ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SUMMARY

Project Name: Menengai Partial Risk Guarantee Project
Country: Kenya
Project Number: P-KE-F00-001

1. INTRODUCTION

Geothermal Development Company Limited (GDC), herein after referred to as the Project Proponent, is one of the key organizations entrusted with energy development in Kenya. It is tasked with accelerating development of geothermal resources to support development of at least 10,000 MW by the year 2030 in line with Vision 2030. The Proponent is 100% Government owned and receives its funding from GoK Treasury and from international partners. The mandate of the Proponent includes surface exploration, drilling, resource management, early generation and promotion of direct utilization of geothermal in Kenya. Towards meeting its obligation, the Proponent is carrying out geothermal drilling of the Menengai Caldera Geothermal Field in Central Rift, which is among the many geothermal prospect areas in Kenya. The project area is situated in Nakuru County and covers an area of about 7,000 km2. Detailed surface studies estimates the Field potential to be over 1600 MW.

To date GDC has drilled and tested over 20 wells at the Menengai Caldera, each with an estimated production 5-10 Mw. GDC has proposed to install 3 × 30-35 MW Modular power stations so as to generate and upload 100 MW of electricity to the National Grid. Kenya Electricity Transmission Company Limited (KETRACO) will construct transmission lines to evacuate power from the proposed Modular power stations through Rongai to connect to Olkaria-Lessos transmission line approximately 15 km from the proposed modular power stations. This ESIA summary therefore includes baseline environmental conditions of the area; description of the proposed project; provisions of the relevant environmental laws and regulations; identification and discussion of any adverse impacts to the environment anticipated from the proposed project; appropriate mitigation measures; and an environmental management plan outline.

2. PROJECT DESCRIPTION AND JUSTIFICATION

2.1. Location: The project is located in the Menengai Geothermal Field on the outskirts of Nakuru Town, about 180 Km west of Nairobi. Nakuru is the fourth largest town in Kenya with a population of about 300,000 and has well developed social amenities such as educational institutions, medical facilities, hotels, banking and shopping facilities. The main economic activities include agriculture, manufacturing, tourism and construction. Electricity and telephone service lines serve most of the habitation and the surrounding farm land. The project area is within 15 km from the 132 kV double circuit Tororo – Lessos - Juja line and about 30 km to the Lanet 132 kV substation.

2.2. Project Description: The proposed project is a Partial Risk Guarantee (PRG) that covers the KPLC against default in payment to the independent power producers (IPPs) and also covers GDC against default in steam supply to the IPPs. The project is part of a larger program aimed at meeting Kenya's rapidly increasing demand for power while diversifying sources of power supply through the development of the country's huge geothermal potential.

The program entails the ongoing Menengai geothermal development project approved by the Bank in 2011 and the proposed developments as given below.

2.2.1. Power Plants

The power plants construction activities will involve demarcation and leveling of the power plant area around construction sites within the Menengai Caldera. Excavation of foundations will be done and soil cuttings removed and where possible used for landscaping and land filling. The power plant equipment will consist of Turbine, Generators, Heat Exchangers. Concrete foundations will be built in excavated areas for mounting the equipment. The equipment will be mounted on the site foundation and assembled by bolting and welding.

2.2.2. Steam gathering system

The design and piping layout will incorporate steam pipeline consisting of steam separator/ heat exchanger, Steam separation station, silencer/muffler. The piping layout will determined based on location of production wells and their respective wellhead pressure and the acceptable turbine pressure. Pipeline supports will be installed along the pipeline routes comprising of steel poles cemented in ground holes. Steam separator vessels will be installed on the pipeline between the productions wells and the power plant. In addition there will be silencers, lined brine sump pond and other control devices such as valves will be installed to control the geothermal fluid discharge. This equipment will be in use under normal operations for venting of the fluid. A chain-link perimeter fence will be installed at the production well, brine sump pond and the power plant. Activities involved during steam field development will also be undertaken with due care to avoid causing adverse impacts on soil profiles and vegetation. The plant and pipelines will then be painted to a color that camouflages the surrounding environment.

2.2.3. Re-injection System

Hot used brine from wellhead steam separators and power plant will be channeled to the re-injection well and injected back to the ground by gravity. Similarly the cold brine will be re-injected through re-injection pipeline from the blow-down re-injection pumps at the power plants.

2.2.4. Water Supply System

GDC has constructed (as part of a previous project) a water storage capacity of 20 million liters supplied from drilled water boreholes and supplemented by supply from the Nakuru Water and Sewerage Company (NAWASCO). The water supplied will be useful for cooling the power plant and the spent geothermal fluids after generation of electricity.

2.2.5. Road Construction

Most of the area is well served by a network of earth and all weather roads. The Nairobi – Kisumu Railway line and Trans-Africa highway passes through the southern part of the area. For purposes of transporting plant and equipment as well as personnel and supplies on daily basis, the project site is connected to the main trunk Nairobi Nakuru road through a reliable all weather road. Road network to various proposed wells is ongoing and is a continuous activity (most of the roads were constructed as part of the drilling project).

2.2.6. Power transmission and Energy Systems

The power generated will be relayed to the constructed switchyard using a 132 kv single circuit transmission line network. The switchyard will be interconnected with switchyard by a bay installed with the controls, protection and supervisory facilities – including communication systems. The transmission lines are of steel lattice towers either suspension or tension towers. The suspension types are made to take vertical loads while the tension towers are light and

designed to take both vertical and horizontal loads. Tension towers are suitable for angle points, dead end points and in areas where topography cannot allow the suspension towers.

The construction of transmission lines will involve excavation of foundations in marked tower sites. Excavations will be carried out manually using locally sourced unskilled labor. In the event that hard rock is encountered, explosives will be used to break the rocks. The lattice tower anchor base will be made of concrete. This will be followed by tower erection. The towers and the accessories shall be transported to sites by trucks and erected with support of cranes. The tower straightening is achieved by guy wire tensioning. In order to prevent tower overloading or excessive movement it is important to ensure the correct tension in all guy wires. The contractor shall develop a tensioning process and ensure all guy wire tensions are checked with a calibrated aviation industry standard tension meter. The tower accessories includes the anti-climbing device and climbing steps; danger contact number and helicopter patrol plates; tower earthing; and aircraft and birds warning devices.

2.2.7. Substations

A substation will be put up for the purpose of boosting power before joining the national pylon grid. The substation will be mounted with equipment such as transformers, circuit breakers, isolators, and switchgears.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1. Introduction

The activities of the proposed project are regulated by several legal instruments and policies, as shown below, which sets the requirements and procedures for obtaining operating licenses and permits. Furthermore all lenders E&S requirements are considered significant rules to be complied with.

Constitution of Kenya 2010	**Kenya Vision 2030**
This is the supreme law of the land and its binding on all activities undertaken within the Republic. The Environmental concerns have been strongly highlighted in the Constitution. The right to a clean and healthy environment has been given recognition. The state is constitutionally obligated to ensure sustainable exploitation and utilization of natural resources and to ensure the equitable sharing of accruing benefits.	The Kenya Vision 2030 is a long-term development strategy of the country. This vision aims at enabling Kenya attain the status of a middle income county with an annual GDP growth of 10% under its economic pillar. The social pillar endeavors to bring about equitable social development in a clean environment. Adequate and reliable energy supply is the cornerstone of both economic and social development. The proposed project thus supports the Vision 2030.
Local Authority Act Cap. 265	**The County Governments Act No. 17 of 2012**
This Act establishes all local governments in Kenya including the Nakuru County Councils.	This statute vests the power of spatial and environmental planning on the county.
Updated Least Cost Power Development Plan 2011	**Kenya National Climate Change Response Strategy**
Kenya‘s power industry generation and transmission system planning is undertaken on the basis of a 20 year rolling Least Cost Power Development Plan (LCPDP) annually. Geothermal resources have been chosen for the future generating capacity in Kenya (GoK, 2011).	This policy paper is a comprehensive response to climate change which poses a threat to Kenya‘s socioeconomic development. The Strategy identifies mitigations efforts to combat climate change in Kenya, chief of which is the Green Energy Development Programme. The development of geothermal in the proposed site is part of the fulfillment of this strategy.
Scaling-Up Renewable Energy Program (SREP) Investment Plan for Kenya	**The Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations 2009**
The objective of the Scaling-Up Renewable Energy Program in Low Income Countries (SREP) is to demonstrate, through pilot operations the economic, social	Regulation 3 prohibits the making or causing to be made of any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort,

and environmental viability of low-carbon development pathway to increasing energy access using renewable energy. The proposed project aims at fulfilling the SREP goal.	repose, health or safety of others and the environment. Regulation 4 prohibits the making or causing to be made of excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others. It is necessary to monitor noise levels continuously.
The Session Paper No. 4 of 2004 (The Energy Policy Document)	**The Environmental Impact (Assessment and Auditing) Regulations, 2003**
The broad objective of the energy policy in Kenya is to ensure sufficient, quality, cost effective and inexpensive supply of energy through use of indigenous energy resources in order to meet development needs, while protecting and conserving the environment.	These 2003 regulations were promulgated to shade light and give concrete substance, detail and procedures required to do EIA under sections 58 to 69 of the Act. Regulation 16 provides that an EIA has to take into account environmental, social, cultural, economic, and legal considerations.
Public Health Act, Cap 242	**The Use of Poisonous Substances Act, Cap 247**
Section 116 of the Act imposes a duty to all local authorities to maintain sanitary conditions within their district and prevent nuisances therein.	Section 3 of the Act casts a duty of all employers of protecting their employees against the risk of poisoning by poisonous substances.
The Wildlife Conservation and Management Act, Cap 376	**Energy Act Cap. 2096**
This act has a purpose to consolidate and amend the law relating to the protection, conservation and management of wildlife in Kenya.	This Act consolidates regulations relating to energy in Kenya. Section 103 of the Act specifically makes provisions on renewable forms of energy including geothermal energy.
The Way Leaves Act, Cap 292	**The Environmental Management and Co-ordination (Water Quality) Regulations, 2006**
The Act in section 3 gives the government power carry any sewer, drain, pipeline or power line into, though, over or under any lands whatsoever, but may not in so doing interfere with any existing building.	Regulation 4 stipulates that everyone has a duty to refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution
Lands Act 2012	**Occupational Safety and Health Act, 2007**
The Kenyan Constitution under the bill of rights provides protection of property rights under Article 40. It further provides for the acquisition of private property by government for public purposes or for public interest. Conditions and guidelines for acquiring are described in Part VIII of the Act.	This Act promotes and guarantees the protection and wellbeing of workers in the workplace. The high temperatures of the steam, emission of hydrogen sulphide, excessive noise and vibrations generated in geothermal development process pose occupational hazards
The Environmental Management and Co-ordination (Waste Management) Regulations, 2006	**The Geothermal Resources Regulations Act, 1990**
Regulation 4 casts a duty on the waste generator to ensure proper waste collection, segregation and disposal in accordance with the regulations. Regulation 5 requires the waste generator to adopt clean production methods so as to conserve energy and reduce emissions or waste that is arising from his activities. The waste generator has a duty to segregate hazardous and non-hazardous waste under regulation 6. Regulation 14 creates a general obligation of pollution mitigations in all industrial undertaking by installing anti-pollution equipment for the treatment of waste emanating therein.	Regulation 6 prohibits the use of a geothermal resource license to give rights over or enter upon a burial ground, church, public roads, national park or reserve. Regulation 9 directs that licensee shall give the Minister thirty days notice of any proposed geophysical survey and drilling. Regulation 10 directs for the supervision of a competent representative of the licensee during the drilling of all bore holes who shall also maintain a driller‘s log for each bore hole. Regulation 13 provides that all geothermal operation must be conducted in a workman-like manner and must prevent the unnecessary waste of or damage to geothermal resources, protect the quality of surface waters, air, and other natural resources including wildlife, protect the quality of cultural resources among other provisions.

Environmental Management and Co-ordination Act 1999, Cap 8	**Geothermal Resources Act - Act No. 12 of 1982**
This is the chief legislation that governs all environmental management in Kenya.	The Act's objective is to control the exploitation and use of geothermal resources and vest the resources in the Government.
The Kyoto Protocol to the United Nations Framework Convention on Climate Change	**Convention on Biological Diversity**
The Kyoto Protocol, requires signatories to the UNFCC to reduce their greenhouses gases emissions to below 5% of their 1990 levels.	Article 1 of the convention states its objectives as the conservation of biological diversity.
Convention on the Protection of the Ozone Layer	**The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in September 1987.**
In March 1985 the intergovernmental negotiations for an international agreement to phase out ozone depleting substances.	This protocol provided for the revision of the phasing schedules on the basis of scientific and technological assessments.

4. DESCRIPTION OF THE PROJECT ENVIRONMENT

4.1. Physical Environment

Along the Kenyan segment of the Eastern African rift valley there are volcanic centers one of which is the Menengai volcano. They are sandwiched between the eastern and western shoulders of the rift valley. The floor of the caldera forms a fairly undulating surface characterized by trachytic and glassy flows, and volcanic soils. At the edge of the caldera is a ring, fault structure that defines the caldera area covering about 77 km2. At the sloppy sides of the volcano are gorge and gully features resulting from surface runoff during rain seasons.

4.2. Climate

The project area is classified into two main agro-climatic zones. Around Nakuru area, mean annual rainfall is approximately 900 mm. The rainfall regimes are bimodal with the long rains occurring in March to July and the short rains in September to November. Temperatures vary with topography and range from 9.4 to 29.3 ºC.

4.3. Geology and Soils

Menengai Caldera is characterized by two trachytic main rock series by age. The older one is that of Pliocene which is characterized by two successive strata. The earlier one is of Pliocene and is characterized by phonolitictrachytes. These appear to have formed during volcanic processes before the formation of the caldera as depicted by their outcrops on the walls of the caldera's ring-structure. The younger rock series is recent (Quaternary) and is characterized by trachyte flows. Like in many other sections Eastern African Rift System, Menengai Caldera occurs within a normal-fault-system. Generally, the occurrence appears as an interruption of intense faulting and fracturing that runs north-south Kenya's rift valley. However at and around the caldera, the ring-structure of the fault created by formation of the caldera is conspicuous. Other associated faults are also observed in and around the caldera. Other noticeable structures are lava flow structures that are depicted by the rocks structures. These include ropy, bandy, blocky and glassy structures of rocks observed inside the caldera during this study.

The soils in the prospect area are volcanic soils of varying thickness. These occur together with superficial deposits. Due to the physiography of the caldera, patches of alluvial deposits are found in some basinal features within the caldera, and the lower areas from the base of the volcano outwards.

4.4. Hydrology

The Menengai area lies on the rift floor that gently slopes northwards. On the east, the Bahati and Marmanet scarps bound the eastern inner rift trough and are relatively higher and wetter grounds. The surface drainage system is therefore largely internal from the east and the western scarps. On the rift floor, the drainage is mainly from Menengai Caldera northwards with the exception of the drainage from the southern rim or slopes of Menengai Caldera into Lake Nakuru. The permanent rivers in the area are Molo and Rongai in the NW area. The perennial rivers are the Crater and Olbanita streams in the eastern parts. The N-S, NE-SW, and NW-SW trending fault/fracture systems provide underground channels resulting to stream water disappearing underground at some places interrupting the Olbanita stream at several places. Other surface water bodies include Lakes Nakuru and Solai, and the Olbanita swamp. Lake Nakuru represents the intersection of a piezometric surface and a topographic surface.

The ground water around Lake Nakuru and northwest of the lake is controlled by a sedimentary formation comprising of lake sediments and reworked pyroclastics. The boreholes immediately to the north and northwest of the lake show lake water contamination indicating interconnection (Geotermica Italiana Srl, 1987). The same sedimentary formations are found in the boreholes located in the east of Menengai caldera implying connectivity with the N-S running Solai tectonic axis. There is one location inside the caldera on the eastern rim where a cold spring occurs at the foot of the caldera, further confirming that the southern part of the Solai tectonic axis is an important control for groundwater movement. The Olbanita swamp is located in an area dominated by dry and thermally anomalous boreholes. The productive ones are characterized by very shallow, low-yield aquifers that get depleted fast since the deeper formations are impervious. These are perched water bodies adjacent to the swamp. Majority of the boreholes in the prospect area were drilled to between 100-200 m depths with yield ranging from 6-20 m3/h.

4.5. Noise

The noise level in the proposed project area was assessed using an Integrated Handheld Sound Level meter (Model Extech 407768). The noise level at the discharging well measured 91.5 dB, which is above the recommended ambient and occupational standards (45 and 85 dB) respectively. As one gets away from the well the noise decreases to a low of 43.5 dB at the pumping station (Pump not running at the time of study). Menengai contain many potential sources of noise, such as generators supplying power to the rig, discharging wells, electric motors, air compressors, mobile machinery, mud pumps, drilling operation, all of which operate around the clock. The environmental noise impact of geothermal drilling operations results from a combination of noise from all these sources propagated to some point beyond the boundary of Menengai to the surrounding areas.

Drilling operation noise levels are higher closer to the drilling rig and under weather conditions that allow drilling noise to dominate the overall noise levels, such as light winds from the drilling sites towards the neighbor, low cloud, temperature inversions etc. Background noise is significantly low at night. Since GDC started the geothermal exploration and development in Menengai, the Environment department has pursued a noise management program which has succeeded in preventing excessive noise pollution particularly around discharging wells and drilling sites. Noise reduction strategies include fixing silencers in the drilling generators; awareness sensitization among the employees and enforcing the use of ear mufflers. In the month of July, 2012 to the Month of February 2013, the highest average noise levels recorded were at MW-14, MW-09, MW-03 and MW-12 respectively were 87.6, 77.3, 76.7, 70.8 dB (A). This was because most of these wells were either under drilling operations or discharging.

4.6. Air Quality

Air quality monitoring has been going on in Menengai project area and gases found included O_2, CO_2, CO, Cl_2, SO_2, and CH_4. It was noted that they were all within acceptable OSHA levels in all working areas monitored. The concentrations of hydrogen sulphide were monitored and it was found that they were high at the weir box in the discharging wells while in the rest of the working areas the concentration levels were zero ppm. However, the concentrations recorded were within OSHA Short Term Exposure level. These locations record low concentrations. At most of these monitored wells, the odour threshold (0.0046 ppm-0.002 ppm or 0.76-3.21mg/ m3) is frequently exceeded, but none of the observation exceed the United States the TLV for hydrogen sulphide which is set at 10 ppm (15 mg/m3) for an eight hour exposure. Note concentrations averaged over eight hours would be expected to be much lower than the short-term average values reported above.

4.7. Water and Effluent Quality

Results of the assessment of quality of drilling water returns, geothermal brine and hot spring show that the brine is alkaline. Chloride concentration is high (444.4 ppm) which is typical of chloride geothermal water. Silica was also higher than the NEMA recommended limits. Except chlorides and conductivity, which varied significantly (subject to experimental errors), compared to the GDC monitoring data, the rest of the data obtained during the ESIA study, fairly agreed with the GDC data. The toxic heavy metals such as lead, cadmium, zinc and copper were below detection limits. With proper disposal, the dangers of accumulation of heavy metals in the environment is minimal and even non-existent considering that the brine is alkaline and therefore uptake by plants especially lead and cadmium from geothermal water is inhibited (Simiyu, 2004). The drilling water returns and brine effluent will be discharged in lined ponds and later reinjected, to safeguard the ground water.

4.8. Biological Environment

4.8.1. Flora

A survey conducted during the EIA study shows that the crater has a total of 217 plant species (Appendix 4). Most of these species belong to herbs (132), while the rest were shrubs (45) and trees (40). The *Rhus natalensis*, *Dodonea sp.* and *Tarchonanthus comphoratus* were among the most dominant species in the caldera. The caldera contains some plant species that are believed to be rare and unique to this area such as *Artemisia afra, Protea gaguedi, Tetradenia riparia, Diplolophium afficanum, Agauria salicifolia* and *Osyris lanceolata.*

4.8.2. Fauna

There are few wild animal species in the project area as reported by FOMEC (2011). This is because large parts of the area are farmlands with no open grazing and dispersal areas. Animal species such as Baboons, Leopards Wild pigs and Snakes are common within Menengai Caldera. Cases of Human - Wildlife conflicts mainly due to invasions of farms by the Baboons and Monkeys have been reported. Antelopes, Dikdik, Gazelles, Monkeys (Vervets, Columbus), Ant bears, Baboons, Leopards, Snakes (Puff udder), Birds (Quills, Guinea fowls, Cave sparrows, bats, weaver birds) and Wild pigs also exist in the project area.

The caldera was found to be a home of 9 species of mammals. Hyraxes, rabbits and baboons were recorded. Evidence of some cats including jackals and leopards was also confirmed from faecal remains and paw-prints.

4.8.3. Herpetofauna

Three reptile families (Agamidae, Boidae and Elapidae) were encountered in the project area. Four species from these families were recorded; namely: Red-headed Rock Agama, the Elmentaita Rock Agama, African Rock Python and Forest cobra.

4.8.4. Birds

A total of 40 birds species were recorded at the Menengai crater. Among them are rare species such as African black eagle. Common bird species spotted in the caldera include malachite sunbird, doves, swifts, swallows and woodpeckers.

4.9. Demographic Characteristics

Based on the 2009 population census, the population of Nakuru County was 1,603,325 with an average growth rate of 3.4 % per annum. Apparently the growth rate is above the then national average of 2.4%. Nakuru has an almost equal number of males and females, for example in 2009 there were 804582 males and Females 798743. The district has a youthful population. The district has a population density of 214 people per sq Km².

4.10. Socio-Economic Characteristics

Based on the survey undertaken by the ESIA most of the respondents were farmers, constituting 58%, while businessmen and women constituted 15%. Teachers, the self-employed and casuals constituted 12% and 7% respectively. Interestingly civil servants and civil society employees were equal and constituted 4% of the respondents. Majority (45%) of the population in the proposed project area, fall within the absolute poverty level. Agriculture is the main source of income with 48% of the population depending on it for their livelihoods. Wage employment contribute 19% while urban self-employed are 23% of the entire population in the project area.

4.11. Education

Nakuru district has a total of 1,219 Pre-Primary schools, 558 Primary Schools, and 140 Secondary schools. The dropout rates for both male and female in primary school is 38%, while in secondary schools it increases to 49.1% and 54.8% respectively. The pupil teacher ratio is 1:35 in primary schools and 1:16 in secondary schools. Enrolment of boys in Pre-Primary, Primary, and Secondary Schools is higher than that of girls. The population of primary school going children was projected to increase from 288,278 in 2002 to 352,465 in year 2008. This represents an increase of 64,187 or 22.3%. This will necessitate investments in educational facilities and services. For the secondary going children population is projected to increase from 125,274 in 2002 to 153,167 an increase of about 22.3%. Overall, this would indicate some preference towards sons in regard to access to education.

4.12. Health

The larger Nakuru District has 15 hospitals and 279 other health facilities that are spread all over the district. According to data from the Demographic and Health Survey (DHS)[1] for 2008-2009, 79.5% of girls and 75.3% of boys under two had received all their basic vaccinations. Under-five mortality rates were higher for boys than for girls, as well rates of malnutrition. This would indicate no pronounced son preference in regard to early childhood care. The most prevalent diseases in the district are Malaria, Upper Respiratory- Tract Infections, Malaria and Skin Diseases. HIV/AIDs prevalence in the district has showed increasing trend, reaching the peak in 1998, before it started showing signs of decline. The declining trend in HIV/AIDs prevalence could be attributed to the fact that Nakuru has been one of the HIV/AIDs pilot campaign districts. However, the prevalence rate of 18% recorded in 2000 is still high especially if translated in terms of figures given the fact that the population of the district is about 1.2 million people. The overall prevalence of HIV/AIDS in Kenya is estimated at 7.4% among persons aged 15-64 years; prevalence among women in this age group is 8.7% and prevalence among men is 5.6%. The impact of the scourge has been felt at all levels of the district‘s economic and social circles. Already Nakuru Town has more than 15 children homes and majority of the children are HIV/AIDS

[1] http://genderindex.org/country/kenya

orphans. This is one of the major challenges facing the major urban centers of Nakuru District; while at village level orphans are being taken care of by the elderly or youth.

4.13. Transport and Communication

Nakuru County is adequately served with loose surface and tarmac roads, railway lines, and telecommunication systems. This has been enhanced by the recent government enhanced investment in road improvement and mobile coverage. The tarmac road network is estimated to extent over 300 kilometers in addition to extensive mobile coverage.

4.14 Food Security

As far as food security is concerned, Nakuru County is fairly food secure. However recent population influx owing to the 2007-2008 post-election violence and subsequent displaced persons in the urban centers seems to have strained the existing food resources. Climate change has also worsened the situation for the peasant farmers owing to their disempowered positions especially financially. Furthermore, women oftentimes tend to be highly affected by worsening situations of food security as women incline to be responsible for food preparation and childcare within the family and are more likely to spend their income on food and their children's needs.[2]

4.15 Sports and Recreation

Being centrally located in the heart of the Rift Valley, Nakuru is a centre of sports and recreation, hosting various primary and secondary schools district and provincial games. It occasionally hosts national and regional games. These are held in the various stadiums in the town.

4.16 Culture

Nakuru County being cosmopolitan, is afloat with the culture of the various communities inhabiting the county, including the Kikuyu, Kalenjin, Maasai, Abaluyha, Abagusii among others.

4.17 Socio-Cultural Issues

The Nakuru County as discussed above is not only cosmopolitan; but has also various hospitals, public and private, as well as housing and educational institutions. Indeed it hosts one of the oldest provincial hospitals, the Rift Valley provincial general hospital & War Memorial Hospital. It occasionally hosts provincial music festivals including rich traditional presentations across the province. Thus the province is socio-culturally rich.

4.18 Gender Issues

The country's Gender Inequality Index score is 0.627 (130th out of 146 countries). Kenya is placed 99th in the 2011 Global Gender Gap Index, with a score of 0.6493.[3]Since the adoption of the new Constitution in 2010, the 30% gender representation recruitment policy in all public offices has seen more women joining senior positions in government. The government has also enacted legislation and programmes to enhance women's access to resources and employment opportunities. Kenya ratified the Convention on the Elimination of All Forms of Discrimination against Women in 1984 and has submitted periodic reports on schedule. Men and women are guaranteed equal status and protection under the law and this is made more explicit in the new Constitution. In 2006 Kenya also enacted the Sexual Offences Act which outlaws violence against women and provides them with greater protection.[4]

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[2] http://en.wikipedia.org/wiki/Gender_and_food_security
[3] http://genderindex.org/country/kenya
[4] http://www.africaneconomicoutlook.org/en/countries/east-africa/kenya/

However, some challenges persist, for instance the Constitution guarantees equality of ownership rights for all Kenyan citizens. Women are free to buy, own and sell assets as they choose. Yet, in practice women's access to land and access to property other than land are severely restricted by customary law, which essentially prohibits women from owning or inheriting land and other forms of property. It is also difficult for Kenyan women to acquire credit since they rarely have assets of their own and therefore cannot provide the collateral required by lending institutions, making it difficult for them to acquire credit. To address such challenges, major commercial banks in Kenya now have at least one financial credit or mortgage product targeting women, and the government has initiated several schemes to enable women to obtain credit, including microcredit.[5] Such aspects need to be taken into consideration during the project preparation phase.

5 PROJECT ALTERNATIVES

The only other alternative for this project would be to have no project at all. The No Project Alternative option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. This option will, however, involve several losses both to GDC, the community and the Country as a whole.

The "No Project Option" is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The Kenyan Government requires energy resources to spur Vision 2030 and No Project Option will impact that negatively;
- Reduced business opportunities due to lack of infrastructure in the proposed project area;
- Reduced interaction both at local, national and international levels by the community, hence education and general awareness is a major loser;
- No employment opportunities will be created for the local community in project area and for Kenyans in general who would have worked in the proposed project area;
- Increased urban poverty and crime in Kenya;
- Discouragement for investors;
- Development of infrastructural facilities (roads, electrical etc.) will not be undertaken;
- Lack of development, research and innovation in the Country;
- Loss of money by government because money has been spent on exploration and well drilling phases.

In addition, the anticipated environmental impacts resulting from pre-construction and construction phases of the proposed project are insignificant. From the analysis above, it becomes apparent that the No Project alternative is not the best alternative to the local people, other Kenyans, and the government of Kenya.

6 POTENTIAL IMPACTS AND MITIGATION/ENHANCEMENT MEASURES

Cumulative impacts for the proposed geothermal Modular power generation unit in the project area will be low to moderate and can be mitigated. No adverse cumulative impacts are expected from implementation of the project in the area if the generation technology minimizes the release of H_2S into the atmosphere. Besides, with geothermal water re-injection, no adverse effect is expected from geothermal brine.

[5] http://genderindex.org/country/kenya

6.1. Dust and Exhaust Emissions

Aerosol contribution to the atmosphere will occur during excavation for construction of brine sump, roads and buildings, and during use of fuel-run equipment including vehicles, generators, and compressors. Oxides of nitrogen, carbon monoxide and oxides of sulphur emitted from internal combustion engines will be released during all phases of the project. During construction, dust will result from disturbances of the surface soils and vehicle travel on unpaved roads. Dust carried by wind blowing across exposed surfaces may have deleterious effect.

6.2. Noise and Vibrations

Noise and vibrations will occur during transportation and installation of equipment, and the power generation process and the noise will vary between 45 and 120 decibels (dB)..

6.3. Liquid Waste

6.3.1. Storm Water

Compaction of surface on well-sites, in roads and campsite construction will create impervious surfaces (slab environment). There is a likelihood of increased storm water runoff from these sites, which result in gully erosion with time. In addition to creating unattractive terrain, this may cause flood incidences along streams downhill during high rainfall times.

6.3.2. Oil Spills

Oil used for machinery will be transported and may be stored at project site. Any major accidental oil spill would impact negatively on the environment as a whole. Cumulatively, small releases of oil would also impact negatively on the environment. Such impacts include creation of new sceneries due to destruction of biological diversity and pollution of water and soil. But these dangers are contained by maintaining the machinery in specific areas designed for this purpose.

6.3.3. Geothermal Waste Water

Geothermal waste water occurs at the well sites as steam condensate and also from the power plants. Depending on the cooling system, geothermal waste water is discharged at the cooling towers. The geothermal wastewater contains pollutants including heat, NH_3, CO_2, H_2S, CH_4, silica and toxic heavy metals such as lead, cadmium, arsenic and mercury.

6.4. Soil Erosion

The proposed project involves activities that will require clearance of areas for project infrastructure such as buildings, brine sump, power station, and electricity transmission lines and therefore excavation to construct roads and level the site, vegetation clearance, and ground vibration are expected. Such activities may loosen the soil hence making it vulnerable to erosion due to wind and surface water run-off. The fact that there is minimum cover of low-slope terrain makes it obvious that without soil erosion prevention measures in place, erosion will take place. This may impact on vegetation and quality of surface water in the environment. The creation of impervious surfaces during site preparation for infrastructure development could also cause increased erosion rates.

6.5. Water Quality Degradation

Project related excavation can lead to surface and ground water quality degradation. Excavation activities can disturb contaminated soil or ground water in the path of the project which could result in transfer of the contamination to surface waters. The excavated area, if linear could act as a conduit to extend groundwater contamination to new areas. Spills of hazardous materials in excavated areas during construction could introduce contaminants to ground water. Development activities such as industrial operations and administration offices development as well as the spillover effect of

development such as increased demand for drinking water and increased auto use can impact water quality by contributing sediment, nutrients, and other pollutants to limit water supplies, increasing the temperature of the water, and increasing the rate and volume of runoff.

6.6. Air quality and dust Impacts

The proposed site is close to discharging wells and there could possibility of the existing wells impacting the construction site with H2S smell in the atmosphere. During the construction phase, atmospheric pollution sources include airborne dust from earthworks, and gases from construction equipment and vehicles. Air emissions from construction machinery, including dust, reduces visibility, soils private property and is aesthetically displeasing – it may also affect palatability of grazing. Dust generated by construction related activities must be minimized. There is need for vehicles speed limits within the project operation sites. The workers and permitted persons in the project site should be provided with relevant personal protective equipment (PPE).

6.7. Climate Change

The proposed development will have no impact on the local climate; however geothermal power stations emit methane and carbon dioxide which are both greenhouse gases. The Modular power plants will have no significant effect on the climate of the area. An equivalent amount of electrical energy delivered by a coal-fired power station, would result in the emission of approximately much higher tons of carbon dioxide. Nevertheless, the quantities of these gases emitted will be substantially less than from a fuel-burning power station of a similar capacity.

6.8. Ground Subsidence

In geothermal development, geothermal fluids withdrawal rate may surpass the natural rate of replenishment. Ultimately pressure drop in the reservoir as a result of fluid withdrawal could occur leading subsidence. In general, subsidence is greater in liquid-dominated fields because of the geological characteristics typically associated with each type of field. Ground subsidence can affect the stability of pipelines, drains, and well casings. It can also cause the formation of ponds and cracks in the ground and, if the site is close to a populated area, it can lead to instability of buildings. Fluid re-injection at proper rates and pressures reduces subsidence potential significantly.

6.9. Solid Waste Generation

During construction solid wastes will be generated. These include cement bags, plastics and timber remains among others. Dumping within the site will interfere with the aesthetic status of the area. This has a direct effect to the surrounding community. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.

6.10. Extraction and Use of Building Materials

Building materials such as hard core, ballast, cement, rough stone and sand required for construction in the proposed project will be obtained from quarries, hardware shops and sand deposit sites such as river beds. Since substantial quantities of these materials will be required for construction of the buildings, the availability and sustainability of such resources at the extraction sites will be negatively affected as they are not renewable in the short term. In addition, the sites from which the materials will be extracted may be significantly affected in several ways including landscape changes, displacement of animals and vegetation, poor visual quality and opening of depressions on the surface leading to several human and animal health hazards.

6.11. Energy Consumption

The project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil energy is non-renewable and its excessive use may have serious environmental implications on its availability, price and sustainability.

6.12. Flora

The vegetation will be cleared during construction of substation, office buildings, transmission lines, and roads. However, this impact is short-term and not significant because the spatial extent will be minimized by ensuring that vegetation disturbance is confined to construct sites. Further, the project sites can be re-vegetated with the same species after construction.

6.13. Fauna

The project area is a protected forest housing wildlife such as monkeys, leopards, several bird species and reptiles (Appendix 4.2 - 4.4). The most significant effect of geothermal power plant operation on the environment is noise, power transmission cables and air pollution. These may disturb the habitat, interfere with breeding and displace the animals and thus increase animal-human conflict. If animals graze at the contaminated sites, the chemical might accumulate in the animal body and cause side effects such as mineral imbalances leading to anemia. However, geothermal effluents from the proposed project will be re-injected and sites will be fenced off. Ultimately animals' access to contaminated sites will be minimal and therefore potential impacts are unlikely to occur.

6.14. Socio-Economic Benefits

6.14.1. Improved infrastructure

The project will provide a number of socio-economic benefits such as improvement of roads, which will increase the area's accessibility; Power and telephone network arising from the project will provide reliable and consistent energy supply and communication respectively and; the power plant will add 90 MW of the national grid. This will go a long way to stabilize electricity supply in the country and reduce power outages during high demands.

6.14.2. Business opportunities

Construction and operation of the power plants in the proposed project area will result into influx of construction workers who will have a positive impact on the local economy in terms of improved business. Construction materials such as building stones and marrum may be sourced from the local communities hence enhancing their income. GDC will sell power generated to Kenya Power and thus earn revenue thereby contribute to national income

6.14.3. Employment

Project activities will provide employment opportunities to the local especially in case of unskilled labor.

6.14.4. Institutional improvement

GDC has a clear and operational corporate social responsibility (CSR) policy which will benefit institutions such as schools and health facilities in the project area.

6.14.5. Tourism enhancement

Geothermal power plants within the Menengai Caldera will enhance the scenery and therefore increase local tourism. Educational tours will equally increase as the power plants provide unique training facilities in the area.

6.15. Environmental Benefits - Cleaner production and reduction of greenhouse gases

Geothermal energy is considered as green energy resource and as such generation of electricity from geothermal energy is an integrated cleaner production technology. The proposed project replaces use of fuel energy to generate electricity. The environmental benefits of the proposed project are realized in terms of reduction of greenhouse gas emissions hence contributing significantly to reduction of global climate change.

6.16. Impact on land use

The proposed project will be located in Menengai Caldera, which is a gazetted government forest reserve. As such there will be no displacement of settled communities. Further, geothermal exploration drilling is already on-going in the Caldera where power plants will be located. The proposed project fits in the ongoing activities and therefore change of user will not be needed for the proposed project. However, the way leave for power transmission lines will pass through individual farms. The width of land affected will normally depend on the magnitude of the transmission line voltage and for the case of 220 kV, the way leave width may range up to 40 m. Way leave ensures safety of the people living close to the transmission lines. GDC will ensure that people whose land is affected by way leave are compensated appropriately.

6.17. Impact on health

The influx of workers may increase pressure on local resources such as water and sanitation, which may lead outbreak of water borne disease namely dysentery, typhoid and diarrhea. Similarly, the influx of workers may also come with negative impacts such as promiscuity and sexually transmitted diseases and danger of increased upsurge in HIV and AIDS infections. Furthermore, negative health impacts that are associated with geothermal power generation include respiratory diseases, nausea and headaches due to inhalation of gases such as H_2S and ear defects due to noise to workers since communities are reasonably far. Although the level of H_2S level from geothermal plants is low and within acceptable occupational limits and thus of low health risks, the odour can be a nuisance. Installation of automated H_2S detectors within working spaces is necessary to mitigate potential impacts.

7. MITIGATION

IMPACT	MITIGATION
Noise and Vibrations	The following noise-suppression techniques shall be employed: Install portable barriers to shield noisy equipment where necessary. Turbine-generator buildings, shall be well-insulated acoustically, and equipped with noise absorptive interior walls. Use quiet equipment (i.e. equipment designed with noise control elements). Limit trucks and other small equipment to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible. Workers on-site will need to wear appropriate hearing protection as a necessary safety precaution to keep the environmental noise level below the 85 decibels (dB) occupational first action limit. In case of non-occupational, the noise level shall be kept within 45 dB ambient limit.
Chemical Pollution	Re-injection of spent geothermal fluid is recommended. If disposed of on the surface, it should be in lined ponds, to prevent infiltration and percolation into the ground water.
Increased Storm Water Runoff	Surface runoff and roof water shall be harvested and stored in underground reservoir for reuse. A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structures will be designed. In the project vicinity, create slab only where necessary and plant lawn grass in areas with no slab and of no use in project operations. Proponent will put measures that will include terracing and levelling the project site to reduce run-off velocity and increase infiltration of rain water into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off. Drainage channels along runoff paths outside project compound

	minimize possibility of gully erosion by creating check dams to reduce runoff erosive energy.
Waste Generation	Domestic liquid waste from the campsite and well drilling sites shall be treated on site in septic tanks since there are no sewer lines in the project area. Additional recommendations for minimization of solid waste especially during construction of the project include: Use of durable, long- lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste Separate and categorize solid wastes into different forms and reuse, recycle, incinerate or dispose of in carefully designated site(s) based on category. Oil absorbent material, traps and storage drums will be used to contain and control any minor releases of engine and other equipment oil.
Soil Erosion	The cleared sites need to be re-vegetated to improve soil cover and minimize soil erosion in addition to improving the aesthetics of the project area.
Water Quality Degradation	Several measures shall be put in place to mitigate the impacts that are likely to lead to water quality degradation. The proponent will: Prepare for emergency response program to ensure quick and safe cleanup of accidental spills. Oil absorbent material, traps and storage drums will be used to contain and control any minor releases of engine and other equipment oil. Identify areas where refueling and vehicle maintenance activities and storage of hazardous materials, if any, will be permitted. If excavation of hazardous materials is required, they will be handled in accordance with applicable regulations
Exhaust Emissions	During the construction the following mitigation measures are proposed: Daily monitoring of air quality standards is proposed; Workers shall be trained on management of air pollution from vehicles and machinery. All construction machinery shall be maintained and serviced in accordance with the manufacturers specifications; Workers shall be trained on dust minimization techniques; The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilized as soon as practically possible; Dust generating activities shall not be carried (excavation, handling and transport of soils) during times of strong winds. Vehicles delivering soil materials shall be covered to reduce spills and windblown dust; Vehicles speeds shall be limited to minimize the generation of dust on site and on diversion and access roads.
Air quality, & Dust Impacts	Water all active construction areas as and when necessary to lay dust. Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard. Pave or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites. Sweep daily (with physical sweepers) all paved access roads, parking areas and staging areas at construction sites. Plant fast-growing trees around the project area to act as a wind breaks to reduce the uplift of particulate matter that lead to respiratory diseases. Plant suitable lawn or ornamental grasses in all open grounds within the project area
Resource utilization Energy Consumption	The proponent shall ensure responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used. In addition, proper planning of transportation of materials will ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. Complementary to these measures, the proponent shall monitor energy use during construction and set targets for reduction of energy use.
Flora & Fauna impacts	Rehabilitation of cleared vegetation needs to be carried out. The constructional and project operational sites especially effluent dumping sites should be fenced off to avoid access by animals. This will also ensure that any disturbance to flora and fauna is restricted to the actual project area and avoid spillover

	effects on the neighboring areas. In the same vein, there will be strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works**.** Another important measure aimed at reducing disturbance of vegetation in the project area will be preservation of individual trees within the site. In addition, the proponent should re-vegetate disturbed areas through implementation of a well-designed landscaping program. It is recommended that part of the topsoil excavated from the construction site be re-spread in areas to be landscaped to enhance plant health. Wildlife should be kept off the construction and operation sites by fencing. The structures should be camouflaged to integrate with the natural environment to reduce visual intrusion. Besides, noise and vibrations should minimized to avoid scaring the animal from their habitats. This latter measure can help reduce human-wildlife conflict.
Resource utilization – water consumption	The proponent shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water wastage and to use water efficiently. The proponent will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps should be fixed promptly by qualified staff. Recycles of water in the cooling towers is highly encouraged to avoid over abstraction of water.
Impact on health	Possible exposure of workers to diseases from building materials at construction site shall be mitigated by occupational health and safety standards enforcement. Waterborne diseases such cholera, typhoid shall be minimized by provision of potable drinking water and proper sanitation and waste management. Proper refuse collection and handling service will be provided by the proponent so that this is not a hazard. HIV/AIDs will be reduced by awareness and sensitization programs with the Proponent‘s CSR policy
Impact on Education & other services	Local residents will be given priority in hiring people to minimize impacts on services such as schools and medical facilities.
Climate Change: emission of CO_2 & CH_4	Methane has the most impact on climate change and for the existing wells it was undetected in Menengai and it is continually monitored for further action in case it becomes a significant issue.
Ground Subsidence	In geothermal development, geothermal fluids withdrawal rate may surpass the natural rate of replenishment. Ultimately pressure drop in the reservoir as a result of fluid withdrawal could occur leading subsidence. In general, subsidence is greater in liquid-dominated fields because of the geological characteristics typically associated with each type of field. Ground subsidence can affect the stability of pipelines, drains, and well casings. It can also cause the formation of ponds and cracks in the ground and, if the site is close to a populated area, it can lead to instability of buildings. Fluid re-injection at proper rates and pressures reduces subsidence potential significantly.
Extraction and Use of Building Materials	To avoid landscape changes, displacement of animals and vegetation, poor visual quality and opening of depressions on the surface leading to several human and animal health hazards, quarry material will be sourced from existing sites that have a remediation plan. For new quarry sites, there would be used following ESIA process and approval by the authorities.
Impact on land use	GDC will ensure that people whose land is affected by way leave are compensated appropriately

8. ENVIRONMENTAL HAZARD MANAGEMENT

Most hazards associated with this project are with regard to occupational health and safety.

8.1. Geothermal Gases

Occupational exposure to geothermal gases, mainly hydrogen sulfide gas, may occur during non-routine release of geothermal fluids (for example, pipeline failures) and maintenance work in confined spaces such as pipelines, turbines, cellars, and condensers. The significance of the hydrogen sulfide hazard may vary depending on the location and geological formation particular to the facility. Where there is a potential for exposure to hazardous levels of hydrogen sulfide, geothermal power facilities should consider i) installation of hydrogen sulfide monitoring and warning systems; ii) Development of a contingency plan for hydrogen sulfide release events, including all necessary aspects from evacuation to resumption of normal operations; iii) provision of facility emergency response teams, and workers in locations with high risk of exposure, with personal hydrogen sulfide monitors, self-contained breathing apparatus and emergency oxygen supplies, and training in their safe and effective use; iv) provision of adequate ventilation of occupied buildings to avoid accumulation of hydrogen sulfide gas; v)

development and implementation of a confined space entry program for areas designated as _Confined Spaces‘ such as turbine, condenser, and cooling water towers; vi) providing workers with a fact sheet or other readily available information about the chemical composition of liquid and gaseous phases with an explanation of potential implications for human health and safety

There are no ambient air quality criteria for hydrogen sulphide currently in force in Kenya. As an interim measure it is suggested that the WHO 24-hour guideline should be used to assess impacts beyond the immediate power station boundary. The approach adopted here is to select criteria that protect human health, local crops and fauna, but will not protect all areas against an odour impact. The WHO (1987) provides useful guidance in this respect (for non-occupational exposure), where it states the following:

- 15mg/m3 (9.9 ppm) is recommended for lowest-adverse health effect of hydrogen sulphide
- A guideline value of 0.10 ppm (0.15mg/m3) with an averaging time of 24-hours
- To avoid odour annoyance among the exposed population, hydrogen sulphide concentrations should not be allowed to exceed 0.0046 ppm (7mg/ m3) , with a 30 minute averaging period
- Installation of a hydrogen sulfide gas monitoring network in the project area and continuous operation of the hydrogen sulfide gas monitoring systems to facilitate early detection and warning;
- Emergency planning involving community input to allow for effective response to monitoring system warnings.

8.2. Heat

Occupational exposure to heat occurs during construction activities, and during operation and maintenance of pipes, wells, and related hot equipment. Non-routine exposures include potential blowout accidents during drilling as well as malfunctions of the steam containments and transport installations.
Recommended prevention and control measures to address heat exposure include:
Reducing the time required for work in elevated temperature environments and ensuring access to drinking water;

- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.;
- Use of personal protective equipment (PPE) as appropriate, including insulated gloves and shoes.

8.3. Noise

Apart from noise from well drilling, noise sources in geothermal power generation facilities are associated with steam flashing and venting. Other sources include equipment related to pumping facilities, turbines, and temporary pipe flushing activities. Noise abatement technology includes the use of rock mufflers, sound insulation, and barriers during drilling, in addition to silencers on equipment in the steam processing facility. Occupational noise and vibration should be managed by the use of appropriate PPE.

8.4. Infrastructure Safety

Communities may be exposed to physical hazards associated with the wells and related pipeline networks. Hazards may result from contact with hot components, equipment failure, or the presence of active and abandoned well infrastructure which may generate confined space or falling hazards. Recommended management techniques to mitigate these impacts include:

- Placement of access deterrents, such as fences and warning signs, to prevent access and warn of existing hazards;
- Minimizing the length of necessary pipeline system is the case in the proposed modular power generation unit;
- Consideration of the feasibility of subsurface pipelines or heat shields to prevent public contact with hot geothermal pipelines;

- Managing closure of infrastructure such as pipelines and access roads, including: cleaning, disassembly, and removal of equipment.

9. MONITORING PROGRAM

Table 1: Construction Phase Environmental and Social Management Plan for the Proposed Project

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs. 000)
Minimize solid waste generation and ensure efficient solid waste management during construction				
Increased solid waste generation	Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling	Proponent & Contractor	Throughout constructio n period	1,000
	Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials	Proponent & Contractor	Continuous	0
	Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed of.	Proponent & Contractor	One-off	0
	Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects	Proponent & Contractor	One-off	8,000
	Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or homeowners.	Proponent & Contractor	One-off	0
	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time	Proponent & Contractor	Throughout constructio n period	To be based on type of use selected
	Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements	Proponent & Contractor	One-off	6,000
	Purchase of perishable construction materials such as paints should be done incrementally to ensure reduced spoilage of unused materials	Proponent& Contractor	Throughout constructio n period	0
	Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste	Proponent& Contractor	Throughout constructio n period	0
Increased solid waste generation	Use construction materials containing recycled content when possible and in accordance with accepted standards.	Proponent & Contractor	Throughout constructio n period	0
	Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site	Proponent & Contractor	Throughout constructio n period	0
	Dispose waste more responsibly by dumping at designated dumping sites or landfills only.	Proponent & Contractor	Throughout constructio n period	20,000
	Waste collection bins to be provided at designated points on site	Proponent& Contractor	Throughout constructio n period	85,000
	Private waste disposal company to be contracted to transport and dispose the solid waste from site	Proponent & Contractor	Throughout constructio n period	
	Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the	Proponent & Contractor	Throughout constructio	

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs. 000)
	solid waste		n period	
Reduce dust emissions				
Dust emission during construction of site infrastructure and transportation of machinery such as modular power generation equipment and their accessories	Ensure strict enforcement of on-site speed limit regulations	Proponent & Contractor	Throughout constructio n period	20,000
	Avoid excavation works in extremely dry weathers	Proponent & Contractor	Throughout constructio n period	
	Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles	Proponent& Contractor	Throughout constructio n period	
	Personal Protective equipment to be worn	Proponent	Throughout constructio n period	
Minimization of exhaust emissions				
Exhaust emission	Vehicle idling time shall be minimized	Proponent & Contractor	Throughout constructio n period	0
	Sensitize truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and to switch off or keep vehicle engines at these points	Proponent & Contractor	Throughout constructio n period	0
Minimization of noise and vibration				
Noise and vibration during construction and generation	Sensitize construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Proponent & Contractor	Throughout constructio n period	0
	Sensitize construction drivers to avoid running of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals	Proponent & Contractor	Throughout constructio n period	0
	Ensure that construction machinery are kept in good condition to reduce noise generation	Proponent & Contractor	Throughout constructio n period	3,000
	Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels	Proponent & Contractor	Throughout constructio n period	15,000
	Workers on-site will need to wear appropriate hearing protection as a necessary safety precaution	Proponent & Contractor	Throughout constructio n period	5,000
	The noisy construction works will entirely be planned to be during daytime when most of the neighbors will be at work	Proponent &Contractor	Throughout constructio n period	0
	Comply with the provisions of Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 regarding noise limits at the workplace	Proponent & Contractor	Throughout constructio n period	0
Minimization of energy consumption				
Increased energy consumption	Ensure electrical equipment, appliances and lights are switched off when not being used	Proponent & Contractor	Throughout constructio n period	0
	Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy	Proponent & Contractor	Throughout constructio n period	5,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs. 000)
	Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts	Proponent & Contractor	Throughout constructio n period	9,000
	Monitor energy use during construction and set targets for reduction of energy use.	Proponent & Contractor	Throughout constructio n period	940
Minimize water consumption and ensure more efficient and safe water use				
High water demand	Install water conserving taps that turn-off automatically when water is not being used	Proponent & Contractor	One-off	-
	Promote recycling and reuse of water as much as possible	Proponent & Contractor	Throughout constructio n period	5,500
	Install a discharge meter at water outlets to determine and monitor total water usage	Proponent & Contractor	One-off	300
	Promptly detect and repair of water pipe and tank leaks	Proponent & Contractor	Throughout constructio n period	5,500
	Sensitize staff to conserve water by avoiding unnecessary water use	Proponent & Contractor	Throughout constructio n period	2,500
	Provide for breathers along the pipeline to minimize pipe busts	Proponent & Contractor	Throughout constructio n period	2,500
Minimize release of liquid effluent				
Generation of wastewater	Provide means for handling sewage generated by construction workers	Proponent & Contractor	One-off	5,000
	Monitor spent geothermal fluids quality regularly to ensure that the stipulated discharge rules and standards are not violated	Proponent	Throughout constructio n period	2,000
	re-inject all geothermal fluids underground	Proponent	Throughout constructio n period	4,000
Minimize occupational health and safety risks				
Posting of abstract of Act, rules and notices	There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices as stipulated in section 121 of the OSHA, 2007.	Proponent & Contractor	One-off	2,500
Incidents, accidents and dangerous occurrences.	Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.	Proponent & Contractor	Throughout constructio n phase	4,000
	Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.	The Contractor, Proponent	Throughout constructio n phase	24,400
Insurance	Ensure that the premises are insured as per statutory requirements (third party and workman‘s compensation)	Proponent	Annually	-
Safety, health and environment (SHE) policy	Develop, document and display prominently an appropriate SHE policy for construction works	Proponent & Contractor	One-off	2,500
Health and safety committee	Provisions MUST be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented	Proponent & Contractor	One-off	5,500
Sanitary conveniences	Suitable, efficient, clean, and adequate sanitary conveniences should be provided for workers	Proponent & Contractor	One-off	5,000
Medical examination	Arrangements MUST be in place for the medical examination of all employees before, during and after termination of	Proponent & Contractor	Throughout constructio	500

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs. 000)
	employment		n phase	
Machinery/equipment safety	Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction and power generation do comply with the prescribed safety and health standards and be appropriately installed, maintained and safeguarded	Proponent & Contractor	One-off	5,000
	Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain	Proponent & Contractor	Throughout construction phase	3,000
	All machines and other moving parts of equipment MUST be enclosed or guarded to protect all workers from injury	Proponent	One-off	2,000
	Train and supervise workers regarding construction and power generation machinery and other procedures/operations	Proponent	Throughout construction phase	5,000
	Equipment such as fire extinguishers MUST be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued	Proponent	Throughout construction phase	500
	Reports of such examinations MUST be presented in prescribed forms, signed by the assessor and attached to the general register	Proponent	Throughout construction phase	30 per examination
Storage of materials	Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse	Proponent	Throughout construction phase	8,000
	Ensure that items are not stored/stacked against weak walls and partitions	Proponent	Throughout construction phase	_
Emergency preparedness and evacuation procedures	Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency	Proponent & Contractor	One-off	500
	Such procedures MUST be tested at regular intervals	Proponent & Contractor	Every 3 months	500
	Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers	Proponent & Contractor	One-off	18,000
	Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site	Proponent & Contractor	One-off	300
	Provide measures to deal with emergencies and accidents including adequate first aid arrangements	Proponent & Contractor	Throughout construction phase	2,500
First Aid	Well stocked first aid box which is easily available and accessible should be provided within the premises	Proponent & Contractor	One-off	5,800
	Provision MUST be made for persons to be trained in first aid, with a certificate issued by a recognized body.	Proponent & Contractor	One-off	10,000
Ensure the general safety and security of the site and surrounding areas				
Increased Pressure on Infrastructure	Coordinate with other planning goals and objectives for the region	Proponent& Contactor	Throughout construction phase	100,000
	Upgrade existing infrastructure and services, if and where feasible.	Proponent& Contactor	Throughout construction phase	
High socio-economic interest of the communities	Have a clear employment policy for the locals and implement it fairly to all neighboring communities	Proponent & GOK	Throughout construction phase	
	Allow access of the community to their grazing grounds and	Proponent &	Throughout	0

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs. 000)
	have regular consultations on matters pertains the grazing grounds and geothermal exploration interface	GOK	constructio n phase	
Insecurity	Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site.	Proponent & Kenya Police	Throughout constructio n phase	100,000
	Body-search the workers on entry, to avoid getting weapons on site, and leaving site to ensure nothing is stolen.	Proponent	Throughout constructio n phase	
	Ensure only authorized personnel get to the site	Proponent	Throughout constructio n phase	
Environmental monitoring of the project				
Environmental concern during the construction phase	Due to the magnitude of the project the proponent will monitor construction phase and ensure that the conditions of approval are adhered to.	Proponent, Contractor , NEMA and Environment Consultant	Throughout constructio n phase	20,000

Table 2: Operation Phase Environmental and Social Management Plan for the Proposed Project

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (KShs. 000)
Balance pressure of strata above geothermal aquifer				
Increased possibility of subsidence due to higher rate of steam extraction compared to rate of natural replenishment of fluids	Re-inject into the geothermal system spent geothermal liquids; Carry out regular geophysical monitoring to detect any changes related to subsidence in the project area and immediate environs	Proponent	At least twice per year	40,000/yr (assuming no hiring required for equipment)
Minimize solid waste generation and ensure efficient solid waste management during construction				
Increased solid waste generation	Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling	Proponent	Continuous	20,000
	Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or homeowners.	Proponent	One-off	0
	Dispose waste more responsibly by dumping at designated dumping sites or landfills only.	Proponent	Continuous	20,000
	Waste collection bins to be provided at designated points on site	Proponent	Continuous	85,000
	Private waste disposal company could be contracted to transport and dispose the solid waste from site	Proponent	Continuous	
	Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste	Proponent	Continuous	
Reduce dust emissions				
Dust emission during operation phase	Ensure strict enforcement of on-site speed limit regulations	Proponent	Continuous	200,000/yr
	Avoid excavation works in extremely dry weathers	Proponent	Continuous	

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (KShs. 000)
	Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles	Proponent	Continuous	
	Plant unused areas of site-compound with lawn or ornamental vegetation	Proponent	Continuous maintenance	
	Personal Protective equipment to be worn	Proponent	Continuous	
Minimization of exhaust emissions				
Exhaust emission	Vehicle idling time shall be minimized	Proponent	Continuous	0
	Equipment shall be properly tuned and maintained	Proponent	Continuous	100,000/yr
	Sensitize all resident and visiting drivers to avoid unnecessary racing of vehicle engines when in project site and its immediate environs.	Proponent	Continuous	0
Minimization of noise and vibration				
Noise and vibration during operation	Sensitize all vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Proponent	Continuous	0
	Sensitize all drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals	Proponent	Continuous	0
	Ensure that construction machinery are kept in good condition to reduce noise generation	Proponent	Continuous	23,000
	Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels	Proponent	Continuous	15,000
	Workers on-site will need to wear appropriate hearing protection as a necessary safety precaution Unpermitted persons and animals should be kept off the drilling and construction site by fencing off the site. Within the project area, keep noise level below the 85 decibels	Proponent	Continuous	50,000
	Comply with the provisions of Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 regarding noise limits at the workplace	Proponent	Continuous	0
Minimization of energy consumption				
Increased energy consumption	Ensure electrical equipment, appliances and lights are switched off when not being used	Proponent	Continuous	0
	Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy	Proponent	Continuous	5,800
	Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts	Proponent	Continuous	9,000
	Monitor energy use during operation and set targets for reduction of energy use.	Proponent	Continuous	940
Minimize water consumption and ensure more efficient and safe water use				
High water demand	Install water conserving taps that turn-off automatically when water is not being used	Proponent	One-off	-
	Promote recycling and reuse of water as much as possible	Proponent	Continuous	5,500

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (KShs. 000)
	Install a discharge meter at water outlets to determine and monitor total water usage	Proponent	One-off	300
	Promptly detect and repair of water pipe and tank leaks	Proponent	Continuous	5,500
	Sensitise staff to conserve water by avoiding unnecessary water use	Proponent	Continuous	2,500
	Provide for breathers along the pipeline to minimize pipe busts	Proponent	Continuous	2,500
Minimize release of liquid effluent				
Generation of wastewater	Provide means for handling sewage generated by site workers	Proponent	One-off	25,000
	Re-inject spent geothermal fluids back into the geothermal system.	Proponent	Continuous	10,000
	Potential for contamination of groundwater by re-injected fluids should be minimized by installation of leak-proof well casings in the injection wells	Proponent &Contractor	One-off	5,000
	Consider use of binary power generation technology that reuses rejected geothermal fluids	Proponent	Continuous	-
	Monitor geothermal effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated	Proponent	Continuous	2,000
Minimize occupational health and safety risks				
Posting of abstract of Act, rules and notices	There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices as stipulated in section 121 of the OSHA, 2007.	Proponent	One-off	2,500
Incidents, accidents and dangerous occurrences.	Ensure that provisions for reporting incidents, accidents and dangerous occurrences during operation phase using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.	Proponent	Continuous	24,000
	Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.	Proponent	Continuous	24,400
Insurance	Ensure that the premises are insured as per statutory requirements (third party and workman‘s compensation)	Proponent	Annually	-
Safety, health and environment (SHE) policy	Develop, document and display prominently an appropriate SHE policy for operation works	Proponent	One-off	2,500
Health and safety committee	Provisions MUST be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented	Proponent	One-off	5,500
Sanitary conveniences	Suitable, efficient, clean, and adequate sanitary conveniences should be provided for workers	Proponent	One-off	5,000
Medical examination	Arrangements MUST be in place for the medical examination of all employees before, during and after termination of employment	Proponent	Continuous	500
Machinery/equipment safety	Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction and power generation do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded	Proponent	One-off	5,000
	Ensure that equipment and work tasks are adapted to fit	Proponent	Continuous	3,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (KShs. 000)
	workers and their ability including protection against mental strain			
Machinery/equipment safety	All machines and other moving parts of equipment MUST be enclosed or guarded to protect all workers from injury	Proponent	One-off	2,000
	Train and supervise workers regarding construction and power generation machinery and other procedures/operations	Proponent	Continuous	5,000
	Equipment such as fire extinguishers MUST be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued	Proponent	Continuous	500
	Reports of such examinations MUST be presented in prescribed forms, signed by the assessor and attached to the general register	Proponent	Continuous	30
Storage of materials	Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency	Proponent	One-off	500
	Such procedures MUST be tested at regular intervals	Proponent	Every 3 months	500
	Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers	Proponent	One-off	18,000
	Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site	Proponent	One-off	300
	Provide measures to deal with emergencies and accidents including adequate first aid arrangements	Proponent	Continuous	2,500
First Aid	Well stocked first aid box which is easily available and accessible should be provided within the premises	Proponent	One-off	5,800
	Provision MUST be made for persons to be trained in first aid, with a certificate issued by a recognized body.	Proponent	One-off	10,000
Ensure the general safety and security of the site and surrounding areas				
Increased Pressure on Infrastructure	Coordinate with other planning goals and objectives for the region	Proponent	Continuous	10,000
	Upgrade existing infrastructure and services, if and where feasible.	Proponent	Continuous	
High socio-economic interest of the communities	Have a clear employment policy for the locals and implement it fairly to all neighboring communities	Proponent & GOK	Continuous	
	Allow access of the community to their grazing grounds and have regular consultations on matters pertains the grazing grounds and geothermal exploration interface	Proponent, & community representatives	Continuous	0
Insecurity	Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site.	Proponent	Continuous	15,000
	Body-search the workers on entry, to avoid getting weapons on site, and leaving site to ensure nothing is stolen.	Proponent	Continuous	
	Ensure only authorized personnel get to the site	Proponent	Continuous	
Environmental monitoring of the project				
Environmental concern during the	Due to the magnitude of the project the proponent will monitor construction phase and ensure that the	Proponent, NEMA	Continuous	20,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (KShs. 000)
construction phase	conditions of approval are adhered to.			

Table 3: Environmental Management Plan for the Decommissioning Phase

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
1. Demolition waste management				
Demolition waste	Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling.	Proponent & Contractor	Once-off	30,000
	All buildings, machinery, equipment, structures and partitions that will not be used for other purposes MUST be removed and recycled/reused as far as possible	Proponent & Contractor	Once-off	20,000
	All foundations MUST be removed and recycled, reused or disposed of at a licensed disposal site	Proponent & Contractor	Once-off	25,000
	Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site	Proponent & Contractor	Once-off	0
	Donate reusable demolition waste to charitable organizations, individuals and institutions	Proponent & Contractor	Once-off	0
Dismantling of modular power generation equipment and accessories	The wells external parts should remove up to the ground level and disposed of as any other scrap metals for recycling.	Proponent	Once-off	10,000
	The well pad should be loosened and levelled with top soils	Proponent, & Contractor	Once-off	5,000
2. Rehabilitation of project site				
Site degradation	Implement an appropriate landscaping and re-vegetation program to restore the site to its original status. Consider use of indigenous plant species in re-vegetation	Proponent, & Contractor	Once-off	12,000
	Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent area and the development.	Proponent & Contractor	Once-off	0

10. PUBLIC CONSULTATIONS AND PUBLIC DISCLOSURE

During the ESIA process the consultants held meetings and interacted with local people, provincial administration, NGOs/CBOs, and other groups represented such as women, youth, church leaders and health workers. This allowed for a greater understanding of the communities leadership, characteristics, and expectations and whether they approved of the implementation of the project.

10.1 Public Participation Process and Outcomes

The public participation process began with stakeholder identification, followed by stakeholder engagement using various methods and ended with data analysis and interpretation.

10.2 Stakeholder Identification

The proposed project affects a wide variety of stakeholders including the general public. The main stakeholders identified are: the local community, administrative representatives of people in the greater project area, key government agencies and NGOs.

10.3 Stakeholder Engagement

The public participation exercise involved administration of questionnaires, stakeholder meetings at - in location and Kabarak (GDC plot) in Rongai division. During this exercise the local people were informed of the proposed project and they freely expressed their interests and concerns, which were collected and documented. The knowledge and experience of the local people is pertinent in impact identification. High priority is given to the concerns of the local people in the project implementation process.

10.4 Outcomes and Expectations

The distribution of the respondent's age group was representative of the main active groups. The results suggest that marriage starts at the age group 21 – 30 years and therefore any benefits to the local community will go to the families rather than individuals. Majority (58 %) of the respondents were farmers, which explains the source of livelihood for the community. About 70% of the farmers own up to 2 acres of land, t*hus concerns were raised that the installation of the modular power plant should not cause any adverse effects to the farms and crops.* Farming is supplemented by other economic activities which include illegal charcoal burning, quarrying, tourism, site hunting, wood logging, and grass harvesting. The main sources of water to the residents are harvested rain water (44%) and piped water (38%). About 11% of the respondents rely on borehole and dam water hence concerns that the *project activities should thus take precaution against pollution of both surface and ground water were raised.*

With regard to awareness of the process of geothermal power generation project implementation and operation processes, all the 131 respondents said they expected benefits and problems related to the geothermal power project's implementation. Key issues raised by the public and leaders in the project area were: air and water pollution, relocation of people, human illnesses, reduced crop production, vegetation clearance, noise pollution, acid rain, reduced rain all, bad odor, fear of volcanic eruption, employment of outsiders, prostitution increases and human-wildlife conflicts. The recognized positive impacts were: job creation, access roads, power supply, water supply, raised property/land value, tourist attraction, enhanced agriculture, boost business, building of health center, reduced power bill, afforestation, building of schools, boost security. These issues were classified as concerns, representing identified negative impacts and expectations, which represented the perceived positive project impacts.

The main strategies proposed by the public were improved water and pollution control (27%), disaster preparedness and infectious disease surveillance (25% each) and sanitation programs (23%). With regard to project acceptance, ninety eight (98%) per cent of respondents recommended implementation of the geothermal power project.

11. COMPLEMENTARY INITIATIVES

11.1. The proposed project will be located in Menengai Caldera, which is a gazette government forest reserve. As such there will be no displacement of settled communities. However, the way leave for power transmission lines will pass through individual farms. *Therefore, GDC will ensure that people whose land is affected by way leave are compensated appropriately by putting in place a*

compensation plan. GDCs will equally complement the project with HIV/AIDS awareness and sensitization programs with GDC's CSR policy.

12 CONCLUSION

12.1. Based on the findings of the ESIA, the proposed project is determined to be feasible as planned. However, like in any other project, the project is bound to have both social and environmental impacts, negative and positive. The ESIA concludes that the positive impacts outweigh negative ones as most of the potential negative impacts identified can be mitigated. Mitigation measures for such negative impacts have been addressed in the ESIA. Furthermore, it is envisaged that the developed ESMPs will enable the GDC to manage or mitigate any negative environmental and social impacts.

12.2. Covenants to be include in the loan condition shall include:

- GDC must put in place a comprehensive OHS management system applicable to employees, subcontractors and the community;
- GDC must compile a detailed surveillance and monitoring schedule for both environment and social activities for each project phase.

12.3. While this transaction is a public sector transaction, it will be disclosed for 60 days as precedence has been set with the PRG for Turkana wind project in 2013 where disclosure was allowed for 60 days on the basis that the IPP's are private companies.

13. REFERENCES AND CONTACTS

13.1. References

Gelas Muse et al "ESIA-Proposed Menengai Modular Geothermal Power Plants" September 2013.

13.2. Contacts

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