exploitations. The team made necessary to have a permanent hydrosedimentological monitoring that allows to monitor and evaluate the potential environmental impacts and guide the future operation of hydroelectric plants. This information cannot be generalized, because technical literature on the subject show that each reservoir has its own characteristics according to the topography, river morphology, the residence time of the water, the flow and affluent dry cargo, the grain size of sediments, as well as other factors. Other actions the project team have performed for habitat restoration is taking are cleaning the reservoir through the withdrawal of woods, demolition and disinfection of residential and productive structures; fencing the preservation area of the reservoir boundary to protect it; riparian reforestation; rescuing aquatic and terrestrial fauna and flora rescue before the reservoir fulfillment, and reintroducing them into nature and into research entities. *Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014), 15, 122-130.* *Madeira Energia S.A., Projeto Básico Ambiental: AHE Santo Antônio (2008).*

		Madeira Energia S.A., "Programa de Monitoramento Hidrossedimentológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008). *Madeira Energia S.A., "Programa de Monitoramento Limnológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008).*
		<u>*RECOMMENDATIONS*</u>: It is not clear yet how is sediment transport going to be affected by the dam, for a higher score documentation demonstrating that sediment transport regime will not be disrupted by the proposed project or that there is a strategy to restore it. Provide documentation with inventory of strategies proposed to restore ecosystem functions including descriptions of restoration plans for the disturbed ecosystems functions.
NW 0.0 Innovate Or Exceed Credit Requirements	**8**	*Innovation:* There are innovations in preserving species biodiversity with numerous programs designed for monitoring, wildlife rescue and habitat restoration within the basic environmental program (PBA) that exceed industry norms and requirements. Many of the subprograms are considered advances in the industry and innovation to the science fields. The environmental impact assessment made a comprehensive identification of the species found in the area. For the herpetofauna group was recorded 110 species, 65 of amphibians and 45 reptiles (21 species of lizards and 16 snakes, alligators four and three turtles). There was also the record of 24 possible new species of amphibians. In terms of endangered species, four species are listed in the Red List of Threatened Species of the IUCN (IUCN, 2004): Geochelone denticulata, Peltocephalus dumerilianus and Podocnemis unifilis, status with listed Vulnerable, and Podocnemis expansa, listed with status Low Risk (Conservation Dependent). The Convention on International Trade Plant Species of Wild Fauna and in Endangered (CITES, 2004) lists 22 species recorded in the study area. Two (Melanosuchus niger and Boa constrictor) are listed in Appendix I, which prohibits the exploitation and trade of individuals and products derived from species worldwide, and 20 are listed in Appendix II, which lists species whose trade must be regulated. Among birds, the study sampled 766 species of birds in the area, only one species considered threatened with extinction was found Culicivora caudacuta. With regard to mammals the study revealed the presence of 83 species of mammals, 18 species of small and 65 medium and large companies, including three semi-aquatic species and three water. Among the recorded species, seven are considered endangered according to Instruction No. 3 of 27 May 2003, the Ministry of Environment, 33 species of medium and large mammals listed in CITES. In the study of the insect fauna, the most representative orders of Lepidoptera and Coleoptera were found. Butterflies and moths have been considered indicators because they act on forest ecosystems as defoliators, decomposers, carnivorous prey or hosts, and its diversity related to the recycling of nutrients, population dynamics of plants and the predator-prey relationship of an ecosystem. For the fish fauna were identified 459 fish species belonging to 245 genera, 44 families and 11 orders. The most abundant orders were Characiformes and Siluriformes, which is consistent with that expected for the Amazon in general. In terms of innovations in the industry, there are structural systems for mitigation and biodiversity preservation,the log interceptor program, and the fish transposition system. The log interceptor system main purpose is to intercept trunks and materials carried by the river. The force of the flow of the Madeira River takes down logs and

		moves them down the river. This system will have the main function to intercept the floating logs, preventing their arrival at the bars; the structure is used for the removal of logs to deposit the left margin. The trunk out system consist of cranes mounted on rails supported on concrete slab, equipped with forks to remove the trunks floating. These logs will be placed in vans, engaged in tug, also mounted on rails in the same slab, and then transported to shore, where they will be deposited in stocks. This system for log interception system for the Santo Antonio project was designed to be temporary action, since the implementation of the upstream Jirau project must necessarily incorporate a definitive structure for this purpose. The proposed fish transposition system helps keep migrating fish such as piramutaba and golden to go upstream to spawn. This system makes part of the activities of ichthyofauna conservation program and the hydrosedimentological Program. The system consists of two fish entrances (fish ladders), one from the central channel of the river and the other near the right margin. The channel has a width of 10 m and a slope of 0.0015385 m / m. There will be floating platforms to help with inspection and monitoring of fish. The Fish Transposition System is a corridor which reproduces the river characteristics, with rapids, natural barriers and a compatible opening, allowing the fish to get used to this new system and follow their natural cycle. The system has been operating since December 2011 and successfully completed its first spawning season with the hydroelectric plant in operation. The efficiency of the system has been monitored by the project sponsor via the radio telemetry technology. Over 200 fish received radio transmitters to show their location in the river. Another technology instituted for the fish transposition is the use of sonar which forms images and shows the fish trajectory, even within the muddy waters of the Madeira River. Efforts were made to not disturb all ecological connectivity of the river with the proposed fish ladders. The hydroelectric is in western Amazon, an important spawning ground for the fish. In fact the ichthyofauna conservation program has the general objective of following the transformations of fish communities and fisheries on the Madeira River, resulting from the implementation of the hydroelectric Santo Antonio. In addition, the results to be obtained aim to guide and generate results for the adoption of strategies to mitigate the impacts caused by the project as well as to follow changes resulting from environmental changes. The program is divided into 4 stages: 1 characterization of historic distribution of fish populations (months 1-34, the period between the installation of the project and the actual commencement of works on the Madeira River); 2 monitoring of changes during construction on the river (months 34-40, the month in which the impoundment will start); 3 characterization of the impact of reservoir formation (41-52 months); and 4 monitoring (54-108 months) of fish fauna and fishing community in the areas of direct and indirect influence of the project. For the implementation of the Santo Antônio hydroelectric construction sites, housing, and access areas, the clearing of approximately 729 ha of native vegetation was necessary. The areas deforested included typologies of open lowland rain forest, broadleaf forest, alluvial open secondary forests, and pioneer floodplain formations.The forest areas that suffer suppression for installation of infrastructure are relatively small compared with the scale of deforestation occurring in the region. However, the level of impact that will be submitted will be intense, due to the total removal of vegetation, removal of top-soil, earthmoving, compaction, etc. Their proper

		rehabilitation, using selected elements of the native flora, it will be important not only for environmental rehabilitation surrounding the dam, but also for educational actions with local residents and visitors. According to the documentation, this serves to strengthen the image of the Brazilian electricity sector, as well as the entrepreneur consortium, as a set of entities with concern and environmental responsibility. The project team, according to the regulations stipulated by IBAMA's basic environmental program, developed a program for the conservation of flora. Within the program ex-situ gene banks were established for selected species especially targeting the conservation of populations of species of economic and dietary importance, occurring in seasonally flooded environments. The development of activities under these programs, therefore, contribute to the knowledge of a region of great floristic diversity of the world. It is intended to mitigate environmental damage, and contribute to the depth of knowledge about the local plant communities. This important scientific work will interact with the regional scientific community, thus contributing to the strengthening of the structures of important Amazonian research institutions. It will also enable the implementation of relevant botanical and ecological studies, the improvement of researchers from collaborating institutions and the training of qualified staff, undergraduate and graduate, in a region still lacks human resources in the environmental area. In addition to scientific publications, dissertations, theses and graduate monographs, there will also be publications for dissemination to society in general, with high quality content informative. That would help the communication activities and public relations - government and business - are based on solid scientific information on the vegetation of the region, interfacing with the Social Communication Program and Environmental Education.
	60	

CLIMATE AND RISK		
	Score	**SAN ANTONIO HYDROELECTRIC PLANT**
CR1.1 Reduce Greenhouse Gas Emissions	**25**	**Restorative** The Santo Antonio hydroelectric is considered to generate low emissions electricity that will be delivered to the grid, thereby displacing CO2 emissions from fossil fueled grid-generated electricity. According to the Clean Development Mechanism Project Design Document Form (CDM-PPD), the estimated annual emission reductions in metric tonnes of CO2 provided by the project participants of the Santo Antonio hydroelectric project are 5,146,403 tons per year. The estimations of the emissions reductions during the project's concession is 51,464,028 tons using 3,150.4 MW as the installed capacity per year. The Santo Antônio Energia won registration to participate in the UN's Clean Development Mechanism (CDM). The permit allows the sale of about 20 million tonnes of carbon credits over the next five years. According to the CDM methodology, the volume of credits equivalent to the amount of greenhouse gases not emitted into the atmosphere, increasing the supply of electricity generated from clean, renewable sources. The Santo Antônio plant produces 8.5 megawatts per km²de reservoir, which is twice the minimum energy efficiency to generate carbon credits. With the use of the bulb turbine that generates power using river flow, the reservoir area was three times

		lower than that of conventional plants using turbines. The reservoir is 421.56 km² area, slightly larger than the area occupied naturally by the river in the rainy season. It is worth noting that the CDM website featured various comments to the third-party certifier known as the Designated Operational Entity (DOE) on concerns about the low estimates for other greenhouse gas emissions such as methane. The project team stated that according to the power density of the project being greater than 10 W/m2, no GHG emissions from the project have to be considered according to ACM0002.
		Source: CDM Executive Board, Clean Development Mechanism Project Design Document Form: Santo Antonio Hydropower Project (2006). *CDM, accessed on 2014, http://cdm.unfccc.int/Projects/Validation/DB/S253ZCTBJU9LJ3VF72CS1J8SHY02PP/view.html* *Jornal Energia, Hidrelétrica Santo Antonio Recebe Certificaçao Para Gerar Créditos de Carbono (2013).*
		RECOMMENDATIONS: Further documentation updating the CDM-PPD form progress into a CDM would help support the score achieved. More information regarding emissions of other greenhouse gas emissions such as methane will also help support and understand the role the hydroelectric and climate.
CR1.2 Reduce Air Pollutant Emissions	**12**	**Conserving** Within the basic environmental project (PBA), there are various air quality monitoring programs: the environmental construction program (PAC) and the environmental management system (SGA). The Environmental Impact Assessment considers air-pollutant emissions from the hydroelectric to be negligible, therefore the project team does not consider necessary to measure air pollutant emissions during the operation of the plant. The PAC aims to prevent and control the direct impacts generated by the construction and implementation activities, to avoid any process that can trigger environmental degradation of their direct influence area. It provides environmental criteria and procedures to be included in the agreements with the construction companies and services that contribute to the implementation of the project, including its subcontractors. Regarding air quality goals during construction, the project team took the following actions: maintenance of equipment and the wetting of traffic routes are routine actions at the construction site; performing analyzes of air quality in work areas and support areas of the construction site of the Santo Antônio; water spraying into the crusher; monitoring of air emissions in equipment, land and water vehicles, as well as checking burning tests, incinerator, black smoke using the Ringelmann scale, among others. The monitoring results show that the evaluated equipment showed no deviations from the permitted air pollutants. This was achieved through the maintenance routines and the training for procedures concerning the measurement of exhaust gases of diesel engines. According to the monitoring results were considered local, fully reversible and short-term. The Environmental Management System (SGA) is the instrument that consolidates the necessary procedures and controls the activities performed in the construction to avoid the environmental issues identified in the assessment process of related project impacts. Although there is no evidence that the project regards meeting the California Ambient Air Quality Standards (CAAQS), the SGA has programs to monitor pollutants of

		concern such as particulate matter, metal fume, organic vapors, inorganic vapors (acids), combustion gases, mists, dust, odors, and CFCs (chlorofluorocarbons).
		Source: Madeira Energia S.A., "Sistema de Gestão Ambiental: Gestão de Emissões Atmosférica e Ruídos" in Projeto Básico Ambiental: AHE Santo Antônio (2008).121-128. UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 80, 286.
		RECOMMENDATIONS: Documentation supporting efforts in reducing air pollution during the operation phase are needed, as well as monitoring data showing that the CAAQS or NAAQS standards have and are not being surpassed. Monitoring should lead to action to meet standards. Besides, the CAAQS criteria requires more information on tests performed on nitrogen dioxide, ozone, lead, carbon monoxide, sulfur dioxide, and particulate matter (PM 2.5 and PM 10).
CR2.1 Assess	**0**	**No Score**

Climate Threat		The project team has taken steps to prepare for climate variation and natural hazards by monitoring climate and creating a database that can serve to create an impact assessment and adaptation plan. A meteorological monitoring program has been implemented by installing a network of stations that produce local data, supplementing existing data from other nearby stations, data for the Santo Antonio hydroelectric and other projects and activities in the region. According to climatological studies, the implementation of the hydroelectric plant is not expected to cause significant climate changes. The meteorological monitoring program looks for the main meteorological variables (air temperature, relative humidity, rainfall, solar radiation, wind direction and speed and atmospheric pressure). It has performed satisfactorily in the two stations of Santo Antônio, with patterns around the medium air in the region and some small deviations around the climatological pattern, and it has not verified any cases of extreme event or if relevant during the first half of 2014. The need to generate meteorological data surrounding the basin's main objective is to monitor the evolution of the climate to support the operation of the hydroelectric. In addition, during operation of the system, warn of possible climate fluctuations against the floods and prolonged droughts, besides the formation of a database that will be a permanent source of information for the expansion, modernization and improvement of future conditions of the watershed the Madeira River. The program consists of the collection and validation of climatological data and continuous updating of its database. The initiative involved the establishment in June 2010, two automatic weather stations: one in Santo Antonio dam and another in Calama (rural municipality of Porto Velho) community. The data are collected minute by minute, integrated GOES satellite broadcast (specific model for atmospheric research), processed and made available via the internet. This network is integrated into the monitoring network of the Department of Environmental Development (Sedam) of the State of Rondônia, which provides information to the public through its website. Monitoring the weather will be permanently held during the lifetime of the Santo Antônio hydroelectric plant.
		Source: Madeira Energia S.A., "Programa de Monitoramento Climatológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 5-6. *UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 87.*
		RECOMMENDATIONS: Beyond the climatological data to assess climate impact, the project should also look at water flow. Flow rates of Madeira are influenced by the local rainfall and meltwater from the Andean slopes, which could be subject to climate threats. The creation of monitoring stations and database over the life of the project will be useful for developing a plan that surveys the important and potential impacts of climate change that can inform project design adaptations or future projects.
CR2.2 Avoid	**6**	**Enhanced**

Traps And Vulnerabilities		Projects should avoid traps and vulnerabilities that could create high and long term costs and risks for the affected communities. Make a plan with long term view of the project that can go beyond the concession period. According to the mitigation and monitoring programs that the project has created, there is a basic evaluation on climatic, ecological threats that can affect the neighboring communities. When creating a plan it is important to understand how the project might affect communities vulnerabilities and resource dependencies, such as unexpected floodings or damages to natural resources such as not having enough fish for fishermen. There is great consideration from the project team to address issues when the infrastructure interferes with environmental and operating conditions. The ultimate goal should be to make a significant contribution to community robustness and resilience in the face of change.
		Source: Madeira Energia S.A., "Programa de Monitoramento Climatológico" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 5-6. *UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 87.*
		RECOMMENDATIONS: Prepare detailed plans to avoid traps and vulnerabilities, as result of the environmental assessments carried out by the project team and in conjunction with the community, regulatory agencies and academia. The mitigation and monitoring programs will prove useful for this need not only to the Santo Antonio, but to other projects being developed in the area. Avoid, alleviate or eliminate significant infrastructure traps with significant costs or other negatives.
CR2.3 Prepare For Long-Term Adaptability	**0**	**No Score**
		Monitoring programs instituted by the project team can serve to prepare the hydroelectric to be resilient to the consequences of long term climate change, be able to perform adequately under altered climate conditions, or to adapt to other long term change scenarios. Strategies for long-term adaptability can be planned using the data collected at the monitoring programs and research labs set up by the project team. Highly resilient infrastructure is adaptive and prepared to face uncertain climatic events that include the effects of increased intensity and frequency of extreme weather events, water scarcity, extended droughts, heat waves, and increased ambient temperature.
		Source: Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014). UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 87.
		RECOMMENDATIONS: Prepare plan and designs for long term climate change. Identify the measures and strategies that the project is utilizing to face long-term threats such as desertification, water and energy shortages, among others. Strategies for managing long-term changes may include structural changes, decentralized systems, natural systems like wetlands to improve water quality, increase adaptive capabilities.
CR2.4 Prepare For Short-Term Hazards	**3**	**Improved**
		The team has considered the types of natural and manmade hazards that are possible in the region such as floods, earthquakes and man-made hazards, and have installed numerous environmental monitoring programs that will shed light on how to deal with short-term hazards as well as long-term ones. In terms of public health hazards, the project team invested in preventing the occurrence of diseases and conditions that lead to the need for hospitalization and increased pressure on scarce hospital services. The data presented in the

socioeconomic diagnosis of environmental impact assessment shows that the structure of health care services, existing today in Porto Velho, is insufficient to meet the satisfaction of the resident population. In order to minimize the impacts of the project on the resident population and health services, a set of assistive nature and monitoring actions will be integrated. A Health Family Program aimed at achieving 100% coverage target of the target population of this Government program, which is currently less than 30%.

During construction, the environmental plan for construction (PAC) was directed to control the negative effects on the environment of the region where the project will be implemented. A criteria for short-term hazards was established for construction and operation of construction sites, the crushing plants, the carpentry yards and frame, camps, access roads and other facilities necessary for the implementation of the Project. These criteria include standards and procedures to prevent contamination of the river water, erosion, unnecessary deforestation, problems for the local population and noise generation, among others.

Deforestation represents a hazard that can lead to erosion and water quality and environmental issues that can increase vulnerabilities against climate change. The continuous process of deforestation of the area is influenced by many variables: large and small farms, implementation and consolidation of settlement projects, expansion of areas of pasture for livestock, expansion and maintenance of the traditional system of family farms, adding value to the land, impunity to environmental laws and even the demarcation of property boundaries, the method used to reduce risk of invasion by third parties.

The socio-patrimonial management program is a strategy set by the project team to improve protection measures beyond existing regulations. It helps establish an effective control over the assets linked to the hydroelectric real estate through terrestrial and river monitoring with observation to areas of weaknesses, maintenance of the information network and identifying risk indicators in equity. These activities can help deter illegal loggers from cutting down trees illegally and help mitigate the deforestation that Rondonia is experimenting. Another method of monitoring is done by InSAR radar bands X and P, airborne - with overflight equipped with radar sensors aircraft, which is done on a monthly basis for the analysis of change detection in areas of the reservoir and surrounding areas.

According to the project team, the monitoring and enforcement actions of environmental integrity and equity primarily aim: the preservation of the reservoir of the Santo Antônio area; curb inappropriate use or reoccupation of the reservoir islands and shores; restrain predatory actions of biota; monitor natural and anthropogenic effects on the projected area of the reservoir; promote integration through collaboration with law enforcement and public safety agencies for surveillance and environmental control, and to establish a synergy of environmental and heritage protection.

The seismological monitoring program in order to understand better the seismic conditions of the area, it has installed 2 seismological stations to record earthquake activity as well as identify the reservoir induced earthquakes in the Santo Antônio area as well as in the Andean region.

Source: UHE Santo Antônio, 11º Relatório Socioambiental Periódico RSAP (2014), 114. Madeira Energia S.A., "Plano Ambiental de Conservação e Uso do Entorno do

		Reservatório" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 89-90. *Madeira Energia S.A., "Programa de Saude Publica" in Projeto Básico Ambiental: AHE Santo Antônio (2008), 1-10.*
		RECOMMENDATIONS: Monitoring should lead towards actions; therefore the project should consider what happens after monitoring, how the data is analyzed, and what actions are committed based on data results. The infrastructure should be prepare for short term hazards, which can occur in 1 in 50 years or 1 in 100 years. Document and identify the strategies used and how the mitigate or minimize the risk of future hazards using environmental restoration. For example, reduce risks through restoration and rehabilitation by reforesting areas susceptible to erosion.
CR2.5 Manage Heat Island Effects	**0**	**No Score**
		There is no documentation attesting initiatives to minimize surfaces with a high solar reflectance index (SRI) to reduce localized heat accumulation and manage microclimates that can affect the ecologies in the area of direct influence as well as in the resettlement areas.
		Source: *Santo Antonio Energia and EQAO, Santo Antonio Hydropower Project (2014).*
		RECOMMENDATIONS: Decrease surfaces areas that produce heat and change the microclimate around them. The heat island effect can be improved by utilizing increased vegetation which helps cools down temperatures with evapotranspiration and increased shade.
CR0.0 Innovate Or Exceed Credit Requirements		*N/A*
	46	

OVERALL:	**339**	**SANTO ANTONIO HYDROELECTRIC PLANT**

APPENDIX E: SOURCES

DOCUMENTATION PROVIDED
General Information.
Plenu's Soluçoes em Gestão LTDA, Relatório Semestral de Monitoramento: Santa Rita January- June 2014 (2014).
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