

Casita-San Cristobal Geothermal Project, Nicaragua

VOL I Executive (Non-Technical) Summary -
ESIA Exploration Phase

18 August 2017

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Glossary of terms

Table 1: Glossary of terms

Term	Definitions
Area of Influence (AOI)	The area over which the impacts of the Project are likely to be felt including all its related or associated (where applicable) facilities such as the transmission line corridor, water and steam pipelines, access roads, borrow pits, accommodation facilities (where required) as well as any reasonably foreseen unplanned developments induced by the Project or cumulative impacts.
Biodiversity	Variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.
Chance find	Archaeological or cultural sites and artefacts, including such items as ceramics, tools, buildings, burials, etc., previously unrecognized in baseline studies that are discovered during the course of exploration activities.
Consultation	Consultation is a two-way process of dialogue between the project company and its stakeholders. Stakeholder consultation is about initiating and sustaining constructive external relationships over time.
Critical habitat	Either modified or natural habitats supporting high biodiversity value, such as habitat required for the survival of critically endangered or endangered species.
Cultural heritage	Defined as resources with which people identify as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions.
Cumulative impacts	The combination of multiple impacts arising from existing projects or activities, and/or anticipated future projects or activities.
Direct area of influence	Considers the physical footprint of the project such as the right of way, construction sites, work staging area and area affected during operational works (e.g. traffic patterns).
Economic displacement	Loss of assets or access to assets that leads to loss of income sources or means of livelihood.
Ecosystem	The interacting system of a biological community and its non-living environmental surroundings.
Emission	Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts.
Environmental and Social Impact Assessment (ESIA)	A forward-looking instrument that is able to proactively advise decision-makers on what might happen if a proposed activity is implemented. Impacts are changes that have environmental, political, economic, or social significance to society. Impacts may be positive or negative and may affect the environment, communities, human health and well-being, desired sustainability objectives, or a combination of these.
Environmental and Social Management and Monitoring Plan (ESMMP)	Summarises the company's commitments to address and mitigate risks and impacts identified as part of the ESIA, through avoidance, minimization, and compensation/offset, and monitor these mitigation measures.
Environmental and social management system (ESMS)	Part of a project's overall management system that includes the organizational structure, responsibilities, practices and resources necessary for implementing the project-specific management program developed through the environmental and social assessment of the project.
Exploration	Geothermal resource confirmation phase that can include surface studies, reconnaissance, exploration drilling, feasibility study and production phase ESIA.
Geothermal power generation	Involves drilling deep production wells into the Earth's crust to harness the thermal energy contained in underground reservoirs of geothermal waters or steam.
Good International Industry Practice (GIIP)	Exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally. The outcome of such exercise should be that the project employs the most appropriate technologies in the project-specific circumstances.

Term	Definitions
Greenhouse gases	The following six gases or class of gases: carbon dioxide (CO ₂), nitrous oxide (N ₂ O), methane (CH ₄), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF ₆).
Grievance mechanism	Procedure provided by a project to receive and facilitate resolution of affected communities' concerns and grievances about the project's environmental and social performance.
Habitat	Terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment.
Hazardous waste	By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Substances classified as hazardous wastes possess at least one of four characteristics—ignitability, corrosivity, reactivity, or toxicity— or appear on special lists.
Indigenous peoples	Defined by the World Bank E&S Framework as a distinct social and cultural group possessing the following characteristics in varying degrees: (a) Self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others; (b) Collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources in these areas; (c) Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture; and (d) A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.
Information disclosure	Disclosure means making information accessible to interested and affected parties (stakeholders). Communicating information in a manner that is understandable to stakeholders is an important first and ongoing step in the process of stakeholder engagement. Information should be disclosed in advance of all other engagement activities, from consultation and informed participation to negotiation and resolution of grievances. This will make engagement more constructive.
Invasive alien species	Non-native species of flora and fauna that are a significant threat to biodiversity due to their ability to spread rapidly and out-compete native species.
Land acquisition	All methods of obtaining land for project purposes, which may include outright purchase, expropriation of property and acquisition of access rights, such as easements or rights of way.
Livelihood	Full range of means that individuals, families, and communities utilize to make a living, such as wage-based income, agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering.
Magnitude	The assessment of magnitude is undertaken in two steps. Firstly, the magnitude of potential impacts associated with the Project are categorised as beneficial or adverse. Secondly, the beneficial or adverse impacts are categorised as major, moderate, minor or negligible based on consideration of a number of parameters.
Natural habitat	Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions.
Net gain (biodiversity)	Development that leaves biodiversity in a better state than before.
Occupational health and safety	The range of endeavours aimed at protecting workers from injury or illness associated with exposure to hazards in the workplace or while working.
Physical displacement	Relocation or loss of shelter.
Pollution	Refers to both hazardous and non-hazardous pollutants in the solid, liquid, or gaseous forms, and is intended to include other forms such as nuisance odours, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light.
Power plant	Second of the two main components of the geothermal power plant process, where the extracted steam is used to generate electricity.
Production	Steam field and power plant development phase that can include production drilling and development of steam above ground system (SAGS) and power plant.
Project affected people	Individuals, workers, groups or local communities which are or could be affected by the project, directly or indirectly, including through cumulative impacts.
Renewable energy	Energy sources derived from solar power, hydro, wind, certain types of geothermal, and biomass.

Term	Definitions
Resettlement framework	Establishes the principles, procedures, entitlements and eligibility criteria, organizational arrangements, arrangements for monitoring and evaluation, the framework for participation, and mechanisms for redressing grievances by which the company will abide during the project implementation.
Sensitivity	The sensitivity of a receptor is determined based on the review of the population (including proximity / numbers / vulnerability), presence of biological features of the site and the surrounding area, soil, agricultural suitability, geology and geomorphology, proximity of aquifers and watercourses, existing air quality, presence of any archaeological features etc.
Significance	Significance of impact takes into account the interaction between the magnitude and sensitivity criteria.
Stakeholders	Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project or the ability to influence its outcome, either positively or negatively.
Stakeholder Engagement Plan	A management tool to guide stakeholder engagement procedures and activities for a project.
Steam fields	First of the two main components of the geothermal power plant process, where the geothermal fluids are extracted, processed and subsequently re-injected.
World Bank Group EHS Guidelines	Technical reference documents for environmental protection and set out industry-specific examples of 'international good practice'. Projects are expected to comply with the levels and measures identified in the General EHS Guidelines where host country requirements are less stringent or do not exist.

Preface

This document provides an executive (non-technical) summary (NTS) of the Environmental and Social Impact Assessment Report (ESIA) of the Casita-San Cristobal Geothermal Project (the “Project”).

The purpose of this NTS is to present the main findings of the ESIA process including the predicted impacts and key management, mitigation and enhancement measures related to exploration drilling work to be performed to confirm the resource potential of the Project.

This NTS is part of the larger package of ESIA documents.

This NTS and the final versions of the ESIA documents will be available in the following locations:

- Cerro Colorado Power (CCP) website:
- www.cerrocoloradopower.com
- Hard copies will be available at a school in El Higueral, Santa Cruz, Las Grietas and San Lucas, in Chinandega
- Electronic copies are also available upon request from CCP

A public consultation meeting will be held in September 2017 at a central location that can be easily accessed (to be announced by CCP closer to the date).

The World Bank will hold a disclosure period (at least 120 days) commencing on 21 August 2017 until 21 December 2017. You may comment through forms that will be available at each school in the four referenced communities, which will be collected by the CCP team to answer any questions presented and to incorporate new information in the final version of the ESIA.

You can also contact the CCP team directly via the following means:

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1 Introduction and background

1.1 Overview

The purpose of this executive (non-technical) summary (NTS) is to present in a clear and simple manner the main findings and conclusions of the environmental and social impact assessment (ESIA) process undertaken for the Nicaragua Geothermal Resource Risk Mitigation Project (the Project). Cerro Colorado Power S.A. (CCP) was awarded the exploration concession by the Government of Nicaragua through a competitive process.

The Government of Nicaragua with the support of the World Bank intend to use World Bank funds (through the Scaling-up Renewable Energy Program (SREP) and International Development Association (IDA)) and other funding, to undertake exploratory drilling works to help confirm the geothermal resource of the field and to mitigate the resource risk in advance of developing the first operational power plant in the Casita-San Cristobal geothermal field. The resource confirmation plus the installation of a small-scale 35MW capacity power plant would mitigate the development risks and increase the prospects of additional investments to unlock the potential in the field.

The Project has two components for development:

- Component 1: Geothermal resource confirmation (exploration phase)
- Component 2: Steam field and power plant development (production phase)

Component 1 is designed to confirm the resource base and to mitigate risks with the view to facilitate the development of the first operational power plant in the Casita-San Cristobal field (Component 2).

CCP has commissioned Mott MacDonald to act as the Environmental and Social Consultant ('ES Consultant') to conduct an ESIA for the exploratory phase drilling works (Component 1).

1.2 What is the objective and scope of the ESIA?

This ESIA is to address impacts associated with "Component 1".

The purpose of this ESIA is to:

- Identify and assess the potential environmental and social impacts that the Project may have on the environment and communities within its area of influence (AOI) for the exploratory phase
- To help avoid, or where avoidance is not possible, minimise, mitigate or compensate for adverse impacts on the environment and communities
- To ensure that the affected communities¹ are appropriately engaged on issues that could potentially affect them
- To promote improved social and environmental performance through the development and effective use of management systems

The WB PSs require consideration of unplanned but predictable development that may occur later or at a different location. For this ESIA this might constitute activities related to Component 2, the production phase. Given that the geothermal resource is yet to be confirmed it is not

¹ Reference to communities includes consideration of impacts on labourers

deemed necessary to fully assess production phase risks and impacts as part of the exploratory phase ESIA, however this ESIA does note that if the field is deemed productive, the exploratory site will most likely become the permanent production drill sites and that there will be a permanent location for the power plant and supporting infrastructure (for example the transmission line).

This ESIA includes a high-level screening of key environmental and social (E&S) constraints related to the permanent siting of production phase facilities as they pertain to the current exploratory drill sites, and the likely locations for the power plant and transmission line. This ESIA considers this to include:

- Confirmation through baseline data collection that there are no significant constraints that would affect the future expansion of the sites for this purpose, for example significant impacts on nationally protected areas / culturally significant areas / surface water features, sensitive human receptors
- Scoping of high-level constraints that would impact on steam collection system between the well pads in their current proposed locations and the likely location of the power plant
- High-level scoping to understand assimilative capacity of the receiving environment for the production phase including inter alia: increased noise, atmospheric H₂S
- The environmental and social management and monitoring plan includes a terms of reference (TOR) for the Component 2 ESIA.

The ESIA is organised as follows:

- **Volume I** - Executive (Non-Technical) Summary (NTS) (English and Spanish)
- **Volume II** - Environmental and Social Impact Assessment (ESIA) – Exploratory Phase
- **Volume III** - Technical Appendices including:
 - Critical habitat assessment (including baseline reports), Mott MacDonald, rev A, July 2017
 - Ecological Baseline report, FUNDAR, 2017
 - Archaeological literature review and rapid site reconnaissance report, Clifford T. Brown, Ph.D. Professor, Department of Anthropology, Florida Atlantic University
 - Mott MacDonald stakeholder consultation - summary of meetings, site visit July 2017
 - Hydrogeological report, Mott MacDonald
 - MARENA environmental resolutions 2009 and 2015
- **Volume IV** - Environmental and Social Management and Monitoring Plan (ESMMP)
- **Volume V** - Stakeholder Engagement Plan (SEP)
- **Volume VI** - Resettlement Policy Framework (RPF)

Table 2 below shows the structure of the Volume II ESIA report.

Table 2: Structure of Volume II ESIA report

Volume No.	Structure	Title
Volume II	Environmental & Social Impact Assessment (this volume)	
	Chapter 1	Introduction
	Chapter 2	Project Description
	Chapter 3	Project Need and Analysis of Alternatives
	Chapter 4	Policy, Legislative and Institutional Context
	Chapter 5	ESIA Framework and Methodology

Volume No.	Structure	Title
	Chapter 6	Information Disclosure Consultation & Participation
	Chapter 7	Baseline Assessment
	Chapter 8	Impact Assessment and Evaluation
	Chapter 9	Mitigation and Management
	Chapter 10	Conclusion

This executive NTS summarises the findings of the ESIA, as set out in Volume II and III; and key management and mitigation requirements as set out in Volume IV to VI.

1.3 Who is Cerro Colorado Power S.A.?

The Project will be developed by Cerro Colorado Power S.A. (CCP, or the Project Developer), as a public private partnership (PPP) between Cerro Colorado Corporation (CCC, a Panamanian subsidiary of Polaris Infrastructure Inc.) and Empresa Nicaragüense de Electricidad (ENEL). CCP is also the geothermal field concessionaire.

Polaris Infrastructure Inc. currently operates the San Jacinto-Tizate geothermal project.

1.4 Project history

The Project has already prepared Environmental Impact Studies (EIS) required for nationally designated Category II projects at the request of the Environmental and Natural Resources Ministry (Ministerio del Ambiente y los Recursos Naturales, or MARENA). The following authorisations have been granted to date:

- April 2009: Nicaraguan Ministry of Energy and Mines (MEM) issues “exploration” concession to CCP to assess geothermal resource to develop a 100km² geothermal resource area along the Casita-San Cristobal volcanic complex in Chinandega Department in north-western Nicaragua.
- November 2009: CCP obtained an environmental permit from the Ministry of Environment and Natural Resources (MARENA) for the preliminary resource assessment phase.
- November 2011: Preliminary surface level reconnaissance work and slim hole drilling completed by CCP identifying potential for high temporary steam resources.
- February 2012: CCP undertook integration of surface exploration and slim hole drilling results with preliminary assessment of the geothermal resource, which indicated that the Project has potential for more than 85MWe of generation capacity over 20 years.
- June 2012: MEM approved the preliminary resource assessment work and authorised CCP to exercise its preferential right to apply to MEM for an “exploitation” concession to pursue below resource confirmation studies and develop a geothermal power plant.
- February 2013: CCP was granted the “exploitation” concession (subject to submission of a drilling program, “exploitation” environmental permit from MARENA and posting of a bond with MEM).
- February 2015: CCP submitted “exploitation” EIA to MARENA for approval.
- July 2015: MARENA approved the “exploitation” EIA which gave the go-ahead to commence an exploration drilling program and operation phase works subject to conditions (including further environmental and social assessment work) as set out in Resolution DGCA-P0034-0B12-011-2015.
- June 2017: MARENA renewed the “exploitation” environmental permit to CCP which had expired in December 2016.

1.5 What ongoing and future requirements are planned?

The following activities are ongoing in relation to Component 1 ESIA or planned in relation to Component 2 works (subject to confirmation of geothermal resource).

Pre-commencement of Component 1 works:

- Finalise land agreements for Component 1 infrastructure and access road in accordance with resettlement policy framework (RPF), prepared as part of this ESIA scope of work
- Preliminary engagement with landowners for transmission line routing assessment
- Public consultation
- Stakeholder disclosure as per stakeholder engagement plan (SEP), prepared alongside this ESIA
- Elaboration of key plans including the Biodiversity Action Plan (also referred to as the Biodiversity Management and Evaluation Plan), Ecological Management Plan (EMP), Habitat Removal and Restoration Plan (HRRP) and reforestation program
- Detailed hydrogeological study (to be undertaken in advance of site establishment works and finalisation of water abstraction locations, to confirm the findings of the preliminary study)
- Confirmation of preferred water abstraction

Pre-commencement of Component 2 works:

- Finalise land agreements for Component 2 infrastructure based on final transmission line, production pad siting and steam above ground system routing
- ESIA for production phase including updates to SEP, ESMMP, RPF as needed
- Address outstanding conditions of the MARENA exploitation authorisation relevant to the production phase (such as providing copies of the specification and calculation of the domestic wastewater treatment system and an Aquifer Protection Plan for Chinandega)

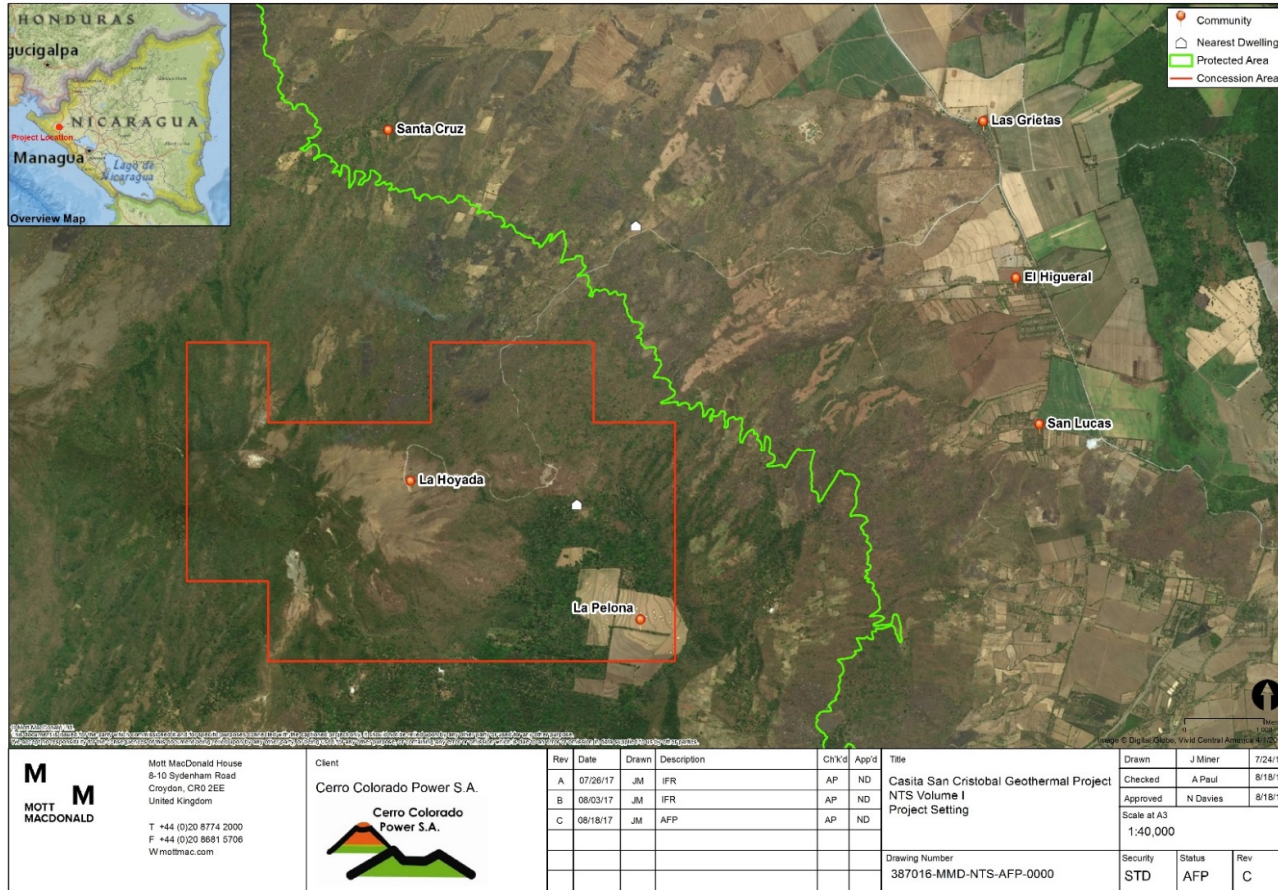
1.6 Where is the Project located?

Located on the south-east slope of the Casita-San Cristobal volcanic complex, the Project concession area covers an area of 20km². The Project site is in the Department of Chinandega, 130km north of Nicaragua's capital city of Managua. The boundaries of three municipalities (Chinandega, Chichigalpa and Posoltega) are located across the concession area.

The concession area includes private lands and extends within the Reserva Natural Complejo Volcánico San Cristobal-Casita (the Nature Reserve). The Nature Reserve is a protected area of 179.64km² that was established by a decree in 1983. The Nature Reserve comprises a chain of five volcanic cones, including the Casita Volcano and the adjacent San Cristobal volcano, which is the country's highest volcano.

No communities are located within the Project concession area however we have identified that there are two houses, with one located near to planned Project activities. The closest settlements to the Project area are: Santa Cruz (4.2km), San Lucas (7.2km), El Higueral (7.7km) and Las Grietas (8.1km). This is illustrated further in Figure 1.

Figure 1: Location of the Casita Geothermal Project



Source: CCP / Mott MacDonald

2 The Project

2.1 Why is the Project needed?

Nicaragua has a wealth of options for renewable energy generation including extensive geothermal resources from its large volcanic chain, and excellent potential for wind and solar.

In terms of energy output, the country has the capacity to generate 5,800 megawatts (MW) annually from clean sources. Currently, however, just over 14% of its renewable potential has been developed (World Bank 2015).

Historically Nicaragua has been dependent on oil based products which led to one of the highest electricity rates in the region. Since 2006 the Government of Nicaragua has made efforts to increase renewable energy project with 58% of the country's energy currently generated from renewable sources.

The energy output of its geothermic resources has an estimated potential of 1,516MW, however, just 154MW have been installed by the country's two existing geothermal power plants.

The Government of Nicaragua has identified the Casita-San Cristobal Geothermal Project as having high potential to support its generation expansion plan and investment in renewable energy.

The objectives of the exploratory drilling are to confirm the exploitable geothermal resource and provide key information necessary to prepare a full project feasibility study, updated geothermal resource model, Component 2 ESIA and address outstanding conditions of the MARENA exploitation authorisation relevant to the production phase (such as providing copies of the specification and calculation of the domestic wastewater treatment system and an Aquifer Protection Plan for Chinandega). Ultimately, the Project will aim to help lower and stabilize Nicaragua's electricity costs to enhance its affordability to reduce poverty and stimulate economic growth and competitiveness.

The following points summarise the need for this Project:

- Contribute to national energy requirements for sustainable development
- Contribute to a diverse stable energy base to secure energy supply for Nicaragua
- Provide continuous, reliable, high efficiency and low-cost energy
- Meet local demand, interconnect to the national grid to lower electricity costs and make it more affordable to reduce poverty and stimulate economic growth
- Provide employment opportunities to the community residing in the region and nearby
- Contribute to the local economy, social and technical infrastructure
- Increase the diversity of energy resources
- Help to meet the Government of Nicaragua's ambitious national target to increase the country's electricity generation from renewable sources to 73% by 2030
- Geothermal generation significantly lowers greenhouse gas emissions

2.1.1 Alternatives considered

At all key stages the Project has performed analysis of alternative options including the 'No Project' option to seek to get the most environmentally and socially beneficial project within the restrictions of the concession area.

The 'no project' alternative would result in:

- Slower transition to 73% electricity generation from renewable energy target
- Continued increase in greenhouse gas (GHG) emissions generated from the combustion of fossil fuels as a result of increasing population and electricity demand
- Geothermal energy from the project would no longer displace an equivalent amount of electricity generated by fuel oil, and in its absence, there would be higher GHG emissions and local pollution that would have unfavourable global climate as well as local air quality and health impacts

Developing geothermal over other renewable generation options is seen as a favourable path for the following reasons:

- The potential for geothermal energy is double than that of other renewables
- Stable power generation compared to wind, solar, and hydro
- Compared to solar renewable options, geothermal offers significantly reduced land take requirements; for example, a geothermal plant requires (per MW) 5% of the area needed for a solar thermal plant (Sustainable Energy for All, 2017)

The general location of well pad sites in geothermal developments is initially constrained by the overall geothermal resource. The site selection process starts with a review of the topography of the area for selecting the location for well pad sites and supporting facilities. Environmental and social impacts are then considered, specifically consideration of options to minimise impact on the sensitive habitats of the Nature Reserve and on nearby receptors, i.e. siting to minimise vegetation removal; following existing road rights of way where possible. This ESIA has also made further recommendations, including amongst others to address impacts to acceptable levels as described in detail in subsequent sections, including:

- Biodiversity Management and Action Plan as required by WB PS6 to demonstrate the gain in critical habitats and no net loss in natural habitats
- Sub-surface archaeological investigation work in advance of ground works to record finds prior to removal
- To undertake monitoring of groundwater within the direct and indirect areas of influence
- Detailed hydrogeological assessment

2.2 What is the Project?

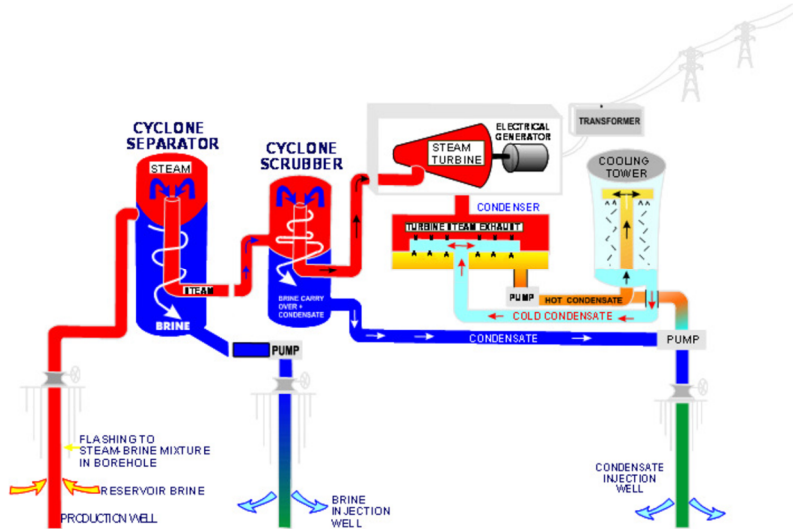
2.2.1 What is geothermal power?

Geothermal power generation involves drilling deep production wells (greater than 2000m in depth) and reinjection wells into the Earth's crust to harness the thermal energy contained in underground reservoirs of geothermal waters or steam. Wells are drilled in clusters (group of wells at one platform), each platform typically comprising two to five wells. These wells bring a mixture of steam, gases and water (brine) to the surface where the steam can be separated and used to power steam turbines to produce electricity. Brine and condensate are returned via reinjection wells back to the geothermal reservoir.

Figure 2: presents a high-level summary of the overall geothermal power plant process for a flash type geothermal plant. The process can be separated into two main components:

- Steam field (including the steam field above ground system (SAGS)), where the geothermal fluids are extracted, processed and subsequently re-injected
- Power plant (comprising steam turbines, generators, condensers and cooling towers), where the extracted steam is used to generate electricity

Figure 2: Indicative diagram of flash type geothermal power plant process



Source: Mott MacDonald, 2013

2.2.2 The Casita-San Cristobal Geothermal Project

The two Components of the Project each have various stages of development:

- Component 1 – Exploration Phase
 - Sub-component 1.1 – Surface studies and reconnaissance (already completed)
 - Sub-component 1.2 – Exploration drilling program (current planned activity, three to five wells)
 - Sub-component 1.3 – Feasibility study and Component 2 ESIA (subject to confirmation of resource)
- Component 2 – Production Phase (subject to confirmation of resource during Component 1)
 - Sub-component 2.1 – Production drilling (estimated six additional production and reinjection wells)
 - Sub-component 2.2 – Construction of steam above ground system (SAGS) and power plant

This ESIA and NTS concerns activities connected with Component 1 exploration phase works only. This ESIA has considered general impacts from the Component 2 production phase to confirm no significant constraints are likely to arise.

Should the geothermal resource be confirmed, a second ESIA will be prepared for Component 2 that expands on this ESIA to cover Component 2 specific activities.

2.2.3 What activities are required to perform Component 1 exploratory drilling?

The main Component 1 Project components includes:

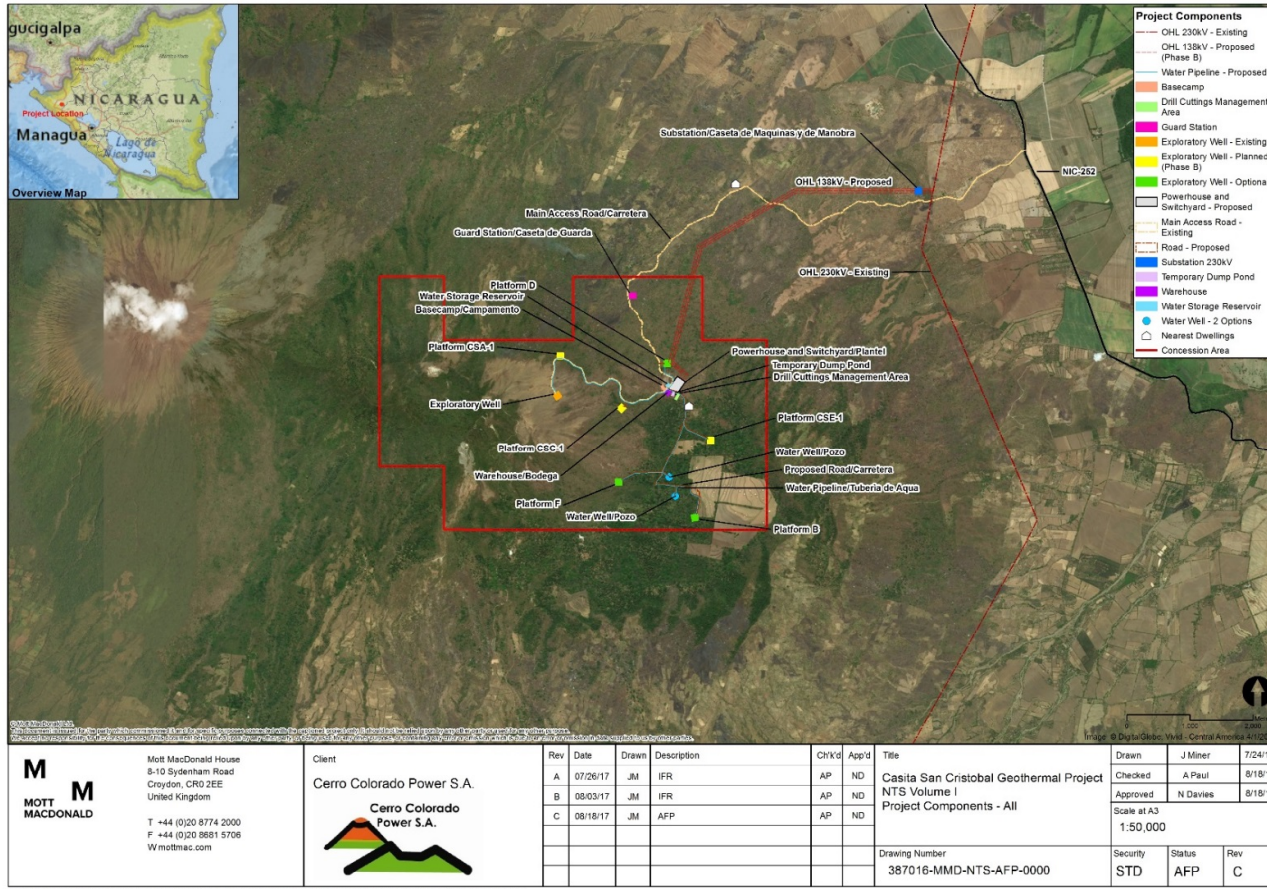
- Well pad foundations for 3-6 wells
- Rehabilitation and expansion of existing main access track (6.2m wide)
- Upgrade / new access roads to Pad A, Pad C, Pad E, Pad B (if needed), Pad F (if needed) and access to the proposed water wells

The following related infrastructure will also be required for Component 1 of the Project:

- 8000m³ water storage reservoir pond
- Water wells (as needed to provide water supply requirements for the drilling rig)
- Temporary water supply pipeline
- Water booster pumping stations
- Temporary materials storage yard and warehouse
- Temporary waste warehouse
- Temporary 8000m³ dump pond
- 5000m³ drill cuttings and muds management area
- Security guard hut

Figure 3 illustrates the location of the Project components.

Figure 3: Project components



Source: Mott MacDonald / CCP

2.2.4 Siting of the required infrastructure relative to the habitats within the Nature Reserve

The Nature Reserve has five management zones: i) core zone, ii) conservation recovery zone, iii) high fragility zone, iv) sustainable production zone, and the v) buffer zone. The main geothermal facilities and Project activities are proposed to take place in the sustainable production zone and the core zone (see Figure 4). The core zone comprises all dense and open broadleaved forests with slopes equal to or greater than 15%; it is an area of protection that covers 35% of the total area of the Nature Reserve. The sustainable production zone is an area dedicated to agricultural and livestock production covering 55.1% of the total area of the protected area. The access road (Component 1) and the transmission line (Component 2) also affect a narrow strip within the buffer zone of the Nature Reserve. Surface studies (geological, geophysical, and geochemical) have already been completed. A small well pad (including its associated access road, which will require significant upgrade works) and a slim core-hole drilled are already existing as part of work performed to date to support confirmation of the availability of a steam resource. Further information is provided below on the potential impact and the management plans for working in the sustainable production zone and the core zone in a way to achieve net gain for affected forest habitat and other mitigation measures.

2.3 How will the Project be funded?

The Component 1 exploration drilling program is estimated to cost US\$40 million and the total Project costs are estimated to be between US\$4.2 and US\$5.0 million per installed MWe. The program will be funded by the World Bank (IDA and SREP² funding) and private investors. Component 2 of the project is estimated to cost between US\$101-118 million, which would be funded by the World Bank (US\$5 million from IDA) and other multilateral and private financiers if the project progresses to this stage based on the results of Component 1.

2.4 What is the planned Project schedule?

The drilling plan assumes initial drilling at three locations (A, C and E). Three additional well pads have been identified (B, D and F) as possible drilling locations for two further wells depending on the results of the first wells drilled (pads A, C and E). Key dates are:

- Month 1 - Civil designs for roads and well pads
- Month 1 - Construct water infrastructure (5 months)
- Month 2 - Road and pad construction (10 months)
- Month 6 - Contractor mobilisation
- Month 8 - Exploration and appraisal wells and well testing (14 months for all five pads) (2 to 3 months per drill site to be drilling in sequence)
- Month 16 - Component 2 feasibility study
- Month 48 - Construction of production infrastructure (production and reinjection wells), permanent accommodation for operations and maintenance personnel, site preparation works, construction of the SAGS, power plant, transmission line and substation)
- Month 72 - Target commercial operation date (COD)

Table 3 sets out the sequence of activities to be performed for the Component 1 exploration drilling.

Table 3: Component 1 exploratory drilling – activities to be performed

Site Establishment	Exploratory Drilling	Site Closure
Month 1	Month 8 to 22	Month 30
<ul style="list-style-type: none"> • Confirm water resources 	<ul style="list-style-type: none"> • Exploratory drilling works 	<ul style="list-style-type: none"> • Removal of drilling equipment and reinstatement of temporary work sites
<ul style="list-style-type: none"> • Site clearance 	<ul style="list-style-type: none"> • Geological sampling and analysis 	
<ul style="list-style-type: none"> • Construction of well pads 	<ul style="list-style-type: none"> • Well testing 	
<ul style="list-style-type: none"> • Construction of temporary water pipeline to supply well pads 	<ul style="list-style-type: none"> • Pumping of water / drilling muds 	
<ul style="list-style-type: none"> • Temporary materials storage yard 	<ul style="list-style-type: none"> • Drilling rig and ancillary equipment maintenance 	
<ul style="list-style-type: none"> • Water intake and pumping stations 		
<ul style="list-style-type: none"> • Construction, rehabilitation and expansion of access roads 		
Abnormal / emergency situations (applicable to all activities): Natural hazards including forest fires, volcanic eruption or earthquake. Anthropogenic hazards such as well blow outs or well kicks.		

² IDA (International Development Agency, part of the World Bank Group); SREP (scaling up renewables program, World Bank)

2.5 What standards have been applied to the Project?

The World Bank has categorised the Project as “environment category A”, requiring a full ESIA against relevant World Bank Performance Standards including preparation of a number of supporting plans and studies. Specific reference has been made to the requirements of the World Bank Safeguard Operational Policies (OPs) and World Bank Group/International Finance Corporation (IFC) Environment, Health and safety (EHS) guidelines including:

- World Bank Operational Policy (OP) 4.03 – Performance Standards for Private Sector Activities (May 2013)
- The World Bank’s (WB) Performance Standards (PS):
 - WB PS1 – Assessment and Management of Environmental and Social Risks and Impacts
 - WB PS2 – Labour and Working Conditions
 - WB PS3 – Resource Efficiency and Pollution Prevention
 - WB PS4 – Community Health, Safety and Security
 - WB PS5 – Land Acquisition and Involuntary Resettlement
 - WB PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources
 - WB PS7 – Indigenous Peoples
 - WB PS8 – Cultural Heritage
- World Bank Group Environmental Health and Safety (EHS) Guidelines considered applicable to this review:
 - EHS Guidelines for Geothermal Power Generation (April 2007)
 - EHS General Guidelines (April 2007)
 - EHS Guidelines for Electric Power Transmission and Distribution (April 2007)
- Core conventions and instruments of the International Labour Organisation (ILO) and United Nations’ (UN)
 - Good International Industry Practice (GIIP)

2.6 How was the location of the infrastructure selected?

At all key stages, the Project has performed analysis of alternative options, including the ‘No Project’ option, to seek to get the most environmentally and socially beneficial project within the restrictions of the concession area.

The following site selection criteria were employed by the Project for the siting of the exploration drilling wells:

- Geological mapping, geochemical sampling of springs and streams along with geophysical surveying such as resistivity (MT/TEM), gravity and mapping of magnetic anomalies
- Gas emissions (radon and carbon dioxide (CO₂))
- Vicinity to the known heat source (in this instance the Casita-San Cristobal volcanos)
- Geological features (adventive cones/craters, faults, lineaments and fractures)
- Accessibility to the drilling well pad sites
- Environmental and social impact (specifically consideration of options to minimise impact on the sensitive habitats of the Nature Reserve and nearby receptors)

2.7 Environmental and social assessment documentation

The Project ESIA is reported in various volumes which together comprise the ESIA. These include:

- Volume I: Executive (Non-Technical) Summary (NTS) – This document, which presents the main findings of the ESIA in simple terminology to ensure Project impacts and management measures are understandable to most readers, including those without technical expertise.
- Volume II: ESIA Main Report
- Volume III: Technical Appendices – supporting information
- Volume IV: Environmental and Social Management and Monitoring Plan (ESMMP)
- Volume V: Stakeholder Engagement Plan
- Volume VI: Resettlement Policy Framework

3 Environmental and social impacts

3.1 What are the Project impacts that could affect the environment and people?

It is recognised that a project of this scale and duration has the potential to impact the environment and the community, both in a positive and negative way.

The ESIA has identified the following potential impacts and has defined actions to manage these impacts so that they do not result in significant environmental or social impacts.

- Social impacts associated with:
 - Employment generation
 - Project induced in-migration
 - Workers health and safety risks
 - Community health, safety and security risks
 - Land acquisition and resettlement

Environmental (bio-physical) impacts connected with changes to habitats, natural drainage systems or subsurface composition as a result of vegetation clearance, site levelling and site works and the supporting activities that are required to undertake this work (delivery of vehicles, equipment, workers) including:

- Impacts on ecology in particular potential impacts to the San Cristóbal-Casita Volcanic Complex as an Important Bird and Biodiversity Area (IBA) and a Key Biodiversity Area (KBA), and the Reserva Natural Complejo Volcánico San Cristobal-Casita as a result of:
 - Permanent and temporary habitat loss from site establishment, access road widening and habitat clearance for supporting infrastructure
 - Accidental introduction and dispersal of invasive species
 - Disturbance to terrestrial species from noise, artificial light and vibration
 - Increase in road kills and injuries to wildlife (including hunting and poaching due to improved access)
- Impacts on cultural heritage and resources, specifically:
 - Disturbances of archaeological artefacts and sites during below ground site establishment works
- Impacts on surface and groundwater resources, specifically:
 - The Argelia Spring, Quaternary deposits Aquifer (Casita hillside and Plain area and the La Pelona caldera) and the La Pelona Andesite Aquifer
 - Seasonal impacts on ephemeral streams in the concession area
- Noise impacts, specifically:
 - Temporary impacts to nearby residential receptors along the access road and near to well pad E from construction and upgrade of existing roads and proposed 24-hour drilling
- Air quality impacts from exploratory phase activities including hydrogen sulphide and other gas releases, exhaust emissions and dust
- Waste generation and management

3.2 How was the Project assessed?

A thorough appraisal has been undertaken for potential impacts arising from the Project including:

- Establishment of the baseline to understand current conditions at and around the proposed Project sites
- Prediction of impacts
- Identification of mitigation measures to be included in the design, procedures, development and management of the Project

For baseline data collection, environmental and socio-economic information on the existing environment and communities has been collated from a range of sources including primary data collection, publicly available information, and through consultation. Primary data was collected through:

- Site visits to the Project area and surroundings
- Biodiversity surveys at all well pads and other infrastructure locations
- Key stakeholder and focus group meetings

Planned well pad and access road locations were visited for primary data collection including ecological field surveys, socio-economic data collection. In addition, existing community water wells were visited to obtain information on existing groundwater and water quality. Baseline data was also collected from secondary data including a wide range of published sources including websites, articles and reports from local authorities, ministries, government organisations, civil society organisations, non-governmental organisations, local media and business groups.

The significance of an impact is described based on sensitivity of project affected persons / environment and magnitude of impacts. Where possible, impact magnitude and sensitivity are described with reference to legal requirements, accepted scientific standards or accepted impact assessment practice and/or social acceptability. Where the ESIA found that the Project could cause moderate to substantially significant impacts then actions or procedures (referred to as mitigation measures) have been developed to avoid, reduce or otherwise mitigate the effects and reduce their significance. A great number of potential impacts can either be avoided or reduced through mitigation; however, some residual environmental impacts may be unavoidable. The ESIA has assessed whether residual impacts, either beneficial or adverse, remain after mitigation. A summary of the key findings for each social and environmental impact is provided in Section 3.4.

3.3 Information Disclosure, Consultation & Participation

The ESIA has been prepared based on consultation with project-affected persons (PAPs), government departments, non-governmental organisations (NGOs) and community representatives, amongst others. Primary data was collected through a socio-economic survey with PAPs which has been used to inform the social impact assessment. The ESIA has a section detailing the consultation that has taken place for the Project during the ESIA phase as well as the key issues raised by stakeholders, which have been considered by specialist contributors.

The key issues raised include concerns relating to the sensitive biodiversity in the Nature Reserve, importance of ongoing communication with the communities, employment opportunities and impact on water resources and cultural heritage as summarised further in Table 4.

Table 4: Summary of issues raised by stakeholders during ESIA phase

Issues raised	Main comments	How they have been addressed in the ESIA
Sensitive biodiversity	Concerns were raised about: Need to minimise deforestation in an already pressurised location Fire risk and forest fires Importance of reforestation to avoid erosion. Information was requested on whether the hot steam created by the Project will impact people.	Addressed in Chapter 8.3. Biodiversity Reforestation identified as mitigation measures. ESMMP sets out routing guidelines for defining rights of way for final routing of infrastructure.
Consultation and information disclosure	There has been little to no information provided on the Project to date. Recommendations for disclosing information and setting up community meetings was provided.	Disclosure methods included in SEP Recommendation from stakeholders on disclosure methods included in SEP
Economy, employment and livelihoods	Job creation, better infrastructure, cheaper energy, generation of taxes for municipalities are Project expectations. The three municipalities want to be prioritised for economic benefits. Queries were made about the Project's impact on schools, and private properties. There is hope there will be benefits for tourism sector. Because of an interest in lessening dependency on petrol and addressing effects of climate change, the Project is considered to be beneficial for all of Nicaragua not just local communities.	Addressed in Chapter 8.2. Socio-economic Local workers from the three municipalities to be prioritized and this is reflected in the ESMMP (including the social action plan).
Water resources	Clarification was requested about whether wells will have to be drilled every two years in addition to the access road and other civil works. San Lucas community said well water is contaminated and civil works like road construction affect the currents that reach them. Community members have expressed high level of concern over the local water quality, linked to the incidents of chronic kidney disorder among plantation workers. There has been no conclusive cause of the disease incidences determined to date.	Addressed in Chapter 8.5. Water resources
Archaeology and cultural heritage	Communities requested that civil works are done with care and take into consideration archaeological and cultural concerns.	Addressed in Chapter 8.4 Cultural heritage
Civil works	It was recommended to hire companies that have MARENA and MEM concessions for exploitation of material banks.	Addressed in Chapter 8.2. Socio-economic

Ongoing information disclosure and consultation is planned for within the ESIA and an outline project performance grievance mechanism to be implemented by CCP is provided.

A stakeholder engagement plan (SEP) has been prepared as part of the ESIA process to manage stakeholder and community relations, expectation, and grievances through participation, consultation and disclosure mechanisms. The SEP is to serve as a management tool to guide stakeholder engagement for the Project lifecycle, including the exploratory ESIA phase. The SEP includes a community grievance mechanism with reporting and resolution procedures. The roles and responsibilities of the Project community liaison officer (CLO) include logging and tracking the resolution of grievances.

3.4 Key findings

3.4.1 Social Impact Assessment

3.4.1.1 Employment generation

The exploration phase, intended to be of a 2.5-year duration, will create employment opportunities for site establishment, drilling and site restoration. Estimated jobs are 100 for site preparation and 100 (60 CCP and 44 contractor) for drilling. The local jobs may provide small contributions to poverty reduction in the area of influence. Minor indirect socio-economic benefits will result from local workers' earning being spent on local goods and services. The exploration phase jobs will be temporary, but the skills and experience gained will benefit future job prospects as workers develop new skills or enhance existing skills. More geothermal projects in the national pipeline could benefit from the increased national skill set. Construction employment will have a minor positive impact for the region. To assist in minimising the environmental impact of Project activities an education awareness and training plan will be developed.

3.4.1.2 Project induced in-migration

Project induced influx can bring both positive and negative socio-economic impacts. The rate and magnitude of in-migration based upon the scale, area, length of opportunities and proximity to a skilled workforce indicate that the Project will generate a low level of negative Project induced in-migration. To minimise the negative and enhance the positive, CCP will:

- Require contractors to sign a code of conduct as part of the mitigation measures pertaining to labour-influx
- Prohibit contractors from hiring staff at site illegally for short-term jobs
- Request main contractors to present their recruiting approach as part of the tender process
- Require main contractors to hold job fairs in each of the three municipalities
- Prohibit worker accommodation located near the well pads and prohibit workers from sleeping at work sites, except for drilling rig personnel (the anticipated exploration workforce is small and any workers from outside the local area will be easily accommodated in Villa 15 de Julio or in Chinandega, a 20 minute to 1 hour drive from site)
- Organise a one-day financial management seminar/workshop for contracted employees at least two months prior to expected end of drilling
- Provide a one or two page or hour monthly brief to workers on stress management, lifestyle campaigns (see additional information about this below under health and safety) and wellness issues
- Require main contractors to organise a short campaign on HIV/AIDS, STIs, Zika virus or other important medical health issue every four months

3.4.1.3 Land use change and resettlement

The Project has not anticipated the need for physical displacement for the exploration phase, at this point. No communities are located within the Project concession area however we have identified that there are two houses. One is located along the main access road and one is located near to well pad E. The ESIA has considered traffic, noise and dust impacts temporary and identified mitigation measures to reduce effects, which are discussed below. The preferred mitigation measure will be discussed among CCP, the landowner and the inhabitants. Economic displacement impacts identified include:

- Permanent land loss and displacement of low productive farmland for Project infrastructure (well pads and access roads)
- Temporary displacement of land for supporting Project infrastructure (water wells, temporary water ponds, laydown areas)

The Project has leased required land from five private owners, three of which are private companies. The land take relative to the total land owned is relatively small and in the worst case does not exceed more than 7.5% of a landowner's total land. Future land needs for Components 1 and 2 are currently unknown and still to be defined. A Resettlement Policy Framework (RPF) has been prepared to guide how future land acquisition will continue in line with good international industry practice.

3.4.1.4 Occupational health and safety, labour and security

All contractors will be required to develop an occupational health and safety plan (OHS) and a security management plan that reflects international standards and good practice. In addition, all contractors will be required to sign onto the CCP labour commitment and the workers' code of conduct.

3.4.1.5 Community health and safety

During exploration, if not mitigated the following activities could cause disturbance or impact the health safety and security of neighbouring villages and local community members:

- Project truck and vehicle movements will increase existing traffic volumes
- Nuisance impacts from increased noise, vibration and dust related to exploration activities (two houses within 100m of the access road have been identified; other houses or human settlements are far enough away to not be impacted)
- Construction site storage of hazardous materials
- Anti-social behaviour

A number of plans will be developed that address community health and safety risks include an emergency preparedness and response plan, security management plan and a traffic management plan.

3.4.1.6 Social action plan

If the viability of the geothermal resource is confirmed, CCP will produce a social action plan for the Project lifecycle that sets out in broad terms how the Project will interact with communities.

3.4.2 Archaeology and Cultural Heritage

The main potential impacts on archaeological and cultural heritage features are generally because of direct impacts from site clearing and construction activities (access roads and well pads).

Impacts will be confined predominantly to the direct area of impact for the Project infrastructure. No above ground sensitive features have been identified in the Project footprint through the site walkover.

To address unforeseen impacts related to cultural heritage, the Project will:

- Undertake further consultation with the National Archaeology Department of the Nicaraguan Institute of Culture and other stakeholders to confirm burial sites and areas whose intangible significance is so far unknown

- Undertake subsurface archaeological study at the sites of direct impact to be completed prior to any site clearance or construction works during site establishment and where necessary develop a cultural resources management plan, if cultural resources are confirmed as present at the site
- Use existing roads and rights of way as much as possible to minimise potential for finding undisturbed finds
- Supporting chance finds procedure to stop works in case of unexpected findings

3.4.3 Biodiversity and Ecology

The Project infrastructure overlaps the boundaries of the San Cristóbal-Casita-Chonco Volcanic Complex Important Bird Area (IBA) and Key Biodiversity Area (KBA) and the Reserva Natural Complejo Volcánico San Cristobal-Casita, resulting in some permanent and temporary impacts to several habitats including secondary dry deciduous tropical forest (4.13ha), open forest succession (1.10ha), agro-forestry and plantations (4.32ha), savannah (0.02ha), rocky outcrops and pioneer vegetation on landslides (0.38ha), and arable land (0.47ha). This represents 0.06% of the area of the Nature Reserve. The overlap of the Project in these areas, triggered the need for a Critical Habitat Assessment (CHA).

Some flora and fauna species of global and/or national conservation importance have been identified but the assessment has determined that these are not significant.

The CHA has been carried out in line with WB PS6 and found that the Project is unlikely to have measurable (i.e. significant) adverse effects on the above species that trigger critical habitat or on the ecological processes that support these species.

The Project has identified the following measures to avoid, minimize, rectify, and offset its impacts on habitats and species of ecological importance to acceptable levels.

- A Biodiversity Management and Action Plan (BMAP) will be prepared to demonstrate net gain in critical habitats and no net loss in natural habitats according to World Bank standards
- A monitoring plan will be prepared as part of the BMAP to measure the success of habitat establishment and to confirm on-site adherence to the mitigation measures defined within the BMAP
- Prepare and implement an Ecological Management Plan (EcMP) as part of the contractor's ESMP which addressed standard impact reduction measures for artificial lighting, noise, dust and prohibition of hunting of wildlife
- Provide support to the *Reserva Natural Complejo Volcánico San Cristobal-Casita* that includes inputs into the new Management Plan for the Nature Reserve, controlling access and improving the protection of the Nature Reserve
- Habitat compensation to be provided by this Project will involve forest habitat creation and restoration in the Nature Reserve. The compensatory habitat will be maintained for the first five years and monitored for ten years in total
- Implement awareness raising and education for local communities through educational programmes
- Implement a carefully designed Habitat Removal and Restoration Plan (HRRP)
- Habitat compensation to achieve net gain for forest habitat is provided in Chapter 9 Conclusions of the Biodiversity section on Mitigation. This represents a framework for a biodiversity offset plan that should be developed before the start of the site establishment. The offset plan can be a stand-alone document or as part of the BMAP.

3.4.4 Resources and Water Quality

3.4.4.1 Changes to natural drainage pathways

During site establishment in Component 1, all worksites and drilling platforms will be constructed with drainage to prevent excessive runoff. Access roads will follow existing paths as far as possible and will be asphalt to minimise erosion by runoff. Road culverts and ditches will be designed with capacity to drain rainfall and sized for extreme weather events.

3.4.4.2 Pollution of groundwater

As with any geothermal project, the Project has the possibility of causing pollution of groundwater as a result of accidental spills, or inappropriate disposal of wastewater from construction activities during site establishment in Component 1. During drilling, there is potential for release of contaminants, drilling fluids or geothermal fluids during water well drilling and exploratory wells. Mitigation measures to minimise surface water run-off and prevent the accidental release of pollutants will be employed on site and advanced groundwater protection techniques will be used during the drilling itself to prevent contamination of the aquifers.

3.4.4.3 Groundwater and water availability

The preliminary hydrological assessment has determined that when considered against total available water resources and current water use needs in the area, the Project could be a minor impact on water availability. The potential effects would be temporary, local reductions in groundwater levels or spring flow whilst drilling is in progress, which may be exacerbated during dry periods. A detailed hydrogeological assessment will be undertaken in advance of site establishment works and finalisation of water abstraction locations, to confirm the findings of the preliminary study. This would include, regular monitoring of groundwater and springs before and during the drilling to ensure that any impacts are accurately recorded, so that alternative water supplies can be arranged for affected users.

3.4.5 Landscape and Visual

Although the new Project infrastructure (drilling rig and supporting ponds, and equipment) for Component 1 would create prominent features in the surrounding landscape that will dominate views close to the site, the general visual amenity of the area would not experience large deterioration due to the temporary nature of the exploration works, and the distance between the drilling sites and the closest dwellings (over 500m), and therefore the impact is of minor adverse significance. The existing land use pattern will be largely unaffected and the landscape character has a large capacity to absorb change. However, while temporary in nature, the Component 1 drilling rigs will create large elements, contrasting with the existing character and there are limited opportunities for additional mitigation due to the scale of the proposed development.

Concerning tourism at the Casita Volcano, there are private tourism initiatives in the municipality of Chinandega such as companies that organise group tours to visit the San Cristóbal-Casita Nature Reserve. It is worth noting that the upper level of the Casita Volcano is occupied by a military base and telephone antennas. Thus, tourists mainly visit the San Cristóbal Volcano, according to stakeholders consulted for this ESIA.

3.4.6 Noise

The key noise-sensitive receptors have been identified as two nearby dwellings. During site establishment and closure works the potential impacts due to noise could include the temporary

disturbance of (e.g. interruption of normal activities and sleep, annoyance, complaint); limited impacts to sensitive ecological habitats are expected, given that no specific ecological receptors of high noise sensitivity were identified in the noise AOI.

Significant noise impacts are not anticipated however the Project will employ good practice measures to minimise noise impacts during all site works and will seek to locate noise generation equipment and activities as far away from receptors as possible.

During drilling mitigation measures to minimise noise impacts from construction will be applied, informing local people on the timing and duration of works and when the noisiest stages are likely to occur.

Baseline noise monitoring has been performed so that changes in noise levels in particular night time noise levels, can be evaluated during drilling to verify no significant impact.

3.4.7 Geology and Erosion

The Project is in a seismic risk zone within the San Cristobal-Casita volcanic range. The San Cristobal volcano is one of the most active volcanoes in Nicaragua having frequent small to medium-sized ash eruptions reported since the 16th century, the most recent in April 2016. The Casita volcano has not been active since the 16th century. The ESMMP addresses the need for an emergency preparedness and response plan that reflects potential impacts to workers in the event of a seismic event and promotes coordination with municipality plans for evacuation. The ESMMP also makes reference to the need for all permanent infrastructure to be specified in accordance with any specific technical norms and international best practice for siting a development in a seismic risk zone.

The impacts on surface and sub-surface geology, slope stability, and erosion has been assessed as insignificant as long as the mitigation measures which have been identified are appropriately implemented.

During the site establishment works for the Project, there is the potential for large volumes of soil to be excavated for levelling of well pads, roads and other construction. The main impacts likely to occur are increased soil erosion, changes in surface water run-off and decreased slope stability. Well blow-outs and workers' health and safety are the main potential impacts during the operation phase. An Emergency Preparedness and Response Plan will be developed as part of the ESMMP.

3.4.8 Soil Contamination

The potential of land contamination has been assessed as being of minor risk. The main potential impacts during the site establishment phase are likely to be from poor handling and storage of chemicals, oils, lubricants etc. as well as poor handling and storage of any waste arising from the Project. During the drilling phase additional potential impacts will arise from the drilling activities and these include the risk of drilling ponds overflowing and potential contamination from cuttings and drilling muds. A waste management plan along with a spill response plan will be in place to ensure appropriate implementation of mitigation measures. Measures outlined in the ESMMP are designed to minimise risk of unplanned discharges to the surrounding environment to negligible levels; this includes proper sizing of ponds (to account for extreme weather events leading to overflow). The ecological management plan and site clearance plan will also make reference to any specific ecological hazards that would need to be considered in the siting of temporary or permanent infrastructure and the ecological management plan requires a site walkover by an ecologist immediately prior to works commencing to assist in site layout.

3.4.9 Air Quality

Air quality impacts and risks of the Project during exploration works that were identified as requiring specific consideration have been identified as:

- Dust emissions from general construction related activities and traffic movements
- Elevated levels of hydrogen sulphide emissions during well drilling and testing
- Risks associated with gas emissions (including hydrogen sulphide) during abnormal operations

The following mitigation measures for controlling air quality impacts have been defined in the Project plans so that impacts can be managed to acceptable levels.

For management of dust emissions, these measures include:

- Management of dust levels from stockpiles, traffic movements and soil movements including sealing or re-vegetating completed earthworks as soon as reasonably practicable after completion
- Minimise material handling and use vehicles with low emissions
- Use water as a dust suppressant where applicable (e.g. using towed water bowsers with spreader bars)

For management of gas emissions including hydrogen sulphide or particulate emissions, the Project will:

- Implement a continuous real-time hydrogen sulphide monitoring programme at all times and at key locations (workers, residents and land users) including hydrogen sulphide detectors, and carbon dioxide and methane monitoring at the well pad installation sites
- Provide emergency response teams, and workers in locations with high risk of exposure, with personal H₂S monitors, self-contained breathing apparatus and emergency oxygen supplies, and training in their safe and effective use
- Implement a site emergency preparedness and response plan to be put in place for drilling activities at each drilling location to control the effects of abnormal drilling events

The emergency response plan will be shared with the local households so that everyone is aware of actions to be taken in the event of an emergency.

3.4.10 Traffic and Transport

Road traffic will increase mainly during the site establishment phase of the Project. Local populations and livestock could be at risk from accidents with increased road traffic. Driving codes should be respected and local people should be given the right of way.

The impacts arising from the site establishment and drilling phases associated with traffic from the Project will be from increased traffic flow and increased risks associated with road safety, in particular from large vehicles. Vegetation clearance will be carried out on access roads to platforms (2.87ha), where habitats are likely to become fragmented as a result of the habitat loss. Improved access roads can also cause an increase in hunting and poaching of wildlife in the Nature Reserve. Plans and measures will be implemented to minimise all traffic activities.

A Traffic Management Plan (TMP) will be implemented. It proposes mitigation measures to enhance the efficient transport of any materials to site, whilst minimizing congestion and disruption which might affect general traffic and the local population.

3.4.11 Materials and Waste Management

The potential impacts from poor handling, use and storage of materials and waste during the site establishment and drilling phases of the Project has been assessed as being of minor adverse significance if all mitigation measures are implemented throughout the Project phases.

The principal potential impacts which can arise from the generation of waste from all phases of the Project are as follows:

- Contamination of receiving environments (particularly surface watercourses, groundwater and soils) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements
- Fugitive emissions, such as dust and odour, associated with the handling and storage of various sources of waste
- The use of landfills - where waste re-use or recovery is not feasible - which is a finite resource
- Disposal of spoil and excavation material which results in land take
- Visual amenity impacts associated with poor storage of waste
- Increased waste miles and emissions of greenhouse gas emissions associated with transporting waste materials from the Project site

Potential impacts generally associated with the wider handling and use of raw materials includes the following:

- Use of potentially finite and / or scarce resources
- Handling and storage of hazardous materials
- Spills and leakages of hazardous materials which lead to an environmental incident

The most significant need for the Project is to ensure that operational controls are used to minimise waste production in the first instance wherever possible. Where waste avoidance is not possible then CCP will maximise re-use and recycling opportunities. A Waste Management Plan will be in place to ensure materials and waste are handled and stored according to GIIP.

3.5 Cumulative impacts with other projects

The main potential for cumulative impacts is identified in relation to the impact on traffic movements in the area where site establishment traffic movement may coincide with harvest periods in the local region. The traffic management plan will address this to minimise impact on local roads. The increased traffic may also lead to increased fragmentation of habitat which will be minimised by prohibiting off-road driving and reducing dust levels by using water sprays/misting. The Project's water abstraction will not put undue strain on water resources when combined with present or future cattle ranching, farming, or tourism activities.

No other significant cumulative impacts have been identified. As indicated in Chapter 8 of this ESIA, the Project will consider any future cumulative impacts as part of its assessment in addition to any significant impacts combined with past and present investments in the area.

3.6 How will CCP manage environmental and social impacts?

As part of this ESIA, CCP will develop an Environmental and Social Management and Monitoring Plan (ESMMP) that draws upon the management and mitigation measures which have been defined within the ESIA. The ESMMP is presented as Volume IV of the ESIA documentation. The primary objective of an ESMMP is to safeguard the environment, site staff

and the local population from site activity that may cause harm or nuisance. The ESMMP is the basis of the environmental and social protection measures to be implemented by CCP and its contractors.

In addition to the ESMMP, several complementary framework plans, policies and procedures have been developed including the following:

Emergency response plan / pollution incident control plan (contingency plan)
Drill cuttings management plan
Traffic management plan
Waste management plan
Hydrocarbon management plan
Recruitment plan
Labour commitment statement
Labour code of conduct
Labour grievance mechanism framework
Site safety and security management plan
Social action plan (investment plan)
Biodiversity action plan
Ecological management plan
Vegetation and herbicide / pest management plan
Soils and vegetation removal and reinstatement plan
Chance finds procedure
Maintenance plan

Responsibilities for implementation are outlined in the ESMMP and fall to CCP and the various contractors.

The implementation of the ESMMP ensures EHS performance is in accordance with national permits and international standards (including the relevant World Bank Operational Policies and World Bank Group EHS Guidelines) and best practice.

CCP will implement the ESMMP within the structure of their corporate Environmental and Social Management System (ESMS).

CCP will hire a team of environmental and social specialists to oversee the works including an environmental officer, health and safety officer, and community liaison officer.

3.7 General conclusions

The general conclusions from the ESIA are:

- The Project can be developed in accordance with MARENA national requirements
- Public perception is good and stakeholders will welcome a clear communication program that CCP will implement as set out in its stakeholder engagement plan
- Within the concession area, land is privately owned by five landowners with only two residential properties close to proposed location of works (one close to the main access road and one close to well access road and well pad)
- The Project will consider any future land requirements and existing land users through negotiated settlement where possible as set out in CCP Resettlement Policy Framework
- Geothermal exploratory drilling may generate negative environmental impacts all of which have been considered can be reduced to acceptable levels with mitigation including noise

management, water management, traffic management, labour management, community health and safety, security and worker safety as set out in the Project Environmental and Social Management and Monitoring Plan (ESMMP)

- The Project can be developed in a way that does not significantly adversely affect the conservation objectives of the San Cristóbal-Casita-Chonco Volcanic Complex IBA/KBA and the Reserva Natural Complejo Volcánico San Cristobal-Casita or critical habitat and flora and fauna that may be supported in the concession area
- The Project will not result in significant habitat loss of dry forest alleviating concerns related to contribution of the Project to deforestation and where deforestation is required the Project will implement a reforestation plan
- Given that the Project is located in critical habitat, and irrespective of Project impacts a Biodiversity Action Plan (BAP) to achieve net gain of biodiversity and a Biodiversity Monitoring and Evaluation Program will be developed and implemented
- Preliminary hydrogeological studies indicate that the Project will not have a significant adverse impact on groundwater levels, water quality and water availability in the local region
- If the geothermal resource is confirmed the Project will develop and implement a social action plan that focuses on the three core areas of concern for the communities: education, tourism and health
- Emission from the geothermal steam / fluids will be controlled using state of the art technology and robust monitoring programmes (air and water) to enable reporting back into the community about pollution levels to alleviate concerns about effects on human health
- A robust archaeological survey and monitoring program will be implemented to address potential to impact on well preserved sub-surface archaeological artefacts and sites of importance
- The Project will play a key step towards confirming the geothermal resource of the Casita Volcano which will support Nicaragua's objective to meet 73% of generation from renewables by 2030

The Project is deemed able to be developed in accordance with MARENA national requirements and in accordance with the World Bank Operational Policy 4.03 for private sector projects as set out in the World Bank Performance Standards.

