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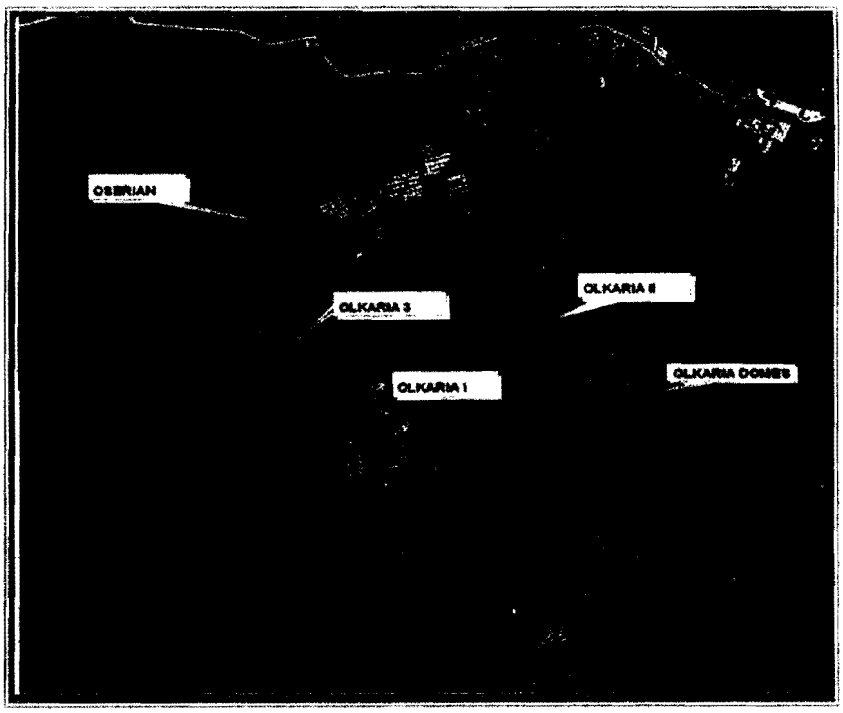
KenGen
Kenya Electricity Generating Company Ltd.

OLKARIA IV (DOMES) GEOTHERMAL PROJECT IN NAIVASHA DISTRICT



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT

DECEMBER 2009

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

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EXECUTIVE SUMMARY

E1 Introduction

Kenya Electricity Generating Company (KenGen) has carried out, since 1980, extensive geothermal exploration, drilling of wells and production of electricity in the Olkaria volcanic complex located in the Kenya Rift Valley, about 120km from Nairobi.

At present, the Olkaria area supports three geothermal plants (Olkaria I, II, and III) that generate electricity from the geothermal resources of the area. The Olkaria geothermal field has now been subdivided into four blocks that include:

- Olkaria East (Olkaria I);
- Olkaria Northeast (Olkaria II);
- Olkaria West (Olkaria III);
- Olkaria Domes (Olkaria IV).

Olkaria East production field supplies steam to the 45 (15X3) MWe Olkaria I power plant while Olkaria Northeast field provides steam to a 70 (2X35) MWe Olkaria II power plant and an additional Unit 3 is under construction. The two power plants are owned by Kenya Electricity Generating Company Limited (KenGen). An Independent Power Producer (IPP), Orpower owns Olkaria III power plant that currently produces 48 MWe.

Olkaria Domes (Olkaria IV) is earmarked for a 140 (2x70) MWe power plant and several exploration wells have already been drilled for this purpose. KenGen has now developed plans to increase geothermal power production in the area under the Least Cost Power Development Plan. This will be achieved by optimizing the current potential in Olkaria I and II and the establishment of Olkaria IV.

In compliance with Kenya's Environmental Impact Assessment (EIA) process, as outlined in the Environmental Management and Co-ordination Act (EMCA) 1999, KenGen completed and submitted an *Environmental Project Report* for the proposed project to NEMA in August and September 2009 respectively. KenGen subsequently prepared and submitted to NEMA the Terms of Reference (ToR) for the full ESIA study for approval leading to the preparation of this report.

Project Description

The proposed power generation system and plant configuration have a conceptual design similar to those of the recently constructed Olkaria II Power Plant. The proposed project involves the construction of a power plant and associated infrastructure such as the cooling tower, steam gathering system, switchyard and transmission line.

The proposed plant site for Olkaria IV is on privately owned land belonging to Kedong Ranch. The plant system will be a single flash condensing type (steam flash).

Project Location

The Olkaria IV Domes Geothermal Field is located about 120km Northwest of Nairobi. Administratively, the project is located within Hells Gate location, Central division of newly created Naivasha district (hived from the former Nakuru District) in the Rift valley Province of Kenya. It is one of the seven sectors of the Greater Olkaria geothermal area (GOGA) located in the central part of the Kenya Rift Valley located 6km to the south of Lake Naivasha.

Methodology

This ESIA Report has been prepared in accordance with the Environmental (Impact Assessment and Audit) Regulations of 2003. It is also guided by the World Bank's requirements for industrial projects and IFC's EHS Guidelines for Geothermal Projects.

The study methodology comprised the following activities:

- Preliminary meetings;
- Data collection and Document review;
- Site inspection and discussions with site personnel;
- Air and Noise Dispersion Modelling;
- Ecological Assessment;
- Social Impact Assessment;
- Community Resources Mapping;
- Meetings with stakeholders;
- Public Consultation;
- Data Analysis;
- Reporting.

The ESIA Report has confined itself to the construction of Olkaria IV and associated infrastructure, although where necessary, issues that have implications on both existing Olkaria I and Olkaria II stations and the proposed Olkaria I Unit 4 and 5 have been examined.

E2 Legislative and Administrative framework

According to section 58 (1) of the Kenya Government's *Environmental Management Coordination Act (EMCA), Number 8 of 1999* the proposed construction of *Olkaria I unit 4 and 5 Geothermal Power Station* project falls under the prescribed list of projects for which environmental impact assessment is mandatory, prior to implementation *(Second Schedule, page 174 of EMCA No.10 electrical infrastructure section (a) electrical generation stations).*

The EMCA has led to the setting up of various Regulations and Guidelines relevant to the project which include the following:

- *Environmental Impact Assessment and Audit Regulations 2003;*
- *Environmental Management and Co-ordination (Waste Management) Regulations 2006;*
- *Environmental Management and Coordination, (Water Quality) Regulations 2006;*
- *Environmental Management and Coordination, Conservation of Biological Diversity (BD) Regulations 2006;*
- *Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations 2006;*
- *Environmental Management and Coordination (Controlled Substances) Regulations 2007;*
- *Environmental Management and Coordination (Wetlands, Riverbanks, Lake Shores and Sea Shore Management) Regulations 2009;*
- *Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations, 2009.*

Other sectoral legislation relevant to the Project includes:

- *Energy Act No. 12 of 2006;*
- *Geothermal Resources Act;*
- *Occupational Health and Safety Act;*
- *Water Act 2002;*
- *The Wildlife (Conservation and Management) Act;*
- *The Fisheries Act;*
- *Local Government Act Chapter 265 (Revised 1998);*

- *The Physical Planning Act Chapter 286;*
- *The Land Acquisition Act Chapter 295;*
- *Registered Land Act Chapter 300;*
- *The Survey Act;*
- *The Tourist Industry Licensing Act.*

The International Guidelines relevant to the project that have been discussed in the report include:

- *World Bank Environmental Assessment Policies and Procedures and relevant Safeguard Policies;*
- *Japan Bank for International Cooperation (JBIC) and JICA Guidelines;*
- *IFC Performance Standards;*
- *African Development Bank (AfDB) Policies.*

According to the International Guidelines the Project has been classified as Category A or Category 1 requiring Full Environmental and Social Impact Assessment Study.

KenGen's Environmental Management Systems

KenGen has established Environmental Management as an integral component of its business planning since the company was established. To meet all the basic environmentally sound and socially acceptable practices at the local and international level, the company initiated the implementation of ISO 14001:2004 standards. Through the EMS system, KenGen has identified and documented its significant environmental aspects and impacts on the environment and set in place interventions to manage these aspects.

KenGen has further articulated its commitment in environmental management to the public and its stakeholders through an Environmental Policy Statement, which is also aligned with its vision and mission statements. The environmental policy statement commits the organisation to compliance with applicable laws and regulations, prevention of pollution, continuous improvement and accountability to the internal and external stakeholders and the public at large.

To successfully sustain the good environmental management practices, KenGen has a fully fledged Environmental and Social Department at Olkaria to undertake the implementation of environmental and social management plans of the existing Olkaria I and Olkaria II Power Plants and carry out monitoring of various parameters.

E3 Description of the Project Environment

Climate

The climatic features in the Rift Valley, including the project area, are closely related to the altitudinal changes and variations induced by the local topography. The floor of the Rift Valley experiences higher temperatures than the highlands. At Naivasha (1,829m above sea level) the mean monthly temperatures recorded range from 15.9-17.8^{0}C with a mean of 16.8^{0}C. The mean monthly temperatures in Naivasha town range from 24.6 – 28.3^{0}C.

Air quality

The geothermal power stations assessed in this study operate by collecting steam from the geothermal fields. The steam is used to drive turbines which generate the electrical energy in a similar way that a coal-fired power station would. The used steam is discharged as liquid water and vapour. The water vapour is harmless in the atmosphere, but associated with the steam are non-condensable gases including carbon dioxide (CO_2), methane (CH_4) and hydrogen sulphide (H_2S). The CO_2 and CH_4 do not pose a threat to ambient air quality, although they are, along with water vapour, greenhouse gases, but H_2S can be toxic at sufficiently high concentrations.

There are no ambient air quality standards for hydrogen sulphide currently in force in Kenya. The study has adopted WHO guidelines and standards. According to the guidelines, 24-hour average concentrations should not be permitted to exceed 0.10ppm (0.15 mg/m^3), beyond the immediate power station boundary.

Hydrogen sulphide concentrations are monitored by KenGen in and around the Olkaria I and II power stations using manually operated samplers. Twelve sites are monitored at Olkaria I since 1997 and six sites are monitored at Olkaria II since 2003.

The objective of these monitoring programs is to monitor occupational health exposures rather than environmental conditions, but the data provide some guidance as to the maximum levels that are likely to arise in the environment close to the power stations and give some "spot" samples of condition in more remote areas for example at the Lake View and Lake Side residential areas. The observations relate to average concentrations over a few minutes and are all made during the day.

Some of these sites are in locations that could reasonably be classed as accessible to the public or at least representative of this area, e.g. KWS Gate, Lake Side, Lake View and the well sites (OW 10 and OW22). Most of the locations record low concentrations, at the well sites as would be expected, the odour threshold 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.

Noise quality

The geothermal power stations assessed in this study generate noise from many sources which can be aggregated into two main sources; the cooling towers and the plant or building housing the turbines.

In addition, geothermal projects involve two other potentially significant sources of noise, namely; construction of drill pads and drilling and testing of wells prior to converting them to production wells. While these latter operations are temporary (lasting for months to a period of around a year) they are potentially significant.

Noise data monitoring is carried out on a weekly basis at Olkaria. Data collected between, January 2005 – June 2009 were analysed for both Olkaria I and II.

Kenyan standards as prescribed by the Environment Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 require night time maximum permissible levels of 35 dB(A) (LAeq-10h) for commercial areas, residential areas and silent zones.

Lake Naivasha Basin

Lake Naivasha is a shallow basin lake, situated 80Km northwest of Nairobi in the Kenyan Rift Valley. The name Naivasha comes from the Maasai *"e-naiposha"*, meaning approximately " *that which is heaving that which flows to and fro'*. The lake contains freshwater supporting a rich ecosystem, with hundreds of bird species, papyrus fringes filled with hippos, riparian grass lands where waterbuck, giraffe, zebra and various antelopes graze, dense patches of riparian acacia forest with buffaloes, bushbuck and other creatures, beautiful swampy areas where waterfowl breed and feed and, at the same time, magnificent views of the nearby volcanoes. Local fishermen depend on the lake for fish and crayfish.

Although the lake is situated in a semi-arid zone, after the rainy seasons, the fragile soils of the surrounding hills and the valley bottom produce grass where the pastoral Maasai bring their herds for dry-weather grazing, thereby depending on the lake and its various watering points.

Soils

The soils of the project area differ widely in depth, texture and chemical properties mainly due to the local geology of the area. Lithologically soils of Naivasha area can be broadly classified into two broad categories including the soils developed on volcanic rock materials and soils developed on lake bed sediments. The former soils are mainly derived from mixed assemblage of acid and basic lavas while the lake sediments are composed of a mixture of volcanic ash, reworked volcanic material and autochthonous organic matter. Along the south eastern shore of Lake Naivasha, diatomite up to 1-2 metres thick is present while in the north and north –eastern shores, silts, clays and recent deposits are common *(Thompson and Dodson 1963).*

Geology

Olkaria volcanic complex is characterized by comendite lava flows and pyroclastics on the surface and basalts, trachytes, and tuffs in the subsurface. The litho-stratigraphy of the Olkaria geothermal area as revealed by data from geothermal wells and regional geology can be divided into six main groups: Proterozoic "basement" formations, Pre-Mau Volcanics, Mau Tuffs, Plateau Trachytes, Olkaria Basalt and Upper Olkaria volcanics.

Topography

The area is bounded to the west by the Mau Escarpment (3080m asl) and the Eburru volcanic pile, to the south east by the Longonot Mountain, to the east by the Kinangop Plateau and to the north and north east by Nyandarua (Aberdare) Range (3900 m asl).

Flora

The Olkaria IV (Domes) area and the entire Hells gate National Park is composed of trees that are up to 20m in height, whether open continues canopy or not. The area is mainly covered by *Tarconanthus camphoratus* and *Acacia xanthophloea* trees mainly standing up to 35m tall. A few of the areas and mainly where the water table is high have some *Acacia drepanolobium.* The woodland vegetation in the project area is a rare feature. In this community, patches of *Setaria sphacelata* appear towards the sloppy grounds. Many of the spaces in this community are occupied by *Aristida, Eragrostis cilianensis along with Tragus berteronianus.*

Fauna species

The area and other environments around it support twenty three species of mammals such as small mammals, large herbivores, and a host of small herbivores. Most common animals include the Eland, Steinbuck, Klipspringer, Water buck, Zebra (*Equus burchelli*), Kongoni (*Acelaphus buselaphus*), Gazelles *(Gazella thomsonii* and *Gazella grantii*), Impala (*Aecpyceros melampus*), dik dik (*Rhyncotragus kirkii*), African giraffe (*Giraffa camelpardis*) and African buffalo (*Syncerus caffer*) among others. The Jackal, Olive baboon, Rock hyrax, Hedgehog, Aardvark and leopard are also common species found in the Hells Gate environment.

Avifauna species

Due to its proximity to Lake Naivasha, the project area has a variety of Avifauna, some of which are threatened. This however is not being treated as stand alone, and is related to the entire Hells Gate National Park, Mt Longonot National Park and the adjacent ranches. To date one hundred and eight species of birds recorded in the area. A 1992 census of birds in this area recoded similar numbers. The cliffs and gorges found in the park are important breeding grounds of some of the bird species including the vultures and swifts.

Social Environment

The power station development area lies in privately owned Kedong Akira Ranch, adjacent to Hell's Gate National Park, which was gazetted in 1984, three years after the East Olkaria Power Station commenced operation.

The proposed site of the Olkaria Domes Power Station lies approximately 3.3 km south east of the existing of Olkaria I Power Station. The southern boundary of the closest flower farm (Oserian) is approximately 5.2 km to the north-northeast of the proposed power station site. The Lake is approximately 5.3 km to the north and Naivasha Town is approximately 22km to the north-northeast.

The primary impact area, for the purposes of the Olkaria socio-economic assessment, is the Hell's Gate National Park and the villages around the domes field. This area is consistent with the anticipated envelope of potential physical impact, due to changes in air quality, noise quality and obstructions from the project constructions.

The secondary impact area includes those areas where the direct workforce and immediate suppliers of indirect labour (both for construction and operation) could reasonably be expected to commute on a daily basis. This includes market centres like Kamere, DCK, Kongoni and Karagita, Ndabibi, Moi Ndabi and Malella.

Cultural Environment

The cultural environment of the project site is mainly influenced by the Maasai Community living in the project area. They are pastoralists and keep cows, goats and sheep as the main source of their livelihood. The settlers graze the vast terrain as this has provided pasture for their animals from time immemorial. The Maasais have lived on this land for as long as many of them can remember. The Maasais have a unique land tenure system and have permanent residential places known as *"Embarnat"* and live in large communities. However, should these permanent locations dry up such that there is no enough pasture for the animals to graze on, some of the Maasai community will move out of the *"Embarnat"* in search of pasture elsewhere temporarily for as long as a year or so only to come back when animal pasture is restored in their previous grazing grounds. The temporary nomadic residences are known as *Ilgobori or Emuate.*

E4 Project components

The process of generating geothermal electricity at the Olkaria IV will be exactly the same as that for the existing Olkaria II power plant.

The main constituents of geothermal fluids are geothermal steam and a small quantity of geogas (comprising carbon dioxide, hydrogen sulphide, oxygen, nitrogen and methane). Geothermal steam will be used to drive two 70 MW turbines, and is therefore the main raw material.

Three main waste products will result from the process:

- Brine, which is separated from the steam at the production wells;
- Condensate, which will be produced when the steam passes over the turbine;
- Non condensable gases, which will be released through the cooling towers.

Geothermal wells will be drilled to provide steam for the process. The physical structures to be constructed comprise a new power station, cooling tower block, steam gathering system, a switchyard and a transmission line.

Activities during operation will be the same as for Olkaria II, namely operation and maintenance of the plant and associated infrastructure.

E5 Project alternatives and technologies

There are three geothermal power plant technologies being used to convert hydrothermal

fluids to electricity. The conversion technologies are dry steam, flash, and binary cycle. The type of conversion used depends on the state of the fluid (whether steam or water) and its temperature. The proposed Power Station will use flash steam technology.

E6 Public consultation and disclosure

The most important social issues within the project area touch on impacts of Olkaria I and II on the labour force and job creation, and the interaction of the Power Stations with the labour force in the flower industry in the surrounding farms and the local communities, in particular the Maasai.

Stakeholders Consulted

Consultative Meetings at district and local levels included discussions with the provincial administration, village elders, KenGen staff, specialists and key informants were done. The consultations included:

- Direct, Personal Interviews with selected informants.
- At least four Focus Group Meetings with authorities and technical personnel (Districts Heads of Department in Naivasha and local administration right from the DC to the Village Heads).
- At least five Public Meetings in the project area.
- Stakeholder's workshop held on 21 October 2009 to present the results of the ESIA Study.

No	Venue	Date	Participants
1	KenGen	10/9/09	• KENGEN staff • GIBB ESIA team
2	Naivasha District Commissioner's Offices	12/9/09	• District Commissioner • KENGEN staff • GIBB ESIA team
3	Simba Lodge Naivasha.	14/9/09	• District Commissioner • Village Elders from manyattas in project area • KENGEN staff • GIBB ESIA team
4	Naivasha District	17/9/09	• District Government Agency Officers
5	Naivasha District	17/9/09	• District Officers, Chiefs and Sub-chiefs
6	Kamere Centre	23/9/09	• 72 villagers including chief
7	Cultural Centre	28/9/09	• Residents of Manyattas in the proposed project area.
8	Ndabibi Location	29/9/09	• 72 villagers including chief and area counsellor
9	Maiella	30/9/09	• 189 villagers including chief
10	Moi Ndabi	30/9/09	• 44 villagers including chief
11	Simba Lodge Naivasha.	21/10/09	• District Commissioner • Village Elders from manyattas in project area • KENGEN staff • District Officers, Chiefs and Sub-chiefs • Other Stakeholders

Project Affected Persons (PAPS) and Project Beneficiaries

Over and above establishment of the PAPs socio-economic environment, the census questionnaire was also designed to get the comments of the PAPs on the project. Copies of the responses are presented in Appendix 3 of this Report.

Results of the Consultation

Acceptance of the project

A good number (99%) of the respondent admitted that they were aware of the project and the activities under the Project. The information had been disseminated through KenGen officials and some mentioned that already the project has been started by drilling the exploration wells meant for the project within the area.

Identification of PAPS

During the public consultation and social assessment, the people living within the project area and are likely to be resettled were identified.

Land acquisition and expropriation

All the respondents expressed fears of the KenGen's ability to expropriate people given previous experience where the local community were forcibly removed from the land without compensation and without due consideration of the historical problems they have faced. They also expressed their fears on embezzling funds meant for the exercise. When it comes to law enforcement in some cases of expropriation, there is still a worrying slowness in monitoring and evaluation of the enforcement measures.

Problem of social integration of family members

The majority of those interviewed (80%) said that the expropriation and relocation of persons to a new site means that the members of the relocated family must be socially integrated in the new community. Indeed, people can live with a new community that does not have the same social organisation as the one they are coming from. Children and vulnerable people can undergo socio-behavioural shock due to this shift in environment.

Land ownership

During community consultation and at public meeting held in Cultural Centre which included the residences of Olo Maiyana, Olo Sinyat, Olo Nongot, Cultural Centre and Narasha, and at meeting held in Maiella. It was clear that there is conflict of land ownership between the Maasai Community living within the project area and Kedong Ranch Ltd. The Land L.R. No.8396 is a large parcel covering some 75,769 acres of land being a leasehold title for a term of 999 years from 1st May 1950 and registered in the name of Kedong ranch Ltd. At the same time, the Maasai community has a claim on this land by virtue of having lived and used the land for a long period of time thereby having an interest in the form of *"Embamat"* – permanent residence. Part of this land would need to be acquired for the purpose of development Olkaria IV power station.

There was also conflict of land ownership *L.R No.8398/2* between the Maasai community and Ngatta Farmers Co-operative Society Ltd. This is part of the land occupied by the Ole Mayana Village presently.

E7 Environmental and social impacts and mitigation measures

Impact Identification

The study has predicted and evaluated anticipated impacts using acceptable standard methods of impact prediction and evaluation. Constant reference to a checklist of project activities was made and scores were assigned in an assessment table in order to make an objective assessment of how each of the project activities would impact on a particular environmental and social medium.

The significance of impacts is subjective, but the value judgments required were best arrived at by consensus. The study team used several approaches such as brainstorming and use of

checklists and matrices, to identify the main sources and establish the potential impacts from the proposed main project activities.

Public participation and consultation with a wide sector of the community were conducted to reduce uncertainty.

Impact assessment scoring

The impacts were evaluated using the parameters of magnitude, significance, probability and duration of occurrence. Evaluation of the identified impacts was guided by careful assessment and judgment of anticipated consequences with regard to set standards or pre-development environmental situation of the site.

Project activities in the Olkaria IV Domes area will involve construction of power station and related facilities. The impacts generated from these works therefore, will generally be incremental in nature.

Positive Impacts

The proposed project will have significant positive impacts when compared to other forms of power production especially thermal power which involves the burning of fossil fuel. The major positive impacts of the project will include:

- Stabilization of electricity in Kenya,
- Reduction of costs of electricity and hence costs of business;
- Promotion of economic growth in the country,
- Contribution to the Government revenue,
- Increased employment,
- Improvement of roads and
- Extension of corporate social responsibility in the project area.

In addition the proposed project is likely to have the potential for carbon trade among other positive benefits.

Negative Impacts

The proposed project will have adverse impacts which will need to be mitigated. The major negative impacts of the project discussed in this report will include:

- Land acquisition and Resettlement,
- Impact on Flora,
- Loss of migratory corridors,
- Loss of habitat,
- Soil erosion,
- Degradation of the cultural values and norms in the area,
- Increase in the levels of crime of the area,
- Degradation of air quality.

The impacts are summarised below:

Land acquisition and expropriation

The proposed Olkaria IV power plant is located on privately owned land belonging to Kedong Ranch. There are also Maasai villages / settlements within the land area (1461 Ha) designated for the project. These villages are:

- Olo Nongot;
- Olo Sinyat;
- Cultural Centre.

For the project to be realised, the villages will need to be relocated. A Resettlement and Compensation Plan is being drawn up separately for this aspect.

Impact on Air Quality

The proposed development will have no impact on the local climate; however geothermal power stations emit insignificant amounts methane and carbon dioxide which are both greenhouse gases.

There are no ambient air quality criteria for hydrogen sulphide currently in force in Kenya. However, World Health Organisations (W.H.O) standards have been applied in this report, and shows that the operations are within the acceptable limits.

From the results of the air dispersion modelling studies, it is notable that the new Olkaria IV power plant which will discharge the H_2S through the cooling tower emission provide much greater plume rise and much better dispersion. Thus the 70 MW plant will create less impact (due to H_2S emissions) than does the original 45 MW Olkaria 1 Power Station. The incremental impact is minimal.

The air quality modelling has been done based on the existing power stations and anticipated stations. The results indicate there is going to be effects of hydrogen sulphide (odour nuisance and possible health effects due to exposure to 0.1ppm H_2S) to the communities living in the following villages:

- Olo Nongot;
- Olo Sinyat;
- Cultural Centre.

The detection of H_2S odour depends on short-term concentrations of a few seconds exceeding the odour threshold. The detection of odour would not normally be sufficient grounds to prevent a development or to require mitigation to be undertaken.

Impact on Noise and Vibration

Noise impacts have been assessed using a noise prediction model to estimate noise levels that will occur in the neighbourhood of the power station and well field during the well testing phase and during operation of the power station. The predicted cumulative noise levels have been presented as contour plots showing the "maximum" predicted noise levels over the area of interest.

From the results of the noise dispersion modelling studies, it is notable that Olkaria IV power plant will impact the following villages;

- Olo Nongot;
- Olo Sinyat;
- Cultural Centre.

The noise modelling studies for the project recommended that all settlements outside the 35dB (A) (LAeq-10h) contour should be relocated as this land will be exposed to noise levels above the acceptable noise limits and there is no other cost effective practical mitigation measure.

Impact on Lake Naivasha

The single source for all water abstraction around the project area is Lake Naivasha. This includes direct water abstraction by the geothermal operations for drilling and housing estate. Other water abstraction is for irrigation purposes.

Historically, water-levels at Lake Naivasha fluctuate significantly and it is likely that they will continue to do so. Lake Naivasha has no surface outlet, with the natural water level changes over the last 100 years being more than 12 meters. The water level can change several

meters within just a few months, causing a shift of the shoreline of several kilometres. For instance, available data shows that the lowest recorded lake level was in 1971 at 1881.6 m asl. Whereas in 2009 the lake level is at 1884.2m asl. These dynamics add an extra dimension to the riparian ecosystem, as well as complicating the water resource management issues.

The amount of lake water drawn by the existing geothermal project and the proposed development has been shown to be a small proportion of the total amount of water abstracted. In 2000, KenGen abstracted an estimated 919,840m^3 of water, and this rate declined until the year 2008 when the abstraction rate increased up to 1,300,620 m^3. The increase in the abstraction rate in the year 2008 was due to the increased drilling activities during that year.

Under normal circumstances otherwise, when no drilling is going on, the average water pumped from Lake Naivasha is approximately 1400m^3 per day. The Olkaria IV will require 2500 m^3 of fresh water at start up. Thereafter for about three years, only a very small quantity of water is necessary for topping up. The estimated total water abstractions from the lake for irrigation purposes is 64,000,000m^3 per year. On its own therefore it is unlikely that the expansion of the geothermal projects will significantly affect the lake level.

It is important to consider that over the expected 30-year life of the proposed power station, there are likely to be periods when the lake level will be very low. KenGen should therefore not rely on the lake as a source of water for the entire life of the power plant. Contingency plans should be made for alternative water sources for drilling and domestic purposes.

Impacts on flora and fauna

Vegetation will have to be cleared at the proposed site, as well as along the new steamline routes. Installation of the steamlines will cause minor disturbances to animals due to clearance of vegetation and increased human activity during the construction phase. These disturbances can be mitigated by controlled clearing and construction activities. In addition, the recently rehabilitated X2 Quarry may have to be reopened for the winning of construction materials.

The area earmarked for Olkaria IV is generally a wildlife dispersal area. Consequently, development of the site will not cause any significant impacts on the faunal community.

However, the brine and steam condensate released from the drain pots into natural watercourses will have concentrations of minerals, fluorides and arsenic. This can pose a threat to wild animals that may drink the brine. All brine and condensate discharges must therefore be re-injected into deep wells.

Insulating Oils and Fuels from the substation

Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF6) may also be used as a gas insulator for electrical switching equipment and in cables, tubular transmission lines, and transformers. SF6 may be used as an alternative to insulating oils. However, the use of SF6, a greenhouse gas with a significantly higher global warming potential (GWP) than CO_2 should be minimized.

Impacts of Fuel and Chemical Storage on Site from the substation

Spilled chemicals can contaminate soil as well as pollute inshore waters and hazardous and flammable substances (e.g. diesel oil, paints, thinner, solvents, etc.) when improperly stored and handled on the site become potential health hazards for construction workers. It is anticipated that refueling and maintenance of large vehicles will take place on the construction site and that, correspondingly, there will be storage of fuel and lubricants on the site.

Visual aesthetics

The power plant and the transmission line will affect aesthetics by:

- Visual impact of the additional power plant and associated infrastructure within the landscape;
- Degrading the surrounding environment (intruding on the view of a landscape);
- Enhancing a resource by evoking an image of economic and industrial strength in the project district.

Socio-economic impacts

For the purpose of assessing social and economic impacts, two areas have been considered. The first is referred to as the primary impact area, which includes the Hell's Gate National Park and the adjoining land to the north, which may experience direct effects due to the project, either due to being able to see the development, experience odours or noise from the project.

Because of variability in the direct impacts as the dispersion conditions change, or as noise propagation conditions change, it is not possible to define these areas precisely. However, beyond a distance of three to four kilometres from the proposed power station, the direct effects are expected to be minimal. The secondary impact area includes a much wider area where other social and economic effects may be experienced. This has been taken to include the Naivasha Location (940 km^2).

The consultants have studied the Municipality development plans and have held discussions with local officials, as well as residents and business people.

The consultants recommend that provided adequate steps are taken, as indicated here, in the area of infrastructure and social facilities, and provided a joint planning approach continues between KWS and KenGen for the optimum management of hell's Gate National Park, the socio-economic aspects of the project will not cause undue concern.

Spread of HIV/ AIDS and STD's awareness

HIV/Aids and STD's awareness during construction is expected to continue even during the operations of the project. KenGen has well established programme which deals with contractor's awareness and campaigns on curbing the spread of HIV/ AIDS and STD's awareness and therefore it is anticipated there impacts will be minimal.

Negative Impacts during Decommissioning

The main negative impacts during the decommissioning phase are the loss of habitat associated with leaving abandoned plant, equipment and buildings without any attempt at rehabilitation. Unplanned, careless and disorganised removal of physical facilities can cause further loss of habitat. Once the structures are removed the sites can be left to undergo succession, or be rehabilitated to achieve average status with the neighbouring area. An additional problem is the abandoned wells (holes) which can be a wildlife and human hazard.

E8 Environmental and social management and monitoring plan

The Environmental Section at Olkaria carries out monitoring activities for the entire geothermal development. It is recommended that monitoring of the following continues, as stipulated in the Environmental Operational Procedures:

- Precipitation chemistry;
- Significant environmental elements;
- Meteorology;
- Noise levels;
- Hydrogen sulphide.

Furthermore, a number of independent studies have been proposed to provide baseline information which will prove valuable in later years to assess the impact of the geothermal power plants on the area of influence. These studies would aim to establish:

- Impacts on resettled community;
- Point sources of pollution affecting water quality in Lake Naivasha;
- Vegetation patterns of Hell's Gate National Park;
- Long-term impacts of geothermal emissions on flowers, horticultural produce and the natural flora;
- Wildlife populations in Hell's Gate National Park and the surrounding areas;
- Changes in land use around the Lake Naivasha Basin.

An environmental and social management plan has been prepared to cover all the phases of the project life: design, construction, operation and maintenance. The plan describes each of the main mitigation measures to be implemented, their frequency, and who should be responsible during and after construction. Environmental and social monitoring, as integral parts of the environmental management plan, has also been included.

Prior to mobilisation, the Contractors should also prepare their own environmental management plans, including a schedule of works, for review by the Project Manager.

The responsibility for supervision and implementing all the proposed mitigation measures during construction and the defects liability period will lie with the Project Manager and the Contractors, respectively. After the defects liability period, responsibility for the maintenance of Olkaria IV will rest with the Geothermal Manager, while monitoring will be undertaken by the Olkaria Environmental Section.

The ESIA proposes that KenGen enhances its capacity of the Environment Section both during the construction and operation phases of the project to be able to cope with additional challenges emanating from this project. This will ensure that all the targets are achieved and that the environmental responsibilities and obligations of ESIA and the respective geothermal stations and sections are satisfied during project implementation.

Conclusions

The proposed project has great economic significance to the country, given the increasing demand for electrical power.

The World Bank and the United States Environmental Protection Agency regard geothermal energy as "clean energy", as it is generally less polluting than fossil fuels. In addition, geothermal energy is considered a renewable as well as sustainable resource.

The study has also established a number of negative environmental consequences that the project activities are likely to induce. The negative impacts changes in Air and noise quality, Land take and involuntary resettlement, Interference with the Hell's Gate Park Operations, and use of water from already declining Lake Naivasha. However, it will be possible to mitigate these negative impacts by implementing the recommended environmental management and monitoring plans.

The Project should comply with all local laws and regulations, which seek to ensure that the construction work does not adversely affect the environment and social community resources. Any adverse impacts that arise will be mitigated on an on-going basis. These shall be included in an updated ESMP.

In conclusion, therefore, provided the recommended mitigation and environmental and social management measures including the Resettlement Action Plan are effectively implemented during the construction and operation phases of the proposed Olkaria IV station, the anticipated environmental and social impacts will, for the most part, have low significance.

The Resettlement Action Plan for the affected community has been prepared as separate Report.

1 INTRODUCTION

1.1 Background

This document is an Environmental and Social Impact Assessment (ESIA) report for the proposed fourth Geothermal Power Plant to be called Olkaria IV Power Station. The project is expected to generate an additional 140MW of electricity per day to the national electricity grid.

Kenya Electricity Generating Company (KenGen) has carried out, since 1980, extensive geothermal exploration, drilling of wells and production of electricity in the Olkaria volcanic complex located in the Kenya Rift Valley, about 120km from Nairobi.

At present, the Olkaria area supports three geothermal plants (Olkaria I, II, and III) that generate electricity from the geothermal resources of the area. The Olkaria geothermal field has now been subdivided into four blocks that include:

- Olkaria East (Olkaria I);
- Olkaria Northeast (Olkaria II);
- Olkaria West (Olkaria III);
- Olkaria Domes (Olkaria IV).

Olkaria East production field supplies steam to the 45 (15X3) MWe Olkaria I power plant while Olkaria Northeast field provides steam to a 70 (2X35) MWe Olkaria II power plant and an additional Unit 3 is under construction. The two power plants are owned by Kenya Electricity Generating Company Limited (KenGen). An Independent Power Producer (IPP), Orpower owns Olkaria III power plant that currently produces 48 MWe.

Olkaria Domes (Olkaria IV) is earmarked for a 140 (2x70) MWe power plant and several exploration wells have already been drilled for this purpose. KenGen has now developed plans to increase geothermal power production in the area under the Least Cost Power Development Plan. This will be achieved by optimizing the current potential in Olkaria I and II and the establishment of Olkaria IV.

GIBB Africa Ltd as a firm of Experts Registered by NEMA was commissioned by KenGen, to undertake Environmental Social Impact Assessment (ESIA) Study for its proposed Olkaria IV Geothermal Power Plant at the Domes Area in Olkaria in Naivasha District. Prior to this, KenGen had submitted the *Environmental Project Report* prepared by West Japan Engineering Consultants to NEMA. KenGen subsequently prepared and submitted to NEMA the Terms of Reference (ToR) for this study for approval.

The geothermal wells exploration phase has not been considered in any detail in this report because this stage is essentially complete at this time and the National Environmental Management Authority had issued license for the EIA for drilling for the geothermal wells.

1.2 Project Location

The Olkaria IV Domes Geothermal Field is located about 120km Northwest of Nairobi. Administratively, the project is located within Hells Gate location, Central division of newly created Naivasha district (hived from the former Nakuru District) in the Rift valley Province of Kenya. It is one of the seven sectors of the Greater Olkaria geothermal area (GOGA) located in the central part of the Kenya Rift Valley located 6km to the south of Lake Naivasha (see Figure 1, 2 and 3).

Access to the site is from the Moi South Lake road through the Hells Gate National Park. The site neighbours Hell's Gate National Park, which was gazetted in February 1984. The park is

spectacularly scenic, its main attractions being the Hell's Gate cliff face, Hell's Kitchen and Ol Njorowa Gorge.

The proposed location is at Kedong, Akira Ranch located to the east of the Eastern Steamfield. Longonot and Maiella Ranches are located to the south. Oserian Estate lies to the north of the Northeast Steamfield and beyond Oserian to the west is Kongoni Farm. The ranches are essentially cattle ranches, although the Maasai have been seen to herd their livestock through the ranches as well as Hell's Gate National Park. Thus the site is located in the midst of an array of environmental and social contexts.

1.3 Project feasibility and justification

Olkaria IV (Domes) is one of the seven sectors of the Greater Olkaria Geothermal Area (GOGA). It is located to the south of Lake Naivasha in Kedong Ranch. Olkaria IV area measures about 4 km^2 that is bound by Hell's Gate and Ol Njorowa Gorge to the west and a ring of domes to the east and south.

A feasibility study for the proposed project was completed by West Japan Engineering Consultants in August 2009.

Kengen proposes to undertake this project for the following reasons:

- Excess steam is available from Olkaria I and II Power Plants;
- Electricity generated by geothermal means is the cheapest of all generation, at base load;
- Geothermal energy is environmentally friendly;
- There is available space for expansion near Olkaria I Power Station;
- The project ranks favourably among projects planned in KenGen's Least Cost Power Development Plan.

1.4 The need for more power resources in Kenya

The current energy policy objectives in Kenya emphasize the need for energy availability and accessibility at cost effective prices. The policy also supports sustainable socio-economic development while protecting and conserving the environment. The main sources of energy in Kenya are electricity, wood fuel, petroleum and renewable energy. Of the total energy requirements in the country, the bulk (68%) of the country's primary energy consumption comes from wood fuel and other biomass sources. This is followed by petroleum at 22%, electricity at 9% and other sources at 1%.

Of the above main sources of energy in Kenya, electricity is very crucial for the economic development of the nation. The provision of inexpensive and reliable supply of electricity is the lifeblood of the economy.

Currently the electricity sector in Kenya only reaches an estimated 10% of the population. Further electricity generation is therefore necessary in order to reach a greater percentage of the population necessary to promote economic growth. The situation is aggravated by the fact that 60% of the electric power produced is based on hydropower which has been often unreliable especially during the dry seasons.

For example in 1999 and 2002, severe droughts greatly affected the power production of the hydroelectric dams along the Tana and nearly brought economic activities to a standstill. Today's (October 2009) hydro electric power situation in the country is still grave. KenGen has already closed the Masinga Dam due to the low water levels in the Tana River and Kamburu Dam could be closed soon if the present dry spell persists. The above experience underscores the need to increase power production and to diversify the power sources.

The implementation of the proposed Olkaria Optimization Project is a step towards energy sustainability in Kenya. When implemented it will help the country to address power shortage and enhance further economic growth.

1.5 Energy situation in Kenya

The most important electricity producer in Kenya is the majority state owned parastatal, KenGen. Besides KenGen there are four (4) Independent Power Producers (IPPs) which include Iberafrica, Westmont, Tsavo Power and Orpower. The Kenya Power and Lighting Company (KPLC), also a state owned parastatal has the monopoly over the transmission, distribution and sale of electricity in Kenya. The power regulator in Kenya is the Energy Regulatory Commission (ERC).

Total installed capacity rose by 6.0% in 2008 compared to 1.7% in 2007. The rise in the installed capacity was the result of increases in thermal and hydro installation from 389.3MW and 677.3 MW in 2007 to 418.9MW and 719.0 MW respectively in 2008. The increase in hydro installation resulted from the commissioning of Sondu- Miriu hydro power project with installed capacity of 60 MW. Geothermal and cogeneration installed capacity remained unchanged over the last three years.

It is noted that total electricity generation recorded a decelerated growth of 2.1% in 2008 compared to a growth of 7.3% in 2007. This was largely due to an 8.9% decline in electricity production from hydro generation power sources. The decline in hydro power generation was attributed to the low water levels at the hydro electricity power generation dams along the Tana River. Generation from thermal oil and geothermal plants rose by 23.6 and 5.1% in 2008 compared to declines of 4.5% and 5.4%, respectively, in 2007.

While diesel generation capacity in Kenya became operational since September 2001, geothermal energy is still the preferred option for electricity system expansion for the Government of Kenya (GoK), because it uses an indigenous energy supply source which reduces exposure of the country to fuel price fluctuations, it increases security of supply and is environmentally preferable to diesel plants.

1.6 Background of the geothermal energy situation

1.6.1 Olkaria I power station

This was the first geothermal power generating station in Africa. Olkaria I has an installed total capacity of 45MW and was commissioned in 1981.

The power station, however, has a steam gathering capacity with potential to produce 70MW. Based on numerical simulation studies for Olkaria geothermal field carried out in 1981, it is estimated that the 2km^2 Olkaria East field could sustain 45MW of electrical power production for 25 years. A total of thirty three (33) wells have been interconnected in this field but only 28 wells are necessary to support generation of 70 MW.

1.6.2 Olkaria II power station

Olkaria II is provided with steam from twenty (20) production wells. The power station was commissioned in September 2003 with installed capacity of 70MW. However, its steam gathering capacity has potential for the production of 98MW. Between Olkaria I and II, there is an estimated steam surplus with potential for the production of 53MW. To utilize this steam potential KenGen is currently building a third generating unit of 35MW at Olkaria II. It was envisaged that a steam pipeline would be built interconnecting the two fields for the purpose of

transferring steam from Olkaria I to Olkaria II to run the Olkaria II unit 3.

1.6.3 Olkaria III power station

The Olkaria III is the first private geothermal power plant in Africa. This is a geothermal steam - binary combined cycle power plant which was built and owned and operated by Ormat. Currently, it produces 48 MW of geothermal power which is sold to KPLC.

FIGURE 1.1: LOCATION OF OLKARIA GEOTHERMAL FIELD IN KENYA

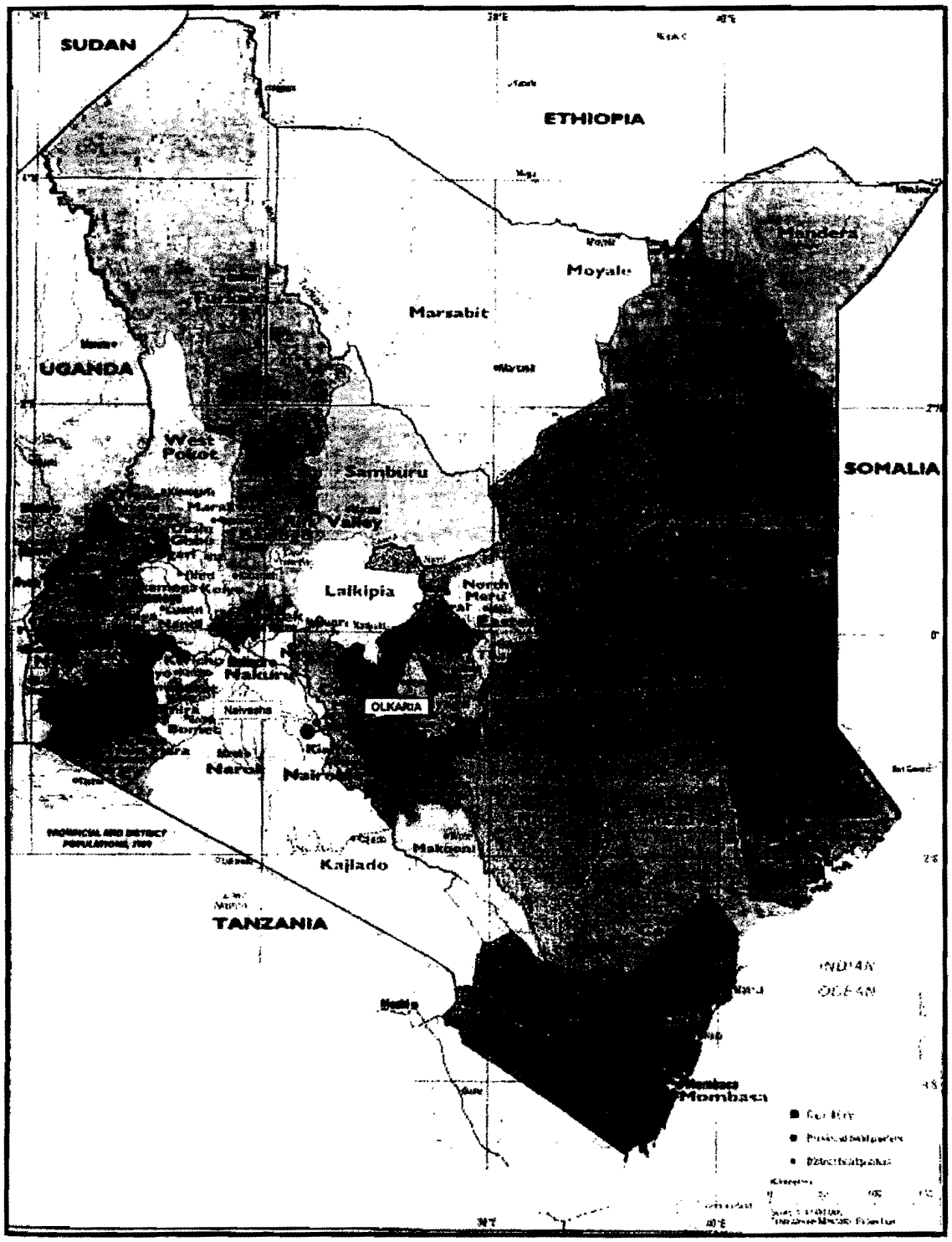

Figure 1.2 Map of the Great Olkaria Geothermal Areas showing location of Olkaria I units 4 and 5

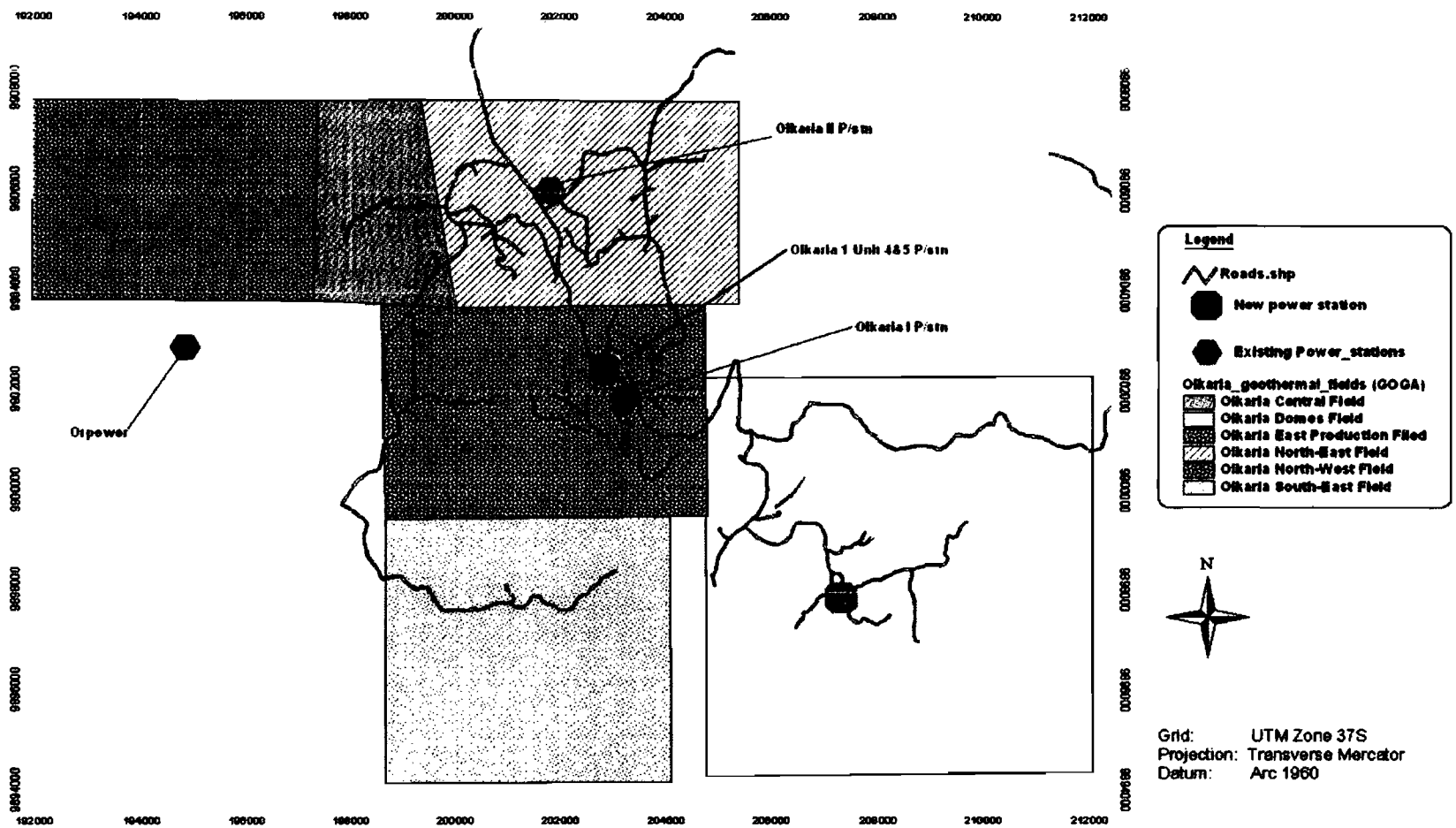

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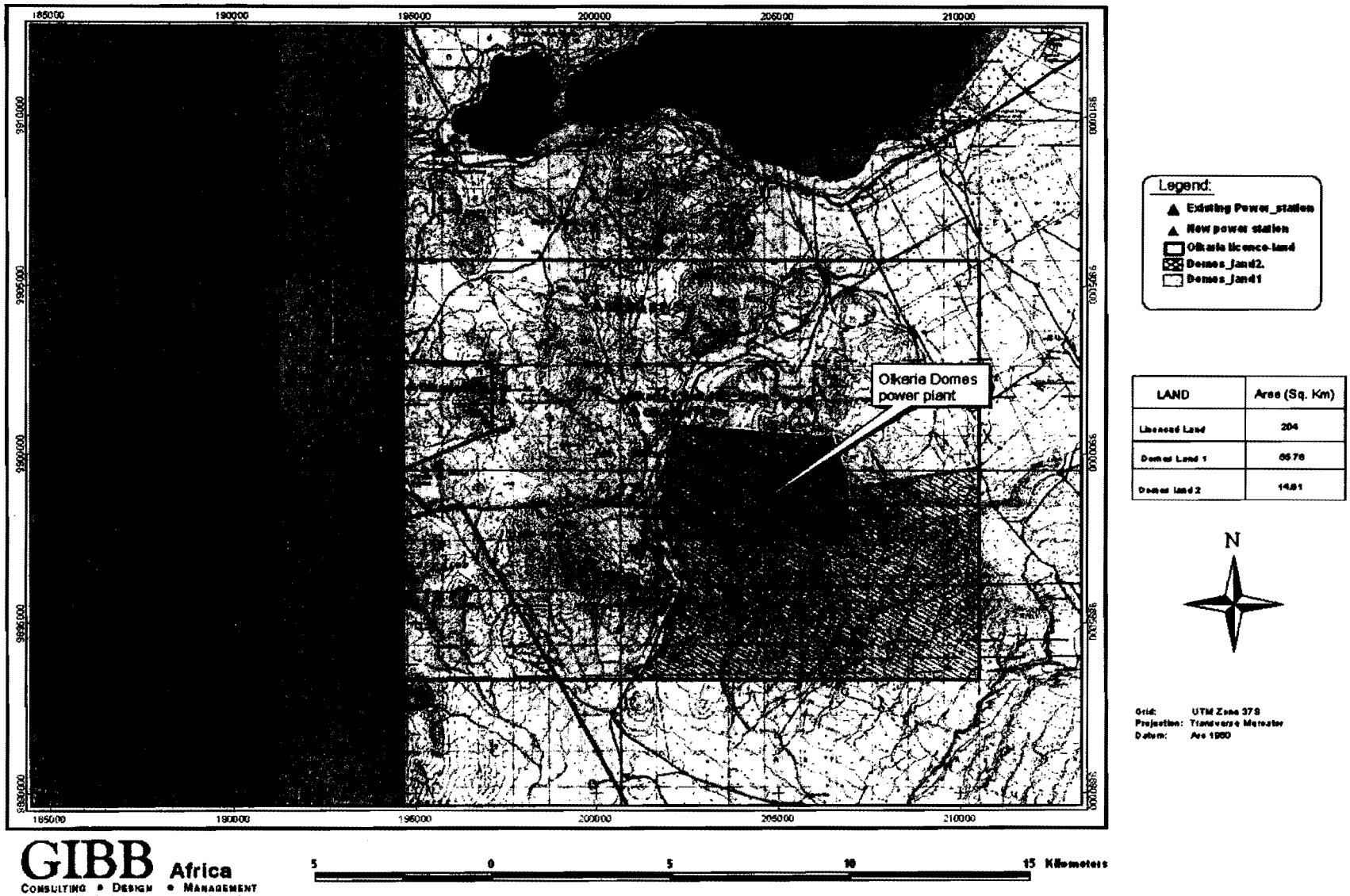
Figure 1.3 Map of the Olkaria geothermal area showing the neighboring facilities for Olkaria Domes



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1.7 Purpose of carrying out the ESIA

1.7.1 Justification for preparation of the ESIA Report

The need to undertake an environmental impact assessment for the project emanates from the following observations, among others:

Under section 58 (1) *of Kenya Government's Environment Management Coordination Act (EMCA), Number 8 of 1999 and the Environmental Impact Assessment and Audit Regulations of June, 2003,* the proposed Construction of *Olkaria IV Geothermal Power Station* falls under the prescribed list of projects for which environmental impact assessment is mandatory, prior to implementation *(Second Schedule , page 174 of EMCA No.10 electrical infrastructure section (a) electrical generation stations).*

The basis is that the proposed project constitutes several activities, which would generate considerable changes and significant effects to the environment including on land, water, atmospheric resources and biological diversity. Thus, the ESIA is designed to establish, in advance, some appropriate level of environmental management measures for synchronization in project activities from the planning stage to implementation.

The proposed Geothermal Project falls under prescribed list of projects (category A) under the World Bank's Operational Policy (OP4.01 -Environmental Assessment). This study will cover *World Bank Operation Policies 4.01, 4.04, 4.10 and 4.11, 4.12.*

1.7.2 Objectives of the ESIA

The aim of the assessment is to highlight potential environmental and social impacts of the proposed project, and to establish an environmental management plan for mitigating the potential negative impacts.

Key specific objectives for the assessment are:

- To outline the objectives of the proposed project activities;
- To review the planning and implementation of the proposed project activities in line with environmental policies and procedures of the Government of Kenya and relevant International Operational Policies to be triggered by the proposed activities, for consideration in the planning and implementation of the project activities;
- To predict the main potential environmental and social impacts of the planned project activities;
- To develop an environmental and social management plan with recommended mitigation measures and strategies for addressing negative impacts in the course of project implementation and operation;
- To develop a resettlement policy action plans for the project;
- To recommend appropriate training for environmental planning and monitoring in the project activities.

1.7.3 Target Group for the ESIA Report

This Environmental and Social Impact Assessment Report has been prepared for use by different stakeholders to be involved in the project. The report contains useful information on policies and procedures to be adhered to, implementation modalities, analysis of potential environmental and social impacts and suggested mitigation measures at various stages of the project activities. The information will be useful in planning, implementation, management and maintenance of the plant.

In this regard, the report will be useful to the following stakeholders:

- The Implementing agency, KenGen;
- The Lead Agencies;
- The NEMA monitoring and compliance section;
- Funding agencies and donors for the proposed Olkaria IV project;
- Planners and engineers to be involved in preparation of designs and plans for project;
- Contractors engaged in the construction works for the project;
- The potential project affected persons (PAPS) living within the project area;
- Beneficiaries of the project both at local and regional level.

1.8 Methodology

1.8.1 Approaches to undertaking the ESIA

This ESIA Report has been prepared in accordance with the Environmental (Impact Assessment and Audit) Regulations of 2003. It is also guided by the World Bank's requirements for industrial projects and IFC's EHS Guidelines for Geothermal Projects.

The study methodology comprised the following activities:

- Preliminary meetings;
- Data collection and Document review;
- Site inspection and discussions with site personnel;
- Air and Noise Dispersion Modelling;
- Ecological Assessment;
- Social Impact Assessment;
- Community Resources Mapping;
- Meetings with stakeholders;
- Public Consultation;
- Data Analysis;
- Reporting.

The ESIA Report has confined itself to the construction of Olkaria IV and associated infrastructure, although where necessary, issues that have implications on both existing Olkaria I and Olkaria II stations and the proposed Olkaria I Unit 4 and 5 have been examined.

1.8.2 Methodology for air quality assessments

(a) Approach to the assessment

The US EPA approved dispersion models *CALMET/CALPUFF (version 5) (Scire et al., 2000A and Scire et al., 2000B)* have been used to assess the effects of emissions from the existing and proposed geothermal plants. *CALMET* is a computer program that prepare the meteorological data into the hourly three dimensional database required by *CALPUFF*, which is the dispersion model that predicts the transport and diffusion of the emissions. The *CALMET/CALPUFF* suite of models is approved by the United States Environmental Protection Agency (US EPA) for air quality assessments. The approval process is time-consuming and the approved versions of the model lag behind the most recent updates. The models used for this assessment were the latest versions available at September 2009 namely *CALMET Version 6.326 Level 080709 and CALPUFF Version 6.262 Level 080725.*

(b) Meteorological data

As indicated above *CALPUFF* requires information about the dispersion characteristics of the area being modelled. In particular, data are required on wind speed, wind direction, atmospheric stability class and mixing height.

A meteorological climate station is operated at X Camp site 2 in Olkaria I however although

this station was operational at the time the 1994 Environmental Assessment was prepared this station does not currently record the hourly wind speed and wind direction data needed for dispersion modelling.

The required data have been generated using the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) prognostic wind field and dispersion model known as TAPM (**CSIRO, 2005**). TAPM generates information on three-dimensional winds and vertical temperature profiles (and other parameters) over a user specified grid. The model makes use of the Australian Bureau of Meteorology's Limited Area Prediction System (LAPS) to generate the three dimensional wind fields. The computed wind fields are based on global observation of temperature, pressure, relative humidity, sea-surface temperatures etc and these parameters are adjusted to take account of local topography, land use etc so that the effects of these relatively small scale features (down to a spatial scale of approximately 1 km) on the synoptic scale winds can be taken into account. These matters are discussed in greater detail by (**Puri, 1997**).

A TAPM model run for 2008 has been made for a prediction grid centred on latitude 0° 52.0' south and longitude 36° 20.5' east (approximately UTM 204000mE, 9904000mN). The TAPM model has then been used to prepare the meteorological inputs required by CALMET, which in turn has been used to produce the required hourly varying 3-dimensional file containing the information on the dispersion parameters required by CALPUFF. The 3-dimensional CALMET grid contains 41 grid points in the east-west direction and 29 points in the north-south direction. Grid points are spaced at 1 km intervals and thus cover an area 28 km (north-south) by 40 km (east-west). The southwest corner of the grid is at UTM (Zone 37) coordinate 183500 m east and 9890500 m north.

For each grid point and for each hour in the year the model produced the required dispersion data in ten layers. The tops and bottoms of the layers were at the following heights above the ground: 0, 20, 40, 100, 200, 400, 1000, 1500, 2000, 2500, and 3000 m. Thus the first layer is centered on the height range 0 to 20 m, namely 10m, the second is centered between 20 and 40 m, namely 30 m and so on.

There is no particular reason for selecting 2008 data for modelling except that it is was the most up-to-date complete year of TAPM data available at the time that the air quality studies were commenced.

(c) Dispersion modelling

CALPUFF was set up to make use of the CALMET meteorological data described above and to make predictions of H2S concentrations for 1-hour, 24-hour and 1-year average periods. Predictions were made at ground-level for a grid with the southwest corner at the same location as the meteorological grid, but the grid spacing was 500 m by 500 m and so the grid size was 81 points east-west by 58 points north-south.

The emissions assumed for the model simulations were taken from data used in the expansion for Olkaria II (Holmes Air Sciences, 2009). The emissions and other parameters required for modelling are shown in Table 1.1 for the existing power stations and Olkaria II (Unit 3) which at the time of writing (October 2009) is under construction. The same information for the proposed power stations is shown in Table 1.2.

The precise locations and designs of the proposed power stations has not been finalised at this time but the locations are known with sufficient accuracy to allow the dispersion modelling assessment to be made. Changes in locations of a hundred metres or less would be of minor consequence in the context of this study.

Table 1.1 Emissions used in modelling existing power stations

Location	Olkaria I		Olkaria II		Olkaria III	
Height of emission point above grade (m)	19		16		19	
Height of grade above sea level (m)	1932		2005		2005	
Exit velocity (m/s)	20.0		9.2		8.6	
Exit temperature (K)	375		304		303	
Diameter of discharge point at tip (m)	0.2		9.14		9.64	
Mass emission rate of hydrogen sulphide for each of three emission points for Olkaria I and for each of 12 emission points for Olkaria II (g/s)	4.46		3.55		3.55	
Existing sources Coordinates of discharge points	Easting 200420 200412 200404	Northing 9901480 9901500 9901525	Easting 199365 199370 199376 199382 199387 199393 199399 199404	Northing 9904727 9904717 9904708 9904699 9904689 9904680 9904670 9904661	Easting 199356 199349 199342 199336	Northing 9904744 9904755 9904766 9904777

Source: GIBB Africa 2009

Table 1.2 Assumed emission parameters used in modelling proposed power stations

Location	Olkaria I Units (4 and 5)		Olkaria IV (Unit 1 and 2)	
Height of emission point above grade (m)	19		19	
Height of grade above sea level (m)				
Exit velocity (m/s)	20.0		8.6	
Exit temperature (K)	375		303	
Diameter of discharge point at tip (m)	0.2		9.64	
Mass emission rate of hydrogen sulphide for each of three emission points for Olkaria I and for each of 12 emission points for Olkaria II (g/s)	4.46		3.55	
Existing sources Coordinates of discharge points	Easting 200420 200412 200404	Northing 9901480 9901500 9901525	Easting 199356 199349 199342 199336	Northing 9904744 9904755 9904766 9904777

Source: GIBB Africa 2009

(d) Air Quality Criteria for Hydrogen Sulphide

The setting of air quality standards is based on considerations of health and amenity. Clearly, concentrations must be set that protect against adverse impacts on human well-being. However, in the case of odorous compounds it may be necessary to set limits lower than those

at which no effect on human health is experienced. In addition, the effect of pollutants on flora, fauna and materials is a matter for consideration. For hydrogen sulphide all of these factors were taken into account and ideally criteria that protect against all adverse impacts adopted.

(e) Threshold Limit Values

A distinction needs to be made between air quality standards for the ambient air and those for the workplace, the latter being referred to as threshold limit values (TLV). TLVs are those doses that cause no apparent harm to workers exposed for eight hours a day, five days a week. In the United States the TLV for hydrogen sulphide is set at 10ppm (15 mg/m3).

Table 1.3 Ambient air quality standards for hydrogen sulphide

Country/State	Concentration (ppm)	Concentration (mg/m3)	Averaging time
California USA	0.042	0.03	60 minutes
New Mexico USA	0.0042	0.003	30 minutes
Texas USA (industrial area)	0.168	0.11	30 minutes
Victoria Australia	0.00014	0.0001	3 minutes
Alberta Canada	0.017 0.014 0.004	0.011 0.009 0.003	30 minutes 60 minutes 24 hours
Bulgaria Czechoslovakia Hungary USSR Yugoslavia Poland (protected)	0.008 0.008	0.005 0.005	30 minutes 24 hours
Finland	0.15 0.05	0.1 0.3	30 minutes 24 hours
Hungary	0.30 0.15	0.20 0.10	30 minutes 24 hours
Israel	0.15 0.045	0.10 0.03	30 minutes 24 hours
Italy	0.10 0.04	0.07 0.03	30 minutes 24 hours
Poland	0.06 0.02	0.04 0.013	30 minutes 24 hours
Romania	0.03 0.01	0.02 0.006	30 minutes 24 hours
Spain	0.01 0.004	0.006 0.00025	30 minutes 24 hours

Source: United States Environmental Protection Agency

(f) Ambient Air Quality

Several countries have adopted both long and short-term hydrogen sulphide standards for ambient air quality criteria (see Table 1.3, prepared from data published by the Subcommittee on Hydrogen Sulfide (1979) and from information published by WHO (1987)). The US EPA has not yet formulated a standard for hydrogen sulphide although several states in the United States have developed independent regional standards. Selected examples that span the range of criteria are also presented in Table 1.3.

The short-term concentrations are generally higher than those for long-term exposure and it is useful to note that short-term exposure to a given concentration of pollutant will in general have less effect than a long-term exposure to the same concentration. Therefore the air quality standards for long-term exposure are usually lower than those for short-term exposure. The most stringent air quality goal presented in Table 1.3 is based on considerations of odour and is applied by the Victorian Environment Protection Authority (VEPA) (Australia).

VEPA sets a goal of 0.0001 ppm (0.14mg/m3) for the maximum 3-minute average ground-level concentration of hydrogen sulphide. This value is approximately 20 per cent of the odour

threshold of 0.00047ppm (0.76 mg/m3), which is the lowest odour threshold reported in the literature. The value is referred to in Victoria, as the design ground-level concentration and it is used by VEPA as the objective, which must not be exceeded when determining stack heights. The reason for selecting an air quality criteria that is apparently less than the odour threshold and well below the concentration at which any health effects have been reported, is that the concentration is expressed as a 3-minute average. The human nose responds to odour exposures of the order of seconds. During any 3-minute period, concentrations at ground-level close to a stack emitting a pollutant may fluctuate by as much as ten times the average value, so that if the 3-minute average air quality goal is set at the odour threshold, this value will be exceeded some of the time. For this reason a level of one-fifth to one-tenth of the odour threshold is usually set as the maximum 3-minute average concentration to protect against such impacts. In practical terms this would result in little or no detectable odour of hydrogen sulphide at ground-level. This is clearly not a necessary goal for all areas, in particular areas such as Olkaria, or for example Rotorua, where natural hydrogen sulphide emissions occur.

The implications of applying the VEPA air quality criteria to the Olkaria project are that human health and amenity would be protected. In addition, in view of the similarity of the response of other animal species to hydrogen sulphide, no adverse impacts are likely to be experienced by the local fauna. For continuous exposure, levels of hydrogen sulphide that are 300 times the odour threshold may be damaging to crops. Thus the adoption of the VEPA criteria should protect against crop damage. Similarly it is unlikely that at these levels there would be any significant deterioration of materials, particularly metals, in the vicinity of the plant.

However, in practical terms this is an unrealistic goal as the stack concentration of hydrogen sulphide in a 105MW power station will be of the order of 4.5 g/m3. To achieve the VEPA ground-level concentrations a dilution of over 32 million would be needed. The VEPA goal is not considered appropriate for the present environment.

The World Bank (1998) sets a standard of 5mg/m3, (3.3 ppm) at the boundary to protect against odour impacts and this is included for completeness.

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:

- *"The lowest-adverse health effect of hydrogen sulphide is 15mg/m3 (9.9 ppm), when eye irritation is caused. In view of the steep rise in dose-effect curve implied by reports of serious eye damage at 70 mg/m3 (46 ppm), a relatively high (safety) protection factor of 100 is recommended, leading to a guideline value of 0.10 ppm (0.15 mg/m3) with an averaging time of 24-hours."*
- *In order to avoid substantial complaints about odour annoyance among the exposed population, hydrogen sulphide concentrations should not be allowed to exceed 0.0046 ppm (7 □g/m3), with a 30 minute averaging period....."*.

The information presented by Nagy (1991) appears consistent with (2) and allows the incidence of odour events to be estimated. This will form the basis of the impact assessment presented in subsequent chapters in this report.

(g) Air Quality Criteria for the study

There are no ambient air quality criteria for hydrogen sulphide currently in force in Kenya. Geothermal wells emit substantial quantities of this gas and it is necessary to set some targets that define environmentally acceptable levels.

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. That is 24-hour average concentrations should not be permitted to be above 0.10ppm (0.15 mg/m3), beyond the immediate power station boundary.

Provided this level is complied with, then health will be safe-guarded with an appropriate margin of safety (namely a factor of 100). All other suggested criteria in this report are to protect against nuisance impacts and therefore should have some flexibility in their application.

Areas where non-KenGen workers are located (for example Oserian Development Company work force) should be assessed on the 60-minute Californian Standard of 0.03ppm (0.042 mg/m3) and residential areas should be considered affected if 30-minute concentrations are above 0.0046ppm (7mg/m3). It is proposed, that in this regard, residential areas housing KenGen workers be treated in the same way as other residential areas.

It is also proposed that areas supporting commercially, culturally or scientifically important vegetation should not be permitted to experience exposures above 0.03ppm (0.042mg/m3) long-term average. These criteria are intended to protect all elements of the environment from the adverse effects of hydrogen sulphide and when used with the dispersion modelling study, results will define what level of effect may be expected in particular areas.

The protection of workers within the power station is beyond the scope of an Environmental Assessment, but it is suggested that the United States TLVs for work-place exposure, namely 10 ppm (15mg/m3) 8-hour average, be used for this purpose.

1.8.3 Methodology for noise quality assessment

The Environmental Management and Coordination (*Noise and Excessive Vibration Pollution) (Control) Regulations, 2009, have recently been published by the National Environmental Management Authority (NEMA, 2009).* The regulations specify the acceptable noise levels in various situations. The first schedule titles Maximum Permissible Noise Levels sets out the relevant assessment criteria for the project. The relevant information is summarised in Table 1.4.

Table 1.4 Part of NEMA First Schedule - specifying maximum permissible noise levels

Zone	Sound Level Limits dB(A) (Leq, 14h)		Noise Rating Level (NR) (Leq, 14h)	
	Day	Night	Day	Night
C. Residential: Indoor	45	35	35	25
C. Residential Outdoor	50	35	40	25

Day is 6:01 am to 8:00 pm (14 hours)

Night is 8:01 pm to 6:00 am (10 hours)

Table 1.5 Part of NEMA Second Schedule - specifying maximum permissible noise evels for construction sites (Measurement taken within the facility)

Facility	Maximum Noise Level Permitted (Leq) in dB(A)	
	Day	Night
(ii) Residential	60	35

Day is 6:01 am to 6:00 pm (12 hours)

Night is 6:01 pm to 6:00 am (12 hours)

Because the power stations, well testing and drilling operations are continuous operations, and the noise emissions are essentially steady and continuous over extended periods, the

assessment criteria are simplified so that most stringent criteria is the one that controls the assessment.

(a) Approach to the assessment

Noise impacts have been assessed using a noise prediction model (NOISE8) to estimate noise levels that will occur in the neighbourhood of the power station and well field during the well testing phase and during operation of the power station. The predicted noise levels have been presented as contour plots showing the predicted noise Laeq, 10h noise levels over the area of interest. Discussion of noise impacts expected during the construction phase is also presented. The following sections provide information on the method used to predict noise levels, the environmental noise quality goals which are appropriate for this environment and the expected impacts due to noise emissions.

(b) Method of Predicting Noise Impacts

The computer-based model used in this study, has been developed for assessing the noise impacts from mining and industrial sources. The model is referred to as NOISE8. The principles, by which the calculations are made, are similar to those used by most consultants and regulatory agencies undertaking similar noise impact assessment work.

The model takes into account three major factors affecting noise propagation: namely the diminution of noise level due to distance as the sound energy spreads outwards from the source; the effects that natural and artificial barriers have on the sound, and the absorption of sound energy by the atmosphere, where some of the vibration energy of the sound is converted to heat in the atmosphere. Some sound energy is absorbed by vegetation but with elevated noise sources such as will apply for the power station this effect is expected to be minor.

The first cause of diminution of sound level due to distance is due primarily to geometric factors and is 6dB each time the distance from the source to the receptor is doubled. The effects of natural and artificial barriers depend on the frequency of the sound and the geometry of the arrangement of the source, receptor and barrier. The estimates of the reduction in noise level due to barriers have been calculated using a procedure set out by Harris (1979). The absorption of noise in the atmosphere depends primarily on the frequency of the sound and the temperature and humidity of the atmosphere. The method used to account for atmospheric absorption is again taken from Harris (1979) and the temperature and humidity assumed to apply was 25°C and 90% relative humidity.

For the model to operate, it requires data on sound power level and the tonal composition of the emitted noises. This information has been determined by on-site measurement of noise emissions from existing East Olkaria Power Station. Among other measurement, the field study determined a weighted sound power levels for the following:

- *Olkaria I cooling towers*
- *Olkaria I plant (i.e. gas ejectors and turbine building)*
- *Olkaria II cooling towers (includes gas ejectors)*
- *Olkaria II plant (i.e. the building housing the turbines and generators)*
- *OW38 (a 12 MW well) under testing at the time)*
- *drilling operations at OW913.*

For the proposed power stations the sound power levels assumed in the modelling were increased by an appropriate amount to account for the larger sizes of the equipment in the new power stations.

Note the new larger power stations might uses larger units or more units of the same size as the Olkaria II station. For example the 70MW Olkaria IV power station will use 70MW units.

The noise assessment assumes these will be 3dB louder than the 35MW units used in Olkaria II. Olkaria IV may use also use larger cooling towers or simply more of the same size as

Olkaria II. In either case the sound power level is increased by the 10log10 (actual power of the proposed unit/power of the unit that the measurement is made from). Thus the noise model can assume that at Olkaria IV, there will be eight cooling towers each emitting twice a sound power level (i.e. 3dB higher) than that which applies at each of the 35MW units at Olkaria II or 16 units each with the same sound power level as at Olkaria II.

For the present study the grid points were spaced at 100 m and covered a rectangular area 20 km in an east-west direction and 25 km in a north-south direction with the southwest corner of the grid at UTM (Zone 37) coordinate 190000 m East and 9891000 m North. The calculations are repeated for each source and the resultant noise level at each grid point is determined by adding the contribution from all of the sources.

The topographical data used in the model to predict the shielding effects of the terrain was based on the endeavour space shuttle program flown over an 11-day period which used side scanning radar to map the topographical variations across the globe. For Kenya the data were available at 3arc second resolution which corresponds to appropriately one height measurement at 90 m intervals at the equator. The data area is available to the public from the United Sates Geological Service (USGS) web site.

Some of the steeper parts of the Gorge and some of the terrain close to cliff faces were not visible to the radar and the anomalous data were filtered from the data file used in the noise model.

1.8.4 Methodology for ecological assessment

A comprehensive survey of biodiversity of the project area was carried out. The key groups included mammals, butterflies, birds, reptiles and flowering plants. The study area was classified into different habitat types. Sampling was carried out in the area in all the existing floral and faunal microhabitats (wetlands, valleys, bushlands, wood lands, grasslands etc).

(a) Vegetation Surveys

(i) Time constrained searches

Hourly sampling periods were carried out per study site. All the different types of flora, fauna and avifauna, numbers and abundance were recorded. This technique was used to generate data on species present at the time of sampling and habitat information. These searches were only done during the day because Hells gate is a protected area.

(ii) Sampling plots

Plots of 20x20m were laid in some of the areas and observations made to determine species diversity, and species types. This is inline with recommended techniques by other researches (KIFCON, 1994). In each plot all plant species were enumerated, and data on density, height and basal area of trees over 5 cm diameters at breast height (DBH) was estimated.

(iii) Line transects

Line transects were established in the project area, and observations (up to 20m) made on each side of the transect. Quantification of species distribution patterns and vegetation dominance was done according to (KIFCON, 1994). The degree of forest or woodland cover was recorded on a five point scale for three life forms i.e. trees, shrubs and herbs (including grasses and pteridophytes). The Daubenmire Cover Scale: 1:0-20%, 2:21-40%, 3:41-60%, 4:61-80% and 5:81-100% was used (KIFCON, 1994). The method is suitable for quantitative vegetation analysis because it allows determination of species population densities and frequencies.

General botanical surveys were undertaken along each transect, within a band of 10 m on either side. These enabled better understanding of the various habitat physiognomic structures. Plant collection and identification was undertaken and those that could not be

identified stored for further verification at East African herbarium in Nairobi.

(iv) Drive transects

Due to the vastness of the area, and presence of wildlife in some areas, vegetation, fauna and avifauna identification was done while in the vehicle driving along already existing roads. The method applied here was mainly visual.

(v) Species Data analysis

Floristic diversity was analyzed using data on species richness (i.e. total number of species recorded per site) and comparison of floristic similarity between transects and sampling plots done. Vegetation structure was determined by analyzing the canopy cover of different vegetation layers (bushes, climbers, shrubs and trees), diameter at breast height (dbh) and height data.

Species uniqueness (endemism, rarity, threat i.e. vulnerable, endangered) was analyzed through comparison with already existing data from previous researches in the area.

(vi) Avifaunal surveys

Various standard bird survey methods were used to sample birds at different micro-habitat types. Identification was mainly by visual, bird calls, feathers and nesting sites.

(vii) Timed Species Counts (TSCs)

Times species counts were used to assess the relative abundance of bird species in Olkaria IV. This entailed recording every new species seen or heard within a sampling period of 40 minutes, which divided into four 10-minute sub-samples (Pomeroy 1992).

For each count, species scored according to when they were first recorded to give a 'commonness index' (4 if in the first ten minutes, 3 if in the next ten minutes and so on - Bennun and Waiyaki 1993).

(viii) Transects (Point Counts and Line transects)

Variable Circular Plot (VCP) method of Distance sampling using point counts (Buckland et. al. 1993) was used to estimate densities of various species in the habitat sites.

(b) Mammal Sampling

Mammals sampling was divided into large, medium and small mammals. Various techniques were applied depending on the species, visibility in the study area and behaviour of various mammal species. The main method used was survey walks and drive transects. This was applied for both direct animal encounters and also for indirect observations using signs such as footprints, dung, scats of cats, hairs, diggings, nest, and urine marking sites, footprints or spoors. A direct animal count was done in habitats where visibility was clear.

1.8.5 Public consultations and social impact assessment

During the ESIA, extensive consultations were undertaken with the various stakeholders. The reasons for the extensive consultations was to take on board, views from a cross section of people, at least from local level, district level, and central government level.

Public consultations and Social impact assessment are critical in preparing an effective ESIA. Public consultations and Social impact assessment for this study were done at various levels in the course of preparing the ESIA. The various methods for consulting the general public include press notices, information notices, brochures/fliers, interviews, questionnaires, open houses, community meetings, advisory committees, and public hearings.

The consultant used primary data collection, which involved participatory rural appraisal, use of checklist, key informant interviews and public meetings (see plates Appendix 4 and Appendix 3 list of participants and minutes of the meetings).

Meeting with the Local Administration D.O's, Chiefs and Assistant Chiefs within the project area at the D.O 1 office in Naivasha.

The public meeting at the Maela settlement in Kongoni Division in Naivasha

The list of stakeholders who attended the public consultations during the ESIA is presented in Appendix 3.

(a) Primary Data Collection

Primary data collection phase involved four approaches. Details are outlined in the following sections.

(I) Participatory Rural Appraisal (PRAs)

To collect qualitative information, participatory consultations with the communities were conducted in the surrounding area. The consultations mainly used public meetings to enquire and analyse various issues that were brought forward by the communities. The discussions centred on key issues relating to the project as well as the communities. In order to collect useful and relevant data, the meetings were held in central locations and market centres where the local communities would attend. The public meetings were held in the following areas Cultural Centre (the meeting included residence of the following villages Cultural Center, Ol Nongot, Ol Sinyat, Ol Maiyana and Ol Narasha (Table 1.1).

The other meetings were held at the following areas:

- Moi Ndabibi, Maela, Ndabibi and Kamere Market Centre

A public meeting was also held with the village elders of above villages.

Table 1.6 Schedule of public meetings conducted

1	KenGen	10/9/09	• KENGEN staff • GIBB ESIA team	Introduction of project teams and liaison persons.
2	Naivasha District Commissioner's Offices		• District Commissioner • KENGEN staff • GIBB ESIA team	Consultation of how to approach the Project Affected Persons (PAPs) and to start off the ESIA Fieldwork
3	Simba Lodge Naivasha.	12/9/09	• District Commissioner • Village Elders from manyattas in project area • KENGEN staff • GIBB ESIA team	Introduction of ESIA Study with focus on conduct of the PAP Census.
4	Naivasha District	17/9/09	• District Government Agency Officers	Consultations on the proposed projects.
5	Naivasha District	17/9/09	• District Officers, Chiefs and Sub-chiefs	
6	Kamere Centre	23/9/09	• 72 villagers including chief	
7	Cultural Centre	28/9/09	• Residents of Manyattas in the proposed project area.	
8	Ndabibi Location	29/9/09	• 72 villagers including chief and area counsellor	
9	Maeilla	30/9/09	• 189 villagers including chief	
10	Moi Ndabi	30/9/09	• 44 villagers including chief	

The use of participatory techniques in undertaking ESIA is of primary importance in ensuring that all stakeholders are mobilised and involved at all stages. Stakeholder consultations provided a unique opportunity to interact and share experiences with the likely project affected persons (PAPS), the people living in the neighbourhood of the project who will be directly involved and affected in the implementation of the proposed project.

(ii) Key Informant Interviews

Key informant interviews using an established checklist of issues in the areas of focus of the baseline survey were conducted to augment and confirm data and information obtained using the other tools and methodologies.

1.8.6 Census and Social Survey

Due to the fact that the proposed project is going to take considerable land currently under settlement and thereby leading to the locals being affected by the project. The sociologist conducted census and social survey in the villages which are likely to be affected using properly trained enumerators to document the exact numbers of the locals living within the proposed project area and to undertake the household data. The enumeration team included tertiary level trained 9 enumerators (six ladies and three boys) to undertake the exercise.

To overcome the possibility of language barriers between the local Maasai community and the enumerators, the services of a local was enlisted to help with translation. The villages where census and social survey were conducted included Cultural Center, Olo Nongot, Olo Sinyat,

Olo Maiyana, Olo Munyak and Narasha.

Challenges to Enumeration

The following challenges were raised by enumerators during and after the exercise:

- According to the community members some villagers were away in the dry season pasture lands and were not expected until the rain season. These people were therefore not enumerated;
- Distance between households in some areas is high, for example in Olo Munyak;
- Communication: Some respondents insisted that their family members translate for them. When questions are translated one cannot be sure that information was not lost in translation. There is the fear that some local translators coach people on the answers to give;
- Objectivity was curtailed due to the possibility or reality of relocation. People were psychologically affected by the possibility that they may loose their homes hence they became defensive. They may need some counselling to help deal with the issue;
- Some people may have been afraid of interviews hence they were purposefully absent and left their wives to answer the questions;
- It was felt that some people have inflated their income and expenditure budgets as they may think that they will also be compensated for that;
- Villages that were enumerated toward the end of the census had more time to prepare and seemed to have been coached on the answers to give as their answers were mostly the same.

1.8.7 Land and property valuation

In order to underscore the value of the properties that might be affected by the project, valuation was undertaken in the villages where census survey was done during the ESIA process.

The assets valued included school buildings, churches and manyattas (both permanent and temporary), trees and land within the proposed project area.

The valuation was based on detailed field data, description on type of property, condition, plinth/built-up area, replacement cost, open market value of land and a 15% disturbance as per, the Land Acquisition Act Chapter 295, Laws of Kenya.

1.8.8 Collection of Secondary Data

This is by no means a replacement of active public consultations. This is an indirect method of gathering views of the public on various issues from secondary sources. Both quantitative and statistical information from relevant secondary sources including various documents and reports on the district in general and from KenGen was collected and further analysed as secondary evidence of consultations.

Such documentation included, ESIA Project Reports, Environmental Audits and Monitoring Reports and the Government offices information on health and agriculture reports, socio-economic profile of the district as well as the district development plan.

1.8.9 Incorporating Public Views into the ESIA report

Views of those affected or interested by the project helped to identify and evaluate social and environmental impacts and were also considered in the formulation of mitigation measures and preparation of the environment management plan.

Table 1.7 Check list for detailed assessment of environmental aspects

Objective	Details	Method of obtaining information	Specific sources
General description of project	Location	Lit (A)	KenGen Library
	Area	Lit (A);	Focus group discussion; Scheme manager
	Project Design	Lit (A); KenGen;	The Olkaria Optimization Study (Phase II); Feasibility Study Report for New Units of the optimization project; Olkaria Appraisal Domes Area drilling Project Report; Olkaria 1 Unit IV and V Environmental Impact Assessment Project Report
Existing environmental conditions			
	Relative humidity	Lit (A)	KenGen
	Temperature	Lit (A), Lit (B)	KenGen
	Rainfall	Lit (A), Lit (B)	KenGen
	Solar radiation	Lit (A), Lit (B)	KenGen
	Pan evaporation	Lit (A), Lit (B)	KenGen
	Wind	Lit (A), Lit (B)	KenGen
	Water resources (both surface & subsurface)	Lit (A), Lit (B)	Focus group discussion; Water Resources Management Authority (WRMA) Naivasha District and Field Survey.
	Hells Gate National Park	Lit (A)	Kenya Wildlife Service (KWS); WWF and Field Survey
	River/rain gauge network status	Lit (B)	KenGen,
	Lake Naivasha	Lit (A); OB	Water Resources Management Authority (WRMA) Naivasha District and Field Survey.
	Water quality	Lit (A)	KenGen
	Vegetation	OB and S	Field survey
	Avifauna	OB and S	Field survey
	Fisheries	OB and S	Field survey
	Health facilities	Focus Group Discussions	MOH Naivasha
	Schools	Lit (A)	Ministry of Education
	Road network and status	OB	Field survey
	Transport	OB	Field survey
	Churches	OB	Field survey
	Preliminary soil texture	Lit (B); IN; OB	KenGen
	Erosion/deposition	Lit (B); OB	KenGen,
	Grazing land	OB, S	Social survey
	Environmental and social components likely to be affected by the project activities	OB, S	Social survey and Environment.
	Public health	OB, S	Social survey
	The magnitude of the changes in air and noise quality parameters	S	Air and Noise modelling.
	Present and projected employment by the Geothermal Plant	; IN	KenGen

NOTES:

Lit (A)	Literature that is already available
Lit (B)	Literature that is not available but can be researched
IN	Consultation with community informants (individual or smaller group)
KenGen	KenGen and other relevant staff
SA	Sampling
OB	Field observation

1.9 Constraints and Limitations

The information presented in this report is by and large consistent with the data and information gathered through the various sources and approaches outlined above. However, just as in any studies, the exercise experienced a number of constraints and as a result, there could be some gaps of information in the report as the consultants could not exhaust the collection of all primary data.

The findings and issues advanced in this report reflect the general views and feelings of some selected people and stakeholders; they may not cover the specific issues from some unique situations or some individuals affected by the project.

Some of the information in the report was processed from secondary sources and such data include information for maps, land resources, atmospheric resources, water resources, biological resources, socioeconomic data on poverty situation in Kenya and data on the role of geothermal energy to the economy of Kenya. It is therefore necessary to understand such information with the time reference and the limitations.

1.10 The ESIA team

The ESIA team comprised the following:

• Elizabeth Ndinya:	Project Director
• Arundhati Willets	Team Leader Technical reviewer
• George Goro Owuor:	Project Manager and Environmental Geologist;
• Nigel Holmes	Air quality and Noise modelling Expert
• Christopher Mbindah	Land Valuer
• Anastasia Ngatti	Social Scientist
• Reuben Onunga	Civil Engineer
• Nicholas Ngece	Ecologist
• Wilfred Ogada	GIS Specialist
• Violet Mulaku	Assistant Sociologist

1.11 Project Implementing Agency

The Project-Implementing Agency is KenGen which is a Parastatal under the Ministry of Energy.

Contact details of KenGen are as follows:

Official Address:	The Managing Director, Kenya Electricity Generating Company Limited,
Postal address:	P.O. Box 47936 - 00100
Physical Address:	Stima Plaza Phase III, Kolobot Road, Nairobi
Telephone:	254-2- 3666706
Facsimile:	254-2-2210694
Contact Persons:	Mr Pius Kollikho

1.12 Structure of the ESIA Report

This report has been prepared under the following chapters:

Executive summary: This chapter presents a summary of the significant findings and recommended actions, with an emphasis on expected impacts and management measures.

Chapter 1: **Introduction:** This chapter gives description of the project proponent profile, type of project proposed, history, location, background, reasons for the ESIA, constraints and limitations and the ESIA team and the ESIA report format.

Chapter 2: **Policy, legal and institutional / administrative framework**: This chapter outlines the Environmental requirements from Kenya and International Donor Policies on Environmental and Social Assessment Procedures (ESAP) relevant to this project.

Chapter 3: **Description of the Project Environment:** This chapter gives description of the environmental setting of proposed project and surrounding areas, e.g., climate, soils, geology, vegetation, fauna, land use, human populations, socio-economics, cultural heritage.

Chapter 4: **Project Description:** This chapter gives a description of the status of the project in the project cycle, details of the proposed project, alternative options, designs and implementation strategies.

Chapter 5: **Alternatives to the Project:** This chapter gives description of the alternative technologies and sources to the projects.

Chapter 6: **Public Consultation Programme:** This chapter gives description of the objectives, methods used and summary of results of the public consultation activities undertaken during the ESIA'.

Chapter 7: **Assessment of Environmental Impacts and mitigation measures:** This chapter presents the analysis of beneficial and adverse impacts of the project on the biophysical and human (social, cultural and economic) environments. The analysis covers anticipated impacts during the construction, operation phases and decommissioning phases and also describes the enhancement and mitigation measures proposed to enhance benefits or prevent, minimize, mitigate or compensate for adverse impacts as well as the estimated cost of mitigation.

Chapter 8: **Environmental and Social Management and Monitoring Plan:** This chapter presents the proposed Environmental and Social Management Plan prepared for the project.

Chapter 9: **Conclusions and Recommendations:** The conclusion briefly presents the environmental and social acceptability of the project, taking into account the impacts and measures identified during the assessment process.

Chapter 10: **Reference:** The chapter presents all the reference material used in the course of the study.

2 REGULATORY POLICY AND LEGAL FRAMEWORK

2.1 Legal framework

Kenya has over 77 statutes which relate to environmental concerns. Most of these statutes are sector specific, covering issues such as public health; soil erosion; protected areas; endangered species; water rights and water quality; air quality, noise and vibration; cultural, historical, scientific and archaeological sites; land use; resettlement; etc.

Previously, environmental management activities were implemented through a variety of instruments such as policy statements and sectoral laws and also through permits and licences. For example, the Physical Planning Act of 1996 empowers local authorities to request existing facilities to conduct environmental assessments, while under the Local Government Act of 1998; it is an offence to emit smoke, fumes or dust which may be a source of danger, discomfort or annoyance.

With the enactment of the Environmental Management and Co-ordination Bill in December 1999, the institutional framework for environmental management was strengthened. The Environmental Management and Co-ordination Act (EMCA) of 1999 provided for the establishment of a National Environment Management Authority (NEMA), which became operational in July 2002, with the statutory mandate to co-ordinate all environmental activities.

2.1.1 Environment Management Act (No. 8 of 1999)

This Act is divided into 13 Parts, covering main areas of environmental concern as follows: Preliminary (I); General principles (II); Administration (III); Environmental planning (IV); Protection and Conservation of the Environment (V), Environmental impact assessments (EIA), audits and monitoring (VI); Environmental audit and monitoring (VII); Environmental quality standards (VIII); Environmental Restoration orders, Environmental Easements (IX); Inspection, analysis and records (IX); Inspection Analysis and Records (X); International Treaties, Conventions and Agreements (XI) National Environment Tribunal (XII); Environmental Offences (XIII).

Under section 58 (1) *of Kenya Government's Environment Management Coordination Act (EMCA), Number 8 of 1999 and National Environmental Management Authority (NEMA) Regulations for Environmental Impact Assessment and Audit of June, 2003,* the proposed Construction of *Olkaria IV Geothermal Power Station* project falls under the prescribed list of projects for which environmental impact assessment is mandatory, prior to implementation *(Second Schedule , page 174 of EMCA No.10 electrical Infrastructure section (a) electrical generation stations).* The basis is that the proposed project constitutes several components of activities, which would generate considerable changes and significant effects to the environment including on land, water, atmospheric resources and biological diversity.

Part II of the Act confers the right of every person to a clean environment and to its judicial enforcement. The Act therefore makes it mandatory for KenGen to work in a clean environment and protect people living close to the project.

Part V Section 44 includes protection of hill tops, hill sides, mountain areas and forests; Olkaria area basically lies on a mountainous dome. KenGen will be required to institute measures for the sustainable use of hill sides, hill tops so as to prevent soil erosion as required by the Act.

Section 51 and 54 deals with conservation of biological resources and protection of the environmental significant areas, the proposed development lies in diverse ecosystem area with the Hell's Gate National Park, which needs to be protected.

Section 56 deals with the protection of ozone layer and emissions of dangerous gases to the atmosphere, the geothermal processes will lead to emission of CO_2. CO and CH4 which are ozone layer depleting substances. KenGen will be required to abide by the allowable discharge limits to the atmosphere.

All the chapters 1 to 13 apply to the new project at one stage or the other and therefore KenGen is required to understand and use the Act in total.

The Act provides for the setting up of the various ESIA Regulations and Guidelines which are discussed below:

(a) Environmental Impact Assessment and Audit Regulations 2003

The Environmental Impact Assessment and Audit Regulations state in Regulation 3 that *"the Regulations should apply to all policies, plans, programmes, projects and activities specified in Part III and V of the Regulations"* basically lists the guidelines of undertaking, submission and approval of the ESIA Report (this report).

(b) Environmental Management and Co-ordination (Waste Management) Regulations 2006

These are described in Legal Notice No. 121 of the Kenya Gazette Supplement No. 69 of September 2006. These Regulations apply to all categories of waste as provided in the Regulations. These include:

- Industrial wastes;
- Hazardous and toxic wastes;
- Pesticides and toxic substances;
- Biomedical wastes;
- Radio-active substances.

These Regulations outline requirements for handling, storing, transporting, and treatment / disposal of all waste categories as provided therein. Wastes contaminated with petroleum product are considered to be hazardous. KenGen will have to abide by these regulations in dealing with waste management especially the provisions of Industrial, Hazardous and toxic wastes which may be generated during there operations.

(c) Environmental Management and Coordination, (Water Quality) Regulations 2006

These are described in Legal Notice No. 120 of the Kenya Gazette Supplement No. 68 of September 2006. These Regulations apply to drinking water, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife and water used for any other purposes. This includes the following:

- Protection of sources of water for domestic use;
- Water for industrial use and effluent discharge;
- Water for agricultural use.

These Regulations outline:

- Quality standards for sources of domestic water;
- Quality monitoring for sources of domestic water;
- Standards for effluent discharge into the environment;
- Monitoring guide for discharge into the environment;
- Standards for effluent discharge into public sewers;
- Monitoring for discharge of treated effluent into the environment.

In fulfilling the requirements of the regulations KenGen will undertake monitoring of both domestic water and wastewater and ensure compliance with the acceptable discharge standards.

(d) **Environmental Management and Coordination, Conservation of Biological Diversity (BD) Regulations 2006**

These regulations are described in Legal Notice No. 160 of the Kenya Gazette Supplement No. 84 of December 2006. These Regulations apply to conservation of biodiversity which includes Conservation of threatened species, Inventory and monitoring of BD and protection of environmentally significant areas, access to genetic resources, benefit sharing and offences and penalties. The Regulations mainly applies due to the location of the proposed project site near to the Hell's Gate National Park. Proper environmental management will be required to conserve the biological diversity within the area.

(e) **Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations 2006**

These regulations are described Legal Notice No. 131 of the Kenya Gazette Supplement no. 74, October 2006 and will apply to all internal combustion engine emission standards, emission inspections, the power of emission inspectors, fuel catalysts, licensing to treat fuel, cost of clearing pollution and partnerships to control fossil fuel emissions used by KenGen. The fossil fuels considered are petrol, diesel, fuel oils and kerosene.

(f) **Environmental Management and Coordination (Controlled Substances) Regulations 2007**

These regulations are described in Legal Notice No. 73 of 2007. The Government of Kenya banned the importation of Chlorofluorocarbons (CFCs) with effect from 1 January 2009, to ensure that Kenya is compliant with the provisions of the Montreal Protocol on Substances that Deplete the Ozone Layer.

This regulation makes it mandatory for industries, and other stake holders in ODS trade, to obtain a license to import these substances. The ozone-friendly refrigerants, oil lubricants, and other ozone-friendly alternative chemicals to CFCs shall be the only ones that shall be licensed for importation for use in equipment. No license shall be issued to any person to import CFCs.

The customs officers, at the points of entry, shall use CFC identifiers to detect and intercept CFCs that may be imported illegally. Intercepted CFC shall be shipped back to the country of origin at the cost to be met by the importer.

(g) **Environmental Management and Coordination (Wetlands, Riverbanks, Lake Shores and Sea Shore Management) Regulations 2009**

These regulations are described in Legal Notice No. 19 of the Kenya Gazette Supplement no. 9, February 2009. These regulations include management of wetlands, wetland resources, river banks, lake shores and sea shores. Specific sections have requirements that apply to Lake Naivasha major source of water supply to KenGen. The regulations will empower the Naivasha District Environment Committee to co-ordinate, monitor and advise on all aspects of wetland and water resource management within the district.

(h) **Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations, 2009**

These Regulations prohibit KenGen from making or causing any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. It also prohibits KenGen from excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment or excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source. Under the regulation KenGen will be required to undertake daily monitoring of the noise levels within the proposed geothermal station to maintain compliance.

(I) Environmental Impact Assessment (EIA) Guidelines for the Tourism Sector In Kenya (9 October 2007)

The development of the EIA guidelines were undertaken in compliance with the Environmental Management and Coordination Act (1999) and the Environmental Impact Assessment and Audit Regulations (2003). The latter, stipulates under section 12, subsection (2) that: *"sectoral Environmental Impact Assessment Guidelines shall be developed by the lead agency in consultation with the National Environmental Management Authority (NEMA)."* The EIA guidelines were formulated in a broad-based consultative process, through gathering and assessing inputs from all established sectoral players in the tourism industry, this applies to the current project and therefore this report.

2.1.2 Energy Act No. 12 of 2006

The provisions of this Act shall apply as herein specified to every person or body of persons importing, exporting, generating, transmitting, distributing, supplying, using electrical energy, importing, exporting, transporting refining, storing and selling petroleum or petroleum products, producing, transporting, distributing and supplying of other forms of energy, and to all works or apparatus for any or all of these purposes". Therefore the Act wholly applies to KenGen from its definition and principle.

This part creates the Energy Regulatory Commission whose functions and powers include issuance of licences, permits and exemptions for electric power and petroleum undertakings, review and approval of the electric power tariffs, imposition and collection of penalties and fines for non- compliance in the energy sector, investigation and resolution of conflicts, formulation of regulations and enforcement of standards in the Energy Sector, formulation and co- ordination of a disaster preparedness plan for the energy sector, ensuring fair play and competition the Energy sector

2.1.3 Geothermal Resources Act

The Geothermal Resources Act, 1982, establishes a series of steps which the geothermal developer must follow. These are the Minister of Energy must first Authorize all resource exploitation; (2) a "geothermal resources license" must be obtained from the Minister to enable the developer to drill, extract, and utilize the resources, and (3) if electricity is to be produced the developer must obtain a license under the Electric Power Act, or if Commercial by-products are reclaimed; the geothermal resources license must include a lease consistent with the Mining Act. KenGen has been issued with a geothermal license under this Act and it is attached in Appendix 5 of this report.

The Geothermal resources Regulations, 1990, set forth a model license which establishes the basis for negotiating the arrangements for obtaining the rights to the Kenyan Geothermal resources license. The Model License establishes a schedule of payment for land rental and royalty for the sale of steam or electricity. It provides for the forfeiture of the license in the event of either unauthorized inactivity on the part of the developer or breach of the geothermal laws, regulations or licence.

The Model License mandates a reporting system and establishes an incentive system whereby the Minister of Energy undertakes to secure a number of investment incentives for the licensee.

The legal basis of Kenya's Geothermal Policy is stated in the Geothermal Resources Act of 1982. The Act was written to control the exploitation and use of geothermal resources, to vest the resources in the Government of Kenya, and to provide for connected purposes. The Act defines terms commonly used in the exploitation of the geothermal resources.

The regulatory aspect of the Geothermal Policy is provided for in the Geothermal Resources Regulations of 1990. These regulations stipulate the procedures to be followed by those who wish to explore, drill, extract and utilize geothermal resources and therefore wholly applies to KenGen from its definition, principle and operation.

(a) Provisions of Geothermal Resources Act

(I) Authority to for Geothermal Resources

Ownership of all geothermal resources under any land is vested with the Government. The Minister for Energy is responsible for declaring any area a geothermal resources area. The Act prohibits any unauthorized use of the geothermal resources. In order to extract and use geothermal resources one has to be granted authority or license. Authority to search for geothermal resources is also granted by the Minister for Energy. The Minister may authorize any person (including a public officer) to make surveys, investigations, tests and measurements in search of geothermal resources. The written authority empowers a person to enter any land specified by the authority, drill any bore, make geological and geophysical surveys and generally do all things necessary in connection with the search of geothermal resources. When practicable, reasonable notice of intention to enter upon any land shall be to the owner or of the land. Also, the authorized person should be ready to produce his notice of authority when required to do so by the owner or occupier of the land on which he intends to enter or has entered. The authority granted is subject to the condition that every bore drilled shall be kept under close supervision, maintained a safe condition and finally left in a condition of lasting safety.

The authority granted is not transferable and is valid for one year but it may be renewed on a yearly basis after expiration. The authority may be revoked if the person to whom it was granted has not complied with any requirement or condition of his authority or if the operations being carried out are detrimentally affecting other specified bores. It may also be revoked if it is in the public interest that the operations being carried out should cease.

(ii) Geothermal Resources License

The Geothermal Resources License may be granted over part or the whole of a geothermal resources area. The license application must be on the approved form and should be accompanied by the prescribed fees. The license granted will be for a term not exceeding thirty years or as the Minister for Energy may determine.

The license shall confer upon the licensee the right to enter upon the land being the subject of the license to drill and to extract geothermal resources and to do all such things as are necessary for the conduct of those operations. This means the right to drill and construct all necessary boreholes, erect the necessary infrastructure for operations, utilize the geothermal resources and subject to the Water Act, reclaim and utilize any water. The licensee also has the right to take and use or apply the geothermal resources for any purpose specified in the license.

Where any by-product obtained in the production of geothermal resources may be reclaimed for further use or sale and is a mineral within the meaning of the Mining Act, the license may be modified so as to allow for the inclusion of a mining lease to enable recovery of that by-product.

The license is renewed for a term not exceeding five years subject to such terms and conditions as the Minister for Energy may think fit. The licensee shall not transfer or assign his license or any part thereof the consent in writing of the Minister for Energy. The license may be declared forfeited if the licensee wholly ceases to work in the area of the license during a continuous six months period without the written consent of the Minister for Energy, or if he a breach or is in default of any provision of the Geothermal Resources Act. The forfeiture of a license shall not affect any liability already by the licensee.

2.1.4 Occupational Health and Safety Act

This is an Act of Parliament which provides for the safety, health and welfare of all workers and all persons lawfully present at workplaces and it also provides for the establishment of the National Council for Occupational Safety and Health and for connected purposes.

It applies to all workplaces where any person is at work, whether temporarily or permanently and therefore will apply to the project both during construction and operation phases.

The purpose of this Act is to:

- Secure the safety, health and welfare of persons at work; and
- Protect persons other than persons at work against safety and health arising out of, or in connection with the activities of persons at work.

The Occupational Health and Safety Act (OSHA) 2007 repealed the Factories and Other Places of Work Act. Anything done under the provisions of the Factories and Other Places of Work Act including subsidiary legislation issued before the commencement of the OSHA 2007 shall be deemed to have been done under the provisions of this Act.

The Factories and Other Places of Work Act had over the years passed several subsidiary rules and regulations for effective implementation of the Act. All shall, as long as it is not inconsistent with OSHA 2007 remain in force until repealed or revoked by subsidiary legislation under the provisions of OSHA 2007 and shall for all purposes be deemed to have been made under this Act.

These regulations include:

- The Factories (Cellulose Solutions) Rules 1957;
- The Factories (Wood Working Machinery) Rules 1959;
- The Factories (Dock) Rules 1962;
- The Factories (Eye Protection) Rules 1978;
- The Factories (Electric Power) (Special) Rules 1978;
- The Factories (Building Operations and Works of Engineering Construction) Rules 1984;
- The Factories and Other Places of Work (Health & Safety Committees) Rules 2004;
- The Factories and Other Places of Work (Medical Examination) Rules 2005;
- The Factories and Other Places of Work (Noise Prevention and Control) Rules 2005;
- The Factories and Other Places of Work (Fire Risk Reduction) Rules 2007;
- The Factories and Other Places of Work (Hazardous Substances) Rules 2007.

The scope of OSHA 2007 has been expanded to cover all workplaces including offices, schools, academic institutions and plantations. It establishes codes of practices to be approved and issued by the Director, Directorate of Occupational Health and Safety (DOHS) for practical guidance of the various provisions of the Act.

Other parameters within the Act relevant to the project include:

- Duties of employers, owners or occupiers of workplace;
- Establishment of safety and health committees;
- Annual safety and health audit of workplaces;
- Safety and Health obligations for persons who may come to premises for work and are not employees of that particular workplace;
- Reporting of any accident, dangerous occurrence or occupational poisoning caused in the workplace to the area Occupational Health and Safety Office. These incidents should be entered in the General Register. In case of a fatal accident information to the area Safety and Health Office should be within 24 hrs and a written notice to the same within 7 days;
- The duties of manufactures, designers, importers and suppliers to ensure that all articles and substances for use at workplace are safe and will not cause injury to health and the environment;
- Duties of self employed persons;
- Duties of employed persons;
- Prohibition of interference or misuse of any appliance, convenience or any other facility provided to secure Safety, Health and Welfare at work by any person (occupier,

self employed person or employed);

- The administration of the Act is the responsibility of a Director and other appointed and gazetted officials (Occupational Health and Safety Officers);
- The registration of all workplaces by the Director DOHS forming the basis of his work statistics;
- Machinery safety to include:
    - Safe use of machinery, plant and equipment;
    - Prime makers and transmission machines;
    - The maintenance, construction of fencing safeguards;
    - The statutory requirements of various machines, plants and equipment (hoists and lifts, chains and ropes, cranes, steam receivers and containers, air receivers, cylinders for compressed liquefied and dissolved gases and refrigeration plants).
- Chemical safety including:
    - Handling, transportation and disposal of chemicals and other hazardous substances;
    - Importance of Materials Safety Data Sheets (MSDS);
    - Labelling and marking of chemical substances;
    - Classification of hazardous chemicals and substances;
    - Establishment and adoption of exposure limits on hazardous substances in a workplace;
    - Control of air pollution, noise and vibrations;
    - Redeployment on medical advice.
- Health, safety and welfare special provision including:
    - Permit to Work systems;
    - Work processes that are likely to harm persons below eighteen (18) years;
    - Supervision of apprentices and indentured learners;
    - Training and supervision of inexperienced workers;
    - Medical surveillance.
- Penalties, offences and legal proceedings including:
    - The upward adjustments of all fines imposed in the event of failure to comply with provisions of the Act;
    - The need to investigate and prosecute the real offender otherwise all those who fail to comply with any provisions of this Act that have been legally imposed on him/her shall be prosecuted;
- The establishment of the safety and Health fund and Safety and Health regulations and procedures thereof;

2.1.5 Water Act 2002

Water in Kenya is owned by the Government, subject to any right of the user, legally acquired. The control and right to use water is exercised by the Minister administering the Act, and such use can only be acquired under the provisions of the Act. The Minister is also vested with the duty to promote investigations, conserve and properly use water through out Kenya. Water permits may be acquired for a range of purposes, including the provision and employment of water for the development of power and other uses. The following are the regulations developed under Water Act 2002 relevant to the project. These regulations will relate to abstraction and use of water mainly from the Lake Naivasha.

(a) The Water Resources Management Rules (2007)

These Rules are described in Legal Notice Number 171 of the *Kenya Gazette Supplementary Number 52 of 2007*. They apply to all water resources and water bodies in Kenya, including all lakes, water courses, streams and rivers, whether perennial or seasonal, aquifers, and shall include coastal channels leading to territorial waters.

The Water Resources Management Rules empower Water Resources Management Authority (WRMA) to impose management controls on land use falling under riparian land.

It also enables any person with a complaint related to any matter covered by these rules to the appropriate office in WRMA as per the Tenth Schedule which provides a format for report on complaints. WRMA is to reply to the complainant with *"copies to all other relevant parties within twenty one days of receiving the complaint, starting with what action is being taken, the position of the Authority on the matter and any recommendation to the complainant."*

The rules also elaborate on the following:

- Mechanisms for appeal;
- Public notification;
- Public consultation;
- Orders on compliance;
- Protection of the integrity of the water resources monitoring network;
- Water Resource User Associations;
- Water Resource Database;
- Approval of activities listed in the fifth schedule of Water Act 2002;
- Authorisation and permitting;
- Wetlands;
- Allocation of water for irrigation;
- Prior right to water for storage;
- Dams;
- Groundwater development and its regulation;
- Control of water pollution and effluent discharge;
- Water works;
- Water use charges on permitted water use;
- Conservation of riparian land and catchment areas;
- Catchment management strategies;
- Protected areas and ground water conservation areas;
- Establishment and protection of reserve water;
- Miscellaneous provisions which include provisions on:
    - Qualifications to practise as a water resource professional;
    - Qualifications for a registered contractor;
    - Recognised water quality laboratories;
    - Emergency orders;
    - Penalties for offences;
    - Revocation of rules under Cap 372.

Part IX : *Conservation of Riparian and Catchment Areas* of the Rules, Section 116(5) states "

Unless otherwise determined by a water resources inspector, the riparian land adjacent to the ocean is defined as a minimum of two metres vertical height or thirty metres horizontal distance from the high watermark, whichever is less".

Section 118 (1) of the Rules state " No person shall undertake the activities listed in the Sixth Schedule on riparian land unless authorised by the Authority in consultation with other relevant stakeholders".

Part A of the Sixth Schedule: *Protection and Conservation of Riparian and Catchment Areas* of the Rules provide activities proscribed on riparian land as:

- Tillage or cultivation;
- Clearing of indigenous trees or vegetation;
- Building of permanent structures;
- Disposal of any form of waste within the riparian land;
- Excavation of soil or development of quarries;
- Planting of exotic species that may have adverse effect to the water resource;
- Or any other activity that in the opinion of the Authority and other relevant stakeholders may degrade the watercourse.

Part IV: *Ground Water* of the Rules, Section 72 (4) state *"Where any borehole or well is intended to be equipped with a motorised pump, the application shall be accompanied by a hydrogeological assessment report in the prescribed form set out in the second schedule".*

Part IV, Section 73 states as follows:

"……

(1) For the regulation of ground water development, the authority will determine the allocation plan for a given aquifer or part thereof, the spacing of boreholes, or wells to be equipped with a motorised plant and will be guided by:

- *Existing borehole or well spacing;*
- *Individual aquifer characteristics, including water quality;*
- *Existing aquifer use;*
- *Existing bodies of surface water.*

(2) The allocation plan shall be available and accessible to the public during normal working hours from any of the Authority Offices.

……"

Part IV, Section 74 states as follows:

"……

(1) All new boreholes and wells to be equipped with motorised pumps shall be subject to test pumping.
(2) Continuous constant rate pumping test of not less than twenty four hours duration and recovery duration of not less than twenty hours or as otherwise stipulated by the Authority.

……"

2.1.6 The Wildlife (Conservation and Management) Act

The Wildlife (Conservation and Management) Act Cap 376 of the Laws of Kenya and the 1989 Amendment is the Principal Act regulating wildlife conservation and management in Kenya. The Act also establishes Kenya Wildlife Service (KWS) as the implementing agency. The Act will apply since the proposed site for Olkaria I Unit 4 and 5 is within Hell's Gate National Park.

Section 3A, of the Act states *"The functions of KWS shall be among others "prepare and implement management plans for National Parks and National Reserves and the display of fauna and flora in their natural state". The Act also authorises the Director to enter into agreement with other competent authorities* for the purpose of ensuring that animal's migration patterns essential for the continued viability of national park and national reserve established pursuant to the Act is maintained.

The Minister responsible for wildlife has discretionary powers to promulgate such regulations to enhance the management of the protected areas. However, such regulations must be reasonable and must not be *ultra vires* to the parent Act. The high degree of inviolability of national parks and reserves is illustrated by the fact that the Act provides specifically that no part of the park may be alienated or excluded or detached from the park except under the authority of a resolution of parliament. Under this Act the KWS and KenGen has entered into agreement in the use of the section of the Hell's Gate National Park under the Memorandum of Understanding between the two Parastatals which is attached in Appendix 6 of this report.

2.1.7 The Fisheries Act

The Fisheries Act Cap 378 of 1989 of the Laws of Kenya provides for development, exploitation, utilisation and conservation of fisheries and for connected purposes. The Act provides for promoting the development of traditional and industrial fisheries, fish culture and related industries through:

- Extension service;
- Research and surveys;
- Infrastructure development;
- Restocking;
- Exploring marketing opportunities;
- Enhancing community participation in fisheries management.

The protection of fish and marine organisms is accomplished through prohibitions against their catching, disturbance or possession. The Act also regulates use of fishing through licensing systems for both local and foreign vessels.

2.1.8 Local Government Act Chapter 265 (Revised 1998)

The Act empowers Local Authorities to make by-laws to control nuisances and to keep premises free from offensive or wholesome matter which could be injurious to health. In addition Section 163(e) of the Act empowers Local Authorities to prohibit and control all businesses and factories that in their operations produce smoke, fumes, chemicals, gases, dust, smell, noise and or vibration that may become a source of danger, discomfort or annoyance to the neighbourhood. The Local Authority is also empowered to refuse licensing or renewal if that granting of the license is not to the public interest or would cause nuisance or annoyance to the neighbours, and should methods adopted to prevent noxious/offensive vapours, gases or smells become inefficient.

Section 166 empowers Local Authorities to prohibit and control development and use of land and buildings in the interest of its area of jurisdiction.

2.1.9 The Physical Planning Act Chapter 286

This is the main Act that governs land planning and all proposed developments must be approved by the respective Local Authority and certificate of compliance issued accordingly.

Under the Act, the Director of Physical Planning advises the Commissioner of Lands on land alienation issues that fall under Government Lands Act and Trust Land Act. The Director also advises the Commissioner of Lands and Local Authorities on land use, sub-division and or amalgamation of land; prepares regional and local physical development plans.

At the District Level, The District Physical Planning Liaison Committee comprises heads of the

various Departments and is chaired by the District Commissioner. One of the major functions of the Liaison Committee is to determine development applications for change of user or sub-division of land that could have significant impact on adjacent land and or breach registered conditions in a given title deed; and also industrial location which could have negative impact on the environment and adjoining land.

The Director is required to publish the regional physical development plan and also notify the Local Authority within whose jurisdiction the plan is to be affected.

Section 30(1) requires a developer in any Local Authority to be granted development permission by the respective Local Authority, failure to which heavy fines will ensue; and the Land Registrar shall decline to register such a document. No sub-division of private land shall take place within a Local Authority unless the sub-division is in accordance with the requirements of an approved local physical development plan.

The Director in consultation with the Board of National Museums may prohibit owner of a building from demolition, alteration or extension if in the Director's opinion the building is of special architectural value or historic interest as stated in Section 47(1).

2.1.10 The Tourist Industry Licensing Act

The Tourist Industry Licensing Act Cap 381 of 1968 of the Laws of Kenya makes provision for regulating the tourist industry with a view to promoting its well being and development. It covers such trade as hotels, safari operations, and boat owners. These trades are regulated through licenses.

2.1.11 Relevant Sectoral Legislation

While the EMCA supersedes all other environmental legislation, numerous other laws and regulations in addition to those described above influence the various aspects and activities of the Project, which include the following among others:

- *Public Health Act, Cap 242 (rev 1986);*
- *Trade Licence Act, Cap 497;*
- *Penal Code Cap 63 (rev. 1985);*
- *Standards Act, Chapter 496 (1974);*
- *Building Code (1968);*
- *Work Injury and Benefits Act (2007);*
- *Food, Drugs and Chemical Substances Act, Cap 254 (rev 1992);*
- *Use of Poisonous Substances Act, Cap 247(rev. 1983);*
- *Traffic Act, Cap 403;*
- *Transport Licensing Board Act (Cap. 404).*

2.2 Administrative framework

In 2001, the Government established the administrative structures to implement the EMCA (the Act). The main administrative structures are described in the following sections.

2.2.1 The National Environment Council

The National Environmental Council (the Council) is responsible for policy formulation and directions for the purposes of the Act. The Council also sets national goals and objectives, and determines policies and priorities for the protection of the environment.

2.2.2 The National Environment Management Authority

The responsibility of the National Environmental Management Authority (NEMA) is to exercise

general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment.

In addition to NEMA, the Act provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC) which will govern the discharge limits to the environment by the proposed project.

2.2.3 Energy Regulatory Commission

Energy Regulatory Commission (ERC) was established as an Energy Sector Regulator under the Energy Act, 2006 in July 2007. ERC is a single sector regulatory agency, with responsibility for economic and technical regulation of electric power, renewable energy, and downstream petroleum sub-sectors, including tariff setting and review, licensing, enforcement, dispute settlement and approval of power purchase and network service contracts. Under the Act KenGen will be required to submit a copy of the ESIA Report and Plant buildings to the Commission for approval.

2.2.4 Provincial and District Environmental Committees

The Provincial and District Environmental Committees also contribute to decentralised environmental management and enable the participation of local communities. These environmental committees consist of the following:

- Representatives from all the ministries;
- Representatives from local authorities within the province/district;
- Two farmers / pastoral representatives;
- Two representatives from NGOs involved in environmental management in the province/district;
- A representative of each regional development authority in the province/district.

The committees are empowered to discuss the environmental issues affecting the area of there jurisdiction, KenGen will therefore be required under the Act to liaise with the Naivasha District Environmental Committee and the Rift Valley Provincial Environmental Committees during the life of the project.

2.2.5 Public Complaints Committee

The Act (EMCA) has also established a Public Complaints Committee, which provides the administrative mechanism for addressing environmental harm. The Committee has the mandate to investigate complaints relating to environmental damage and degradation. Its members include representatives from the Law Society of Kenya, NGOs and the business community.

2.3 International Guidelines

2.3.1 Japan Bank for International Cooperation (JBIC) Guidelines

The Japan International Cooperation Agency (JICA), which is responsible for the implementation of technical cooperation and the preliminary study of grant aid projects in Japan's bilateral grants, prepared environmental guidelines for infrastructure projects in 1990, which were later revised, and the new guidelines for environmental and social considerations completed in March 2004. These guidelines cover development studies, preliminary studies of grant aid projects and technical cooperation projects. Their objectives are to encourage the recipient governments to take appropriate considerations of environmental and social factors as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly.

(a) Japan's Official Development Assistance Charter, June 30 1992

This charter was established to obtain broader support for Japan's Official Development Assistance (ODA). The basic philosophy of this charter is that the international community, from a humanitarian viewpoint, cannot ignore the fact that many people in developing countries, which constitute a majority among countries in the world, suffer from famine and poverty. Japan's ODA is provided in accordance with the principles of the United Nations Charter, as well as an additional four principles.
Further outlined in the Charter are the priorities, measures for the effective implementation of ODA, and measures to promote understanding and support at home and abroad. African countries are considered priority regions in the Charter, as well as infrastructure improvement, hence the application of this Charter to the current project.

(b) Japan Bank for International Cooperation (JBIC) Guidelines for Confirmation of Environmental and Social Considerations, 2002

JBIC establishes and makes public the above guidelines with the objective of contributing to efforts by the international community, particularly developing regions, towards sustainable development, through consideration of the environmental and social aspects in all projects subject to lending or other financial operations. Environmental and social considerations refer not only to the natural environment, but also to social issues such as involuntary resettlement and respect for the human rights of indigenous people.

Procedures for confirmation of environmental and social considerations include:

- Screening: each project is classified in terms of its potential environmental impact, taking into account such factors as the sector and scale of the project; the substance, degree and uncertainty of its potential environmental impact; and the environmental and social context of the proposed project site and surrounding areas;
- Categorization: Three categories A, B, and C exist. A proposed project is classified as Category A if it is likely to have significant adverse impact on the environment; Category B if its potential adverse environmental impact is less adverse than that of Category A projects; and Category C if it is likely to have minimal or no adverse environmental impact. This project is classified as Category B, under Section (1), Paragraph 2, Article 23 of The Japan Bank for International Cooperation Law.
- Environmental review for each category: This includes evaluation of measures necessary to prevent, minimize, mitigate or compensate for potential negative impact, and measures to promote positive impact if any such measures are available (Category A). The scope of environmental reviews for Category B projects may vary from project to project, but is narrower than that for Category A projects. Environmental reviews for projects in Category C do not proceed beyond screening.
- Monitoring: JBIC in principle confirms through the borrower over a certain period of time, the results of monitoring the items which have a significant environmental impact by the project proponents.

According to JBIC categorisation, this project falls under category A because there are likely to significant impacts to the project environment due to its location within Hell's Gate National Park.

2.3.2 World Bank Safeguard Policies

(a) Environmental Assessment (Operational Policy, OP 4.01)

The objective of OP 4.01 is to ensure that Bank-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. This policy is triggered if a project is likely to have potentially adverse environmental risks and impacts in its area of influence. OP 4.01 covers impacts on the natural environment (air, water and land); human health and safety; physical cultural resources; and transboundary and global environment concerns.

Thus, the construction and operation of geothermal generating station is likely to have environmental impacts, which require mitigation.

(b) Natural Habitats (Operational Policy, OP 4.04)

This policy recognizes that the conservation of natural habitats is essential to safeguard their unique biodiversity and to maintain environmental services and products for human society and for long-term sustainable development. The Bank therefore supports the protection, management, and restoration of natural habitats in its project financing, as well as policy dialogue and economic and sector work. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and most native species.

The proposed geothermal stations have the potential to cause conversion (loss) or degradation of natural habitats within the Hell's Gate National Park area, directly (through construction) as well as indirectly (through human activities induced by the project).

2.3.3 IFC Performance Standards

These are set out to help in carrying out the policies set out in the Operational Policy on Environmental Assessment (OP 4.01) and related documents. More specifically, detailed environmental, health and safety guidelines exist for electric power generations and for Geothermal Power Plants.

2.3.4 African Development Bank (AfDB) Requirements

In January 2004, the Boards approved the new Bank Group Policy on the Environment, which incorporates and redefines the former policy on environmentally sustainable development in Africa. The new policy acknowledges that to sustain economic growth in Africa, there is an urgent need to preserve and enhance the ecological capital that enriches such growth. Two guidelines relevant to the new Policy on the Environment were completed and disseminated in 2004, namely the Strategic Environmental Impact Assessment Guidelines (SEIA) and the Integrated Environmental and Social Assessment Guidelines (IESA). Of importance to this study are the IESA Guidelines, which are designed to ensure that both environmental and social issues are mainstreamed in Bank projects throughout the project cycle.

The IESA guidelines present the most frequent potential impacts and enhancement/mitigation measures for the considered sub-sector. The guidelines also outline indicators that could be useful for monitoring the considered projects. Sectoral guidelines exist, and those that most closely apply to this study are found in Appendix 6: Hydropower Production, Transportation, and Distribution.

According to AFDB categorization, the project is classified under category 1, since the proposed project will generate more than 30MW of electricity and will also involve the resettlement of over 50 Households and more than 200 people.

2.4 KenGen's Environmental Management Systems

KenGen has established Environmental Management as an integral component of its business planning since the company was established. To meet all the basic environmentally sound and socially acceptable practices at the local and international level, the company initiated the implementation of ISO 14001:2004 standards. Through the EMS system, KenGen has identified and documented its significant environmental aspects and impacts on the environment and set in place interventions to manage these aspects.

KenGen has further articulated its commitment in environmental management to the public and its stakeholders through an Environmental Policy Statement, which is also aligned with its vision and mission statements. The environmental policy statement commits the organisation to compliance with applicable laws and regulations, prevention of pollution, continuous improvement and accountability to the internal and external stakeholders and the public at large.

To successfully sustain the good environmental management practices, KenGen has not only continued to commit resources in enhancing staff capacity through relevant training and awareness locally and abroad but is also taking the lead in initiating the Clean Development Mechanism (CDM) projects of the Kyoto protocol.
Currently, six projects have been cleared by the World Bank and several others still under review.

In ensuring legal compliance with EMCA 1999, annual environmental audits are done and submitted to the National Environmental Management Authority (NEMA) and Energy Regulatory Commission (ERC). All upcoming power projects are also subjected through Environmental Social and Impact Assessment (ESIA) studies and issuance of permits before implementation (this project).

Since 60% of the country's power need is from hydro, the company is financing Catchment Preservation in all the five-catchment towers on its own and through the Kenya Energy Sector Environment Program (KEEP).

The key benefits anticipated by KenGen through good environmental performance and management are:

- *Compliance with prescribed regulations and especially the national Environmental Management & Coordination Act 1999;*
- *Improved resource efficiency and waste reduction through optimal use of resources and waste reduction strategies;*
- *Systematic and integrated approach to environmental management*
- *Improving our public image and community relations*
- *Continually improve economic-environmental performance and*
- *Increasing confidence of stakeholders;*
- *Enhancing global market access with environmentally conscious partners;*
- *Achieving greater employee satisfaction;*
- *Institutionalization of pollution prevention strategies.*

2.5 International Conventions

2.5.1 Vienna Convention for the Protection of the Ozone Layer

Intergovernmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of the Vienna Convention for the Protection of the Ozone Layer. This Convention encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and the exchange of information.
The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in September 1987, and was intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments. The Protocol was adjusted to accelerate the phase out schedules. It has since been amended to introduce other kinds of control measures and to add new controlled substances to the list.

2.5.2 Convention on Biological Diversity

The purpose of this convention is to ensure the conservation and sustainable use of biodiversity. Kenya signed the convention on 5th June 1992 and ratified the same on 26th July 1992. The National Environment Management Authority (NEMA) is the national focal point to this Convention on Biological Diversity. The provisions of this Convention have been integrated in many laws of Kenya.

2.5.3 The Ramsar Convention

Kenya ratified the convention in June 1990. The Ramsar Convention on Wetlands is primarily concerned with the conservation and Management of Wetlands. Parties to the convention are also required to promote wise use of wetlands in their territories and to take measures for the conservation by establishing nature reserves in wetlands, whether they are included in the Ramsar list or not.

The proposed project is expected to observe and adhere strictly to the Ramsar Convention's principles of wise use of wetlands in the project area. Wetlands are defined by the convention on Wetlands or the Ramsar Convention (1971) as: "Areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salty, including areas of marine water the depth of which at low tide does not exceed six meters"

In Kenya, as well as in east Africa, wetlands are defined as: " areas of land that are permanently, seasonal or occasionally water logged with fresh, saline, brackish or marine water, including both natural and manmade areas that support characteristic biota" the latter definition has the approval of the national wetland standing committee of Kenya's Inter ministerial Committee on Environment (IMCE). It is the refinement of Ramsar Convention's definition for the East Africa and does not exclude anything defined by the Ramsar Convention. This definition included swamps, marshes, bogs, soaks, shallow lakes, ox-bow lakes, river meanders and flood plains, as well as riverbanks, lakeshores where wetland plants grow. It also includes marine and inter-tidal wetlands such as deltas, estuaries, mudflats, mangroves, salt marshes, sea grass beds, shallow coral reefs and creeks.

2.5.4 Convention on the Wetlands of International Importance as Waterfowl Habitat

This convention is also referred to as Ramsar Convention. Its main objective is to promote conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world. Kenya ratified the Convention on 5th June 1990.

2.5.5 Convention on the Conservation of Migratory Species of Wildlife Animals

This Convention is also referred to as Bonn Convention. It is intended to ensure that migratory species of wild animals spelt out on Appendix I and II to that convention are protected from extinction. The Convention requires intergovernmental cooperation to ensure that the species are allowed to migrate as their nature and their habit is preserved. The Convention was adopted on 23rd June 1979 and came to force on 1st November 1983.

2.5.6 African Convention on the Conservation of Nature and Natural Resources

This convention reaffirms the importance of natural resources both renewable and non renewable, particularly the soil, water, flora and fauna. The main objective is to facilitate sustainable use of the above resources. The convention was adopted in Algiers on 15th September, 1968 and came into force on 16th June 1969.

2.5.7 Convention on International Trade in Endangered Species

This Convention was adopted on 3rd March 1973 and came into force on 1st July 1975. The purpose of the Convention is to regulate the international trade in wild plants and animals that

are at risk of extinction as a result of trade. The Convention seeks to control trade not only in live species but also in dead specimen and their derivatives. The Kenya Government ratified CITES on 13th December 1978. The lead agency for the CITES in Kenya is the Kenya Wildlife Service (KWS).

2.5.8 United Nations Convention to Combat Desertification

The above Convention was adopted on 17th June 1994 in Paris and came into force on 26th December 19976. Kenya ratified the Convention in 24th June 1997. The purpose of the UNCCD is to address the problem of the degradation of land by desertification and the impact of drought particularly in arid and dry semi-humid areas. NEMA is the focal point for the Convention.

2.5.9 The 1992 United Nations Framework Convention on Climate Change (UNFCCC)

The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The UNFCCC was adopted on 9th May 1992and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994. NEMA is the focal point for the Convention.

2.5.10 Kyoto Protocol to the United Nations Framework Convention on Climate Change

The Kyoto Protocol requires signatories to the United Nations Framework Convention on Climate Change to reduce their green house emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India, and Australia are not signatories to the Protocol. NEMA is the national focal point for this Protocol.

2.5.11 Agenda 21

Kenya continues to implement Agenda 21 to support sustainable development through the integration of environmental concerns into the national development policies, plans, and programmes.

2.5.12 Millennium Development Goals

Whilst there is no mention of energy in each of the eight Millennium Development Goals (MDGs), energy services is inevitably an essential input to achieving all the eight goals. This is due to the fact that in order to implement the goal accepted by the international community, to halve the proportion of people living below the poverty line, by 2015, access to affordable energy services is a prerequisite.

2.5.13 Convention on the Rights of the Child

The Convention on the Rights of the Child (CRC), 1989 is the most comprehensive compilation of international legal standards for the protection of the human rights of children. The CRC is also the most widely ratified international human rights treaty, ratified by all countries in the world, with the exception of two. The Convention acknowledges children as individuals with rights and responsibilities according to their age and development (rather than the property of their parents or as victims), as well as members of a family and community. Underlying the Convention are four main principles: non-discrimination, the best interests of the child, the right to life, survival and development and the right to participation.

The CRC reaffirms children's basic human rights to health, shelter and education. Special emphasis is placed on safeguarding family unity and the reunification of families (Articles 8, 10, 20). Another fundamental right enumerated in the Convention is the child's right to education and the obligation of states to make primary education free and compulsory for all children (Articles 28, 29). Education has also been identified as an effective and essential form of protection for displaced children. For example, displaced children in school may be more protected from the risks of military recruitment, exploitation and abuse. Educational and

recreational activities, like sports, can also help children recover from the trauma of conflict and displacement *(Internal Displacement Monitoring Centre, 2004).*

2.5.14 Convention on the Elimination of all forms of Discrimination against Women

The Convention on the Elimination of all forms of Discrimination against Women (CEDAW) places explicit obligations on states to protect women and girls from sexual exploitation and abuse.

Universal Declaration of Human Rights (Article 7), the UN Charter (Articles 1, 13, 55, and 76) and the International Covenant on Civil and Political Rights (Article 24) reaffirm the freedoms and rights of all children, including internally displaced children.

3 DESCRIPTION OF THE PROJECT ENVIRONMENT

3.1 Project Setting

The Olkaria IV Domes Geothermal Field is located about 120km Northwest of Nairobi. Administratively, the project is located within Hells Gate location, Central division of newly created Naivasha district (hived from the former Nakuru District) in the Rift valley Province of Kenya.

The Olkaria geothermal field is located 6 km to the south of Lake Naivasha in Kenya's Rift Valley, and occupies a circular area of about 68.25 km^2. Olkaria IV (Domes) is one of the seven sectors of the Greater Olkaria Geothermal Area (GOGA). It is located to the south of Lake Naivasha in Kedong Ranch. Olkaria IV area measures about 4 km^2 that is bound by Hell's Gate and Ol Njorowa Gorge to the west and a ring of domes to the east and south.

The first generating unit at Olkaria I was commissioned in 1981, and the second and third phases were commissioned in 1982 and 1985, respectively, to generate a total of 45 MW of electricity. Olkaria II was constructed between 2000 and 2003. and the plant began generating electricity in September 2003, producing a total of 64 MW.

The proposed power plant location is at Kedong, Akira Ranch located to the east of the Eastern Steamfield. Longonot and Maiella Ranches are located to the south. Oserian Estate lies to the north of the Northeast Steamfield and beyond Oserian to the west is Kongoni Farm. The ranches are essentially cattle ranches, although the Maasai have been seen to herd their livestock through the ranches as well as Hell's Gate National Park.

Thus the site is located in the midst of an array of environmental and social contexts.

3.2 Physical and Biological Environment of the project area

3.2.1 Climate

The climatic features in the Rift Valley, including the project area, are closely related to the altitudinal changes and variations induced by the local topography. The floor of the Rift Valley experiences higher temperatures than the highlands. At Naivasha (1,829m above sea level) the mean monthly temperatures recorded range from 15.9-17.8^{0}C with a mean of 16.8^{0}C. The mean monthly temperatures in Naivasha town range from 24.6 – 28.3^{0}C.

The baseline climate data recorded by KenGen has been evaluated from a model known as TAPM, and are discussed in succeeding sections below.

(a) Rainfall

The baseline daily rainfall is measured at four sites, X2 Camp site, Site, North East Olkaria and Lake View .The data has been collected from Environmental section of KenGen. Data for the 15-year period January 1994 to December 2008 has been analysed to show the monthly average rainfall totals over the last 15 years in the project area.

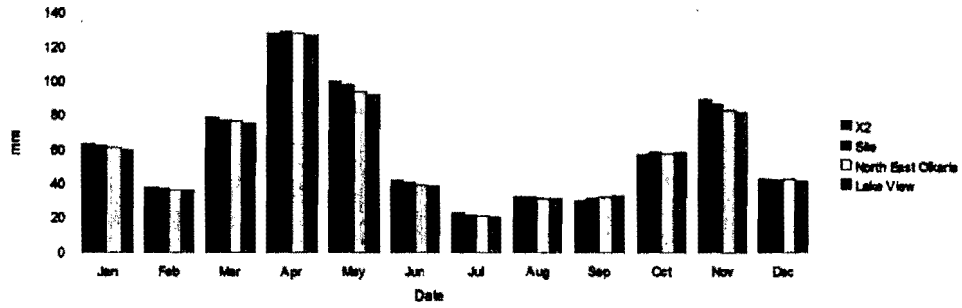


Figure 3.1 Average annual rainfall in the project area from 1994 to December 2008

Average annual rainfall totals have been 724.4, 715.4, 703.5, and 695.3 for X2, Site, North East Olkaria and Lake View respectively. Thus there is little spatial variation in the annual rainfall totals.

(b) Temperature

Maximum and minimum temperatures are recorded at 9am and 3pm as is the dry and wet bulb temperature, which is used to determine relative humidity. A hygrothermograph is also operated at the X2. Figure 4.2 shows the recorded daily minimum temperature recorded at 9am and the maximum temperature in the period leading up to the 3pm recording period. Temperatures show relatively modest season variation as would be expected at this latitude and in the period of record March 2001 to September 2009 did not exceed 35°C or fall below 0°C.

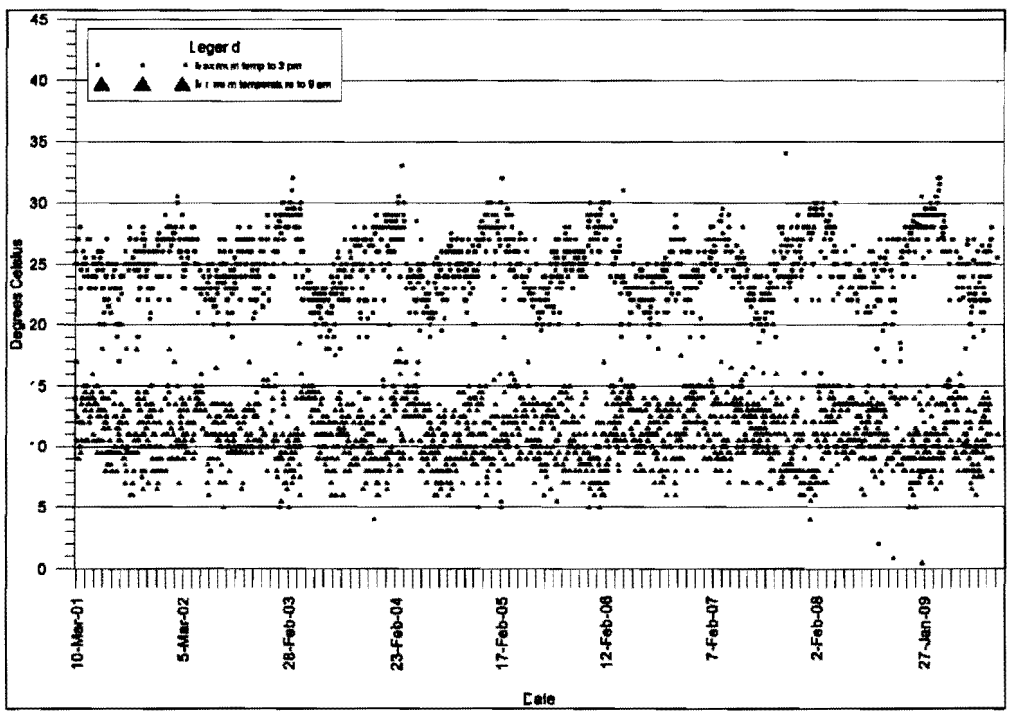


Figure 3.2 Maximum and minimum temperatures recorded at X2

(c) Humidity

Observations of relative humidity determined from the 9am and 3pm data recorded at KenGen X2 Camp site are shown in Figure 3.3. The data show the normally diurnal variation with higher values occurring in the cooler morning periods 9am and lower value in the warmer afternoon period at 3pm.

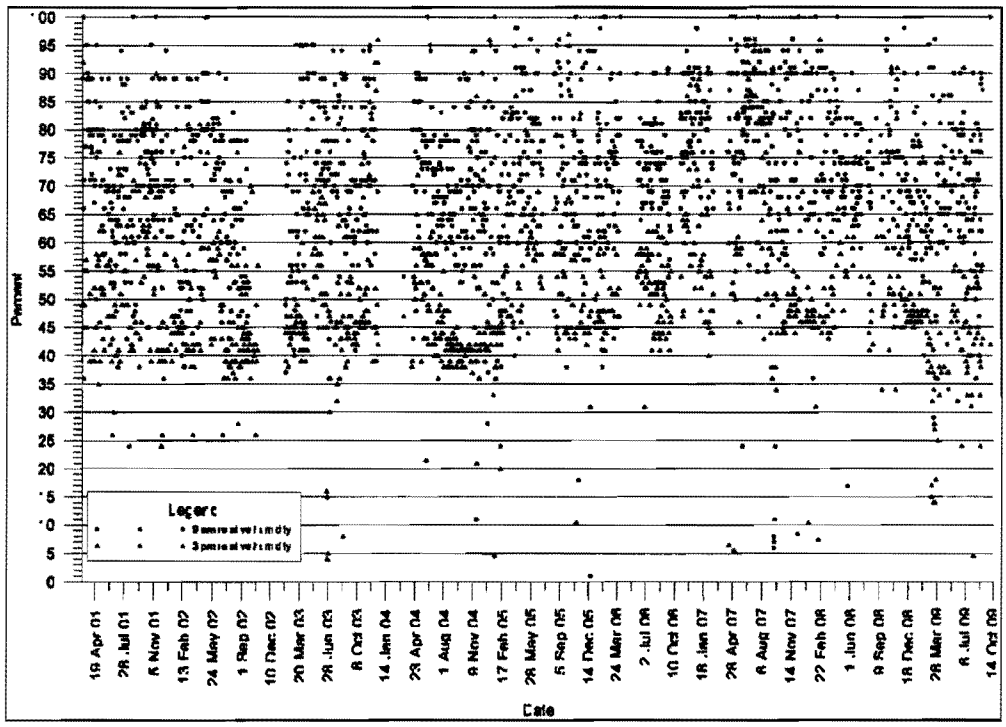


Figure 3.3 Relative humidity

3.2.2 Air quality

The geothermal power stations assessed in this report operate by collecting steam from the geothermal fields. The steam is used to drive turbines which generate the electrical energy in a similar way that a coal-fired power station would. The used steam is discharged as liquid water and vapour. The water vapour is harmless in the atmosphere, but associated with the steam are non-condensable gases including carbon dioxide (CO_2), methane (CH_4) and hydrogen sulphide (H_2S). The CO_2 and CH_4 do not pose a threat to ambient air quality, although they are, along with water vapour, greenhouse gases, but H_2S can be toxic at sufficiently high concentrations. In addition H_2S will accelerate the corrosion of metals. KenGen is currently taking daily monitoring H_2S concentrations in the air and the results have been used for modelling of the possible effects of air quality to the environment posed by the new plant.

(a) Occurrence of Hydrogen Sulphide

Hydrogen sulphide (H_2S) is a noxious and potentially poisonous gas, with the odour of rotten eggs. It occurs naturally, and approximately 90 per cent of global emissions are estimated to be of natural origin (WHO 1987). It has long been recognised as a potential health threat to man both from natural and man-made sources and there are over 150 years of scientific literature describing its properties and toxicity (see review by the Subcommittee on Hydrogen Sulfide, 1979). However, it is not a widespread urban pollutant and is generally localised near emission sources such as sewage treatment plants, petroleum refineries and kraft paper mills. Typical concentrations vary widely in different parts of the world, for example, over a 2.5 year

period in northwest London, concentrations were generally found to be less than 0.0002ppm (0.3mg/m3), in and around the city of Rotorua, New Zealand there is usually sufficient hydrogen sulphide to cause detectable odours and during continuous monitoring hydrogen sulphide concentrations of 0.05 ppm (80 mg/m3) were exceeded for more than 55 per cent of the time in winter (WHO, 1987).

(b) Properties of hydrogen sulphide

Hydrogen sulphide is colourless, flammable, denser than air and liquefies at -60°C. It is soluble in both polar and non-polar solvents and is rapidly oxidised in air and in solution. It is corrosive to many metals and may discolour paint by its reaction with the metals present in the pigments. Because of its density when it is concentrated, it will have negative buoyancy and sink to the lowest point. In geothermal projects it is usually associated with high concentrations of carbon dioxide, which is also denser than air. Thus a slow leak of the non-condensable fraction of cooled geothermal gas emitted into a sheltered environment, can allow a build-up of dangerous concentrations of hydrogen sulphide in low-lying or sheltered and enclosed areas. Such areas are unlikely to be naturally occurring topographical features such as gullies or valleys, but could be the concreted cellars that are part of the well-heads, or sumps within the power station.

The controlled discharge of non-condensable gases from the power station may contain initially up to approximately 4.9 per cent hydrogen sulphide and 96 per cent carbon dioxide *(Ewbank Preece Limited, 1989 (Page B/16))*. This mixture is initially denser than air, but it is mixed very rapidly with the ambient air. For practical purposes, the hydrogen sulphide emitted from the gas ejectors will not preferentially settle out from the plume any more than the oxygen, which comprises approximately 20 per cent of the ambient air, will settle out from the less dense nitrogen, which forms approximately 78 per cent of the ambient air. The only time when this is likely to be a potential safety hazard, is in enclosed areas.

There is considerable variation in the response of the human nose to odour. A range of odour thresholds (where 50 per cent of the population can detect the presence of the odour) have been reported for hydrogen sulphide (0.76-3.21 mg/m3) 0.00047-0.002ppm (*Warren Springs Laboratory, 1980)*. Other studies give different values. The most recently published study (Nagy, 1991) presents detailed information on the percentage of people responding to the odour of hydrogen sulphide at different concentrations. Nagy's paper is particularly useful because it provides information on the response of the 18 people in the two odour panels as the concentration varies. From the data it is possible to determine the percentage of people who would be expected to detect the odour at a given concentration. One person out of the 18 (approximately 5 per cent) reported an odour at 0.0013ppm (2 mg/m 3), nine of the 18 (50 per cent) detected the odour at 0.0046 ppm (7mg/m 3) and 17 of the 18 (approximately 95 per cent) reported the odour at 0.023 ppm (35 mg/m3).

Nagy also provides information about the number of people describing the odour at a complaint level as the concentration varies. Approximately five percent consider the odour at a complaint level at 0.0017ppm (2 mg/m 3), 50 per cent at 0.016ppm (20 mg/m 3) and 95 per cent at 0.247ppm (395 mg/m 3).

At the above concentrations, no harmful effects to human health are known. At higher concentrations, where it is extremely toxic, it produces complete fatigue of the olfactory nerve and its presence cannot be detected. Its odour therefore serves as an important warning of its presence at safe concentrations.

In the above discussion, it should be remembered that the odour panel studies select panellists who pass a test which ensures a certain minimum sensitivity to odours and they are not permitted to eat, drink flavoured beverage or smoke for 30 minutes prior to the test, nor are they permitted to use scented cosmetics for at least one hour before the test. In addition, the test room is free of interfering odours. Given test conditions and the fact that people regularly exposed to hydrogen sulphide have a decreased sensitivity to its odour, it is considered that using these criteria for assessing the response of the exposed population at Olkaria may significantly overstate the incidence of odour. The criteria would be more appropriate for

short-term visitors, but they would still be subject to interfering odours.

(c) Effects on Humans and other animal life

The toxic effects of hydrogen sulphide vary according to the dosage and have been classified in the scientific literature into three categories, namely, acute, sub-acute and chronic. In view of some lack of agreement in the literature about these different nomenclatures, the Subcommittee on Hydrogen Sulfide has determined some clarifying definitions of these terms.

Acute intoxication refers to the effects of a single exposure to a massive dose of hydrogen sulphide of the order of 1000ppm (1.61g/m3). There is evidence that at this concentration hydrogen sulphide exerts an effect on the whole nervous system by inhibiting the enzyme cytochrome oxidase, which is involved in the aerobic metabolic pathway. The symptoms are an initial stimulation of respiration resulting in very rapid breathing and subsequent depletion of carbon dioxide in the blood. This leads to respiratory inactivity that may spontaneously reverse if the depletion has not gone too far. However, if breathing does not spontaneously recommence and artificial respiration is not given, death from suffocation occurs.

At concentrations above 1000ppm (1.61g/m3), hydrogen sulphide may have a direct paralysing effect on the nervous system. In this case no stimulation of breathing occurs and there is immediate respiratory failure. However the heart does not stop beating immediately and artificial respiration can be given until the levels of hydrogen sulphide in the bloodstream drop sufficiently to allow breathing to resume. Hydrogen sulphide is very rapidly oxidised in the blood and is not considered a cumulative poison.

Sub-acute intoxication refers to the effects of continuous exposure to mid-level concentrations of hydrogen sulphide, 100-600ppm (0.16-0.96g/m3). At these concentrations irritation of the mucous membranes of the eye and the entire respiratory tract can occur. While eye irritation is by far the most common symptom of sub-acute poisoning, irritation of the respiratory tract can in some circumstances lead to severe and even fatal complications such as pulmonary oedema.

Chronic intoxication is defined as the effects of intermittent exposure to low or intermediate concentrations 50-100ppm (80-160mg/m3) of hydrogen sulphide. These are characterised by "lingering" largely subjective manifestations of illness. There is no universal agreement in the literature about this category as a clinical entity distinct from repeated episodes of sub-acute intoxication.

The effects of hydrogen sulphide exposure at various concentrations are summarised in Table 3.1 *(adapted from "Hydrogen Sulfide", The Subcommittee on Hydrogen Sulfide, 1979 and including data from Nagy, 1991).*

The effects of hydrogen sulphide on other animal species have been the subject of laboratory investigation and some insights into the biochemical mechanisms by which the gas exerts its toxic effects have resulted from this work. The toxicity of hydrogen sulphide for several species is summarised in Table 3.2 and compared with the effects on humans (prepared from data published in "Hydrogen Sulfide", Subcommittee on Hydrogen Sulfide, 1979 and WHO, 1987).

The symptoms of hydrogen sulphide poisoning are similar across species and as can be seen from Table 3.2, the susceptibility of different animal species does not vary greatly.

(d) Effects on Materials

Hydrogen sulphide is corrosive to metals including copper, silver and even gold. It also reacts with lead-based paints to produce discolouration. Apart from aesthetic considerations, this corrosion of metals can cause problems in electronic equipment when connecting wires are affected.

Table 3-1 Permissible concentrations in the workplace assuming 8-hour shifts, 5-day weeks

Lowest reported odour threshold	0.00047	0.00066
5% detection limit 50% detection limit 95% detection limit	0.0013 0.0046 0.0230	0.002 0.007 0.035
Offensive odour	0.003-0.005	0.004-0.007
Threshold limit value a	10	14
Threshold of serious eye injury	50-100	20-140
Olfactory paralysis	150-250	210-350
Pulmonary oedema, threat to life	300-500	420-700
Strong nervous system stimulation	500-1000	700-1400
Immediate collapse with respiratory failure	1000-2000	1400-2800

Source: The Subcommittee on Hydrogen Sulfide, 1979 and including data from Nagy, 1991

Table 3.2 Concentrations of hydrogen sulphide resulting in sub-acute intoxication syndromes in various species

Canaries	80- 321 (50-200)	321 (200)
White rats	80- 884 (50-550)	804 (500)
Dogs	80-1045 (50-650)	964 (600)
Guinea pigs	161-1205 (100-750)	1205 (750)
Goats	160-1446 (100-900)	1446 (900)
Humans	161- 964 (100-600)	964-1607 (600-1000)a*

*Immediately fatal

Source: Hydrogen Sulfide", Sub-committee on Hydrogen Sulfide, 1979 and WHO, 1987).

(e) Existing air quality

Hydrogen sulphide concentrations are monitored by KenGen in and around the Olkaria I and II power stations using manually operated samplers. Twelve sites are monitored at Olkaria I and six sites are monitored at Olkaria II as follows:

Olkaria I

- MV-Rig Workshop
- Power Station
- Administration building
- Seal pit I
- Seal pit I
- OW-10
- OW-22
- KWS Gate
- Lake View
- Lake Side
- Stores
- Scientific lab

Olkaria II

- Compressor room
- Hot well 1

- Hot well 2
- Cooling towers
- Power station building, and
- Administration building.

The objective of these monitoring programs is to monitor occupational health exposures rather than environmental conditions, but the data provide some guidance as to the maximum levels that are likely to arise in the environment close to the power stations and give some "spot" samples of condition in more remote area for example at the Lake View and Lake Side residential areas. The observations relate to average concentrations over a few minutes and are all made during the day.

A total of approximately 6874 measurements have been made at the twelve sites under the Olkaria I program, which provided data covering the period 28 April 1997 to 15 September 2009 for this study. For Olkaria II 1535 measurement, made at the six sites over the period 9 December 2003 to 15 September 2009, have been made available for this study. The data is summarised in Tables 3.3.

Some of these sites are in locations that could reasonably be classed as accessible to the public or at least representative of this area, eg KWS Gate, Lake Side, Lake View and the well sites (OW 10 and OW22). These locations record low concentrations, OW As would be expected for most of these monitoring locations, the odour threshold 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.

Table 3.3 Results of Olkaria I hydrogen sulphide monitoring program (ppm)

Parameter	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Number of observations	755	816	791	632	628	762	467	394	356	353	485	435	237	263	251	264	257	263
Maximum	0.8	4.4	2.2	2.8	3.4	1.4	2.3	0.2	0.1	0	2.3	1.6	1.2	1.2	0.9	2	2.1	0.9
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.02	0.36	0.05	0.14	0.17	0.09	0.05	0	0	0	0.07	0.06	0.01	0.01	0.01	0.04	0.02	0.02
Number of observations greater than 1 ppm	0	102	9	29	43	9	4	0	0	0	10	9	1	1	0	4	2	0
Number of observations greater than 0.1 ppm	60	489	132	194	217	245	100	9	1	0	73	61	3	11	9	26	16	21

3.2.3 Noise quality

The geothermal power stations assessed in this report operate by collecting steam from the geothermal fields. The steam is used to drive turbines which generate the electrical energy in a similar manner that a coal-fired power station would. The operating power stations generate noise from many sources which for modelling purposes can be aggregated into two main sources (1) the cooling towers and (2) the plant or building housing the turbines.

At Olkaria I the gas ejector and the plant are essentially co-located, whereas at Olkaria II the gas ejection occurs in the cooling towers so that the actual noise sources in the aggregations are different for the two power stations, but this does not change the way the noise modelling will be undertaken. In each case the power stations have been represented as two classes of noise sources (1) the cooling tower system and (2) the plant. It is understood that the design of Olkaria I (Units 4 and 5) will be similar to the design of Olkaria II and the noise emission for the new power station has been based on measurements taken at Olkaria I.

In addition the project involves two other potentially significant sources of noise, namely construction of drill pads and drilling and testing of wells prior to converting them to production wells. While these latter operations are temporary (lasting for months to a period of around a year) they are potentially significant and are discussed in this report. However the main emphasis in the report is on the assessment of noise from the permanent operation of the power stations.

Noise data monitoring is carried out on a weekly basis at Olkaria. Data collected between, January 2005 – June 2009 were analysed for both Olkaria I and II. A summary of noise data in Absolute decibels (dB(A)) is presented in Table 3.4 below:

Table 3.4 Maximum Permissible Noise Levels

Power Station	57-99	Compressor room	53-98
Administration block	34-93	Hot well unit I	54-93.1
Scientific Lab	26-83	Hot well unit II	43-93.5
Olkaria stores	28-86	Cooling Towers	52-92.7
M.V Rig workshop	20-72.1	Power Station	58-98.8
OW 10	30-82	Administration block	28-90.2
OW 22	22-88.2		
KWS Gate	5-63		
Lake side	20-48		
Lake View	20-62		

Source: KenGen Olkaria Geothermal Power Project, Environmental section.

Kenyan standards as prescribed by the Environment Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 require the following for a residential area.

Table 3.5 Maximum Permissible Noise Levels

		Day	Night	Day	Night
C: Residential	Indoor	45	35	35	25
	Outdoor	50	35	40	25

Day: 6.01 a.m. – 8.00 p.m. (Leq, 14 h)
Night: 8.01 p.m. – 6.00 a.m. (Leq, 10h)

Noise impacts have been assessed using a noise prediction model to estimate noise levels that will occur in the neighbourhood of the power station and well field during the well testing phase and during operation of the power station. The predicted cumulative noise levels have

been presented as contour plots showing the "maximum" predicted noise levels over the area of interest. Discussion of noise impacts expected during the construction phase is also presented.

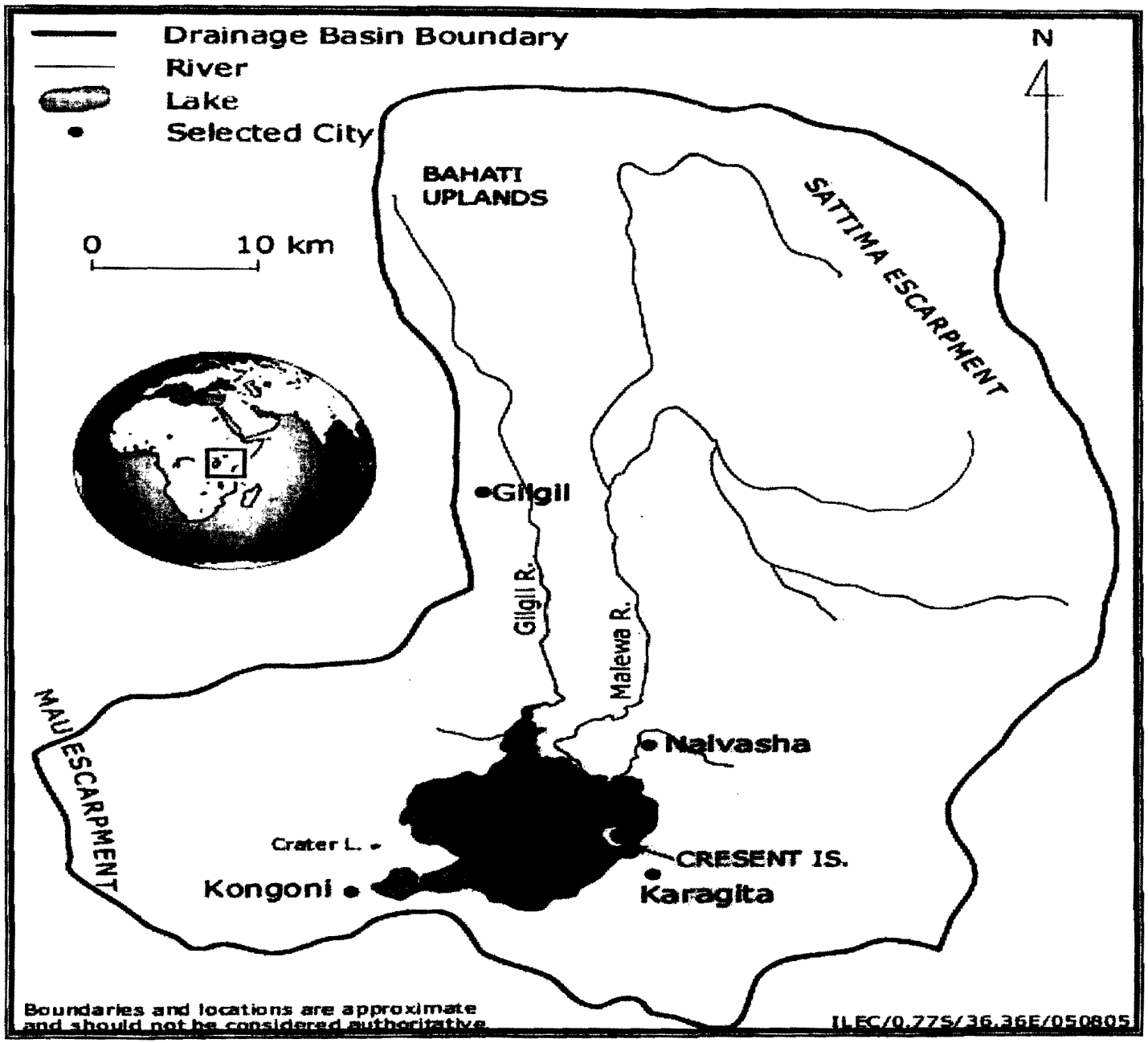
3.2.4 Lake Naivasha Basin

Lake Naivasha is a shallow basin lake, situated 80Km northwest of Nairobi in the Kenyan Rift Valley. The name Naivasha comes from the Maasai *"e-naiposha"*, meaning approximately " *that which is heaving that which flows to and fro'*. The lake contains freshwater supporting a rich ecosystem, with hundreds of bird species, papyrus fringes filled with hippos, riparian grass lands where waterbuck, giraffe, zebra and various antelopes graze, dense patches of riparian acacia forest with buffaloes, bushbuck and other creatures, beautiful swampy areas where waterfowl breed and feed and, at the same time, magnificent views of the nearby volcanoes. Local fishermen depend on the lake for fish and crayfish. Although the lake is situated in a semi-arid zone, after the rainy seasons, the fragile soils of the surrounding hills and the valley bottom produce grass where the pastoral Maasai bring their herds for dry-weather grazing, thereby depending on the lake and its various watering points.

Situated west of the main lake is Lake Sonachi, a small paradise on its own. Sonachi (or Crater Lake as it also is known) is in the caldera of a small volcano, with its own microclimate. A dense forest covers the steep walls of the crater. High biomass production has been recorded in this highly alkaline lake, which often hosts flocks of flamingos.

Lake Naivasha has no surface outlet, with the natural water level changes over the last 100 years being more than 12 meters. The water level can change several meters within just a few months, causing a shift of the shoreline of several kilometres. These dynamics add an extra dimension to the riparian ecosystem, as well as complicating the water resource management issues.

Figure 3.4 Lake Naivasha Basin



(a) Biophysical features

(i).1 General Setting

Lake Naivasha is located (0.45^{0}S, 36.26° E), altitude 1,890 m asl, lies on the floor of Africa's Eastern Rift Valley, covering approximately 140 km^2. It is the second-largest freshwater lake in Kenya, and one of a series of 23 major lakes in the East Rift Valley—8 in central Ethiopia, 8 in Kenya, and 7 in Tanzania—spanning latitudes from approximately 7^{0}N to 5°S. The overall climate of the Eastern Rift Valley is semi-arid.

(i).2 Geology, Soils, Groundwater

The soils around the lake are developed on volcanic ashes, mainly composed of fine pumice grains, and pumice layers are abundant. The interaction between volcanic deposits and water in the lakes causes the geneels of zeolite minerals. Due to their high pumice content; the soils around the lake are very permeable, with a very low water-holding capacity.

Groundwater plays an important role in the hydrology of the Lake Naivasha system. The leakage from the lake is part of the groundwater system, and exact identification of this mechanism could provide for a better exploitation of groundwater resources. Although groundwater is the recipient of most agrochemicals used around the lake, the water flow is generally away from the lake. Thus, the chance that agrochemicals will end up in the lake is low. The aquifers around the lake have very high yields, and all irrigation north of the lake is based on groundwater.

Because of the alkaline nature of the volcanic rocks, the soils and groundwater have high sodium content. This causes a problem for growing high-quality crops, since the soil structure is unsuitable. In general, groundwater in the area south of Lake Naivasha is not very suitable for irrigation. Mixing groundwater with surface water could prove a viable option. The abundance of pumice is going to play an important role in the hydroponic irrigation systems, since pumice is a perfect sub-stratum for hydroponic culture.

The presence of zeolites also is recognized, but not well researched. Zeolites play an increasing important role in organic farming and modern land management. They have very high soil water retention capacities, and extremely high Cation Exchange Capacities (CEC). They are able to capture ammonia (NH4), an important fertilizer. Thus, more research on the potential of zeolites in the floricultural industry around the lake is highly recommended.

(i).3 Climate

The drainage basin lies within the range of the Inter tropical Convergence Zone (ITCZ). Mount Kenya and the Nyandarua Range capture moisture from the monsoon winds, casting a significant rain shadow over the Lake Naivasha basin. The rainfall distribution has a bi-modal character, with long rains during April - June and short rains during October-November.

The long-term spatial rain distribution varies from about 600mm at Naivasha Town to some 1000mm on the slopes of the Nyandarua Mountains. The Kinangop Plateau experiences an annual rainfall between 1,000-1,300mm. The open water evaporation of Lake Naivasha is approximately 1,720 mm/year.

(i).4 Lake Water – level variations

Recordings of the water level have been made at different places around the Lake. The range of water levels during the past century can be seen to span 15m. There are several periods of

rapid rise or fall as well as a particularly protracted period of decline from the 1920s to 1950's. After the heavy "long rains" in 1977, the water level rose until mid 1979 by approximately 3m. After some decline a new peak occurred after heavy rains in April – May 1981. Since early 1984 the level has been falling steadily, and In January 1988, it was 5m below the 1983 peak occurred, it was 5m below the 1983 peak and was infact at its lowest level since 1960. The onset of long rains in April 1988 brought an end to the decline, at least for the time being.

Ase et al., (1986) concluded that the water balance of Lake Naivasha had a rather unstable equilibrium, and that river inflow just below the average makes the lake level drop considerably. On the other hand, lake level can be shown to be sensitive to high inflow lake level rose by over a meter in only a month in May 1977.

The lake's water level fluctuations have attracted the interest of both scientists and water managers. In 1948, Mr. Tetley (an Hydraulic Engineer in Nairobi) wrote: "The lake reached its next highest peak in 1917 and since that year (1917) to April 1946 the level had a drop of about 1m; its area shrank from say 86 square miles to less than 33 square miles and it lost about fifteen sixteenth of the volume of water all in 29 years.

Verschuren et al. (2000) studied the lake levels over the past 1000 years, identifying 4 periods when the lake almost went dry, as well as periods with higher water levels than present. To date, the studies on lake level-fluctuations have not been found to show any direct relationship with local rainfall (Harper et al.,1990), except that periods of exceptionally high rainfall are followed by lake level rises (e.g 1922, 1930, and 1961-63). Annual evaporation always exceeds rainfall (Ase et al.,1986). In statistical analysis, however, Vincent et al,. (1979) suggested that the lake's level is an indicator of the long term pattern of high altitude climate – particularly the penetration of equatorial westerlies and the influence on land above 2500m asl. Evidence for this hypothesis came from the monthly correlation of lake level changes with precipitation data from high – altitude meteorological stations (at 2700 m), and the correlation of lake – level within the altitude of the snout of the Lewis Glacier on Mt Kenya. Long term fluctuations showed close similarities with those of Lake Turkana, which also has a mountainous catchments and no surface outlet – compared to no similarities with the fluctuations in Lake Victoria.

Figure 3.5, 3.6 and 3.7 shows trends in the Lake Levels over the years, no measurements were taken from 1993 to 1996.

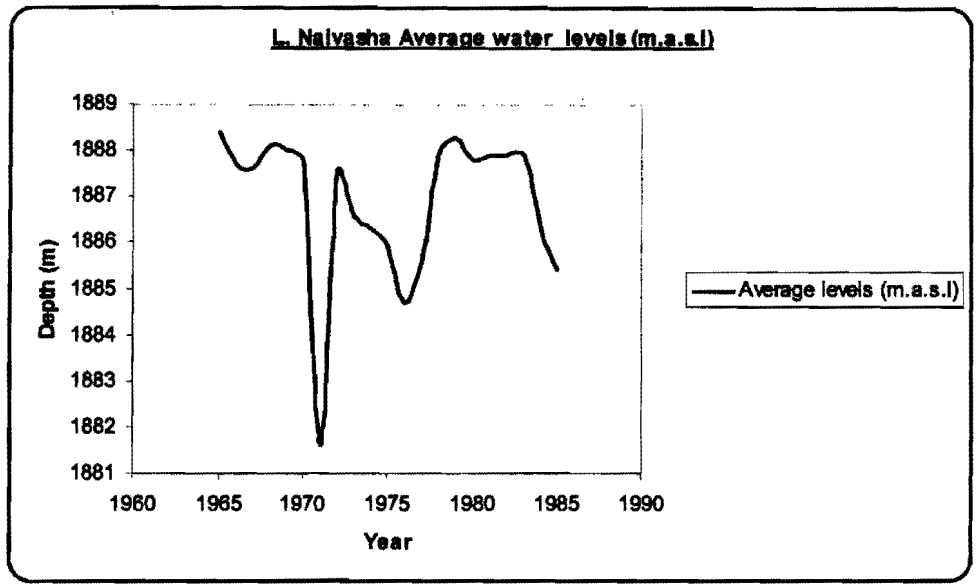


Figure 3.5 Lake levels from 1965 to 1985

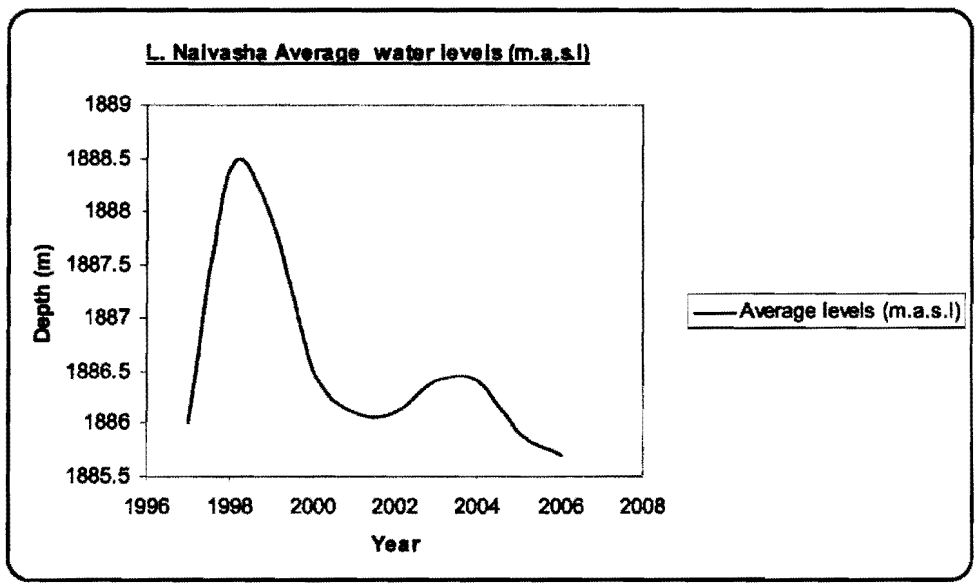


Figure 3.6 Lake levels from 1996 to 2006

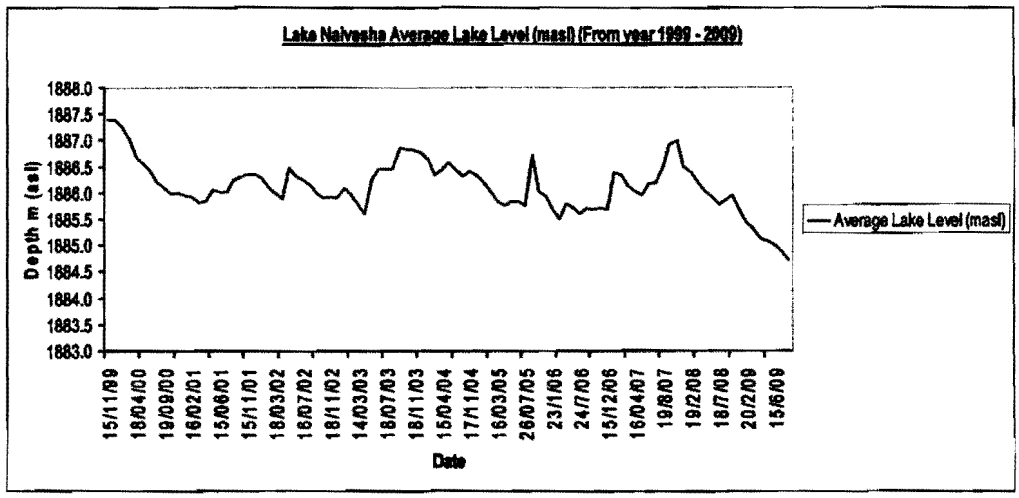


Figure 3.7 Lake levels from 1996 to 2006

(i).5 Hydrology and the Water Balance

The lake is fed by two perennial rivers, the Malewa and the Gilgil Rivers, discharging 80% and 20%, respectively, of the total inflow. The Karati River drains the area east of the lake, being ephemeral and flowing approximately 2months per year. The area south of Lake Naivasha does not produce much runoff reaching the lake. The drainage from the Mau Hills and Eburu to the west infiltrates before it reaches the lake.

Both the Malewa and the Gilgil Rivers yield water of excellent quality. The Electric Conductivity (EC), a proxy for Total Dissolved Solids (TDS), may change very rapidly in a few hours, although the mean EC for both rivers is around 100 uS/cm. Like all natural water in the area, the sodium content is relatively high.

The lake fills a shallow water basin with gentle slopes. Thus, both the area and the water evaporation increase with rising lake levels. The lake exhibits a dynamic behaviour. Its water level follows the long cycles of wetter and dryer periods with the amplitude of about 12m over the last 100 years.

Lake Naivasha actually consists of three lakes. The Crescent Lake, the deepest part of the lake (18m depth) can be connected to the main lake, depending on lake levels. Oloiden is a smaller lake at the south end of the Lake Naivasha and, depending on lake levels, can be distinct from the main lake.

The main lake is shallow (max. 8 m). Additionally, Crater Lake or Sonachi is located near the south-western part of Lake Naivasha, but it is independent from the main lake.

Although the lake has no surface outlet, it still has good water quality, with an EC value of approximately 300 uS/cm. It has been recognized for a long time that only underground outflow could explain the freshness of the lake water. The groundwater levels, and the isotopic composition of groundwater, indicate that this flow is both to the north and the south. A small part of the groundwater evaporates, and will escape in the form of fumaroles in the geothermal areas. The remainder flows into Lake Magadi and Lake Elmenteita, taking thousands of years for the water to arrive at these lakes.

The lake itself can be considered a groundwater outcrop of a very good shallow aquifer that drains into a deeper aquifer system, which carries the water towards the terminal lakes (Magadi and Elmenteita). The groundwater system around the lake is complex, with important

management implications that is beyond the scope of this report. The water generally flows away from the lake, with the exception of the western direction, where an inflow from the Ndabi Plains enters.

The water balance of the lake has been calculated with a water balance model (Mmbuie 1999). The water balance is calculated for the period 1934-1983 (Table 3.6), therefore representing the period before large-scale water abstractions began.

Table 3.6: Lake Naivasha Water Balance (1934-1983), Mmbuie 1999)

95	220	260	55

(i).6 Biosphere

Little natural vegetation is left in the catchment. The headwaters of the Malewa River, the lake's main water source, are situated in the Aberdare National Park and adjoining gazetted forest. The vegetation consists of humid Afro- mountain forest and bamboo. Fog frequently occurs, and may play a role in the water balance. Although the Kinankop and Bolosat Plateau were large grassland plains in the past, an estimated 30% is now covered with maize or vegetables, and many fast growing tree species. The upland areas are largely covered by tree-savannah landscape and dryland forest, and remnants of this forest can still be seen on the escarpment. In the past, the bottom of the Rift Valley was an open savannah landscape.

Lake Naivasha supports unique habitats, particularly the fringing papyrus swamp and associated freshwater biodiversity. As previously noted, the ecosystem comprises three chemically distinct water bodies, the main freshwater lake, a more alkaline and sometimes-connected lake (Oloidien), and a crater lake (Sonachi).The littoral zone is inhabited by macrophytes that provide suitable habitats for fish feeding and breeding, and mulch for invertebrates. Although the species composition has changed over time, the dominant floating species are *Cyperus papyrus, Eichhornia crassipes (exotic), Pistia stratiotes, Salvinia molesta (exotic), Wolffia arrhiza and Nymphaea (water lilies).* Submerged plants include *Potamogeton schweinfurthii, P. pectinatus, P. octandrus, Najas pectinata, N. caerulea, Utricularia reflexa, and U. gibba.* Although the areas of submerged macrophytes vary considerably, the littoral zone comprises about one third of the lake. This habitat exerts great influence on the lake's biology and chemistry, and the plants also are responsible for the richness of the bird population.

Water lilies almost disappeared in the 1980's thought to be caused by the introduced crayfish and accidentally-introduced Coypus. The papyrus is considered the most important plant of Lake Naivasha, occurring in the shallow water of the lake edge, and on land where the sub-surface soil was saturated. It almost completely surrounds the lake, forms floating islands in the lake and can be found up to km up the Malewa River. It acts as an efficient silt and nutrient filter, and is capable of recycling excess nutrients. It also forms an important habitat for fish (where submerged or floating) and wildlife (e.g., birds, hippos, buffalo) which use it as safe refuge and feeding area. The quantity of papyrus in the lake has varied tremendously as a consequence of fluctuating water levels, fires and, in some cases, human encroachment.

One hundred and forty-three (143) phytoplankton taxa have been recorded in the lake, including the species *Microcystis, Lyngbya, Oscillatoria and Melosira.* The photosynthetic rate is about 5 mg $02/m^3/d$ in the open lake (o mg Chl-a/m^3). Most productivity occurs in the top 3m of the lake. The more alkaline Oloidien and Sonachi lakes are more productive, with *Spirulina* significantly present. The main zooplankton genera are *Cladocera, Copepoda and Rotifera.* The zooplankton biomass is positively correlated with the chlorophyll-a (algal) concentrations, since zooplankton feed on the phytoplankton. Twenty-eight taxa of invertebrates have been recorded, associated with macrophyte beds.

The small-toothed carp (*Aplocheilichthys antinoril)* and *Barbus amphigramma* were the only fish species in the lake before 1925 (the paucity of species probably due to historical episodes

of lake desiccation). The *antinorii* species had disappeared by 1962, likely a direct result of the introduction of the largemouth bass. The present fish population comprises introduced species, including largemouth bass *(Micropterus salmoides)*, introduced from the United States in 1927, 1951 and 1956, Tilapia zulu (1956 from Lake Victoria: the introduction also contained *Oreochromis leucostictus,* now the most numerous fish, ahead of bass), and other *tilapiine* species not encountered today. Three cyprinodonts, *Gambusia, Poecilia and Lebistes,* were introduced to control mosquitoes. The exotic rainbow trout (*Onchorhynchus mykiss)* occasionally strays into the lake from the Malewa River, while *Barbusamphigramma* migrates between the lake and the river.

The Louisiana red swamp crayfish *(Procambarus clarkii)* was introduced in 1970, as a food source for the bass.

The main food source for fish fry is zooplankton (60%) and chironomid larvae, followed by algae and detritus. Larger bass feed on crayfish, fish fry and frogs. Juvenile fish exert predation pressure on the zooplankton in the littoral zone, whereas the zooplankton remains relatively untouched in the open waters. The fish are a source of food for numerous piscivorous birds (e.g., fish eagles, ospreys, cormorants, kingfishers, herons, pelicans), and also comprise an important fishery that is a source of income and animal protein for the human population around the lake and in nearby towns.

The Naivasha Thorn or Yellow Fever Tree *(Acacia xanthophloea)* is the dominant terrestrial tree species, forming the woodland around the lake. It is an important habitat for birds and other wildlife, and the undergrowth provides an important buffer against erosion and helps prevent the transport of silt and nutrients to the lake. Many animals are found on the shores of the lake, in the acacia woodlands and the neighbouring national parks and sanctuaries, including hippopotamus (a population of over 600), waterbuck, buffalo, giraffe, eland, zebra, Thomson's and Grant's gazelles, bushbuck, duikers, mongooses, otters, various snakes and rodents, and the occasional leopard. The Malewa River delta comprises Acacia woodland, before giving way to papyrus swamp.

Lake Naivasha regularly supports congregations of more than 20,000 water birds, with a mean of 22,000 (1991-1997). The riparian, papyrus and littoral macrophyte zones provide safe haven, foraging and breeding ground for many resident and migrant bird species, and other wildlife such as the hippo, waterbuck and buffalo. The woodland within the ecosystem provides habitat for the globally-threatened grey-crested helmet-shrike (vulnerable). Another globally-threatened bird found in this location is the Basra Reed Warbler (near- threatened), a winter visitor and passage migrant whose exact status is unknown. There also are regionally-threatened species, both as regular visitors and residents (e.g. great crested grebe (critical), Maccoa duck (endangered), African darter, great egret, saddle-billed stork, white-backed duck, Baillon's crake and African skimmer (all vulnerable)). The riparian/papyrus habitat supports certain endemic species, such as papyrus gonolek and white-winged swamp-warbler. The large mammals, especially the hippos, may play an important role in phosphorus recycling around the lake.

(i).7 Water Abstractions

Lake Naivasha bears tremendous importance in the project area as a source of freshwater. The wetland associated with the lake provides a habitat for a wide range of aquatic flora and fauna. The water from the lake and the associated aquifers is utilized for, among others, domestic use, watering of livestock, irrigation of agricultural land, and geothermal drilling and process activities. According to Sayeed (2001), the total area of irrigated land stands at 5,000 ha, as shown in Table 3.7. However, Lake Naivasha Growers Group (LNGG) estimates the total irrigated area to be much less, probably ranging from 1,500-2,000 ha.

Table 3.7 Water Abstractions

Flower (open)	952.2	63.34	22,014,007
Flower (greenhouse)	613.6	50.0	11,198,200
Vegetables	1623.1	34.67	20,539,600
Fodder	756.4	16.58	4,577,506
Wheat	164.3	25.12	1,506,434
Grass	561.3	16.58	3,396,819
Macadamia nuts	360.7	3.34	439,729
Total Agricultural Crops	5031.6	29.95	63,672,295
Water Abstraction other than Irrigation			**1,508,439**
Total water abstraction			**65,180,734**

Source: Sayeed (2001).

Abstraction of water for irrigation is taken through pumping directly from the lake, and accounts for 97.7% of the water abstracted from the lake (see Table 3.1). The most important issue with regard to water resources of Lake Naivasha is the sustainable rate of water abstraction from the lake. In 1990 the total abstraction of water from the lake estimated on the basis of power consumption in pumping was 59.3 x106 m³ (Sinclair Knight et al, 1994).

Olkaria Power Project abstracts water from this lake for use in drilling wells and other uses in the power station operations, as well as for domestic use in the company offices and the housing estates. In 2000, KenGen abstracted an estimated 919,840m^3 of water, and this rate has been decreasing until the year 2008 when the abstraction rate increased up to 1,300,620 m^3. The increase in the abstraction rate in the year 2008 was due to the increased drilling activities during that year. Under normal circumstances otherwise, when no drilling is going on, the average water pumped from Lake Naivasha per month is approximately 1400m^3 per day but this will be expected to be approximately 2500m^3 per day during full operation of the plant under this project. Table 3.8 below, shows water Abstraction from Lake Naivasha for the Olkaria Geothermal Station (m^3).

Table 3.8 Water Abstraction from Lake Naivasha for the Olkaria Geothermal Station (m3)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JAN	68780	48960	67392	65208	48122	69993	41259	43805	93692	145642	**692853**
FEB	68400	124200	48048	36816	64208	51526	35740	50570	100595	106123	**686226**
MAR	76320	78120	50232	34632	47888	36638	27608	20431	85217	131094	**588180**
APR	84600	40680	39624	38064	52943	31689	32838	40344	79804	152618	**593204**
MAY	53640	43200	38376	39936	46730	27785	31522	25725	93756	134931	**535601**
JUN	72720	56520	37752	56784	39288	36171	32859	40501	83078	148298	**603971**
JUL	114120	64800	41184	42744	33324	25652	36511	55858	84282		**498475**
AUG	103320	56520	64272	39279	48412	27721	40642	71631	115143		**566940**
SEP	90360	71280	44828	33404	41497	25237	36007	70362	148900		**561875**
OCT	55800	57960	38688	29385	43200	33341	34389	87722	118931		**499416**
NOV	71280	73944	28392	46406	52677	32470	31605	76191	156409		**569374**
DEC	60500	41808	48360	37510	43822	33233	21800	67862	140813		**495708**
TOTAL	**919840**	**757992**	**547148**	**500168**	**562111**	**431456**	**402780**	**651002**	**1300620**	**818706**	**6891823**

Source: KenGen Olkaria Environmental Section 2009

(i).8 Water Quality, Aquatic Ecology, Sediment Load

Several authors have previously reported on the lake's water quality. The natural water quality is influenced mainly by solute inputs and lake level variations. The Total Dissolved Solids (TDS) increase in times of receding lake levels, and decrease after floods. Irrigation from the lake decreases the TDS concentration, whereas irrigation from the rivers increases TDS concentrations.

No disturbing trends, however, have been detected so far. Total phosphorus (T-P) is one of the elements controlling the lake's tropic status, Abiya (1996) and Kitaka (2000).

Water transparency (Secchi depth) varies with site, ranging between, 5-150cm. It is lowest in the north swamp area, where suspended sediment is brought in by the rivers. Low transparency also can be caused by algal growth, and algal blooms have been observed, albeit infrequently. Very few analyses are available on the pesticide levels in the lake. Gitahi et al. (2002) reported that organochlorines could be detected in black bass and crayfish, although no organophosphates were detected in the same samples. The total load to the lake has been calculated on the basis of farm data.

Table 3.9 below summarises monitoring data for important environmental elements in water at various locations. Lead levels were noted to increase in Lake Naivasha water. Fluoride levels exceeded national guidelines at all sampling points, but when compared with World Bank guidelines fluoride concentrations were excessive only at the wells.

Table 3.9 Range of Chemical Elements of Environmental Significance in Water (ppm), 1993 - 2002

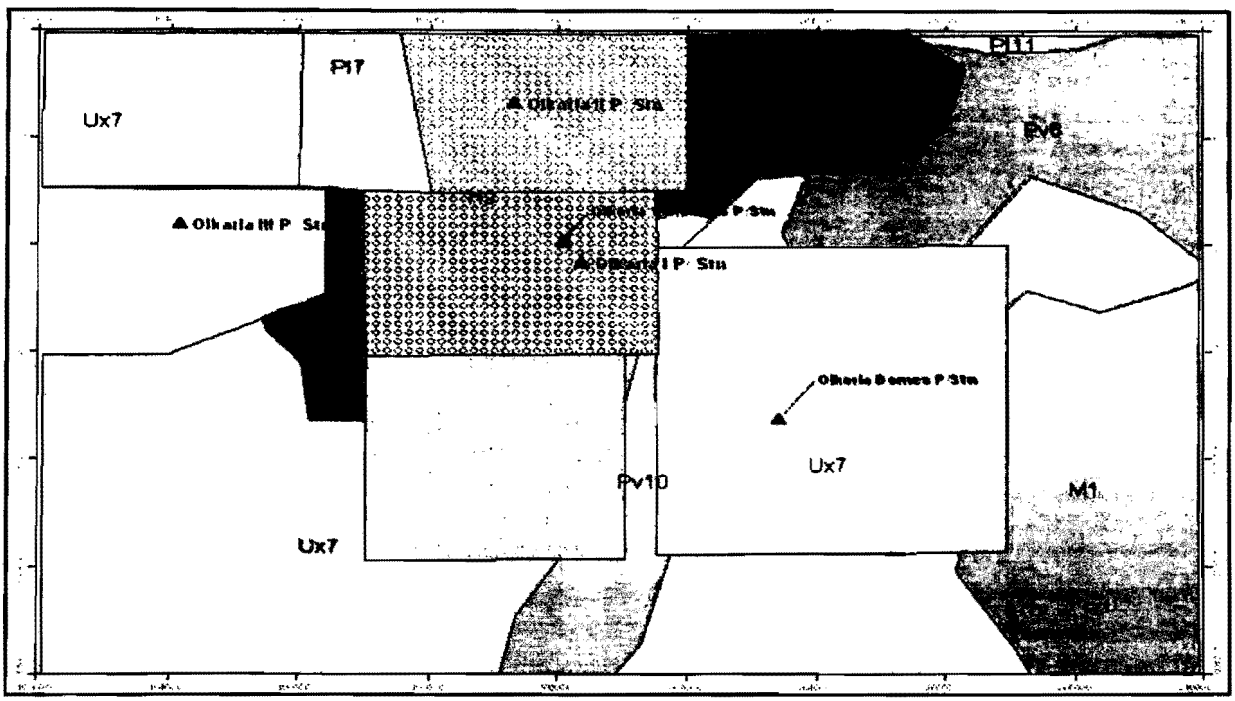
Wells	0.053-1.58		0-0.12	0-0.43	0.25 – 17.1	0-3.0	0.01128	0-3.2
Olkaria I		0-0.53	0-0.03	0-0.19	1.83-8.14	0-0.13		0 – 1.33
Old X2 Camp	0.0097	0-0.2		0-0.02	1.73-9.20	0-0.13		0-5.01
Lakeside Estate		0 – 0.3		0-0.02	1.80 – 9.30	0-0.0.13		0-2.48
Lakeview House Estate		0-0.007	0-0.02	0-0.004	1.85-9.0	0 – 0.1		0-0.87
L Naivasha	0.00009		0-0.002	0-0.05	0-13.63	0-0.2	0.0020	0-0.51
Naivasha Town	na	na	na	na	na	na	na	na
World Bank Guidelines	100		0.1	0.5	20	0.1	10	1
NEMA Guidelines	10	2	0.01	0.05	1.5	0.05	5	1.5

Source: KenGen Olkaria Geothermal Power Project, Environmental Section

3.2.5 Soils

The soils of the project area differ widely in depth, texture and chemical properties mainly due to the local geology of the area. Lithologically soils of Naivasha area can be broadly classified into two broad categories including the soils developed on volcanic rock materials and soils developed on lake bed sediments. The former soils are mainly derived from mixed assemblage of acid and basic lavas while the lake sediments are composed of a mixture of volcanic ash, reworked volcanic material and autochthonous organic matter. Along the south eastern shore of Lake Naivasha, diatomite up to 1-2 metres thick is present while in the north and north –eastern shores, silts, clays and recent deposits are common (Thompson and Dodson 1963).

Figure 3.9 Exploratory Soil Map of Olkaria Area



Soil Legend

M MOUNTAINS AND MAJOR SCARPS (slopes predominantly over 30%)

MP Soils developed on ashes and other pyroclastics rocks of Recent volcanoes

M1 complex of: excessively drained, shallow to moderately deep, brown to dark brown, firm and slightly smeary, strongly calcareous, stony to gravelly clay loam; in many places saline and/or sodic and with inclusions of lava fields (ando-calcaric REGOSOLS, partly lithic phase)

H HILLS AND MINOR SCARPS (slopes predominantly over 16%)

HV Soils developed on undifferentiated Tertiary volcanic rocks (olivine basalts, rhyolites, andesites)

H9 well drained, shallow, dark reddish brown, friable, very calcareous, bouldery or stony, loam to clay loam; in many places saline (LITHOSOLS; with calcic XEROSOLS, lithic, bouldery and saline phase and Rock Outcrops)

U UPLANDS

Ux UPLANDS, UNDIFFERENTIATED LEVELS (undulating to rolling; altitudes and base level variable)

UxV Soils developed on undifferentiated volcanic rocks (mainly basalts)

Ux7 well drained, shallow, dark brown, friable, strongly calcareous, strongly saline and moderately sodic, stony loam; with a stone surface (dissected older piedmont plain) (calcaric REGOSOLS, stone-mantle and saline-sodic phase)

P PLAINS

Pv VOLCANIC PLAINS

PvP Soils developed on ashes and other pyroclastic rocks of Recent volcanoes

excessively drained to well drained, very deep, dark greyish brown to olive grey, stratified, calcareous, loose fine sand to very friable fine sandy loam or silt (ando-calcaric REGOSOLS)

Pv10 imperfectly drained, very deep, yellowish brown to olive gray, friable, slightly saline, slightly sodic, sandy loam to silt loam, with a brittle and strongly sodic deeper subsoil (gleyic SOLONETZ, saline and fragipan phase)

Pl LACUSTRINE PLAINS

PlX Soils developed on sediments from volcanic ashes and other sources

Pl7 imperfectly drained to poorly drained, very deep, dark greyish brown to dark brown, firm to very firm, slightly to moderately calcareous, slightly to moderately saline, moderately to strongly sodic, silt loam to clay; in many places, with a humic topsoil; Subrecent lake edges of the Central Rift Valley (undifferentiated SOLONETZ, saline phase)

PlP Soils developed on sediments mainly from volcanic ashes

Pl11 complex of:
- well drained, moderately deep to deep, dark brown, friable and slightly smeary, fine gravelly, sandy clay loam to sandy clay, with a humic topsoil (ando-haplic PHAEOZEMS)
- imperfectly drained, moderately deep to deep, strong brown, mottled, firm and brittle, sandy clay to clay (Gamblian lake of the Central Rift Valley), (gleyic Cambisols, fragipan phase)

LEGEND

Soil_Data
- M1
- H9
- Ux7
- Pv6
- Pv10
- Pl7
- Pl11

▲ Existing Power_stations

▲ New power stations

Olkaria_geothermal_fields (GOGA)
- Olkaria Central Field
- Olkaria Domes Field
- Olkaria East Production Field
- Olkaria North-East Field
- Olkaria North-West Field
- Olkaria South-East Field

(a) Soils developed on Basaltic rocks

These soils are thin and decode friable grey-brown to light bluish colour. Texturally soils of this unit are fine grained and well drained with ABC profile development. However the transition between the AB horizons is not very clear and in most cases inferred as AC soil profile horizons. The structure is moderate, fine to medium, sub angular to angular blocky.

(b) Soils developed on Phonolitic rocks

These are weathered shallow soils that are relatively black but are, however, admixed with red soils apparently having a poor-drained clayish loam texture. The soils are hard when dry, friable to firm when moist, slightly sticky and slightly plastic when wet. In most of the area the soils tend to form AC profile development, with A-horizon characterized by feldspathic rich particles. The soil structure is moderate, coarse columnar, breaking into moderate, medium to coarse angular blocky.

(c) Soils developed on Trachytic rocks

Soils of this suite are typically grey, medium to coarse grained often decoding trachytic-texture in appearance. In areas where the trachytic rocks have been highly weathered the characteristic greyish colour is altered to light shades of greenish grey. These soils depict ABC soil profile development. However distinction between BC horizons is not clear, and in some areas the BC horizon is missing. The structure is moderate, coarse to medium, sub angular to angular blocky. Soils developed on Commendites and Rhyolitic rocks. These are weathered light to dark grey soils typically consisting medium to coarse granular gradational texture. The unique characteristic of the soils are sodic firm and friable in nature. Profile development with these suite formABC soil horizons though variation in thickness and depth is highly dependent on the topography and the intensity of the weathering processes.
Soil structure is moderate, coarse to medium, sub angular to angular blocky.

(d) Soils developed on Pyroclatic rocks

Soils of this suite mostly consists ashes, agglomeratic and tuffaceous material making up considerable proportions. They are highly weathered soils that are fairly rich red soil of reasonable and sometimes considerable thickness. Apparently soil colours vary widely with other soils decipherıng gradational grey to fine buff-coloured ashes. Soil structure portrayed by this suite is moderate, coarse to medium, sub angular to angular with ABC soil profile development.

(e) Soils developed from lake beds sediments

Soils of this suite are characterised by litho-facies/biofacies of diatomite lake sediments. The diatomite beds of the Ol Njorowa Gorge consist by almost 100% of intact or variably fragmented diatom valves. Phytoliths and sponge spicules appear in subordinate numbers, i.e., less than 1% of the total number of counted particles. Glass shards and siliciclastic material are more frequent, but are generally restricted to the dark layers within the diatomite beds. The soil classification scheme within the diatomite laminations links to macroscopic and microscopic character of the sediments. In particular the diatomite beds can be classified into three lithologic facies:

- Pure-white diatomite with weak lamination,
- Diatomite with distinct lamination and
- Grayish diatomite with a relatively high clastic component, but without clear lamination.

Generally, soils developed on diatomite beds portray white to grayish colour with very little inclusions of red stained clastic particles. The soil structure is moderate to firm, fine to medium. The soils are friable when moist, slightly sticky and slightly plastic when wet.

(f) Soil Contamination

The Environmental Section at Olkaria has monitored concentrations of elements of environmental significance in soil since 1993. The results are presented in Table 3.10 below. The table shows that arsenic levels in the soils tested at the wells exceeded recommended guideline values. Other elements were found to be well within the maximum acceptable concentrations. While levels for these elements at the wells, Olkaria I and the old X-2 campsite may be attributed to geothermal activities, this may not be true for the other sampled locations, as other agricultural and industrial activities in the Lake Basin may also influence the concentrations of various elements in the soils.

Table 3.10 Range of Chemical Elements of Environmental Significance in Soils (ppm), 1993 - 2002

Wells	0.045-25	0-1.8	0-0.1	0-0.9	0.4	0-4.3	0.1007 - 0.1065	1.8-9.5
Olkaria I	0-0.4	0-0.01	0-0.1	0-0.4	2.4-2.8	0-0.4	0-0.01	0-0.1
Old X2 Camp	0.09-0.5	0-0.49	0.06-0.5	0	0-1.5	0.0005	2.43-7.01	
Lakeside Estate		0.1-0.4	0-0.02	0.1-0.19	0.41-0.6	1.5-5.0	0.1-0.4	0-0.02
Lakeview House Estate		0.4-0.8	0.1-0.2	0.5-0.6	2.9-4.9	0.4-0.8	0.1-0.2	0.5-0.6
L Naivasha	0.00009	0.8-1.2	0.1-0.2	0.1-0.5	2.3-2.4	0.8-1.2	0.1-0.2	0.1-0.5
Naivasha Town	na	0-0.02	0.01-0.6	0.06-1.9	3.8-4.43	0-0.02	0.01-0.6	0.06-1.9
World Bank Guidelines	100	100	0.1	0.5	20	0.1	10	1
NEMA Guidelines	10	10	2	0.01	0.05	1.5	0.05	5

Source: KenGen Olkaria Geothermal Power Project, Environmental Section

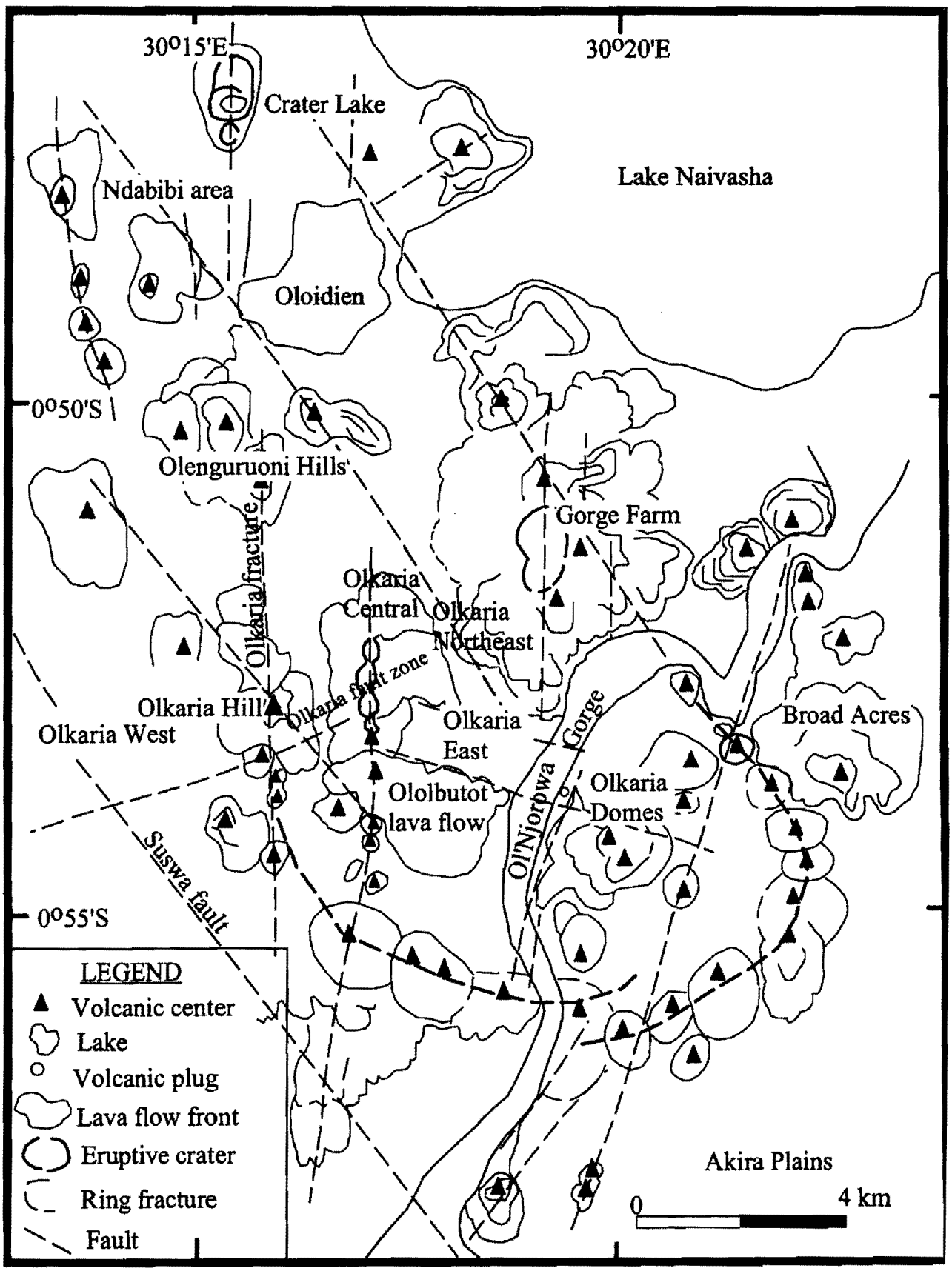
3.2.6 Geology

Olkaria volcanic complex is characterized by comendite lava flows and pyroclastics on the surface and basalts, trachytes, and tuffs in the subsurface. The litho-stratigraphy of the Olkaria geothermal area as revealed by data from geothermal wells and regional geology can be divided into six main groups: Proterozoic "basement" formations, Pre-Mau Volcanics, Mau Tuffs, Plateau Trachytes, Olkaria Basalt and Upper Olkaria volcanics. The Pre-Mau formation is not exposed in the area, but outcrop on the rift scarps in the parts of the Southern Kenya Rift. Mau Tuffs are Pleistocene in age and are the oldest rocks that crop out in the Olkaria area. The Upper Olkaria formation consists of comendite lavas and their pyroclastic from Suswa and Longonot volcanoes and minor trachytes and basalts (Omenda, 1997; Clarke et al., 1990; Thompson and Dodson, 1963). The youngest of the lavas is the Ololbutot comendite, which, has been dated at 250±100 yrs BP using ^{14}C from carbonized wood obtained from a pumice flow associated with lava (Clarke et al., 1990). The geothermal system in Olkaria is bound by the ring structure which is thought to be a caldera marked by numerous volcanic cones and domes to the east and to the south, the western edge being marked by Olkaria hill.

The Kenya Rift is part of the East African Rift system, which is an active continental divergent zone. The Southern segment of the Kenya Rift Valley is a unique petrographic province comprising of at least four Quaternary to Recent volcanic complexes namely Suswa, Longonot, Olkaria, and Eburru. Although these volcanoes are located only about 40km from each other, the eruptive products show marked compositional contrasts, requiring differences in magmatic processes. The rocks are characterised by subalkaline / peralkaline trachyte and /or peralkaline rhyolite volcanism with basalts being confined to eruption sites between individual centres. The segment of the Kenya Rift has anomalously high heat flow due to

shallow intrusions. Active geothermal systems are associated with the volcanic centres. This paper summarizes the geology of the southern segment of the Kenya Rift and discusses reasons that indicate greater geothermal potential for Olkaria and Eburru and promising geothermal potential for Suswa and Longonot volcanic centres all with an estimated potential of more than 1000 MWe. These include the youthfulness of the volcanic activities, large shallow magma chambers, fractured reservoir rocks, and favourable hydrogeology. Geothermal energy in Kenya is mainly utilized for generation of electricity and to a very small extent in direct use for drying pyrethrum, soil fumigation and in greenhouse heating.

Figure 3.10 Geological Map of Olkaria Area



(a) Seismic Monitoring of the Olkaria Geothermal Area

There is daily monitoring of seismic data by the Geophysics section of KenGen at Olkaria. Monitoring of the geothermal area of Olkaria has shown interesting micro-seismic activities, mainly located along the linear trends that follow the Ololbutot fault zone, Olkaria fault zone , a NE - SW zone extending from the EPF to the NE and two sub parallel NW – SE trends through the EPF and the south of the Ololbutot lava. These areas exhibit characteristic events whose hypocentre depths do not exceed 6km (Simiyu et al 1996).

Micro seismic activities located at the intersections of the different cluster trends show higher concentrations of smaller and shallow events that are interpreted to be caused by fluids movement along fault zones.

Two kinds of seismic signals have been observed at Olkaria based on their waveform and spectral content, Volcano-tectonic signals with well defined P and S phases and signals due to possible fluid movement within the reservoir characterised by lack of clear phases and spectra and with one dominant frequency.

The relationship between seismicity and fluid movement within the geothermal system has not been well established. This will need more detailed investigation beyond the scope of this report.

(b) Hydrogeology

The hydrogeology of central to southern portion of the rift valley is mainly controlled by the rift flanks faults, the grid faulting and the tectono-volcanic axis along the rift floor. Fluids are recharged laterally from the high rift flanks and axially along the rift floor southwards.

Analysis of the elevation of the ground water in the boreholes in the area done by Clarke et al. (1990) shows that the water table is shallowest around Lake Naivasha getting deeper towards the south with those drilled between Longonot and Suswa never encountering water at drilled depth.

The grid faulting act as channels for ground water or they provide permeable barriers to lateral flow. A micro seismic study has shown that the grid faulting unlike the escarpment faulting is quite active suggesting they are open (Allen et al., 1989). Thus the faulting causes the ground water to flow from the escarpments to the centre and then follow longer flow paths reaching greater depths, and aligning their flow within the rift along its axis. Due to the southward sloping of the rift floor, the axial flow from Lake Naivasha could also be an important source of recharge in the area south of the lake. The N-S normal faults could be very instrumental in channelling the fluids to the area. In Olkaria and Eburru where drilling has been carried out, the geothermal reservoirs are hosted by the faulted Plio-Pleistocene Plateau Trachytes, which are common within the floor of the southern Kenya Rift valley. It is therefore probable that the reservoirs of Suswa and Longonot are hosted in the same formation (International Geothermal Conference, Reykjavík, Sept. 2003 Session #4).

3.2.7 Topography

The area is bounded to the west by the Mau Escarpment (3080m asl) and the Eburru volcanic pile, to the south east by the Longonot Mountain, to the east by the Kinangop Plateau and to the north and north east by Nyandarua (Aberdare) Range (3900 m asl). The following physiographic units can be distinguished within the larger project area.

(a) The Rift floor

The Rift Valley floor is largely covered with sediments that accumulated in lakes during the Gamblian stage of the Pleistocene period. The rift floor shows a great variety of topographical features caused by earth movements. It abounds with craters, remnants of pre-existing craters, fault scraps, fissures gorges, steam jets and other formations.

(b) Lake Naivasha

To the north of Olkaria the topographical features are dominated by Lake Naivasha Basin, a depression dominated by four water bodies including the Crescent Island, the main Lake, Lake Oloidien and the Crater Lake.

(c) The Kinangop Plateau

The Kinangop Plateau is located to the north - eastern of Naivasha basin between the southern mountains of the Aberdare range and the Rift floor. It is a broad flat high plain ranging in height from about 2,379 m to a little over 2,440 m asl. The plateau is deeply incised by the Makungi, Kitiri and Engare Magutyu tributaries of the Turasha river, which forms part of the Malewa river—the largest river flowing into Lake Naivasha.

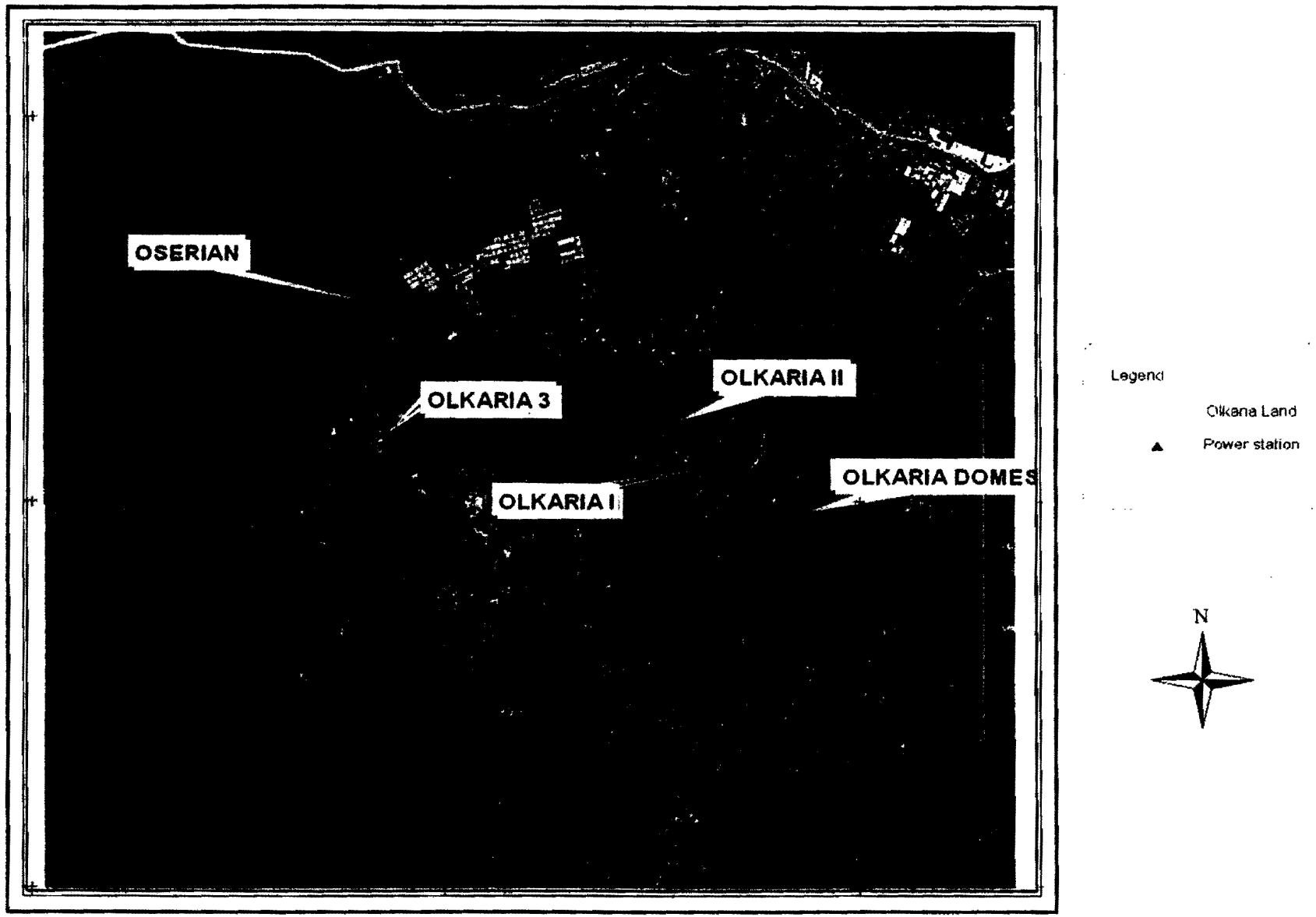
(d) Mau Escarpment

The Mau forms the western wall of the Rift Valley in the Naivasha area. It is composed largely of soft volcanic ashes and tuffs with rare out crops of agglomerate and lavas. Drainage from the Mau Escarpment probably does not reach Lake Naivasha by means of surface water courses.

(e) Olkaria area

The general topography of the study area is characterised by a wide range of associated features with volcanic activity including craters, remnants of pre-existing craters, fault scarps, fissures and steam jets. The Olkaria area where the present geothermal plants are located comprises volcanic features that consist of steep sided domes formed from pyroclastic rock and lava flows. The domes enclose an approximately circular depression that has been cut by the Njorowa Gorge, which was formed by the out flowing water from Lake Naivasha. The power stations (Olkaria I & II) are located in the centre of the depression. Within this complex, there are several small valleys that drain the upper slopes and discharge runoff and sediments to the foot slopes and plains below. The various volcanic masses and the scarp formed both by faulting and erosion creates topography of impressive proportion of Njorowa gorge (Hell's Gate) with its sheer faces curved from sheets and plugs of intrusive commendite is characterized by steep and deeply incised stratified deposits and stream jets.

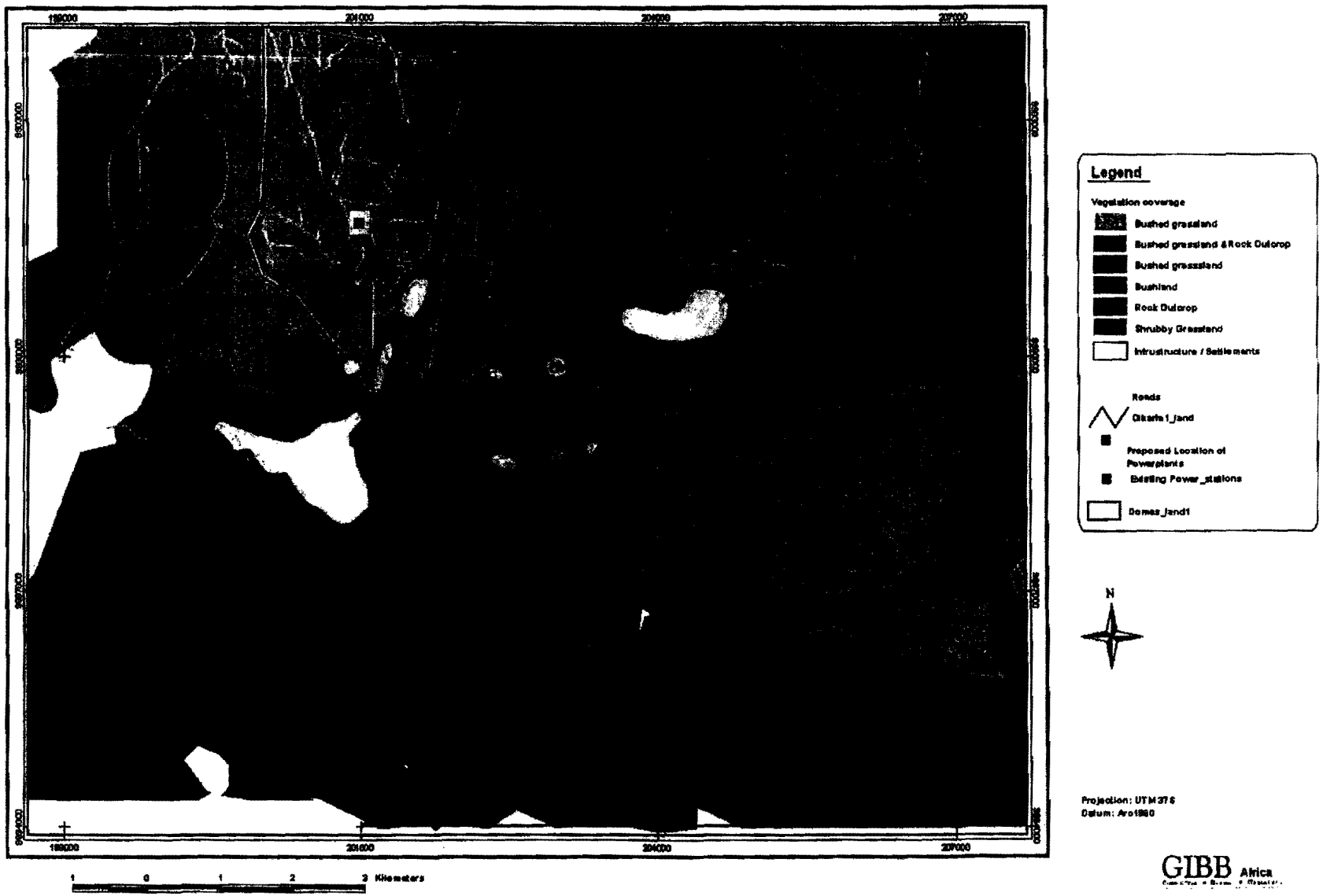
Figure 3.11 Aerial view of the Topography of Olkaria Geothermal Area



3.2.8 Flora

Generally the biological environment of the Lake Naivasha basin has been substantially disturbed by human activities. For example, most of the land in this area is used for human settlement, urban development, small and large arable farming, ranching, floriculture and other land uses. What has remained of the natural vegetation is basically a mosaic of various vegetation types interspersed with human settlement and farmlands. However, remnants of natural habitats are found in the protected area especially in the Hell's Gate National Park and adjacent ranches. The prominent vegetation types around Lake Naivasha including the project area are woodlands, bush lands and wetlands as outlined in the following sections.

Figure 3.12 Vegetation Cover of the Project Area



(a) The woodland community

The woodland community of Olkaria IV (Domes) and the entire Hells gate National Park is composed of trees that are up to 20m in height, whether open continues canopy or not. The area is mainly covered by *Tarconanthus camphoratus* and Acacia *xanthophloea* trees mainly standing up to 35m tall. A few of the areas and mainly where the water table is high have some *Acacia drepanolobium*. The woodland vegetation in the project area is a rare feature. In this community, patches of *Setaria sphacelata* appear towards the sloppy grounds. Many of the spaces in this community are occupied by *Aristida, Eragrostis cilianensis along with Tragus berteronianus.*

(b) The bush land community

The Domes area has bushland vegetation as the most prominent. This is in line within the entire of the Hells gate National Park. The association in this area is the *Acacia- Tarconanthus* association, which is characterized by shallow soil with stunted growth tree species. This community comprises of mainly *Tarchonanthus camphoratus* which is called *"leleshwa"* by the Maasai. Due to the nature of water systems and soils in the area, the prominent *T. camphoratus* and the interspersed *A. drepanolobium* seems to have taken up the entire environment. This community is made up of bushes that do not exceed 10m. It is the community that makes up the bulk of Hells Gate National Park. This bush land vegetation is interspersed with *Acacia drepanolobium* a plant with large inflated galls which shelter colonies of ants, *Crematogaster mimosae*. The galls produce a low whistling sound when the wind blows and hence the plant is referred to as whistling thorn. Patches of *Setaria sphacelata, Aristida, Eragrostis cilianensis and Traqus berteronianus make* up other grass ecosystems in this area.

Other common grasses in the bush grass land community of the project area include *Cymbopogon nardus, Setaria sphacelata, Themeda triandra, Eragrostis cilianensis, Hyparrhenia hirta, Cynodon dactylon, Pennisetum clandestinum, Digitaria abyssinica* among other grasses. *Cyperus* mainly appears where there are no signs of disturbance while *cynodon* occurs in pockets of locally high raised ground where wildlife tend to frequent.

Although the vegetation of the Olkaria area is predominantly a bush land community, local differences on vegetation types have been reported. A study carried out 1992 by Sinclair & Knight reported the park to comprise seven major vegetation groups viz, grassland, bush land, shrubbed grassland, bushed grassland, rock outcrops and barren land. Flora of the Olkaria Domes field comprises eighty five families and a total of three hundred and four plant species.

It was reported that *Setaria sphacelata* is more predominant towards the sloping areas, mainly the rocky ground with shallow soils, while *Digitariais* common in areas of deeper soils. Herbs also seems to have taken up a big area of the project area, and associations of *Striga*, Cassia *momosoides, Cycnium, Hibiscus, Indigofera, Salva, Tephrosia and Hypoestes*. Other includes *Pentanisisa, Monsonia longipes and Euphorbia inaequilatera.*

The *Tarconanthus –Acacia-Cympopogon-Themeda-Setaria* shrub grassland association is also a common feature. *Conspicous Cympopogon caesius* and *Themeda triandra* is dominant. This kind of association allows very little growth of forbs, but due to overgrazing occurs in small patches, with occurrence of Indigofera and Ocimum.

The grassland community in the proposed project area comprises mainly of *Digitaria abyssinica-Cyperus-Cynodon* association, but mainly in the low lying areas, depressions with impeded drainage. Areas where the drainage is particularly good, *cynodon* predominates, with occasional *Chenopodium, Polygala sphenoptera, Spolobolus* and *Vemonia*. Occurrence of *Solanum nigrum* was also recorded is some of the sites.

Some of the areas had a number of rock outcrops, with *Tarconanhus* and Acacia as dominant. *Setaria* and *Eragrostis* were also common, with occasional creepers of *Cynium* Cassia and *Themeda triandra.*

At the Domes area, the West side of the hills had predominant *Cymbopogon* and *Setaria* with *Ficus, Teclea simplicifolia*, and Asparagus and *Rhus natalensis. Occassional Cussonia spicata* and *Cordia sinensis.* There is also *Chloris gayana* and *Setaria verticillata* as well as *Panicum maximum.*

(c) Wetlands communities

Olkaria IV fields do not have any wetlands apart from the occasional valleys that carry water during the wet seasons. The nearest wetlands to the domes are the brine ponds at Olkaria I have been colonised by *Typha domingensis* that forms well developed fringing vegetation around the ponds perimeter and the channels leading to the ponds. Several sedges including *Cyperus Immensus, Cyperus* papyrus and other members of *Cyperaceae* are also associated with the brine ponds. Other nearby wetlands includes Lake Naivasha. The Eastern and Northern shores of Lake Naivasha are rich in *Cyperus* papyrus and *Typha domingensis* while a large development of submerged and floating aquatic plants exists.

3.2.9 Fauna species

The domes area has some wildlife species as is true for other parts of Hell's Gate National Park, the neighbouring Longonot National Park and other areas where the land use (mainly ranching) is compatible with wildlife ecology. Olkaria IV is mainly within the Kedong Ranch, and has for many years been used as a dispersal area for wildlife in Mt Longonot and Hells Gate National Park. The area and other environments around it support twenty three species of mammals such as small mammals, large herbivores, and a host of small herbivores. Most common animals include the Eland, Steinbuck, Klipspringer, Wildebeest, Water buck, Zebra (*Equus burchelli*), Kongoni (*Acelaphus buselaphus*), Gazelles *(Gazella thomsonii* and *Gazella granti*), Impala (*Aecpyceros melampus*), dik dik (*Rhyncotragus kirkii*), African giraffe (*Giraffa camelpardis*) and African buffalo (*Syncerus caffer*) among others. The Jackal, Olive baboon, Rock hyrax, Hedgehog, Aardvark and leopard are also common species found in the Hells Gate environment.

Due to proximity of the project area to human settlements, and varying land use systems in place, and human encroachment, limited movement of wildlife has been evident. This has resulted to low numbers of animals and low biodiversity of animals in the Hell's Gate as compared to other National Parks in the country. There is a limited movement of animals especially to the north of the Hells Gate National Park. This is mainly due to human encroachment particularly the flower growing activities that are in close proximity to the above two parks. The domes area is however not much affected by these settlements, and has largely been a dispersal area for wildlife.

The present populations of wildlife in the area have been rapidly declining due to a number of factors, including human wildlife conflict, drought and encroachment. Close to twenty years ago, Sinclair and Knight et al. (1992) carried out animal counts in the Hell's Gate National Park as part of Olkaria II environmental impact assessment. Nakuru Wildlife Forum and Nakuru Wildlife Conservancy have carried out subsequent animal counts in the above park and the surrounding areas..

(a) Fish fauna and fisheries species

Although there are no specific fish areas in the proposed project area, it is supposed that activities carried out could be of some effect to fishery situation. Its proximity to Lake Naivasha may have some effect, especially if brine wastes are redirected there. The fish species include the black bass (*Micropterus salmoides*), two types of cichlids (*Tilapia zilli* and *Oreochromis leucostictus*) the common carp (*Cyprinus carpio*), and the Louisiana red clay fish (*Procambarus clarkia*)

3.2.10 Avifauna species

Due to its proximity to Lake Naivasha, the project area has a variety of Avifauna, some of which are threatened. This however is not being treated as stand alone, and is related to the entire Hells gate National Park, Mt Longonot National Park and the adjacent ranches. To date one hundred and eight species of birds recorded in the area. A 1992 census of birds in this area recoded similar numbers. The cliffs and gorges found in the park are important breeding grounds of some of the bird species including the vultures and swifts. Lake Naivasha support a diverse water bird community with more than 80 species regularly recorded during censuses. Large concentrations of Fish eagles (*Haliaeetus vocifer*), Kingfishers (*Ceryle rudis* and *Alcedo cristata*), Sacred ibises (*Threskiornis aethiopicus*), Coots (*Fulica cristata*) and Ducks (*Anas sp*) are a common feature of the ecosystem. The Great Crested Grebe, the African Darter, Great Egret, Saddle-billed stork, White-backed Duck, the Baillon's Crake and African Skimmer are all threatened and the Lake Naivasha ecosystem is one of the few areas that they are found.

3.3 Social Environment

This section reports the results of the socio-economic baseline studies. It provides information on the relationship of the project area to the administrative boundaries, baseline data on population size, Hell's Gate National Park, economic structure and labour, employment, community infrastructure, transport, Maasai and other issues, which will assist in determining how the project will affect the social component of the environment.

3.3.1 Impact Areas

The power station development area lies within the Hell's Gate National Park, which was gazetted in 1984, three years after the East Olkaria Power Station commenced operation. The proposed site of the Olkaria Domes Power Station lies approximately 3.3 km south east of the existing of Olkaria I Power Station. The southern boundary of the closest flower farm (Oserian) is approximately 5.2 km to the north-northeast of the proposed power station site. The Lake is approximately 5.3 km to the north and Naivasha Town is approximately 22 km to the north-northeast.

Primary Impact Area - The primary impact area, for the purposes of the Olkaria socio-economic assessment, is the Hell's Gate National Park and the villages around the domes field. This area is consistent with the anticipated envelope of potential physical impact, due to changes in air quality, noise quality and obstructions from the project constructions.

Secondary Impact Area -This area includes those areas where the direct workforce and immediate suppliers of indirect labour (both for construction and operation) could reasonably be expected to commute on a daily basis. This includes market centres like Kamere, DCK, Kongoni and Karagita, Ndabibi, Moi Ndabi and Maiella.

3.3.2 Town Council Boundaries

The, 'Naivasha Township' is also used by Naivasha Municipal Council to refer to the entire area covered by the council. The boundaries of this area are identical to those of Central division, except for the Northern section. The area is 940 km^2 and includes the project area.

Within this 'Township' area, lies Hell's Gate Ward, covering most of the area likely to be affected by the project.

3.3.3 Existing infrastructural services in the area of operation

Naivasha Municipality is the largest town in this area and serves as the District headquarters of Naivasha District. The major highway serving the Naivasha District and the surrounding area is the Nairobi-Kampala Road that passes 30km to the north of the Olkaria Geothermal Plant. The project area is accessed by the Moi South Road a tarmac road which is motorable

all year round. To the north of the project area is the Moi North, a murrum/earth road that serves the area north and west of the Lake Naivasha. The project area is served by several airstrips many of them private facilities associated with flower, ranching, hotel and tourism activities around Lake Naivasha. Naivasha is served by subscriber trunk dialling (STD) telephone and cell phone communicating services. The latter are provided by several service providers including Safaricom, Zain, Orange and Yu. There are reliable post office facilities and banking services in and around Naivasha town. The project area and surroundings have electric power connection. There are several important institutions in the area including schools, missionary stations, hospitals, tourist, facilities, prisons and hotels. Among the notable institutions are the Naivasha Secondary School, Naivasha District Hospital, Naivasha Country Club, Hell's Gate National Park, Kenya Commercial Bank and Delamere Dairies to name but a few.

3.3.4 Administration set up

The project area is situated in Olkaria sub-location, Hell's Gate location in Naivasha Division of Naivasha District. Naivasha District is one of the newly created districts, hived off from the larger Nakuru District in the Rift Valley Province. Administratively the Naivasha District is divided into five divisions including Central Division, Gilgil, Elementaita, Mai Mahiu and Kongoni and it has fifteen locations.

3.3.5 Population and Demographics

Naivasha boasts of a population of approximately 306,143 persons, 152,672 males and 153,471 females (2005 statistics but this will change after 2009 statistics results are released). More than half of this population is found within Naivasha town and the lake region, which covers less than a quarter of the total district square area.

The growth rate for Naivasha Municipality from 1989-1999 was 15.3%. This growth rate is attributed to the phenomenal development in horticultural activities around Lake Naivasha, which has encouraged the in-migration by people in search of employment. (*G. N. Wetangula, 2007, Olkaria Domes Appraisal Drilling Project, Environmental Impact Assessment Study.)*

Demographic data for the project area were obtained from the 1999 Population Census CBS, January 2001. Table 3.11 below shows population figures and densities for the year 1999, for areas that will be directly influenced by the project. For comparison purposes, figures for Naivasha District and the country as a whole are also presented.

Table 3.11: Demographic characteristics for the project area and its environs

Naivasha Town	-	77.8	18,963	18,301	37,264	479	11,598	3
Longonot	Longonot	189.3	5,372	5,792	11,164	59	2,484	4
Maiella	Maiella	40.9	3,912	4,135	8,047	197	1,949	4
	Kongoni	91.6	1,600	1,571	3,171	35	1,098	2
Ndabibi	Ndabibi	120.7	1,825	1,801	3,626	30	791	
Hell"s gate	Olkaria	339.4	11,324	10,022	21,346	63	8,874	2
mirera	96	9,931	10,215	20,146	210	6,227	3	
Naivasha division	-	1782.3	80,323	78,356	158,679	89	46,735	3*
Nakuru district	-	7242.3	598,703	588,336	1,187,039	164	296,451	4

Source: *Population and Housing Census, 1999*

*The average household size here is obtained by dividing the total population by the number of households. However, information obtained for 1999 from the Naivasha Divisional Agricultural

Office gives a total population of 158,220, and the number of households as 47,095, but the average household size as being 7 persons, and density as being 98 persons/sq km.

The intercensal growth rate for Naivasha Municipality from 1989-1999 was 15.3% (cf. national intercensal average growth rate of 2.9%). This growth rate is attributed to the phenomenal development in horticultural and floricultural activities around Lake Naivasha, which has encouraged the in-migration by people in search of employment. However, population projections obtained from the District Statistics Offices for 2002 for Naivasha Division indicate a total population of 175,457, indicating a growth rate of 3.4% from 1999-2002. This dramatic decline in growth rate is to be expected as markets for floricultural and horticultural produce are becoming saturated, and availability of land for these activities is now limited. Table 3.12 presents the population projections in the project area.

Table 3.12 Population Projections in the Project Area

Naivasha Town	-	77.8	18,963	18,301	37,264
Longonot	Longonot	11,164	13,486	15,633	17,947
Maiella	Maiella	8,047	9,721	11,269	12,937
	Kongoni	3,171	3,830	4,440	5,097
Ndabibi	Ndabibi	3,626	4,380	5,077	5,828
Hell□s Gate	Olkaria	21,346	25,786	29,893	34,319
Mirera	20,146	24,337	28,213	32,390	
Naivasha division	-	158,679	191,689	222,220	255,122

Source: Based on *Population and Housing Census, 1999 projections.*

(a) Migration and settlement

Naivasha district has one of the highest rates of external and internal migration in the country. External migration involves movement of people from other districts into Naivasha in search of employment while internal migration involves movement of people from one division to another within the District. Many of the migrants have moved into towns within the District. As a result, the urban population growth rates for some of the urban centres in the District are higher than the national urban growth rate. Naivasha recorded a growth rate of 15.3 % from 1989-1999.

These high urban growth rates have also increased the demand for services such as education, water, sanitation, health, housing and other services, which has put a strain on the local authorities who are responsible for these services. As a result of the migration trends, the District's population has been increasing steadily, resulting in the establishment of new settlements. These centres, namely Kasarani, Karagita, DCK, Kongoni and Kamere Estate, are inhabited by people from a mixture of tribes from different parts of Kenya, many of whom are working at the numerous flower and horticultural farms.

3.3.6 Agricultural activities

The natural land potential of the floor of the Rift Valley including the Naivasha Basin has been described by Jaetzold and Schmidt (1983). According to this document, the project area falls under the Upper Midland (UM5-UM6) zone where rainfall is low (600-950 mm per year) and unreliable. Traditionally, the main agricultural activity of the area has been ranching. However, the area around Lake Naivasha has now become an important centre for flower and vegetable production in the country for export to the European market. The favourable climate and soils and ample supply of irrigation water from the Lake Naivasha are ideal conditions for intensive production of cut flowers and horticultural crops such as green beans. Large tracts of land have been cleared to make way for green houses, and expanses of woodland and fringing swamps have been cleared with cultivation sometimes extending right down to the lake edge.

Today, the total area of commercial scale irrigation for cut flowers and vegetables around Lake Naivasha is estimated to be 3,000-5,000 hectares. Major companies involved in flower cultivation include, among others, Oserian Company, Sher Agencies, Homegrown, Gold Smith Seeds, Kijabe Ltd and Wild Flowers Ltd.

To the west, south and east of the Olkaria Power Station beyond the boundaries of Hell's Gate National Park, the land is mainly used for ranching. The major ranches are the Kedong Ranch and Longonot Ranch situated to the south and east of the National Park, 38 and Kongoni Farm to the west of the Park. A summary of agricultural activities in the district according to Nakuru District development plan (2002-8) is as follows:

- Average farm size (small scale) - 2.5 acres;
- Average farm size (large scale) - 1,100 acres;
- Main food crops produced - Maize, Beans, Irish potatoes, and vegetables;
- Main cash crops produced - Pyrethrum, Flowers, and Wheat;
- Total acreage under food crops - 130,098.2 ha;
- Total acreage under cash crops - 23,481.7 ha;
- Population working in the agricultural sector - 224,051 persons;
- Population of fish farmers - 90 persons;
- No. of landing beaches - 3 number.

3.3.7 Tourism

Tourism is an important activity around Lake Naivasha, as well as in the project area. Presently, several tourist facilities including hotels and lodges have been developed to cater for the growing industry. With spectacular scenery, presence of charismatic wildlife and avifauna, a fine climate, tranquil surroundings and easy access, Naivasha area has become an important centre for local and international tourism. Conditions that favour tourism in the project area include proximity to Nairobi, the presence of Hell's Gate and Longonot National Parks, and the fact that the project area is part of the Rift Valley, which has many other tourism sites such as Lake Nakuru National Park, Lake Elementaita and other attractive areas. The presence of Olkaria geothermal power station also serves as a tourist attraction for both local and international people. In Hell's Gate National Park visitors can view game while in Lake Naivasha, bird watching, hippo viewing and water sports are popular tourist activities. The monthly distribution of visitors in the Hell's Gate and Longonot National Parks is presented in Table 3.11. The monthly distribution of visitors show a peak in the months of June, July and August which corresponds with higher collection of revenue (Table 3.13).

Figure 3.15 Tourists sites Map

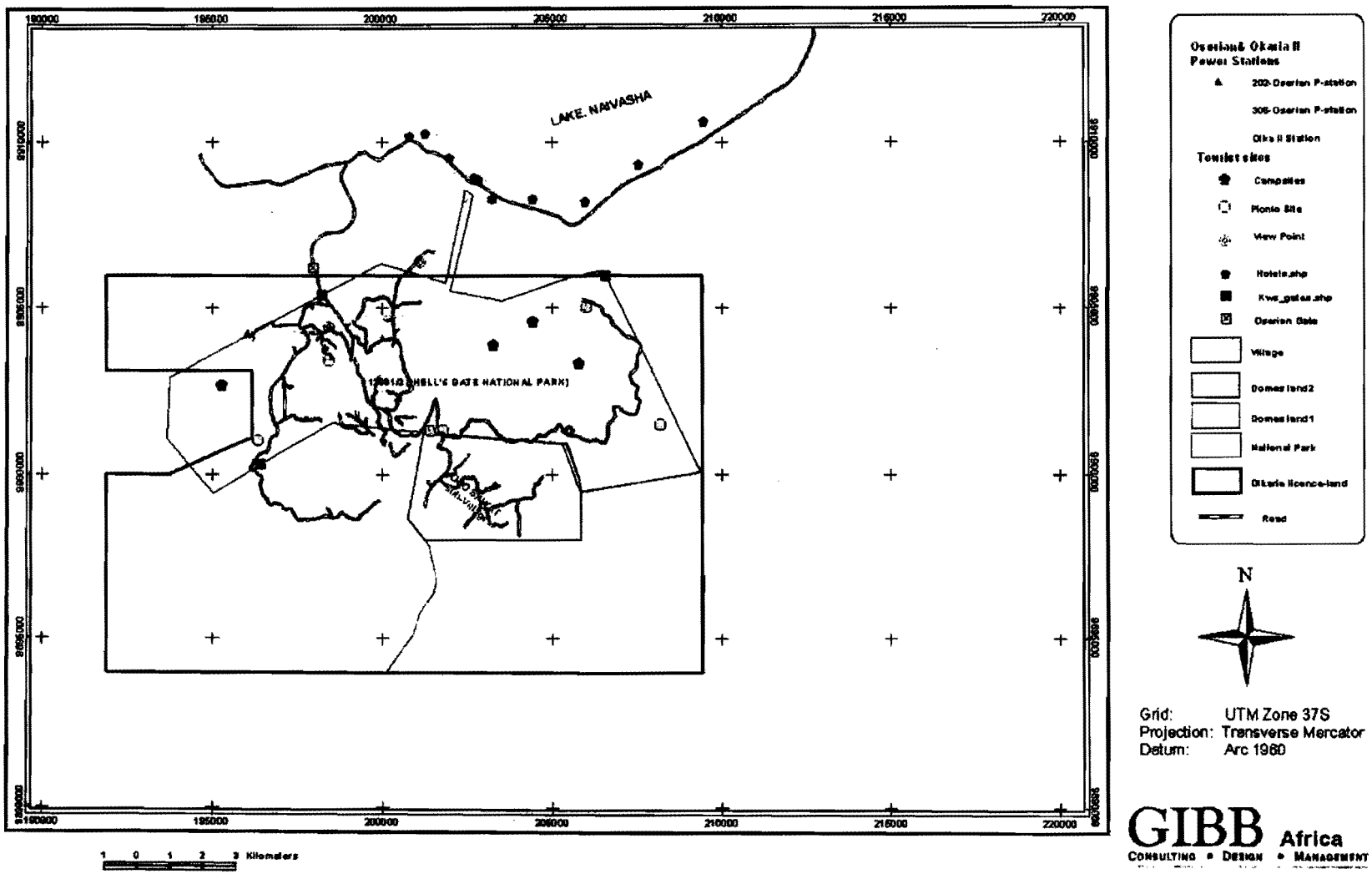


Table 3.13 Monthly Distribution of Visitors in Hell's Gate and Longonot National Parks

2001	2,304	3,140	4,405	3,296	2,747	3,910	4,345	4,809	4,262	3,921	2,753	3,380	43,272
2002	1,417	1,991	3,437	1,756	2,442	4,329	4,952	5,789	2,966	3,055	2,754	2,712	37,600
2003	1,649	2,868	3,390	3,464	3,017	3,327	3,468	5,063	4,643	5,510	4,584	2,793	43,776

Source: Kenya Wildlife Service, Nairobi

Table 3.14 Monthly Revenue Collection at Hell's Gate 2001-2 (ksha)

Jan	752,202	604,036
Feb	879,860	842,330
Mar	851,712	894,200
Apr	949,472	544,502
May	718,592	534,712
Jun	915,966	938,556
Jul	1,421,898	1,524,426
Aug	1,417,459	1,687,053
Sept	1,263,076	1,055,230
Oct	1,034,194	987,346
Nov	758,866	756,125
Dec	865,090	926,815

Source: Records from the Olkaria Power Station

Due to increasing tourist appeal of the area, several stakeholders have now taken initiatives to diversify land use to enhance wildlife conservation. These include Kedong Ranch, Longonot Ranch, Kongoni Farm, Marula Farm, Delamere Estates, KWS Training Institute, Kijabe Limited, Oserian, Mundui, and Nderit Farms. Some of the above farms and ranches have also developed accommodation and other facilities to attract tourists. Indicators point to an upsurge in tourism development in this area. These include several upcoming tourism facilities such as the Great Rift Valley Lodge (on the way to Eburru), Naivasha Simba Lodge, Naivasha Sopa Hotels (part of Mara Sopa Group) and other tourist facilities. In addition, there are local initiatives (although not targeting the same calibre of clientele) that meet a wide range of local demands, such as the Yellow Green, Cray Fish and Fischers Tower Hotels all situated along Moi South Road. In Naivasha town there have been recent developments, including Wambuku Hotel, Comfort Hotel, Lake Tourist Lodge, Ken Vash Hotel, Maiewa Gardens, Antonioz Hotel, Silver Hotel and Labelle Inn.

Based on the bright future for tourism in this area the community around the lake has recognised this potential. As a result they have now formed a local tourism initiative (Lake Naivasha Tourism Group - LNTG) that is an integral component of the Lake Naivasha Management Committee. The Tourism Group gives advice to stakeholders on planning, sustainable management of tourism and natural resources, wise use, waste management, lobbying and networking for the sustainable tourism development in this area. The Tourism Group is able to promote sustainable tourism through the Lake Naivasha Management Committee which has now been recognized by the National Environmental Management Authority (NEMA) as the institution charged with the responsibility of implementing the Lake Naivasha Management Plan.

3.3.8 Health Profile

The health facilities in the district are divided into different levels based on the types of services they can offer. These are explained in Table 3.15 below:

Table 3.15 Levels of Health Facilities

Level I Health Facility:	Primary Health Care. First contact with medical facility. Primary health care in the developed countries is usually the province of a medically qualified physician. In the developing countries first contact care is often provided by non-medically qualified personnel such as a community health care worker.
Level II Health Facility:	This could be a health centre or a rural/ community hospital. Level II health facilities should include a room in which minor surgical procedures can be performed under local anaesthesia. They need to be equipped to perform basic resuscitation, and to have facilities for observation of patients for 24-48 hours if required.
Level III Health Facility:	This type of facility employs specialist services and is offered by institutions such as teaching hospitals and units devoted to the care of particular groups—women, children, patients with mental disorders, and so on.
Level IV Health Facility:	Is equivalent to the district hospital level, and is where patients with more serious problems can be referred for surgery.

Source:WHO

(a) Health facilities in the Project Area

Naivasha District Hospital is the main hospital within the District. The facility provides the following services:

- In and Out Patient Services;
- Comprehensive Care Unit;
- Imaging services such as X-Ray and ultrasound;
- Dental Services;
- Orthopeadic Services;
- Mortuary Services;
- Attendance to tuberculosis (TB) and Leprosy;
- Laboratory Services;
- Physiotherapy;
- MCH and Family Planning Services;
- Theatre Services;
- Pharmacy services with the following provided free of charge:
  - Anti-malarials;
  - Drugs for children under the age of five years;
  - Anti Retrovirals (ARVs).

There are 62 health facilities in Naivasha District. The health facilities are divided into different levels as shown in the Table 3.16 below:

Table 3.16 Health Facilities in Naivasha District

Level II Health Facility			
Government of Kenya	**Faith Based Organisations**	**Non-Governmental Organisation**	**Private**
Karagita	ACK Canaan	Delamere Manera	Wayside
Maraigushu	Naivasha Medical	Panda Flowers	Goshen
Karate	Upendo Village	Ol Njorowa Farm	Safariland
Nyamathi		Aquillas	Better Health Services
Naivasha NYS		Delamere Soysambu	Oxallis
Naivasha Prison Annex		Marie Stopes	Kimilili
Rocco		Bigot Flowers	Kasarani
GK Farm		Nacohag	Bethania
Mai Mahiu			St. Anne
Longonot			Prime Medical
Ndabibi			Gilgil Community
Moi Ndabi			Camp Brethren
Karunga			Rehnms Med
Eburru			

Level II Health Facility			
Government of Kenya	**Faith Based Organisations**	**Non-Governmental Organisation**	**Private**
Gilgil ASTU			
NYS Gilgil			
Kiambogo			
Kiptangwanyi			
Kijani			
Miti Mingi			
Level III Health Facility			
Government of Kenya	**Faith Based Organisation**	**Non-Governmental Organisation**	**Private**
Naivasha Maximum Prison	Holy Spirit	Oserian	Rhein Valley Maternity
Maiella	Holy Trinity		Lake View Nursing Home
Ol Joral			Wangu Maternity
			Mulemi Maternity
Level IV Health Facility			
Government of Kenya	**Faith Based Organisation**	**Non-Governmental Organisation**	**Private**
Naivasha District Hospital	St. Mary's Mission Hospital	Sher Karuturi Hospital	Polyclinic Hospital
Gilgil Sub-District Hospital		Homegrown Hospital	Mt. Longonot Hospital
Gilgil Regional Hospital			

(b) Disease Prevalence in the Project Area

In the year 2008, disease prevalence data in Naivasha District were as follows:

Table 3.17 Disease Prevalence in the Project Area

1	Respiratory Diseases	102,401
2	Malaria	93,316
3	Diarrhoeal Diseases	29,766
4	Skin Diseases including ulcers	22,426
5	Rheumatism, joint pains etc	13,771
6	Intestinal worms	11,085
7	Pneumonia	10,596
8	Accidents (including fractures and burns etc.)	10,411
9	Dental disorders	9,771
10	Pyrexia of unknown origin	9,574
	Other diseases	69,009
Total		400,180

Source: Naivasha District Medical Officer, 2009

Only three out of the top ten prevalent cases are non-communicable diseases. The data shows that some of the illnesses are from environmental factors such as mosquitoes and malaria as well as diarrhoeal diseases and intestinal worms that are spread by contamination of water or soil. There are no incidences of malnutrition in the project area.

(c) HIV / AIDS Prevalence

The prevalence rate of HIV/AIDS in the District is 5.3% as per the District's Medical Officer of Health office in Naivasha. The National AIDS Control Council (NACC) has offices in Naivasha District located at the Naivasha District Commissioner's Office.

The District Area Co-ordinator's Office is equipped to provide free sensitisation on HIV/AIDS and can on request, facilitate mobilisation of formation of Health Clubs for interested groups. The sensitisation is not strictly for HIV / AIDS but also encourages formation of initiatives for control of other diseases.

They also sensitise various organisations and companies in the project area to establish Peer Educator groups.

Table 3.18 below shows numbers of patients under HIV/AIDS care in the district are as follows.

Table 3.18 Disease Prevalence in the Project Area

Patients under care	6,215	749	6,964
Patients on ARVs	2,194	332	2,526
Total	8409	1081	9490

Source: Ministry of Public Health and Sanitation 2009

3.3.9 Education

Schools around Lake Naivasha are divided among four zones: Naivasha, Maragisho, Longonot and Maiella Zones. Maiella Zone covers the schools around the project area, and has 18 public schools and 8 private primary schools, 1 public secondary school and 1 Catholic sponsored secondary school. Mvuke Primary School is in Maiella Zone, and is assisted by KenGen. The table 3.19 shows the schools within the Olkaria Geothermal area. Olo Munyak School is not registered with the Ministry of Education. Registered schools are included in the Kenya Government Free Education programme.

From this programme they would be eligible to get the following:

- Books;
- Staffing;
- Monitoring of school management (Quality Assurance);
- Furniture for schools;
- The government also sponsors the school in terms of furniture and in-house training for teachers in subjects such as HIV/AIDS, FGM etc.

Table 3.19 Schools in the Project Area

Olkaria Primary School	Early childhood to class 2	Cultural Centre	Cultural Centre and Olo Maiyana	Newly registered
Olo Nongot Primary School	Early childhood to class 8	Olo Nongot	Olo Nongot and Olo Sinyat	Registered
Narasha Primary School	Early childhood to class 8	Narasha	Narasha, Olo Munyak and Cultural Centre	Registered
Olo Munyak School	Early childhood	Olo Munyak	Olo Munyak	Not Registered

Source: GIBB Census survey and Ministry of Education

3.3.10 Energy

Electricity is the main source of energy for lighting in the vicinity of the proposed project. Most institutions and residential houses have been connected to the power grid. However, some of the unplanned low income housing at Kamere, Kwa Muhia and DCK are not connected. In KenGen staff houses, electricity and liquefied petroleum gas (LPG) is the main source of energy for cooking while in the upcoming low class houses which form the majority the main source of energy for cooking includes kerosene, charcoal and wood fuel. The increase in population is a major threat to the forestry resource close to the project area. The expected power consumption based on the current consumption is not going to drastically interfere with the supplies to the national grid.

3.3.11 Land tenure

Before Kenya became a British Colony, a huge part of land in the Rift Valley including the project area, was occupied by the Maasai Community. The land under the Masaai occupation was community owned including the rivers, lakes and salt licks. The plains were used for grazing during the rain seasons while the highlands were used for grazing during the dry seasons.

Following the building of the Uganda Railway across the Rift Valley in 1900, the Maasai were moved south of the Railway in 1905 to make way for European Settlement. Much of the land around Lake Naivasha was subsequently settled by the European farmers for mixed livestock and agricultural farming. In 1932, an agreement was reached between the Colonial Government and the Lake Naivasha Riparian Owners Association (LNROA) that stipulates modalities of utilising the riparian land below 1906m asl.

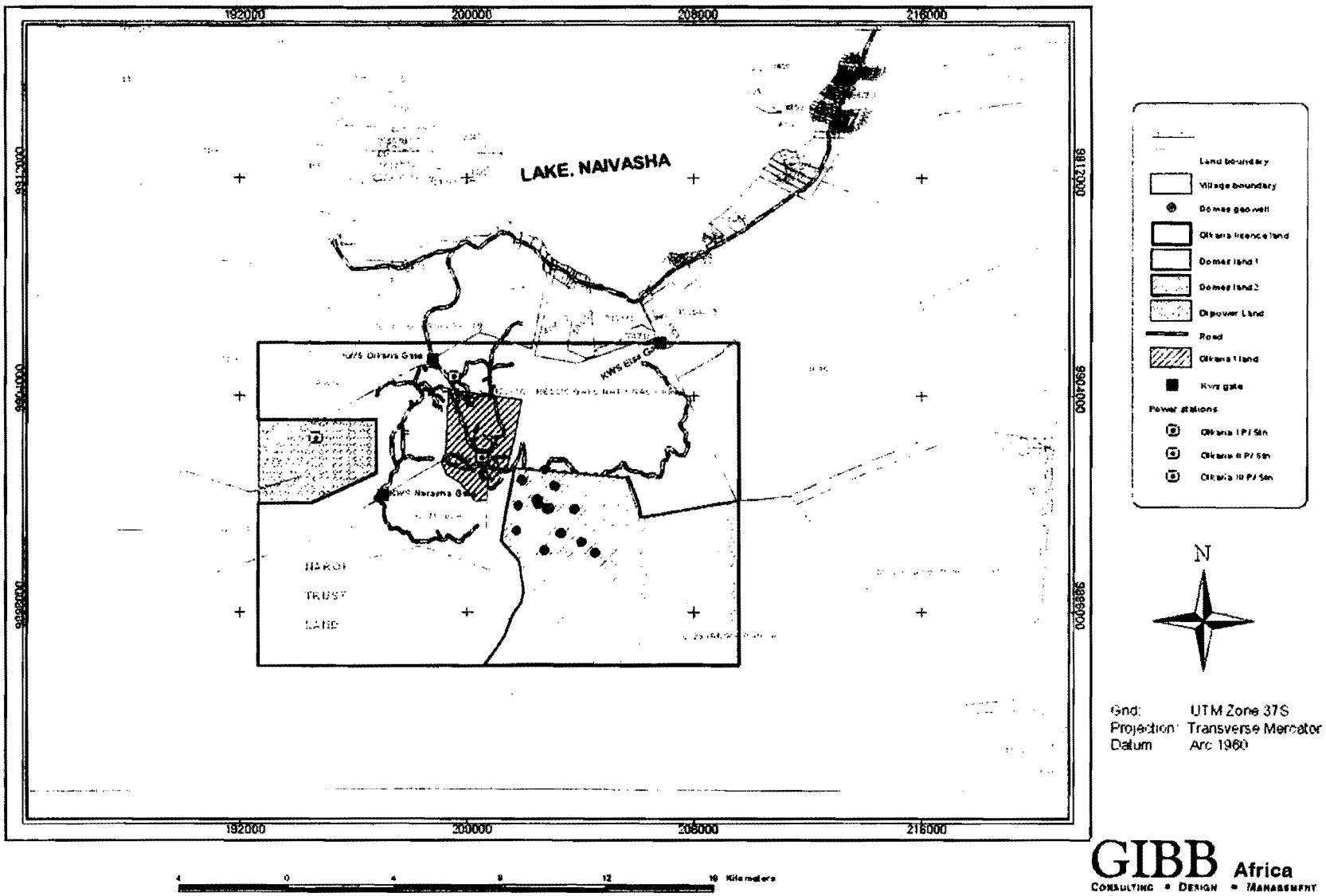
After 1963, following the attainment of independence in Kenya, some of the land in the Rift Valley especially on the Naivasha basin and the land on the eastern flanks of the Rift Valley in Kinangop Plateau and Kipipiri was settled by the landless local community from Central Province. Some of the former settler's large farms were sold to the land buying companies and subsequently divided to the shareholders.

At present the land in the project area including Hell's Gate National Park and the Lake Naivasha falls within Naivasha Municipal Council boundaries. Land ownership in the project area and the surroundings falls into two broad categories. These include the Government Trust land and Private Ownership. The former is land owned by the Government through Government ministries, state corporations local authorities and other public institutions. Included in this category is the Hell's Gate National Park, Longonot National Park, Lake Naivasha and land occupied by the Olkaria I & II power stations and the associated facilities.

Private land includes land privately owned and registered with a title deed under freehold or leasehold modality. This includes ranches (Kedong and Longonot ranches), large farms (Kongoni, Oserian, and Ndabibi Farms), land under flower farms (Oserian, Homegrown, Sher Karuturi Agencies etc) and other privately owned land around the lake.

An interesting observation with regard to the land tenure of the project area is the access to the lake. Although the lake is a public property, access to the lake is mainly through private property. The issue of the establishment of corridors that facilitate the community to access the lake has not been adequately resolved. A feature of interest in this study is the ownership of land on the site earmarked for the establishment of Olkaria IV in the Domes area. Officially this is in the Akira section of the Kedong Farm. However, this area is currently occupied by the Masaai Community, who also claims ownership to the land.

Figure 3.16 ***Land Tenure Map***



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3.3.12 Land use

Currently the land in the project area and surroundings support multiple land ecosystem including farming, tourism, wildlife conservation, power generation, human settlement, infrastructure, industrial development and other uses. Traditionally, the main agricultural activity of the area has been ranching. However, the area around Lake Naivasha has now become an important centre for flower and vegetable production in the country. In the last twenty years or so, this area has seen an extra ordinary explosion of horticulture and floriculture for European export market.

Large tracts of land have been cleared to make way for green houses. The favourable climate and soils and ample supply of irrigation water from the Lake Naivasha are ideal conditions for intensive production of cut flowers and horticultural crops such as green beans. Large areas of woodland and fringing swamps have also been cleared with cultivation sometimes extending right down to the lake edge. Today, the total area of commercial scale irrigation for cut flowers and vegetables around Lake Naivasha is estimated to be 3-5,000 hectares.

Major companies involved in flower cultivation include Oserian Company, Sher Karuturi, Homegrown, Gold Smith Seeds, Kijabe Ltd. and Wild Flowers Ltd. among other flower growing concerns. To the west, south and east of the Olkaria Power Station beyond the boundaries of Hell's Gate National Park, the land is mainly used for ranching. The major ranches are the Kedong Ranch and Longonot Ranch situated to the south and east of the National Park and Kongoni Farm to the west of the Park. These ranches also form important dispersal areas for wildlife from the Hell's Gate and Longonot National Parks. Other important ranches around the project area include Oserian, Kongoni and Ndabibi Farms.

3.4 Civil Society, Non-Governmental and Community Based Organisations

3.4.1 Non-Governmental Organisations

The mandate of some of the registered Non-Governmental Organisations (NGOs) in Naivasha District goes beyond combination of resources to include environmental management and development issues. Table 3.20 below shows the NGO's dealing with environmental management and development issues.

Table 3.20 Environmental Youth Grups in the Project Area

[illegible]	[illegible]	[illegible]	[illegible]
Sustainable Development Youth Group	-	-	• Environmental conservation and management; • Farming and Poverty Eradication; • HIV / AIDS.
Olo Sinyat Community Based Organisation (CBO).	19	10	• Community Rights; • Development; • Education including adult education; • HIV / AIDS; • Female Genital Mutilation (FGM).
Kidong Nyota Women's Group	6	19	• Fishing; • Pooling of financial resources (Merry-go-round).
Youth Action on Climate and Environmental Rehabilitation	17	13	• Recycling; • Organic farming; • Environmental conservation; • Sports.
Naivasha District CSO Forum	42	20	• Protect the environment and natural resources within the Lake Naivasha Basin.
Naivasha Partners for Development	10	16	• Planting trees; • Garbage Collection; • HIV / AIDS including voluntary counselling.

Oseko Self Help Group	28	3	• Community based socio-economic development; • Poverty eradication; • Planting trees.
Lake Naivasha Basian Sean Group	9	6	• Planting Trees.
Grass Roots Community Save Lake Naivasha	5	10	• Recycling; • Conservation.
Pamoja Self Help Group	12	8	• Planting trees.
Mwitiria Self Help Group	8	12	• Planting trees.
Olkaria Naiposha Self Help Group	20	5	• Initiate socio-economic development projects.
Living Way Education	7	18	• Planting trees.
River Malewa Fish Self Help Group	35	13	• Fishing.
Eco-conscious Alliance	28	8	• HIV / AIDS; • Poverty eradication; • Environmental conservation.

Source: Social Services Office, Naivasha Municipality, 2009.

3.4.2 Women's Groups

African culture has been invoked to legitimise differences in gender status, values and roles and to justify unequal gender relations in a manner that, to a large extent, favours men and disadvantages women. This is documented by various authors and institutions (Nyerere, 1973; ECA, 1994; World Bank 1995, 2000). Customary and traditional practices in many African countries prevent women from controlling and inheriting land and other resources on an equal footing with men. Information on contributions of women in economic activities is also lacking. In Kenya, for example, it is estimated that nearly 60 per cent of female activities are not captured in the System of National Accounts (SNA) as compared to 24 per cent of male activities (World Bank, 1998). Failure to capture women's contributions may lead to inadequate consideration of their needs for income, training, credit and technology during project development. (African Development Bank, 2001).

Involvement of women and institutions for gender development should be done from project planning stages to ensure that they are properly represented at all stages of the project.

Naivasha District has registered women's self-help groups. These groups are mostly for economic empowerment of women and to increase there purchasing power. Table 3.21 below shows the women group in the district.

Table 3.21 Registered Women Groups in the District

Siloam Kinamba	Maraingushu	17
Urumwe	Kinambi	60
Tumaini CPK Good Faith	Karate	38
Kandege	Hells Gate	30
Talent Taps	Naivasha Central	16
Mahindu	Gatamaiyo	16
Panda Harvesters	Naivasha Town	26
Jipeleleze	Naivasha Town	17
Mirera Chechinia	Hells Gate	20
Welinde	Olkaria	30
Express	Olkaria	23
Kamuyu Tuinuane	Hells Gate	24
Joywell	Naivasha	24
Nyakio	Hells Gate	21
Humble	Naivasha Town	21
Smart Sis	Naivasha	15
Vanilla Site	Naivasha Town	26
Kioneki	Naivasha	16
Website	Naivasha	18

Tuinuane	Hells Gate	25
New Hope	Lake View	20
Baraka YMCA	Hells Gate	25

Source: District Cultural office 2009

Four women groups mainly Kandege, Mirera Chechinia, Welinde, Express and Kamuyu Nyakio, Tuinuane and Baraka YMCA operate within the project area of influence.

3.4.3 Youth Groups

The Kenya Government started a Youth Development Fund that extends credit to registered youth groups for socio-economic development. Naivasha District has a Youth Office located at the Naivasha District Commissioners Compound. There are a total of approximately 176 registered youth groups in the project influence area.

3.4.4 Vulnerable Groups

Information on the greater project area (former Nakuru District) shows the following data on people who are physically challenged:

Table 3.22 Vulnerable Groups in the District

[illegible]	[illegible]	[illegible]	[illegible]
Missing Hand	1.9	1.7	0.4
Missing foot	2.3	2.4	0.0
Lame	25.7	28.6	55.0
Blind	7.8	6.2	0.0
Deaf	5.9	4.6	0.0
Dumb	9.0	6.0	8.4
Mental	18.4	18.2	33.6
Paralysed	10.0	14.9	12.7
Other	31.5	31.4	15.7

Note: percentages don't add up to 100 due to multiple responses.

3.5 Cultural Environment

The cultural environment of the project site is mainly influenced by the Maasai Community living in the project area. They are pastoralists and keep cows, goats and sheep as the main source of their livelihood. The settlers graze the vast terrain as this has provided pasture for their animals from time immemorial. The Maasais have lived on this land for as long as many of them can remember. The Maasais have a unique land tenure system and have permanent residential places known as *"Embarnat"* and live in large communities. However, should these permanent locations dry up such that there is no enough pasture for the animals to graze on, some of the Maasai community will move out of the *"Embarnat"* in search of pasture elsewhere temporarily for as long as a year or so only to come back when animal pasture is restored in their previous grazing grounds. The temporary nomadic residences are known as *Ilgobori or Emuate.*

This section therefore briefly discusses the history, culture, shelter and the influence of the modern world to the community. It is important to note that the community is going to be the most affected by the proposed development as described in earlier sections.

3.5.1 Maasai Community

According to Wikipeadia, the free encyclopaedia the Maasai are an indigenous African ethnic group of semi-nomadic people located in Kenya and northern Tanzania. Due to their distinctive customs and dress and residence near the many game parks of East Africa, they are among the most well known of African ethnic groups.

They speak Maa, a member of the Nilo-Saharan language family that is related to Dinka and Nuer, and are also educated in the official languages of Kenya and Tanzania: Swahili and English. The Maasai population has been variously estimated as 377,089 from the 1989 Census or as 453,000 language speakers in Kenya in 1994 and 430,000 in Tanzania in 1993 with a total estimated as *"approaching 900,000"*. Estimates of the respective Maasai populations in both countries are complicated by the remote locations of many villages, and their semi-nomadic nature.

Although the Tanzanian and Kenyan governments have instituted programs to encourage the Maasai to abandon their traditional semi-nomadic lifestyle, the people have continued their age-old customs. Recently, Oxfam has claimed that the lifestyle of the Maasai should be embraced as a response to climate change because of their ability to farm in deserts and scrublands.

(a) History

According to their own oral history, the Maasai originated from the lower Nile valley north of Lake Turkana (North-West Kenya) and began migrating south around the fifteenth century, arriving in a long trunk of land stretching from northern Kenya to central Tanzania between the seventeenth and late eighteenth century. Other ethnic groups were forcibly displaced as they settled there. The Maasai territory reached its largest size in the mid-nineteenth century, and covered almost all of the Great Rift Valley and adjacent lands from Mount Marsabit in the north to Dodoma in the south. At this time the Maasai raided the groups who were staying in the areas they wanted to occupy. Raiders used spears and shields, but were most feared for throwing clubs (*orinka*) which could be accurately thrown from up to 70 paces (appx. 100 meters). In 1852 there was a report of a concentration of 800 Maasai warriors on the move in Kenya. In 1857, after having depopulated *the "Wakuafi wilderness"* in south-eastern Kenya, Maasai warriors threatened Mombasa on the coast of Kenya. Because of this migration, the Maasai are the southernmost Nilotic speakers.

Maasai are pastoralist and have resisted the urging of the Tanzanian and Kenyan governments to adopt a more sedentary lifestyle. They have demanded grazing rights to many of the national parks in both countries.

The Maasai stood against slavery and lived alongside most wild animals with an aversion to eating game and birds. Maasai land now has East Africa's finest game areas. Maasai society never condoned traffic of human beings, and outsiders looking for people to enslave avoided the Maasai.

Essentially there are twelve geographic sectors of the tribe, each one having its own customs, appearance, leadership and dialects. These subdivisions are known as the Keekonyokie, Damat, Purko, Wuasinkishu, Siria, Laitayiok, Loitai, Kisonko, Matapato, Dalalekutuk, Loodokolani and Kaputiei.

(b) Culture

Maasai society is strongly patriarchal in nature with elder men, sometimes joined by retired elders, deciding most major matters for each Maasai group. A full body of oral law covers many aspects of behaviour. Formal execution is unknown, and normally payment in cattle will settle matters. An out of court process called *'amitu'*, 'to make peace', or *'arop'*, which involves a substantial apology, is also practiced. The Maasai are monotheistic, and they call God *Enkai or Engai. Engai is* a single deity with a dual nature: *Engai Narok* (Black God) is benevolent, and *Engai Nanyokie* (Red God) is vengeful. The *"Mountain of God", Ol Doinyo Lengai,* is located in northernmost Tanzania. The central human figure in the Maasai religious system is the laibon who may be involved in: shamanistic healing, divination and prophecy, ensuring success in war or adequate rainfall. Whatever power an individual laibon had was a function of personality rather than position. Presently Many Maasai have become Christian, and to a lesser extent, Muslim.

Traditional Maasai lifestyle centers on their cattle which constitutes the primary source of food. The measure of a man's wealth is in terms of cattle and children. A herd of 50 cattle is respectable, and the more children the better. A man who has plenty of one but not the other is considered to be poor.. A Maasai myth relates that God gave them all the cattle on earth, leading to the belief that rustling cattle from other tribes is a matter of taking back what is rightfully theirs, a practice that has become much less common.

(c) Shelter

As a historically nomadic and then semi-nomadic people, the Maasai have traditionally relied on local, readily available materials and indigenous technology to construct their housing. The traditional Maasai house was in the first instance designed for people on the move and was thus very impermanent in nature. The *Inkajijik* (houses) are either star-shaped or circular, and are constructed by able-bodied women. The structural framework is formed of timber poles fixed directly into the ground and interwoven with a lattice of smaller branches, which is then plastered with a mix of mud, sticks, grass, cow dung and human urine, and ash. The cow dung ensures the roof is water-proof. The *enkaji* is small, measuring about 3x5m and standing only 1.5m high. Within this space the family cooks, eats, sleeps, socialises and stores food, fuel and other household possessions. Small livestock are also often accommodated within the *enkaji.* Villages are enclosed in a circular fence *(Enkang)* built by the men, usually of thorned acacia, a native tree. At night all cows, goats and sheep are placed in an enclosure in the center, safe from wild animals.

(d) Influence of the modern world

Government policies such as the preservation of parks and reserves, with the exclusion of the Maasai, along with increasing populations, etc, have made the traditional Maasai way of life increasingly difficult to maintain.

With increasing poverty and migration, the traditional authority of Maasai elders appears to be lessening.

Over the years, many projects have begun to help Maasai tribal leaders find ways to preserve their traditions while also balancing the education needs of their children for the modern world. The emerging forms of employment among the Maasai people include farming, business (selling of traditional medicine, running of restaurants/shops, buying and selling of minerals, selling milk and milk products by women, embroideries), and wage employment (as security guards/ watchmen, waiters, tourist guides), and others who are engaged in the public and private sectors..

Many Maasai have moved away from the nomadic life to responsible positions in commerce and government. Yet despite the sophisticated urban lifestyle they may lead, many will happily head homewards dressed in designer clothes, only to emerge from the traditional family homestead wearing a shuka (colourful piece of cloth), cow hide sandals and carrying a wooden club (o-rinka) - at ease with themselves and the world.

(e) Influence of the Community to the project area

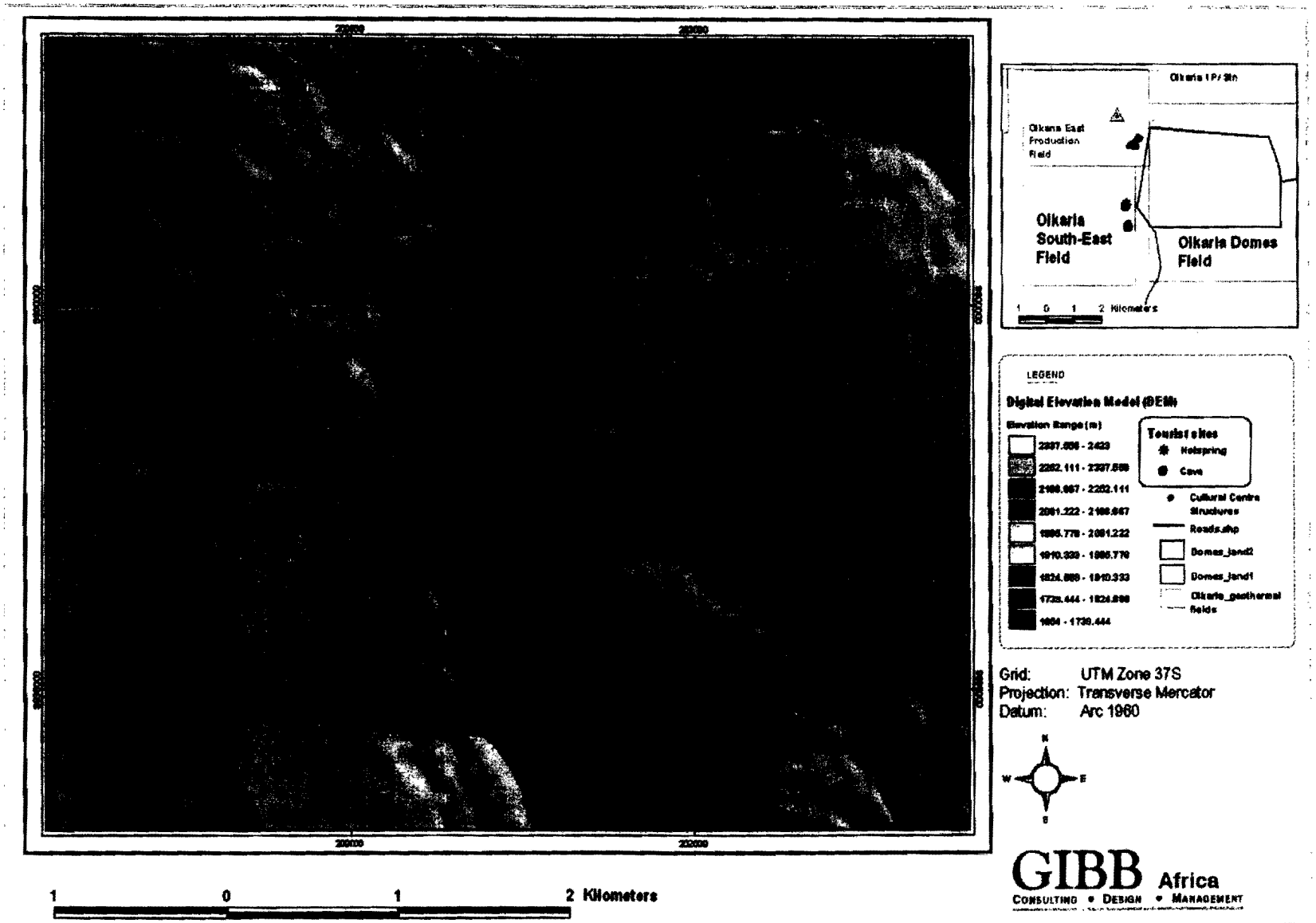
There are several cultural sites within the project area which are mainly due to their culture and mode of living includes:

- Oloor Karia Masai Cultural Centre;
- Ol Njorowa Gorge;
- Caves with leopards and big snakes;
- Hot Springs with boiling water.

The cave is called *"Keekonyokie"* cave and it has cultural value as it was used by the *"Olopeles"* age group from the Enkapune community. The new morans slaughter their goats in the cave to signify 'bravery". This age group can be dated to the late 1800s.

Other resources of cultural value in the project area include *Red Ochre* (fumaroles) sourced from Olkaria for use on Moran's hair as well as white soil sourced from Narasha. These are also used by old men during weddings.

Figure 3.29 A cultural centre and tourist sites map



3.5.2 Archaeological

Although the project area has not yet been associated with any archaeological site investigations carried out by the National Museums of Kenya (NMK) have shown that the Nakuru – Naivasha basin is an important area for archaeological and cultural artefacts. Indeed this area as well as other locations on the Rift Valley floor provided suitable habitats for early hominids and their associated fauna. This area has yielded significant stone tools including the artefacts (Eburran Industry) dated between 13,000 and 9,000 years ago that have been found at Gamble's Cave and Nderit Drift area near Nakuru. Other areas of archaeological importance are located at Kariandusi near Lake Elmenteita and Hyrax Hill near Nakuru.

4 PROJECT DESCRIPTION COMPONENTS AND PROCESS ACTIVITIES

4.1 Generation of Geothermal electricity

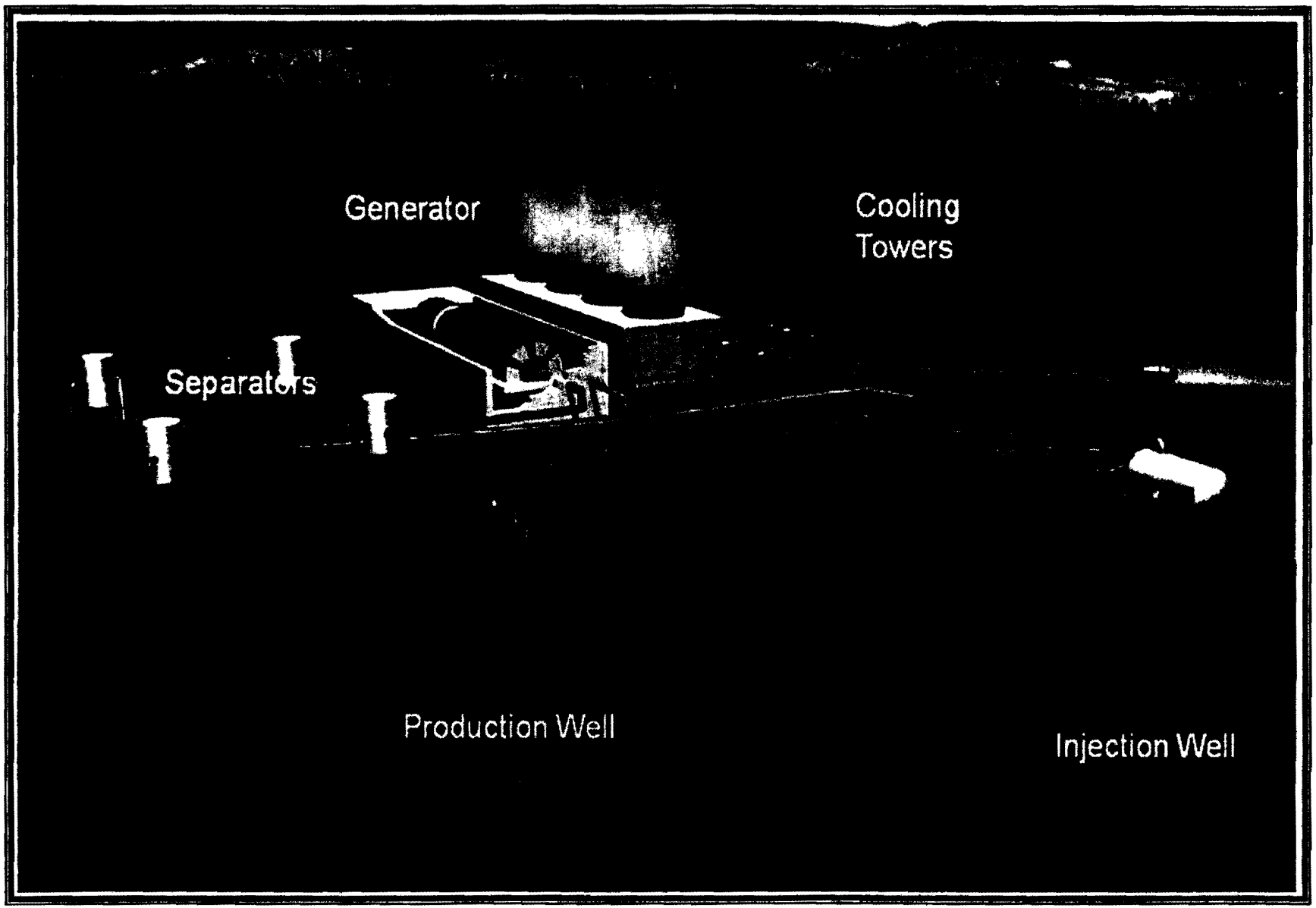
Geothermal energy is continuously created beneath the Earth's surface from the extreme heat contained in liquid rock (magma) within the Earth's core. When this heat naturally creates hot water or steam, it can be piped to the surface and then used to turn a steam turbine to generate electricity.

The process of generating geothermal electricity at the Olkaria IV domes will be exactly the same as that for the existing plant Olkaria II. It will basically consist of the following steps:

- Steam from the production wells will pass through a separator, where water (or brine) will be separated from the steam;
- The brine will be re-injected into a deep well;
- The steam will pass through steam scrubbers before being transmitted to impact reaction turbine, which will generate electricity;
- After passing over the turbine, the steam will be condensed;
- Hot condensate will be pumped through the cooling towers. Non condensable gases will be emitted from the cooling towers, while cool condensate will be re-circulated to the condenser;
- As the circulating condensate will be acidic, it will be dosed with soda ash (sodium carbonate). In addition, the condensate will be dosed with biocide (hypochlorite) to prevent bacteria growing in the fins of the cooling tower;
- Any additional condensate will be pumped into different re-injection wells.

A schematic diagram of geothermal system is presented in Figure 4.1 below:

Figure 4.1 Schematic diagram of geothermal process



4.2 Description of the works

The proposed power generation system and plant configuration at the new units at Olkaria IV (Domes) have not been conceptualised and are proposed to be designed to be similar to those of the recently constructed Olkaria II Power Plant.

The designs and related notes pertaining to Olkaria II and feasibility study reports for the proposed components have therefore been availed and reviewed for purposes of understanding of the proposed project.

Details of the additional local infrastructure to be implemented alongside the project have also been provided by the Client and are covered in this assessment.

The following key project components are to be implemented.

4.2.1 Plant site

The location of the Olkaria Domes new power plant will be the flat area south of the well OW-908. This location can minimize the impact to the landscape conditions from the Gorge, and is relatively flat land where the sufficient area can be secured for the new power plant construction.

The proposed power plant location is also close to the main production zone of the Olkaria Dome field.

4.2.2 Power Plant

The Olkaria Domes new units 1 and 2 will be constructed such that the capacity of each of the two units will be 70 MW for the optimum utilization of the available geothermal resource at the Olkaria Domes sector.The design steam pressure and temperature will be 6 bara and 158.7°C.

The new units 1 and 2 will be identical in the power generation system and configurations. The plant system will be single flash condensing type.

4.2.3 Gathering System

(a) Design Conditions

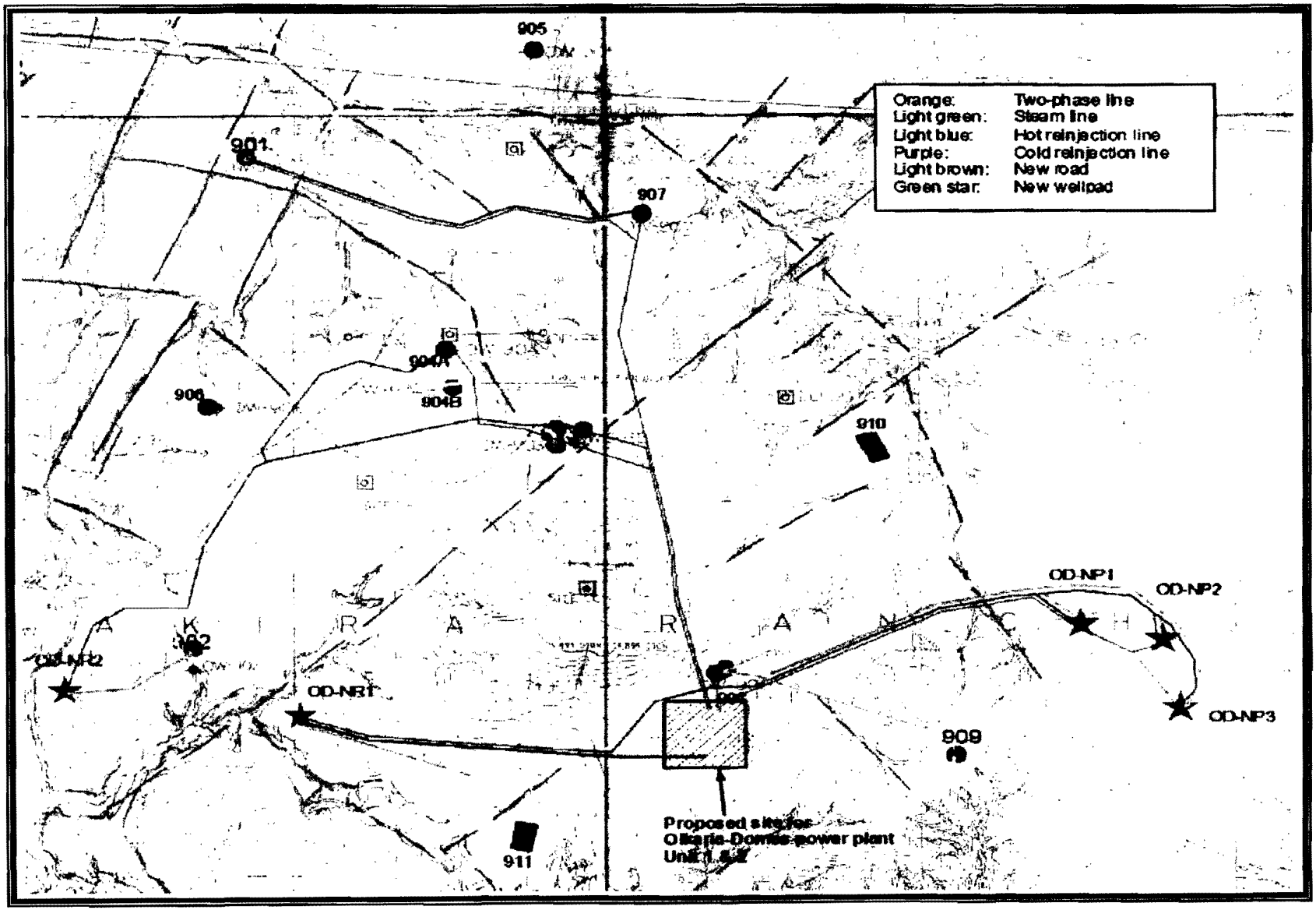
The pipeline layout is based on the location of wells used in the reservoir simulation and the forecasted mass flow rate of each production well at Olkaria Domes for Case 1 is the basis of sizing of the pipeline.

Pipe sizing was done to meet the recommended turbine admission pressure (6 bara) and the wellhead pressure (8.5 bara) assumed in the reservoir simulation.

In Olkaria Domes, higher pressure drop is assumed compared to those in Olkaria I and II because (1) the production well pads, especially OW-901, OW-907, OD-NP1 to NP3, are far from the power plant, and (2) a long two phase pipeline will be used to send fluid from the pad OW-910 to the separator at the pad OW-908.

All hot brine in Olkaria Domes will be injected underground at new reinjection pads OD-NR1 and OD-NR2 except the brine from the pad OW-907 which will be re-injected at the pad OW-907. OW-905 was not included in the study because it is very far from the power plant, there are gorges between the well pad and the power plant, and its production is small.

Figure 4.2 Layout of the gathering system for Olkaria Domes



(b) Pipeline Route

Hot reinjection lines are routed to avoid hill climbing and too much pressure drop in order to prevent flashing of brine in pipe without brine booster pump.

From pad OW-907, brine will be sent to pad OW-901 through pipeline along the existing road because other reinjection pads ODNR1 and OD-NR2 are far from OW-907 and gorges or a hill are barring the ways of pipeline.

Brine separated at the pad OW-901, together with the brine from pad OW-901, will be injected underground through reinjection wells in the same well pad. Steam pipe goes along the road to OW-907 and there it is connected to the steam pipe line comes from pad OW-907 and goes to the power plant.

From the pads OW-903 and OW-904, brine goes down the hill to the west and flows to OD-NR2. Steam pipe from these well pads will be connected the pipeline from OW-907 or go to the power plant along the pipeline form OW-907 depending on pipe sizing.

Since the elevation of the pad OW-910 is relatively low and the way to the reinjection wells at pad OW-901 is far and barred by gorges, there is no place to send brine if brine booster pump is not used. Two-phase fluid will therefore be sent to the separators at pad OW-908.

Two-phase fluid from pad OW-909 goes down the hill and flows into the separators at pad OW-908.

At the new production pads OD-NP1, OD-NP2 and OD-NP3, brine will be separated at the well pads and go to pad OW-908 gradually descending the north side of the hill. The steam pipeline from these well pads also goes along the brine pipeline. A bridge for the pipes may be necessary to traverse the small gorge on the north hillside.

An access road for the OD-NP1, OD-NP2 and OD-NP3 will be constructed along the brine pipeline. Access roads to OD-NR1 and OD-NR2 are also to be constructed.

From pad OW-908, brine flows down to west and is re-injected at OD-NR1. The cold reinjection line for cooling tower blowdown will also go along the hot reinjection line form OW-908. The cooling tower blowdown will be re-injected through wells shallower than hot reinjection wells.

(c) Steam Line

Basically each production wellpad has one separator except the pad for well OW-908 where three 150t/h separators are installed to process two-phase fluid from pads OW-908, OW-909 and OW-910.

Steam pipeline from the pad of well OW-903 is separate from the pipeline from OW-901, OW-907 and OW-904 because of large steam production of OW-903 pad and relatively long distance to the power plant.

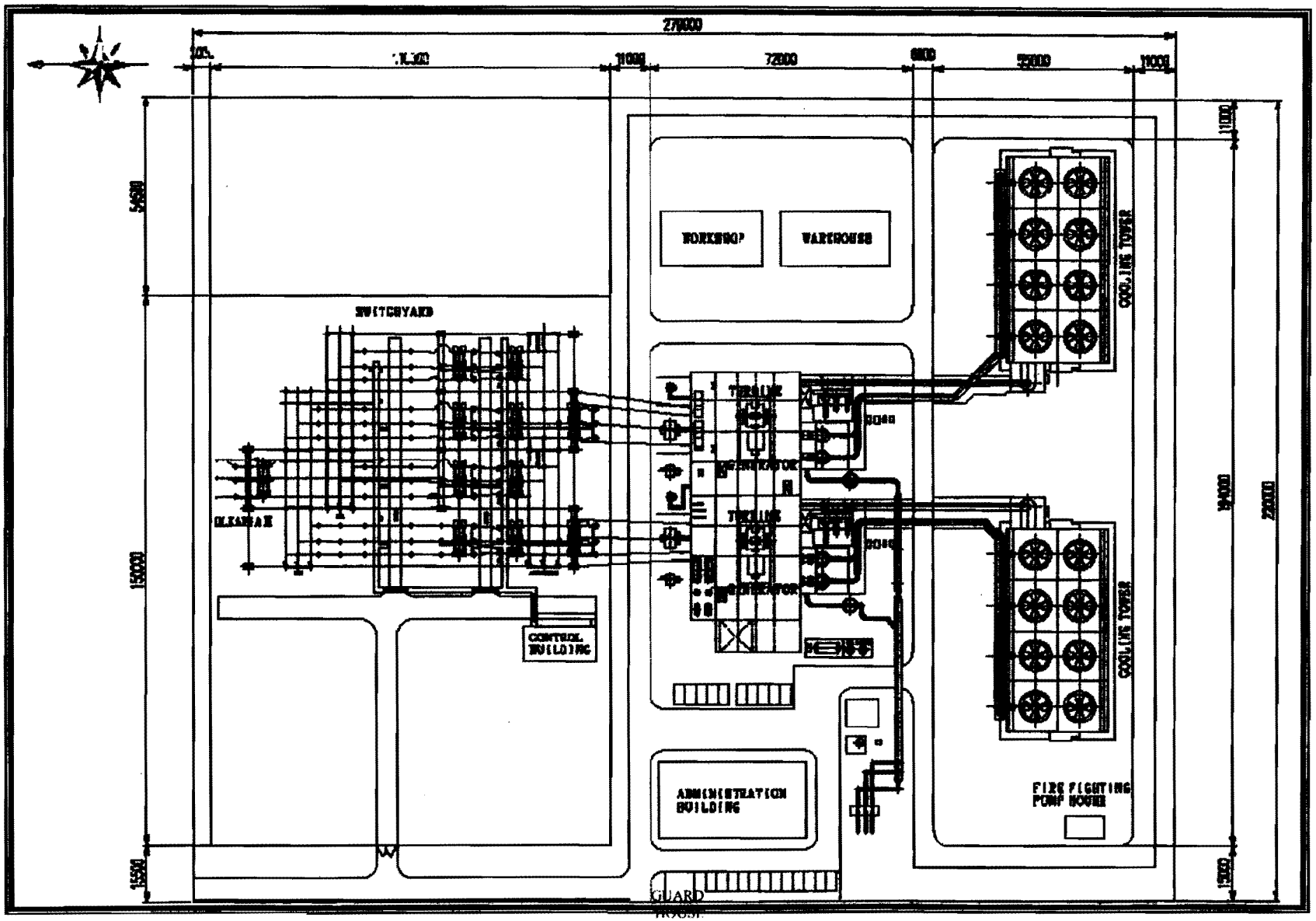
(d) Hot Reinjection Line

All brine will be sent to the reinjection wellpads by gravity and injected underground as for existing units of Olkaria II.

(e) Cold Reinjection Line

The re injection line of cooling tower blow-down will be branched from the main cooling water system of the power plant through the blow-down re-injection pumps.

Figure 4.3 Site Layout of the Olkaria 1 units 4 & 5 (70 MW x 2) power plant



4.2.4 Switchyard and Transmission Line

The electrical power to be generated by units 1 and 2 of Olkaria Domes will be delivered to Suswa Substation by double circuit transmission line.

(a) Switchyard

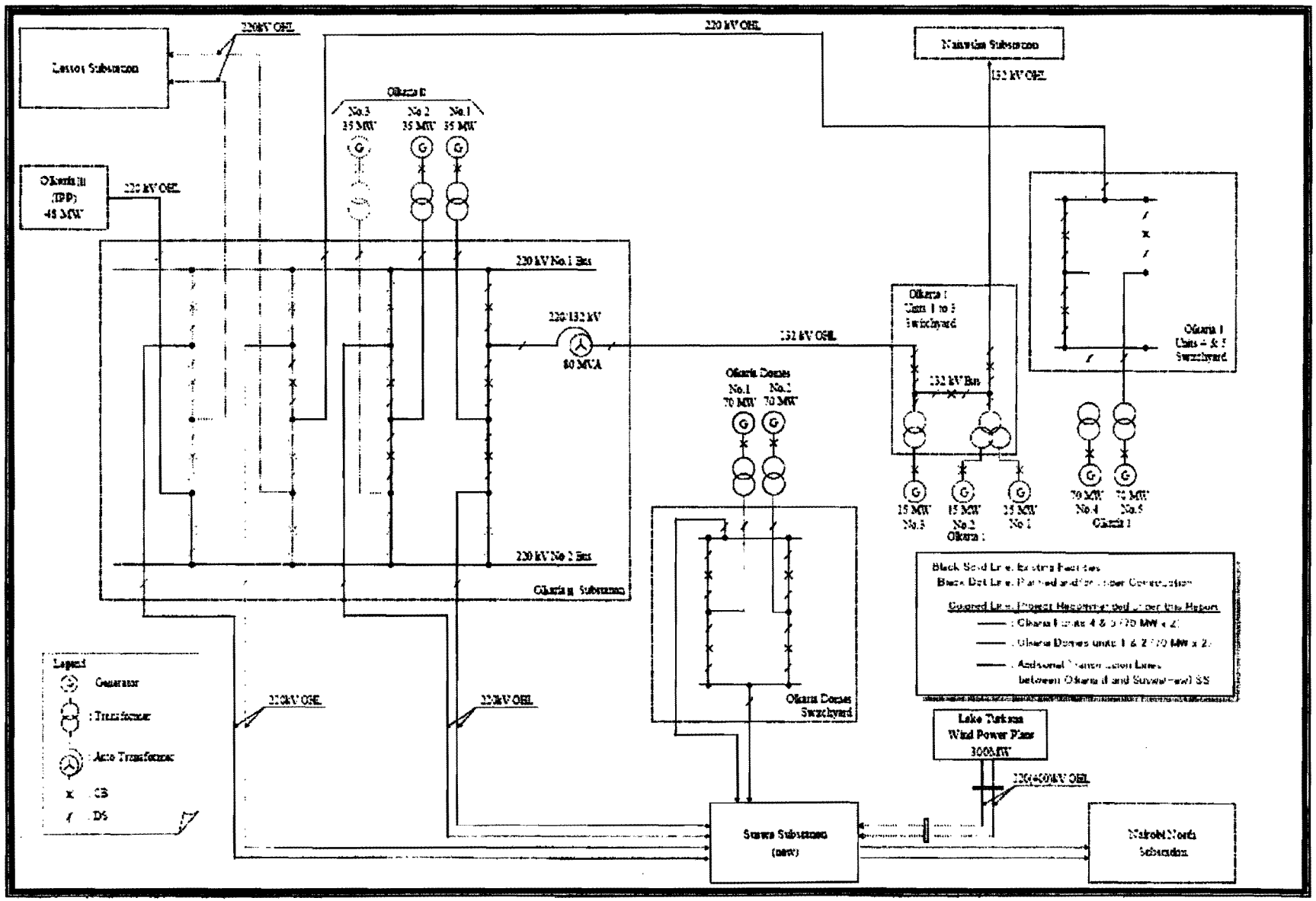
The switchyard will be configured as a 220kV ring bus (which is an adopted standard for 220kV substations in Kenya) with 4 bays.

(b) Transmission Line

The length of the transmission line for Olkaria Domes to Suswa Substation is approximately 20 km.

The communication from Olkaria Domes to Olkaria II will be through OPGW which is planned to be installed on the towers and be connected at Suswa Substation by the modification of the existing communication system. Further connection to the grid operator system will be made at Suswa Substation as well.

Figure 4.4 Transmission line and switchyard configuration for the Olkaria geothermal power plants after developments



4.2.5 Construction Schedule of Surface Facilities

The construction of unit 1 will take 24 months from the contract effective date including a 2 month commissioning and testing period. The power receive will be in the 21st month, and the initial steam receive will be in the 22nd month.

Unit 2 will be completed 3 months after unit 1 is completed.

The above mentioned construction schedule is presented as the challenging shortest case replying the KenGen's strong intention of the soonest completion of the additional power plants in order to contribute with power supply to the very critical power situation in Kenya.

The presented construction schedule is ideal and very challenging, and there would be little time allowance for unforeseen and/or un-expected events during the project implementation which may result from the special site conditions close to the national park, hilly topographic condition at the construction site, the environmental requirements, the climate conditions, flooding in rainy seasons, etc.

The recommendation should be reviewed and re-studied further at the project implementation stage.

4.2.6 Earthworks and excavations

The significant earthworks are anticipated construction of the power plant and related facilities. Since the design has not been done it is difficult to estimate the exact quantities of materials which will be removed. Unattended open trenches exposed over long period of time may be harmful to persons and animals which may fall or be trapped in them and water may also stagnate in them forming breeding zones for mosquitoes and pathogens.

On the other hand, piled excess soils from excavations for filling and reinstatement works on the sides of the trenches may be washed away during rain either into the trenches or away to surface run off if not protected adequately.

4.2.7 Condition of Roads network to the domes

The road from Olkaria I to the Domes cuts through a rolling to a hilly terrain punctuated by steep slopes at isolated sections. The 12km earth road is in poor condition necessitating extensive repairs and/or reconstruction; loose surface which generate dust during use, insufficient width, broken road section, steep gradients are common. Currently the road is only passable to 4WD vehicle.

There are no major water causes crossed by the 12km road. Currently, there are few culverts along the earth road. The culverts are generally in good condition with clear outlets and intact headwalls and can be retained. However their adequacies will be checked from hydrological computations during the design. Further, the existing rolling to steep terrain is likely to reduce drainage challenges.

The existing traffic is very light, consisting of tourist vehicles and construction vehicles. It should be easily possible to pass this traffic during construction with few diversions in isolated sections. The traffic is expected to increase during the project implementation and after completion of the Olkaria II occasioned by educational and excursion activities that the new project will generate.

The design will most likely recommend total reconstruction and upgrading to bituminous surface; probably surface dressing. The construction will most likely involve a significant amount of earthworks; cuts, to achieve the appropriate grades. Because of the likelihood of generating a significant amount of materials from the cuts and short length of the road, one quarry site is likely to be adequate

4.2.8 Raw materials and process chemicals

The main raw material is geothermal steam. At Olkaria II, some 495,000 kg of steam is consumed by the two existing turbines per hour; the two new units will probably use approximately two million kg of steam. Non condensable gases (NCGs) will make up 55 between 0.30 - 0.34% by weight of the main steam. The measured composition by volume of the main steam flowing through each of the existing turbines is:

- Steam - 99.85 – 99.87%;
- Carbon dioxide (CO2) - 0.108 - 0.123 %;
- Hydrogen sulphide (H_2S) - 0.010 - 0.013%;
- Oxygen (O2) - 0.001 – 0.002%;
- Nitrogen (N2) - 0.011- 0.012 2%.

This composition will remain much the same for Olkaria IV. Small quantities of sulphur oxides (SOx), methane (CH4), ethane (C2H6) and radon (Rn) will also be present in the geogas. Table 4.2 below shows the actual composition of the non condensable gases in the main steam in Olkaria II compared with levels as predicted in the 1994 EIA study. Table 4.1 below shows the composition of non Condensable Gases (% by Volume) in Olkaria II.

Table 4.1: Composition of non-condesable gases Condensable Gases (% by Volume) in Olkaria II

Carbon dioxide (CO2)	91- 96%	82.0 – 83.1%
Hydrogen Sulphide (H2S)	1.2 – 4.9%	7.7 – 8.7%
Oxygen (O2)	-	0.77 – 1.3%
Nitrogen (N2)	-	8 – 8.5%
Hydrogen (H2)	0.7 – 3.3%	Not measured
Methane (CH4)	Less than 2%	Not measured

The Table 4.1 indicates that the amount of hydrogen sulphide is 2-7 times more than initially estimated, but the amount of carbon dioxide was 9-14% lower than anticipated. A similar composition is expected for Olkaria domes. Water from Lake Naivasha is used as a coolant in the cooling towers. This is a closed system, where there is a balance between condensed steam and emissions released through the cooling towers. There are currently three units in Olkaria I.

The Olkaria IV will require 2500 m^3 of fresh water at start up. Thereafter for about three years, only a very small quantity of water is necessary for topping up.

An amount of approximately 300 kg of soda ash (sodium carbonate) will be used per day to dose the condensate produced by the new unit in order to maintain a pH value of 7-9, to eliminate algal and bacterial growth. Water for the new cooling towers will be shock-dosed with sodium hypochlorite (approximately 200 litres will be required per day) and biocide (approximately 200 litres of biocide will be needed per month) to prevent algae and other bacteria clogging up the cooling tower fins. Some water from the new cooling tower will also be cold reinjected, and will also be neutralised with soda ash.

Other chemicals currently used on site and will also be used include diesel oil for the standby generator, silica gel to dry air going into the transformers, greases and lubricants for maintenance of the plant and equipment, paints, detergents and solvents. Mercury is stored the Instrumentation Laboratory for calibrating plant control instruments. It is not anticipated that the volumes required of these chemicals will increase substantially for use at the new unit.

5 PROJECT ALTERNATIVES AND TECHNOLOGIES

The Energy situation in Kenya dictates that there is need to develop the electricity generation capacity in the country for faster economic growth.

Currently electricity is available to less than 10% of Kenya's population, and persistent load shedding is affecting the productivity of the industrial and agricultural sectors, leading to reduction in economic growth. Electricity demand in Kenya is growing and the electricity system is vulnerable due to its high dependency on supply from hydroelectric plants that often have limited water capacity to supply demand.

5.1 No Action Alternative

Kenya Electricity Generating Company Limited, KenGen is the leading electric power generation company in Kenya, producing about 85% of electricity consumed in the country. The company utilises various sources to generate electricity ranging from hydro, geothermal, thermal and wind. Hydro is the leading source, with an installed capacity of 677.3MW, which is 72.3 per cent of the company's installed capacity.

The Kenya Electricity Generating Company Limited (KenGen) is currently able to generate about 85% of the total national capacity while independent power producers (IPPs) contribute the balance of 15%. KenGen is working towards enhancing its capacity through hydro-plants and geothermal sources among other initiatives, but additional sources would still be required to meet the anticipated growth in demand and provide diversification of technology and fuels.

The country produces a total of 1267.9 MW of electricity. Most (57%) of this production (719.0 MW) is hydro power. The bulk of hydro power in the country is generated in several power stations along the Tana River at Masinga, Kamburu, Gitaru, Kindaruma, Kiambere, Turkwell Gorge and Sondu Miriu power stations and other minor stations including the Tana, Sagana, Ndula, Gogo, Sosiani and Mesco.

Due to over reliance in the hydropower over the last ten years the country has paid a high price over heavy reliance on single source of power. In 1999 and in 2002, severe droughts nearly brought the Kenyan economy to a standstill after the hydro power dams dried out leaving power rationing in its wake. This experience has underscored the need to diversify the power sources in Kenya.

KenGen is currently undertaking several projects listed below in the Country to achieve the electricity generation deficit.

- Third Unit for Olkaria II Geothermal Power Station;
- Optimisation of Olkaria Power Stations – Olkaria IV and I Unit 4 and 5;
- Optimisation of Kiambere Hydro Power Station;
- Redevelopment of Tana Hydropower station;
- Kipevu III Thermal Power Project (Medium Speed Diesel);
- Sangoro Hydro Power Plant;
- Ngong Wind Project; Phase II
- Kindaruma Hydro 3rd Unit Project.

The 'no action alternative' is therefore not feasible development option for this project.

5.2 Alternative sources of electricity generation

The summary of the key issues with the Power generation options available in Kenya is given in Table 5.1 below.

Table 5.1: Summary of the key issues associated with the different fuel types available in Kenya

Geothermal power	Rift Valley	Sustainable Non-polluting Little environmental impact.	It can only be developed in selected volcanic areas	Medium to long term solution – Available
Hydropower	Tana River Catchment Western Kenya Small micro schemes	Compact; a large amount of electrical power can be produced by a moderately sized station Sustainable	The building of dams is usually environmentally destructive. River valleys are often fertile and densely populated resettlement. The water released from a hydro-power station often comes from the bottom of a dam. Water is often released from a hydro-power dam at times that depends on power consumption not ecological needs.	Medium to long term solution – Available
Solar Power	Throughout Kenya	Sustainable It is a well proven technology; Well suited to providing power in home or single building applications.	The manufacturing process requires large amounts of energy; Does not produce much power when the sun isn't shining, and negligible power at night. An alternative power supply is needed for these periods. Electricity generated by solar panels is quite expensive.	Short term but limited solution - Available
Wind Power	Limited application	Sustainable Non-polluting A well proven technology	Does not produce power when the wind isn't blowing, so a back-up electrical supply is also needed If batteries provide the backup they have the disadvantage of being expensive and needing to be replaced every few years	Medium to long term solution
Liquid Fuel	Imported via Mombasa	Generators are very compact. Produces less CO2 than coal.	Not believed sustainable long term Produces carbon dioxide (CO2), The world's oil reserves are limited. Oil spills, cause severe pollution. Some oils contain high levels of sulphur.	Medium to long term solution
Coal	None	Relatively low cost compared to other fuel type options.	Not available, needs to be imported Not sustainable Produces more carbon dioxide (CO2) per Watt-hour of energy than any other generation method; Very large quantities of ash have to be disposed of Some coal contains significant amounts of sulphur, one of the main causes of acid rain. Coal also contains small amounts of heavy metals.	Long term solution

Gas	Tanzania	Relatively low cost fuel option when available Generators are very compact Produces less CO2 than coal or oil Can be used in HFO plants with minor alterations.	Not available, needs to be imported from Tanzania Need to build extensive pipeline Not sustainable Produces carbon dioxide. (CO2), Natural gas reserves are limited.	Medium to long term solution
Electricity from Waste	Has to be near reliable sources of solid waste	Generate energy whilst reducing the volume of waste	Generate energy whilst reducing the volume of waste Produces high levels of carbon dioxide and nitrogen dioxide Ash disposal and air pollution emissions Toxic materials include trace metals such as lead, cadmium and mercury, and trace organics, such as dioxins and furans.	Medium to long term solution
Conventional nuclear power	None	Compact a large amount of electrical power can be produced by a moderately sized station. Low fuel costs Small number of accidents; Normally does not produce any significant atmospheric Pollutants Quantity of waste produced is small	Expensive, especially in capital costs, maintenance costs, and due to the long lead time in planning and construction; There is a danger of radiation release. While there are few accidents the consequences of Some accidents may be catastrophic. Decommissioning a nuclear power station at the end of its useful life is very difficult and expensive. Safe long-term disposal of nuclear waste is difficult. The lead time in building a nuclear power station is around ten years A tempting target for terrorist attack.	Long term solution, 10 year lead time.

The use of geothermal energy as a source of power generation has a number of environmental benefits.

The project will directly contribute to economic growth by alleviating the persistent electricity interruptions that affect the productivity of the industrial, commercial and agricultural sections of the Kenyan economy. It will mitigate the effects of power shortages that hinder economic development in the short and long term, by providing base load power supply which is consistent with the least cost expansion plan. Moreover, it will supply the much needed back-up power for Kenya's hydroelectric dam system which is prone to water shortages and climatic uncertainty.

The project will use an indigenous energy resource for power generation. Therefore it will reduce exposure of the economy to fossil fuel price fluctuations and the associated exchange rate risk for fuel procurement. In addition it will be benefit regional environment (especially air quality) since geothermal electricity production produces none of the conventional air pollutants associated with alternative fossil fuel generation options. It will also supply jobs to some local residents and be a source of local economic growth.

The global benefits of the project include avoided GHG emissions. In particular it provides for substantial carbon dioxide emission reductions in comparison to fossil fuel based generation of a similar capacity. In this way this project will help remove one of the barriers to geothermal utilization and encourage the development of the resource at

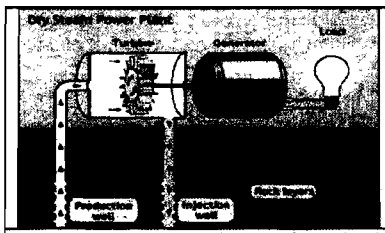
Olkaria, and possibly in other fields within Kenya and elsewhere where such potential exists.

5.3 Alternative technologies for geothermal electricity generations

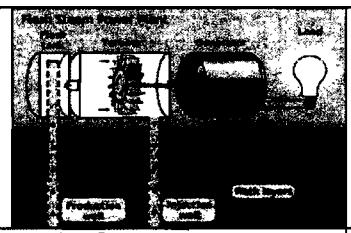
There are three geothermal power plant technologies being used to convert hydrothermal fluids to electricity. The conversion technologies are dry steam, flash, and binary cycle. The type of conversion used depends on the state of the fluid (whether steam or water) and its temperature.

5.3.1 Dry steam Power Plants

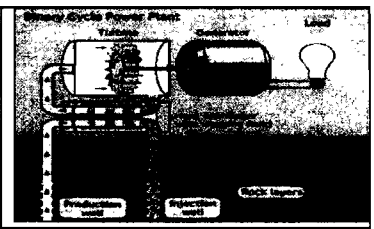
Dry steam power plants systems were the first type of geothermal power generation plants built. They use the steam from the geothermal reservoir as it comes from wells, and route it directly through turbine/generator units to produce electricity, this the case used in Olkaria I power stations.



Dry Steam Power Plant (Olkaria I)



Flash Steam Power Plant (Olkaria II and Proposed for Olkaria IV)



Binary – Cycle Power Plants.

5.3.2 Flash steam Power Plants

Flash steam plants are the most common type of geothermal power generation plants in operation today and this is the technology proposed for Olkaria IV. They use of steam at temperatures greater than 1500C that is separated (flashed) and piped, then condensed steam is cooled at the cooling tower and the excess condensate re-injected.

Geothermal fluids above 360°F (182°C) can be used in flash plants to make electricity.

5.3.3 Binary-Cycle Power Plants

Most geothermal areas contain moderate-temperature water (below 400°F). Energy is extracted from these fluids in binary-cycle power plants. Hot geothermal fluid and a secondary (hence, "binary") fluid with a much lower boiling point than water pass through a heat exchanger. Heat from the geothermal fluid causes the secondary fluid to flash to vapor, which then drives the turbines. Because this is a closed-loop system, virtually nothing is emitted to the atmosphere. Moderate-temperature water is by far the more common geothermal resource, and most geothermal power plants in the future will be binary-cycle plants.

Binary cycle geothermal power generation plants differ from Dry Steam and Flash Steam systems in that the water or steam from the geothermal reservoir never comes in contact with the turbine/generator units.

Olkaria III is a Binary Geothermal Power Plant. It is comprised of air-cooled ORMAT Energy

6 PUBLIC CONSULTATION AND DISCLOSURE

6.1 General

Public consultation is useful for gathering environmental data, understanding likely impacts, determining community and individual preferences, selecting project alternatives and designing viable and sustainable mitigation and compensation plans.

Public consultation in the ESIA process is undertaken during the project design, implementation and initial operation. The aim is to disseminate information to interested and affected parties (stakeholders), solicit their views and consult on sensitive issues.

Inadequate public consultation can result in significant information gaps, which could mislead environmental planners undertaking an environmental assessment. Lack of attention to communication and consultation processes can generate individual, community, or regional opposition to a project. This can ultimately be a cause of substantial delays, increased costs, and unsatisfactory compromise solutions, which could have been avoided through earlier consultation.

Participation is a process through which different stakeholders influence and share their views regarding development initiatives and the decisions and resources that affect them. The effectiveness of resettlement programs is directly related to the degree of continuing involvement of those affected by a project. Comprehensive planning is required to ensure that local government, NGOs, project staff and affected men and women (displaced and host) interact regularly and purposefully during all stages of the Project. The participation of different social groups directly affected by a project is a prerequisite of resettlement planning. The involvement of the Project Affected Persons (PAP) in the design of the mitigation and/or resettlement plan increases the probability of success.

6.1.1 Public consultation and involvement for energy projects

The major purpose of the project is to increase energy production and consequently improve the economic and social well-being of the area of the project. Although energy projects usually achieve this objective, they could often have been more successful if more attention had been paid to the social and economic structure of the project area.

Changing land-use patterns are common causes of problems. Small plots, communal land-use rights and conflicting traditional and legal land rights all create difficulties when land is taken over by the project. Land tenure / ownership patterns are almost certain to be disrupted by this project.

User participation at the planning and design stages can minimize negative impacts and maximize positive ones. Consultations with NGOs and project affected persons (PAPS) can be particularly helpful in minimising adverse socio-economic impacts.

6.2 Aims and objectives of the public consultation program

The overall goal of the consultation process is to disseminate project information and to incorporate the views of the Project Affected Persons (PAP) in the design of the mitigation measures, management plan and Resettlement Action Plan.

The specific aims of the consultation process are to:

- Improve Project design and, thereby, minimize conflicts and delays in implementation;
- Facilitate the development of appropriate and acceptable entitlement options;
- Increase long term Project sustainability and ownership;
- Reduce problems of institutional coordination;
- Make the resettlement process transparent; and
- Increase the effectiveness and sustainability of income restoration strategies, and improve coping mechanisms.

An important element in the process of impact assessment is consulting with stakeholders to gather the information needed to complete the assessment.

The main objectives of community consultations were to:

- Disseminate information and collect opinions on the proposed project by:
  - Providing clear and accurate information about the project to the communities;
  - Facilitating the consideration of alternatives, mitigation measures and trade-offs;
  - Obtaining the main concerns and perceptions of the population and their representatives regarding the project;
  - Providing an opportunity for the public to influence project design in a positive manner to facilitate creation of a sense of ownership of the proposal;
- Understand the communities views on project impacts and plausible mitigation measures by:
  - Obtain opinions and suggestions directly from the affected communities on their preferred mitigation measures; and
  - Obtaining local and traditional knowledge that may be useful for decision making;
  - Ensuring that important impacts are not overlooked and benefits are maximised;
- Provide a platform for future consultations by:
  - Reducing conflict through the early identification of contentious issues;
  - Improving transparency and accountability of decision making;
  - Facilitating participation to increasing public confidence in the EIA Process.
  - Identifying local leaders with whom further dialogue can be continued in subsequent stages of the project.

The Agenda for consultations with government agencies was:

- Defining the institutional framework;

- Discussing recent experience in the District with respect to compensation eligibility criteria and entitlement packages;
- Obtaining from the authorities their environmental and socio-economic concerns and perceptions regarding the proposed geothermal projects
- Discuss the role of the authorities in public information dissemination, monitoring and management plan.

6.3 Stakeholders Identification

6.3.1 General Consultations

The following stakeholders were identified during the consultation process:

Table 6.1: Stakeholder identification

Stakeholder groups	Stakeholders identified	Consultation platform
Project Proponent	KENGEN staff at the head office in Nairobi; KENGEN Staff at Olkaria Power Stations.	o Group Discussions; o One-on-one interviews with specific departmental heads.
Project Affected Persons	Residents of settlements within the immediate project's zone of influence.	Door to door consultations using survey forms as part of the social survey.
	Residents of settlements bordering the project's immediate zone of influence that is the area directly outside the power stations and Hells Gate National Park	Information sessions followed by question and answer sessions through a public baraza / meeting. The venues of the meetings had to be easily accessible to the people and included market centres or area chief's compounds.
	Key informants among the project affected persons. These included: o Village Elders and Chairmen; o Youth members; o Women in the communities; o Teachers in schools within the project area.	o Meetings; o One-on-one interviews.
Administrative Representatives of people in the greater project area, that is Naivasha District	Naivasha District Commissioner, District Officers and Location Chiefs	Information sessions followed by focus group discussions
Key government agencies. These are agencies involved in management of relevant sectors of the bio-physical and socio-economic environment of the project area	Ministry and National Authority representatives at the District level for: o Environment; o Mining; o Wildlife; o Water resources management; o Health; o Education; o Land tenure and ownership; o Livestock.	o Information sessions followed by focus group discussions; o One on one interviews to collect specific information.

Stakeholder groups	Stakeholders identified	Consultation platform
Non-governmental organisations (NGOs):	Registered organisations dealing with conservation in the project area. These included: o Worldwide Fund for Nature; o Lake Naivasha Riparian Organisation; o Bird Life International.	One on one interviews to collect specific information

6.3.2 Consultations during development of the RAP

An additional objective of consultations for an ESIA with resettlement is to secure participation of PAPs in planning and implementation of their own resettlement especially in establishing:

- Expected resettlement impacts;
- Resettlement schedule;
- Resettlement site;
- Relocation timing and needs;
- Procedures for grievance address and resolution;
- Feasible activities for monitoring and evaluation

(See list of participants and minutes of the meetings Appendix 3 and photographic plates Appendix 4):

6.4 Results of the Consultation

6.4.1 Acceptance of the project

A good number (99%) of the respondent admitted that they were aware of the project and the activities under the Project. The information had been disseminated through KenGen officials and some mentioned that already the project has been started by drilling the exploration wells meant for the project within the area.

6.4.2 Identification of PAPS

During the public consultation and social assessment, the people living within thé project area and are likely to be resettled were identified as shown Table 5.2 below. The total population to be resettled represents 0.567% of the total population in Naivasha District.

Table 6.2: People living within the Project Area

Village	Men	Women	Boys	Girls	Elderly	Total
Narasha	93	137	105	138	0	473
Cultural Centre	64	52	55	49	1	221
Olo Maiyana	125	111	174	114	0	524
Olo Nongot and Olo Sinyat	136	99	157	128	0	520
Total	418	399	491	429	0	1737

Source: GIBB Census Survey 2009

6.4.3 Land acquisition and expropriation

The respondents expressed fears of the KenGen's ability to expropriate people given.

However KenGen has carried out a similar exercise at Sondu Miriu Hydro Power Project in Western Kenya which was largely successful.

6.4.4 Problem of social integration of family members

The majority of those interviewed (80%) said that the expropriation and relocation of persons to a new site means that the members of the relocated family must be socially integrated in the new community. Indeed, people can live with a new community that does not have the same social organisation as the one they are coming from. Children and vulnerable people can undergo socio-behavioural shock due to this shift in environment.

6.4.5 Difficulty of reverting to the same organization

It is very difficult to recover assets that one had before being expropriated, attest more than 92% of those interviewed during our survey. This situation is even worse if the expropriated persons are not guided and supported by local authorities and project managers during this operation.

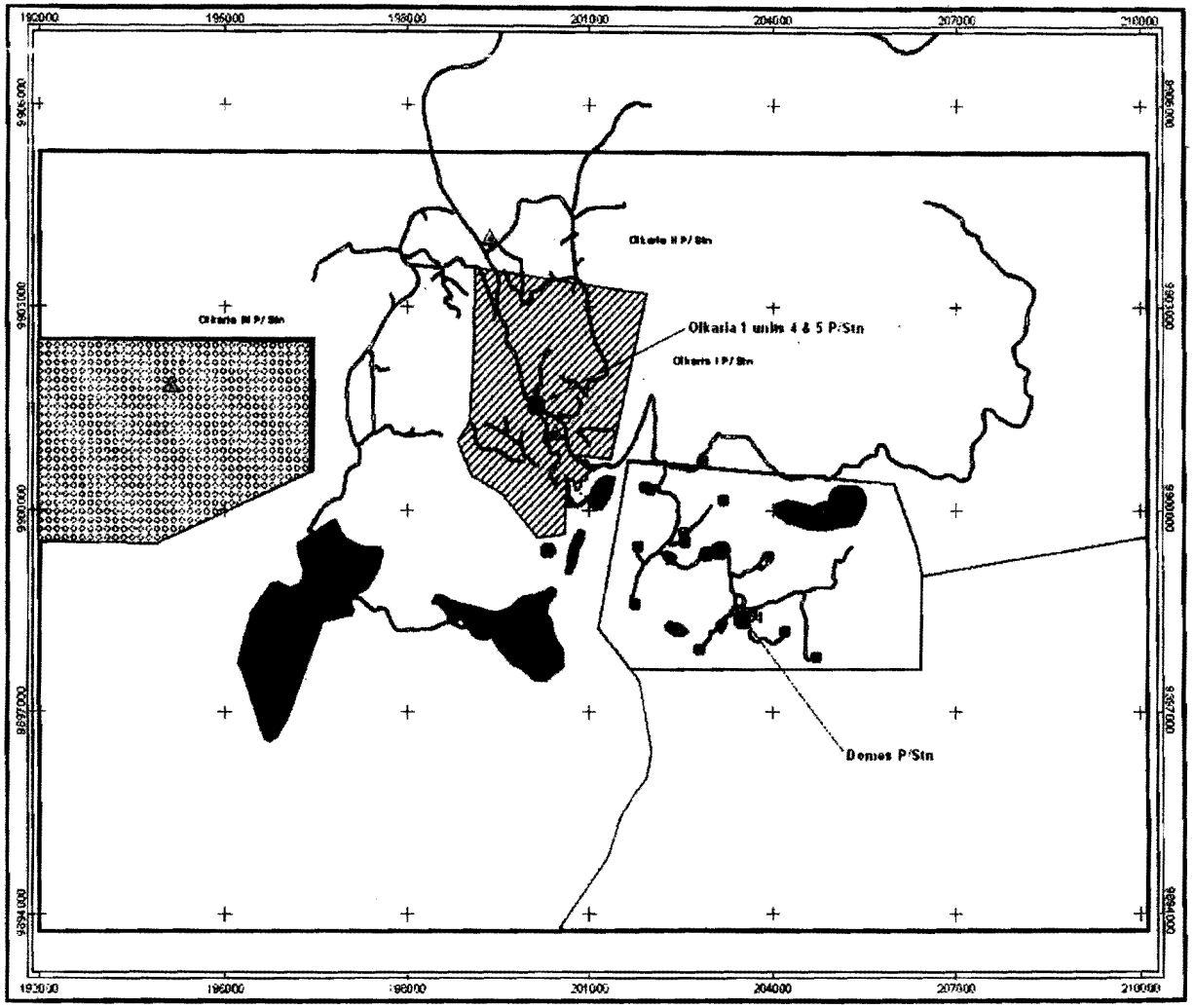
6.4.6 Loss of pasture

Due to the pastoralist nature of the Maasai, there were fears that the relocation exercise may not take the advantage of grazing lands they already enjoy at the area.

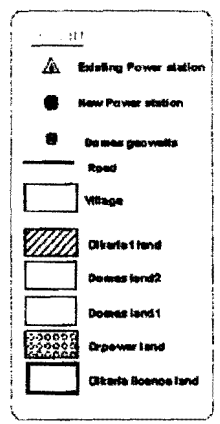
6.4.7 Land ownership

During community consultation and at public meetings which were held in Cultural Centre which included the residences of Olo Maiyana, Olo Sinyat, Olo Nongot, Cultural Centre and Narasha, and at meeting held in Maiella. It was clear that there is conflict of land ownership between the Maasai Community living within the project area and Kedong Ranch Ltd. The Land L.R. No.8396 is a large parcel covering some 75,769 acres of land being a leasehold title for a term of 999 years from 1st May 1950 and registered in the name of Kedong ranch Ltd. At the same time, the Maasai community has a claim on this land by virtue of having lived and used the land for a long period of time thereby having an interest in the form of *"Embarnat"* – permanent residence. Part of this land would need to be acquired for the purpose of development Olkaria IV power station.

Map of Maasai settlement within the project area



No.	Name	Area (Ha)
1	OLO SINYAT sub-Village 1	6.3
2	OLO SINYAT sub-Village 2	2.6
3	CULTURAL CENTRE	14.3
4	OLO SINYAT sub-Village 3	4.0
5	OLO SINYAT sub-Village 4	2.3
6	OLO SINYAT sub-Village 5	5.6
7	OLE MAYAN VILLAGE	9.4
8	OLO ONONGOT VILLAGE	63.7
9	OLE MAYAN VILLAGE	140.1
10	OLE MAYAN VILLAGE	3.9
11	NARASHA VILLAGE	336.6



Grid: UTM Zone 37S
Projection: Transverse Mercator
Datum: Arc 1960

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6.4.8 Public Health

In all the areas where public meetings were held and in all focus group discussions. The following were the community perceptions in terms of public health brought about be degradation of air quality by the geothermal wells.

The respondents in the social survey were asked to rank the disease prevalence in the past year. Majority of the respondents reported malaria and stomach pains. The following scores were derived from the study:

Table 6.3: Disease prevalence within the Project Area

Cultural Centre	36	20	0
Olo Maiyana	36	32	0
Olo Nongot and Olo Sinyat	47	16	0
Narasha	41	0	26

Source: GIBB Census Survey 2009

It is possible that the eye infections within the manyattas are exacerbated by the presence of houseflies at the manyattas. The housefly feeds on human foodstuffs and wastes where they can pick up and transport various disease agents. In warm climates, the filth fly, *M. sorbens* which is closely related to the housefly is considered important in the spread of eye infections. (World Health Organisation, 1992).

6.4.9 Sanitation

According to the social survey, communities living in Olkaria area rely on pit latrines or go to the bush. Pit latrines include Ventilated Improved Pit (VIP) Latrines with slabs or without and the more traditional pit latrine structure.

Table 6.4: Sanitation facilities for households in the (four manyattas randomly sampled)

Cultural Centre	20	18	38
Olo Nongot and Olo Sinyat	36	24	60
Olo Maiyana	22	38	60
Narasha	33	13	46
TOTAL	**111**	**93**	**204**

6.4.10 Effects to the iron sheets

The residences living near the project area complained that H_2S fumes emitted from the geothermal operations which may ends up corroding iron sheets.

6.4.11 Employment

From the public meetings it was mentioned that in the past KenGen has not been considering locals in employment, whenever it has been done they have been given less rewarding jobs like security guards and giving out goods jobs to outsiders. They recommended that unskilled jobs should be shared among villages living within the project area.

6.4.12 Trees planting

Most residents requested KenGen to support them by giving out tree seedlings during rainy seasons. The request was mainly in Ndabibi, Maiella and Moi Ndabi.

6.4.13 Earth tremors

Most residents indicated that they normally feel vibrations especially whenever KenGen is testing the production of there new wells. However no cracks were noticed within the nearby houses.

6.4.14 Social services

Generally social services in the project area include health facilities, education, water supply, sanitation facilities, and sources of energy. During the study, members of the villages visited reported types of social services and the quantity of each that existed in the villages. From the findings it is clear that social services available in villages are inadequate compared to the existing population.

(a) Responses to HIV/AIDS

There was a mixed perception about HIV/AIDS prevalence, impact and strategies to check the disease during the public meetings, with some people singling the disease as an individual concern and requiring individual decisions especially with regard to sexual behaviour. While all participants were aware of HIV/AIDS, there was contention on how to control its spread due to various factors such as poverty, ignorance, access to and use of prophylactics (condoms), behavioural change and etc.

Some opposed use of condoms claiming that condoms inhibited sexual fulfilment while others felt shy to buy or collect them free from health facilities. However, shopkeepers in some villages stated that condoms were being collected / purchased in their shops.

(b) Water services

One of the indicators to measure the level of development is the accessibility of people to social services including water. Without adequate water, women spend a lot of productive time to collect water from far places. Kenya government has put a lot of effort to improve the quality and the quantity of water services in the country. However, the targets have never been met because of challenges facing the water sector.

During public consultation, the local community mentioned that there was no clean water supply in most of the neighbouring villages like Ndabibi, Moi Ndabi, Maeilla areas. The residences requested KenGen to support them with provision of water.

(c) Education

The level of education for the majority of the respondents in the proposed project area was found to be primary school level. However this is more of a common phenomenon in rural areas as opposed to urban centres where there are people from different parts of the country. This can be explained by the fact that those with higher education qualification tend to migrate to urban areas to seek employment and or training opportunities. It was encouraging to learn from the field findings that out of 400 respondents, 73% could read and write while just 17% admitted to being unable to read and write.

(d) Sources of energy

The national electricity supply grid does not serve several villages and market centres within the project area and the community mentioned that almost all the inhabitants depend on fuel wood, charcoal and kerosene for their domestic energy needs.

Most residences were unhappy that the electricity is generated nearby, but they still lack power and were angry they are suffering because of industrialisation of bigger towns like Nairobi. They requested KenGen to support them get supplies from the national grid.

(e) Cultural rights and sacred sites

There are several cultural sites within the project area as mentioned in section 3.5.1 of this report, the Maasai villages mentioned loss of revenue from tourists should they relocated away from this sites. They requested, KenGen consider compensating for their cultural sites.

(f) Gender

Social survey revealed that there was gender bias in terms of representation of females in meetings, in all the meetings female sat far away from men and they rarely contributed. It was also revealed that females take bigger roles in construction of the family houses.

However in terms of family property, it was noted that women had less authority and decisions over family properties including farms and jointly harvested crops. It is only the head of the family (men) who has the mandate to decide on domestic matters particularly household income. The women seemed to have accepted this subordinated position as a cultural norm, perhaps influenced by traditional culture.

Early marriage has an influence on the education and mortality rate of women in the study area; most women marry at the age of 17 and 18 years. Early marriage also influence the level of education for most women in the project area, some of girls are forced to get out of school to marry.

6.4.15 Comments on the Proposed Project

The documented comments on the proposed project are summarised below:

Table 6.5: Comments on the Proposed Project

Aspect	Summary of Comments
Support for the Project:	• The project will bring development to the country; • Good as the country will save on foreign exchange; • Agree with the project as it is benefiting the whole country.
Social Responsibility:	• Consider employing some community members; • It is a good project but it should also benefit the PAPs through employment, water, hospitals / health centres, security, roads electricity and education scholarships for children; • Vote of thanks to KENGEN; • Commend the company for giving them an ear to voice their concerns.
Conflict Management:	• Ensure unity during project implementation; • To avoid confrontation like the Mau issue, the resettlement should be done in a humane manner; • There should be no use of force.

Aspect	Summary of Comments
Perceptions and issues raised on the proposed project	• It is life threatening because of construction of wells; • Concern on effects of gases on health and the environment and whether they would be compensated for it; • There should be adequate information passed to the communities (on the project and its implementation process).
Resettlement:	• Resettlement should include provision of water, land deeds and security; • They should not loose current benefits after resettlement; • No complaint so long as compensation and resettlement is taken care of; • Would not like to move but will do so as he has no other choice; • Land for compensation should be enough for livestock keeping and fertile enough to grow crops; • It is not a good idea as they do not want to move; • An agreement should be signed before relocation to avoid a repeat of the previous injustices.

6.4.16 KenGen's Corporate Social Responsibility (CSR)

KenGen has a Corporate Social Responsibility Programme that can be broken down to activities conducted annually by KenGen's Geothermal Power Station. A summary and financial implication of the CSR activities for the year 2009 is presented in Table 6.5 below.

Table 6.6: KenGen CSR activities in 2009

Activity	Amount
Transport for sick people to Hospital	196,560
Supply of pipes and fittings to Eseneto Water Project	1,600,000
Supply of Water to the Olkaria Maasai community	2,520,000
Water supply to Eburru	1,039,000
Donations of tree seedlings to local community	1,000,000
Donations of tree seedlings to Ewaso Catholic Church	100,000
Donations of tree seedlings to Eburru Cypress Primary School	100,000
Scholarships	120,000
Total	**7,224,880**

Source: GIBB Census Survey 2009

However, during public consultations, most residences rubbished this programmes as "not enough" in some areas the community insinuated that what KenGen has put in their CSR is not exactly what is being done on the ground.

KenGen should develop a mechanism to identify community needs through a participatory approach. This will however be limited to the funds available for the annual CSR Programme. It is therefore imperative that KenGen communicate the financial capacity of the programme in a clear and transparent manner to avoid resentment and conflicts.

6.5 Public Disclosure of ESIA Findings

A public meeting was held on 21 October 2009 to disclose the findings of the ESIA study. In attendance were government agency representatives, Naivasha District Administration Officers and community representatives of PAPs. The presentations were made in both English and Swahili to ensure that information was disseminated to all stakeholders present.

The meeting also provided a platform to raise queries on issues that were not clear or to add information that stakeholders felt was not properly covered in the report.

The presentations were classified as follows:

- ESIA Study findings;
- Air and Noise Modelling findings;
- Resettlement Action Plan Study findings.

The focus of the discussions was on environmental and social impacts of the proposed projects and not necessarily to establish land ownership. This was however a main issue for the stakeholders present. The participants were however informed that this was not a platform to establish land ownership but to discuss on expected project impacts.

The following issues were discussed:

Table 6.7: Highlights of public disclosure meeting

Aspect	Issue	Comments on issue
Health impacts	PAPs felt that since they are yet to see negative health impacts arising directly from the project emissions of noise and hydrogen sulphide, they do not see the need for resettlement	The main reason for resettlement is land acquisition for the power station. The meeting was informed that it would not be feasible for communities to live within the power station or in its impacted area; Standards for noise and air quality are set as a precautionary measure to prevent health impacts instead of having to deal with incidences.
Scope of Consultations	Need for in-depth information from the study findings	The full report will be available for in-depth reading and comments through the future consultations to be carried out by NEMA in compliance with the Environmental Impact Assessment and Audit Regulations.
Social Amenities	Loss of social amenities	As earlier presented, the RAP recommended re-establishment of social amenities and or access to current social amenities as

		used by PAPs.
Negotiations for the resettlement process	Community involvement in RAP Planning	The meeting was informed that this was not the last consultation on resettlement. Future meetings will be planned through community leaders before compilation of the final RAP report.

6.6 Future Consultations

6.6.1 Presentation of the EIA Project Report / Disclosure

The ESIA Report, upon submission to NEMA will be sent to various Lead Agencies for comment.

The report is also to be sent to the District Environment Committee (DEC) for comments. The DEC should engage persons, groups and institutions identified in this report.

Women and youth from the project affected communities should also be encouraged to view the report and give their comments. These groups can be accessed through the registered women and youth groups in the district.

6.6.2 Future Consultations for RAP

Future consultations during resettlement are scheduled to enable free flow of information between the various stakeholders as follows:

Project proponent and representatives of the PAPs:	o Facilitate negotiation of compensation packages; o Establish resettlement assistance required; o Co-ordinate timing of scheduled resettlement activities; o Provide a platform for information updates on resettlement progress and outcomes of the monitoring and evaluation exercises.
PAPs and RAP Implementation Personnel:	Provide a platform for direct communication between RAP implementers and PAPs.
Representatives of the PAPs and Local Government:	Provide a platform for direct communication between PAP representatives and Local Government.

7 ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

7.1 Potential Impacts

Economic, social and environmental change is inherent to development. Whilst development aims to bring about positive change it can lead to conflicts. In the past, the promotion of economic growth as the motor for increased well being was the main development thrust with little sensitivity to adverse social or environmental impacts. The need to avoid adverse impacts and to ensure long term benefits led to the concept of sustainability. This has become accepted as essential feature of development if the aim of increased well being and greater equity in fulfilling basic needs is to be met for this and future generations.

Therefore this ESIA is a formal process to predict the environmental consequences of the proposed developments and to plan appropriate measures to eliminate or reduce adverse effects and to augment positive impacts:

The ESIA thus has three main functions:

- To predict problems/ impacts;
- To find ways to avoid them,
- To enhance positive effects / impacts.

Geothermal development can have numerous impacts, which if not mitigated can make geothermal resource not environmentally viable. The significant environmental impacts that are associated with the current geothermal utilization at Olkaria I and II include the following:

- Exposure to the hydrogen sulphide;
- Exposure to high noise and vibrations;
- Water utilisation and wastewater from the geothermal wells.
- Effects to flora and fauna within and without HGNP
- Effects on human settlements nearby

Apart from the issues above there are no specific environmental problems that could emerge under the new project, which are peculiar to the current operations. KenGen has also put in place very stringent environmental monitoring programmes where it conducts both external and internal environmental audits as required by the Environmental Management and Coordination Act.

This chapter will therefore highlight significant cumulative impacts which will be induced by the proposed geothermal power station at Olkaria IV.

To this end, the focus of this chapter will be:

- To identify and analyze the extent of the environmental and social impacts from the project;
- To assess the environmental impacts of the operation and maintenance activities;
- To assess the social impacts from the project;
- To discuss the decommissioning of the project.

7.2 Definition and Classification of Environmental Impacts

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be:

- Positive (beneficial) or negative (adverse);
- Direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect.

Impacts are termed cumulative when they add incrementally to existing impacts. In the case of the project, potential environmental impacts would arise during the construction and the operations phases of the project and at both stages positive and negative impacts would occur.

7.2.1 Impact Significance

The purpose of this ESIA study report is to identify the significant impacts related to the project or activity under consideration and then to determine the appropriate means to avoid or mitigate those which are negative.

Significant impacts are defined, not necessarily in order of importance, as being those which:

- Are subject to legislative control;
- Relate to protected areas or to historically and culturally important areas;
- Are of public concern and importance;
- Are determined as such by technically competent specialists;
- Trigger subsequent secondary impacts;
- Elevate the risk to life threatening circumstances; and
- Affect sensitive environmental factors and parameters.

7.2.2 Impact identification

The study has predicted and evaluated anticipated impacts using acceptable standard methods of impact prediction and evaluation. Constant reference to a checklist of project activities was made and scores were assigned in an assessment table in order to make an objective assessment of how each of the project activities would impact on a particular environmental and social medium. The significance of impacts is subjective, but the value judgments required were best arrived at by consensus. The study team used several approaches such as brainstorming and use of checklists and matrices, to identify the main sources and establish the potential impacts from the proposed main project activities. Public participation and consultation with a wide sector of the community were conducted to reduce uncertainty. Table 7.1 overleaf summarizes the anticipated environmental problems observed which may be created by the project.

Table 7.1 Summary of environmental impacts in Olkaria

ENVIRONMENTAL COMPONENTS / PROJECT ACTIVITY	Climate	Geology	Soils	Surface water resources	Surface water quality	Groundwater abstraction	Topography and geomorphology	Archaeology	Flora	Terrestrial fauna	Aquatic fauna	Air quality	Noise and vibration	Cultural heritage and sites	Local communities	Rural livelihoods	Current land use	Future land use options	Local economy	Regional and national economy	Local infrastructure and services	Health and safety	Aesthetic and amenity values
CONSTRUCTION																							
Power Plant	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
Cooling Towers		x	x	x						x	x	x	x	x	x	x	x	x			x	x	x
Pipeline Route		X	x									x		x	x			x			X	x	x
Steam line		X									x	x		x	x			x			X	x	x
Hot re-injection line	x	x				x											X						
Cold-re-injection line					X	X					x				x		X		x			x	x	x
Switch yard and Transmission Line		x	x			x			x		x				x	x	x	x	x			x	x	x
Infrastructure Roads and Buildings.	X	x	x			x			x		x				x	x	x	x	x			x	x	x
OPERATION AND MAINTENANCE																							
Geothermal process												x	x		x	x			x			x	
Water abstraction				x		X			x		x				x	x			x				
Infrastructure management	X														x	x			x		X		
DECOMMISSIONING AND CLOSURE																							
Plant closure				x	x										x	x		x	x	x		x	x
Decommissioning of construction site															x	x		x	x			x	x

7.2.3 Impact assessment scoring

The impacts were evaluated using the parameters of magnitude, significance, probability and duration of occurrence. Evaluation of the identified impacts was guided by careful assessment and judgment of anticipated consequences with regard to set standards or pre-development environmental situation of the site. The score of each of the impacts is an average value of scores from at least three study team members. The assessment and assignment of values to each identified impact was based on the values developed in Table 7.2 below which is adapted from the International good practices. Positive impacts were evaluated by assigning positive scores.

Table 7.2 Scale for evaluation of project impacts

Score	-1 (+1)	-2 (+2)	-3 (+3)	-4 (+4)	-5 (+5)
Magnitude or extent	Impacts will occur only on site		Impacts will occur within a 3-5km radius of site		Impacts will occur regionally
Significance	Low. *Small changes which are hardly detectable*	Moderate. *Impact measurable, but does not alter processes*	High. *Many people, animals, plants affected. Major disruption of ecosystem processes*	Very high. *Loss of people, bio-diversity, property, loss of local livelihood systems.*	Unknown, *Insufficient information is available- apply pre-cautionary principle*
Probability of occurrence	Possible. *impact can occur but controllable*		Probable. *The impact is likely to occur but Can be controlled by effective Measures.*		Definitely to occur.
Duration of occurrence	Short term. *During construction phase only*	Medium term. *During early operations*		Long term. *For the entire operational phase*	Very long term. *For the entire operational phase and after closure*

Project activities in the Olkaria Domes area will involve construction of power station and related facilities. The impacts generated from these works therefore, will generally be incremental in nature.

7.3 Positive Impacts

The proposed project will have significant positive impacts when compared to other forms of power production especially thermal power which involves the burning of fossil fuel. The major positive impacts of the project will include stabilization of electricity in Kenya, promotion of economic growth in the country, contribution to the Government revenue, increased employment, and improvement of roads and extension of corporate social responsibility in the project area. In addition the proposed project is likely to have the potential for carbon trade among other positive benefits.

Table 7.3 Impact scoring for positive impacts

Aspect	Score
Aspect/Impact : Increased power supply to the national grid	
Occurrence	Score
Magnitude or extent	5
Significance	5
Probability of occurrence	5
Duration of occurrence	5
Aspect/Impact : Promotion of Economic growth	
Occurrence	Score
Magnitude or extent	5
Significance	5
Probability of occurrence	5
Duration of occurrence	5
Aspect/Impact : Creation of Employment	
Occurrence	Score
Magnitude or extent	5
Significance	5
Probability of occurrence	4
Duration of occurrence	3
Aspect/Impact : Increased contribution to the Government Revenue	
Occurrence	Score
Magnitude or extent	5
Significance	5
Probability of occurrence	5
Duration of occurrence	5
Aspect/Impact : Opportunity for training and skills acquisition	
Occurrence	Score
Magnitude or extent	5
Significance	5
Probability of occurrence	5
Duration of occurrence	5
Aspect / Impact: Extension of Corporate Social Responsibility	
Occurrence	Score
Magnitude or extent	3
Significance	5
Probability of occurrence	5
Duration of occurrence	5

Aspect/Impact : Improved provision of infrastructural facilities within the area	
Occurrence	Score
Magnitude or extent	3
Significance	5
Probability of occurrence	5
Duration of occurrence	5
Aspect/Impact: Potential for Carbon Market	
Occurrence	Score
Magnitude or extent	3
Significance	3
Probability of occurrence	3
Aspect/Impact: Increase in Tourism	
Occurrence	Score
Magnitude or extent	5
Significance	3
Probability of occurrence	4

7.3.1 Increase power supply to the national grid and thereby stabilization of electricity

As discussed in Chapter 1 under the need for energy and the energy situation in Kenya there is acute power supply problems in Kenya today. The development of the proposed project will play a significant role in the stabilization of power situation in the country. Following the development of the project as proposed in the Feasibility Study Report, Olkaria Geothermal Power Plants (GPPs) will be one of the largest electric power generating field supplying with a total of 482MW (including Olkaria III IPP production of 48MW) The extra power added to the national grid will play a big role in the stabilization of electricity in the country.

The introduction of Olkaria additional power (280 MW) in the national grid will alleviate power outages especially during the dry seasons and help to reduce the country heavy reliance on the power production from the oil and diesel power generators. Power from Olkaria is of strategic national importance especially at this time when hydro power is proving to be very unstable due to the variability of the hydrological regime along the Tana River catchments.

7.3.2 Promotion of Economic growth

As discussed in Chapter 1 under the need for energy and the energy situation in Kenya there is acute power supply problems in Kenya today.

This project will play a significant role in stimulating economic growth in Kenya. The power input will contribute significantly to the Kenya's Rural Electrification Programme which has potential to promote spin-off effects on rural economy in Kenya. The proposed project together with other untapped proven potential in and around Olkaria also has power export potential to the neighbouring countries including Uganda, Tanzania and Southern Sudan.

On a wider context, the energy situation in Kenya is unsatisfactory as evidenced by the frequent unplanned power outages, an important circumstance which slows down the economic development in the country. Power produced by the proposed project will to a large extent contribute in the alleviation of the current situation and promote economic growth. Nearly 60% of the power capacity in Kenya is based on hydropower.

Over the last ten years or so the country has paid a heavy price for over reliance on hydropower. For example, between 1999 and 2002, severe droughts nearly brought economic activity in Kenya to a standstill after the hydropower dams along the Tana River nearly dried out leaving power rationing in its wake. Reduction of hydro power production during the dry spells was compensated by increasing the power production of the diesel plants and rationing of power. This increased the cost of power production. In addition, there was a resultant loss of economic production due to rationing. In 2000 (a very dry year), KenGen hired 100MW extra diesel generators. The total extra cost for power generation was US$ 632 million and the lost production due to rationing was estimated to be US$ 1,400 million. These experiences

have underscored the need to diversify the power sources in Kenya to enhance economic growth at a time that a sign of economic recovery is being seen.

7.3.3 Creation of employment

This project will create job opportunities in the project area and beyond. Direct job opportunities will be available for high calibre professionals including geologists, engineers, mechanics and consultants. It is, however, unlikely that the local community will benefit from this calibre of specialised job market. Of greater relevance to the local community will be job opportunities involving unskilled and semi-skilled labour especially during the construction phase of the proposed project. Activities such construction of access roads, clearing of vegetation, operation on the quarries and borrow pits, establishment of the trace for the power transmission lines and the installation of the steam gathering and power plants will generate opportunities for the employment. The total peak workforce during the Main Civil Works and Power Station, High Voltage, Sub-stations, High Voltage transmission line and Steamfield Development Construction is estimated to be 1500.

Most of the of unskilled labour force will include members of the local communities in the project area who will be hired by the project as drivers, masons, loaders, carpenters, cooks, security personnel and other assorted workers. Indirectly the project will create opportunities for self employment in the project area. This will spring from spin-off activities including trade, accommodation, and supply of goods and services to both the skilled and unskilled labour.

7.3.4 Increased Contribution to Government Revenue

The proposed project will contribute towards the boosting of Government revenue in the form of tax revenue. The project will generate income to the Government through Geothermal license Fee, EIA license fee of KSh 1,000,000 and withholding tax from remuneration paid to employees at graduated scale rates. Through engagement of employees, the project developer will generate revenue for the Government in the form of Pay As You Earn (PAYE).

The project developer will pay Value Added Tax (VAT) for most of the items bought. In addition, there will be other taxes including operating licences and corporation tax at 30% of net income.

7.3.5 Improved infrastructure in the project area

The proposed Project is associated with the construction of new roads to serve the proposed power plants especially Olkaria II Units 4 & 5 and Olkaria IV (Domes). In addition the proposed project will involve the establishment of access roads associated with the proposed transmission lines especially the 15 km transmission line from Olkaria IV (Domes) to the point of connection to the existing 220kV transmission line between Olkaria II Switchyard and Nairobi North Substation. The new roads will improve communication in the project area and to a limited extent promote economic activities including livestock trade in the project area and beyond.

7.3.6 Extension of Corporate Social Responsibility

Corporate social responsibility is the management of business processes in a socially responsible way in order to achieve an overall positive impact on the work force, their families as well as the local community and society at large. In this context, KenGen will continue to use part of their earnings to re-invest in communities in which the company's earnings are generated. The proposed project expansion will see an increase in KenGen's corporate social responsibility activities. KenGen has played a major role in assisting community projects in Naivasha and beyond. In 2009, the Company participated in different activities in the improvement of the livelihoods of the local communities in several sectors including transport, water supply, and education, rehabilitation of roads, health, recreation and environment conservation among other sectors. It is expected that KenGen corporate social responsibility to the workers and local community will expand with the implementation of the proposed Optimization Project.

7.3.7 Potential for Carbon Market

At present the energy power production in Kenya over relies on hydropower (approximately 50%) which is negatively affected by increasingly erratic climate changes, including higher incidence of drought. As such, the proposed Optimization Project will increase the resilience of the Kenya power generation vis-à-vis potential climate risk variations in Kenya. It is most likely that the proposed Optimization Project can meet all the necessary requirements to become a carbon project under the Clean Development Mechanism (CDM). In this case, the proposed project may achieve CO_2 emission reduction by replacing electricity generated by fossil fuel fired power plant connected to the national grid. However, the full carbon credit potential of the proposed project needs will be carried out by a CDM consultant.

7.3.8 Opportunity for training and skills acquisition

The proposed Project activities will be numerous and challenging. Successful implementation of the project activities will require dynamic and multi-disciplinary professionals. Regular short and tailor made training courses and seminars will be organised to reinforce the capacity of the stakeholders during the entire project period. Some of the proposed training activities will this report proposes include Water Management, Environmental Management, Water catchment protection and Waste management. The training activities will be undertaken during both construction and operation phases of the project.

7.3.9 Increase in Tourism

Kenya being one of the few countries in the world with Geothermal Power Station, this has been used in the past for domestic tourism and also for international tourism thus the proposed development is likely to attract more tourists to the area thus generating more foreign exchange. In order to achieve this however, there is the need to change the existing perceptions about the Hell's Gate National Park. It is suggested that the park be designated into two areas, namely the geothermal zone and the National Park zone, so as to clearly distinguish options for visitors to the area. This zoning will enable the joint KenGen-KWS management to issue different sets of rules and regulations pertaining to the two different zones. This strategy will strengthen the concept of the peaceful coexistence of the two and promote the concept of sustainable development.

7.4 Negative Impacts during Construction

Geothermal development can have numerous impacts, which if not mitigated can make geothermal resource not environmentally viable. Geothermal utilization can cause surface disturbances, physical effects due to fluid withdrawal, noise and emissions of chemicals. It can also affect the neighbouring communities either socially or economically. Key environmental impacts anticipated from the proposed project include the following:

- Impact on Flora and Fauna;
- Noise pollution;
- Degradation of air quality;
- Water usage and discharge of wastewater from drilling operations and from geothermal operations;
- Socio –economic effects.

Table 7.4 below shows the negative impacts scoring during construction.

Table 7.4 Negative Impacts during construction

Aspect/Impact: Land acquisition and Resettlement	
Occurrence	Score
Magnitude or extent	-3
Significance	-4
Probability of occurrence	-5
Duration of occurrence	-1
Aspect/Impact : Impact on Flora	
Occurrence	Score
Magnitude or extent	-1
Significance	-3
Probability of occurrence	-5
Duration of occurrence	-1
Aspect/Impact : Impact on Fauna	
Occurrence	Score
Magnitude or extent	-4
Significance	-4
Probability of occurrence	-3
Duration of occurrence	-3
Aspect/Impact : Impact on Air Quality	
Occurrence	Score
Magnitude or extent	-1
Significance	-2
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Impact on Noise and Vibrations	
Occurrence	Score
Magnitude or extent	-1
Significance	-2
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Impact on Soil	
Occurrence	Score
Magnitude or extent	-1
Significance	-2
Probability of occurrence	-5
Duration of occurrence	-5

Aspect/Impact : Impact on Quarry sites	
Occurrence	Score
Magnitude or extent	-1
Significance	-1
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Landslides and soils creep	
Occurrence	Score
Magnitude or extent	-1
Significance	-1
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Archaeological Artefacts and ritual sites	
Occurrence	Score
Magnitude or extent	-5
Significance	-1
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Impact on solid wastes	
Occurrence	Score
Magnitude or extent	-1
Significance	-2
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Public Safety and Health	
Occurrence	Score
Magnitude or extent	-1
Significance	-1
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Occupational Health and safety	
Occurrence	Score
Magnitude or extent	-1
Significance	-1
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Cultural Changes	
Occurrence	Score
Magnitude or extent	-1
Significance	-1
Probability of occurrence	-1
Duration of occurrence	-1

7.4.1 Land acquisition and Resettlement

The construction of the Project will involve land acquisition, removal of buildings, and population resettlement. The total permanent land acquisition will involve about 3610 acres of land in required for construction of the Power station and related facilities. About 20% of land to be acquired is occupied by villages described in section 3 of this report.

The Full Report of land acquisition and Resettlement and related socio-cultural impacts and mitigation measures to the community has been presented in Volume II of this Report. However, Land acquisition and resettlement will be carried out in accordance with land administration laws of Kenya and World Bank Policies. The compensation and resettlement will be guided by the principle objectives that the affected people will have their former living standards and income-earning capacity improved or at least restored. The affected people must be provided with adequate support during the transition period.

7.4.2 Impact on Flora

The vegetation of the Domes area comprises seven major vegetation groups as described in section 3. These include bush land, bushed grassland, shrubbed grassland, grassland, rock outcrops and barren land. The generation unit, cooling towers and the switchyard extension will all be constructed in areas that will be cleared. These developments will disturb the plant community.

Some disturbance will be expected to vegetation in the process of laying down the new steam lines. However, it is unlikely that any sensitive floral species will be affected. A more pronounced impact may be due to invasion of the area by invasive species. One source of concern during construction is the demand for fuel wood by the workforce, which may result in the felling of trees.

Charcoal burning at the proposed Olkaria IV site

firewood collection at Olkaria IV Domes Area

The following management and mitigation measures are proposed:

- The clearing of vegetation and trees will be strictly controlled and will be limited to what is absolutely necessary and will not be done indiscriminately. Diligence on the part of the Contractor and proper supervision of the workforce is important in this respect;
- Disturbed areas will be re-vegetated with locally occurring grasses, shrubs and trees;
- All the areas that are cleared during the course of construction will be quickly rehabilitated with appropriate indigenous flora to prevent the growth of opportunistic species;
- Workforce engaged in the construction process will be provided with alternatives to fuel wood and charcoal for cooking (eg kerosene cookers), so that the pressure on fuel wood and charcoal will be reduced.

7.4.3 Impact on Fauna

(a) Loss of migratory corridors

Olkaria IV is mainly a dispersal area as well as a migration corridor for wildlife. Lying just adjacent to Hells Gate, and within the ranch, this is a very important environment for wildlife conservation. Development in this area will mean that migratory corridors will possibly be affected, while dispersal areas for some of the animal species reduced. The free movement of animal between Hells Gate National Park, Mt Longonot National Park, and adjacent game ranches might be limited. In 1994, an environmental assessment study carried out in the project area by Sinclair Knight, and a subsequent one by *Wetangula 2007*, predicted the loss of habitats, potential toxic effect of brine and death of animals due to road accidents as the major negative impacts of the geothermal development with regard to animal conservation. Although the construction of Olkaria I and II did not have very pronounced effects on animals

in Hells Gate National Park, this may be the case for the Olkaria IV. Measures need to be put in place to ensure animal movement is not interfered with.

However, during the assessment there were no figures either from KWS and KenGen to show that the number of animal deaths and the relationship of deaths with the toxic brine in Olkaria I.

(b) Loss of habitat

Approximately 54 hectares of land within the Kedong Ranch Limited will be cleared for the purpose of building the power station and related physical facilities at Olkaria IV. Kedong Ranch has a total land of approximately 79,500 hectares. Therefore total area to be cleared represents 0.07% of the Kedong Ranch, which will be equivalent to habitat loss. This is negligible and no effects are anticipated more than what is being felt at the moment.

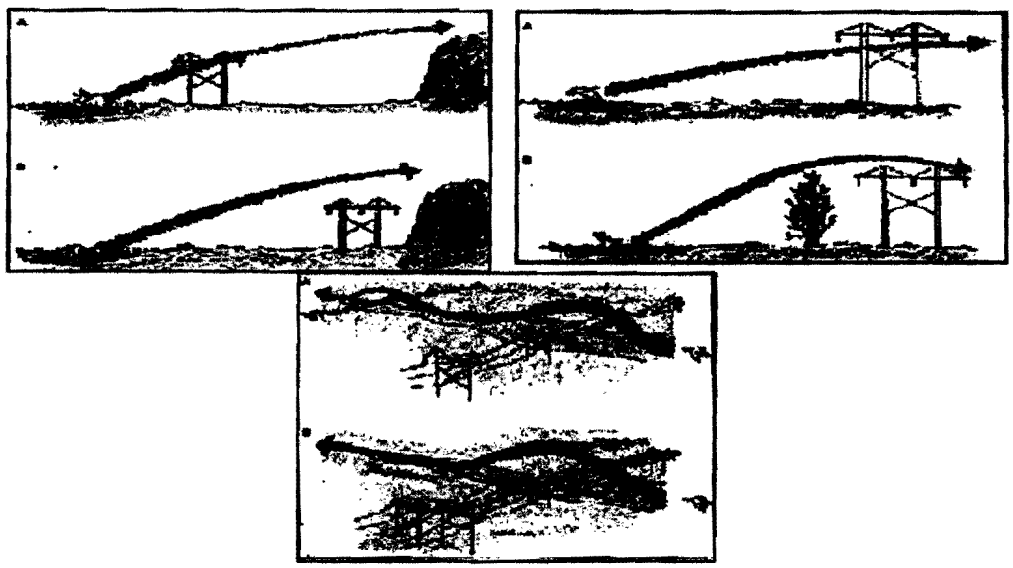
The physical facilities which include the power station buildings, roads, steam pipes and the well-heads, will result in a minor reduction in the area available as wildlife habitat. There will be perimeter fence on the Plant area as already in existence for the Olkaria I, II and III this serves as an impediment to the movement of wildlife, preventing grazing animals from using the space between the wellheads and around the power station. In the case of fire, local extinction of enclosed species could occur. This impact is restricted to medium to small sized mammals that cannot pass through the wire-mesh.

(c) Risk of electrocution

Risk of electrocution by large climbing animals, such as vervet monkeys or bats are not expected as the spacing of the conductors and the length of the insulators exceeds the reach of the climbing species and wingspan of bats present in Hell's Gate National Park (HGNP). A reach of at least 1m – with the animal touching both the insulators and conductors at the same time- would be required to achieve a short circuit between the conductor and tower. No species known in the HGNP, or elsewhere in the study area, has a reach this long.

The proposed transmission line is expected to be located as far away as possible to any significant bird breeding or staging areas and migratory bird routes will be considered during planning and construction (see section 3.2.10). It is also recommended that KenGen considers electing of bird friendly power line designs, and use of bird warning devices (fig 7-2) below.

Fig 7-1: Location of transmission towers to prevent birds from colliding with conductors



(d) Steam Pipes interference

The elevated steam pipes in the existing power stations Olkaria I and II may interfere with movement routes of animals in addition to taking over space that would otherwise provide extra habitat. The pipes also have a negative visual impact which reduces the natural appearance of the area.

The proposed Steam pipes will have animal loops to allow easy passage of the animals.

(e) Roads and traffic

High speeds of vehicles to and from the other power stations Olkaria I and II cause accidents that kill wild animals. The only way to avoid this is to reduce the speed limit on these roads. This will be difficult to enforce unless speed humps are introduced at appropriate points along the routes to the new station.

(f) Labour Workforce

The main impacts of the labour workforce on the fauna include;

- Direct killing of animals for food, through conflicts or accidentally;
- Noise and animal harassment;
- Use of wood for fuel and other purposes interfering with habitat.

The number of people at the construction site should be monitored regularly at Olkaria Gate and in the employment records.

Workers behaviour and attitudes towards wildlife should be monitored with the aim of teaching them how to reduce human wildlife conflict. Night activities should be banned to allow animals to have access to areas and resources inaccessible during the day, because of human presence and construction activities.

(g) Fencing

The major impact of fencing is the restriction of animal movements. The amount of fencing will be kept to the minimum possible during constructions. It should also be close to the construction so that large areas which are not needed are not enclosed and therefore inaccessible to animals.

(h) Fire

Bush fires are difficult to put out in steep, rocky and rugged terrain like Hell's Gate. The fire destroys habitat and kills small vertebrates and invertebrates. The fire also alters the microclimate. The extent and magnitude of the damage is determined by the amount and degree of dryness of fuel material. Fires can be caused by deliberate actions, carelessness or by accident.

Construction workers should be informed on the dangers and implication of bush fires, how they can be prevented and put out.
Temporary and permanent firebreaks should be erected where construction activities are likely to cause fire. Surveillance and warning systems should be established especially during high fire risk periods. In addition, fire-fighting equipment should be in place to help in fighting fires before they consume extensive areas.

The following mitigation measures are proposed:

- Animal numbers, movements and distribution should be monitored. This should be done either independently by KenGen or in liaison with KWS. KenGen's Environmental Unit should actively participate in these studies and should be made aware of the findings of these studies and the management decisions which are made as a result of these findings. It is further proposed that the numbers should be monitored in the larger Nakuru District in liaison with the KWS and Environmental Conservancy Groups within the District and this should be done during dry and wet seasons.;
- Install a game –proof fence around each toxic brine pond, with screening or netting over the top to keep out birds;
- Drains and steam lines should be designed located in ways that do not interfere with animal corridors (as done for Olkaria II);
- The movement in the Park of construction traffic, as well as traffic generated by KenGen activities, should be controlled and no movement should be allowed at night;
- Introduction of speed bumps and speed limits enforcement will prevent death of animals as a result of over speeding;
- The construction activities should be kept to a minimum to avoid loss of habitat;
- Introduction of speed humps to reduce animal deaths from excessive vehicle speeds;
- Training of workers regarding park regulations particularly with regard to interaction with animals and littering. KenGen should ensure that poaching does not occur and personnel found interfering with wildlife should be dismissed;
- Adequate waste management facilities should be provided and regular monitoring conducted by KenGen for compliance;
- Cleared areas should be rehabilitated with indigenous vegetation as soon as possible to restore habitat;
- In general, fencing should be kept to a minimum to avoid loss of habitat. Care should be taken to ensure that there are no small animals trapped inside fenced areas;
- Vehicle movements within the park should be monitored and time limits enforced;
- KenGen in liaison with KWS appoints three senior members of staff based in Olkaria on the Hell's Gate National Park Management Committee. The personnel should be the Geothermal Development Manager, and the other two nominated by him.

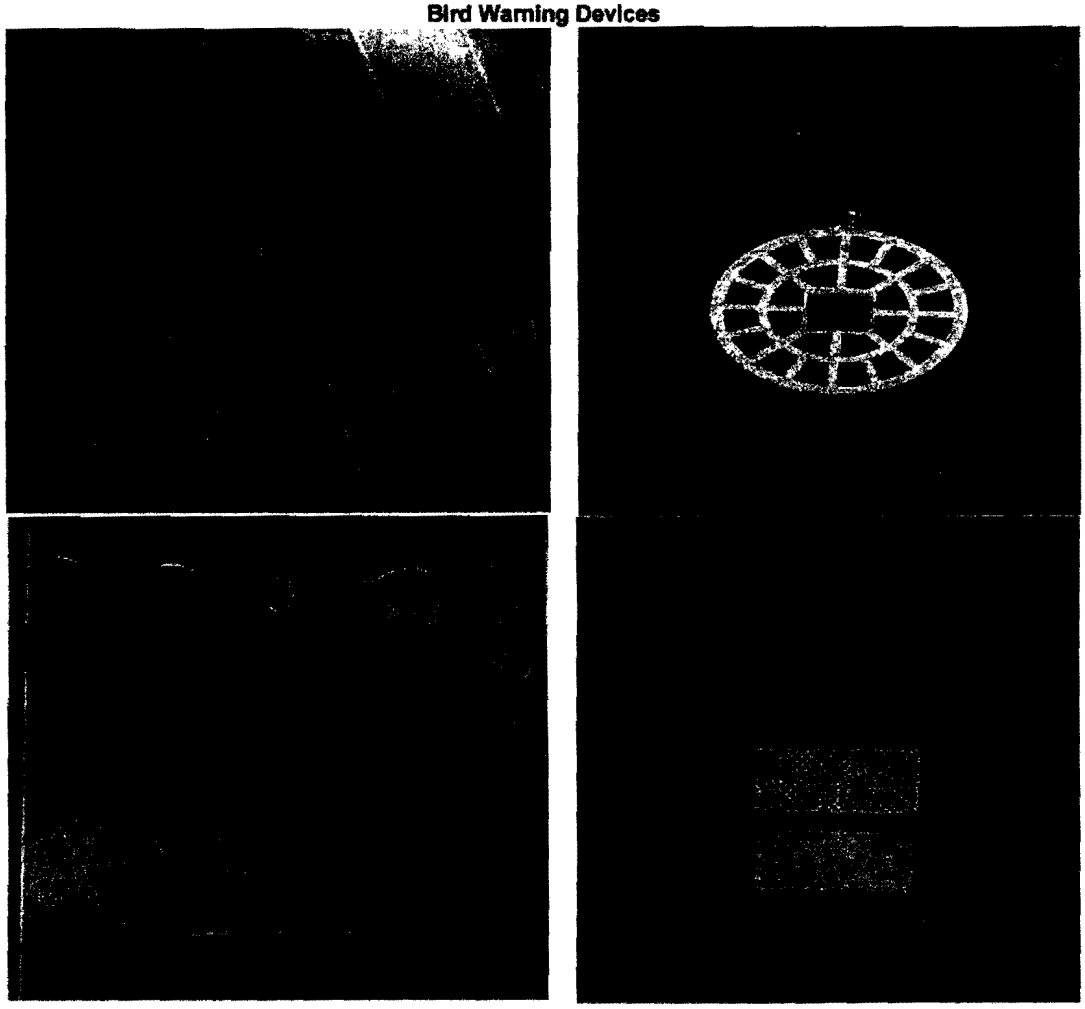
The following measures are proposed to mitigate negative impacts on avifauna:

- Identify locations as far away as possible from any significant bird breeding or staging areas;
- Consider migratory bird routes when planning the route of the proposed transmission line;

- Use existing towers for new lines (upgrade);
- Construct underground transmission lines where expected to cross bird migratory routes;
- Dress existing and proposed transmission lines with conspicuous bird warning devices, where necessary, such as areas where bird migratory routes cannot be avoided;
- Locate the proposed transmission line adjacent to prevailing natural obstacles such as trees or cliffs to prevent collision by birds with conductors;
- Use of bird warning devices on transmission lines and insulating certain components on the towers to make them 'bird friendly'. Figure 7-2 presents a sample of the variety of bird warning devices currently available.

Fig 7.2: Variety of bird warning devices available

Bird Warning Devices



7.4.4 Impact on Soils

It is inevitable with a development of the type of the Olkaria IV Project that some impact on soils will take place. However, if appropriate and timely erosion control techniques are used, these can be kept to a minimum and the problems which have developed as a result of the

existing operations, can be avoided. Most of the issues have already been discussed in Section 3.2.5 in relation to the existing development.

The following mitigating measures are recommended for the proposed development.

Some disturbance of the soil will inevitably occur during the construction phase but this can be minimised by re-vegetating the disturbed area as soon as possible so that soil erosion does not occur. As discussed in Chapter 3.2.5, native grasses such as Star grass should be planted as quickly as possible. It is pertinent to note that vegetation that is attractive as animals as a source of food should be avoided in the first instance when attempts are made at revegetation.

Even strong fencing around areas being revegetated has proved insufficient protection against the larger herbivore such as buffalo. To avoid problems of this sort it is suggested that less palatable plants such as the *Tarconanthus Camphoratis-Oleleshua*, which is native and widespread in the area should be used.

Other measures to mitigate soil erosion during construction include the following:

- No grey water runoff or uncontrolled discharges from the site/working areas (including wash down areas) to adjacent watercourses and/or water bodies shall be permitted;
- Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site;
- Runoff loaded with sediment and other suspended materials from the site/working areas should be prevented from discharging to adjacent watercourses and/or water bodies must be prevented;
- Potential pollutants of any kind and in any form shall be kept, stored and used in such a manner that any escape can be contained and the water table not endangered;
- Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas (including groundwater) are not polluted.

7.4.5 Impact on quarry sites

Materials sites (quarry and other borrow areas) if not reinstated and rehabilitated after project completion, cause landscape scarring, dangers of over hanging cliffs and falling rocks which creates environmental, health and safety hazards. The project is likely to exploit the existing quarries currently used in for construction of Olkaria II unit 3.

The following are the mitigation measures proposed during extraction of natural resources for materials:

- All borrow pits sites shall be clearly indicated on a plan and approved by the local authority;
- Appropriate authorisation to use the proposed borrows pits and quarries will be obtained before commencing activities;
- Borrow pits and quarries shall be located more than 100 meters from watercourses in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse;
- Notice will be given 14 days to nearby communities of intention to excavate in the borrow pits or quarries;
- Borrow rehabilitation plans, will be prepared prior to use and approved by the local authorities;
- Storm-water and groundwater controls shall be implemented to prevent runoff entering streams and the slumping of soil from hillside above;
- The use of borrow pits or quarries for material spoil sites must be approved by the local authorities (and/or with the appropriate consent of the "landowner"). Where this occurs, the materials spoiled in the borrow pit shall be profiled to fit into the surrounding landscape and covered with topsoil.

In the event that blasting for rock will be done the following mitigation measures are proposed:

- A current and valid authorisation from the Department of Mines prior to any blasting activity shall be obtained;
- A qualified and registered blaster by the Department of Mines and Geology shall supervise all blasting and rock-splitting operations at all times;
- The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area);
- The Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on Site;
- The Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock. Environmental damage caused by blasting/drilling shall be repaired at the Contractor's expense;
- The Contractor shall ensure that adequate warning is provided to the local communities immediately prior to all blasting. All signals shall also be clearly given;
- The Contractor shall use blast mats for cover material during blasting. Topsoil shall not be used as blast cover.

7.4.6 Landslides and soil creep

Due to the mountainous and rolling nature of the terrain, huge excavations are expected during construction and there is possibility of interference with the slope stabilities of mountains thereby leading to landslides and soil creep. There is likely going to be reduction of shear strength caused by digging at mid-slope or at the foot of the slope during construction.

The following mitigation measures are proposed

- Retaining walls;
- Benching for cut and fill.

7.4.7 Water

Approximately, 200m^3/ per day of water will be used during construction. The contractors will be required to adopt water – saving construction practices and conduct training of construction workers to minimize the discharge of wastewater.

In particular, no significant changes are forecast to the water supply and quality classification of the receiving water bodies which can't be mitigated. However for good practice the following mitigation measures are proposed especially during construction phase, where there could be significant pollution if proper procedures are not followed.

The following mitigation measures are proposed:

- No landscaping should be allowed from lake water;
- Continued monitoring of Lake Levels;
- Accidental leakages and bursts to water supply pipelines should be reported and repaired immediately;
- Recycling of water as much as possible should be encouraged for example water used for curing of concrete can be used for spraying dusty roads;
- Control of the water flows and the water consumption records must be kept and availed to the Supervising Engineers at the end of working day;
- All employees should be trained on water usage practices like unnecessary opening taps should be discouraged;
- Monitoring of taps and there efficiency should be done regularly;
- Curing of concrete should be done in conservancy tank to avoid wastage;
- Harvest water during rainfall times.
- The Contractor shall arrange for the necessary approvals / permits from the water authorities for the abstraction of water.

- The Contractor will be required to comply with the water quality regulations as described in Chapter 2;
- No grey water runoff or uncontrolled discharges from the site/working areas (including washdown areas) to adjacent watercourses and/or water bodies shall be permitted;
- Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site;
- The Contractor shall instruct their staff and sub-contractors that they must use toilets provided and not the bush or watercourses;
- Reduction of baseline water quality through construction actions / activities shall be prevented (for example coffer dams, silt traps or plastic lining).

7.4.8 Air quality and dust

The proposed site is close to Olkaria I and II and expected that there could possibility of the existing plants impacting the Construction site with H_2S gas in the atmosphere. During the construction phase, atmospheric pollution sources include airborne dust from earthworks, and tail gases from construction equipment and vehicles. The dust will settle on flora, and can cause respiratory problems for local residents. Air emissions from construction machinery, including dust, is regarded as a nuisance when it reduces visibility, soils private property, is aesthetically displeasing or affects palatability of grazing. Dust generated by construction related activities must be minimised.

During the construction the following mitigation measures are proposed:

- Daily monitoring of air quality standards as done in Olkaria I and II 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 minimisation techniques;
- The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilised as soon as practically possible;
- Dust generating activities shall not be carried (excavation, handling and transport of soils) during times of strong winds. The Resident Engineer shall suspend earthworks operations wherever visible dust is affecting properties adjoining the work site;
- Vehicles delivering soil materials shall be covered to reduce spills and windblown dust;
- Vehicle speeds shall be limited to minimise the generation of dust on site and on diversion and access roads.

7.4.9 Noise and vibration

The main sources of noise during construction phase will include blasting, heavy equipment, transportation vehicles and the existing plants currently.

During construction the following mitigation measures are proposed:

- Noise levels shall be kept within acceptable limits and construction activities shall, where possible, be confined to normal working hours in the residential areas;
- Schools, hospitals and other noise sensitive areas shall be notified at least 5 days before construction is due to commence in their vicinity. Any excessively noisy activity shall be conducted outside school hours.

7.4.10 Solid wastes

During the construction phase, two types of solid wastes will be generated: spoils and domestic refuse.

Construction waste will be generated while the works are ongoing. This will consist of building materials, concrete, paper and plastic (for example from packaging materials and lagging), timber, scrap metal, etc. Apart from visual impacts, debris can affect water quality.

During construction the Contractors will construct various facilities, which have to be removed and dismantled on completion of the works.

Sludge from the condenser and cooling tower at Olkaria I, including the new units, will be dried, encased in concrete and buried since it contains toxic non-biodegradable substances. At present it is envisioned that silicate deposits in the steamlines will be buried at the Olkaria dumpsite.

During construction where the Contractor is required to spoil material, environmentally acceptable spoil sites must be identified and approved by the Resident Engineer taking into consideration the following:

- Preferably to be located on land already cleared wherever possible. Communities shall be involved in the site location to avoid destruction of any ritual site or any other conflict;
- Diligence on the part of the Contractors during construction activities will minimise the amount of debris, and also will ensure that debris is disposed of in a sensible manner, at a specified and approved dump.
- The tender documents should specify the proper disposal of waste during construction.
- The tender documents should also ensure that the Contractors leaves the site in a clean and sightly condition on completion of works. The Contractors should be required to restore and landscape all areas to the satisfaction of the Project Manager.
- All solid waste generated during construction and operation should be carefully monitored, collected, stored, and taken out of the park for disposal.
- Waste generated during the operation of the plant must be segregated at source, inventorised and appropriate methods of disposal determined.
- The need to be more than 100 meters from watercourses and in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse;
- The development and rehabilitation of spoil areas shall include the following activities:
    - Stripping and stockpiling of topsoil;
    - Removal (to a nominal depth of 500mm) and stockpiling of subsoil;
    - Placement of spoil material;
    - Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site;
    - Placement of excavated subsoil and then topsoil over spoil material;
    - Contouring and re-vegetation;
    - The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.

7.4.11 Public safety and health

The proposed development may be instrumental in the decline in health of a local population in several ways, this include:

- Facilitate the transmission of diseases;
- Contaminate the local water supply;
- Pollute the air;
- Become a source of noise pollution.

Disease transmission may be facilitated by the migration of people, which invariably will be brought by the project during construction. Work crews—as well as the relatives and dependents that usually follow them—may bring with them a multitude of communicable

diseases including diphtheria, poliomyelitis, tetanus, and malaria. At the same time, it is possible that a disease endemic to the project area will be contracted by the work crew, and then transmitted to a population near the next work site.

7.4.12 Occupational Health and safety

Occupational health and safety hazards during the operations of any power plant are common. The health and safety issues specific to the proposed construction and operations of the station include the following:

- Vehicle / worker accidents;
- Vehicle / wildlife accidents
- Diesel exhaust;
- Electrical hazards;
- Hydrocarbon spills;
- Electric and magnetic fields.

The following mitigation measures are proposed:

- Compliance with all standard and legally required health and safety regulations;
- Provision of a standard first aid kit at the site office at all times;
- Provision of fire-fighting equipment available at the stations;
- 'Hot' work activities shall be restricted.

Specific to hydrocarbon spills:

- The source of the spill shall be isolated and the spillage contained using sand berms, sandbags, sawdust, absorbent material;
- The area shall be cordoned off and secured;
- There will always a supply of absorbent material readily available to absorb/breakdown the spill and the quantity of such materials shall be able to handle a minimum of 200litres of hydrocarbon liquid spill;
- The treatment and remediation of areas affected by emergencies shall be undertaken to the reasonable satisfaction of the local authorities.

7.4.13 Archaeological Artefacts and cultural sites

There are several cultural sites within the project area as mentioned in section 3.5.1 of this report. Mitigation measures of the relocation of the cultural sites have been dealt with in the Volume II of this Report.

No archaeological artefacts exists in areas which are proposed for development, however should such sites be found during excavation of earthworks, trenching etc, the National Museums of Kenya should be informed immediately. If any cultural relic is found, work will cease immediately until relevant authorities have a chance to evaluate the significance of the nature of such findings. In the unlikely event of a new archaeological discovery, the government agencies will be consulted to determine if changes in alignment are necessary.

7.4.14 Cultural changes and spread of HIV/AIDS and STD's awareness

As a result of different opportunities that will unfold due to the project, more people of different behaviour and backgrounds will flow into the area. Job speculators during the project will come with new ideas that will diffuse in the community altering the style of living, thinking consequently norms and values of the indigenous people will be weakened. This might end up introducing urban set up values. Some of the implications could be disruption of local cultural setting, insecurity and marriage conflicts and increased spread of sexual related diseases like HIV/ AIDS. Interaction with these incoming people will have varying impacts on local culture as well as socio – economic implications, with consequences, including: spread of sexual diseases, banditry, prostitution, etc. This would lead to excessive use of funds on curative measures, loss of able bodied persons and hence low production and development in general.

The project is likely to increase the attractiveness of the area, which may result into the following:

- Degradation of the cultural values and norms in the area;
- Increase in the levels of crime of the area;
- Increased desirable and undesirable social interaction in the area.

The following mitigation measures are proposed:

- Strengthening cultural organizations and encouraging competition;
- Organizing cultural tournaments;
- Creating and increasing the number of vocational training centres;
- Mobilizing and sensitizing the population on reproductive health and STIs;
- Ensuring that the project contributes to the creation of an atmosphere that is conducive to the functioning of all social centres which are in the project zone of influence;
- Engaging in communication activities for behaviour change in the area of HIV and AIDS and peaceful coexistence.
- Conducting public awareness campaign including provision of condoms to the project team and the public;
- The implementers of the project will have to work closely with various HIV/AIDS organisations working in the project zone of influence in order to achieve the best results.

The impact is not limited to the project area but this is normal with projects of this magnitude, however it is anticipated that if the above mitigation measures are implemented the impact will be insignificant.

7.5 Negative Impacts during Operations

Table 7.5 Negative Impacts during operations

Aspect/Impact : Impact on Air Quality	
Occurrence	Score
Magnitude or extent	-5
Significance	-5
Probability of occurrence	-4
Duration of occurrence	-3
Aspect/Impact : Impact on Noise and Vibration	
Occurrence	Score
Magnitude or extent	-1
Significance	-2
Probability of occurrence	-4
Duration of occurrence	-3
Aspect/Impact : Water disposal	
Occurrence	Score
Magnitude or extent	-3
Significance	-3
Probability of occurrence	-4
Duration of occurrence	-2
Aspect/Impact : Impact on Flora	
Occurrence	Score
Magnitude or extent	-1
Significance	-3
Probability of occurrence	-3
Duration of occurrence	-4
Aspect/Impact : Impacts on Fauna	
Occurrence	Score
Magnitude or extent	-3
Significance	-2
Probability of occurrence	-3
Duration of occurrence	-4
Aspect/Impact : Impact on Lake Naivasha	
Occurrence	Score
Magnitude or extent	-3
Significance	-3
Probability of occurrence	-4
Duration of occurrence	-4
Aspect/Impact : Soil erosion and sedimentation	
Occurrence	Score
Magnitude or extent	-5
Significance	-4
Probability of occurrence	-3
Duration of occurrence	-1

Aspect/Impact : Earthworks and excavations	
Occurrence	Score
Magnitude or extent	-5
Significance	-5
Probability of occurrence	-1
Duration of occurrence	-1
Aspect/Impact : Socio-economic impacts	
Occurrence	Score
Magnitude or extent	-5
Significance	-5
Probability of occurrence	-4
Duration of occurrence	-3
Aspect/Impact: Oil / Hazardous pollution	
Occurrence	Score
Magnitude or extent	-5
Significance	-5
Probability of occurrence	-4
Duration of occurrence	-3
Aspect/Impact : Spread of HIV/ AIDS and STD's awareness	
Occurrence	Score
Magnitude or extent	-1
Significance	-3
Probability of occurrence	-5
Duration of occurrence	-5
Aspect/Impact : Occupational Health and safety	
Occurrence	Score
Magnitude or extent	-4
Significance	-3
Probability of occurrence	-4
Duration of occurrence	-4

7.5.1 Impact on Air Quality

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 power station will have no significant effect on the climate of the area. Carbon dioxide emissions from the existing and proposed power stations generating 140MW for a year are estimated to be 87 200 tonnes. An equivalent amount of electrical energy delivered by a coal-fired power station, with 37 per cent efficiency burning black coal with calorific value of 23 MJ/kg and carbon content of 65 per cent, would result in the emission of approximately eleven times as much (964 027 tonnes) 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. The amount of methane emitted is estimated to be 119 tonnes per year for the two power stations generating 280MW for one year.

There are no ambient air quality criteria for hydrogen sulphide currently in force in Kenya. Geothermal wells emit sub stantial quantities of this gas and it is necessary to set some targets that define environmentally acceptable levels.

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:

- *"The lowest-adverse health effect of hydrogen sulphide is 15 mg/m3 (9.9 ppm), when eye irritation is caused. In view of the steep rise in dose-effect curve implied by reports of serious eye damage at 70 mg/m3 (46 ppm), a relatively high (safety) protection factor of 100 is recommended, leading to a guideline value of 0.10 ppm (0.15 mg/m3) with an averaging time of 24-hours."*
- *In order to avoid substantial complaints about odour annoyance among the exposed population, hydrogen sulphide concentrations should not be allowed to exceed 0.0046 ppm 0.1g/m3), with a 30 minute* averaging period.....".

Therefore the 24-hour average concentrations should not be permitted to be above 0.10ppm (0.15 mg/m3), beyond the immediate power station boundary.

7.5.2 Air Dispersion Modelling results and assessment of effects

To assess the effects of the developments a number of operating cases have been modelled. Each case represents a set of operating power stations and three have been selected to show how air quality will be affected. For each case the models have been used to predict the maximum 1 hour, 24 hour and 1 year concentrations.

The cases modelled are:

- Case 1 -Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and including the new Unit 3 that is currently under construction);
- Case 2 – Olkaria I (Units 1, 2, 3 and new Units 4 and 5) and Olkaria II (Units 1, 2 and 3);
- Case 3 – Olkaria I (Units 1, 2, 3 and new Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and Olkaria IV (Units 1 and 2).

The results are presented in Figures 3.4 to 3.12 as follows

- Predicted 1-hour average H_2S concentrations due to emissions from Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and 3) Case 1;
- Predicted 24-hour average H_2S concentrations due to emissions from Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and 3) Case 1;
- Predicted 1-year average H_2S concentrations due to emissions from Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and 3) Case 1;
- Predicted 1-hour average H_2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) Case 2;
- Predicted 24-hour average H_2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) Case 2;
- Predicted 1-year average H_2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) Case 2;
- Predicted 1-hour average H_2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and emissions from Olkaria IV - Case 3;
- Predicted 24-hour average H_2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and emissions from Olkaria IV - Case 3;
- Predicted 1-year average H_2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and emissions from Olkaria IV - Case 3

In practice it is only the last case that needs to be examined in detail to assess the effects of the fully developed project.

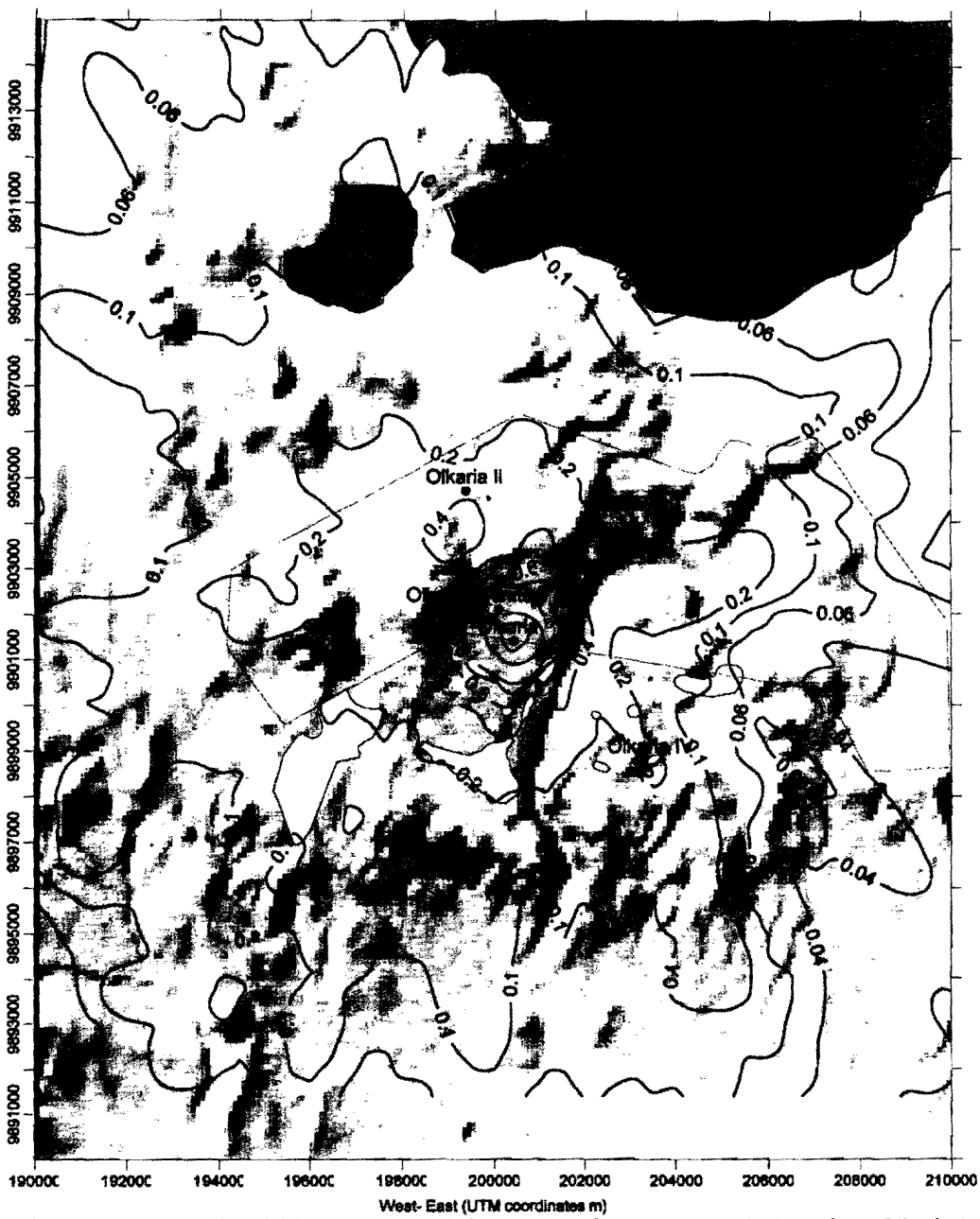


Figure 7.3 **Predicted 1-hour average H2S concentrations due to emissions from Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and 3) - Case 1 (ppm)**

Figure 7.4 **Predicted 24-hour average H2S concentrations due to emissions from Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and 3) - Case 1 (ppm)**

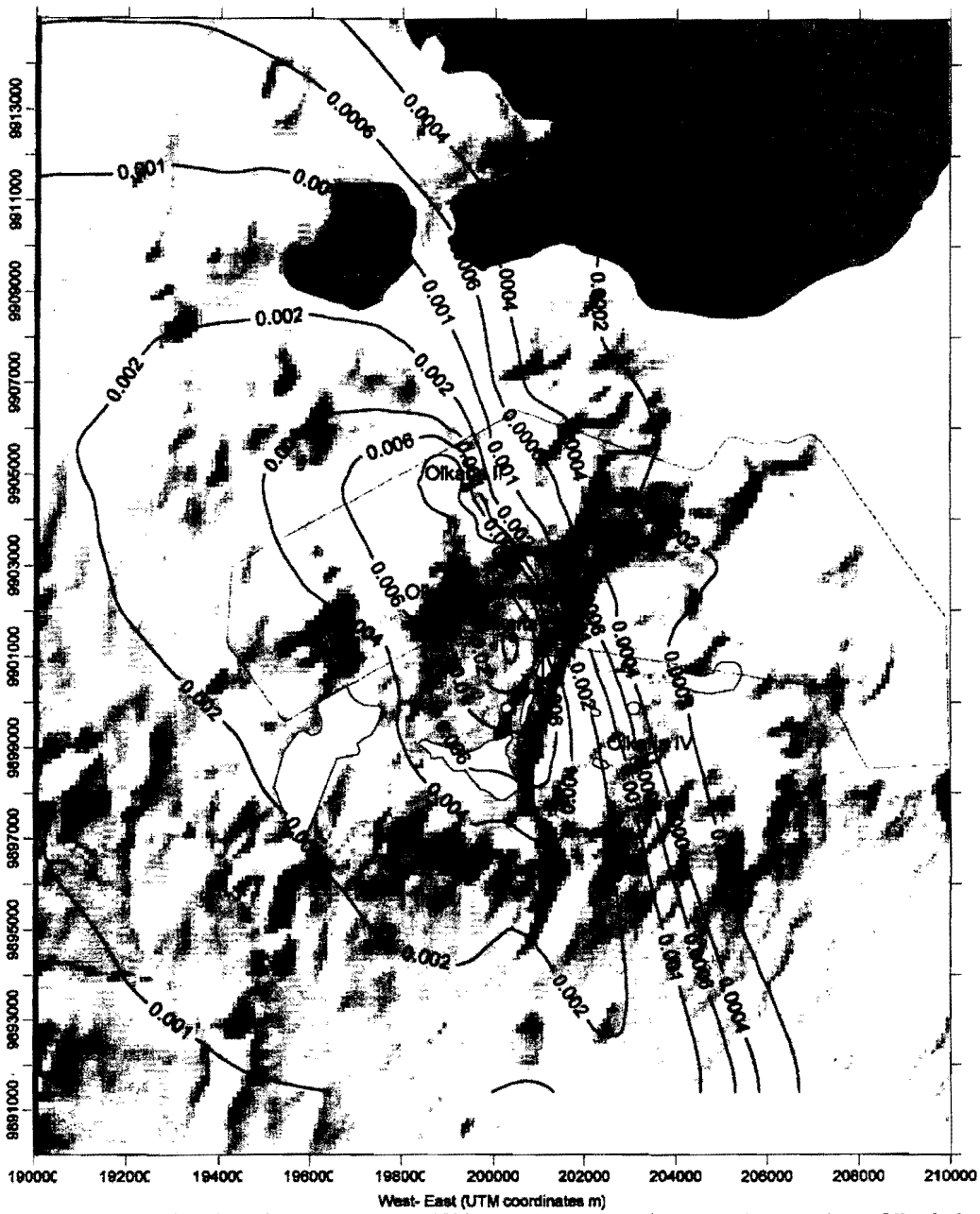


Figure 7.5 **Predicted 1-year average H2S concentrations due to emissions from Olkaria I (Units 1, 2 and 3) and Olkaria II (Units 1, 2 and 3) - Case 1 (ppm)**

Figure 7.6 Predicted 1-hour average H2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) - Case 2 (ppm)

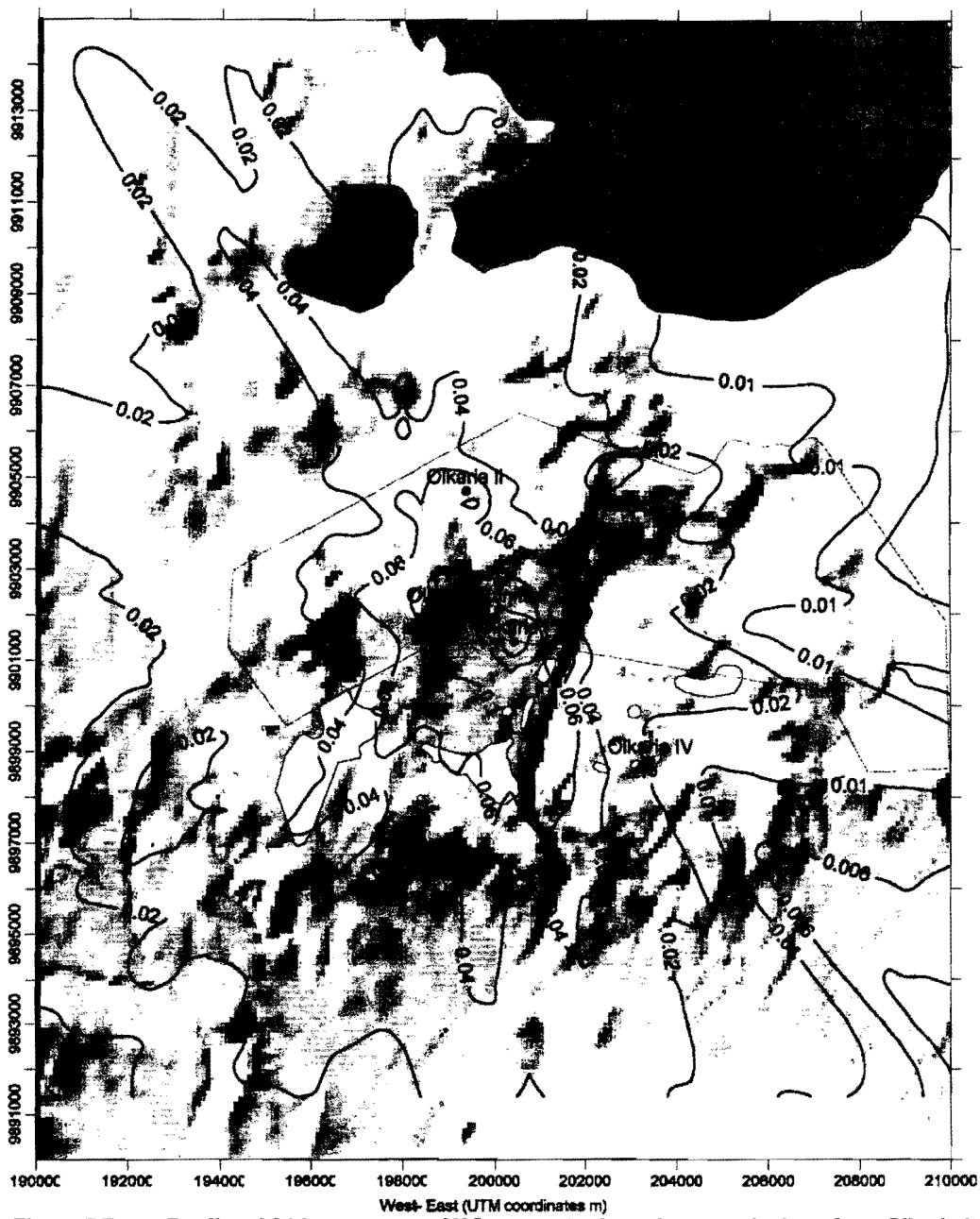


Figure 7.7 Predicted 24-hour average H2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) - Case 2 (ppm)

Figure 7.8 Predicted 1-year average H2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) - Case 2 (ppm)

Figure 7.9 Predicted 1-hour average H2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and emissions from Olkaria IV - Case 3 (ppm)

Figure 7.10 Predicted 24-hour average H2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and emissions from Olkaria IV - Case 3 (ppm)

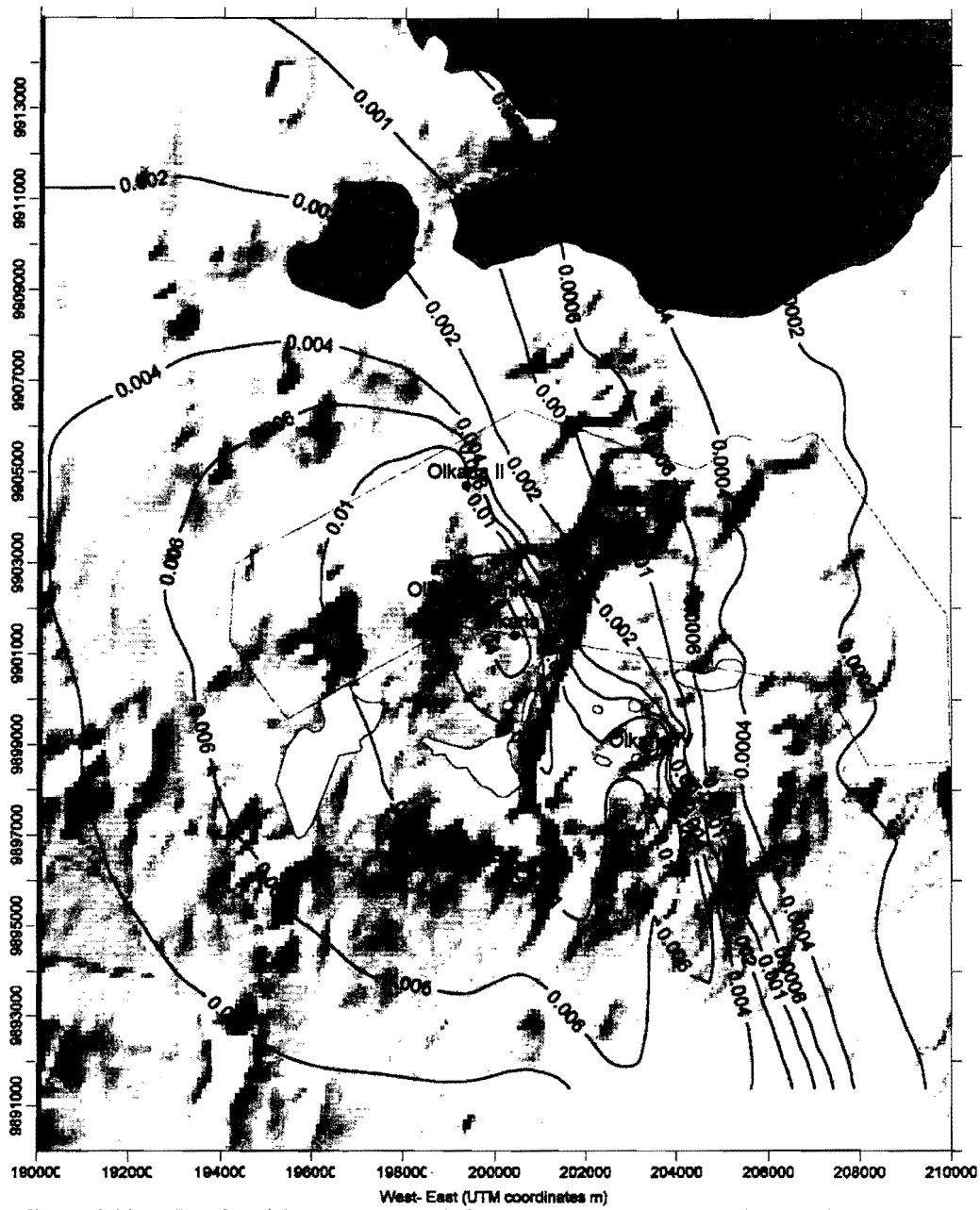


Figure 7.11 Predicted 1-year average H2S concentrations due to emissions from Olkaria I (Units 1, 2, 3 and Units 4 and 5) and Olkaria II (Units 1, 2 and 3) and emissions from Olkaria IV - Case 3 (ppm)

Figure 7.11 shows the predicted 24-hour concentrations for the fully developed proposal. The land predicted to be affected by 24-hour average H_2S concentration above 0.10ppm is shown using a red contour. It includes that if the assessment criteria is set at the guideline set by the WHO (1987) of 0.10ppm averaged over 24-hour then shows the impacted area.

Land where the H_2S concentrations are predicted to exceed a 24-hour average of 0.10ppm is shown in red. The other figures can be used to compare the effects of adding the additional emissions to the air shed. It is notable that the new plants which discharge the H_2S through the cooling tower emission provide much greater plume rise and much better dispersion. Thus the 70 MW plant creates less impact (due to H_2S emissions) than does the original 45 MW Olkaria 1 Power Station.

The detection of H_2S odour depends on short-term concentrations of a few second exceeding the odour threshold. The detection of odour would not normally be sufficient grounds to prevent a development or to require mitigation to be undertaken. In the New South Wales (a state of Australia) the assessment procedures for odorous industries are based on risk and require that (for sparsely settled rural areas the odour level for an odour-producing industry should not exceed 7 odour units on more than 44 hours in the year. (Note air with an odour level of 7 odour units requires dilution by a factor of seven to reduce the odour to the point where 50% of the population could just detect the odour in laboratory conditions).

Thus in North South Western direction there is no upper limit set but for 99.5% of the hours in a year the odour should be less than 7 odour units. Compliance with the WHO 24-hour assessment criterion does not ensure that odours will not be detected.

The cumulative project H_2S emission within this area will be 0.1ppm/mg/m^3. There are no major impacts foreseeable different from the current situation which can't be mitigated.
The following management and mitigation measures are proposed:

- Daily Monitoring of H_2S will be carried out;
- Training workers on the dangers of exposure to H_2S;
- Relocating the Community living within the project area.

7.5.3 Impact on Noise and Vibration

To assess the effects of the developments a number of operating cases have been modelled. Each case represents a set of operating power stations. Seven cases were modelled, but Case 3 essentially duplicated Case 1 and only six cases (Cases 1, 2, 4, 5, 6 and 7) are presented to show the impacts of the project and its various components. The six cases are described below:

- Case 1 - Olkaria 1
- Case 2 - OW38
- Case 4 - Olkaria 1 + Olkaria II (Units 1 and 2)
- Case 5 - Olkaria 1 + Olkaria II (Units 1, 2 and 3)
- Case 6 - Olkaria 1 + Olkaria II (Units 1, 2 and 3) + Olkaria I (Units 4 and 5)
- Case 7 - Olkaria 1 + Olkaria II (Units 1, 2 and 3) + Olkaria I (Units 4 and 5)+ Olkaria IV +OW28

The results are presented in Figures 3.13 to 3.17. In practice it is only Case 2 (Figure 3.14) and Case 7 (Figure 3.17) that need to be considered in detail.

The other cases may be of interest to readers wishing to examine how different components of the project affect the noise environment and contribute to the overall impacts.

In interpreting the figures readers should understand that in the absence of topographical shielding the noise contours from each source would appear approximately circular, at least for locations far from the power station. Topography shields some locations better than others. This is particularly apparent for the Gorge where observers in the bottom of the Gorge would be shielded from the noise while others on the high ground, but further away, are predicted to experience higher noise levels because they are not shielded as effectively.

Finally the maps show the Maasai villages as yellow (irregular shapes), terrain is indicated qualitatively by a shade of green (low elevations are dark green and higher elevations are light green) and noise level contours in 5 dB(A) increments are either black or red.

Figure 3.14 shows the noise levels predicted to be produced by OW38, which is currently being tested. This well is test at approximately 12 MW so is at the maximum levels of both power and presumably noise that would be expected in the Olkaria well fields. The red contour shows the 35 dB(A) Laeq-10h.

Land within this contour is affected by noise levels above the night time maximum permissible limit for residences in Kenya. It can be seen that the topography affects the shape if the affected land but broadly speaking the affected land extends up to approximately 1.5 km from the well. Well testing is a temporary activity can last over several months and a well testing program can involve many wells. It is difficult there to know how affected groups of people should be considered in this case. It is suggested that groups lying within 1.5 km of a well under test should be offered the opportunity to be re-located.

Figure 7.12 Predicted noise levels due to Case 1 - Olkaria 1 (dB(A) LAeq-10h)

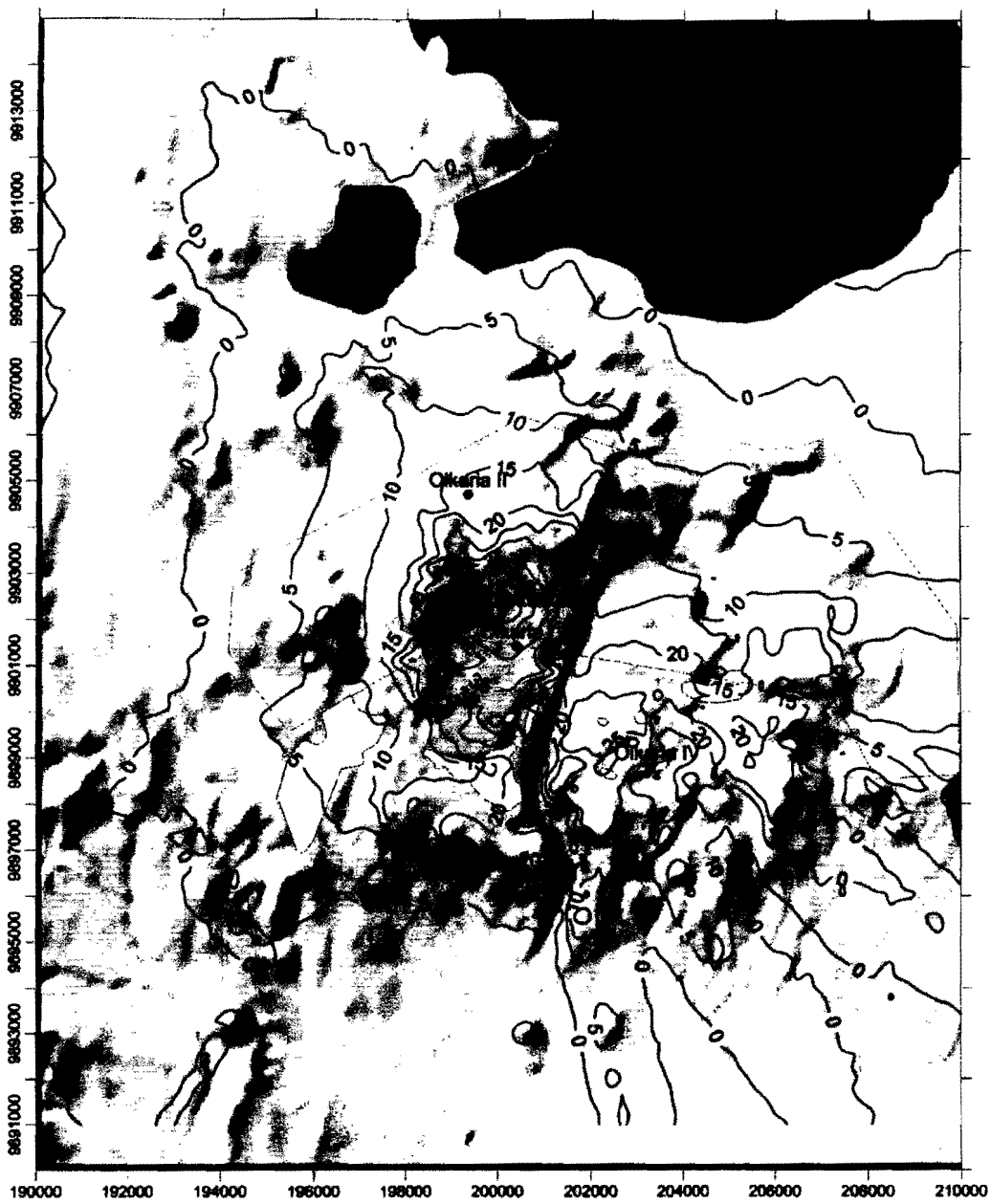


Figure 7.13 Case 2 – OW38 (dB(A) LAeq-10h)

Figure 7.14 **Case 4 - Predicted noise levels due to Olkaria 1 + Olkaria II (Units 1 and 2) (dB(A) LAeq-10h)**

Figure 7.15 **Case 5 - Predicted noise levels due to Olkaria 1 + Olkaria II (Units 1, 2 and 3) (dB(A) LAeq-10h)**

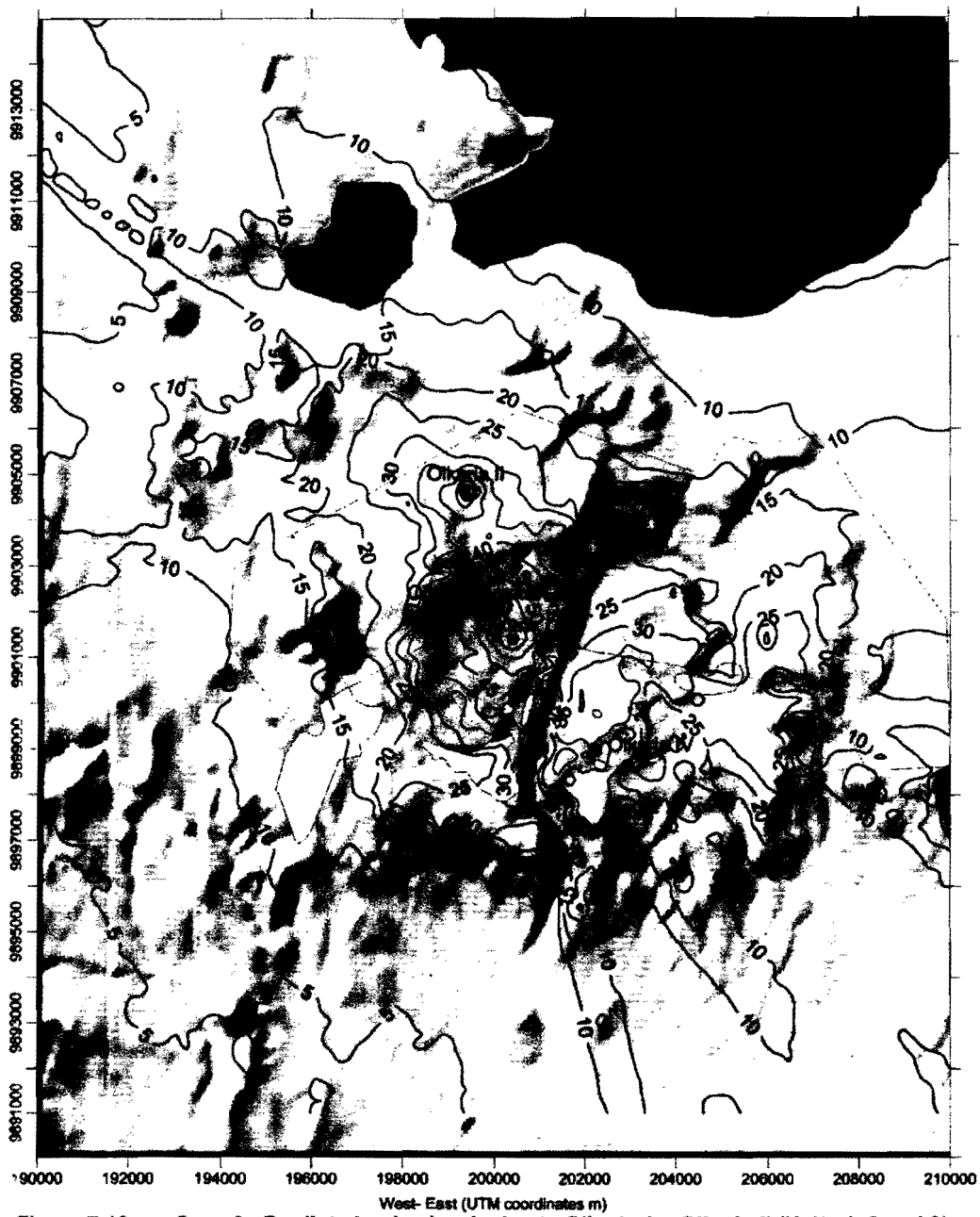


Figure 7.16 **Case 6 - Predicted noise levels due to Olkaria 1 + Olkaria II (Units 1, 2 and 3) + Olkaria I (Units 4 and 5) (dB(A) LAeq-10h)**

Figure 7.17 **Case 7 – Predicted noise levels due to Olkaria 1 + Olkaria II (Units 1, 2 and 3) + Olkaria I (Units 4 and 5)+ Olkaria IV +OW28 (dB(A) LAeq-10h)**

Figure 7.17 shows the predicted noise levels for the fully developed project. It is recommended that all settlements inside the 35 dB(A) (LAeq-10h) contour should be re-located as this land is predicted to be affected by noise levels above the NEMA night time maximum permissible levels and there is no other cost-effective practical mitigation measure.

During operations the following mitigation measures are proposed:

- Provision of PPE's to the workers;
- Daily noise monitoring will be conducted.

7.5.4 Water disposal

140MW geothermal developments produce a substantial amount of waste-water, which needs to be disposed of safely without adverse effects on the environment. The proposed long-term method of waste-water disposal is by deep re-injection, which should have minimal surface no impact.

The disposal of geothermal waste waters poses a problem because the fluid is a brine containing chemicals in concentrations that are potentially harmful to both flora and fauna. A 140MW development produces a substantial volume of waste water, all of which needs to be disposed of safely. The preferred option for waste brine disposal during steamfield operation and that recommended in the feasibility report, is for deep re-injection into a number of purpose drilled or unused production wells and this option is to be implemented.

7.5.5 Impact on Flora

It is difficult to assess precisely the impact of hydrogen sulphide emissions on vegetation although the predicted ground-level concentrations are such that there are unlikely to be major adverse effects.

It is evident that fire has been playing a role in maintaining the proportions of *Acacia - Tarchonanthus* - and grasses in most of the area where these occur. *Tarchonanthus comphoratus* is a fire-tolerant species with a tendency to sprout back after a burn.
Themeda triandra is another species which has evolved successfully with fire in East Africa rangelands, where burning tends to increase range biomass production under this particular grass. The overall effect of fire on these communities would be to perpetuate those species that are fire-tolerant to the detriment of others which are susceptible to destruction by fire. There are several factors, however, that influence fire in rangelands, such as the season, availability of fuels, prevailing winds and so on, which are beyond the scope of this report. It is noteworthy that prolonged incidence of fire in a range area like Olkaria would eventually introduce more open plant communities with reduced dense bushland. Thus *Tarchonanthus - Themeda - Acacia- Setaria/Digitaria* associations would have a tendency to predominate in rather open bushed grasslands should repeated incidences of fire occur.

The release of brine into ponds from the existing power station has influenced the growth of *Typha* and *Cyperus* as the main wetland plants able to resist the high levels of concentrated salts. This type of vegetation seems to be tolerant to the brine, but at the periphery of the ponds, *Acacia xantholpholea* should be introduced rather than Eucalyptus species. The pepper tree *Schinus molle* normally has a shallow root system and in volcanic soils this type of rooting is unlikely to support the growth of large trees for a long period of time. There are suitable indigenous trees such as *Olea europeas ssp africana*, the African olive, which would certainly do well in this environment. Various species of *Ficus* could also do well in this area and are fairly easy to establish.

It is predictable that the vegetation of gullies and luggas is likely to be adversely affected by brine if these are used as drainage channels. Normally these drainage areas do not get water at regular intervals throughout the year, only during the rainy season. Having brine trickle constantly throughout the year would certainly introduce changes in species composition. Sedges are likely to invade the channels, but the steep slopes are not likely to be affected, since the level of brine is fairly low. Silt depositions in the channels tends to form dry season grazing areas with *Pennisetum, Setaria* and a host of palatable herbaceous species, which will certainly disappear with the introduction of brine.

The release of brine into drainage channels should therefore be discouraged and as much as possible the brine should be held in the drainage ponds closest to the source. The more

environmentally acceptable way of discharging brine would be to deliver it in concrete piping to a central pond, ensuring that it does not come into contact with vegetation or wildlife and even domestic livestock.

The following management and mitigation measures are proposed:

- A program to assess the possible impacts on the commercial flower farms in the area should be carried out as long term monitoring measure of the impact of hydrogen sulphides to the nearby flower farms. This will be a continuing program and in addition it is recommended that there should be several small "flower gardens", within the site where hydrogen sulphide concentrations are predicted to be greatest;
- Vegetation monitoring will be taken seriously, mainly near the power plant, the wells and along the steam pipes and monitoring of potential long-term effects on natural vegetation will be carried out in the area.
- The brine and condensate discharges will be deep re-injected in order to avoid potential toxic effects on flora or used for drilling.

7.5.6 Impacts on Fauna

The main impacts of fauna during operations will be the same the case during the construction phase and has been discussed in section 7.4.3 but the impacts will be severe during the construction phase of the project, due to the animals trying to adjust to possible changes to the environment, the other effects to the animals will be discussed in relevant subsections like air quality, noise, ponding and vehicle movement.

7.5.7 Impact on Lake Naivasha

The single source for all water abstraction is Lake Naivasha. This includes direct water abstraction for drilling and housing estate.

The amount of lake water drawn by the existing geothermal project and the proposed development has been shown to be a small proportion of the total amount of water abstracted. On its own therefore it is unlikely to affect the lake level significantly.

Historically water-levels at Lake Naivasha fluctuate significantly and it is likely that they will continue to do so. It is important to consider that over the expected 30-year life of the proposed power station, there are likely to be periods when the lake level is very low. KenGen should therefore not rely on the lake as a source of water for the entire life of the Power Station. Contingency plans should be made for alternative water sources for drilling and domestic purposes when the need arises.

The following mitigation measures are proposed:

- No landscaping should be allowed from lake water;
- Continued monitoring of Lake Levels;
- Accidental leakages and bursts to water supply pipelines should be reported and repaired immediately;
- Recycling of water as much as possible should be encouraged for example water used for curing of concrete can be used for spraying dusty roads;
- Control of the water flows and the water consumption records must be kept and availed to the Supervising Engineers at the end of working day;
- All employees should be trained on water usage practices like unnecessary opening taps should be discouraged;
- Monitoring of taps and there efficiency should be done regularly;
- Curing of concrete should be done in conservancy tank to avoid wastage;
- Harvest water during rainfall times.
- Use of water from Lake Naivasha will not be avoided. However, management has already put in place measures that will ensure wastage of water resources is minimal.

For cooling purposes, re-injection of water and or recycling has been considered in the designs;
- Proposed use of brine for drilling to minimise abstraction.

7.5.8 Soil erosion and sedimentation

Due to the scarce vegetation and shallow and disturbed soil in the proposed power plant site and surrounding areas (wildlife, tourist traffic, livestock farming, agriculture and human settlement), the surface run off is expected to be significant during heavy rains. The steam fields are exposed and slopes are steep along the steam gathering system corridors.

It is envisaged that erosion will be experienced in the entire project area if no proper slope protection and adequate drainage infrastructure is not constructed to control the run off.

Soil erosion is caused by practices which (by action or inaction) either permit intense rainfall to strike the unprotected soil surface, or encourage the accumulation of large volumes of runoff, or allow runoff to flow rapidly across the soil surface thereby removing the surface layers of the soil.

Sedimentation and high water turbidity during heavy rains is likely to occur. This may worsen the already reported high deposit levels in the lake and lower the physical and chemical quality of the water being abstracted.

It is recommended that effectiveness of the erosion control measures be monitored. Soil conditions should be reviewed, at monthly intervals during construction and at yearly intervals during operation, by a soils expert. Finally, it is recommended that KenGen nominates an officer to take responsibility for the day to day control of all activities that could lead to soil erosion. The officer should be briefed by a soils expert as to the nature of risks and should be provided with sufficient authority to direct contractors concerning day to day activities that could lead to erosion.

The design in nutshell should consider the following mitigation measures during operation of the project:

- Proper designs and layout of field to avoid steep gradients should be done, budget for and presented in the Engineering Report;
- The design should considered appropriate terracing due to the nature of topography of the area;
- Planting of trees along the gullies and areas susceptible to erosion is proposed;
- Re-forestation or re vegetation of areas cleared during construction should be done.

7.5.9 Oil / Hazardous pollution

Hazardous materials, hydrocarbons, including solvents, coolants, acids, and, alkalis, will be used in operations. The following mitigation measures are proposed:

- Hazardous materials shall be stored above flood level;
- Areas for the storage of fuel and other flammable materials shall comply with standard fire safety regulations;
- Chemicals and fuel shall be stored in storage tanks within a secure compound. All chemicals and fuels shall be stored in accordance with manufacturer's instructions;
- Storage areas or secondary containment shall be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them;
- The minimum volume for secondary containment shall be 110% of the capacity of the largest tank system, plus 10% of the total capacity of all other separate tanks and containers within the bund wall with closed valves for controlled draining during rains;
- Pipe-work carrying product from the tank to facilities outside the containment shall be provided with secondary containment;

- Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges shall be located within the containment or provided with own containment.

7.5.10 Socio-economic Impacts

For the purpose of assessing social and economic impacts, two areas have been considered. The first is referred to as the primary impact area, which includes the Hell's Gate National Park and the adjoining land to the north, which may experience direct effects due to the project, either due to being able to see the development, experience odours or hear noise from the project. Because of variability in the direct impacts as the dispersion conditions change, or as noise propagation conditions change, it is not possible to define these areas precisely. However, beyond a distance of three to four kilometres from the proposed power station, the direct effects are expected to be minimal. The secondary impact area includes a much wider area where other social and economic effects may be experienced. This has been taken to include the Naivasha Location (940 km^2).

Further, in assessing the impacts of the proposal the two stages of the project have been included. These are construction and operation. Decommissioning is also discussed very briefly as the precise nature of this phase is not known.

The consultants' findings on anticipated impacts and appropriate mitigating measures throughout all sectors follow a broad theme of provision of the required facilities by the project, rather than relying on Naivasha town and the facilities of the Municipality. This is because, as reported in the baseline study, Naivasha town and its environs has witnessed very rapid population growth over the last ten years. While many employers around the lake have provided housing, schooling and other facilities for their employees, some have not and those that have, do not provide for the large number of casual workers who gravitate to the area.

This effect, compounded by very little development in the Municipality itself in recent years, has lead to a situation where the infrastructure of Naivasha town is stretched far beyond capacity. Social services are inadequate, as are health, education, water and community facilities. Apart from a few small projects, no systematic development has taken place for many years in the public housing sector and private development has been limited and largely unplanned. The impact of the unplanned population increase is visible throughout the municipality. The roads are in a parlous state and even major residential areas are either not served at all by roads, or the roads are no longer in a condition fit for vehicular traffic. With a rapidly growing informal sector, building kiosks and workshops along the smaller streets, both suburban dwellers and business people complain of frequent water shortages.

The consultants have studied the Municipality development plans and have held discussions with local officials, as well as residents and business people. The clear conclusion is that any major project in the Naivasha area, including the Olkaria geothermal project, is advised, both in its own interests as well as the Municipality's, not to put any further burdens on the infrastructure of Naivasha town. The approach will have to be one of self-sufficiency within the project area.

The consultants recommend that provided adequate steps are taken, as indicated here, in the area of infrastructure and social facilities, and provided a joint planning approach continues between KWS and KenGen for the optimum management of hell's Gate National Park, the socio-economic aspects of the project will not cause undue concern.

7.5.11 Spread of HIV/ AIDS and STD's awareness

Spread of HIV/Aids and STD's awareness has already been discussed under section 7.4.14 impacts during construction; however this is expected to continue even during the operations of the project.

The following mitigation measures are proposed during operations of the project:

- Mobilizing and sensitizing the population on reproductive health and STD's;

- Ensuring that the project contributes to the creation of an atmosphere that is conducive to the functioning of all social centers which are in the project zone of influence;
- Engaging in communication activities for behaviour change in the area of HIV and AIDS and peaceful coexistence.
- Conducting public awareness campaign including provision of condoms to the project team and the public;
- The implementers of the project will have to work closely with various HIV/AIDS organisations working in the project zone of influence in order to achieve the best results.

7.6 Negative Impacts during Decommissioning

The main negative impacts during the decommissioning phase are the loss of habitat associated with leaving abandoned plant, equipment and buildings without any attempt at rehabilitation. Unplanned, careless and disorganised removal of physical facilities can cause further loss of habitat. Once the structures are removed the sites can be left to undergo succession, or be rehabilitated to achieve average status with the neighbouring area. An additional problem is the abandoned wells which can be a wildlife and human hazard.

Negative impacts can be reduced by consideration in the planning stage of the design of some of the physical facilities and roads with the aim of transferring them to tourism and wildlife viewing circuits once the project is abandoned. Most of the buildings should be semi-permanent so that they can be easily removed with little disruption. Professional removal of plant and building will also ensure that no further loss of habitat and unnecessary disturbance of wild animals which may have learnt ways of living alongside the project during its operation period. After the removal of plant, revegetation should be encouraged to increase the rate of recovery.

It is not easy to underscore the severity of the negative impacts during decommissioning however a full ESIA will be done for decommissioning of the power station.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental Social Management Plan (ESMP) is prepared to show how site specific concerns and mitigation measures are addressed through the detailed design, pre-construction, construction and post-construction / operation phase of the Project.

The (ESMP) has been developed with project knowledge and information available to date. Some of the Project's final details, such as proposed locations of construction camps, disposal areas for construction debris among other issues, are unknown at the present time. As project commencement and scheduling plans are developed and changed, components of the ESMP might require amending. This is therefore a working document, which can be updated whenever new information is received or site conditions change.

To ensure that the negative environmental impacts can be controlled and mitigated effectively, a stringent and scientific management and monitoring plan has been prepared. The ESIA proposes that KenGen enhances its capacity of the Geothermal Resource Development (GRD) Environment Unit Section at Olkaria both during the construction and operation phases of the project to be able to cope up with additional challenges emanating from this project. This will ensure that all the targets are achieved and that the environmental responsibilities and obligations of ESIA and the respective geothermal stations and sections are satisfied during project implementation. The Environmental Unit will principally be charged with the responsibility for monitoring implementation of the environmental management and monitoring plan.

8.1 Auditing of the ESMP

The GRD Environment Unit shall conduct quarterly audits to ensure that the system for implementation of the ESMP is operating effectively. The audit shall check that a procedure is in place to ensure that:

- The ESMP being used is the up to date version;
- Variations to the ESMP and non-compliance and corrective action are documented;
- Appropriate environmental training of personnel is undertaken;
- Emergency procedures are in place and effectively communicated to personnel;
- A register of major incidents (spills, injuries, complaints, legal transgressions, spot fines and penalties etc) is in place and other documentation related to the ESMP;
- Ensure that appropriate corrective and preventive action is taken by the Contractor once instructions have been issued.

8.2 Responsibilities of the ESMP

8.2.1 Responsibilities

In order to ensure the sound development and effective implementation of the ESMP, it will be necessary to identify and define the responsibilities and authority of the various persons and Organizations which will be involved in the project. The following entities should be involved in the implementation of this ESMP:

- KenGen Head Office;
- GRD Environment Unit;
- Contractor;
- Naivasha Municipal Council;
- NEMA.

(a) KenGen

It will be the responsibility of KenGen to oversee or appoint qualified and competent team to oversee the construction and operational phases of the Project.

(b) The GRD Environment Unit

The GRD Environment Unit will be required to oversee the construction programme and construction activities performed by the Contractor, in compliance with the ESMP.

The project management should co-ordinate all aspects of the environment during project implementation and operations. This should include following the construction to monitor, review and verify the implementation of the project's ESMP.

(c) The Contractor

The contractor will be required to comply with the requirements of the ESIA, the ESMP within this report and other relevant legislations.

(d) Naivasha Municipal Council

The relevant departmental officers in Naivasha Municipal Council should be called upon where necessary during project implementation to provide the necessary permits and advisory services to the project implementers.

(e) NEMA

The responsibility of the National Environment Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment.

8.3 Environmental and Social Management during construction phase

8.3.1 Environmental Management Plan

An Environmental Management Plan is required to be prepared to identify and sequence environmental activities that are needed in order to complete a required construction process.

The Environmental Management Plan would identify reference documentation, the approval required to complete that activity and the verification documentation to be produced as evidence of satisfactory completion. The Environmental Management Plan would also identify where "hold points" would be required. These are where continuation of subsequent activity is prohibited unless a former activity has been signed-off. The EMP would be broken down into various activities as listed in Chapter 4 will be undertaken.

8.3.2 Method Statements

Method statements would be completed on behalf of the Main Contractor or Sub Contractor by trained engineers or other appropriate experienced personnel, in consultation with on-site environmental staff and, where necessary, environmental specialists. Their production would include a review of the environmental risks and commitments, as identified in the EMP and risk assessment, so that appropriate control measures are developed and included within the construction process.

Method statements would be reviewed by the KenGen's Environmental Manager, the Main or Sub Contractor's appointed environmental manager and, where necessary, by an appropriate

environmental specialist. Where necessary, all method statements would be submitted to the enforcement agencies (NEMA, KWS, Naivasha Municipal Council.) as appropriate. Method statements would contain as a minimum:

- Location of the activity and access/egress arrangements.
- Work to be undertaken and methods of construction.
- Plant and materials to be used.
- Labour and supervision requirements.
- Health, safety and environmental considerations.
- Any permit or consent requirements.

8.3.3 Site Environmental Standards

These would be agreed with the GRD Environment Unit and would detail the minimum measures that should be achieved for general operations that would fall outside the risk assessment/method statement procedure designed to cover the majority of construction activities. They would cover issues such as storage of materials, management of waste, water pollution, noise and vibration, and water pollution control. The standards would be printed on A3 posters, placed on site notice boards and used as a briefing tool on site.

8.3.4 Control of Construction Processes

(a) Training, Awareness and Competence

The raising of environmental awareness is viewed as a crucial element in the appreciation and implementation of the Construction Environmental Management Plan. As a consequence, all staff would undergo environmental awareness training, initially by way of the pre-start induction process. A project specific training plan that identifies the competency requirements for all personnel allocated with environmental responsibilities would be produced and would be contained within the CEMP. Training for all personnel identified in the training plan would be completed before commencement of the associated construction activities. Line managers and supervisors would ensure that all personnel engaged in activities that may have an impact on the environment are competent to carry out their duties or, where necessary, arrange for suitable training to be undertaken.

(b) Supervision of Construction Activities

All construction and installation activities including those carried out by subcontractors and suppliers would be supervised, or regularly checked through the completion of site inspections by the Contractors Environmental Manager, to ensure that requirements identified in risk assessments or method statements have been implemented. The frequency and extent of this supervision would vary according to the degree of competence displayed by the workforce and the level of risk to the environment.

(c) Inspection of Other Operational Impacts

Appointed environmental representatives would carry out weekly inspections of their respective construction areas, to verify that housekeeping or supporting controls are being implemented effectively. These inspections would utilise the site environmental standards as the minimum standards that should be achieved, with necessary actions being recorded and raised at weekly progress meetings. Subsequent inspections would commence with a review of all outstanding actions from previous reports to verify that they have been completed.

(d) Inspections by the Environmental Team

Environmental deliverables required by the CEMP would be subject to regular independent inspections by either the Environmental Manager or the relevant environmental specialists. These inspections would be used to confirm that:

- Construction works are progressing in accordance with the agreed method

statements';

- Agreed protection or mitigation measures are in place, prior to or during the implementation of construction activities;
- Construction works have been completed in accordance with the design and;
- Commitments made during the statutory process.

(e) Environmental Inspection and Reporting

The Contractors Environmental Manager would carry out an assessment of the Project's environmental performance, based upon the reports from the environmental management representatives during the period, reports from the environmental specialists and from his own site inspections. This would be carried out at a frequency at no greater than monthly intervals but could be held more regularly depending on the nature of the construction activity. An assessment of the performance over the month would be made and quantified. A monthly report detailing performance for the period would be provided to the KenGen's Project Manager and would include a summary of environmental inspections completed, audits undertaken, complaints and incidents.

(f) Environmental Monitoring

Monitoring of noise, vibration, dust and water quality would be carried out in accordance with the specialist environmental procedures and environmental commitments made. The GRD Environment Unit would maintain a register of all environmental monitoring.

(g) Control of non-conformance

Non-conforming products or processes would initiate a Non-Conformance Report, which would identify the nature of the problem, the proposed corrective action, action taken to prevent recurrence of the problem and verification that the agreed actions have been carried out.

(h) Communication and Co-ordination

Internal project communications would be via two processes:

- Weekly team meetings;
- A monthly Project Environmental Review;

(i).1 Weekly team meetings

Weekly meetings chaired by the Client's Environmental Manager would be held by each of the construction teams to review performance and co-ordinate short-term planning of forthcoming activities. Environmental management representatives would use these meetings to report on the findings of their inspections together with any systematic or recurring issues. Actions from these meetings would be recorded via minutes and reviewed by the Contract Manager.

(i).2 Monthly Project Environmental Review

Environmental issues would be primarily discussed at a monthly Project Environmental Review, chaired by the Contract Manager and attended by the Contractors Environmental Manager, the Clients Environmental Manager, relevant sub contractors environmental representatives and, when necessary, environment specialists and representatives from statutory consultees. The Project Environmental Review would:

- Consider past performance from inspections, audit reports and monitoring data.
- Plan actions required to mitigate forthcoming risks.
- Disseminate best practice.

8.3.5 Environmental due diligence during construction

During the construction phase, environmental due diligence will be incorporated into the Project implementation mainly to:

- Control the residual risk of accidental environmental damage;
- Prevent the negative environmental impacts during construction.

The contractor(s) and supervising Engineer will have the primary responsibility for the due diligence. The supervising Engineer will be required to include environmental considerations in the monthly progress reports and indicate progress in the implementation of mitigation measures as outlined in the ESMP.

The Construction risks to be monitored will include, but not be limited to the following issues:

- Handling of hazardous materials as part of construction activities;
- Movement of machinery;
- Management of borrow areas;
- Sedimentation of watercourses
- Collection and disposal of wastes;
- Management of pollution incidents.

Tables 8.1, gives a summary of the Environmental and Social Management Plans during Construction, phases of the project.

Table 8.1 ESMP Olkaria Domes Unit I and II during construction

Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
Land acquisition and Resettlement	Land acquisition and resettlement will be carried out in accordance with land administration laws of Kenya, World Bank Policies and Japanese Charter.	Sound relocation and resettlement.	KWS, Contractor and KenGen.	Daily; Quarterly Reports	RAP REPORT
Impact on Flora	• The clearing of vegetation and trees will be strictly controlled and will be limited to what is absolutely necessary and will not be done indiscriminately. Diligence on the part of the Contractor and proper supervision of the workforce is important in this respect; • Disturbed areas will be re-vegetated with locally occurring grasses, shrubs and trees; • All the areas that are cleared during the course of construction will be quickly rehabilitated with appropriate indigenous flora to prevent the growth of opportunistic species; • Workforce engaged in the construction process will be provided with alternatives to fuel wood and charcoal for cooking (eg kerosene cookers), so that the pressure on fuel wood and charcoal will be reduced.	- To maintain ecosystem with minimal disturbance.	KWS, Contractor and KenGen.	Daily; Quarterly Reports	KES 3,000,000.00 (planting of 1000 trees after construction of the plant)
Impact on Fauna and Hell's Gate National Park wildlife	• Animal numbers, movements and distribution should be monitored. This should be done either independently by KenGen or in liaison with KWS. KenGen's Environmental Unit should actively participate in these studies and should be made aware of the findings of these studies and the management decisions which are made as a result of these findings. It is further proposed that the numbers should be monitored in the larger Nakuru District in liaison with the KWS and Environmental Conservancy Groups within the District and this should be done during dry and wet seasons.; • Install a game –proof fence around each toxic brine pond, with screening or netting over the top to keep out birds; • Drains and steam lines should be designed located in ways that do not interfere with animal corridors (as done for Olkaria II); • The movement in the Park of construction traffic, as well as traffic generated by KenGen activities, should be controlled and no movement should be allowed at night;	- To maintain ecosystem with minimal disturbance.	KWS, Contractor and KenGen.	Annual animal census.	KES 3,000,000.00

Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
	• Introduction of speed bumps and speed limits enforcement will prevent death of animals as a result of over speeding; • The construction activities should be kept to a minimum to avoid loss of habitat; • Introduction of speed humps to reduce animal deaths from excessive vehicle speeds; • Training of workers regarding park regulations particularly with regard to interaction with animals and littering. KenGen should ensure that poaching does not occur and personnel found interfering with wildlife should be dismissed; • Adequate waste management facilities should be provided and regular monitoring conducted by KenGen for compliance; • Cleared areas should be rehabilitated with indigenous vegetation as soon as possible to restore habitat; • In general, fencing should be kept to a minimum to avoid loss of habitat. Care should be taken to ensure that there are no small animals trapped inside fenced areas; • Vehicle movements within the park should be monitored and time limits enforced; • KenGen in liaison with KWS appoints three senior members of staff based in Olkaria on the Hell's Gate National Park Management Committee. The personnel should be the Geothermal Development Manager, and the other two nominated by him. The following measures are proposed to mitigate negative impacts on avifauna: • Identify locations as far away as possible from any significant bird breeding or staging areas; • Consider migratory bird routes when planning the route of the proposed transmission line; • Use existing towers for new lines (upgrade); • Construct underground transmission lines where expected to cross bird migratory routes; • Dress existing and proposed transmission lines with conspicuous bird warning devices, where necessary, such as areas where bird migratory routes cannot be avoided; • Locate the proposed transmission line adjacent to prevailing				

Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
	natural obstacles such as trees or cliffs to prevent collision by birds with conductors; • Use of bird warning devices on transmission lines and insulating certain components on the towers to make them 'bird friendly'. Figure 7-2 presents a sample of the variety of bird warning devices currently available.				
Impact on quarry sites landscape scarring, dangers of over hanging cliffs and falling rocks which creates environmental, health and safety hazards:	- Inform community living at/near the sites that the areas have been selected for exploitation. - Arable lands should not be used as borrow sites whenever possible. For new borrow sites the topsoil (30cm) should be put aside and used for reinstatement after construction is over to minimise the impact on ecosystem and agriculture. - Plan access to borrow sites. - Control and restrict access to borrow sites (e.g. by fencing). - Control earthworks. - Proper management of excavation activities. - Landscape, terrace and if necessary grass sites. Replace trees that are removed during excavation. Mitigation measures proposed during blasting: - Obtain current and valid authorisation from Department of Mines prior to any blasting activity; - Qualified and registered blaster from the Department of Mines shall supervise all blasting and rock-splitting operations at all times; - The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area); - The Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on Site; - The Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock. Environmental damage caused by blasting/drilling shall be repaired at the Contractor's expense; - The Contractor shall use blast mats for cover material during blasting. Topsoil shall not be used as blast cover.	Rehabilitation of Quarry and borrow sites after completion of construction.	KWS, Contractor and KenGen.	Immediately after closure.	KES 1,000,000.00

Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
Landslides and soil creep	- Retaining walls; - Benching for cut and fill.	- To avoid rock falls and landslides	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	No additional Cost best on sound Engineering practice.
Archaeological Artefacts and ritual sites	- The Contractor and EPO will conduct additional surveys before the start of construction to determine if any potential archeological sites exist.	- To avoid destruction of archaeological sites	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	No additional Cost best on sound Engineering practice.
Air quality and dust	- 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 minimisation techniques; - The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilised as soon as practically possible; - Dust generating activities shall not be carried (excavation, handling and transport of soils) during times of strong winds. The Resident Engineer shall suspend earthworks operations wherever visible dust is affecting properties adjoining the work site; - Vehicles delivering soil materials shall be covered to reduce spills and windblown dust; - Vehicle speeds shall be limited to minimise the generation of dust on site and on diversion and access roads.	- To reduce pollution of ambient air;	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	KES 20,000 per Quarter
Water utilization	- Management of water usage. - Plan for harvesting and storage of water during rains for use during construction. - Control contamination	- To reduce water wastage during construction	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	No additional cost. Performance is dependent on sound supervision and engineering practices.
Noise and vibration	- Supervise construction traffic. - Maintain construction equipment according to manufacturers' specifications. - Workers in the vicinity of high level noise to wear safety & protective gear. - Noise levels shall be kept within acceptable limits and construction activities shall, where possible, be confined to normal working hours in the residential areas; - Schools and other noise sensitive areas shall be notified at	- To reduce noise pollution.	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	No additional cost. Performance is dependent on sound supervision and engineering practices.

Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
	least 5 days before construction is due to commence in their vicinity. Any excessively noisy activity shall be conducted outside school hours.				

Solid wastes	- Preferably to be located on land already cleared wherever possible. Communities shall be involved in the site location to avoid destruction of any ritual site or any other conflict;
	- Diligence on the part of the Contractors during construction activities will minimise the amount of debris, and also will ensure that debris is disposed of in a sensible manner, at a specified and approved dump.
	- The tender documents should specify the proper disposal of waste during construction.
	- The tender documents should also ensure that the Contractors leaves the site in a clean and sightly condition on completion of works. The Contractors should be required to restore and landscape all areas to the satisfaction of the Project Manager.
	- All solid waste generated during construction and operation should be carefully monitored, collected, stored, and taken out of the park for disposal.
	- Waste generated during the operation of the plant must be segregated at source, inventorised and appropriate methods of disposal determined.
	- The need to be more than 100 meters from watercourses and in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse;
	- The development and rehabilitation of spoil areas shall include the following activities:
	  - Stripping and stockpiling of topsoil;
	  - Removal (to a nominal depth of 500mm) and stockpiling of subsoil;
	  - Placement of spoil material;
	  - Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site;
	  - Placement of excavated subsoil and then topsoil over spoil material;
		- To maintain sound waste management practice.	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	No additional cost. Performance is dependent on sound supervision and engineering practices.

Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
	- Contouring and re-vegetation; - The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.				
Public safety and health	- Monitor solid/ liquid waste disposal and collection facilities; - Place warning signs during construction; - Consult with beneficiary community and health workers.	- To reduce transmission of diseases.	Supervising Engineer and the Contractor.	Daily; Quarterly Reports	No additional cost.
Cultural changes and spread of HIV/AIDS and STD's awareness	- Strengthening cultural organizations and encouraging competitions; - Organizing cultural tournaments; - Creating and increasing the number of vocational training centres; - Respecting important tourist and historical monuments ; - Mobilizing and sensitizing the population on reproductive health and STIs; - Ensuring that the project contributes to the creation of an atmosphere that is conducive to the functioning of all social centres which are in the project zone of influence; - Engaging in communication activities for behaviour change in the area of HIV and AIDS and peaceful coexistence. - Conducting public awareness campaign including provision of condoms to the project team and the public; - The implementers of the project will have to work closely with various HIV/AIDS organisations working in the project zone of influence in order to achieve the best results.	- To reduce transmission of diseases; - To reduce the breakdown of the socio-cultural practice of the natives. - To create awareness of the HIV/AIDS.	Expertise: Ministry of Environment personnel Expertise: Ministry of Health personnel	Quarterly reporting and training.	KES 1,140,000

8.4 Environmental Management during operation phase

The Environmental Management of the project relies on the project proponent KenGen and it is anticipated that KenGen will increase its current Capacity of Environmental section to deal with new development.

Tables 8.2, gives a summary of the Environmental and Social Management Plans during Operation, phases of the project.

Table 8.2 ESMP Olkaria Domes Unit I and II during operation phase

Environmental aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
Impact on Air Quality	Land acquisition and Resettlement	- To avoid exposure of the community living around the project area to poor quality air.	KENGEN	Daily monitoring of air quality	No additional cost
Impact on noise and vibration	Land acquisition and Resettlement	- To avoid exposure of the community living around the project area to poor quality air.	KENGEN	Daily monitoring of noise and vibration	No additional cost
Water	- No landscaping should be allowed from lake water; - Continued monitoring of Lake Levels; - Accidental leakages and bursts to water supply pipelines should be reported and repaired immediately; - Recycling of water as much as possible should be encouraged for example water used for curing of concrete can be used for spraying dusty roads; - Control of the water flows and the water consumption records must be kept and availed to the Supervising Engineers at the end of working day; - All employees should be trained on water usage practices like unnecessary opening taps should be discouraged; - Monitoring of taps and there efficiency should be done regularly; - Curing of concrete should be done in conservancy tank to avoid wastage; - Harvest water during rainfall times. -	- Conservation of Lake Naivasha	KENGEN	Daily monitoring of noise and vibration	No additional cost
Impact on Flora	- A program to assess the possible impacts on the commercial flower farms in the area should be carried out as long term monitoring measure of the impact of hydrogen sulphides to the nearby flower farms. This will be a continuing program and in addition it is recommended that there should be several small "flower gardens", within the site where hydrogen sulphide concentrations are predicted to be greatest; - Vegetation monitoring will be taken seriously, mainly near the power plant, the wells and along the steam pipes and monitoring of potential long-term effects on natural	- To maintain ecosystem with minimal disturbance.	KENGEN	Daily; Quarterly Reports	KES 1,000,000.00 Planting trees within the identified buffer zone.

Environmental aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
	vegetation will be carried out in the area. - The brine and condensate discharges will be deep re-injected in order to avoid potential toxic effects on flora or used for drilling.				
Soil erosion	- The design should considered appropriate terracing due to the nature of topography of the area; - Planting of trees along the gullies and areas susceptible to erosion is proposed; - Re-forestation or re vegetation of areas cleared during construction should be done.	To conserve soil and avoid stripping of top soil	KENGEN	Daily; Quarterly Reports	No additional cost
Impact on Fauna and Hell's Gate National Park wildlife	- Animal numbers, movements and distribution should be monitored. This should be done either independently by KenGen or in liaison with KWS. KenGen's Environmental Unit should actively participate in these studies and should be made aware of the findings of these studies and the management decisions which are made as a result of these findings; - Drains and steam lines should be designed located in ways that do not interfere with animal corridors;(as done for Olkaria II); - The movement in the Park of construction traffic, as well as traffic generated by KenGen activities, should be controlled and no movement should be allowed at night; - Introduction of speed bumps and speed limits enforcement will prevent death of animals as a result of over speeding; - The construction activities should be kept to a minimum to avoid loss of habitat; - Introduction of speed humps to reduce animal deaths from excessive vehicle speeds; - Training of workers regarding park regulations particularly with regard to interaction with animals and littering. KenGen should ensure that poaching does not occur and personnel found interfering with wildlife should be dismissed; - Adequate waste management facilities should be provided and regular monitoring conducted by KenGen for compliance; - Cleared areas should be rehabilitated with indigenous vegetation as soon as possible to restore habitat; - In general, fencing should be kept to a minimum to avoid loss of habitat. Care should be taken to ensure that there are no small animals trapped inside fenced areas;	- To maintain ecosystem with minimal disturbance.	KWS, KENGEN	Annual animal census.	KES 200,000.00

Environmental aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Frequency of monitoring	Cost
	- Vehicle movements within the park should be monitored and time limits enforced; - KenGen in liaison with KWS appoints three senior members of staff based in Olkaria on the Hell's Gate National Park Management Committee. The personnel should be the Geothermal Development Manager, and the other two nominated by him.				
Oil / Hazardous pollution	- Hazardous materials shall not be stored within 2 kilometres of the top water level of public water supply reservoirs; - Hazardous materials shall be stored above flood level; - Areas for the storage of fuel and other flammable materials shall comply with standard fire safety regulations; - Chemicals and fuel shall be stored in storage tanks within a secure compound. All chemicals and fuels shall be stored in accordance with manufacturer's instructions; - Storage areas or secondary containment shall be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them; - The minimum volume for secondary containment shall be 110% of the capacity of the largest tank system, plus 10% of the total capacity of all other separate tanks and containers within the bund wall with closed valves for controlled draining during rains; - Pipe-work carrying product from the tank to facilities outside the containment shall be provided with secondary containment; - Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges shall be located within the containment or provided with own containment. -	- To maintain sound waste management practice.	KENGEN.	Daily; Quarterly Reports	No additional cost. Performance is dependent on sound supervision and environmental practices.
Occupational Health and safety	- Compliance with all standard and legally required health and safety regulations; - Provision of a standard first aid kit at the site office at all times; - Provision of fire-fighting equipment available at the stations; - 'Hot' work activities shall be restricted. - Specific to hydrocarbon spills: - The source of the spill shall be isolated and the spillage contained using sand berms, sandbags, sawdust, absorbent material;	- To maintain sound waste management practice.	KENGEN	Daily; Quarterly Reports	KES 1,000,000 (Purchase of PPE for staff).

	- The area shall be cordoned off and secured; - There will always a supply of absorbent material readily available to absorb/breakdown the spill and the quantity of such materials shall be able to handle a minimum of 200litres of hydrocarbon liquid spill; - The treatment and remediation of areas affected by emergencies shall be undertaken to the reasonable satisfaction of the local authorities.				
Public safety and health	- Monitor solid/ liquid waste disposal and collection facilities; - Place warning signs during construction; - Consult with beneficiary community and health workers.	- To maintain sound waste management practice.	KENGEN	Daily; Quarterly Reports	No additional cost. Performance is dependent on sound supervision and environmental practices.
Socio-economic impacts	- Ensuring that existing utilities are not over strained - KenGen to provide Housing and other amenities for the proposed new work force.	- To maintain sound waste management practice.	KENGEN	Daily; Quarterly Reports	Budget will be included in the Engineering Report.
Cultural changes and spread of HIV/AIDS and STD's awareness	- Strengthening cultural organizations and encouraging competitions; - Organizing cultural tournaments; - Creating and increasing the number of vocational training centres; - Respecting important tourist and historical monuments ; - Mobilizing and sensitizing the population on reproductive health and STIs; - Ensuring that the project contributes to the creation of an atmosphere that is conducive to the functioning of all social centres which are in the project zone of influence; - Engaging in communication activities for behaviour change in the area of HIV and AIDS and peaceful coexistence. - Conducting public awareness campaign including provision of condoms to the project team and the public; - The implementers of the project will have to work closely with various HIV/AIDS organisations working in the project zone of influence in order to achieve the best results.	- To reduce transmission of diseases; - To reduce the breakdown of the socio-cultural practice of the natives. - To create awareness of the HIV/AIDS.	Expertise: Ministry of Environment personnel Expertise: Ministry of Health personnel	Quarterly reporting and training.	KES 1,140,000

8.5 Environmental and Social Monitoring

8.5.1 Monitoring during construction and operation

Not all impacts on the environment can be foreseen during the design and construction phases. For this reason, it is proposed that a component of environmental auditing and monitoring be included in both the construction and operation phases of the Projects. Monitoring and auditing will essentially serve the following purposes:

- Measure the attainment (success or failure) of mitigation measures to ameliorate foreseen impacts;
- To spot unforeseen impacts, especially the ones related to the Park Management;
- Assist in assessing whether the designs and technologies are suitable and satisfactory;
- Facilitate better management of the Power Station.

During the construction phase, it is particularly important to ensure that all the features of the designs as presented in the design reports and drawings are implemented.

During the operation period there is need to ensure that the operating and performance standards of Geothermal Power Station are followed and achieved.

Environmental and social monitoring during construction and operation helps to predict unforeseen environmental and social impacts and allows measures to prevent or avert adverse impacts to be developed or introduced in a timely manner.

Maintenance of infrastructure during construction and operation is also important in contributing towards environmental conservation by for example, preventing soil erosion along the road and its upstream and downstream catchments and ensuring proper drainage of run-off, away from the road.

During the construction and operation phase, monitoring will be undertaken to ensure that proposed mitigation measures for negative impacts and enhancement measures for positive impacts are implemented.

Tables 8.3, gives a summary of the Environmental and Social Monitoring Plans during Operation phase of the project.

Table 8.3 Environmental and Social Monitoring Plan during Construction and operation phase

Land acquisition and resettlement	LAR	LAR	RAP Report	RAP Report	KENGEN
Air	TSP, , H_2S, CO_2, CH_4	Populated areas	Daily	Daily	GRD Environment Unit, KenGen, NEMA, ERC and Contractor.
Wastewater and surface water	TSS, COD, BOD, DO, pH, oil, phenol	Effluent outlets; local drinking water supply sources; important water bodies	Monthly for 3 consecutive days	Monthly	GRD Environment Unit, KenGen, NEMA, ERC and Contractor.
Noise	dB	Sensitive spots	Daily	Daily	GRD Environment Unit, KenGen, NEMA, ERC and Contractor.
Solid waste	Slag, domestic refuse, metallic scraps, sludge	Disposal sites	Quarterly	Daily	GRD Environment Unit, KenGen, NEMA, ERC and Contractor.
Spoils	Visual inspection	Entire site	Daily	Daily	GRD Environment Unit, KenGen, NEMA, ERC and Contractor.
Soil erosion	Visual inspection	Entire site	Biweekly	Biannual	GRD Environment Unit, KenGen, NEMA, ERC and Contractor.
Public safety	Signs, culverts, public safety records	Entire site	Monthly	Monthly R	GRD Environment Unit, KenGen, NEMA, ERC and Contractor, DOSH
Hells Gate National Park	Wildlife species, landscape	Within nature reserves and scenic areas	Monthly	Annual Census.	GRD Environment Unit, KenGen, NEMA and KWS
Induced socio-economic benefits	Increased attractiveness of the area	Naivasha District Growth Plans.	—	Year 2, 5 and 10 of operation	KenGen, District Statiscal Office.
Community participation and performance of CSR	Number of participants	Project communities	Semi-annually	Annual	KENGEN

BOD = Biochemical oxygen demand, CO = Carbon monoxide, COD = chemical oxygen demand, dB = decibel, DO= Dissolved oxygen, LAR = land acquisition and resettlement, pH measure of acidity/alkalinity, TSP = Total suspended particles, TSS = Total suspended solids.

8.6 Training and Capacity Building

Successful implementation of the ESMP will require coordination of all stakeholders. Capacity of the stakeholders during the entire project period will need to be reinforced through regular short and tailor made training courses and seminars. Basing on the knowledge gaps identified during the consultations and the needs identified in the Environmental and Social Management Plan important areas are:

- Air and Noise management;
- Water and wastewater management;
- Occupational Health and Safety;
- Hell's Gate National Park management

Training of the staff at the Power Station can be based on modules aimed at the following:

- Developing awareness of the need to consider environmental issues during construction, operation and maintenance of the Power Plant;
- Creating awareness and understanding of the environmental legal framework pertaining to geothermal power generation projects;
- Developing skills in the following areas:

    i) Environmental Auditing;
    ii) Environmental monitoring;
    iii) Incorporation of mitigation measures at all stages of the project;
    iv) Reviewing ESIA reports and incorporating measures into the decision-making process.

9 CONCLUSION

The proposed project has great economic significance to the country, given the increasing demand for electrical power.

The World Bank and the United States Environmental Protection Agency regard geothermal energy as "clean energy", for the following reasons;

- Emissions associated with generating electricity from geothermal technologies are negligible because no fuels are combusted. Geothermal facilities have significantly lower carbon dioxide emissions than fossil fuels.
- Geothermal power plants usually re-inject brine (spent geothermal fluids), eliminating impacts of pollution of surface and ground water resources.
- Geothermal technologies do not produce a substantial amount of solid waste while creating electricity.
- Geothermal power plants typically require the use of less land than fossil fuel power plants.
- Geothermal plants can co-exist successfully with other land uses.

Furthermore, geothermal energy is considered to be renewable because the reservoirs are continuously being replenished. It is also sustainable these sources will replenish naturally into the future and faster than they can be used.

The study has also established a number of negative environmental consequences that the project activities are likely to induce. The negative impacts changes in Air and noise quality, Land take and involuntary resettlement, Interference with the Hell's Gate Park Operations, and use of water from already declining Lake Naivasha. However, it will be possible to mitigate these negative impacts by implementing the recommended environmental management and monitoring plans.

The Project should comply with all local laws and regulations, which seek to ensure that the construction work does not adversely affect the environment and social community resources. Any adverse impacts that arise will be mitigated on an on-going basis. These shall be included in an updated ESMP.

In conclusion, therefore, provided the recommended mitigation and environmental and social management measures including the Resettlement Action Plan are effectively implemented during the construction and operation phases of the proposed station at Olkaria IV, the anticipated environmental and social impacts will, for the most part, have low significance.

The Resettlement Action Plan for the affected community has been prepared as separate Report.

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APPENDICES

Appendix 1 List of Plant and Animal Species in Olkaria Area

APPENDIX 1

APPENDIX 1A: List of plant species found at Hells Gate National Park

ACANTHACEA
Moechma debile (Forssk.) Nees
Justicia sp 'A' of U.K.W.F.
Hypoestes arisata (Vahl) Roem. & Schult.
Thunbergia verticillaris Sims
Hypoestes veticillaris (Linn.f.)
Roem, & Schult
Dyschoriste radicans Nees

ADIANTACEA
Pellaea calomelanos (Swartz) Link
P. quadripinnata (Forssk.) Prantl
P. adiantoides (Wild.) J. Sm
P. viridis (Forssk.) Prantl
Actiniopteris radiate (Swartz) Link

AGAVACEAE
Sansevieria ehrenbergii Bak.
S. intermedia N.E. Br.

AIZOACEA
Hypertelis bowkeriana Sond.
Delosperma nakurense (Engl.) Herre
Sesuvium sp.

AMARANTHACEAE
Aerva lanata (L.) Juss.
Cythula cylindrical Moq.
Amarathus hybridus L.
Achyranthes aspera L. va. Pubescens (Moq.)
C.C. Townsend
Gomphrena celosioides Mart.

ANACARDIACEAE
Rhus natalensis Krausss
Rhus vulgaris Miekle

APOCYNACEAE
Carrisa edulis (Forssk.(Vahl

Acokanthera schimperi (DC.) Benth
Schefflera volkensii (Harms) Harms
Cussonia spicata
C. arboea

ASCLEPAIDACEA
Sarcistenna vunubake (L.) R. Br.

GLEICHENIACEAE
Dicranopteris linearis (Burm.f.)

ASPLENIACEAE
Asplenium aethiopicum (Burm. f.)
Becherer

BORAGINACEA
Asplenium steudneri Vatke ssp
Bullatum Verdc.

CEASALPINIACEAE
Cassia didymobotrya Fres.
C. grantii Oliv.
C. mimosoides L.

CAPPARACEAE
Capparis tomentosa L.
Maerua sp.
Cleome monophylla L.

CAMPANULACEAE
Wahlenbergia abyssinica (A. Rich.) Thulin
W. virgata Engl.

CARYOPHYLLACEAE
Pollichia campestris Ait
Silene burchellii DC

CARYPHYLLACEAE
Pollichia campestris Ait.
Silene burchellii DC.

CHENOPODIACEAE
Chenopodium opulifolium Koch. & Ziz.
C carinatum R. Br.

C. pumilio R. Br.

COMMELINACEAE
Commelina benghalensis L.
C. imberbis Hassk.
C. africana L.
C. purpurea Rendle
Aneilema sp.

COMPOSITAE
Tarchonanthus camphorates L.
Psiadia punctulata (DC.) Vatcke
Tagetes minuta L.
Bidens pilosa L.
Osteospermum vaillantii (Decne) T. Norl.
Aspilia mossambicensis (Oliv.) Wild
Bothriocline fusca (S. Moore) M. Gilbert
Notonia hildebrandtii Vatcke
Felicia abyssinica A. Rich. (Thunb.) Nees
F. municata
Carduus nyassanus (S. Moore) R.E. Fries
Helichrysum cymosum
H. globesum Sch. Bip.
H. glumaceum DC.
H. odoratissimum (L.) Less.
Bidens ruepellii (Sch. Bip.) Sherff
Galinsoga parviflora Cav.
G. ciliata (Rafn.) Blake
Artemisia afra Willd.
Conyza newii Oliv. & Hiern
Crassocephalum mannii (hook. f.) Milne-Redh.
C. crepidioides (Benth.) S. Moore
Pluchea bequaertii Robyns
Vernonia lasiopus O. Hoffmn.
Hirpicium diffusum (O. Hoffm.) Roess.-
Gutenbergia cordifolia Oliver
Senecio handensis S. Moore (syn. S. petitianus)

CRASSULACEAE
Crassula coleae Bak.
C.alba Forssk.
C. pentandra (Edgerworth) Schonl.-
C. alsinoides (Hook. f.) Engl.
C. volkensii Engl.

Cotyledon barbeyi Schweinf.
Kalanchoe densiflora Rolfe
K. glaucescens Britten
K. lanceolata (Forssk.) Pers.-
Umbilicus botryoides A. Rich

CRUCIFERAE
Rorippa cryptantha (A. Rich.) Rob. et Boutique)
R. micrantha (Roth) Jonsell
Farsetia undulicarpa Jonsell
F. stenoptera Hochst. ssp. stenoptera
Crambe abysssinica R.E. Fries

CUCURBITACEAE
Cucumis sp.
Kedrostis foetidissima (Jacq.) Cogn.
Zehneria scabra (Lin. f.) Sond.

CUPPRESSACEAE
Juniperus procera Endl.

CYPERACEAE
Fimbristylis exilis (H.B.K.) Roem. & Schult.
F. hispidula (Vahl) Kunth
Bulbostylis coleotricha (A. Rich.) C.B. Cl.
Mariscus amauropus (Stendel) Curf.
Cyperus obtusiflorus Vahl
C. rigidifolius Steudel
C. laevigatus
C. immensus C.B. Cl.

DAVALLACEAE
Oleandra distincta Kunze

EBENACEAE
Euclea divinorum Hiern

ERICACEAE
Agauria salicifolia (Lam.) Oliv.
Erica arborea L.

EUPHORBIACEAE
Euphorbia inaequilatera Sond.
E. kibwezensis

Ricinus communis L.
Phyllanthus rotundifolius Willd.

FLACOURTIACEAE
Dovyalis abyssinica (A. Rich.) Warb.

GERANIACEAE
Geranium aculeolatum Oliv.
G. ocellatum Cambess.
Monsonia Angustifolia A. Rich.
Pelargonium allchemilloides (L.) Ait.

GLEICHENIACEAE
Gleichenia linearis (Burm.) C.B. Cl.
Dicranopteris linearis (Burm. f.) Underw.-

GRAMINEAE
Rhynchelytrum repens (Willd.) C.E. Hubbard
Setaria pumila (Poir.) Roem. & Schult.
Panicum maximum Jacq.
Sporobolus fimbriatus (Trin.) Dur. & Sch.
Eragrostis cilianesis (All.) F.T. Hubboard
Brachiaria leersioides (Hochst.) Stapf
Pennisetum squamulatum Fresen
P. Procerum (Stapf) W.D. Clayton
P. clandestinum Chiov.
Cynodon dactylon (L.) Pers.
C. nlemfuensis Vanderyst var. nlemfuensis
C. plectostachyus (K. Schum.) Pilg.
Chloris gayana Kunth
Harpachne schimperi A. Rich.
Hyparrhenia hirta (L.) stapf
H. papillipes (A. rich.) Stapf.
Themeda triandra Forssk.
Tragus berteronianus Schult.
Digitaria abyssinica (A. Rich.) Stapf-
Aristida keniensis Henr.
A. congesta Roem. & Schult.
A. adoenisis Hochst.
A. mutabilis Trin. & Rupr.
Cymbopogon nardus (L.) Rendle
Sporobolus africanus (Poir.) Robyns & Tourney
S. macranthelus Chiov.
Setaria sphacelata (Schummach.) Moss var. aurea

(a. Br.) W.D. Clayton
Eragrostis racemosa (Thunb.) Steud.
E. tenuifolia (A. Rich.) Steud.
E. tenuifolia (A. Rich.) Steud.
E. olivacea K. Schum.
E. braunii Schweinf.
Dactyloctenium aegyptium (L.) Wild.
Paspalum scrobiculatum L.
Microchloa kunthii Desv.
Heteropogon contortus (L.) Roem. & Schult.

HYPERICACEAE
Hypericum revolutum Vahl

IRIDACEAE
Aristea angolensis Bak.
Gladiolus newii Baker ssp. newii

LABIATAE
Tetradenia riparia (Hochst.) Codd
Becium obovatum (E. Mey.) N.E. Br.
Ocimum suave Willd.
Leucas glabrata (Vahl) R. Br.
L. pratensis Vatke
L. neuflizeana Courb.-
Plectranthus marrubioides R.H. Willemse
P. zatarhendi (Forssk.) E.A. Bruce
P. caninus Roth
P. pubescens Bak.
Leontis mollissima Guerke
L. nepetifolia R. Br.
Satureja biflora (D. Don) Benth.
Iboza multiflora (Benth.) E.A. Bruce
Fuerstia africana T.C.E.Fr.

LILIACEAE
Asparagus buchananii Bak.
A. africanus Lam.
Bulbine abyssinica R. Rich.
Kniphofia thomsonii Bak.
Aloe kedongensis Reynl.
A. myriacantha (Harv.) R. & S.
A. secundiflora Engl.
Gloriosa superba L.

LINACEAE
Linum volkensii Engl.

LOBELIACEAE
Lobelia holstii Engl.

LOGANIACEAE
Buddleia polystachya Fresen.

LORANTHACEAE
Englerina heckmanniana (Engl.) Balle
Odontella fischeri Engl.
Tapinanthus zizyphifolius (Engl.) Danser

LYCOPODIACEAE
Lycopodium cernuum L.
MALVACEAE
Abutilon mauritianum (Jacq.) Medic.
A. longiscupe Hochst.
Hibiscus fuscus Garcke
H. flavifolius Ulbr.
H. aponeurus Sprague & Hutch.
Sida tenuicarpa Vollensen
S. cuneifolia Roxb.
S. rhombifolia L.
S. schimperiana A. Rich.-
S. ovata Forssk.
Pavonia patens (Andr.) Chiov.

MELASTOMATACEAE
Dissotis irvingiana Hook. var. alperstis
(Taub.) A.R. Fernandes
Forma alpestris
D. senegambiensis (Guill. & Perr.) Tiana var.
senegambiensis
S. senegambiensis (Guill. & Perr) Triana var.
alpestris (Taub.) A. & R. Fernandes

MELIACEAE
Ekebergia capensis Sparrm.

MIMOSACEAE
Acacia seyal Del. var. seyal

A. gerrardii Benth. var. gerrardii
A. drepanolobium Sjostedt
A. xanthophloea Benth.

MORACEAE
Ficus ingens Miq.
F. pretoriae B. Davy
F. thonningii Guerke

MYRICACEAE
Myrica salicifolia A. Rich.

MYRSINACEAE
Myrsine africana L.

OLEACEAE
Olea europaea L. ssp.
africana (Mill.) S.P. Green

OPHIOGLOSACEAE
Ophioglossum rubellum A. Br.

ORCHIDACEAE
Angraecum humile Summer
Ansellia gigantean Reichb. f. var. nilotica
Cyrtorchis arcuata (Lindl.) Schltr.
Pleroglossaspis ruwenzoriensis Rolfe

OXALIDACEAE
Oxalis obliquifolia A. Rich.

PAPIOLIONACEAE
Crotalaria sp. aff. C. chrysochlora Harms
C. dewildermaniana Wilczek
C. deserticola Bak. f.
C. agatiflora Schweinf. ssp. engleri (Taub.) Polhil
C. spinosa Benth.
C. incana L. ssp. purpurescens (Lam.)
Milne-Redh.
C. agatiflora Schweinf. ssp. agatiflora
C. chrysochlora Harms
Indigofera tanganyikensis Bak. f. var.
strigulosior Gillett
I. ambelacensis Schweinf.

I. masaiensis Gillett
I. bogdanii Gillett
I. arrecta A. Rich.
Zornia pratensis Milne-Redh.
Z. setosa Bak. f. ssp. obovata (Bak.f.)
J. Leon & Milne-Redh.
Argyrolobium rupestre (E. Mey.) Walp.
Lotus becquetii Boutique
L. goetzii Harms
Macrotyloma axillare (E. Mey.) Verdc.
Tephrosia emeroides A. Rich.
T. linearis (Willd.) Pers.

PITTOSPORACEAE
Pittosporum viridiflorum Sims

PHYTOLACCACEAE
Phytolacca dodecandra L'Herit.
P. octandra L.

POLYPODIACEAE
Pleopetis macrocarpa (Willd.) Kaulf.

POLYGALACEAE
Polygala abyssinica R. Br.
P. amboniensis Gurke
P. sphenopterea Fresen.

POLYGONACEAE
Rumex usambarensis (Damer) Dammer
Polygonum senegalense Meisn.
Oxygonum sinuatum (Meisn.) Dammer

PROTEACEAE
Protea gaguedi J.F. Gmel.

RHAMNACEAE
Scutia myrtina (Burm. f.) Kurz.

RUBIACEAE
Galium aparinoides Forssk.
G. spurium L.
Kohautia caespitose Schnizl. var.
amaniensis (K. Krause) Brem.

Pentas zanzibarica (Kl.) Vatke
P. parvifolia Hiern
Oldenlandia corymbosa L.
O. scopulorum Bullock
O. wiedemannii K. Schum.
Rubia cordifloia L.
Pentanisia ouranogyne S. Moore
canthium phyllanthoideum Baill.

RUTACEAE
Teclea simplicifolia (Engl.) Verdoon

SANTALACEAE
Osyris abyssinica A. Rich.

SAPINDACEAE
Allophylus abyssinicus (Hochst.) Radlk.
Dodonea angustifolia L.f.
D. viscose L. Jacq.

SCROPHULARIACEAE
Alectra sessiliflora (Vahl.) Kunth
var. senegalensis (Benth.) Hepper
Miscpates orontium (L.) Rafin
Cycnium volkensii Engl.
C. tubulosum (L.f.) Engl. ssp.
montanum (N.E.Br.) O.J. Hansen
(syn. Rhamphicarpa Montana)
Striga linearifolia (Schum. & Thonn.) Hepper
Hebenstretia dentate L.
Pseudosopubia hildebranditii (Vatke) Engl.
Striga asiatica (L.) Kuntze
Cycniopsis obtusifolia Skan
Craterostigma pumilum Hochst.

TILIACEAE
Grewia similis K. Schum.

TYPHACEAE
Typha latifolia L.
T. domingensis Pers.

ULMACEAE
Trema guineensis (Schm. & Thonn.) Ficalho

SOLANACEAE
Solanum incanum L.
S. mauense Bitter
S. nigrum L.
Cestrum aurantiacum Lindl.
Datura stramonium L.
Nicotiana glauca R. Grah.
Withania somnifera (L.) Dunal

UMBELLIFERAE
Ferula communis L.
Heteromorpha trifoliolata (Wendl.) Eckl,. & Zeyh

VERBENACEAE
Clerodendrum myricoides Vatke
Lippia ukambensis Vatke
L. javanica (Burm.f.) Spreng
Lantana camara L.

VISCACEAE
Viscum tuberculatum A. Rich.

VITACEAE
Cyphostemma nierense (Th. Fr. jr.) Desc.

ZYGOPHYLLACEAE
Tribulus terrestris L.

APPENDIX 1B List of Mammals of the Project Area

Aardvark	Orycteropus afer
Buffalo	Syncerus caffer
Dik-dik	Rhynchotragus Kirkii
Eland	Taurotragus oryx
Giraffe	Giraffa cemelopardalis
Grants gazelle	Gazella grantii
Hare	Lepus spp
Hedgehog	Erinaceus albiventris
Impala	Apyceros melampus
Jackal	Canis spp
Klipspringer	Oreotragus oreotragus
Kongoni	Alcephalus buselaphus coki
Leopard	Panthera pardus
Lior	Panthera leo
Mole rat	Tachyorectes plendens
Olive baboon	Papio anubis
Rat-like rodents -	
Reedbuck	Rendunca redunca
Rock hyrax	Heterophyrax brucei
Spring hare	Pedetes capensis
Squ rrel	Finisciurus spp
Steinbuck	Rhaphicerus campestris
Thompsons gazelle	Gazella thomsonii
Warthog	Phacochoerus aethiopicus
Waterbuck	Kobus defessa
Zebra	Equus burchelli

APPENDIX 1C List Birds of the Project Area

Common Name	Scientific Name
Abyssinian Scimitarbill	Phoeniculus minor
African Fish Eagle	Haliaeetus vocifer
African Hawk Eagle	Hieraaetus spilogaster
African Hobby	Falco cuvieri
African Hoopoe	Upupa epops
African Pied Wagtail	Moticilla aguimp
African Rock Martin	Hirundo fuligula
Anteater Chat	Myrmecocichla aethiops
Auger Buzzard	Buteo rufofuscus
Batleur	Terathopius ecaudatus
Bearded Woodpecker	Thripias namaquus
Black-backed puffback	Dryoscopus cubla
Black-breasted Apalis	Apalis flavida
Black-headed Oriole	Oriolus larvatus
Black-lored Babbler	Turdoides melanops
Blue-eared Glossy Starling	Lamprotornis chalybaeus
Brimstone Canary	Serinus sulphuratus
Bronze Sunbird	Nectarinia kilimensis
Brown Woodland Warbler	Phylloscopus umbrovirens
Brown-headed Tchagra	Tchagra australia
Buff-bellied Warbler	Phylloclais pulchella
Chin-spot Flycatcher	Batis molitor
Cinnamon-breasted Rock Bunting	Emberiza tahapisi
Cocqui Francolin	Francolinus coqui
Common Sandpiper	Tringa hypoleucos
Common Waxbill	Estrilda astrild
Crimson-rumped Waxbill	Estrilda rhodopyga
Crombec	Sylvietta brachyrura
Crowned Plover	Vanelus coronatus
Didric Cuckoo	Chrysococcyx caprius
Diongo	Dicurus adsimilis
Dusky Flycatcher	Alsenax adustus
Egyptian Vulture	Neophron percnopterus
European Swallow	Hirundo rustica
Fiscal Shrike	Lanius collaris
Fox Kestrel	Falco alopex
Golden-breasted Bunting	Emeriza flaviventris
Gold-tailed Woodpecker	Campethera cailliautii
Grey Flycatcher	Bradornis microrhynchus

Grey Wagtail	Motacilla clara
Grey-backed Camaroptera	Camaroptera brevicaudata
Grey-backed Fiscal Shrike	Lanius excubitorius
Grey-headed Sparrow	Passer griseus
Grey-rumped Swallow	Hirundo griseopyga
Harrier Hawk	Polybariodes radiatus
Helmeted Guinea Fowl	Numida melaegris
Hildebrandt's Francolin	Francolinus hildebranti
Horus Swift	Apus hours
Hunter's Sunbird	Nectarinia hunteri
Klaas's Cuckoo	Chrysococcyx klaas
Kori Bustard	Ardeotis kori
Lammergeyer	Gypaetus barbatus
Lanner	Falco biarmicus
Laughing Dove	Streptopelia senegalensis
Little Swift	Apus affinis
Long-crested Eagle	Lophaetus occipitalis
Mottled Swift	Apus aequatorialis
Nightjar sp.	Caprimulgus sp.
Nubian Vulture	Torgos tracheliotus
Nyanza Swift	Apus niansae
Ostrich	Struthio cemelus
Peregrine	Falco peregrinus
Pin-tailed Whydah	Vidua macroura)
Plain-backed pipit	Anthus leucophrys
Purple Grenadier	Uraeginthus ianthinogaster
Rattling Cisticola	Cisticola chiniana
Red-billed Oxpecker	Buphagus erythrorhynchus
Red-chested Cuckoo	Cuculus solitarius
Red-eyed Dove	Streptopelia semitorquata
Red-faced Apalis	Apalis rufifrons
Red-rumped Swallow	Hirundo daurica
Redwing Bush Lark	Mirafra hypermetra
Redwing Starling	Onychognathus morio
Richard's Pipit	Anthus novaeseelandiae
Richenow's Weaver	Ploceus baglafeht
Ring-necked Dove	Streptopelia capicola
Robin Chat	Cossypha caffra
Rufous Sparrow	Passer motitensis
Rufus-naped Lark	Mirafra africana
Rupell's Vulture	Gyps ruppellii
Scaly Francolin	Francolinus squamatus
Scarlet-chested Sunbird	Necterinia senegalensis
Schalow's Wheatear	Oenanthe lugubris

Secretary Bird	Saggitarius serpentarius
Speckled Mousebird	Colius striatus
Speckled Pigeon	Columba guinea
Spotted Eagle Owl	Bubo africanus
Stone Chat	Saxicola torquata
Superb Starling	Spreo superbus
Tawny Eagle	Aquila rapax
Tawny-flanked Prinia	Prinia sublava
Temminck's Courser	Cursorius temminckii
Tropical Boubou	Laniarius ferruineus
Variable Sunbird	Necterinia venusta
Verreaux's Eagle	Aquila verrauxii
Vitteline Masked Weaver	Ploceus velatus
Whalberg's Eagle	Aquila wahlbergi
White Pelican	Pelicanus onocratalus
White-backed Vulture	Gyps bengalensis
White-browed Coucal	Centropus superciliosus
White-browed Robin Chat	Coccypha heuglin)
White-eyed Slaty Flycatcher	Dioptornis fischeri
White-fronted Bee Eater	Merops bullockoides
Willow Warbler	Phylloscopus trochilus
Wood Warbler	Phylloscopus sibilatrix
Yellow Bishop	Euplectes capensis
Yellow-rumped Seed Eater	Serinus atrogularis
Yellow-vented Bulbul	Pycnonotus barbatus

Appendix 2 KENGEN'S Quality Assurance Documentation

BUREAU VERITAS
Certification

Certification
Awarded to

KenGen

KENYA ELECTRICITY GENERATING COMPANY LIMITED (KENGEN)

P.O BOX 47936-00100
NAIROBI, KENYA

Bureau Veritas Certification certify that the Management System of the
Above organisation has been audited and found to be in accordance
With the requirements of the management system standards detailed below

Standards

ISO 14001:2004

Scope of supply

GENERATION OF ELECTRICITY USING THERMAL, GEOTHERMAL, HYDRO AND WIND ENERGY

Original Approval Date: **22ND JULY 2009**

Subject to the continued satisfactory operation of the organisation's Management System,

This certificate is valid until: **21ST JULY 2012**

To check this certificate validity please call: **(+254 20 4450560)**
Further clarifications regarding the scope of this certificate and the applicability of the Management System requirements may be obtained by consulting the organisation.

Date: **22ND JULY 2009**

Certificate Number **IND95078**

MANAGING OFFICE ADDRESS: Bureau Veritas Certification (Kenya) Ltd, [illegible] Nairobi, Kenya
CERTIFICATION AUTHORITY: [illegible]

BUREAU VERITAS
Certification

BUREAU VERITAS 1828

Certification

Awarded to

KenGen

KENYA ELECTRICITY GENERATING COMPANY LIMITED
(KENGEN)
P.O BOX 47936-00100
NAIROBI, KENYA

Bureau Veritas Certification certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standards detailed below

Standards

ISO 9001:2008

Scope of supply

GENERATION OF ELECTRICITY USING THERMAL, GEOTHERMAL, HYDRO AND WIND ENERGY

PERMITTED EXCLUSION (S)
7.3 – Product design & development

Original Approval Date: **22ND JULY 2009**

Subject to the continued satisfactory operation of the organisation's Management System,

This certificate is valid until: **21ST JULY 2012**

To check this certificate validity please call: **(+254 20 4450560)**
Further clarifications regarding the scope of this certificate and the applicability of the Management System requirements may be obtained by consulting the organisation.

Date **22ND JULY 2008**

ANAB

Certificate Number: **IND95079**

MANAGING OFFICE ADDRESS: Bureau Veritas Certification (Kenya) Ltd, Box [illegible] Nairobi, Kenya.
CERTIFICATION AUTHORITY: [illegible] INDIA, Bureau Veritas Certification, [illegible]

KenGen
Kenya Electricity
Generating Company Ltd.

CORPORATE ENVIRONMENTAL POLICY STATEMENT

KenGen is fully committed to long-term environmentally sustainable development that is consistent with National and International Standards in the generation of safe and reliable electric energy.

To achieve this commitment, KenGen shall:

- Maintain and continually improve its Environmental Management System, based on the ISO 14001 Standard, prevent pollution and mitigate environmental impacts resulting from its operations and related activities.
- Comply with or exceed the requirements of all applicable environmental laws, regulations and permit conditions.
- Conserve energy generation resources such as water, fuel oil, coal, steam, and biomass through application of state of the art technology and methods.
- Set and continually evaluate environmental objectives, performance metrics and targets.
- Ensure its employees receive training on the EMS, key environmental impacts and responsibilities associated with their individual jobs.
- Participate and promote projects and programs that contribute to reduction of Greenhouse Gas Emissions such as the Clean Development Mechanism (CDM) and therefore contribute to the earth's sustainability.
- Communicate its Environmental Policy and Performance to employees and other stakeholders.

Signed

Date: 3rd June 2009

MANAGING DIRECTOR & C.E.O

Appendix 3 Copies of Minutes of Public Consultation meetings and Public Consultations Forms

MEETING AT THE MAASAI CULTURAL CENTRE

MINUTES FOR THE VILLAGE MEETING HELD AT CULTURAL CENTRE ON 28 SEPTEMBER 2009

AGENDA: PUBLIC CONSULTATIONS AND DISCUSSIONS ON THE OLKARIA I UNIT 4 AND 5 AND OLKARIA IV POWER STATION PROJECTS.

Minute 28/1: Preliminaries

The meeting began with a word of prayer at 12 noon.

Minute 28/2: Chairman's Introductory Note

The Chairman, Mr. Orkoskos, explained that people are present after coming back from cattle herding. They would therefore like to know the project description and requirements in detail.

Minute 28/2: Introduction of the Proposed Project by the Project Environmentalist

- G Owuor explained the project description in summary, showing the spatial extent of the proposed project area for Olkaria IV power station. He also explained the need for expansion of geothermal power development based on the country's need for electricity in the face of current power rationing.
- He further explained that there are people living within the proposed project area and due to the expected safety threat to people living in the project area, there would be need for resettlement, should the project go forward.
- The community was informed that an Environmental and Social Impact Assessment Study was being conducted to identify the expected positive and negative impacts of the proposed project
- He clarified that the resettlement would be done in a procedural and humane manner and not through evictions and invited the community members to give their comments and opinions on the proposed project.

Minute 28/4: Comments, questions and issues raised by community members

Village Chairman: Mr. Orkoskos

- Due to the big number of attendants, the chairman requested that four men and four women to speak for the people after which any matters arising will be discussed. As the chairman he had comments to give as well.
- He stated that historically, the Maasai occupied a large part of the country but have been marginalized over time. Meetings have been held in the past but people were not given the minutes. He also clarified that the project found the community and not the other way.
- Mr Orkoskos stated that his family was moved from the land on which Olkaria I is located.

Inquiry by M Kenya:

- Who exactly was coming to develop geothermal power, is it Ministry of Wildlife, Geothermal Development Company (GDC) or Kengen?
- Why not simply compensate them instead of having to re-locate them? For example, compensation for construction wayleaves for the pipes.

Answer by G Owuor

- G Owuor clarified that in the past ESIAs were not conducted as this began with the enactment of the Environmental Management and Co-ordination Act (EMCA) in 1999. In addition, procedures for conduct of resettlement have been changing over time to allow for more humane procedures in resettlement.
- On the need for moving now after all these years as KENGEN neighbours, the environmentalist explained that there will be new impacts from Olkaria IV and Units 4 and 5 of Olkaria I leading to increased cumulative environmental impacts from Olkaria I, II, III and Iv.

Inquiry by M Kenya

Are there any other organizations involved in the project?

Answer by G Owuor

G Owuor answered that as KENGEN and the Government of Kenya may not be able to finance a project of this magnitude, international financing corporations would end up funding the project. Examples of these corporations include World Bank, International Finance Corporation, Japan International Co-ordination Agency and African Development Bank.

Inquiry by M Kenya

There was a meeting for village elders in Simba Lodge and the agenda for the meeting was not provided beforehand. He also heard that a surveyor was at the village. He however feels that an information session should have been done for each villager before the census was done. Secondly as there was no letter to the village elder, some villagers felt that there could have been a sinister agenda behind the whole exercise.

Answer by G Owuor

G Owuor apologized for not having written a letter to the village elder, however, the consultants had contacted the District Commissioner to organize for the meeting who in turn contacted the village elders so as to follow the civil administration organization. The consultants had met with the DC and the village elders prior to the census so as to enable the community leaders to communicate the purpose of the exercise to the community.

Inquiry by unidentified villager

Why was the study ongoing yet the project had already started?

Answer by G Owuor

G Owuor explained that what was going on was the exploration for Olkaria IV. The current study was for the power generation station.

Inquiry by M Kenya

If there is no land for people to be resettled what will happen? How can NEMA help them and why is KENGEN telling them to move?

Answer by G Owuor

The study is meant to identify all these constraints and find solutions.

Inquiry by unidentified villager

What is the extent of the project impacts? Will it pass through Narasha, Cultural Centre, Olo Mayana and Olo Munyak? As staff working in Olkaria power stations are fine, why should the locals move?

Answer by G Owuor

G Owuor answered thay the extent for the study covers the areas with the wells and the results of the noise and air modeling studies. Hence the inclusion of all these villages.

As for KENGEN staff safety, KENGEN has an Occupational Health and Safety Policy, facilities and procedures for the safety of staff. They however do not have the resources to provide the same for the communities.

Comment by M Ole Senjo

He has lived in the project area for 69 years. The power generation companies and the park found them living in the project area and they are yet to have any negative health impacts from living in the vicinity of the project area.

Comment by G Saidenya

The community has lived in the project area all these years and they have titles for the land. However, people had been forcefully evicted in the past. The area they were pushed to right now (Cultural Centre) is prone to flooding. The power companies have also not built them health centres, roads or given them access to health centres. He feels that the power companies are waiting for them to die out thus leaving the land empty for the power companies to move in.

Cultural centre was established to provide an income and to maintain the maasai culture. KENGEN does not employ people from this community even when they are educated.

Kedong is a desert thus not a good resettlement option. They would not like to be resettled in areas that are not productive in terms of agriculture and pasture. Examples of good areas are Ndabibi, Moi Ndabibi and Kongoni.

Mai Mahiu is not a good option for rettlement as the community were psychologically affected the last time they were there when they were shot at by helicopters some fatally, to chase them out of the area.

Comment by Z Ngamusi

People feel that the decision has already been made yet they do not want to move. The community is yet to see any benefits from the current project. Moreover, he was one of the people who were "conned" in 1975 during the gazettement of Hells Gate National Park. They had been told to expect benefits from the park such as reduction of livestock diseases from their interactions with wild animals. He is yet to see the benefits of the park. Despite being shot at in the past, he will not agree to move.

Comment by Pastor Senjo

People have been counted before but they were not compensated. The community therefore has no faith in the resettlement process. The distances between Olkaria and the settlements differ. He wonders why the people in cultural centre and Narasha were counted yet those in Oserian and Kamere were not. They therefore feel as though the process is targeting the Maasai community to move them from their land.

Comment by G Saidenya

The community should be given a certain amount from KENGEN income (profit shares). The community does not get any scholarships from KENGEN. For example, the Maasai community in Magadi benefits from the company.

Each village has 12 elders and they should be invited to any future meetings. Members from other areas (manyattas) were also present for the meeting

World Bank has allocated money before but none of it has ever been given to the community for schools, hospitals or roads. KENGEN also needs to compensate other people such as people in Oserian, Kamere and other areas.

Minute 28/5: Closing

There being no other business the meeting closed at 2pm.

MEETING AT MOI NDABI

MEETING AT THE CHIEF'S OFFICE IN NDABIBI

MINUTES FOR THE VILLAGE MEETING HELD AT THE CHIEF'S OFFICE-NDABIBI LOCATION ON 29 SEPTEMBER 2009

AGENDA: PUBLIC CONSULTATIONS AND DISCUSSIONS ON THE OLKARIA I UNIT 4 AND 5 AND OLKARIA IV POWER STATION PROJECTS.

Minute 29/1: Preliminaries

The Chief introduced the consultation team to the villagers. The consultation exercise was part of the agenda of the baraza.

Minute 29/2: Introduction by G Owuor

The environmentalist presented a summary of the project description including the expected benefits. He explained that the purpose of the meeting was to get the comments and concerns of the residents of Ndabibi as neighbours of the proposed project. He further explained that the study was on environmental impacts thus he elaborated that environmental issues touched on air, water and soil quality, human health, effects on livestock and wildlife.

Minute 29/3: Issues and Comments raised by Ndabibi residents

- Hassan G commented that he had lived in Ndabibi for 40 years and was yet to see any negative impacts. He would however like to see the youth in the area getting jobs which would be a positive impact.
- A villager (who did not state his name) explained that he has noticed that livestock miscarry their young before the end of the gestation period. On inquiring from the old men in the village, he was informed that this started occurring when KENGEN became operational. The iron sheet roofing also doesn't last as long as it used to.
- Milka Wakonyo stated that the steam affects children and sick people especially those with respiratory problems.
- Another villager stated that they have been experiencing earthquakes and faulting since 2003. The community therefore requested that KENGEN sends a geologist to take a look at the faults and advise them accordingly. ADC had given the people farms but they had to move when the crack started forming. It gets worse with the El Niño rains. There is also a rotten smell that reaches the village during the rain season during which children get colds and people get sick.
- People also used to plant oranges and cypress but nowadays they do not do so well. The community therefore wonders if it is simply because of change in weather patterns or whether the fumes from Olkaria have anything to do with the changes.
- Another villager thanked KENGEN for power as previously the village was in darkness. He however asked when the distribution lines would be expanded to all the homesteads in Ndabibi. He would like for youth in Ndabibi to get jobs in the proposed project.
- John K stated that they were not against the project. As KENGEN has tree seedlings, a good CSR programme would entail KENGEN providing the community with tree seedlings for the community members to plant in their homesteads and help improve the air quality.
- Milka Wakonyo also stated that other CSR programmes would include development of water projects, construction of a new primary and secondary school and initiatives to help mentally handicapped children / members of the community. Currently people collect water from steam jets which is not always adequate.
- The Chief reported that he had received a report that some village elders asked for a sh 5,000 bribe from a resident of Ndabibi in order to secure a job in KENGEN.

Minute 28/4: Responses by A Ngatti

The environmentalist stated that some of the environmental impacts expressed by the villagers would be confirmed during the current study. As of now it is known that the "rotten smell" which is hydrogen sulphide has some environmental impacts. The extent and severity of these impacts at Ndabibi may be less than those at the power station itself but this can be confirmed during the study. The ESIA report will then be made public so that the community can be informed and given a chance to comment whether the proposed mitigation measures are adequate.

Minute 28/5: Response by Mr. Ndetei of KENGEN

Mr. Ndetei stated that he had noted that the community members had asked if KENGEN could provide tree seedlings. He informed the villagers that the would simply have to put a request in writing to KENGEN's environmental officer.

Minute 28/6: Comment by the area Counselor and area Chief

The counselor stated that he had already received 3,000 tree seedlings from KENGEN which are in the pubic school. the Chief also stated that he had received 2,000 trees from KENGEN. The seedlings are all to be used in the Location.

Minute 28/7: Resettlement of Project Affected Persons (PAPs)

G Owuor explained that the people living in the proposed project area would have to be resettled. These people currently live in the villages of OLO Maiyana, Olo Sinyat, Olo Nongot, Cultural Centre and possibly Narasha. One of the suggested areas of resettlement was Ndabibi Location. He therefore inquired to get their comments on the issue.

The villagers wanted it known that there are some of them within the location who currently do not have land. They however stated that so long as they acquire that land in a proper / legal manner, the residents of Ndabibi would welcome them with open arms.

Minute 28/8: AOB

The Chief requested the residents to avail themselves once the ESIA report was made public to give their comments and views.

There being no other business the meeting closed at 5.00pm with a word of prayer.

MINUTES FOR THE VILLAGE MEETING HELD AT MOINDABI SUB LOCATIONON 30 SEPTEMBER 2009

AGENDA: PUBLIC CONSULTATIONS AND DISCUSSIONS ON THE OLKARIA I UNIT 4 AND 5 AND OLKARIA IV POWER STATION PROJECTS.

Minute 30/1: Preliminaries

The meeting began with a word of prayer from one of the residents at 3.15PM.

Minute 30/2: Assistant Chief Introductory Note

The Assistant Chief Mr.John Kamau explained to the residents the purpose of the meeting and invited G.Owuor to explain in details on the upcoming project.and why the residents had to be consulted before implementation of the project.

Minute 30/3: Introduction of the Proposed Project by the Project Environmentalist

- G Owuor explained the project description in summary, showing the spatial extent of the proposed project area for Olkaria IV power station. He also explained the need for expansion of geothermal power development based on the country's need for electricity in the face of current power rationing.
- He further explained that there are people living within the proposed project area and due to the expected safety threat to people living in the project area, there would be need for resettlement, should the project go forward.
- Moindabi community was informed that an Environmental and Social Impact Assessment Study was being conducted to identify the expected positive and negative impacts of the proposed project
- He clarified that the resettlement would be done in a procedural and humane manner and not through evictions and invited the community members to give their comments and opinions on the proposed project.

Minute 30/4: Assistant Chiefs Invite for Comments

The Assistant Chief commented first before inviting comments from the residents. He commented on Job opportunities from the existing Kengen Projects where he said that they should be included in meetings held periodically concerning the project that affects the community and not only when the Kengen staff want to make a visit to the area; the village should be considered when job opportunities are available so as to benefit the residents since they are immediate neighbours to the power station

Minute 30/5: Residents Comments
The residents in support of what the assistant chief said had the following comments:

- *The fumes from the kengen holes affect their health where they experience headaches*
- *The emissions from the stations mix with rain water forming sulphuric acid which corrodes their roofs*
- *They emphasized on equal job opportunities to all the villages surrounding the station so that they can benefit from the station*
- *They requested if kengen can assist in installing electricity to pump water from the boreholes instead of using diesel which is rather expensive*

- *Trees should be distributed oftenly as they help keep the environment clean from the fumes and may act as water catchment areas which will in turn make their land fertile*
- *The running water from a nearby source goes to waste so they requested if a dam could be built to trap the water so that they can harvest the water and use it for other purposes*
- *Infrastructure improvement (roads,water,electricity) and also if more schools can be built in the area to improve their living standards*
- *One of the residents wanted to know the depth of the Kengen* holes and whether the fumes from the holes affects their soil

Minute 30/6: Respondance From Kengen Staff and G.Owuor from GIBB AFRICA

Nicholas Wairegi from Kengen commented on the issues raised by the residents as stated below;

- *The community should form a committee or agree on one person who will be representing them in the meetings held at Kengen so as to improve their chances of job opportunities since they have someone to link them to the community.*
- *Concerning the trees he said that trees are only distributed during the rainy season when the grounds are fertile so that they can not go to waste due to lack of water. He however said that they have been distributing trees to schools in the area where they are sure of maximum care from the school community. He assured them that more trees will be distributed as soon as the rains set in .*
- *Concerning the upcoming olkaria project he assured them that once the power station is built this will reduce the amount of hazardous fumes that escape into the atmosphere so the issue of fumes affecting their health will be solved .*
- *He assured the residents that issues such as the dam, electricity to pump their water from the boreholes are under discussion and they will be kept updated through their assistant chief.*
- *G.Owuor assured the residents that the Kengen holes are about 1km below ground surface and so this does not have an impact on their soil.*

Minute 30/7: Closing Remarks from the Assistant Chief

The Assistant Chief concluded the meeting by assuring the residents that a representative committee will be formed to represent them at Kengen,he later gave a vote of thanks to all the attendants and there been no other issue to discuss the meeting ended at 4.00PM with a word of prayer form one of the residents .

(attendance list attached behind)

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

WE, THE UNDERSIGNED CONFIRM THAT WE ATTENDED THE ABOVE MEETING

SISI , AMBAO SAINI ZETU ZIKO HAPO CHINI, TUNATHIBITISHA TULIHUDHURIA KATIKA MKUTANO ULIOFANYIKA

DISTRICT/WILAYA: NAIVASHA DATE/TAREHE 30/9/09 **SAA/TIME** ____________

NA KWAMBA KUMBUKUMBU ILIOAMBATANISHWA NI SAHIHI.

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
GEORGE OWUOR	GIBB AFRICA	[signature]
RICHARD K. NKONGONI	A.G. CHIEF	[signature]
JANE W. NDUNGU	KENGEN STAFF	[signature]
Anastasia Ngatti	GIBB AFRICA	Ngatti
Cllr. Joseph M G. Kamau	Ndabibi Ward	[signature]
MARY W. NDUNGU	Ndabibi C.A	Ndungu
Anne Wambui	Ndabibi	Anne
MARGARET WAITHERA	Bahati	Waithera
Waithera Njogu	Kibuuti	Waithera
Mary Nganga	Ngobolu	M
Naomi Njeri	Kibuuti	[signature]
Joyce Muthoni	Kibuuti	Joyce
Mary Kamau	Banati	[signature]
MARGARET NGIMA	CENTRAL	[signature]
MARTHA WAMBUI	KIBURUTI	[signature]
MIRIAM WAKONYO	NDABIBI ward	[signature]
MARY NGIGI	[illegible]	Mary
[illegible] KIRIGHI	[illegible]	[signature]
JOSEPH MUASYA	CENTRAL	Joseph
Hassan Bullow	NCA	[signature]
LEONARD Wakaranja	Mwingarwa	[signature]
Joe Tunji	NGOZETI	
SAMWEL [illegible]		

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
JOYCE CHEPKEMOI	CENTRAL	[signature]
BENEDETTA MUTHONI	CENTRAL	[signature]
[illegible] YAROR	CENTRAL	[signature]
Joshua Mungai Njau	Central	[signature]
DAVID KIBET	CENTRAL	[signature]
[illegible] KIBIKI	CENTRAL	[signature]
Julius Mwaura	NDABIBI	[signature]
JAMES NDUATI	CENTRAL	[signature]
Joseph Kungu Gitau	Kibuiyi	[signature]
Alcli Kalu	CENTRAL	[signature]
Peter Wairimu	NDABIBI	[signature]
LEIPI TIMEH	Central	[signature]
Joseph Kamanga	Central	[signature]
Elijah Muriu	gapoge	[signature]
Beatrice Wanjiru	Central	[signature]
Esther Wangui	Mbaruk	[signature]
Samuel Chege Macharia	Central	[signature]
John Ngarua	Kiburuti	[signature]
Jackson Kariuki	MIRITHI	[signature]
Joh. Muriza	Central	[signature]
Philip Lizita	CENTRAL	[signature]
Halima Ali	Bahati	[signature]
Hawa Okolos	Ndabibi	
Naikelele [illegible] Bahati		
JOSEPH Amchen	Central	
Dennis Lanyana	Central	[signature]
Raphael [illegible]	Ngobole	[signature]
Jacob Lolimo	Central	

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
JOHN GEKONGA	Central	[signature]
Paul Ngigi	Kitaeta Ndabibi	[signature]
Muriu Kariuki	Ndabibi	[signature]
[illegible]	CENTRAL NDABIBI	[signature]
Simon Mwangi	Kangethe ndaa	[signature]
Robert Gathuri	Ndabibi	[signature]
Mehaki Meri	Central	[signature]
[illegible] Ekaot	Abaluti	[signature]
[illegible]	BN Balich	[signature]
Mary Okwam	Central	
Jonathan Ngatian	Central	
Skamau K.	Farmer	Skamau K.
Dominic Mwangi	Orthodox	[signature]
[illegible]		
ALEX RANKA	FARMER	
Julius Nyaga	[illegible]	[signature]
Ben [illegible]	farmer ndabibi	[signature]
[illegible]	Central	
PETER [illegible]	CENTRAL	[signature]
Ann Wanjiku Kibe	Central	
NDIRANGU K ROBERT	Central	[signature]

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

MOINDARI SUBLOC

WE, THE UNDERSIGNED CONFIRM THAT WE ATTENDED THE ABOVE MEETING

SISI , AMBAO SAINI ZETU ZIKO HAPO CHINI, TUNATHIBITISHA TULIHUDHURIA KATIKA MKUTANO ULIOFANYIKA

DISTRICT/WILAYA: NAIVASHA **DATE/TAREHE** _____ **SAA/TIME** _____

NA KWAMBA KUMBUKUMBU ILIOAMBATANISHWA NI SAHIHI.

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
JOHN M. KIMANI	MOINDARI	Chief (Ass.)
AMOS S. MUNCHA	TANGI TATU	
SAMSON ESHO	TANGI TATU	
[illegible]	[illegible]	
peter [illegible]	[illegible]	
JOSEPH MWANGI W.	[illegible]	
[illegible]	[illegible]	
FRANCIS KARUGA	MOINDARI	
Christopher Gichuki	Crater Lake	
[illegible]	Crater Lake	
[illegible]	[illegible]	
[illegible]	[illegible]	
JOSEPH KAMAU	SERE	
[illegible]	[illegible]	
MOSES MUTEG	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
PAUL KIMANI	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

MOINDABI

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
Stephen Gichuhi K.	Sero	[signature]
David Kanyonyi N.	Moi ndabi	[signature]
Paul Mbugua	Moi Ndabi	[signature]
Samuel Githinji	Sero	[signature]
Gabriel Kuyungi	Moi Ndabi	[signature]
Jackson Tuvere	Moi-Ndabibi	[signature]
Patrick Kihiu	Moi ndabibi	[signature]
Alfred Kirui	Creator	[signature]
Ades Ngai	Moi ndabibi	
John Maina	"	
Simon Gishuru	"	
James Kiunjo	"	
James Gishuru	"	
Rael Chebol	"	
Samson Maison	"	
Hussein Omar	"	
Ali Mohammed		
Hassan	"	
Njonge Muturi	"	
Francis Kimani	"	
Ngige John	"	

INITIAL MEETING WITH VILLAGE ELDERS

MINUTES FOR THE MEETING HELD AT SIMBA LODGE WITH MAASAI VILLAGE ELDERS ON 14 SEPTEMBER 2009 ON THE PROPOSED KENGEN OLKARIA IV PROJECT.

Minute 1: Preliminaries

- The meeting began at 1130 am with a word of prayer. The meeting was conducted in swahili to ensure that everyone understands the proceedings;
- The DC is the chairperson of the meeting. If there are any additional meetings the DC was requested to help co-ordinate;
- Elizabeth Ndinya introduced the team, who introduced themselves including the enumerators;
- 12 Village elders and representatives introduced themselves. One village elder was however missing.

Minute 2: Address by KENGEN Olkaria General Manager

- KENGEN Olkaria General Manager summarised that the project was under Olkaria I and Olkaria IV whereby KENGEN plan to generate 280MW which will be added to the national grid. Apart from the units themselves the project will introduce infrastructure to the project area to support the new units.

Minute 3: Address by the District Commissioner

- DC thanked KENGEN and GIBB for calling for this meeting;
- He gave a summary of the importance of electricity generation in Kenya especially in light of the current rationing. He also stated that the government is committed to electricity generation;
- He explained that geothermal power is one of the sources to be tapped for electricity generation and pointed out that the Rift Valley has great potential for geothermal power production;
- He however pointed out that co-operation of stakeholders is important for this programme to be implemented;
- The DC pointed out that another aspect for consideration of land that will be required for expansion. It would therefore be important that all stakeholders be involved to ensure that the process is open and smooth;
- The village elders were therefore informed that their presence was important as the leaders of the Maasai community in the project area;
- He explained to the leaders that they would be called upon to identify any people who may settle in with the intention of getting compensation falsely. It would therefore be important that once the enumeration commences people should not move into the area.

Minute 4: Address by E Ndinya

- Gave thanks to all for attending and explained that this is the initial meeting and that other meetings will be forthcoming, including one to present the study findings;
- Minute 3: Address by G Owuor-Field Work Team Leader;
- Social Impacts assessment is important as it is important to understand how the project will affect the social environment;
- He asked for permission from the village elders to conduct the social survey. He requested that cut-off date be today. This is because with technology, it would be very easy for people to communicate on what is going on;
- He then introduced the Social Environmentalist to give a summary of the Survey Form.

Minute 5: Issues raised by Village Elders / Leaders.

- The elders stated that they have a secretary to translate to English
- In the past they lived where Olkaria II is and were displaced to where Olkaria IV is. They are happy about this meeting and will participate fully.
- He assured the DC and KENGEN Manager that they support the project and are together with the government.
-
- The stated that the land required for the project belongs to them and the land is already occupied and the people own the land. They are however ready to dialogue.
- They thank KENGEN for considering them as previously they were never recognized but now they are being consulted as stakeholders.
- They however do not support forced eviction.
- Welcomed the GIBB Team and stated that they will give the information required.
- Will need to understand from GIBB the expected project impacts to justify eviction.
- They will take the message to the grassroots and ensure that they will not bring people from other areas.
- They will support the project but also expect to benefit from the project.
- They have documentation to support the fact that the land belongs to them. Thus they are asking for information on the correct procedure for resettlement and that is should be done in a humane way. Each individual should be dealt with fairly.

Minute 6: Question by Land Valuer

Do they have documentation for land ownership? This question would be answered later in the agenda.

Minute 7: Additional issues raised by Village Elders

Mr. Kipenju Ole Topoika

Kenya power started in 1971. They never objected and have always moved. They however were not consulted previously and thus thank KENGEN for this meeting.

They are not against any development. They feel they have been marginalized in the past yet the resources are in their home.

Mr. Siloma

They were inhumanely re-located in the past. Houses were burnt yet their grandfathers were from that area.

KENGEN has helped the community and have lived in harmony since 1971. The point to note is that people would not be living there if they had other alternatives.

Mr. Orkoskos

Was forcefully evicted from Olkaria II and are thankful that this process is now inclusive of them. Assured the meeting that they aim for peaceful co-existence. He asked that they should be treated humanely. This is their home and they were born there

Mr. Kisotu:

Thanked the DC for his efforts as he is concerned with the District members' welfare. He wanted to clarify that the first KENGEN wells and Hell's Gate National Park found the people there. At that time

there was no knowledge of title deeds. This awareness came later. He stressed that KENGEN and the DC should know that the land belongs to them. They are given minimal benefits which include jobs as casuals. They however have community members with higher qualifications for employment by KENGEN.

People die all the time as other people eat from their land but they, the resource owners, are left hungry. Permanent schools are not built there as the community members are told that they do not own the land, therefore permanent structures cannot be built. In the same line, an NGO has proposed to lay for them a water pipe from KENGEN to their households. This was also stopped as it was stated that the community members do not own the land.

Assured the team that they will guide the enumerators through the villages.

Bishop Nkipai

They have an inter-denominational group that looks into the needs of the Maasai community, hence he was invited for this meeting. They know where all the community members live.

He stated the importance of establishing the impacts of the project on the community. People have co-existed with other projects and also benefited from having the project in their land.

He pointed out that displacement of people without giving them re-location options could negatively affect the environment as they would be forced to move into areas that may be demarcated as conservation areas.

The community has had land issues since colonial times, when they were displaced by colonialists and marginalized. He therefore stated that the communities have land ownership documentation.

KENGEN were therefore invited to go and see the documentation at a later date.

Ole Topoika

In 1966 Ole Topoika (Ole Sinyat) was employed by Kedong. He is the one who did the beacons for Kedong boundaries thus he knows that the Kedong boundary does not reach the land where Olkaria IV is located. He can show KENGEN the boundary for Kedong in relation to Olkaria IV. Other land owners in the vicinity include Kedong, Akira Ranch and Longonot.

The DC re-assured the elders that their issues were being taken into consideration hence the meeting.

Minute 8: Question by Land Valuer

The land valuer requested the village elders to show him their village boundaries. The villages are:

- Cultural Centre;
- Ol Olongonot;
- Olo Mayana;
- Olo Munyak;
- Sanctuary;
- Narasha.

Minute 9: Issues raised

- Clarification of cut-off date: Stated that there is no corruption so people should be given more time before census can begin;
- Asked that the findings and recommendations of the study be presented to stakeholders;
- Asked to be given information on possible project impacts so that they can give informed comments;
- Thanked the DC and KENGEN for the initiative.

Minute 10: Resettlement Options

The elders stated that they would have to discuss that with the villagers on possible relocation options. They however raised the following questions:

What about expansion in future days? This information is important so that the communities do not end up selecting a land parcel where they would have to be re-located again. Could other communities that could be affected in any future expansion program also be counted under this study?

- The GM Olkaria explained that this is the first stage and that once the study is done the report would be taken back to KENGEN and the Government for discussion. The outcomes would them be tabled to the community to get their comments on the whole study.
- KENGEN knows the areas with potential for geothermal power production so that information will be made available. They therefore would not agree for people to be re-settled in these areas.
- He explained that in a geothermal power production site, there are areas where human occupation is not allowed due to the possible safety risks they would be under. The study is expected to show areas.

Will the team be doing the work together?

- The enumerators and surveyors are conducting different studies thus they will be working independently. They different team members can also plan a schedule with the village elders during the session after lunch break.

The Meeting took a lunch break at 2pm.

Minute 11: Consultation Program

- Cultural Centre Wednesday 16/9/09
- Olo Sinyat Thu 17/9/09
- Olo Olongonot Thu 17/9/09
- Olo Mayan Friday 18/9/09
- Narasha Sat 19/9/09
- Sanctuary Sunday 20/9/09
- Olo Muyak Wed 16/9/09

The cut-off date was therefore set at Wednesday, 16/9/09 which is also the census start date.

MINUTES FOR THE PUBLIC CONSULTATION MEETING WITH NAIVASHA DISTRICT OFFICERS AND CHIEFS ON THE PROPOSED KENGEN OLKARIA I UNIT 4 AND 5 AND KENGEN OLKARIA IV POWER STATIONS HELD ON 17 SEPTEMBER 2009.

Minute 1: Preliminaries

The meeting began at 2pm with a word of prayer. The ESIA Team presented a summary of the proposed project.

Minute 2: Comments and Issues Raised by Participants

District Officer (DO) Kongoni

The DO stated that she should be informed and involved in the public meetings.

Chief Hells Gate Area

- All the villages to be affected by the project have cases on land disputes;
- Ownership disputes will have to be resolved;
- Past evictions have pushed the community members to the limits. There are neighbours in the area who are farmers such as the Maiella area;
- Community has not benefited from employment by KENGEN;
- Projects on Community Social Responsibility (CSR) cannot be implemente because companies in the area do not want permanent settlers there;
- Total eviction and resettlement should be discussed at length.

Chief Maiella Area

- Land disputes were resolved and there are no pending cases. Ngati Farmers are to sell land for drilling. The people are to be relocated to an area as awarded by the court;
- The people from Maiella sell their land for drilling of wells but they do not get jobs;
- Developments by KENGEN are not given to the people of Maiella;
- Fumes from the station make the vegetation dry up;
- Water drainage should include drainage of brine;
- Are there any effects of project impacts on the iron sheets?

Chief Moindabi Area

- There are odours in the area and chickens have been known to die;
- Noise effects are also felt in the area.

Chief Karati Area

- Human animal conflicts are experienced when animals migrate to other locations. These animals include zebras and baboons;
- There would be changes in the social lives of project affected persons through hpurchase of land;
- KENGEN CSR programmes are not being felt. For example they gave the chief only 1000 tree seedlings;
- The have rain precipitate which is yellowish in colour.

Chief Hells Gate

- KENGEN should consider rural electrification for surrounding communities as a CSR program. Kamere Centre which is 2km away has no power;
- CSR for Naivasha Community could include construction of secondary schools and employment for the youth. More graduates from the area should be employed. There should be a structured memo on employment at the DO's Office. Currently KENGEN employ a cleaning contractor from Nairobi;
- He recommends benefits to the people who gave the land to KENGEN. Expansion of the area would lead to more industries;
- They have security problems due to conflicts on illegal grazing between herders and farmers. In the months of January to April as there are no areas for grazing;
- KENGEN should provide transport for public meetings;
- What is the effect of drilling wells on Lake Naivasha?
- The road constructions should open up the satellite areas;
- There will be a reduction on tourism benefits from cultural centre as only KWS will be left to benefit from Tourists. The gorge is a strategic area for local communities which allows them to attract tourists;
- The communities are anxious to know how wide the geothermal area is;
- Impacts on education: there are three schools in the project area that is Narasha, Olkaria and Olo Nongot Primary which are partly sponsored by KENGEN;;
- The KENGEN community is expected to live in a closed off area separate from the rest of the community. This should reduce incidences of HIV/AIDS infections;
- Tree seedlings should be given to compensate for vegetation loss in the area;
- KPLC is yet to compensate people for the 220KV line for the Turkana wind power and Olkaria-Kessos line.

Chief Kijabe (Mai Maahiu)

KENGEN should show the co-relation between geothermal activity and faults in the area.

Minute 3: AOB

There being no other business the meeting closed at 4.30pm.

MEETING AT MAIELLA SETTLEMENT

MINUTES FOR THE VILLAGE MEETING HELD AT MAIELLA LOCATION ON 30 SEPTEMBER 2009

AGENDA: PUBLIC CONSULTATIONS AND DISCUSSIONS ON THE OLKARIA I UNIT 4 AND 5 AND OLKARIA IV POWER STATION PROJECTS.

Minute 30/1: Preliminaries

The meeting began with a word of prayer from one of the residents at 12.45PM.

Minute 30/2: Chief and Assistant Chief Introductory Note

The Chief Mr.Francis Kuria and Assistant Chief Mr. Julius Mwangi explained to the residents the purpose of the meeting and invited G.Owuor to explain in details on the upcoming project.and why the residents had to be consulted before implementation of the project.

Minute 30/3: Introduction of the Proposed Project by the Project Environmentalist

- G Owuor explained the project description in summary, showing the spatial extent of the proposed project area for Olkaria IV power station. He also explained the need for expansion of geothermal power development based on the country's need for electricity in the face of current power rationing.
- He further explained that there are people living within the proposed project area and due to the expected safety threat to people living in the project area, there would be need for resettlement, should the project go forward.
- Maiella community was informed that an Environmental and Social Impact Assessment Study was being conducted to identify the expected positive and negative impacts of the proposed project
- He clarified that the resettlement would be done in a procedural and humane manner and not through evictions and invited the community members to give their comments and opinions on the proposed project.

Minute 30/4:Chiefs Invite for Comments

The Assistant Chief commented first before inviting comments from the residents. He commented on various complains from residents on the fumes that come from the Kengen Holes and requested if the issue can be addressed as soon as possible .

Minute 30/5: Residents Comments
The residents in support of what the assistant chief said had the following comments:

- *The fumes from the Kengen holes has affected them as follows:*
  - *They experience headaches, Typhoid since they feed on rainwater from their roofs which are corroded and pregnant women have miscarried ,*
  - *Their livestock especially chicken have died because of the fumes*
  - *Shortage of crop harvest has been experienced due to sulphuric acid from the holes being washed down to the soils that makes the soil infertile,*
  - *Their human lifespan has also been reduced due to effects of the fumes*
  - *The emissions from the stations mix with rain water forming sulphuric acid which corrodes the roofs of their houses*
- *They have experienced earth tremors which originate from the station which makes them feel insecure on their safety*

- *The residents recommended the following:*
    - *They requested if kengen can assist in installing electricity to pump water from the boreholes instead of using diesel which is rather expensive*
    - *Trees should be distributed oftenly as they help keep the environment clean from the fumes and may act as water catchment areas which will in turn make their land fertile*
    - *Crop seedlings should also be distributed to support food security in the area.*
    - *Infrastructure improvement (roads,water,electricity,hospitals should be fully equipped to avoid long distances to Naivasha town for treatment) and also if more schools can be built in the area to improve their living standards*
    - *Job opportunities should be equally distributed among the villages surrounding the project so as to improve their living standards*
    - *Iron sheets should be distributed periodically to replace the ones corroded by the fumes from Kengen.*
    - *Inorder to reduce conflicts among them(kikuyus) and maasais the maasai should be allocated land far away from them incase there will be need for resettlement for these communities*
    - *All homesteads should be allocated piped water to reduce the long distances covered in search of water.*

Minute 30/6: Respondance from Kengen Staff and G.Owuor from GIBB AFRICA

Nicholas Wairegi from Kengen commented on the issues raised by the residents as stated below;

- *Concerning the trees he said that trees are only distributed during the rainy season when the grounds are fertile so that they can not go to waste due to lack of water. He however said that they have been distributing trees to schools in the area where they are sure of maximum care from the school community. He assured them that more trees will be distributed as soon as the rains set in.*
- *Concerning the upcoming olkaria project he assured them that once the power station is built this will reduce the amount of hazardous fumes that escape into the atmosphere so the issue of fumes affecting their health will be solved.*
- *He assured the residents that issues such as electricity to pump their water from the boreholes are under discussion and they will be kept updated through their assistant chief.*
- *G.Owuor assured the residents that studies will be done on typhoid diseases caused by the Kengen fumes and results will be given to them through their chief*
-

Minute 30/7: Closing Remarks from the Assistant Chief

The Chief concluded the meeting by assuring the residents that he will make a follow up on the issues they have raised, he then advised them not to resist incase they are resettled to avoid conflicts with the government, he later gave a vote of thanks to all the attendants and there being no other business to discuss the meeting ended at 2.15PM with a word of prayer form one of the residents .

(Attendance list attached behind)

MINUTES FOR THE MEETING HELD IN KAMERE AS PUBLIC CONSULTATION FOR THE PROPOSED OLKARIA IV AND I AT KAMERE MARKET CENTRE ON 28 SEPTEMBER 2009

Minute 1: Preliminaries
The Area Chief commenced the meeting at 4.30pm by introducing the GIBB Environmental team.

Minute 2: Introduction of Project
The Environmentalist (G Owuor) gave a summary of the proposed project to start off the discussions

Minute 3: Comments by Community Members

Mr. Soloo:

- There are no roads, water supply or electricity in Kamere. When there's no power, thieves attack the households at night;
- As KENGEN gets power from Natural Resources in the area, they should help by supporting community initiatives;
- Humane Treatment: some people from the community went to KENGEN to ask for employment but they were called for security guards;
- Would like to get better quality of water with help from KENGEN;
- As this is KENGEN land, they would like to get space for their market;
- KENGEN should help them get power instead of taking it all to Nairobi

Grace Njuguna:
- Would like to get better roads and water with help from KENGEN

John:
- KENGEN has been here for years with a dispensary in the area (Mvuke) yet the people in Kamere have to go all the way to Naivasha for medical services. As KENGEN is a parastatal they should help to improve access to medical care.

Environmental Impacts

- They have noted that KENGEN gives milk to their staff in the morning;
- Inquired whether other communities in the project area will also be consulted? He was informed that they would be consulted.

John Lekisa
- Pregnant women are the people who are most affected by hydrogen sulphide.

A lady however refuted the claim as she stated that she has had three successful pregnancies and births. She also pointed out that there are people who work in flower farms in the area.

Benson Macharia

- The Naivasha community depends on Lake Naivasha for water supply. He inquired whether KENGEN activities affect the supply.

Patrick Karakacha

- He stated that increase in power plants will lead to an increase in population. How would the additional waste water be handled?

- He inquired whether the current methods are polluting the lake.
- He also stated that some people in Kamere fetch water from a pipe whose source is unknown.

Andrew

- If the project is expanding it is important for the people to understand the benefits and negative impacts of the project. They would also like to know the status of environmental impacts, social benefits and legal compliance of the projects;
- He would also like that more meetings of this nature are held so that people can give more input.

- A villager who did not identify himself inquired if monitoring of seismic data in the project area was being done;
- He was informed that KENGEN has been monitoring seismic activity.

Minute 4: AOB

There being no other business the meeting closed at 5.30pm.

Kenya Electricity Generating Company Limited (KenGen)

Business Development Division

MEETING ATTENDANCE REGISTER

Date: 14th September 2009 Time: 11:00AM

Location: District Commissioner's Chambers Sinba Lodge

Meeting Purpose: Stake holders meeting for [illegible] Projects — Environmental & Social Impact Assessment

No.	Name	Designation	Organization	Phone	Sign
1	MOSES NTHIGA	PROJECTS ENGINEER	KenGen	[illegible]	MOSES
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	CHRIS [illegible]	[illegible]	KENGEN	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	KENGEN		
[illegible]	[illegible]	[illegible]	[illegible]		

Kenya Electricity Generating Company Limited (KenGen)
Business Development Division

MEETING ATTENDANCE REGISTER

Date: 19/05/09 [illegible]

Contact: [illegible]

Meeting Purpose: [illegible]

No.	Name	Designation	Organization	Phone	Sign
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]		[illegible]
8	[illegible]	[illegible]	[illegible]		[illegible]
9	[illegible]		[illegible]		[illegible]
10	[illegible]				[illegible]
11	[illegible]		[illegible]		[illegible]
12	[illegible]		[illegible]		[illegible]
13	[illegible]		[illegible]		[illegible]

Kenya Electricity Generating Company Limited (KenGen)
Business Development Division

MEETING ATTENDANCE REGISTER

Date 18/09/09 Start time 10:00 Ref.

Convened: DISTRICT COMMISSIONER Venue SIMBA LODGE

Meeting Purpose: EOM - STAKEHOLDERS MEETING

No	Name	Designation	Organization	Phone	Sign
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

MEETING WITH NAIVASHA DISTRICT OFFICERS AND CHIEFS

MINUTES FOR THE PUBLIC CONSULTATION MEETING WITH NAIVASHA DISTRICT OFFICERS AND CHIEFS ON THE PROPOSED KENGEN OLKARIA 1 UNIT 4 AND 5 AND KENGEN OLKARIA IV POWER STATIONS HELD ON 17 SEPTEMBER 2009.

Minute 1: Preliminaries

The meeting began at 2pm with a word of prayer. The ESIA Team presented a summary of the proposed project.

Minute 2: Comments and Issues Raised by Participants

District Officer (DO) Kongoni

The DO stated that she should be informed and involved in the public meetings.

Chief Hells Gate Area

- All the villages to be affected by the project have cases on land disputes;
- Ownership disputes will have to be resolved;
- Past evictions have pushed the community members to the limits. There are neighbours in the area who are farmers such as the Maiella area;
- Community has not benefited from employment by KENGEN;
- Projects on Community Social Responsibility (CSR) cannot be implemente because companies in the area do not want permanent settlers there;
- Total eviction and resettlement should be discussed at length.

Chief Maiella Area

- Land disputes were resolved and there are no pending cases. Ngati Farmers are to sell land for drilling. The people are to be relocated to an area as awarded by the court;
- The people from Maiella sell their land for drilling of wells but they do not get jobs;
- Developments by KENGEN are not given to the people of Maiella;
- Fumes from the station make the vegetation dry up;
- Water drainage should include drainage of brine;
- Are there any effects of project impacts on the iron sheets?

Chief Moindabi Area

- There are odours in the area and chickens have been known to die;
- Noise effects are also felt in the area.

Chief Karati Area

- Human animal conflicts are experienced when animals migrate to other locations. These animals include zebras and baboons;
- There would be changes in the social lives of project affected persons through hpurchase of land;
- KENGEN CSR programmes are not being felt. For example they gave the chief only 1000 tree seedlings;
- The have rain precipitate which is yellowish in colour.

Chief Hells Gate

- KENGEN should consider rural electrification for surrounding communities as a CSR program. Kamere Centre which is 2km away has no power;
- CSR for Naivasha Community could include construction of secondary schools and employment for the youth. More graduates from the area should be employed. There should be a structured memo on employment at the DO's Office. Currently KENGEN employ a cleaning contractor from Nairobi;
- He recommends benefits to the people who gave the land to KENGEN. Expansion of the area would lead to more industries;
- They have security problems due to conflicts on illegal grazing between herders and farmers. In the months of January to April as there are no areas for grazing;
- KENGEN should provide transport for public meetings;
- What is the effect of drilling wells on Lake Naivasha?
- The road constructions should open up the satellite areas;
- There will be a reduction on tourism benefits from cultural centre as only KWS will be left to benefit from Tourists. The gorge is a strategic area for local communities which allows them to attract tourists;
- The communities are anxious to know how wide the geothermal area is;
- Impacts on education: there are three schools in the project area that is Narasha. Olkaria and Olo Nongot Primary which are partly sponsored by KENGEN;;
- The KENGEN community is expected to live in a closed off area separate from the rest of the community. This should reduce incidences of HIV/AIDS infections;
- Tree seedlings should be given to compensate for vegetation loss in the area;
- KPLC is yet to compensate people for the 220KV line for the Turkana wind power and Olkaria-Kessos line.

Chief Kijabe (Mai Maahiu)

KENGEN should show the co-relation between geothermal activity and faults in the area.

Minuts 3: AOB

There being no other business the meeting closed at 4.30pm.

MEETING IN DO'S OFFICE NAVAISHA 17/7/09

PRESENT

NAME	DESIGNATION	AREA	MOBILE	SIGNATURE
SABINAH W. MULE	D-O	MAAI MAHIU	0725840981	
JULIANA M. NYAGAH	D.O	KONGONI	0722820290	
NDERITU T.W.	D.OI	NAIVASHA	0736114400	
Samuel M. Kinimoni	CHIEF	KARATI	0721233879	
Micheal W. Kiretu	CHIEF	NAIVASHA EAST	0720728406	
Godfrey. N. Chege	Asst Chief	OLKARIA	0720280937	
JOEL.K. RUTTO	AG. CHIEF	NAIVASHA Town Loc.	0722-778400	
ZACHARIA K IGERIA	CHIEF	MAAI MAHIU	0722249440	
Julius Mwang.	ASST/chief	Morilla	0720292629	
MUSA LOKIYOE	CHIEF	MALEWA Loc	-0716-964810	
MARGRET MUKURIA	ASS/CHIEF	MUNUNGA	-0725741902	
JAMES N. NJAU	ASST CHIEF	KIJABE	-0725286111	
GEORGE KAGWIMA	CHIEF	LONGONOT	-0725741289	
JAMES NDUNGU	ASST-CHIEF	SATELITE	-0720482166	
DAVID KAVIKU	ASST-CHIEF	MIRERA	-0720563560	
PHILIP N. ARIRI	ASST CHIEF	LAKEVIEW	0724-772153	
Richard K. Nkonyoni	Ass-Chief	Kipkonyo	0721843783	
John M Kamau	Ass/Chief	Moindabi Loc	0726122109	
Francis M. Kamau	Chief	Maiella Loc.	[illegible]	
Robert M. Gichuhi	Ass/Chief	Karuna	[illegible]	
Hussein J. Gawo	Chief	Hells Gate	[illegible]	
J. B. Aluodo	D.O, Central		073-234330	

MEETING WITH YOUTH AT CULTURAL CENTRE

MINUTES FOR THE MEETING WITH YOUTH REPRESENTATIVES OF CULTURAL CENTRE TO DISCUSS IMPACTS AND MITIGATIONS OF RESETTLEMENT OF THE COMMUNITY YOUTH

Date: 10 November 2009
Venue: Olkaria Primary School Compound

Agenda

1. Comments on the relocation
2. Matters Arising
3. A.O.B

Minute 1: Preliminaries

The meeting was called to order at 12.45 pm after introduction of the GIBB Environmental Team and the youths. The youths raised their fears concerning the community's educational tour to Sondu Miriu. They were neither consulted nor involved in the entire process and it is the reason no youth from Cultural centre went on that trip.

Minute 2: Issues to be addressed during relocation

The youths are not opposed to relocating but the following issues need to be addressed:

- KenGen should provide employment to the youths;
- In the new area, there should be a school, church, and a recreational facility preferably a sports ground and a social hall;
- This land should be accessible with good road network;
- The youths should be given disturbance allowance for relocating to unfamiliar grounds;
- KenGen should provide scholarships to the youths;
- The houses to be constructed should be of a better quality. They should be concrete with a separate kitchen, bathroom and toilet;
- The place should be provided with water. Cultural centre has sufficient water, a project that was initiated by friends from France. The community therefore should enjoy the same privileges in their new residence;
- Adult education programs should be initiated by the government and KenGen so that the larger population of adults who are illiterate can get some literacy;
- Culture centre should be relocated to the new area;
- The company should also help in establishing and equipping a dispensary.

Minute 3: Cultural concerns

The gorge and caves within the area are very important to the Maasai community since most of their rituals and rites are conducted in this place. If they are going to be relocated, then there should be a memorandum of understanding between the community and relevant authorities to access the gorge for their rites and rituals.

Minute 4: Welfare of orphans

When relocation is due the orphans need to be considered and be supported by KenGen. This assistance could be in terms of offering scholarships among other forms of assistance to improve their future livelihoods.

Minute 5: Youth group activities

The youth have an organization, Olkaria Community Tour Guide registered with the Ministry of state for Sports and Gender, whose vision is to develop a campsite, an educational centre, a hotel and a museum to create more employment opportunities for the youths. With regard to museum, friends from France had pledged to partner with the community to develop this facility. In fact, the foundation has already been laid for this purpose. The organization's main activities are: Visitors' tour guiding; Environmental conservation programs; Provision of security to the visitors in conjunction with KWS and KenGen, Performance of cultural songs and dance to the visitors among other activities. This therefore implies that the youths depend entirely on cultural centre for their livelihoods.

On a typical high season the, cultural centre accrues in income of KShs. 40,000 while the youth group gets about KShs. 10,000 per day as compared to KShs. 4,000 per day during low season. This money is distributed to members on a monthly basis to cater for their welfare.

Bearing the above factors in mind, relocation will adversely impact on the livelihoods of these youths. However, the youths reckoned that they would not want to interfere with the governments programs for development but raised the following concerns:

- After the community has relocated, will the visitors be guaranteed of their security?
- Will the environmental programs especially tree planting they had initiated with KenGen continue?
- Shall KenGen continue providing tree seedlings to the community even after relocation?
- Will the youths continue accessing the gorge which is of cultural importance to them free of charge?
- Shall KenGen employ these youths? From the past experience, KenGen laid off all youths from cultural centre except one after they tried to fight for their rights. Still on employment, it is like other villages have been given undue advantage. This shows that employment is not done in a transparent manner. They would therefore be keen to see how it will handle this issue this time round;
- When the cultural centre which is known all over the world, who is going to do the marketing to inform the tourists of the relocation?

Minute 6: Land and Land Tenure Issues

The cultural centre is estimated to be about 2000 acres. In the new area, the youths feel that the people from this area should be independent from other villages so as to minimize the conflicts.

This relocation program is marred with a lot of political interference especially from some chairmen who are very wealthy and influential hence taking advantage of those who are poor and illiterate. If the relevant authorities are not careful, these people might take most of the land and allocate to themselves hence marginalizing the majority who are poor.

Each person at the age of 18 years and above owns his own land though there are no titles. Therefore when relocation is done, each person should be given his own land

Minute: Access to credit facilities

Since the youths have organized themselves in a youth group, they were of the opinion that they are helped on how to access credit facilities in terms of youth development enterprises fund and other credit facilities to establish business and cater for their own welfare hence improve their livelihood.

Minute 8: AOB

In case of any future educational trips, the youths should be given priority since they are quick to learn and can come and share the information with the rest of the community members including women.

In any future meetings, the youths should be duly represented.

There having been no other business, the meeting was closed with a word of prayer.

DISCUSSIONS WITH WOMEN AT CULTURAL CENTRE

CULTURAL CENTRE PUBLIC CONSULTATION MEETING WITH WOMEN.10/11/2009

Socio-economic snapshot from the women's point of view

- Women were not actively consulted and involved in the planning hence the importance of this meeting.
- However, they usually participate in village meetings and agree with the resolutions made
- Appreciated the coming of visitors and enquired on the type of housing in the new area
- They live in cultural centre as a community and no outsider has come in.
- They acquired the land long ago but they have never accessed the surveyor
- They are involved in businesses especially bead making
- The youths help them as tour guides when visitors come
- The importance of cultural centre for their traditions and culture
- There is a museum and a hospital in the cultural centre
- There is also a church
- The centre also has got water and they have been supported by people from France to plant trees within the centre
- Every development is made possible because of the proceeds from the cultural centre
- Women agree to relocate but they need to be supported in development of social amenities including schools, hospital with a maternity wing, water
- The cultural centre women should be taken to the same area to continue with their communal lifestyle
- They appreciate the good relationship they enjoy with KENGEN and KWS. The women re quest that they should not be taken far away with KENGEN and KWS.
- The new residence should have all the amenities and they should not be removed away from that place again
- They know they have resources including minerals but they do not have the technological know how. Those who exploit the resources should also give back to them
- Cultural centre is everything to them. All the income to educate children and other household issues is accrued from the cultural centre.
- Provide employment opportunities to women and the youth
- Cultural centre has a management committee that is responsible for the development.
- The government also benefits from this cultural centre in terms of tourism revenue and therefore should help the residents
- The gorge provides income to the residents
- The importance of the gorge to the community in terms of promotion of culture
- The community owns land but does not have land titles and hence they cannot sell.

- There are orphans within the community and therefore these children need to be supported.
- The men attend meetings but more often than not, they are not given the clear picture of what is happening.

- Total orphans are taken care of by their grandparents
-
-

Assistance during relocation

- Women request that when there are meetings between KENGEN and GIBB they should also be involved.
- Watering points for the animals should be established in the new area of relocation
- Traditional birth attends should be trained
- The roads to the cultural centre should be developed
- Before relocation, the women request for food aid

Access to credit and economic activities

The women have experienced losses since they no longer make beads sa they were told the project is starting soon. They have not improved their manyattas

Women should be helped to form groups and access loans to improve their livelihoods

Land tenure

- They need individual land titles. They should not be mixed withpeople from other villages
- In the new land, a new cultural centre should be developed

Comments on resettlement and rehousing

Type of rehousing- the women want modern houses with a separate kitchen. In addition, the women recommend that the manyattas should be but at the centre

The women should be helped by developing hostels for tourists

Separate toilets and bathroom per household

Problems of school going children- lack of food, less income, harassment by men, lack of exposure especially on the side of the men who do not value education. Children need to be motivated to go to school: lack of equipments and learning facilities. Government should help in this.

There are also gender based violence issues

MEETINGS WITH MINISTRY REPRESENTATIVES AT NAIVASHA DISTRICT

MINUTES FOR THE PUBLIC CONSULTATION MEETING WITH NAIVASHA DISTRICT HEADS OF DEPARTMENT ON THE PROPOSED KENGEN OLKARIA I UNIT 4 AND 5 AND KENGEN OLKARIA IV POWER STATIONS HELD ON 17 SEPTEMBER 2009.

Minute 1: Preliminaries

The meeting began at 10am with a word of prayer. The ESIA Team presented a summary of the proposed project.

Minute 2: Comments and Issues Raised by Participants

Water Resources Management Authority (WRMA)

The representative from WRMA raised the following:

- Is all the water abstracted from Lake Naivasha returned to the Lake?
- What is the quality of water to be returned to the lake?
- After cooling, what happens to the waste water?
- What is the percentage of water currently returned?
- Whenever one abstracts an extra amount of water there should be a penalty but that has not been allocated.
- KENGEN should pay WRMA in terms of KWh generated.
- Payment for cooling water is currently being processed.
- KENGEN is a class D (Major) abstractor thus they (KENGEN) should install an abstraction monitoring device.

Ministry of Agriculture (MoA)

The MoA representative asked whether hydrogen sulphide released by the project affects crops (and vegetation) and to what extent. He also inquired on steps that can be taken to manage this.

Department of Physical Planning

The representative from the Physical Planning Department stated that KENGEN would have to submit an application to the Naivasha Municipal Council for approval of the development.

Ministry of Livestock Development (MoLD)

The representative from MoLD raised the following issues:

- What precautions would be taken for livestock in the area?
- What is the total area affected by the current activities at Olkaria I?
- Where will the local community graze their livestock during the operational period of the proposed projects?

Public Health Office (PHO)

The representative from PHO raised the following issues:

- Sanitation impacts: what are the measures in place for abatement of the long and short term effects of pollution, dust and vectors?
- Records on public health should be obtained from the Public Health Officer.

- What measures are being taken to provide alternative water sources for drilling? Can they drill boreholes for their purposes as Lake Naivasha is currently stressed?
- What is the current water consumption rate for Olkaria I and II?
- The study should refer to the Water Act on pollution of water resources.
- Some studies have been done on the Lake Naivasha which would provide information of relevance to the project.

National Environment Management Authority (NEMA)

The representative from NEMA raised the following questions:

- How does hydrogen sulphide interfere with rain water?
- Land Issue: the court of appeal has a pending case on land ownership. Nothing can be done on the area until the case has been determined.
- Narok or Nairobi Central Registry would have proper records of Kedong Ranch ownership.
- Cultural Centre: where to and how would it be moved as it is a tourist site?
- Will the pastoralists still have access to the Lake during the operational phase?

Physical Planning Department

There is need for change of use and amalgamation of parcels of land prior to project implementation.

Minute 3: AOB

- The Heads of Department requested for a tour of the facility once it has been commissioned;
- The Government previously preferred hydropower by geothermal is the one that is being focused on now;
- The Worldwide Fund for Nature (WWF) has done a lot of research on Malewa area and Lake Naivasha Basin. They are currently running programmes on silviculture.

There being no other business the meeting closed at 2pm.

MEETING NAIVASHA DISTRICT 17 SEPTEMBER 20[illegible]

NAME	DESIGNATION	DEPARTMENT	SIGNATURE
Githinji Thengi	DMEO	MOA 0726 [illegible]	[signature]
Stephen Kagunda	FORESTER	KFS 072[illegible]42	[signature]
Kimani Muiru	SCM [illegible]	[illegible] 0721[illegible]344	[signature]
Justus M' Kimotito	Livestock officer	MOLD 0725[illegible]825	[signature]
Paul C. Mutiuhe	Supt (water)	WATER [illegible]	[signature]
NELSON MATIVA	FISHERIES OFFICER	FISHERIES 0[illegible]219	[signature]
VINCENT OSEWE	Physical planner	Provincial Physical Planning Naivasha 072[illegible]	[signature]
Johnstone Mulaa	Communication Asst.	WCDF [illegible]	[signature]
GEORGE O. NYANGWESO	DISTRICT LAND REGISTRAR	LANDS [illegible]	[signature]
NJUGI KARANJA	Public Health officer	MOPHS	[signature]
MWAURA D.N	DISTRICT DEV OFFICER	MinPlanning & Vision 2030	[signature]
Tom Nyangau	Dist. Settlement Officer [illegible]		[signature]
DERITU T W	SNR D.O. NAIVASHA	NAIVASHA	07[illegible]1144[illegible]

STAKEHOLDERS MEETING FOR DISCLOSURE OF ESIA STUDY FINDINGS

MINUTES FOR THE PUBLIC CONSULTATION AND DISCLOSURE WORKSHOP FOR THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED OLKARIA I UNIT 4 AND 5 AND OLKARIA IV GEOTHERMAL POWER STATIONS HELD AT SIMBA LODGE IN NAIVASHA.

DATE: 21 OCTOBER 2009
VENUE: TSAVO ROOM
ATTENDANCE BY:

- INSTITUTIONAL REPRESENTATIVES;
- REPRESENTATIVES OF PAPs TO BE RESETTLED;
- KENGEN;
- GIBB AFRICA LIMITED.

Preliminaries: Welcoming Remarks by Geothermal Development Manager

G Muchemi welcomed all present and presented the program and stated that the District Commissioner was the chair of the meeting.

He informed the participants that the meeting is to provide a platform for the stakeholders to give their comments. A future Consultation meeting could be held by NEMA.

Minute 1/21/2009: Address by District Commissioner

The DC stated that Naivasha District has the potential to alleviate the national problem on electricity generation.

He thanked the current neighbours of the power station for the peaceful co-existence in the past. He also stated that it is a good thing that the process is now consultative and will enable the PAPs to discuss with the Government.

He requested that personal politics at the village level should be kept aside to ensure that the process goes on well.

He informed the meeting that to attain Kenya's Vision 2030, energy is an important factor to ensure that the vision comes to fruition.

He stated that for the project to continue, the need for re-settlement has been confirmed from the ESIA Study.

He thanked GIBB Africa for the study and thanked KENGEN Management for the peaceful co-existence of the power station with the District Residents.

He encouraged the PAP representatives and Institutional Heads to participate fully in the discussions.

Minute 2/21/2009: Presentation on Geothermal Development by KENGEN

G Muchemi presented a summary of the Feasibility Studies for Olkaria Power Station. The highlights are:

- There will be an increase in geothermal power production with 280MW to bring the total power production to 430MW.

- Geothermal power is cheaper as current high electricity bills are due to fuel costs for thermal power plants;
- The project is to have three contracts for:
    - Consultancy;
    - Construction (International Contractors);
    - Local infrastructure (Local Contractors);
- The project is to have power wells and re-injection wells, totaling to USD 1,315 million;
- 50% of the wells have been drilled;
- Estimated / tentative project timelines are 2009 to early 2013.

He informed the meeting to put their questions ready for the question and answer session as scheduled in the program.

Minute 3/21/2009: Presentation on ESIA Study by GIBB Africa Limited

GIBB Africa presented a summary on the study using three power point presentations based on:

- ESIA Study findings;
- Air and Noise Modeling findings;
- Resettlement Action Plan Study findings.

The presentations were done in both English and Swahili to overcome any possible language barrier problems.

The meeting went on hold to allow for a lunch break.

Minute 4/21/2009: Comments by Stakeholders

Mr. Maenga Ole Kisotu: Olo Nongot

Have been moved before to make way for geothermal power and for Hell's Gate National Park for the good of the Nation and for them.

Is there any new technology to be used?

The land in Olo Sinyat is 4200 acres. He doesn't see how the project will take up all the land. He therefore asked why the station cannot co-exist with the people living there as of now, with the project established on the exact piece of land that they need.

He would not accept to move for other people to "eat" there.

All the settlements are in one farm therefore it is one community, not different communities.

Mr. Ngamasiayi: Olo Nongot

He lives in Olo Nongot. These projects are also present in Oserian which has human settlement. He is yet to see benefits from land use by KWS and KENGEN. He is yet to see any person employed by KWS. There are no permanent employees from the community in KENGEN. On health impacts, he is yet to see negative health impacts on the existing community.

This shows that there is some form of tribalism in the proposal to move the Maasai Community.

Mr. Parsambula Orkosokos: Cultural Centre

They do not have any objections to KENGEN projects. He therefore does not see why they have to move yet they have not disrupted KENGEN activities to-date. He therefore feels that there are benefits in the project area that KENGEN is trying deny them.

Hassan Ole Narangaik: Olkaria

He said that the chief is not new in the area, he sees him as a mediator between the community and KENGEN. He retaliated that there are people living in Oserian but he knows that it is private land. The resource is under their land and has been there. Yet in those times no one was told to move.

He feels that the census is not representative as people have left the settlement to graze.

He understands that the report has been developed but feels that they are communities with a specific lifestyle. They therefore cannot be moved haphazardly as there will be physical and socio-cultural impacts on their lives.

Jackson Roinge: Narasha

He lives in Narasha but the area belongs to the whole community. The people who work in KENGEN have very good health yet the PAPs are skinny. He still wants to know what these people eat.

He feels that in future the people living in Narasha will still be moved. Since people are being compensated for Olkaria IV, he is wondering where the compensation from Olkaria I is.

He requested that the study looks into the resettlement issue properly as he is feels the old men do not believe there will be compensation. The station should therefore take a smaller piece of land like two thousand acres and leave the rest to the people.

He says that the well for Orpower is in Narasha and people have not died, hence if the effects are the same they should be left to live there.

Patrick Karanja: Maiella

He stated that he's the chairman for Ngati farmers and that he is glad as the meeting has given him good information on the government plans.

He feels that the study has been done, but as he has seen from the presentation, the study has not shown who the owner of the land is. There are no titles stated for the settlements shown. They are the ones who sold the land for Olkaria I. How is KENGEN going to deal with the actual land owners.

G Muchemi: KENGEN

He clarified that this meeting is not to discuss who the land owner is. The meeting is focused on Environmental and Social Impacts of the project.

NEMA District Environment Officer: Naivasha District

She clarified that the Study was not by NEMA but by GIBB as registered by NEMA. The study looks at biophysical and socio-cultural impacts and the proposed mitigation measures. The report therefore does not look at land ownership.

Air quality standards will be effected in November.

Hassan Ole Narangaik: Olkaria

Why hasn't NEMA gone to Oserian to check on the human standards there?

District Public Health Officer

The officer had the following questions:

- What did the report mean by there being an in-active dispensary?
- The hospital was built based on a catchment area. The report was however based on a catchment area. If this hospital is moved how will the non-PAPs benefit?
- How is the health of the people in Olkaria be monitored. How will the waste be managed?
- When it rains, hydrogen sulphide converts to sulphuric acid. How is the report proposing to manage this? The surface run-off is also flowing to Lake Naivasha Basin. How will the project manage this?
- If the school is moved what about children who go there but are not from the project area?
- Does the study show the pit latrines used in terms of type of pit latrine?
- When people are moved to the new area, where will they get water supply from, seeing as currently it is being supplied by KENGEN.

Mr. Ngamasiayi: Olo Nongot

Where was NEMA when this project commenced? He feels they should look into the historical impacts before we start looking at future impacts.

Cllr. P. Maranga: Councillor Olkaria Ward

He was not consulted during the study.

He asked when this process started for the meeting to state the expected close down date for the study.

He asked how the concerns of the individual PAP will be met.

What is the benefit of the project to the people? He asked for an agreement between KENGEN and the community for direct benefits to the project such as a share of the project profits going to the community.

Chief Mai Maahiu Location

This is not a new development. Considering the government proposals, we need to expand the power production. This cannot be done without negatively affecting the people living in the project area. The report has given expected impacts and that is why this meeting is discussing the impacts on district level. He would like that the meeting be open minded to see the national benefits, yet be open to clearly state the expected negative impacts at the household levels.

This meeting is a discussion and all issues should be discussed at this sitting. Before, the humane regulations were not being followed, but today, the regulations have to be followed for development.

Minute 5/21/2009: Responses to Questions

A Ngatti: GIBB Africa

Public Consultation: The consultation process is on-going. Those who were not consulted at the household level or through the public baraza, were being consulted at this forum. There are more consultations scheduled for the future including consultations on the ongoing RAP study. NEMA also puts the submitted ESIA report in a public place and gives the public 60 days to comment on the study.

Inactive Dispensary: The dispensary was built by the community for government workers when they do health campaigns. However the building is now shaky and unsafe for use hence it is inactive.

Moving of the Schools: From the study the students who go to Olkaria Primary and Olo Nongot Primary are all from the Project Affected Community. Therefore there are no students from outside the project area who would be affected by the relocation of the school.

Moving of Naivasha District Hospital: The study stated that people should be given access to a level IV health facility; not that the project will result in moving the hospital.

Disruption of Water Supply: The report recommended that KENGEN re-establish the water and sanitation facilities and in the case of sanitation, that they provide facilities and awareness programmes for all community members.

Types of Pit Latrines: Data collected on sanitation facilities shows the different types of latrines used, from traditional pit latrines, Ventilation Improved Pits, pit latrines with slabs etc. the report recommends that they install VIP Latrines to improve sanitation standards.

Waste Management and Monitoring: The report contains recommendations for waste management according to type, that is hazardous and non-hazardous wastes. The project is also to comply with NEMA waste management regulations. Additionally, KENGEN conducts daily monitoring of specific parameters including hydrogen sulphide and they submit their annual audit reports to NEMA.

G Owuor: GIBB Africa

H_2S Monitoring: KENGEN to do monitoring by building a structure with iron sheets to monitor effects of hydrogen sulphide on iron sheets. This is because the information available now cannot conclusively state impacts of H_2S on iron sheets.

Impacts on air quality will increase due to increased. Secondly one cannot live inside a factory therefore it will be difficult for people to live inside the power station. Thirdly, workers in KENGEN abide by the 8 hour occupational exposure levels which are less stringent as opposed to 24 hour residential exposure levels.

Peter Ouma: KENGEN
Geothermal power in Oserian is not of good quality and that is why KENGEN is not there. It is therefore not discrimination on the Maasai.

Minute 6/21/2009: Comments

Felix Mutukuti Ministry of Energy:

The government saw that ESIA is important and began in 1999, and that is why it was not followed up on in the past.

Since NEMA cannot be everywhere, they send registered consultants such as GIBB. The government looks at everyone's' needs. He therefore asked that everyone be counted.

He asked for co-operation as the meeting is not to negatively impact anyone, but to ensure that every person's needs are looked into.

Minute 7/21/2009: Response to Comments

Peter Suyanga: Olo Sinyat

He corrected that they did see GIBB and that they were counted and they gave information to GIBB. It is just the pain of past injustices that made them say that.

Maenga Kisotu: Olo Nongot

He stated that GIBB was there to count people, it is just that he was hurt by the thought of having to move hence the earlier statement.

E Ndinya: GIBB Africa

Speaking on behalf of GIBB she reassured the Maasai Community that GIBB is aware that this is a sensitive issue and further reassured them that the process will be sensitive to their concerns in terms of time needed for them to make consultations and decisions.

Minute 6/21/2009: Future Consultations

The meeting resolved to call the Maasai Elders aside and decide on the next date for the meeting in order to give them time to communicate this meeting's proceedings to the community and chart a way forward.

Minute 7/21/2009: AOB

There being no other business the meeting closed at 5.30pm.

MINUTES FOR THE PUBLIC CONSULTATION MEETING WITH NAIVASHA DISTRICT HEADS OF DEPARTMENT ON THE PROPOSED KENGEN OLKARIA I UNIT 4 AND 5 AND KENGEN OLKARIA IV POWER STATIONS HELD ON 17 SEPTEMBER 2009.

Minute 1: Preliminaries

The meeting began at 10am with a word of prayer. The ESIA Team presented a summary of the proposed project.

Minute 2: Comments and Issues Raised by Participants

Water Resources Management Authority (WRMA)

The representative from WRMA raised the following:

- Is all the water abstracted from Lake Naivasha returned to the Lake?
- What is the quality of water to be returned to the lake?
- After cooling, what happens to the waste water?
- What is the percentage of water currently returned?
- Whenever one abstracts an extra amount of water there should be a penalty but that has not been allocated.
- KENGEN should pay WRMA in terms of KWh generated.
- Payment for cooling water is currently being processed.
- KENGEN is a class D (Major) abstractor thus they (KENGEN) should install an abstraction monitoring device.

Ministry of Agriculture (MoA)

The MoA representative asked whether hydrogen sulphide released by the project affects crops (and vegetation) and to what extent. He also inquired on steps that can be taken to manage this.

Department of Physical Planning

The representative from the Physical Planning Department stated that KENGEN would have to submit an application to the Naivasha Municipal Council for approval of the development.

Ministry of Livestock Development (MoLD)

The representative from MoLD raised the following issues:

- What precautions would be taken for livestock in the area?
- What is the total area affected by the current activities at Olkaria I?
- Where will the local community graze their livestock during the operational period of the proposed projects?

Public Health Office (PHO)

The representative from PHO raised the following issues:

- Sanitation impacts: what are the measures in place for abatement of the long and short term effects of pollution, dust and vectors?
- Records on public health should be obtained from the Public Health Officer.

- What measures are being taken to provide alternative water sources for drilling? Can they drill boreholes for their purposes as Lake Naivasha is currently stressed?
- What is the current water consumption rate for Olkaria I and II?
- The study should refer to the Water Act on pollution of water resources.
- Some studies have been done on the Lake Naivasha which would provide information of relevance to the project.

National Environment Management Authority (NEMA)

The representative from NEMA raised the following questions:

- How does hydrogen sulphide interfere with rain water?
- Land Issue: the court of appeal has a pending case on land ownership. Nothing can be done on the area until the case has been determined.
- Narok or Nairobi Central Registry would have proper records of Kedong Ranch ownership.
- Cultural Centre: where to and how would it be moved as it is a tourist site?
- Will the pastoralists still have access to the Lake during the operational phase?

Physical Planning Department

There is need for change of use and amalgamation of parcels of land prior to project implementation.

Minute 3: AOB

- The Heads of Department requested for a tour of the facility once it has been commissioned;
- The Government previously preferred hydropower by geothermal is the one that is being focused on now;
- The Worldwide Fund for Nature (WWF) has done a lot of research on Malewa area and Lake Naivasha Basin. They are currently running programmes on silviculture.

There being no other business the meeting closed at 2pm.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

OLKARIA I UNITS 4 & 5 AND OLKARIA IV POWER STATIONS

STAKEHOLDERS' CONSULTATION MEETING

21ST OCTOBER 2009 - LAKE NAIVASHA SIMBA LODGE

ATTENDANCE SHEET

NO.	NAME	DESIGNATION	INSTITUTION/ ORGANIZATION	ID NO.	SIGNATURE
1.					
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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

OLKARIA I UNITS 4 & 5 AND OLKARIA IV POWER STATIONS

STAKEHOLDERS' CONSULTATION MEETING

21ST OCTOBER 2009 - LAKE NAIVASHA SIMBA LODGE

ATTENDANCE SHEET

NO.	NAME	DESIGNATION	INSTITUTION/ ORGANIZATION	ID NO.	SIGNATURE
23	CAROLYN KIPSANG	P.L	KENGEN	[illegible]	[signature]
24	[illegible]	[illegible]	KENGEN	[illegible]	[signature]
25	NDEGE ANDREW	SFMN	KENGEN	[illegible]	[signature]
[illegible]	CYRUS KARIMITHI	AMRA	KENGEN	7038314	[signature]
[illegible]	CORNELIUS NDETEI	[illegible]	KENGEN	[illegible]	[signature]
[illegible]	[illegible] NDEGE	CE	KenGen	[illegible]	[signature]
[illegible]	WAIREGI NICHOLAS	SS&Q.E	KENGEN	219[illegible]	[signature]
[illegible]	KOSIKO & [illegible]	Chairman Cultural Centre	Cultural Centre		[signature]
[illegible]	JACKSON TOKINAI	Chairman Naivasha [illegible]	[illegible] Community	2224223	[signature]
[illegible]	[illegible]	Chairman [illegible]	Naivasha Community		[signature]
33	[illegible]	[illegible]	[illegible]		[signature]
34	[illegible]	[illegible]	[illegible]	[illegible]	[signature]
[illegible]	SAMUEL KINGORI	DPHO-NAIVASHA	MINISTRY OF HEALTH	[illegible]	[signature]
[illegible]	WILFRED OGADA	GIS	GIBB Africa	[illegible]	[signature]
[illegible]	ELIZABETH NDINYA	Project Director	GIBB Africa	[illegible]	[signature]
[illegible]	[illegible]	Chief	[illegible]	[illegible]	[signature]
[illegible]	[illegible]	Project Manager	GIBB Africa	[illegible]	[signature]
[illegible]	CHRISTOPHER MBINDAH	VALUER	GIBBAF.	[illegible]	[signature]
41	MUTUKU D. M	DAO	MOA	[illegible]	[signature]
42	Stephen N. [illegible]	ALPO	Ministry of [illegible]	[illegible]	[signature]
43	Hannah Alathon	[illegible]	[illegible]	[illegible]	[signature]
44	[illegible]	Chairman	[illegible]	[illegible]	[signature]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

OLKARIA I UNITS 4 & 5 AND OLKARIA IV POWER STATIONS

STAKEHOLDERS' CONSULTATION MEETING

21ST OCTOBER 2009 - LAKE NAIVASHA SIMBA LODGE

ATTENDANCE SHEET

NO.	NAME	DESIGNATION	INSTITUTION/ ORGANIZATION	ID NO.	SIGNATURE
45	MAENGA OLE KISOTU	CHAIRMAN	OLOONONGOT		[signature]
46	NWANGI SURURU	CHAIRMAN	OLOMAYIANA	2059689	[signature]
47	DANIEL SHAA	MEMBER	CULTURAL	1153328	[signature]
48	SIMON KISOTU	MEMBER	OLOONONGOT	24552535	[signature]
49	MUSA KEBENYE	MEMBER	OLOMAYIANA	9218732	[signature]
50	DR KOSKOS PARSAMPULA	CHAIRMAN	CULTURAL CENTRE		[signature]
51	George Mwaniki	CHIEF	OOT	9530754	[signature]
52	Peter Ikiloba	SCIENTIST	KWS	[illegible]	[signature]
53	BENJAMIN KUBO	MANAGER GDC	GDC	0754277	[signature]
54	FELIX N. MUTUNGUTI	GEOLOGIST	MINISTRY OF ENERGY	0549173	[signature]
55	Geoffrey G. Nduati	CDA	Kenken		
56	Mohammed Birik	DC	KWS		
57	KHAMISI SULEIMAN	DC office	NAIVASHA	22145539	[signature]
58	DAVID [illegible]	DC office	NAIVASHA	10223182	[signature]
59	Gabriel Ntangila	Scientist	Kengen	756169	[signature]
60	VINCENT OBEWE	[illegible]	[illegible] Naivasha	[illegible]	[signature]
61	Moses N Tanga	CF Projects	Kengen	5713333	[signature]
62	Margaret Ngugi	Secretary	Kengen	23730971	[signature]
63	[illegible]	[illegible]	[illegible]	586143	[signature]
64	Rev Joseph K. Kinyua	VICAR	ACK NAIVASHA	[illegible]	[signature]
65	Rose Cima	AMAS	KENGEN	33366526	[signature]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

OLKARIA I UNITS 4 & 5 AND OLKARIA IV POWER STATIONS

STAKEHOLDERS' CONSULTATION MEETING

21ST OCTOBER 2009 - LAKE NAIVASHA SIMBA LODGE

ATTENDANCE SHEET

NO.	NAME	DESIGNATION	INSTITUTION/ ORGANIZATION	ID NO.	SIGNATURE
66	[illegible]	[illegible]	[illegible]	8393907	[illegible]
74	MARTHA NJESA	EIA OFFICER	KWS	[illegible]	[illegible]
63	Cllr. Peter Paranga	Councillor [illegible]	Olkaria ward	20792828	[illegible]

MEETING AT KAMERE MARKET CENTRE

MINUTES FOR THE MEETING HELD IN KAMERE AS PUBLIC CONSULTATION FOR THE PROPOSED OLKARIA IV AND I AT KAMERE MARKET CENTRE ON 28 SEPTEMBER 2009

Minute 1: Preliminaries
The Area Chief commenced the meeting at 4.30pm by introducing the GIBB Environmental team.

Minute 2: Introduction of Project
The Environmentalist (G Owuor) gave a summary of the proposed project to start off the discussions

Minute 3: Comments by Community Members

Mr. Soloo:

- There are no roads, water supply or electricity in Kamere. When there's no power, thieves attack the households at night;
- As KENGEN gets power from Natural Resources in the area, they should help by supporting community initiatives;
- Humane Treatment: some people from the community went to KENGEN to ask for employment but they were called for security guards;
- Would like to get better quality of water with help from KENGEN;
- As this is KENGEN land, they would like to get space for their market;
- KENGEN should help them get power instead of taking it all to Nairobi

Grace Njuguna:
- Would like to get beiter roads and water with help from KENGEN

John:
- KENGEN has been here for years with a dispensary in the area (Mvuke) yet the people in Kamere have to go all the way to Naivasha for medical services. As KENGEN is a parastatal they should help to improve access to medical care.

Environmental Impacts

- They have noted that KENGEN gives milk to their staff in the morning;
- Inquired whether other communities in the project area will also be consulted? He was informed that they would be consulted.

John Lekisa
- Pregnant women are the people who are most affected by hydrogen sulphide.

A lady however refuted the claim as she stated that she has had three successful pregnancies and births. She also pointed out that there are people who work in flower farms in the area.

Benson Macharia

- The Naivasha community depends on Lake Naivasha for water supply. He inquired whether KENGEN activities affect the supply.

Patrick Karakacha

- He stated that increase in power plants will lead to an increase in population. How would the additional waste water be handled?

- He inquired whether the current methods are polluting the lake.
- He also stated that some people in Kamere fetch water from a pipe whose source is unknown.

Andrew

- If the project is expanding it is important for the people to understand the benefits and negative impacts of the project. They would also like to know the status of environmental impacts, social benefits and legal compliance of the projects;
- He would also like that more meetings of this nature are held so that people can give more input.

- A villager who did not identify himself inquired if monitoring of seismic data in the project area was being done;
- He was informed that KENGEN has been monitoring seismic activity.

Minute 4: AOB

There being no other business the meeting closed at 5.30pm.

PUBLIC CONSULTATION MEETING : KENGEN OLKARIA I & IV PROJECT

ATTENDANCE LIST : KAMERE CENTRE

MKUTANO WA WANAKIJIJI KUELEZEA JUU YA MRADI WA KENGEN OLKARIA I NA IV

NAME / JINA	SIGNATURE / SAHIHI
Samuel Ndegwa [illegible]	[illegible]
WANJIRU KURIA	[illegible]
[illegible]	[illegible]
PAULINE WANGUI	[illegible]
JANET A. MATANO	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Anthony CHEPTAIS	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Margaret [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[redacted]

PUBLIC CONSULTATION MEETING KENGEN OLKARIA I $ IV PROJECT

ATTENDANCE LIST: KAMERE CENTRE

MKUTANO WA WANAKIJIJI KUELEZA JUU YA MRADI WA KENGEN OLKARIA I NA IV

NAME / JINA	SIGNATURE / SAHIHI
Geoffrey N. Chege ASST. Chief	[signature]
Antony W. Maihana	[signature]
David Ondondo	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible] Wanjiru	[signature]
[illegible]	[signature]
Wilson [illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
Timothy [illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible] Barasa	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]
[illegible]	[signature]

NAME / JINA	SAHIHI / SIGNATURE
[illegible] Kwelo	
Sabha Klaus	
Vincent Chibuzo	
Johnson Kuris	
Solomon [illegible]	
[illegible]	

NAME/JINA	SIGNATURE/SAHIHI
Josephine Amina	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible] Kimani	[illegible]
[illegible]	[illegible]

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

NGATTI FARMERS Maiella

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
25 Wairimu Mwangi	Yaita.	
26 Monera Wairimu	Kahuho	
27 Hannah Wambui	"	
28 Mary Wanjeru Muchiri	Dry.	
29 Silvia Hard	Maiella Centre.	
30. Ruth Wambui Kuria	Kahuho.	
31 Josphine Waithera K.	Ngungi.	
32. Mumbi Mwangi	Yaita.	
33 Kamau Kinuthia	Mukinyaini.	
34 Maina Kio.	Kawanguare	
35. Mwangi Mbogo	Mukuramuini.	
36 Kariuki Githinji	Yaita.	
37. Patrick Gichinga	Kahuho	
38. John Gathii	Gogoi.	
39 Kariuki Muchiri	Ngungi	
40 James Maina	"	
41 Alice Ngugi	Gogoi	
42 Richard Mwangi K.	Dry.	
43 Tabitha Muthoni	Kahuho	
44 Alice Waithera	"	
45 Simon Ngugi	Gogoi	
46 Rea Wanjiru	Yaita	
47 Grace Wanjiru Kuria	Kawanguare	
48 Tabitha Wambui	Maiella Centre	
49 Sarah Muthoni Ngugi	Ngungi.	
50 Hannah Wairimu Gitau	Ngungi.	
51 Wanjiru Kimani	Githanje	
52 Rahab Wanjiku	Kahuho	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS, FOR KENGEN OLKARIA IV PROJECT

NGATTI FARMERS

WE, THE UNDERSIGNED CONFIRM THAT WE ATTENDED THE ABOVE MEETING

SISI , AMBAO SAINI ZETU ZIKO HAPO CHINI, TUNATHIBITISHA TULIHUDHURIA KATIKA MKUTANO ULIOFANYIKA

DISTRICT/WILAYA: NAIVASHA DATE/TAREHE ____________ SAA/TIME ____________

NA KWAMBA KUMBUKUMBU ILIOAMBATANISHWA NI SAHIHI.

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
1 Allan Mburu K.	Kahuho.	
2 Roii Mugwe.	Dry.	
3 Njoroge M Kanini	Yatta	
4 Daniel Wanjohi M	Ngaguti	
5. Francis Mwangi K.	Kahuho	
6. Margret Ngendo N.	Kahuho	
7. Boniface Mucheru	"	
8 Lucia Njeri Kimani	Kahuho	
9. Lea Wairimu M.	Dry.	
10 Lucy Wambari Mwangi	Gaiano.	
11 Naomi Wambui	[illegible]	
12 Tabitha W Kimani	Mukuyaini	
13 Agnes Nyambura	Dry	
14 Teresiah Muthoni	Yatta	
15 Veronica Rurian	Ngaguti	
16 Susan M Wanjiru	Kahuho	
17 Sarah Njoki Ngenga	"	
18 Wangari Kihara	Yatta	
19. Mary Ngina	Kahuho	
20 Hannah Nyambura	Dry	
21 Susan Wanjiku	Dry.	
22 Elizabeth Kimani	Dry.	
24 Kuria W Kimani	[illegible]	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

NGATTI FARMERS.

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
Geoffrey Njuguna Kinyua	Yaida	
Michael Macharia	Yaida.	
Chege Maesha	Yaida	
Peter Mburu Thuita	Yaida.	
John Kimani	Mukuranduku	
Githongo Karagachu	Dry.	
John Muchiri	Gitamayu	
Francis Kimani	Dry	
James Mburu	Goitim	
Clement Kimani	Ngaunji.	
Joseph Mwangi	Yaida	
Francis Njoroge	"	
Richard Kamau	Ngaunji.	
Peter Waweru	Mukuranduku	
Paul Mbugua	Dry.	
Mbuthia Kamau	Gaiga	
Joseph Karanja	Mukuranduku	
Njoroge Kamiri	Dry.	
Francis Kimaingu	Maella Centre	
Paul Muiruri	Dry.	
Hiram Gitonga	"	
Chege Wakanyi	Ngaunji	
Ngaruiya Kanyanjua	Gitamayu	
Peter Njenga	Yaida	
Michael Ngugi	Dry C.	
Joseph Kimani	Gitamayu	
Githinji Kamau	"	
Kanandu Mbuga	Kamuthi	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

NGATTI FARMERS.

	Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
80	Benard Gitau	Yatta	
81	Isaac Ngerith	"	
82	Michael Ngugi	Gicheri	
83	David Njuguna	Ngugini	
84	Benson Kimani Kariuki	Mukuru	
85	Peter Kuria Kimani	Yatta	
86	Kio Murera	Kahuho	
87	Daniel Manu	Yatta	
88	Mwangi Nja	Kanyagwaru	
89	John Ngenga Karanja	Kahumbu	
90	Karuku Kimoi	Mukuru	
91	Bianett Kamau Chege	Dry	
92	Karanja Kigaini	"	
93	Clement Mwangi	Kahuho	
94	Elias Mrembo	Ngugini	
95	Kingara Mwaura	Kahuho	
96	Geras Thaga	Ngugini	
97	Kinyua Gathua	Githima	
98	Paul Njuguna	Ngugini	
99	John Mugo Karanja	Ngugini	
100	John Wakiba	Gicheri	
1	John Ngige Nganga	Dry	
2	Peterson Mungai Muhuka	Dry	
3	Njuguna Kamau	Gicheri	
4	Daniel Wainaina Chege	"	
5	Julius Mugai Wanjiru	Kahumbu	
6	Mugo Ruhiu	Yatta	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

NGATTI FARMERS

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
Gitau Muchiri	Mukorozweki	
Alan Mburu Mbugua	Dry	
David Kuria	Dry	
Simon Njenga Mukiri	Mukorotuku	
Kimani Kachanja	Yatta	
Mwangi Nganga	Gorigori	
Daniel Mwaniki	Dry	
Hassan Gathenu	Yatta	
Thiongo Karagacha	Dry	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

NGATTI FARMERS - Claim of Ownership of part of the land.

WE, THE UNDERSIGNED CONFIRM THAT WE ATTENDED THE ABOVE MEETING

SISI , AMBAO SAINI ZETU ZIKO HAPO CHINI, TUNATHIBITISHA TULIHUDHURIA KATIKA MKUTANO ULIOFANYIKA

DISTRICT/WILAYA: NAIVASHA **DATE/TAREHE** _____ **SAA/TIME** _____

NA KWAMBA KUMBUKUMBU ILIOAMBATANISHWA NI SAHIHI.

	Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
1	PATRICK KARANJA	CHAIRMAN NGATI	
2	PETER NGAHU MARA		
3	DAVID NJUGUNA KANGETHE		
4	FRANCIS M KURIA	CHIEF	
5	JULIUS MWANGI	ASS. CHIEF	
6	MUNSINGH MARUICI	COUNCILLOR	
7	[illegible]	[illegible]	
8	[illegible]	[illegible]	
9	[illegible]	[illegible]	
10	[illegible]	[illegible]	
11	[illegible]	[illegible]	
12	[illegible]	[illegible]	
13	[illegible]	[illegible]	
14	[illegible]	[illegible]	
15	[illegible]	[illegible]	
16	[illegible]	[illegible]	
17	[illegible]	[illegible]	
18	[illegible]	[illegible]	
19	[illegible]	[illegible]	
20	[illegible]	[illegible]	
21	[illegible]	[illegible]	
22	[illegible]	[illegible]	
23	[illegible]	[illegible]	

CONSULTATIONS WITH PROJECT AFFECTED PERSONS FOR KENGEN OLKARIA IV PROJECT

~~KENGEN STAFF~~ NGATTI FARMERS.

Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
WAIREGI M. NICHOLAS	KENGEN	[signature]
LIZ A NJAGA	KENGEN	[signature]
MARGARET N. KABUNYI	KENGEN	[signature]
Kimani ole Naiohe	Kahimanyo	
Gibson Ndungu	Maiella Centre	
Daniel Kihiko	Mukurautuku	
David Mwangi	Ngungi,	
Gladys Ihuo Mwangi	"	
Patrick Munga	Yaita	
Karanja	Yaita	
Kamau Kahero	Nguguini	
Kabiba Gitau	Ngugini	
Joseph Kamau	Mukurautuku	
Kageche Mbugua	Nguguini	
Karugi Mwaniki	Ary	
Simon Gachie	Nguguini	
Ngatwa Githua	Ary	
Peter Kimemia Kamau	Dry	
Gonni Muhia Muni	Ary	
Ngunga Wakaba	Goitii	
Njunge Gachuru	"	
Richard Macharia	Gathonga	
Gitungu	Kahunu	
Parapara	Nguguini	
Stephen Mbugua	Yaita	
Stephen Mwaura	Kamunyu	
Joseph Kamau Mburu	Kaw...	
Gideon Kagua	Kahuro	

Samuel Kuria	Mukurweini
Daniel Ngugi K.	Kahuro
Joseph Kihiu	"
David Kinyua	Kawangware
Joseph Gitonga	Ngurubani
John Mugo	Gitambaya
Philip Gitonga	Dry.
John Kariuki	Gaianoi
Joseph Mainai	Ngurubani
Mary Wambura R	Gocoi

	Name of Participant / Jina la Mshiriki	Village / Mkaazi kijiji / kata	Signature / Saini uthibitisho wa mahudhurio
53	Naomi Muragi W.	Nguhini	
54	Alice Mumbi Njugi	Kanangware	
55	Grace Wambiru	Dry	
56	Kamau Munia	Kahumbu	
57	Kimbe Mbiu	Kahuro	
58	Njeri Wangira	"	
59	Nancy Kuria	Yaita	
60	Kabiaa Mbugua	Gitambaya	
61	Antony Thumbi Mbau	Yaita	
62	Simon Mathari	Nguguini	
63	John Githiga	Mukurwe-ini	
64	Paul Njuguna	Gaiga	
65	Benard Kariuki	Yaita	
66	Paul Wanjau	Gaiga	
67	Njuguna Mwangi	Nguguini	
67	Ndegwa Njiru	Gaiga	
68	Kamjohn Kamau G.	Nguguini	
69	David Mwangi Murani	Maiella Centre	
70	James Mbugua	Dry	
71	Boniface Muuria	Nguguini	
72	Joseph Njogu N.	Gaiga	
73	Hannah Wambura	Nguguini	
74	Charles Mbugua	Town	
75	Simon Njeroge	Dry	
76	Ngugi Njoroge	Nguguini	
77	Geofrey Ricu	Yaita	
78	Peter Kabiu	Kahuro	
79	Bonface Kuria Muli	Yaita	

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I7 **Do you have any other comments about the proposed development?**

supportive, it will bring development to their locality.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	450
J1/2	Goats	100
J1/3	Sheep	200
J1/4	Pigs	
J1/5	Chicken	15
J1/6	Ducks	
J1/7	Other	Donkey 5

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Not a bad idea
Consider employing some community
members [illegible] to [illegible] raise [illegible] living standard

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	300
J1/2	Goats	
J1/3	Sheep	800
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- It is good but it should also help us through employment, scholarships for children education

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	10
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	6
J1/6	Ducks	
J1/7	Other	Donkey - 1

300

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- ensure unity is attained like during other project
- Ensure permanent employment opportunities
- Water accessibility to where we will be more

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	80
J1/2	Goats	600 & 500
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	Donkey – 10

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

It is really helpful to us as a community and Kenya in general & I highly welcome the project.
Thank you [illegible]

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	50
J1/2	Goats	} 20
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

don't count their goats & sheep [illegible]

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

- Electricity - security
- Water -

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	16
J1/2	Goats	90
J1/3	Sheep	200
J1/4	Pigs	~~X~~
J1/5	Chicken	~~X~~
J1/6	Ducks	~~X~~
J1/7	Other	Donkey - 4

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	50
J1/2	Goats	50
J1/3	Sheep	80
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	20
J1/2	Goats	20
J1/3	Sheep	50
J1/4	Pigs	—
J1/5	Chicken	—
J1/6	Ducks	—
J1/7	Other	—

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

- Provide jobs
- Build houses
- provide roads
- Security from animals
- provide water into households

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	100
J1/2	Goats	100
J1/3	Sheep	300
J1/4	Pigs	—
J1/5	Chicken	5 & 3 chicks
J1/6	Ducks	—
J1/7	Other	Donkey 4

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

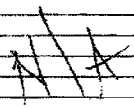
J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?



J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	50
J1/2	Goats	50
J1/3	Sheep	250
J1/4	Pigs	X
J1/5	Chicken	7
J1/6	Ducks	X
J1/7	Other	Donkeys 2

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- It would be better to benefit the community since the govt as well as the company

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	4
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

OL 3

[illegible]

I7 **Do you have any other comments about the proposed development?**

- Employment opportunities should be made available
- Access to electricity & water
- Roads development
- [illegible] implementation [illegible]

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	100
J1/2	Goats	50
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	40
J1/2	Goats	30
J1/3	Sheep	5
J1/4	Pigs	
J1/5	Chicken	100
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	5 2 [illegible]
J1/2	Goats	6 0
J1/3	Sheep	1 5 3
J1/4	Pigs	
J1/5	Chicken	1 1
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

To avoid confrontations like the Ngau issue it should be done in a humane organized manner. While compensation funds should be disbursed in the shortest time possible.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	Was 60 now 40
J1/2	Goats	40
J1/3	Sheep	70
J1/4	Pigs	
J1/5	Chicken	/
J1/6	Ducks	/
J1/7	Other	/

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

→ will improve economy right now we don't have enough elec. & there's rationing.
→ save on foreign x's by reducing import of power.
→ people should not live near the power plants, with its hazards. When he moved here, his eyes started being affected even though it had abated earlier.

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?** Kisii

J1/1	Cows	3
J1/2	Goats	0
J1/3	Sheep	0
J1/4	Pigs	0
J1/5	Chicken	Yes ~ like 15
J1/6	Ducks	10
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	40
J1/2	Goats	38
J1/3	Sheep	20
J1/4	Pigs	
J1/5	Chicken	10
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	20
J1/2	Goats	15
J1/3	Sheep	20
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- The project is good & the benefit is towards to improve the country's economy
- But we should also benefit from it through employment
- If the place we will be shifted to can access electricity it will be very nice

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	11
J1/2	Goats	60
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

} both goats & sheep are 60 (it is a taboo to count your livestock in our culture)

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

The project is good as they have to be responsible for the land.

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	4
J1/2	Goats	Lots
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

hunting as they are used to live alone
used to eating meat from the domestic
but have 2 [illegible]

i7 **Do you have any other comments about the proposed development?**

-ve - and they fear not for the idea to [illegible] but has no way no other choice.

- climate change.

+ve - no complain and compensation investigation is taken care of.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?** [illegible]

J1/1	Cows	5
J1/2	Goats	39
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	20
J1/6	Ducks	
J1/7	Other	

Donkey 2

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

I agree with the project but I should be involved in one of the activities because they are in my land.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	2
J1/2	Goats	4
J1/3	Sheep	3
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

NONE

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

	3 problem

17 **Do you have any other comments about the proposed development?**

The piece of land should be enough for livestock keeping and fertile enough to grow crops. Roads should be tarred. [illegible] of [illegible] even before the time of relocation. There should be no use of force.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	15
J1/3	Sheep	57
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

→ It's good and happy [illegible] help them and compensate them for they are also human[illegible]

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	**Cows**	
J1/2	**Goats**	
J1/3	**Sheep**	
J1/4	**Pigs**	
J1/5	**Chicken**	
J1/6	**Ducks**	
J1/7	**Other**	

N/A

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

Supportive, as long as they are consulted well and in a transparent way

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	25 -> 28
J1/3	Sheep	7
J1/4	Pigs	
J1/5	Chicken	10
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

	Problem to earn a livelihood

I7 **Do you have any other comments about the proposed development?**

Pleased not oppose the development but the area to be moved is has to be acceptable to them

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	N/A
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

- I would like to get a nice place to also farm
- The project is good because it will not only improve our living standards as a country but will also promote our tourism & investment

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	5
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

Supportive, but want to be well taken care of in resettlement.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	X
J1/2	Goats	XX
J1/3	Sheep	XX
J1/4	Pigs	X
J1/5	Chicken	XX
J1/6	Ducks	X
J1/7	Other	X

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Sweet – Their major concern is that the company did not regard them before and they never recognized that and did not assist them.
- Have cases of those dead of diseases unknown of the cases affected them – will they be compensated?

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	30
J1/2	Goats	43
J1/3	Sheep	27
J1/4	Pigs	—
J1/5	Chicken	10
J1/6	Ducks	—
J1/7	Other	—

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Should be ~~people~~ adequate information passing.
- Should be relocated to places where they live as they are currently — as close neighbours.

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	15
J1/2	Goats	11
J1/3	Sheep	30
J1/4	Pigs	—
J1/5	Chicken	—
J1/6	Ducks	—
J1/7	Other	—

Thank the respondent for their time and co-operation!

Owns two structures.

I7 **Do you have any other comments about the proposed development?**

Job allocations - and promptly
casuals or permanent

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	5
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

As long as the resettlement is worthwhile life is ok.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

N/A

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

Job opportunities
food availability — water availability

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	X
J1/2	Goats	X
J1/3	Sheep	X
J1/4	Pigs	X
J1/5	Chicken	X
J1/6	Ducks	X
J1/7	Other	X

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

N/A

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own? N/A

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

There could be no school around
" " " " water supply
" would " adjoining [illegible]

I7 **Do you have any other comments about the proposed development?**

- to not want to move

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	20
J1/2	Goats	126
J1/3	Sheep	2[illegible]
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!

- there may be no water
- there will be no firewood
- " " " " no school

I7 **Do you have any other comments about the proposed development?**

- This not a good idea because they do not want to move

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	100
J1/2	Goats	1000
J1/3	Sheep	
J1/4	Pigs	-
J1/5	Chicken	3
J1/6	Ducks	-
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- The project has not affected anything even my livestock so I do not see why we are being moved but I guess its a nice project to help the whole County

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	5
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

	They are ready to ask if the relocation is peaceful?

I7 **Do you have any other comments about the proposed development?**

It's producing electricity for the whole country so they are ready to cooperate and they are happy they considered dialogue.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do** you own?

J1/1	Cows	[illegible]
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

Air pollution

Am happy for the project but we would have to gain from it

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	30 5
J1/3	Sheep	25
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

They should implement the resettlement plan

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

N/A

Thank the respondent for their time and co-operation!!

	The Neighbours

I7 **Do you have any other comments about the proposed development?**

This should not be approved.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	2
J1/2	Goats	8
J1/3	Sheep	15
J1/4	Pigs	
J1/5	Chicken	2
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Provide electricity
- Employment

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	12
J1/2	Goats	60
J1/3	Sheep	30
J1/4	Pigs	N/A
J1/5	Chicken	12
J1/6	Ducks	
J1/7	Other	Donkeys

Thank the respondent for their time and co-operation!!

i7 **Do you have any other comments about the proposed development?**

- Get back their businesses they used to do at the [illegible] [illegible] coz they need to stop
- Employment.
- Would like to know if they relocate how will their business continue esp selling [illegible] to the tourists.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	5
J1/2	Goats	~~40~~ 20
J1/3	Sheep	20
J1/4	Pigs	N/A
J1/5	Chicken	3
J1/6	Ducks	N/A
J1/7	Other	N/A

Thank the respondent for their time and co-operation!!

lack of employment

17 **Do you have any other comments about the proposed development?**

- positive change the project bringing
- provide employment (workers) to the people

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	N/A
J1/2	Goats	50
J1/3	Sheep	50
J1/4	Pigs	N/A
J1/5	Chicken	N/A
J1/6	Ducks	N/A
J1/7	Other	[illegible]

Donkey 1

Thank the respondent for their time and co-operation!!

- Consider health / Education, Fire wood etc.
- Unfamiliarity with the Place.

- NOT knowing what is going on.
esp. Women & Children.
- Let it be shown where they are going.
- Access to amenities (hosp, Education etc)

I7 **Do you have any other comments about the proposed development?**

- We have children - Must continue
- Livestock ways; Chakula - Mifugo.
- Ukuaji - Chakula ya binadamu.
- Kampuni - Kutoa Credit Services hosp.
- Tukumilikwe Wanapoenda wanaelewa huko.
- Assurity of place to be livable (habitable).

NB - When relocated let there be an agreement of the action (any pple as human beings not animals.
- Note this is because of previous injustices considered.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

N/A

Thank the respondent for their time and co-operation!!

- Note; concern on where to be relocated - Maasai of the community don't want to be relocated to [illegible] [illegible] [illegible] [illegible] [illegible]
- (Security)
- community livelihood

moving kids to a different school & climate
- Employment (Kengen Provide casual jobs)
- What comments will [illegible] .

I7 **Do you have any other comments about the proposed development?**

- Provide Employment if he [illegible] to move from [illegible] [illegible]
- Good environment [illegible] due to the children

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	10
J1/2	Goats	30
J1/3	Sheep	50
J1/4	Pigs	N/A
J1/5	Chicken	10
J1/6	Ducks	
J1/7	Other	1 cat [illegible] dogs.

Thank the respondent for their time and co-operation!!

CC

I7 **Do you have any other comments about the proposed development?**

- Its a good thing (development).
- Assistance kwa kujenga / na ~~kwa~~ kuendeleza mashua vile tuko hasa hii.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	10
J1/2	Goats	40.
J1/3	Sheep	40.
J1/4	Pigs	None
J1/5	Chicken	10
J1/6	Ducks	NON
J1/7	Other	—

Thank the respondent for their time and co-operation!!

OL1

I7 Do you have any other comments about the proposed development?

No Comment

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	10
J1/2	Goats	200
J1/3	Sheep	
J1/4	Pigs	—
J1/5	Chicken	—
J1/6	Ducks	—
J1/7	Other	Donkey — 3.

100 } 200.
100 }

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

- Notice to be given in good time.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	80
J1/2	Goats	50
J1/3	Sheep	130
J1/4	Pigs	—
J1/5	Chicken	—
J1/6	Ducks	—
J1/7	Other	

Donkey - 2

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- We want Kenmare's help like neighbour in terms of employment – permanent
- Shule, Kanjenanga [illegible]
- Hospitali, Kanjenjwa –
- Maji – Kambe Jingumba – pipe.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	117
J1/2	Goats	374
J1/3	Sheep	200
J1/4	Pigs	–
J1/5	Chicken	–
J1/6	Ducks	–
J1/7	Other	

Donkey – 20.

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

1 - Please consult before relocation with the community.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	200
J1/2	Goats	600
J1/3	Sheep	
J1/4	Pigs	—
J1/5	Chicken	6
J1/6	Ducks	—
J1/7	Other	

200 / 400 } 600.

Punda (Donkeys) - 7.

Thank the respondent for their time and co-operation!!

I7 Do you have any other comments about the proposed development?

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	25
J1/2	Goats	60
J1/3	Sheep	90
J1/4	Pigs	—
J1/5	Chicken	30
J1/6	Ducks	—
J1/7	Other	Donkey — 1

Thank the respondent for their time and co-operation!

I7 **Do you have any other comments about the proposed development?**

- The day of relocations lets be given enough time to prepare.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	20
J1/2	Goats	150
J1/3	Sheep	100
J1/4	Pigs	—
J1/5	Chicken	—
J1/6	Ducks	—
J1/7	Other	Found a Donkey — 10.

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	20
J1/2	Goats	20
J1/3	Sheep	5
J1/4	Pigs	
J1/5	Chicken	3
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

- Still not get food
- " " " water
- " " " [illegible]

I7 **Do you have any other comments about the proposed development?**

- They need to find a place for them to move and the same assistance she has been getting to be provided, her children to have something to eat and a school to go to.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	20
J1/2	Goats	30 [illegible]
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

Supportive: does not think that the change will have any bad effect on them.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	40
J1/2	Goats	30
J1/3	Sheep	300
J1/4	Pigs	
J1/5	Chicken	200
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

	- Destroying during relocation

I7 **Do you have any other comments about the proposed development?**

- wants a share of the good things that will come out of the project.
- wants employment.
- wants to better the living condition of the family through this project.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	200.
J1/2	Goats	600 5
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	5.
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

The project is a good idea especially if Jangani can get them a share of the good that will come out of it.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	50
J1/2	Goats	100
J1/3	Sheep	200
J1/4	Pigs	
J1/5	Chicken	10
J1/6	Ducks	
J1/7	Other	donkey 2

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

Would like to be informed before dalling and construction starts

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	300
J1/2	Goats	1000
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- ITS a priviledge to me because of employment
- Children's education scholarship
- Electricity providence to Kungu as a whole

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	50
J1/2	Goats	} 200
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	Donkey - 5

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Request if this project can offer Scholarship and Permanent employment and also benefit the Community that has occupied this land for many years

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	20
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	6
J1/6	Ducks	
J1/7	Other	Donkey - 3

½ 50

Thank the respondent for their time and co-operation!!

→ It may be difficult to access water, shops & other amenities in the new area.

I7 **Do you have any other comments about the proposed development?**

→ Should be shown the new area before being resettled

→ There should be [illegible] in livestock to make the people [illegible]

[illegible]

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	10
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

0LJ

I7 **Do you have any other comments about the proposed development?**

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	26
J1/2	Goats	56
J1/3	Sheep	71
J1/4	Pigs	
J1/5	Chicken	24
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	250
J1/2	Goats	260
J1/3	Sheep	311
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	20
J1/2	Goats	40
J1/3	Sheep	50
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	130
J1/2	Goats	30
J1/3	Sheep	150
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

To be able to provide a laundry and bathroom option

Building plots for the other siblings

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	X
J1/2	Goats	X
J1/3	Sheep	X
J1/4	Pigs	X
J1/5	Chicken	X
J1/6	Ducks	X
J1/7	Other	X

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	15
J1/2	Goats	15
J1/3	Sheep	12
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Water provision
- [illegible] compensation
- Access to hospital
- Good roads

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	6
J1/2	Goats	50
J1/3	Sheep	
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- If it is possible can we get electricity?
- Fikia should not be [illegible] relocation should [illegible]
- Hospitals improved schools.
- Should be allowed to pass through the gate when taking [illegible] to hospital

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	100
J1/2	Goats	150
J1/3	Sheep	200
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Let it continue as it will contribute to growth of the country

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	
J1/2	Goats	12
J1/3	Sheep	14
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

Loss of neighbourhood & friends if relocated

I7 **Do you have any other comments about the proposed development?**

Provide employment

Provide education for children.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	2
J1/2	Goats	7
J1/3	Sheep	10
J1/4	Pigs	N/A
J1/5	Chicken	N/A
J1/6	Ducks	N/A
J1/7	Other	N/A

Thank the respondent for their time and co-operation!!

	Not sure if could access firewood + charcoal
	Loss of neighbourhood + friends

I7 **Do you have any other comments about the proposed development?**

Employment required
Benefits
Spouse education to be considered

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	6
J1/2	Goats	10
J1/3	Sheep	30
J1/4	Pigs	N/A
J1/5	Chicken	7
J1/6	Ducks	
J1/7	Other	1 Cat 3 Dogs

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

— to be given land & comfortable settlement.

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	17
J1/2	Goats	7
J1/3	Sheep	43
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

donkey - 3

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

It will be good if it reduces [illegible] and the isolation of the area especially access to communication line & medical facilities and electricity

J LIVESTOCK OWNERSHIP

J1 **How many Livestock do you own?**

J1/1	Cows	
J1/2	Goats	6
J1/3	Sheep	14
J1/4	Pigs	
J1/5	Chicken	[illegible]
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

Supportive as it provides use of natural resources and brings development.

Negative due to the resettlement [illegible] [illegible] [illegible] security and accessibility to infrastructure and utilities.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	11
J1/2	Goats	13
J1/3	Sheep	8
J1/4	Pigs	-
J1/5	Chicken	20
J1/6	Ducks	-
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

this good.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	70
J1/2	Goats	100
J1/3	Sheep	300
J1/4	Pigs	
J1/5	Chicken	20
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

-> Kengen should be sincere with the community to avoid anger from them.

-> It should fully compensate them with their current measures (situation).

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	150
J1/2	Goats	3Nil
J1/3	Sheep	10
J1/4	Pigs	
J1/5	Chicken	10
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

— The Compensation Should be done according to what they own.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	240 340
J1/2	Goats	100
J1/3	Sheep	300 1500
J1/4	Pigs	
J1/5	Chicken	
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

- Reasons to create more employment for them for they have given them to land.

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	160.
J1/2	Goats	200.
J1/3	Sheep	520
J1/4	Pigs	
J1/5	Chicken	10.
J1/6	Ducks	
J1/7	Other	

Thank the respondent for their time and co-operation!!

I7 **Do you have any other comments about the proposed development?**

→ It's good & we are happy Kengen has appreciated us but should not fool us but compensate us fully and appropriate.

J **LIVESTOCK OWNERSHIP**

J1 **How many Livestock do you own?**

J1/1	Cows	200
J1/2	Goats	100
J1/3	Sheep	700
J1/4	Pigs	
J1/5	Chicken	20
J1/6	Ducks	
J1/7	Other	

Dog – 5 Donkey – 7

Thank the respondent for their time and co-operation!!

OL 2.

I7 Do you have any other comments about the proposed development?

It to be fully compensated

J LIVESTOCK OWNERSHIP

J1 How many Livestock do you own?

J1/1	Cows	20
J1/2	Goats	100
J1/3	Sheep	150
J1/4	Pigs	
J1/5	Chicken	5
J1/6	Ducks	
J1/7	Other	

Bee 4 Donkey - 4

Thank the respondent for their time and co-operation!!

Appendix 4 Photographs

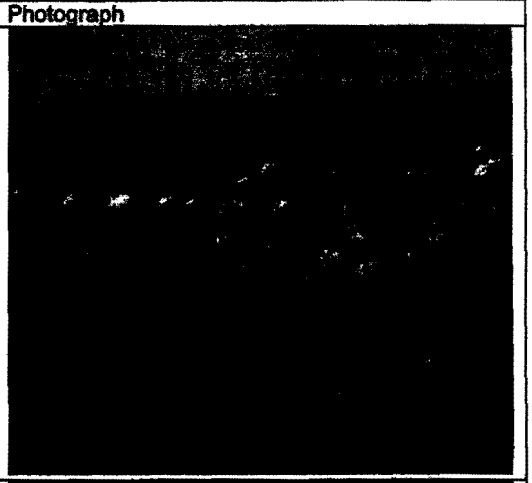
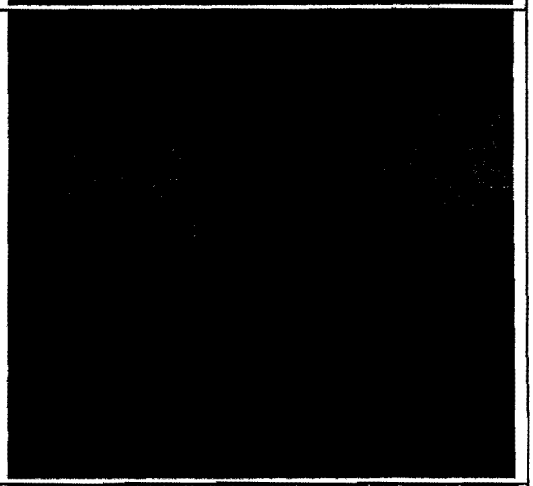
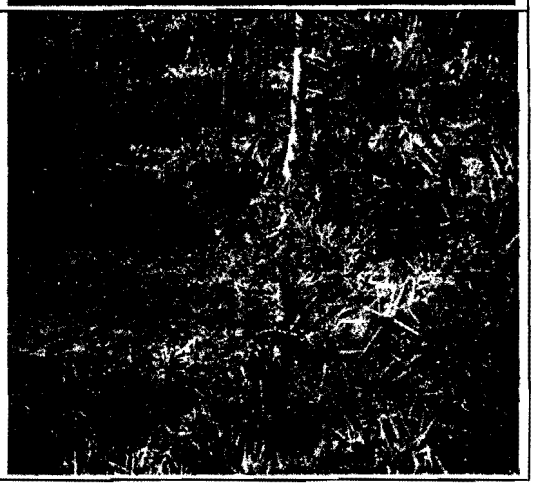
Plate	Description	Photograph
Plate 1	Olkaria Domes Area and exisitng exploration wells	
P ate 2	General Landscape in the Project Area	
Plate 3	Vegetation in the general project area.	

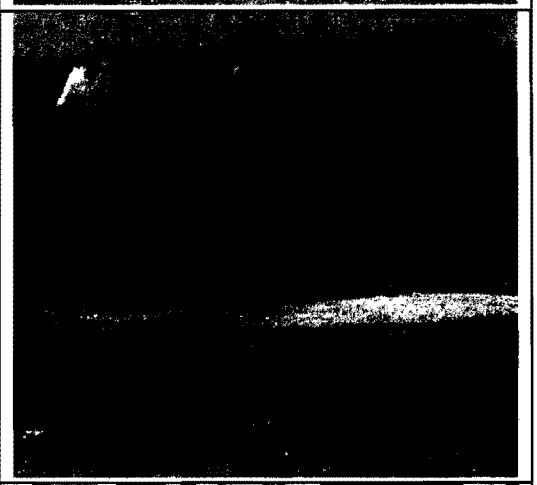
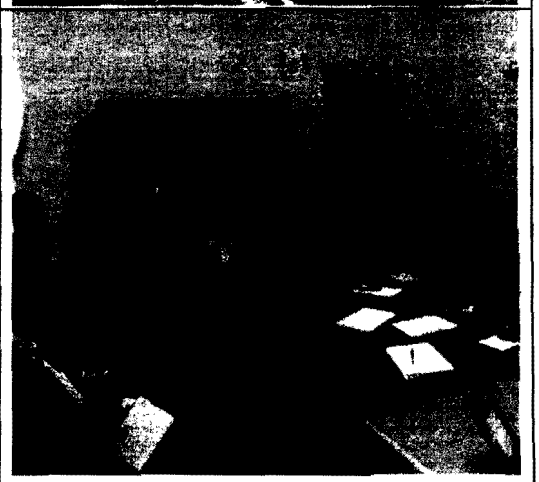
Plate	Description	Photograph
Plate 4	Settlements in the Project Area: Maasai Cultural Centre	
Plate 5	Olo Nongot Settlement.	
Plate 6	Participants at Initial Public Meeting for Community representatives for Maasai Manyattas in Project Area.	

Plate	Description	Photograph
Plate 7	Public Barazas with residents of neighbouring settlements outside the Project area.	
Plate 8	Public Consultation Meeting with Naivasha District Officers and Chiefs	
P ate 9	Existing Infrastructure at the Power Station	

Appendix 5 KENGEN's Geothermal License

THE REPUBLIC OF KENYA

MINISTRY OF ENERGY

THE GEOTHERMAL RESOURCES ACT, 1982
(Act No.12 of 1982)

AND

THE GEOTHERMAL RESOURCES REGULATIONS, 1990
Geothermal Resources Licence No 172008

This Geothermal Resources Licence is granted this 19th day of September, 2008 by the Minister for Energy to Kenya Electricity Generating Company (KenGen), Stima Plaza, Kolobot Road, Parklands of P.O. Box 47936, 00100, Nairobi, Kenya (the "Licensee") pursuant to the Geothermal Resources Act, 1982 (the "Act") and the Geothermal Resources Regulations, 1990 (the "Regulations")

1. The Licensee is hereby granted the following exclusive rights:

(a) The right and privilege to enter and explore, drill for, extract, produce, utilise and dispose of geothermal steam and associated geothermal resources in or under the land described in Appendix I and shown on the map set forth in Appendix II hereof (the "Licence Area");

(b) The right to construct or erect and to use, operate and maintain within the Licence Area, together with ingress and egress there upon all wells, pumps, pipes, pipelines, buildings, plants, sumps, lined pits, reservoirs, tanks, waterworks, pumping stations, steam electric power generating plant, transmission lines, substations, facilities, electric transformers or telephone lines or cables and such other works and structures and to use so much of the surface of the land in the Licence Area as may be necessary or convenient for the production, utilisation and processing of geothermal resources or for the fur

enjoyment of the rights granted hereunder, subject to compliance with all applicable laws and regulations.

(c) In so far as it may be necessary for and in connection with the operations described in this Licence, the right to:

(i) drill and construct all necessary boreholes;

(ii) erect, construct and maintain houses and buildings for the Licensee's own use and for use by the Licensee's employees;

(iii) erect, construct and maintain plant, machinery, buildings and other erections as may be necessary;

(iv) utilize the geothermal resources;

(v) subject to the Water Act 2000, reclaim and utilise any water; and

(vi) construct and maintain roads and other means of communication and convenience;

subject to compliance with the Environment Management and Co-ordination Act 1999, relevant environmental regulations and all other applicable laws and regulations.

(d). The rights to take, use or apply the geothermal resources for the purpose of generating electric power at Olkaria II power station.

2. The rights granted shall be for a term of thirty (30) years from the date hereof and such term be renewed at the option of the Licensee, for one further period of five (5) years ; provided the Licensee has complied with all the terms hereof and subject to such terms and conditions as the Minister thinks fit

3 The Licensee shall pay the Minister for the grant of the rights and privileges under this Licence:

(i) yearly in advance a rental of about Kshs. Fifty Three (Kshs [illegible]) per hectare amounting to Kshs. One million (Kshs. [illegible]) for each and every year or part thereof for which this licence is in effect and if such rent is not paid within three months of becoming due, a penalty of ten percent (10%) shall be payable as if it were part of the rent

(b) a royalty of nought percent (0%) of the value of each kilowatt hour sold by the Licensee.

4. The licensee shall comply with the provisions of the Regulations and the drilling conditions specified in the Second Schedule thereto.

5. The Licensee shall carry out an appraisal of the geothermal resources in the Licence Area. The Minister designates the Chief Geologist of the Ministry of Energy, as his authorised representative for the purpose of receiving results of any geothermal appraisal programme and other written reports required under the Act or the Regulations.

6. The Licensee shall not transfer or assign this License or any part thereof without the consent of the Minister signified by endorsement hereon, which consent shall not be unreasonably withheld.

7. The Licensee shall conduct operations under this Licence in workmanlike manner and in accordance with all applicable statutes and regulations to prevent bodily injury, danger to life or health or damage to property.

8. The Licensee shall comply where appropriate with the Health and Safety Guidelines as set out in the relevant Laws of Kenya and in the absence of such laws with the most recent World Bank guidelines currently in force, where appropriate.

9. The Licensee shall keep open at all reasonable times for the inspection of the duly authorised representative of the Minister, the Licence Area and all such improvements, machinery and fixtures thereon and all pertinent records, maps, reports, books of accounts relative to the operations under the Licence Area.

10. The Licensee shall:

(a) [illegible] to the Minister for any damage suffered by the Minister to other rights existing in or connected with the Licensee's activity and operations conducted pursuant to this Licence except where damage is caused by employees or representatives of the Minister;

(b) [illegible]

licence) and if the same are not so removed they may be sold by auction at the risk of the Licensee.

(c) The net proceeds of the sale conducted pursuant to paragraph (b) shall be held by the Minister until applied for by the Licensee but may be used in the repair of breaches or faults not made good by the Licensee and for payment of the costs incurred in conducting the sale. Any costs incurred in such repair of breaches or faults or in conducting any sale shall be in accordance with the usual or customary rates for the type of expenditure involved and in all cases shall be reasonable and fair.

34 (a) The Minister may, at the request of the Licensee, make available to the Licensee such land as the Licensee may reasonably require for the conduct of operations under this Licence and:

(i) where such land is trust land, the Minister shall procure that Government shall, subject to paragraph (b) of this clause set apart such trust land in the License Area in accordance with the Trust Land Act (Cap.288) and Chapter IX of the Constitution;

(ii) (1) where such land is private land, the Minister shall procure that the Government of Kenya acquires the land in accordance with the applicable laws.

(2) Prior to the Licensee requesting the Minister to make available to the Licensee private land for conduct of operations under this Licence, the Licensee shall first enter into negotiations with the owner or occupier of such private land for granting of the required permission or authorisation or for the acquisition of the required permission or authorisation or for the acquisition of the required interest (including way leave) over such land.

(3) In the event that the owner or occupier of any such private land fails to grant to the Licensee the required permission, authorisation or interest in the land within one hundred and twenty (120) days of commencement of negotiations between the Licensee and such owner or occupier, the Minister shall procure the Government to obtain in accordance with the applicable laws, the

required permission, authorisation or other interest in the land;

(4) In carrying out negotiations with the owner or occupier of private land, the Licensee shall act diligently. For the purpose of this clause "**diligently**" shall include pursuing all reasonably available procedures for obtaining the required permission, authorization or interest in land, including the offer of a rent or purchase price or other consideration which a person carrying out the Licensee's activities would reasonably expect to pay for the grant of such permission or authorization or interest in land,

(iii) where such land is within a "**National Park**" or "**National Reserve**" within the meaning of the Wildlife (Conservation and Management) Act, (Cap 376) the Minister shall procure the Government to obtain all necessary consents and authorizations from a competent authority. The Licensee shall on its part provide the Minister with a sufficient description of the area required for its operations and supply such other information as may be required by the Minister or the competent authority for the issue of such consent or authorization;

(iv) The Licensee shall pay or reimburse the Minister any reasonable compensation that may be required for obtaining permission, authorization or interest, or for the setting apart use or acquisition of any land as the Licensee may reasonably require for the conduct of operations under this Licence.

(b) Where the Licensee has occupied trust land for the purpose of its operations before that land has been set apart, the Licensee shall notify the Minister in writing of the need to set apart such land before the end of the two (2) years period referred to in Section [illegible] of the Constitution.

(c) The Minister shall procure that the Government shall grant or cause to be granted to the Licensee and its contractors and sub contractors such way leaves, easements, temporary occupation or other permissions within and (if necessary) without the [illegible] Area as are necessary to conduct such operations and in particular for the purpose of laying, operating and maintaining [illegible] lines, cables, communication facilities, road and rights of [illegible]

(d) The Minister shall procure that the Government shall at all times give the Licensee and its contractors and sub contractors the right of ingress to and egress from the Licence Area to and from, in particular, the facilities wherever located for the conduct of operations under this Licence.

15. The Minister shall, subject to applicable laws and regulations, obtain for the Licensee any permit necessary to enable the Licensee to use the water in the Licensee Area for the purpose of operations under this Licence but the Licensee shall not unreasonably deprive the users of land, domestic settlement or cattle watering place of the water supply to which they are accustomed.

16. The Licensee shall, where applicable, pay compensation as required by Section 19 of the Act.

17. Where the Licensee intends to occupy or disturb the surface of any particular area of private land or to disturb or otherwise interfere with any crops, trees, buildings or works thereon, the Licensee shall give not less than twenty one (21) days notice in writing of his intention to the person in visible and immediate occupation of the land affected thereby and if practicable to the owner of the land, and shall comply with Section 20 of the Act.

18. (a) The Licensee shall notify the Minister, before operations begin, of the name and address of the person resident in Kenya who will supervise the operations under this Licence and prior notice of any subsequent change shall be given to the Minister.

(b) (i) Every notice demand or other communication under this Licence shall be in writing and may be delivered personally or by letter or facsimile transmission despatched by the parties to each other in accordance with the details set out below or to such other address and/or facsimile number as the parties may notify each other in accordance with this clause for the purpose:

The Licensee:

The Managing Director
Kenya Electricity Generating Company (Kengen) Limited
Kengen Plaza, Kolobot Road, Parklands
P.O. Box 47936, 00100
NAIROBI, KENYA

The Minister:
Ministry of Energy
Nyayo House
P. O. Box 30582, 00100
NAIROBI

(ii) Every notice, demand or other communication shall be deemed to have been received (if sent by post) twenty-four hours after being posted first class postage prepaid (if posted from and to an address within Kenya) or 5 working days after being posted prepaid airmail (if posted from or to an address outside Kenya) at the time of actual delivery or (in the case of a facsimile transmission) receipt if during normal business hours on a working day in the place of intended receipt or to the facsimile transmission number specified above, and otherwise at the opening of business in that number on the next succeeding such day.

19. (a) Where the Minister or the Licensee is prevented from complying with this Licence by *force majeure*, the party affected shall promptly give written notice to the other and the obligations of the affected party shall be suspended, provided that party shall do all things reasonable within its power to remove such cause of *force majeure*. Upon cessation of the *force majeure* event, the party not affected shall promptly notify the other party.

(b) In this clause, "*force majeure*" means an occurrence beyond the reasonable control of the Minister or of the Licensee which prevents either of them from performing their obligations under this Licence.

(c) For the purpose of this clause promptly shall be deemed to mean a period of twenty one (21) days.

(d) Where the party not affected disputes the existence of the *force majeure* that dispute shall be referred to arbitration in accordance with the provisions for arbitration contained in this Licence.

(e) Where an obligation is suspended by *force majeure* for more than three (3) years, the parties may agree to terminate this Licence by notice in writing without further obligations.

Appendix 6 MoU between KENGEN and KWS on infrastructural Developments in Hells Gate National Park

MEMORANDUM OF UNDERSTANDING (MoU)

BETWEEN

KENYA WILDLIFE SERVICE

AND

KENYA ELECTRICITY GENERATING COMPANY

GEOTHERMAL DEVELOPMENT IN HELL'S GATE AND LONGONOT NATIONAL PARKS

THIS Memorandum of Understanding (MoU) is made the [illegible] of February Two Thousand and Eight between KENYA WILDL[illegible]E, a body corporate established under the Wildlife (Conservation and Management) Act, Cap 376 of the Laws of Kenya, whose address is Langata Road, Post Office Box Number 40241, Nairobi in the Republic of Kenya (hereinafter called "the Service") of the one part and THE KENYA ELECTRICITY GENERATING COMPANY LIMITED, a limited liability company incorporated under the Companies Act, Cap 486 of the Laws of Kenya and whose address is Post Office Box Number 47936, Nairobi (hereinafter called "the Company") of the other part.

WHEREAS:

A The Service is legally entrusted with the management of Hell's Gate and Longonot National Parks and the conservation of all types of fauna and flora found therein.

B The Company is involved in the exploration and production of geothermal power within the environs of Hell's Gate and Longonot National Park by virtue of Gazette Notice No. 585 dated 2nd March, 1973.

C The Service has no objection to the Company engaging in the exploration and production of geothermal power/energy within the said National Parks.

PURPOSE

This MoU is entered into by the parties to ensure proper co-existence and safeguard the interests of the two parties and therefore it shall operate so long as the need for the parties to work in the same environment and area exists.

NOW THIS MoU WITNESSETH that it is hereby agreed and declared by and between the parties hereto as follows:

In this MoU, unless the context otherwise requires

'Agent' means a person appointed by the Company to act on his behalf

'Company Premises' means all and any part of or portion of Nakuru Park that the Service shall by way of lease or otherwise transfer to the Company for its use.

'Contractor' means a person contracted by the Company carry out work, or to provide supplies under a specific contract

'Flora" means all the plants of a particular area or period of time

'Fauna' means all animals of a particular area or period

"National Park' means any area of land declared to be a National Park under section 7 of the Wildlife Act Cap 376

"Reinjection' means the process of returning separated geothermal wastewater back to the Geothermal Reservoir

"Term" means the term of this Memorandum of Understanding

'Visitor' means one who visits the Company premises, on the Company's invitation or to carry out official business with the company.

ARTICLE 1: ENVIRONMENTAL CONSERVATION

The Service shall regularly educate the staff of the Company on the national parks rules and regulations particularly with regard to their interaction with wild animals proper disposal of litter and proper handling of park visitors by the Company's staff and Security contractor of the he eries

1.1 Flora

The impacts on flora are assessed as being due to impacts during construction namely removal and destruction of vegetation in areas to be cleared for roads, buildings and other structures.

(a) The Company shall not remove any natural vegetation unless it is absolutely essential for example in the construction of infrastructure or propagation in which event such physical removal shall be kept to the minimum

(b) The Company shall deep-re-inject all waste water and brine if possible in future power stations and production fields in order to recharge the Reservoir and avoid any pollution of the environment

(c) The Company shall reduce surface discharge and well testing period to the lowest minimum possible

(d) The Company shall in collaboration with the Service, ensure that all opportunistic plant species that may have been introduced in the process of earthworks shall be uprooted and burned at designated areas so as to prevent them the spread of the species

Such species and any other species classified by the Service for destruction by the Company

(e) The Company shall, in collaboration with the Service's herbarium, immediately rehabilitate all areas cleared of flora by planting appropriate indigenous plant species. Such species shall be classified as appropriate by the Service and shall be planted by the Company in the cleared areas

(f) The Company shall give to the Service a schedule for any rehabilitation of cleared areas and will place signs to indicate such areas that will be undergoing the said rehabilitation

(g) Both parties shall by all means possible jointly endeavour to continuously monitor the abundance and diversity of natural vegetation

1.2 Fauna

The main areas of concern are loss of habitat from a variety of causes, the waste being used for drinking water by animals and the death of animals through road accidents by speeding vehicles

(a) The Service and the Company shall only fence such areas, as both parties shall have identified as dangerous or appropriate for the protection of people. Such fences shall not enclose animals

(b) The Company in consultation with the Service shall ensure that pipelines and any other earthworks that obstruct identified animal movement paths are identified early and are taken into consideration and incorporated into the design

(c) Both parties shall erect speed bumps and other reasonable barriers on road sections identified by the Service to have animal paths for the purpose of eliminating the danger caused to animals by over-speeding motor vehicles.

(d) Both parties shall ensure that night movement of motor vehicles in the National Parks is not allowed with exception of essential Company operations and necessary park patrols

1.3 Soil

Studies carried out during the EIA study of Olkaria II power station concluded that the potential for erosion by water in Hells Gate and Longonot Parks is high. If appropriate and timely erosion control techniques are used impacts can be kept to a minimum and acceptable level

(a) The Company shall minimize cutting slopes in its areas of operation and fill earthworks.

(b) The Company shall maintain all roads associated with new power stations as agreed upon by both parties.

(c) Both parties shall monitor the effectiveness of erosion control measures by making regular visual inspections at construction sites and annually in operation phases. If the erosion control measures are not found to be sufficient, the Company shall take the necessary remedial action to implement more effective measures to the satisfaction of the service.

(d) The Company shall nominate an officer to monitor soil conservation operations and the officer shall have sufficient authority in matters regarding soil conservation

(e) Both parties shall exchange information on research in soil erosion control and research on soil conservation generally in the parks

1.4 Air

The approach for air quality impacts used is the use of dispersion model with the on-site meteorological data to estimate ground level concentration of hydrogen sulphide

(a) The Company shall continue meteorological monitoring at identified sites agreed upon by both parties and utilize any data collected to ensure good quality of air in and around the park. The Company shall regularly avail to the Service details of efforts to minimize air pollution resulting from geothermal and utilization

(b) The Company shall always monitor hydrogen sulphide as an endeavour to verify the prediction made by dispersion modeling and such model must be fine-tuned so that the Company may have an improved tool to assess impacts and to provide further data for other environmental monitoring programmes such as vegetation monitoring. The Company shall avail such data to the Service at agreed intervals.

1.5 Noise

Noise impact assessment is undertaken for well –testing, construction and operational phases of the project

(a) The Company shall regularly monitor noise levels in areas settled by the Service's staff and at different vantage points.

(b) Both parties shall make their own arrangements to use rotational allocation of duties programme for their staff at stations where noise levels are above WHO acceptable limits for long periods.

(c) Both parties shall avail detailed and exhaustive information on noise levels in the park and forewarn park visitors of the excessive noise emitted by wells under test. The information will generally be transmitted through the Service's outlets in form of brochures and guidebooks.

ARTICLE 2: TOURISM PLANNING AND AESTHETICS

(a) Both parties shall from time to time hold joint meetings to discuss and agree on plans for expansion of development. In this regard, each party shall have at least one of its members co-opted in the other party's planning committees at all times during the existence of this MoU.

(b) Subject to the Service's consent, both parties may discuss and agree on road designs and construction for the purpose of harmonizing the transport network within Hell's Gate and Longonot National Parks.

(c) The Company undertakes to plant sufficient and suitable trees to obscure the view of power stations and enhance the natural features of the park.

(d) Both parties shall be responsible for enhancing safety and security in the parks for visitors and their staff.

(e) The Company shall, in consultation with the Service, plant or construct future steam gatherings system with materials blending with the environment.

ARTICLE 3: LAND MANAGEMENT

(a) The Company shall pay the Service a sublease fee which shall be agreed upon by both parties, terms and conditions of which shall be inserted in the relevant sublease title deed or agreement

(b) The Service shall exempt the Company from paying land rates for sub-leased areas

(c) The Service shall accord the Company its employees, Contractors, agents and official visitors access to all work areas. Such details shall be disclosed to the Service, before contract work commences.

(d) Incase the Company enters into an agreement with any other parties, then the Company bears the responsibility of disclosing all intended activities and clearing them with the Service before works commences

ARTICLE 4: SECURITY

(a) Parties shall co-operate in matters of security in the Park and the Company Premises and where necessary co-ordinate their security arrangements for the benefit of the Company's agents and servants or contractors.

(b) The Service shall be responsible for the security of all public areas including driveways passage-ways and entrances which are outside the Company Premises while the Company shall be responsible for the security of its agents, servants, contractors and visitors within the Company Premises

ARTICLE 5: EASEMENTS, PASSAGEWAYS AND ENTRANCES

(a) The Service agrees to ensure that the Company shall peaceably hold and enjoy the Company Premises during the Term, without any interruption or disturbance by itself or any person rightfully claiming under or in trust of

(b) The Service agrees that save for cases of emergencies or where the overriding security concerns requires otherwise, it shall keep open all easements, passageways, driveways, gates and entrances to the Company Premises and it shall only change such easements, passageways, driveways and entrances upon giving the company reasonable notice of not less than three months prior to making such changes. Further provided, the company an

opportunity to object to such changes. Where the company objects to any such changes, parties shall make all due efforts to amicably find a mutually acceptable resolution but when agreement is not reached within thirty (30) days after notice of objection from the Sub-lessee, the dispute may be referred to arbitration under Clause 8 herein.

ARTICLE 6: JOINT COMMITTEE

(a) For the proper implementation of this MoU and other Agreements, each party shall within one month of its execution nominate two persons to a Joint Implementation Committee

(b) The Joint Committee shall be charged with considering and agreeing on areas of joint activities and projects for the parties under this MoU, resolving any dispute that may arise and generally ensuring the smooth implementation of this MoU

(c) The Joint Committee shall at its first meeting select one member to be the Chairman. The chairman shall serve a term of one year and may not be re-elected for the consecutive year. As much as possible, parties shall rotate the position of chairman between themselves for each successive year

(d) The Joint Committee shall meet at least once every quarter of the year at such a place as its chairman may decide. All meetings shall be chaired by the Chairman or in his absence any other member appointed for the meeting by the other members. Quorum for meetings shall be at least one representative from the each party to this MoU

(e) Decisions of the Joint Committee shall be submitted to the respective Chief Executive Officers for ratification before implementation which ratification shall be given or denied within a reasonable time

ARTICLE 7: REVIEW AND TERMINATION

(i) Any party that wishes to review the terms of this MoU must first serve upon the other three (3) months' notice of such intention with particulars of the proposed review. Parties shall thereafter either through the joint committee or through other representatives meet within a reasonable time to review the MoU

(ii) this Memorandum of Understanding may only be terminated

(a) By the mutual agreement of both parties
(b) Where a dispute has arisen between the parties and after arbitration, the Arbitral Tribunal has made an order for termination

ARTICLE 8: DISPUTE RESOLUTION

(1) Each party hereto should use its best efforts to settle amicably all disputes arising out of or in connection with this MoU or in its interpretation.

(2) Either of the Parties may refer any dispute with notice to the other party to the Joint Committee of the MoU provided for under Clause 6 for its consideration. The joint Committee shall consider the matter within fourteen (14) days of such notice and shall either unanimously agree on an amicable resolution or by notice to the parties, inform them that the dispute cannot be amicably resolved and the parties may invoke Clause 8 (3) of this Agreement.

(3) Where any dispute arising out of or in connection with this Agreement cannot be amicably resolved at the Joint Committee, such dispute may be referred by any party to arbitration in accordance with the provisions of clause 8 (4) hereof and upon giving Notice to the other party.

(4) If the parties hereto so agree, the dispute shall be referred to a single arbitrator or if they are unable to agree upon the person to be the arbitrator within fourteen (14) days after Notice referred to in clause 8 (3), the sole arbitrator shall, at the request of either party hereto, be appointed by the Chairman of the Kenya Branch of the Chartered Institute of Arbitrators of the United Kingdom. The sole Arbitrator agreed upon or appointed must be a practicing advocate of the High Court of Kenya of not less than twenty years standing. The Arbitration shall be held in Nairobi.

(5) Except as stated herein, arbitration proceedings shall be conducted in accordance with the rules or procedures for arbitration of the Chartered Institute of Arbitrators.

(6) If for any reason the sole Arbitrator is unable to perform his function a substitute shall be appointed in the same manner as the original arbitrator.

(7) The decision of the arbitrator shall be final and binding on the parties.

(8) Each Party shall bear its own legal expenses, and shall jointly and equally bear with the other Party or Parties the expenses of the sole Arbitrator and of the arbitration proceedings provided that the arbitrator may rule that the other party shall pay the costs of the of the party in whose favour the ruling would have been made.

(9) The Parties agree that the arbitration shall be kept confidential and that the existence of the proceeding and any element of it including but not limited to any pleadings, briefs or other documents submitted or exchanged, any testimony or oral submissions and any awards) shall not be disclosed beyond the Tribunal, the Kenya Branch of the Chartered Institute of Arbitrators of the United Kingdom, the Parties, their counsel and

any person necessary to the conduct of the proceeding, except as may be lawfully required in judicial proceedings relating to the arbitration or otherwise.

In WITNESS whereof the parties hereto have set their respective hands the day and year hereinbefore written.

SIGNED by JULIUS KIPNG'ETICH
for and on behalf of
KENYA WILDLIFE SERVICE
In the presence of:-

THOMAS O. OGOLA
ADVOCATE.
P.O. Box 62358-00200, NAIROBI

Advocate

SEALED with the Common Seal of
THE KENYA ELECTRICITY
GENERATING COMPANY LIMITED
In the presence of

Managing Director

Company Secretary

Appendix 7 GIBB Registration and Practising License

FORM 7

Registration No. 0001

THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

CERTIFICATE OF REGISTRATION AS AN ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT EXPERT

This is to certify M/s **GIBB (Eastern Africa)**

of **P.O. BOX 300020 NAIROBI.** (Address)

has been registered as an Environmental Impact Assessment Expert in accordance with the provisions of the Environment Management and Coordination Act and is authorized to practice in the capacity of a Lead Expert/Associate Expert/Firm of experts (type) **FIRM EXPERT.**

Dated this **10^TH** day **FEBRUARY** of **2004**.

Signature [signature]

(Seal)

Director General

The National Environmental Management Authority

FORM 7 (r.15(2))

Application Reference No: 0001
Licence No: 0038
FOR OFFICIAL USE

THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT PRACTICING LICENCE

M/S.....GIBB AFRICA LIMITED.....(individual or firm) of

Address.....P.O BOX 30020-00100.....

.....NAIROBI.....

.....

is licenced to practice in the capacity of a (Lead Expert/Associate Expert/Firm of Experts).....

.....FIRM OF EXPERTS.....

in accordance with the provisions of the Environmental Management and Coordination Act.

Dated this .....08th.....Day .....April.....of 20....09.....

Signature.....

(Seal)

Director General
The National Environment Management Authority

Conditions of Licence

1. This licence expires on 31st December, 20..09.

Appendix 8 Terms of Reference for the ESIA Study

SECTION 5. TERMS OF REFERENCE AND SCOPE OF SERVICES

PREAMBLE

This document comprises the Terms of References and Scope of Services for Environmental and Social Impact Assessment (ESIA)[4] Study Consultancy for development of two (2) geothermal projects at Olkaria area in Naivasha District: The proposed geothermal projects are:

(i) Construction of a new 2X70 MW Geothermal Power Plant at Olkaria Domes area, to be called Olkaria IV Power Station and

(ii) Construction of 2X70 MW Geothermal Power Plants at Olkaria East Production Field to be called Olkaria I Units 4 and 5 Extension Power Project. These two Units are extensions of the existing 3X15 MW Olkaria I Power Station

The two geothermal power projects will be financed as one package and implemented around the same time.

The Olkaria IV and Olkaria I Units 4 and 5 power stations will be located near each other. However, the land use systems in the locations of the two geothermal stations are different. Olkaria I Units 4 and 5 will be located in an already existing geothermal production area which belongs to Kenya Electricity Generating Company (KenGen) while Olkaria IV is located in a new area, which belong to private land owners. It is therefore proposed that two separate EIA reports be prepared for each of the geothermal power plant projects.

Full EIA studies is required for the proposed geothermal projects in-line with the national Environmental Management and Coordination Act (1999) and Environmental (Impact Assessment and Audit) Regulations (2003) of Kenya and also with the World Bank operational directives and the Equator Principles.

Comprehensive ESIA studies covering the project area has been done previously and EIA licenses issued including the following:

(i) Olkaria II Geothermal Power Project

(ii) Olkaria II Unit 3 Geothermal Extension Project

(iii) Olkaria IV (Domes area) Appraisal and Production Drilling

In addition a project feasibility study for optimized development in Olkaria has been done including Environmental Scoping.

[4] The abbreviations EIA and ESIA are used alternately in this document and mean Environmental and Social Impact Assessment.

Further, the Environment Project report for Olkaria I Units 4 & 5, and Olkaria IV power projects will be submitted to KenGen by 20th August 2009. The ESIA, Feasibility and Environment project reports for the above projects contain a lot of baseline data and can therefore be used for references as necessary. These reports and necessary maps will be availed.

1. OBJECTIVES OF THE TOR

KenGen intends to improve its power production in the country by developing the environmental clean and renewable geothermal sources of energy. This Terms of Reference and Scope of Services have been compiled in accordance with the requirements of the national Environmental Management and Coordination Act (1999) and Environmental (Impact Assessment and Audit) Regulations of 2003 of Kenya and also with the World Bank operational policy 4.01 for Category A Projects, which require full ESIA studies. This will serve to guide the EIA study culminating in preparation of two separate ESIA study reports for Olkaria IV and Olkaria I Units 4 and 5 Geothermal Projects in compliance with Environmental Assessment guidelines and to correctly inform decision-making on the environmental impacts and management requirements of the project. The projects implementation and EIA schedules are attached. The assignment will be guided but not limited to the Terms of Reference and Scope of Services

2. BACKGROUND

2.1 KenGen Profile

Kenya Electricity Generating Company Limited (KenGen) supplies bulk (about 75%) of electricity consumed in Kenya. The company uses various energy sources to generate electricity ranging from hydro, thermal, wind and geothermal. KenGen currently owns and operates two geothermal power stations with a total installed capacity of 115 MW at Olkaria in Naivasha District, Rift Valley Province of Kenya (Olkaria Location Map Attached). Olkaria is located about 120 km northwest of Nairobi City. Olkaria I has 3X15MW units with a combined generation capacity of 45 MW and Olkaria II has 2X35MW units with a combined generation capacity of 70MW. A third generation unit of 35 MW is under construction at Olkaria II.

2.2 Project Objectives

KenGen proposes to develop to develop a new 2X70 MW Olkaria IV Geothermal Power Station at Olkaria Domes area and a 2X70MW Olkaria I Extension Geothermal Power Stations within the existing East Production Field. The location map of Olkaria IV and I is attached.

2.3 Implementing Agency/Sponsor

Kenya Electricity Generating Company limited (KenGen) is the implementing agent. The project is sponsored by the Government of Kenya (GoK) through the Ministry of Energy (MoE). GOK owns 70% of the total shares of KenGen.

Finance for the proposed geothermal projects is being sought from Development Financial Institutions including Japan Investment Corporation Agency (JICA), International Development Agency (IDA) of World Bank Group, AFD and European Investment Bank (EIB) among others.

The National Environmental Management Authority (NEMA) and all of the above institutions require full ESIA studies for the projects to be done before execution of the works. The ESIA study will be done by an EIA consultant. The ESIA including development of a Resettlement Action Plan (RAP), Environmental Management Plan (EMP) and Monitoring Programme are to be developed out as per the schedule attached with a completion date of **October 2009** for submission to NEMA for approval and issue of EIA Licenses.

2.4 Project Components

The proposed 2X70 MW generation units at Olkaria IV will constructed. However, only 1X70 MW generating unit (Unit 4) will be constructed. The generating Unit 5 at Olkaria I will be built later.
Execution of the works will be undertaken through the following contracts:

(i) Consultancy Services Contract- for Work Supervision

(ii) Steamfield Development Contract

(iii) Power Station Construction

(iv) High Voltage Substations and Transmission

(v) Local Infrastructure Works - such as water, access roads, engineers office, construction electricity and telecommunication

All the above contracts will be financed as a package. However, drilling of the geothermal steam production wells is being done in a separate contract, which is financed separately and is ongoing.

2.5 Area to be Assessed

A map is attached showing the proposed Olkaria IV and Olkaria I Units 4 and 5 power plants will be located. A ketch map showing the proposed route of the high voltage transmission lines is also attached.

2.6 Summary of Environmental and Social Setting

The Olkaria geothermal project area already has four geothermal power stations in operation including two stations operated by Independent Power Producers (IPPs). The existing 45MW and proposed Olkaria I Units 4 and 5 are located on KenGen land which is also gazetted as a National Park (Hell's Gate National Park). The park

has wild animals and is frequently visited by both local and foreign tourists. Many tourists especially schools and other institutions visit the park to see the geotherma power stations. Olkaria IV is located on private land (Kedong Ranch) adjacent to HellsGate National park. Some Maasai communities live in some parts of the Kedong Ranch. Lake Naivasha, which is a Ramsar site, is located about 15 km to the North o the project site.

3. EIA REQUIREMENTS AND REGULATIONS

The proposed project falls under the Second Schedule Section 58 Parts (1) and (4) of the Environmental Management and Co-ordination Act (EMCA) of 2000. Unde EMCA, an EIA study is mandatory and an EIA License must be obtained from the NEMA before any developments of the proposed geothermal power projects are undertaken.

In addition, the EIA study process including the content of the reports will be governed by the applicable local and international standards and best practices, suc as World Bank EIB, JICA, and AFD operational policies, guidelines and standards on geothermal power projects and relevant international environmental agreements t which Kenya is a party.

4. STUDY AREA OF LIKELY MAJOR IMPACTS

The projects area already has four geothermal power stations in operation including two stations operated by Independent Power Producers (IPPs). Olkaria I is o KenGen land which is also gazetted as a National Park (HellsGate National Park The park has a variety wild animal and avifauna populations and is frequently visited by both local and foreign tourists. Many tourists especially from schools and oth educational institutions visit the park to see the geothermal power stations. In additio to the HellsGate National Park, there are many private owned game sanctuaries in Naivasha.

The vegetation types are mainly associations of *Tarconanthus* (Mleleshwa) an Acacia species

Olkaria IV is located on private land (Kedong Ranch) adjacent to HellsGate Nationa Park. Some Maasai communities live in some parts of the Ranch. Lake Naivash which is a Ramsar site, is located about 15 km to the North of the project site. The lake provides water requirements for domestic consumption, horticultural farmin geothermal drilling and power plant operations, among other economic activities. Th horticultural farms have large number of workers as they are labor intensive. A number of tourist hotels offering accommodation and conference facilities, have bee developed in Naivasha especially around the Lake Naivasha.

5. SCOPE OF SERVICES

The EIA Study Reports will describe the boundaries in time and space. The temporal boundaries of the study (the length of time over which project environmental effect (positive and negative) are anticipated to occur) will reflect the decommissioning

period, and extent of any potentially significant environmental effects (positive and negative) that may remain beyond the decommissioning period, including any potential accidents or malfunctions of the proposed geothermal projects.
Spatial boundaries will reflect the geographical extent to which activities associated with the proposed geothermal projects are anticipated to occur in the existing environment and the extent of existing or anticipated positive and negative environmental effects, including cumulative environmental effects. Spatial boundaries will be referred to as the "Assessment Area" and will be defined. Administrative and technical boundaries of the assessment will also be defined, where appropriate.

5.1 The Projects Overview

5.1.1 Proponent and Projects History

Provide the name of the proponent, the name of the legal entity that will develop, manage and operate the proposed Projects, a corporate profile, and an overview of the Projects.

5.1.2 EIA Study Area

Provide maps showing boundaries and a legal description of the proposed lease area, the development area and all locations of proposed development activities. Include the lands that will be directly disturbed by the Projects or by associated infrastructure as well as cumulative, regional, spatial and temporal aspects for individual environmental components outside the Projects Area and lease boundaries where an environmental effect can reasonably be expected. Illustrate the Study Area on topographic maps and photos.
Include:

(i) Maps of appropriate scale to identify the proposed development area, the status of land tenure, existing and proposed land dispositions, and the location of infrastructure associated with the Projects;
(ii) The location of streams and other geographic information such as natural features that may be affected by development within the Projects Area or changes to infrastructure as a result of the Projects development;
(iii) The rationale used to select boundaries for EIA Study Areas for environmental components; and
(iv) Discussion of how the Study Areas were adapted or modified through the public participation process.

5.1.3 Projects Component and Development Schedules

Provide a development plan and overview of the projects components that are proposed, including

(i) Activities associated with the construction, operation, restoration, and decommissioning of the projects, and associated infrastructure;
(ii) The phases of the proposed development including construction, operation, restoration and abandonment; and
(iii) The proposed development schedule for each phase of the Projects.

5.1.4 Project Justification and Alternatives

Discuss the need for the Projects and consider the implications of proceeding with the Projects, specifically addressing the following:
(i) The additional energy capacity the projects are expected to provide;
(ii) Alternative methods of electricity generation;
(iii) Existing and alternative Projects infrastructure;
(iv) An overview of any alternatives considered economically feasible; and
(v) The implications of development for potential future developments in the Projects Area of influence.

5.1.5 Regulatory Review

Identify all regulatory approvals applicable to the Projects, including environmental and operational approvals at the municipal and national levels. Summarize government policies, integrated resource plans, and planning or study initiatives pertinent to electricity generation and geothermal development and discuss their implications for the Projects. Review applicable international agreements, policies and guidelines and indicate their implications on the proposed projects.

5.1.6 Summary of EIA Reports

Summarize the EIA study report including environmental and socio-economic implications of key construction and operation activities associated with the Projects, proposed mitigation strategies, residual impacts, monitoring programs, cumulative effects and any follow-up programs required.

Include a glossary of terms and a list of abbreviations to assist the reader in understanding the material presented. Include tables that cross-reference the report to the EIA Terms of Reference and to any current applications submitted pursuant to the national legal requirements.

5.2 Description of the Proposed Projects

5.2.1 Development of Project Sites

Describe the site selection, project components and process for the proposed facilities including the following:
(i) The economic, technical and environmental factors that contributed to the decision-making process for development within the Projects Area;

(ii) The site selection process for new infrastructure such as location of new powerhouse, office buildings, access roads, water supply, etc. Indicate the technical, geotechnical, economic and environmental criteria considered;
(iii) The general geothermal development activities and schedules that characterize the construction, operation, restoration, and abandonment phases;
(iv) The proposed geothermal power plant construction methods, designs criteria, development activities and schedules for the Projects, including activities such as vegetation clearing, soil salvage, waste disposal, road construction, water quantities, and reclamation;
(v) Maps and diagrams at appropriate scale to illustrate the development plan, management systems and associated infrastructure; and
(vi) Specific activities that will be undertaken to prevent or reduce the potential adverse environmental or social impacts through project processes.

5.2.2 Infrastructure, Utilities and Transportation

Describe infrastructure components, proposed and existing, for the development within the Projects Area of influence. Descriptions of infrastructure will include the following:

(i) Public and worker access;
(ii) Utilities;
(iii) Raw material handling and transport;
(iv) Components identified through public participation program;
(v) Location plans for infrastructure such as processing, office, waste management facilities;
(vi) The anticipated changes to traffic (e.g., type and volume) on public roads, from the project site, during the construction and operation of the Project.
(vii) Discuss and evaluate any expected impact and suggest any required mitigation measures;
(viii) How the materials will be moved to and from the site;
(ix) How watercourse crossings will be handled; and
(x) How public access to, or within the Projects will be managed for each phase of the Project.

5.2.3 Air Emissions Management

Identify all potential sources of emissions from development within the Project Area, for each source:

(i) Describe the emissions (H_2S, NO_x, CO_2, total particulates PM_{10}, $PM_{2.5}$, Volatile Hg, metals, etc) from the project including emissions from, operating equipment, vehicles, ventilation, heating, road, crusher and other facilities;
(ii) Describe the monitoring and control systems that KenGen proposes to use; and

(iii) Describe the management program to address all relevant fugitive dust and other emissions.

5.2.4 Water and Wastewater Management

Identify the process and potable water requirements for the Projects including start up and emergency operation conditions. Describe water treatment requirements and any chemicals that the project plans to use, and:

(i) Provide a baseline description of water quality through use of water samples tested in NEMA accredited laboratories.
(ii) Identify potential sources of water quality concerns associated with the Projects;
(iii) Describe plans to monitor and prevent or reduce impacts on water quality;
(iv) Provide descriptions and drawings for water management facilities;
(v) Quantify water diversions from surface water or well water systems to meet process and potable water requirements, indicate the source of the water and release locations; and
(vi) Provide a summary of KenGen management plan to prevent or reduce impacts to surface and groundwater flow, and a spill response plan should an accidental release occur.

5.2.5 Hazardous Hydrocarbons, Chemicals and Waste Management

Provide a waste management plan for the proposed operation, including information on waste quantities, storage, handling and disposal methods for each waste type, and:

(i) Potential sources of waste associated with the Projects;
(ii) The location and amount of all chemicals stored on site with a description of containment and environmental protection measures;
(iii) Identify the location, nature and amount of on-site hydrocarbon storage;
(iv) Discuss containment and other environmental protection measures;
(v) Demonstrate how selected practices comply with national regulations; and
(vi) Describe KenGen's plan to minimize and recycle wastes, where possible.

5.2.6 Monitoring, Operation and Contingency Plans

Summarize the key elements of environmental, health and safety plans and programs, and describe corporate policies and procedures, operator competency training programs, spill and emission reporting procedures, and emergency response plans.

5.2.7 Restoration and Closure

Provide a conceptual site abandonment and restoration/ closure plan for the Projects Area, including:

(i) Restoration methods relative to drainage control, land stability, soil salvage, soil replacement, re-vegetation and interim land management;
(ii) Identify restoration and land use objectives and describe how the restoration plan will meet those objectives;
(iii) An outline of the restoration schedule and a description of how restoration success will be measured and evaluated;
(iv) A re-vegetation plan including flora types, timing, monitoring, interim land management (erosion control) and invasive species control;
(v) Anticipated waste types, their sources and amounts;
(vi) A waste management Plan for the decommissioning exercise; and
(vii) The anticipated differences between pre- and post-development landscape or vegetation types, wildlife habitats, aesthetics, traditional uses, recreation use, or commercial operations.

5.3 Environmental and Social Impact Assessment

5.3.1 Impact Assessment Requirements

Provide information on the existing environmental resources and resource uses that could be affected by proposed geothermal developments. Identify the environmental components potentially affected by the Projects. Describe and rationalize the selection of key indicators selected. These environmental indicators will be used to estimate the scale of impact and to evaluate the appropriateness of the environmental management programs. For each environmental component and indicator:

(i) Describe the existing baseline condition;
(ii) Identify the activities associated with the Projects Area that have the potential to affect the environmental component and indicator being considered;
(iii) Describe the nature of the environmental effects associated with the Projects, including information on magnitude, probability of occurrence, frequency, extent, duration and seasonal timing for each environmental effect;
(iv) Present environmental protection plans to prevent, minimize, or mitigate negative environmental effects from the Projects; and
(v) Present an Environmental Management Plan to identify, monitor and manage potential environmental changes in order to demonstrate that the Projects will operate in an environmentally sound manner over the life of the Project

5.3.2 Cumulative Environmental Impacts

To assess the cumulative environmental effects:

(i) Describe the methodology used to identify and assess the cumulative effects and provide the detail as to how conclusions were drawn;
(ii) Define the Study Area's spatial and temporal boundaries for each environmental component and indicator examined;
(iii) Assess the reasonably-foreseeable environmental effects of the proposed Projects in combination with other existing and proposed Projects, activities and land uses in the region; and

(iv) Assess the appropriateness of information from other developments used and identify any deficiencies or limitations in the information.

5.4 Description of Baseline Environmental and Social Conditions

Collate, evaluate and provide baselines data on the relevant physical, biological, and socio-economic characteristics of the development site and area of influence. These include:

The physical environment: geology and seismic history of development areas, topography and drainage patterns, soils, climate and meteorology, ambient air quality, ambient noise emissions, noise and air emission sources, surface and ground water hydrology, water resources and adequacy of supply, existing water pollution discharges, and receiving water quality and other parameters .

The biological environment: type and diversity of flora and resident and migratory faunal composition, rare and endangered species within or in areas adjacent to the project development sites or high voltage transmission lines, sensitive habitats , including parks, or reserves, significant natural sites etc., species of commercial importance and species with potential to become nuisance, vectors or dangerous.

The socio-economic environment: including both present and projected where appropriate, population structure, land tenure and land use systems, planned development activities, community structure, employment, distribution of income, goods and services, recreation, public health, cultural properties (archaeological and historical sites), indigenous people, customs, aspirations and attitudes.

5.5 Description of relevant Legislative and Regulatory Considerations

The relevant regulations and standards governing environmental quality, health and safety, wildlife conservation and other ecologically sensitive areas, land use, etc, at local, regional, national and international levels, shall be described. These include, the national EMCA (1999), Environmental (Impact Assessment and Audit) Regulations of 2003, Wildlife Management Act, Water Act, OHSA (2007) etc. and applicable international guidelines such as the IDA, EIB, AFD etc. If transboundary impacts are likely, relevant conventions should be described.

5.6 Determination of Potential Impacts of the Proposed Geothermal Projects

The EIA study team will be required to carry out an initial scoping of the potential environmental impacts arising from the proposed project. Further screening of the impacts will be done to narrow down to the most significant impacts after identification of the potential environmental impacts. These will include but not limited to the following:

A description of all the environmental impacts on nature and human environments

(i) Air quality - impacts of fugitive dust and gaseous emissions for example hydrogen sulphide (H_2S) on ambient air quality and health of workers
(ii) Noise emission
(iii) Water sources, quality and quantity
(iv) Wildlife conservation
(v) Social concerns
(vi) Traffic
(vii) Vegetation cover
(viii) Induced land use changes
(ix) Occupational health and safety hazards
(x) Solid, liquid waste disposal

5.6.1 Land Tenure and Land Use Systems

Provide the following:

(i) The existing land uses in the Study Area including, commercial, fishing, agriculture, forestry, wildlife and tourism and cultural uses;
(ii) Describe the land tenure and land ownership systems in the project area;
(iii) The local community traditional and existing land use practices including agriculture, water source, livestock keeping and fishing;
(iv) Any unique sites or special features in the Study Area;
(v) The land use interests of other groups or community initiatives;
(vi) Description of the land use and resource policies and planning initiatives in the Study Area, including wildlife management and conservation, basin-wide integrated management plans, water, and the energy policies of Kenya, components of the Projects that have the potential to affect other land uses, and discuss the nature and significance of the effects on those land uses;
(vii) The aesthetic impacts of the Projects on regional recreation activities and public land uses during and after development;
(viii) Mitigation strategies to address these anticipated impacts, and outline KenGen's management capacity to implement these strategies;
(ix) The public participation program and plans to mitigate impacts with the existing land users;
(x) Describe the effects of increased traffic on transportation routes;
(xi) The cumulative effects of the Projects relative to other existing or proposed projects on regional and public land uses, including agriculture and settlements
(xii) The plans to mitigate the effects of the Projects and alternatives considered.

5.6.2 Climate, Air Quality and Noise

Discuss the baseline climatic and ambient air quality and noise emissions conditions. In addition, model dispersion of identified air pollutants and noise spread and provide the following information:

(i) Projects components and activities that will affect air quality both locally and regionally;

(ii) Air quality components of concern, including emissions from point sources and their dispersion contours, fugitive dust, construction, and vehicles;
(iii) Possible effects from the deposition of primary particulate matter and impacts on surface water, soil and vegetation;
(iv) The nature and significance of changes in ambient air quality expected as a result of the Project and the impacts associated with these changes.
(v) Discuss how air emissions will likely disperse in the Study Area
(vi) Describe methodology used to determine changes in ambient air quality, justify the methodology used, and identify any shortcomings or constraints on the findings;
(vii) A plan to minimize dust emission levels from the Projects;
(viii) The nature and significance of changes in noise levels as a result of the Projects;
(ix) The implications of increased hydrogen sulphide gas and noise levels and proposed measures to minimize hydrogen sulphide gas and noise resulting from the development. This will be done considering magnitude, frequency, duration and time of day and the performance potential of these measures;
(x) Cumulative effects of the Projects in combination with other activities in the regional Study Area; and
(xi) Mitigation and monitoring measures to address climate, air quality and noise concerns.

5.6.3 Geology/ Hydrogeology, Terrain and Soil Profiles

Describe and map, on an appropriate scale, the geology, terrain and soils, and drainage patterns of the Projects Area. Also provide the following:

(i) A biophysical map of the Study Area, including mapping of topographic and geological and hydro-geologic features;
(ii) An evaluation of the sensitivity of geological properties in the area in relation to the projects and to project activities such as earthworks;
(iii) Soil materials and landforms in the Projects Areas prone to erosion;
(iv) An evaluation of the geological stability of the area including the frequency and magnitude of earthquakes in the area;
(v) The components of the proposed developments that have the potential to affect geology, hydro-geology, terrain and soils;
(vi) The nature and significance of the anticipated changes to the pre-development topography, elevation, drainage patterns and soils that will result from surface disturbance at the site and any potential for subsidence;
(vii) A soil management plan to ensure proper soil salvage, storage and replacement when required for restoration;
(viii) Cumulative effects of the Projects in combination with other activities in the regional Study Area; and
(ix) Mitigation measures to be implemented to reduce impacts of effects.

5.6.4 Vegetation

(i) Describe and map, the vegetation communities in the Projects Study Area;
(ii) Describe and evaluate the forest resources, if any, affected by the Projects development,
(iii) Identify the components of the Projects development that have the potential to affect vegetation and forest resources;
(iv) Discuss the mitigation measures to be implemented to minimize impacts on vegetation and forest resources;
(v) Identify rare, threatened or endangered plant species or communities found here and their associated habitat requirements;
(vi) Describe measures to avoid or minimize disturbance to rare plant species and communities, and
(vii) Identify cumulative effects of the Projects in combination with other activities in the Study Area.

5.6.5 Wildlife

(i) Provide a detailed description on the wildlife types (both terrestrial and aquatic) in the Area of Study;
(ii) Describe wildlife habitat types, quality and wildlife use in the Projects Area of influence;
(iii) Identify potentially significant wildlife species, and associated habitat requirements;
(iv) Identify the components of the Projects that have the potential to affect wildlife, wildlife habitat use and habitat quality;
(v) Identify indicator species in the Projects Study Area where they assist in the understanding of the impacts of the Projects;
(vi) Identify the predicted effects of the Projects on wildlife, wildlife habitat and habitat quality during and following decommissioning; and
(vii) A mitigation plan to minimize wildlife habitat loss and disturbance to wildlife;
(viii) Identify cumulative effects of the Projects in combination with other activities in the regional Study Area.

5.6.6 Hydrology

Describe the following:

(i) The surface drainage patterns and surface and underground water hydrology of the Study Area,
(ii) Identify the infrastructure that will be used to meet drainage, process water, fire protection and sewage management requirements at site;
(iii) Identify wastewater effluents and runoff from the Projects Areas of influence;
(iv) The alterations in surface drainage patterns at the Projects, the impacts of these changes on downstream areas and how these impacts will be mitigated and monitored;
(v) Discuss the probable maximum flood and maximum precipitation events relative to project design and subsequent inundation of surrounding land.

(vi) Identify cumulative effects of the Projects water requirements in combination with other activities in the regional Study Area.

5.6.7 Water Quality

Undertake the following:

(i) Describe baseline water quality conditions in the Projects Area of influence with reference to the appropriate water quality parameters;
(ii) The activities that have the potential to affect surface and underground water quality and aquatic communities during the life of the Projects;
(iii) Assess the magnitude of the potential impacts of activities on surface water quality;
(iv) Determine the local and regional extent of potential impacts as well as their frequency, duration, magnitude and seasonality;
(v) Assess the magnitude of each potential impact on water quality relative to existing water quality and accepted water quality guidelines;
(vi) Describe the proposed mitigation and monitoring measures (water management and waste water management treatment systems) to protect water quality; and
(vii) The cumulative effects of the Projects in combination with other activities in the regional Study Area.

5.6.8 Fisheries

Provide the following:

(i) The fisheries resource in the Projects Study Area of influence, including species composition, distribution, relative abundance, seasonal habitat movement patterns and general life history patterns;
(ii) Identify critical or sensitive habitat such as spawning, rearing, and migration areas, with reference to species' distributions;
(iii) Identify the components and activities associated with the Projects that have the potential to affect the fisheries resource and habitat during and after the Project development;
(iv) Discuss the nature and significance of the predicted impacts, their duration and their spatial extent (site-specific, local, or regional);
(v) A proposed mitigation plan to minimize effects on the fisheries resource and habitat; and
(vi) Identify cumulative effects of the Projects in combination with other activities in the regional Study Area

5.6.9 Social and Economic Information

Discuss the nature and significance of the operations in the Projects Area of influence on the regional and local socio-economic conditions and the impacts associated with these effects, including consideration of the following:

(i) Workforce;

(ii) Local employment and training;
(iii) Market opportunities and procurement;
(iv) Local services and infrastructure;
(v) Timing and size of workforce during construction and operation;
(vi) Tourism, recreation, hunting, and fishing; and
(vii) Population changes;
(viii) Discuss corporate policies and programs respecting the use of local, products and services, including an estimated breakdown of locally and non-locally sourced raw material, construction labour, and total overall benefits of the proposed geothermal development;
(ix) Discuss the socio-economic implications of not proceeding with the Projects; and
(x) Identify the measures proposed to enhance positive effects or mitigate negative effects.

5.6.10 Public Health and Safety

Describe aspects of the Projects that may have implications for public health and safety and:

(i) Describe plans to prevent or minimize the potential for adverse impacts on public health and safety;
(ii) Identify concerns, if any, raised by the public during the environmental assessment process with respect to health and safety; and
(iii) Provide a summary of the emergency response plan and discuss mitigation plans that will be implemented to ensure workforce and public safety during construction and operation of the Projects.

5.7 Analysis of Projects Alternatives

A comparison of the proposed projects site, design, technology, processes, and mitigation measures for adverse negative impacts with any other alternative power projects including "No Project Option" will be made.

5.8 Identification of Institutional Needs to Implement EIA Recommendations

Review the institutional framework at national, regional and local levels and recommend steps to strengthen or expand them so that the management and monitoring plans in the EIA can be effectively implemented. The reviews may include enactment of new laws and regulations, agencies, inter-sectoral arrangement, management procedures, training, financial support etc.

5.9 Development of Environmental Management Plans (EMPs)

Develop Environmental Management Plans (EMPs) for each of the proposed projects with details of feasible and cost effective mitigation measures to prevent or reduce

each of the anticipated significant negative environmental and social impacts to acceptable levels. Include measures to address emergency response requirements for accidental events. The impacts and costs of implementation of the mitigations and institutional and training requirements will be estimated. Compensation to affected parties for impacts, which cannot be mitigated, shall also be considered. The EMPs will include the following;

(i) Work programmes,
(ii) Budget estimates
(iii) Schedules,
(iv) Staffing and training requirements
(v) Assignment of responsibilities for implementation of the EMP.

5.10 Development of Monitoring Plans

Detailed monitoring plans for each of the proposed geothermal projects will be prepared to monitor the implementation of mitigation measures and the impacts of the proposed projects during construction and operation. An estimate of the capital and operating costs and a description of other inputs such as training and institutional strengthening needed to implement the plan shall be included.

5.11 Stakeholders Consultations and Public Participation

KenGen will finance and assist the EIA consultant in obtaining the views and contributions of the stakeholders and the public. The consultant will provide relevant materials to affected groups and interested parties in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. The Consultant should maintain a record of public consultations and the record will indicate: means other than consultations e.g surveys. used to seek views of stakeholders; the date and location of the consultation meetings. list of attendees and their affiliations and contact addresses: and summary minutes.

In summary, the Consultant is expected to describe the following:

(i) Public participation program for each of the Projects, including consultation with local communities:
(ii) Public participation methods, timing, and the type of information provided to the public;
(iii) Summarize the issues identified during the public participation process including the views of the various parties with respect to these issues;
(iv) Include a list of the stakeholders that were represented during the public participation process;
(v) The responses to issues or concerns raised during the public participation program: and
(vi) Discuss public input that has been incorporated into the proposed Project design, environmental management systems. mitigation plans, and monitoring programs.

6. REPORTS

The ESIA report shall be concise and limited to significant environmental and social issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting the data. The EIA report shall be organized according to the outline below:

(i) Executive Summary

(ii) List of Acronyms and Abbreviations

(iii) Table of Contents

(iv) List of Tables and Figures

(v) Policy, Legal and Administrative Framework

(vi) Description of the Proposed Project

(vii) Baseline Data

(viii) Significant Environmental Impacts

(ix) Analysis of Alternatives

(x) Environmental Management Plant (EMP)

(xi) Environmental Monitoring Plan

(xii) Stakeholders Consultations and Public Participation

(xiii) An Identification of Gaps in Knowledge and Uncertainties, which were encountered in compiling the information;

(xiv) An Economic and Social Analysis of the Proposed Project

(xv) Appendices - List of EIA Experts, References, Records of Meetings etc

7. CONSULTING TEAMS

This EIA study will require inter-disciplinary analysis. The skills required include the following:

(i) Environmental Management and Planning

(ii) Ecology

(iii) Hydrology and Hydrogeology

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CLIENT: KENYA ELECTRICITY GENERATING COMPANY LTD

PROJECT: ENVIRONMENTAL SOCIAL AND IMPACT ASSESSMENT REPORT JOB NO: JK1384A

TITLE: OLKARIA IV DOMES PROJECT

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DATE: 18 DECEMBER 2009	SIGNATURE	SIGNATURE	SIGNATURE

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