ENVIROMENTAL IMPACT ASSESSMENT STUDY REPORT

For

THE PROPOSED WASTE TAILINGS LAB, PRECIOUS METAL RECOVERY, WASTE TREATMENT AND RECYCLING PLANT IN NYAMARANGA VILLAGE OF SUNA WEST DISTRICT – MIGORI COUNTY

L.R. NO. SUNA WEST/WASIMBETE/1885

PROPONENT:	**EIA EXPERT**
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DOCUMENT AUTHENTIFICATION

This project report on Environmental Impacts Assessment has been prepared by Environ Consulting Ltd a NEMA registered and licensed EIA/EA Firm of Experts.

This report has been done with reasonable skills, care and diligence in accordance with the Environmental Management and Coordination Act, 1999 and the Environmental (Impact Assessment and Audit) Regulations 2003.

We the undersigned, certify that the particulars given in this report are correct to the best of our knowledge.

Sign: …… ……

Date

Firm of Experts

PROPONENT

Sign: …… ……

Dr. Philip Mwabe Date

ABSTRUCT

Varied amounts of mine tailings are produced every passing in all mines around the world. These when left unattended to or untreated, may be cause environmental and health concern to the area and the people around such mines. Companies, individuals and government (both local and national) must find a way of proper disposal and management of the all hazardous waste including recycling and incineration as proposed in this report. This will therefore require appropriate technologies to be developed, whereas, ascertaining appropriate engineering properties of tailings. Laboratory study will therefore be appropriate tool to aid in discovering the basic properties of tailings and to scrutinize their consolidation and parchedness behavior. The purpose of this report therefore, is to conduct a feasibility study to support the Environmental Impact Assessment (EIA) that would have to be done before such a station can be constructed. The feasibility study presented here provides information about identified impacts and assessed consequences caused by installation of the proposed project in the area. Methods used to present the study were mainly performed by field studies at the suggested alternative sites and by informal key informant interviews with experts from the county government. The result of the report shows a summary of similar consequences at the suggested sites but the analysis, including additional aspects, concluded a differentiation between the sites that enabled a final recommended location.

ACRONYMS AND ABBREVIATIONS

CPP	Consultation and Public Participation
EA	Environmental Audit
EASL	Environmental Analytical Services Ltd
EIA	Environmental Impact Assessment
EHS	Environment, Occupational Health and Safety
EMS	Environmental Management System
EMP	Environmental Management Plan
EMCA	Environmental Management and Coordination Act, 1999
NEMA	National Environment Management Authority
NEAP	National Environmental Action Plan
NEC	National Environmental Commission
NPEP	National Poverty Eradication Plan
NWRM	National Water Resource Management
NWSS	National Waster Service Strategy
WRM	Water Resource Management
WSS	Water and Sewerage Services
WSSD	World Summit on Sustainable Development
WSTF	Water Service Trust Fund
PEC	Provincial Environmental Commission
OSHA	Occupational Safety and Health Act

EXECUTIVE SUMMARY

In the mining industry, a vast amount of fine-grained milling wastes (tailings) are produced in mineral processing plants each day. The wastes are generally in the form of slurry that is deposited hydraulically in the disposal area. How to effectively and economically dispose of the waste has become a major issue facing all mining operations. Knowledge regarding the basic physical properties of the tailings, and their consolidation and desiccation behaviors are necessary to understand the tailings material behavior and to further improve the efficiency of disposal

Waste tailings management should be an integral part and a well spelt process in the mining industrial development in Kenya and all over the world. Without this, all activities would be detrimental the environment and to life in general. Waste management in the Kenya has been assumed to be managed by the National Environmental Management Authority (NEMA) and the County governments. However, The national environmental management authority have had private entities to help in the collection, transfer of wastes to designated areas and waste management through other means including incineration. It is in this regard that Environmental Analytical Services Limited (EASL) was registered to provide assistance in the management of mining waste in the region and provide assistance in other areas within the nation. Upon realization of the growing hazardous wastes challenges posed by the mining industry, EASL is seeking to improve mining waste management by installing a waste lab, precious metal recovery and a waste treatment facility and recycling facility in Nyamaranga Village in Suna West – Migori Constituency to increase mining waste handling capacity with enhanced safety and health and without compromising environment and public health.

Such facilities are known to play an important role in a community's total waste management system, serving as the link between a community's solid waste collection program and a final waste disposal facility. The side products from the mining industry include large amounts of removed top-soils, waste rock and tailings which are classified as waste materials. Most of this waste is placed within the mine area, in either piles or in pools. The utilization and characterization of the by-products is regulated by legislation, alignments and directives on environmental protection, soil extraction and mining waste

The realization of the project will ensure that waste will be transported using tracks and deposited for testing, pretreatment, recycling wherever appropriate and final disposal of the remaining waste as appropriate either in landfills or incineration. At the station wastes sorting otherwise called material recovery station using localized mechanical biological treatment system to remove recyclable items from the waste stream. In the realization of the project, the proponent will employ soil washing of contaminated soil and ensuring proper disposal at the process end.

The installation of the proposed project is necessitated by the ever escalating hazardous waste generation from mining industry and other developments activities in Kenya. The

implementation of Environmental Management and Coordination (Waste Management) Regulations, 2006 implies the need to cope and comply with other regulatory framework.

The company's waste management strategy desires to have a source reduction and recycling approach to its waste management which will also play an integral role in the country's total waste management system. These two activities will significantly reduce the weight and volume of waste materials requiring disposal, which reduces transportation, landfill, and incinerator costs. Source reduction consists of reducing waste at the source by changing product design, manufacturing processes, and purchasing and sales practices to reduce the quantity or toxicity of materials before they reach the waste stream. The Environmental Management and Coordination Act (EMCA) promote source reduction as the waste management technique of choice.

The availability of a commercial hazardous waste treatment facility is not only a critical environmental issue, but also an essential economic factor for a country that aspires to grow its industrial base. Most international companies expect a hazardous waste management program to be in place that is both economical and meets international standards, especially ISO 14000 considerations. Besides, without the means to treat and dispose hazardous wastes, it is not possible to enforce the current environmental legislation.

The installation of waste tailing laboratory coupled with waste treatment and recycling will increase the handling capacity of hazardous waste which will both assist the economic growth of industries and provide a proper treatment and disposal route that is affordable. The company has acquired 7.7 hectares (L.R. No. Suna West/Wasimbete/1885) in Buhembu Suna West – Migori County in South Nyanza. Local Authority change of user to Industrial use has been undertaken to effect the installation of the aforesaid project. The purpose of this EIAS report submission to the National Environment Management Authority (NEMA) is to grant the proponent an opportunity to install the proposed development. It has good geological structure in a remote location that will ensure list interference from the locals.

Our investigation examined the potential impacts of the project on the immediate surrounding with due regard to all the phases from installation through to completing, operation and decommissioning. It encompasses all aspects pertaining to the physical, socio-cultural, health and safety conditions at the site and its environs during and after installation of the project. During the screening exercise, issues identified as those that may be impacted upon by the project activities include: air quality, health and safety, and other environmental hazards and socio-economic welfare of the surrounding communities.

The purpose of this study will ensure that all negative impacts to human habitation and the environment at large is checked and suggestions of handling is incorporated in the development process. It is, therefore, expected that there will be potential emission of various gases and particulate matter into the atmosphere from the handling process, impact to water resources through surface runoffs. This scenario implies potential linkages with the surrounding environment and ecological setting that require to be addressed during the

construction and upon commissioning. The following sections outline these linkages as well as proposed corrective measures.

ANTICIPATED IMPACTS

Positive Impacts

Tailings are the byproducts that remain following the extraction and recovery of valuable minerals from mine operations. They are generated by a milling process and are a mixture of finely-ground sand-to silt-sized rock particles, water, and processing reagents. These wastes might be detrimental to the environment if not managed. Tailings and waste rock storage facilities must be designed, constructed and operated to the highest standards, taking into account the eventual need for closure and rehabilitation. Optimum strategies for facility management are site specific and therefore the facility location, disposal method, approach to water management and long term closure objectives must be clearly defined. Laboratory testing is designed to compliment real-life shipment validation, and often it is immediately apparent that a laboratory test is needed. In some cases a field evaluation may be required to deliver a greater insight on a particular performance. The project will provide:

i) An opportunity to screen waste prior to disposal

ii) Research and analytical within a state of the art lab in the area which is lacking within the area

iii) An opportunity to serve as a convenience center for public use in waste management

Accurate precious metal analysis is routinely carried out to determine the precious metal content in a wide variety of different materials. This is particularly important for fineness determination for the hallmarking of precious metals for jewellery use. The precious metal concentration in different materials can vary from parts per million (ppm) or lower in car catalyst or powdered ore samples, to virtually 100% in jewellery alloys or bullion bars.

The proposed project has an overall positive implication to the country, and especially for the mining industry, miners and the local residents within the precinct of the mines. The major threat to the environment and human health today is risks associated with waste management. Not all waste sources are capable of handling hazardous and toxic materials within the premises without compromising the health of their own workers or the neighboring communities. The result of waste generators disposing wastes without appropriate equipment has been pollution of environmental resources and particularly water sources, air pollution, land contamination and even direct effects to human health. In this regard, therefore, the following are considered main benefits of the proposed tailing waste management, precious metal recovery, and hazardous waste management in the incineration process:

(i) Providing tests to the precious minerals for the mining industry thus saving time in sourcing for the same service in the neighbouring country – Tanzania

(ii) Promoting business for the precious mineral

(iii) Mopping up of hazardous and toxic materials in the precious mineral process chain

(iv) The station will act like a filter to ensure that the many different types of waste end up in the right places. They improve the ability to reuse or recycle as much waste as possible

(v) Ash from the incineration plant will be used in brick/slab making thereby providing building material for construction industry.

(vi) In improving efficient waste management after doing your bit to sort waste and recyclables before placing them in the correct areas

(vii) The facility will provide a safe point for disposal of mining hazardous and toxic wastes, most of which currently is dumped into public garbage disposal sites with adverse implications to thee ecology and human health,

(viii) The facility will provide a multiple of direct and indirect employment opportunities within the country

POTENTIAL NEGATIVE IMPACTS

The schedule below provides an outline of the anticipated impacts. The impacts have been predicted such as to cover the construction, operation and decommissioning phases of the project.

Development Stage	Environmental Aspects	Anticipated Impacts
Construction	Environmental Pollution	▪ Emissions into the air of dust, ▪ Emissions from construction equipment and material deliver trucks, ▪ Public nuisance from construction equipment.
	Drainage	▪ Change in storm water regime around the site, ▪ Soil erosion creating siltation of natural drains during rains, ▪ Discharge of wastewater from the site into dry drainage system with risks of environmental pollution downstream.
	Social Issues	<u>Noise Levels:</u> ▪ High noise levels from construction machinery and materials' delivery trucks,
		<u>Health and Safety:</u> ▪ Bronchial infections from dusts and other emissions, ▪ Risks to food based industry in the area, ▪ Water sources contamination, ▪ Risks to health and safety of the construction workers
		<u>Cultural Values:</u> ▪ Social interaction of construction workers with local communities, ▪ Moral effects as a result of increased earnings
Operation	Waste Water Aspects	▪ Surface water contamination, ▪ Land and soil degradation ▪ Pollution from disposal of scrap oil, leachates and wastewater, ▪ Pollutants from hazardous wastes holding yard, ▪ Pollution from off-site solid waste dumping,
	Air Quality	▪ Aerial emissions from the kilns and other stacks,– carbon dioxide, nitrogen oxides, hydrocarbons, water vapour, hydrogen chloride gas, ▪ Arial pollution from dust, kiln fly ash, emissions, etc., ▪ Particulate matter blown from waste holding yards,

Development Stage	Environmental Aspects	Anticipated Impacts
	Noise Levels	▪ Occupational health and safety of the workers, ▪ Levels above the ambient noise levels the surrounding areas,
	Biological Diversity	▪ No signs of significant wild life in the area, ▪ Removal of grass cover, arid trees and shrubs, ▪ Related microorganisms associated with the scarce vegetation removed.
Operations	Social Impacts	<u>Income Generating Initiatives:</u> No directly negative impact to income generation on the area. Positively affecting the local social and economy
		<u>Social and Cultural Issues:</u> ▪ Social nuisance from pollution to physical environment such as land and air by emissions from the site, ▪ Social complaints and concerns on health and safety, ▪ Cultural intrusion from employee intrusion, ▪ Conflict on land use, ▪ Conflicts at off-site solid waste dumping areas, ▪ Potential of social diseases (HIV/AIDS, TB, etc.).
		<u>Health and safety:</u> ▪ Risk to workers' health from aerial emissions originating from the site operations, ▪ Risks to life through outbreak of fires, ▪ Risks of fire to the site property and that of the neighbours, ▪ Risks from internal movements of workers and customers, ▪ Slippery surfaces, e.g. store rooms,
Operations	Solid Waste Management	▪ Risks to Health and safety, ▪ Risks to environmental pollution, ▪ Ground water quality degradation at off-site disposal sites, ▪ Aesthetic pollution in the site and neighbourhood (acetylene gas production residuals – calcium oxide slurry), ▪ Public nuisance at off-site disposal sites, ▪ Illegal waste dumping
	Compliance	▪ Penalties from non-compliance,

The Site

At the time of the initial assessment to ascertain the proposed site location, 7.7 hectare piece of land had been approved for execution of the proposed project. The proposed piece of land is located in Nyamaranga/Wasimbete area of Suna West District in Migori County – South Nyanza. Change of user from agricultural land to industrial use has been obtained to aid the construction and installation of the project.

Electricity needs will be met from the KPLC grid where applicable. In addition, the company will employ the use of power generator to cater for most of the power needs within the site's operation activities. The main road access to the facility is an all weather road that is accessible and is currently used in the area. The proponent will improve the road to the site to ensure accessibility especially on bridges to accommodate the heavy commercial vehicles that might be employed in the operation of the facility.

The site is expected to be designed such as to ensure optimal utilization of space, ensure minimal waste movement, easy and safe movement for the forklifts and other machines. At full operations the plant is expected to help recycle a lot of waste from within the country. Wastes will be segregated and contained safely at specific locations around the premises. Spills, emissions and friable materials will be contained within the premise.

Findings

At the time of this assessment, the 7.7ha parcel owned by the project owner had the change of user given to facilitate the project construction. Of the land portion, the proponent will develop design and apportion site plan to ensure maximum use of given land parcel. Land use in the surrounding areas area either homesteads and or parcels of land under small scale agricultural use. The area is still sparsely populated and as a result only one homestead could be sighted at around one hundred meters from the proposed site.

No form of services such as water supply from the county government is available to the site and the surrounding area while the access road will be upgraded and re-constructed where possible to sustain it in good usable condition due to envisaged increase in traffic flow. Detailed physical and social status of the site area in given under chapter 3 of the report (baseline information).

ENVIRONMENTAL MANAGEMENT PLAN

This environment management plan presents integrated scenarios with the environmental aspects, anticipated impacts during construction and occupation as well as preventive (mitigation) action plans. Other issues covered include the responsibilities, costs implications, timeframes and parameters for monitoring of the trends. The EMP matrix is designed such that it is self-implementing and can be implemented.

The development and operation of the waste management plant would be expected to observe environmental conservation requirements in accordance to the national regulations. To realize this goal, acceptability and minimal effects to the physical environment as well as the wellbeing of the surrounding communities will require to be integrated in the completion of the project through constant consultations, evaluations and review of the design aspects and modes of operation throughout the project cycle. Among the factors that need to be considered in this project implementation and its post evaluation initiatives will include;

(i) Preservation of the natural beauty of the immediate surrounding areas,

(ii) Control of soil erosion and siltation of rivers downstream as public sources of water,

(iii) Enhanced integration of environmental, social and economic functions,

(iv) Incorporation of safety provisions in the premises including easy accessibility to the road, adequate in-house signage and information systems among others.

(v) Enhancing the contractor's performance,

(vi) Realization of cordial relations among various community, economic, social and cultural groups as well as between the local community and the contractor,

(vii) Enhancing equity and maximizing social and economic benefits for the local community through income generation from employment,

It is recommended that specific guidelines are developed to allow integration of environmental management considerations in the construction, commissioning as well as the use of public amenities and resources within site area. The guidelines will be a basis for compliance actions, responsible practices for the local residents and appropriate code of conduct for all stakeholders to the project. Among the factors that need to be considered in this guideline will include;

(i) The contractor and other players in the construction activities be prevailed upon to implement this EMP,

(ii) The development should appreciate the interests of the neighbouring communities at all stages of the project,

(iii) Maintenance of the natural beauty of the countryside around the site area such as to include green belts and other beatification initiatives,

(iv) Enhanced integration of environmental, social and economic functions in the project design and implementation plans including safety provisions,

(v) A site specific environmental, health and safety plan is established soon after commissioned.

In order to implement the management plan, it is recommended that a position is created for an appropriate expertise to oversee matters of environment and social management as well as enhanced safety and security measures within and around the site. The services of an environmental expert may be required to co-ordinate and monitor environmental management for the site during construction and post monitoring audits. This would be done under the responsibility of the site contractor during construction.

The responsibility relationships are presented in the EMP matrix alongside the timeframe, targets and the cost estimates.

CHAPTER ONE:

1. INTRODUCTION

1.1 Background Information

Tailings consist of ground rock and process effluents that are generated in a mine processing plant. Mechanical and chemical processes are used to extract the desired product from the run of the mine ore and produce a waste stream known as tailings. This process of product extraction is never 100% efficient, nor is it possible to reclaim all reusable and expended processing reagents and chemicals. The unrecoverable and uneconomic metals, minerals, chemicals, organics and process water are discharged, normally as slurry, to a final storage area commonly known as a Tailings Management Facility (TMF) or Tailings Storage Facility (TSF). Not surprisingly the physical and chemical characteristics of tailings and their methods of handling and storage are of great and growing concern.

Tailings are generally stored on the surface either within retaining structures or in the form of piles (dry stacks) but can also be stored underground in mined out voids by a process commonly referred to as backfill. Backfilling can provide ground and wall support, improve ventilation, provide an alternative to surface tailings storage and prevent subsidence (EC 2004).

The challenges associated with tailings storage are ever increasing. Advances in technology allow lower grade ores to be exploited, generating higher volumes of waste that require safe storage. Environmental regulations are also advancing, placing more stringent requirements on the mining industry, particularly with regard to tailings storage practices. This ultimately places added pressure on the operators of a tailings facility who carry out the day to day roles of tailings discharge and water management. The majority of historical tailings related incidents have been influenced by poor day to day management, which has resulted in the strengthening of regulations controlling tailings storage today

Waste management is an integral part of industrial development in Kenya and all over the world. Without this, all the development activities would be detrimental the environment and to life in general. Waste management in the Kenya has been assumed to be managed by the National Environmental Management Authority (NEMA) and the County governments. However, The national environmental management authority have had private entities to help in the collection, transfer of wastes to designated areas and waste management through other means including incineration. It is in this regard that Environmental Analytical Services Limited (EASL) desires to develop and integrated waste management system comprising of a waste tailings management system, precious metals recovery and refining lab, contaminated soil management through washing and incineration wherever required while giving priority to recycling of the tailing waste by making bricks and cabros for the construction industry. Upon realization of the growing hazardous wastes challenges especially from the mining industry, EASL is seeking to provide a solution of tailing waste management which is currently lacking in the area although mining industry is being expanded in the region as a whole.

The installation of the proposed project is necessitated by the ever escalating hazardous waste generation from the mining industry and associated activities in Kenya including oil and gas exploration. The drafting and implementation of Environmental Management and Coordination (Waste Management) Regulations, 2006 requires that all waste producers must take cognizance to environmental protection by managing all wastes produced.

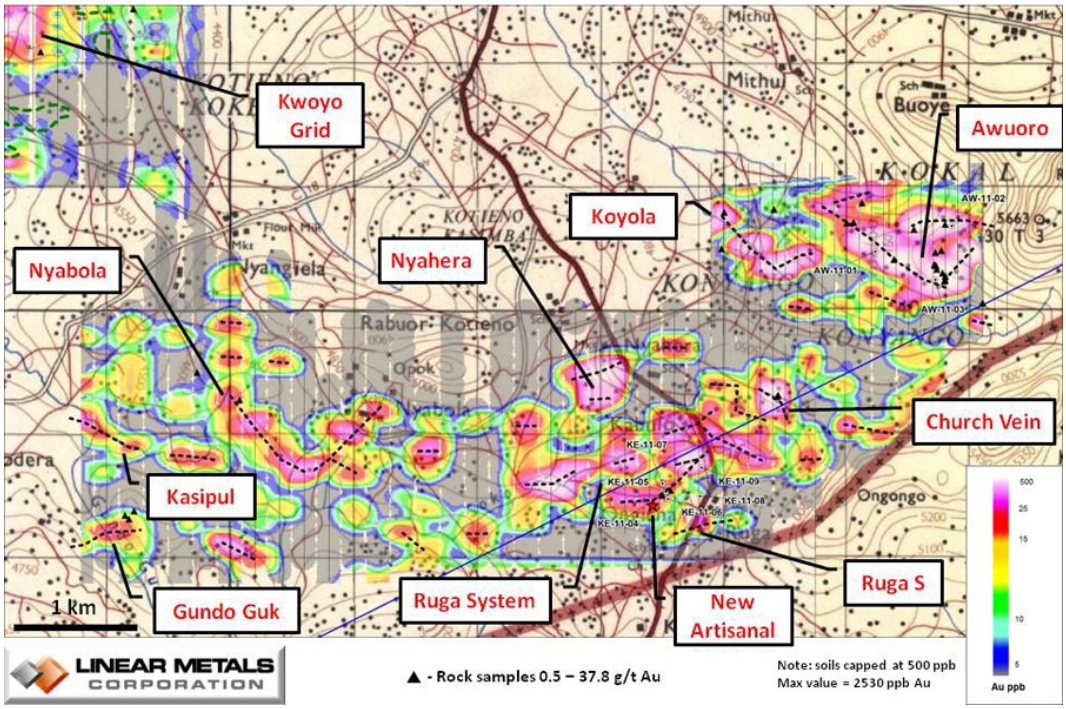
1.2 Project identification and justification

Competing factors such cost, the environment, safety and technical viability are at the forefront of thinking when today's mining organizations are investing in new tailings systems or retrofitting existing ones. The process-water lock-up and increasing land take needed by conventional tailings. These new methods are designed to maximize water recovery and minimize our environmental footprint. But the capacity of these measures is constrained significantly now. More work is needed to make them suitable for today's modern mining operations.

Adding to the challenge is the fact that ore grades are continuing to decline as older, higher-grade deposits are being exhausted. These suboptimal grades need significantly larger throughputs at the plant to maintain profitability. So, the cost and technical viability of the tailings solutions increases, too. In addition, recent failures in the industry are pushing for more highly regulated and lower risk methods of managing tailings. We all must do our part to minimize liability and ultimately eliminate the potential for catastrophic impacts to the environment and downstream communities.

The demand for precious metals including gold, copper and other precious metal has contributed to development of such industry while providing income to those involves in the chain of use. The locals in Migori County have delved into precious metal mining and recovery using local and traditional methods over the years. It is in this regard that EASL desires to improve the process of mining of these precious metals within the area whereas helping in the managing of tailing waste. Surveys and studies have been done and still being carried out to outline precious minerals deposit and distribution within the entire South Nyanza region. Below is a sample of mapping carried out by linear metal to determine mineral distributions in the wider South Nyanza region.

Awuoro-Kanga Grids: Au-in-Soils, workings/samples, and DDHs



In order to create sustainability, it is important to implement a sustainable and environmentally friendly a waste management that will be beneficial for the public health and for the environment. The establishment of an environmental lab will provide value addition to the mining industry, whereas waste management and recycling aspect will be a positive step towards a more sustainable society and environmental management strategy. The proposed project will provide a more efficient waste management system by decreasing amount of waste from such activities by giving room to recycling. To engage citizens in the aim of a better waste system through recycling aspect will be an asset in the municipality since it could create awareness regarding the importance with recycling and reuse of materials.

The Industrialization in Kenya and the implementation of Environmental Management and Coordination (Waste Management) Regulations, 2006, has necessitated the need to develop a proper and environmentally friendly way of handling all wastes more so hazardous wastes to include treatment facilities and proper containment to cope with the increased demand from industry and at the same time meet the ever demanding regulatory framework. Environmental Analytical Services Ltd was registered and among its objectives was to provide local industry and the public sector with the technical infrastructural capacity to manage hazardous wastes and provide technical support in the mining industry. The proponent of the aforesaid project is has demonstrated that it has a capacity to handle projects such as the proposed in addition to hazardous waste handling by bringing on board experience and expertise to the management of such waste within Kenya.

As a result of the increasing waste disposal problem not only in the mining industry but also within other sectors that contribute to economic development, Environmental Impact study is

necessary as a requirement by the international and the national environmental authorities to address the new/upcoming projects and developments. The purpose of this EIAS; therefore, is to provide baseline information upon which subsequent environmental audits studies shall be based in line with environmental (impact assessment and Audit) Regulations 2003, Kenya Gazette Supplement No. 31, Legal Notice No. 101 0f 13th June 2003, provide environmental management plan (EMP) for the project and to highlight tailing waste management strategies to be employed during the project life cycle. The study will also seek public participation and stakeholders review in line with the proposed project.

The planning and execution of the proposed project will ensure that the needs of the companies that will use the facility should be accommodated. Key variables to consider include waste type and quantity, site constraints, climate, wind, customers (private, commercial or public) and local zoning requirements. Examining these details will help produce an efficient operation. In considering the location, Environmental Management Services has acquired enough space within the county to erect the facility.

Our investigation involved examination of the potential impacts of the project on the immediate surrounding with due regard to all the phases from installation through to completing, operation and decommissioning. It encompasses all aspects pertaining to the physical, socio-cultural, health and safety conditions at the site and its environs during and after installation of the project. During the screening exercise, issues identified as those that may be impacted upon by the project activities include: air quality, health and safety, and other environmental hazards and socio-economic welfare of the surrounding communities.

The proposed project will be a key component of cost-effective solid and liquid waste management. The realization of the project will ensure that waste from local mining sites is examined sorted, treated and deposited in an environmentally friendly manor whereas providing technical lab support for the industry which is currently lacking in the entire region. In addition, the main benefit will include: -

- Provides opportunity to screen incoming mining waste and other wastes for such purposes as removing hazardous waste or recovering recyclables
- Providing environmental lab for those who engage in mining industry and other environmental matters that require lab services,
- Provides a trash and recyclable material drop-off location from the industry
- Provide waste management services to the county and those who may require these services through incineration process

1.3 OBJECTIVE SCOPE AND CONTENT OF THE EIA PROCESS

1.2.1. Objectives

The purpose of this EIAS is to ensure adequate identification of potentially negative environmental impacts. Secondly to propose workable mitigation measures and thirdly to formulate an environmental management plan (EMP) articulating envisaged impacts.

The overall objective of the study on the other hand is to ensure that all environmental concerns are integrated in all the project development processes with an aim of managing hazardous waste without compromising the natural environment and the ecology of the area.

Specific objectives include:

i. To identify possible environmental impacts, both positive and negative

ii. To assess the significance of the impacts

iii. To assess the relative importance of the impacts of relative plan designs, and sites

iv. To propose preventive mitigation and compensative measures for the significant negative impacts of the project on the environment.

v. Generate baseline data for monitoring and evaluating how well the mitigation measures are being implemented during the project cycle.

vi. To present information on impact of alternatives

vii. To present the results of the EIAS that can guide informed decision making and safe operation of the incineration plant

1.2.2. Scope

The Environmental Impact Assessment was conducted at the site and the surrounding area. The assessment involved the physical examination, interviews with beneficiaries, neighbouring communities, relevant consultants and government agencies.

To generate environmental impacts assessment study report for submission, it involved a systematic examination of all proposed activities including: Climate - Air quality - Topography - Geology - Hydrogeology - Hydrology - Terrestrial flora and fauna - Cultural and natural resources - Land use and land classification - Noise and vibration - Infrastructure and communications - Social-cultural-economics

The project assessment investigates and analyses the anticipated environmental impacts of the proposed development in line with the Environmental (Impact Assessment and Audit) Regulations of 2003.

Consequently, the report will generate the following:

- Nature of the project
- The location of the project including the physical area that may be affected by the project activities
- The activities that shall be undertaken during the project phases
- The potential environmental impact of the project and mitigation measures to be undertaken during and after the project cycle
- An action plan for prevention and management of possible accidents during the project cycle
- A plan to ensure that the health and safety of the workers and the neighbouring communities
- The economical and socio-cultural impacts to the local community and the nation in general
- The project budget
- Any other information that the proponent may be requested to provide by NEMA

1.2.3. Criteria

The environmental impact assessment was carried out in line with the environmental management, statutory and regulatory requirements in Kenya as outlined in section two of this report, the Environmental (Impact Assessment and Audit) Regulations 2003 and best practice guidelines on safety and health as per the Occupation Safety and Health Act, 2007.

Following the preliminary visit of the proposed site, the following was undertaken

(i) Screening of the project, a process that identified the project as being among those that requiring EIA under schedule 2 of the EMCA 1999

(ii) A scoping exercise that identified the key issues to be identified in the study

- ❖ Documentary review on the nature of the proposed activities, policy and legal framework, environmental setting of the area and other available relevant data/information
- ❖ Detailed discussions with the proponent and the consultation with the relevant officials in the regulatory authorities

- Physical investigation of the site and the surrounding areas using a pre-prepared checklist identifying possible environmental and human safety issues that are likely to be affected
- Reviewing the proposed project designs and implementation plan/schedules with a view to suggesting suitable alternatives
- Developing an environmental management plan with responsibilities, schedules, monitorable indicators and time frame among other aspects
- A comprehensive report including all issues as listed in the Environmental (Impact assessment and audit) Regulations 2003

1.4 TERMS OF REFERENCE (TOR)

The environmental Impact (EIA) report considered the following aspect and other that proved of significance during the study

1. Project identification and background
2. Project developments impacts on the ecology. This in essence covered:
    - The impacts of the development on biodiversity both within and outside the project development site
    - Impacts on habitat quality and issues of habitat disruptions
    - Surface water runoff and containment

3. Social implications of the development within the locality, region and nationally. This included:
    - Economic implications of the development
    - Security, risk and safety
    - Employment
    - Livelihoods
    - Public health implications
    - Demand and development of infrastructures and social amenities

4. Assess the impacts of development on landscape and land use:
    - Determine the impact on change on civic shape, scenery, aesthetic modifications
    - Examine the compatibility and complimentarily of the development of the surrounding land uses

5. Assess the impacts of the development on current demands on water source as well as possible implications on surface and ground water qualities and quantities

6. Develop an environmental management plan (EMP) that would mitigate the possible impacts on the environment

1.5 Duties of the Proponent

The report emphasizes the duties of the proponent and the contractor/supplier during the project phase. It will be the duty of the proponent to ensure that all legal requirements as pertaining to the development are met as specified by the law. The proponent will also ensure that the proposed EMP is implemented to avert all the negative aspects the project might pose to the environment, the community and workers. The proponent will also come up with the budget to implement the EMP and ensure that regular audits are carried out and reports submitted to NEMA.

1.6 Duties of the contractor/supplier

- Prepare and maintain an approved time and progress chart showing clearly the period allowed for each section of the work
- The contractor/supplier is to comply with all regulations and by-laws of the local authority including serving notices and paying of the fees
- The contractor shall make good at his own expense any damage he may cause to any public and private roads and pavements in the course of carrying out his work
- The contractor/supplier shall be responsible for all the action of the sub-contractor in the first instance
- The contractor or supplier shall take all possible precaution to prevent nuisance, inconvenience or injury to the neighbouring properties and to the public generally, and shall use proper precaution to ensure that safety of willed traffic and pedestrian
- All work which may produce under level of noise, dust vibration or any other discomfort to the workers, and/or guest of the client must be undertaken with care with all necessary precautions taken
- The contractor or supplier shall upon completion of working remove and clear away all plant rubbish and unused materials and shall leave the site in a clean and tidy state to the certification of the site engineer. He shall also remove from the site all rubbish and dirt as it is produced to maintain the tidiness of the premise and its immediate environs
- The standard of workmanship shall not be inferior to the current British codes of practice or the Kenya Bureau of Standards where existing. No materials for use in the permanent incorporation into the works shall be used for any temporary works or purpose other than that for which it is provided. Similarly, no material for temporary support shall be used for permanent incorporation into the works.
- All the materials and workmanship used the execution of the works shall be of the best quality and description. Any material condemned by the site engineer shall immediately be removed from the sit at the contractor/supplier expense

CHAPTER TWO

2. PROJECT DESCRIPTION

2.1 Nature of the project

The proponent - Environmental Analytical Services Ltd - is seeking to construct a waste tailing treatment and incineration plant, precious metal recovery laboratory and a recycling plant of tailing waste to manufacture bricks and cabros for sale. The proposed precious mineral laboratory is meant to provide the fastest processing turnaround time (to reduce metals costs), fair, straightforward treatment, and extraordinary standards of service.

Waste will be transported using tracks, weighed and deposited for pretreatment in designated areas before final disposal/recycling as appropriate either in landfills or incineration or any other method appropriate depending on the nature of waste being handled. At the station sorting of waste otherwise called material recovery station after offloading, there will be waste blending and storage. Contaminated soil management area will be provided together with evaporation pit, precious/trace metal recovery plant, incineration plant, ash management area and finally brick plant. The site will also have a fuel station, office block, laboratory and clinic and a cafeteria.

2.1.1 Office Block and Laboratory

Mining industry has a vast amount of fine-grained milling wastes (tailings) are produced in mineral processing plants each day. The wastes are generally in the form of slurry that is deposited hydraulically in the disposal area. How to effectively and economically dispose of the waste has become a major issue facing all mining operations. Knowledge regarding the basic physical properties of the tailings, and their consolidation and desiccation behaviors are necessary to understand the tailings material behavior and to further improve the efficiency of disposal.

The objective of installing a laboratory study is to ascertain basic properties of tailings and to examine their consolidation and desiccation behavior. Most laboratory tests will be carried out using the standard ASTM test procedures. However, due the complexity of the tailings and the technical requirement for deposition, some special test techniques will be required for specific analysis. In this regard, therefore, special experimental methods will used to carry out the consolidation and desiccation behavior tests.

The laboratory will also provide an added value addition to miners in providing mineral identification and analysis and providing an avenue for quality and quantification of minerals. Examination of gold will generally carried out through a fire assay process to isolate the precious metals and followed by gravimetry or atomic absorption spectrometry (FAAS) to determine sample concentrations within the lab. In giving support to the laboratory activities, there will be a precious/trace metal recovery plant where trace minerals and metals will handled.

2.1.2 Contaminated Soil Area

The facility is designed to have a designated area for receiving and managing of contaminated soil. The plant will help prevent/reduce the discharge of pollutants to storm water from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly. The following steps will be employed to help reduce storm water pollution from contaminated soil:

- Conduct thorough inspection of the soil and review of related documents related to site from which the soil is obtained. Physical examination of the soil may also come handy in managing contaminated soil
- Prevent leaks and spills to the natural environment. This means that there shall be a containment provision in the plant.
- The facility will there after offer soil washing to remove contaminants from the soil and subject the remainder to other treatment before final disposal

2.1.3 Evaporation pit

Washout from contaminated soil will be channeled to evaporation pit for saturation through evaporation process. All necessary precautions and preventive measures should be taken to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventive measures may consist of, but are not limited to, berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.

2.1.4 Waste Managing Area

All wastes to the facility will be weighed in the weigh bridge before offloading in the waste receiving area. The waste management area will include: waste offloading area, waste blending area and waste storage area. Here, waste will be sorted, blended depending on the nature and stored before subjecting the waste to various treatment and final disposal as appropriate.

The waste received may be mixed depending on sources. Parts of the waste may require varying handling options such as to including incineration, holding in bunkers or recycling. Sorting bay will therefore, be provided fitted with appropriate quantification facilities, documentation and holding zones. Necessary safety and environmental protection provisions will be provided

2.1.5 Incineration Plant

The design, acquisition and final installation of the incineration plant has been done and will be in conformity to the Waste Management Regulation, 2006, guidelines, criteria, procedures for installing/operating incinerators. In addition it has been proposed to the proponent that he shall regularly subject its operation to air quality measurements to ensure sound environmental management in its operation.

The solid waste container of the incinerator shall include a $5m^3$ solid waste container, attached to a feed conveyor system for loading the materials into the screw hopper. The facility shall be installed to have a height efficiency steam generator for recovering heat from the resulting exhaust gases. The generator shall include sufficient heat exchange surface to remove 65-80% of the available heat. The standard unit for solid waste uses a conservatively designed afterburner to assure maximum oxidation and minimal particulate emissions. The rotary system is sized based on operating with materials that require constant mixing, drying, and agitation.

The Rotary Kiln System will be equipped with modulating Natural Gas or light oil burners with flame safety. The burners will be mounted to the outer shells of both chambers and are directed to assure maximum turbulence. Also included will be complete fuel trains. The ash shall drop out of the primary chamber once the proper burn time has elapsed. Directly below the opening shall be a collection container or an optional ash conveyor to an ash container. The ash shall be cooled with water spray prior to removal for emptying.

The incineration plant will be fitted with constant air emission monitors that will provide a CEM including a draw sample system that will monitor O_2, CO, HCl, hydrogen fluoride, sulphur dioxide, NOx, particulate, and HC. This will eventually regulate particulate matter to the atmosphere reducing air pollution.

2.1.6 Brick Plant and Ash Management

Brick plan will offer waste recycling option for the tailings and spent ash by making of bricks for other construction industry. This seems to be a viable option in waste management plan by reducing disposal options which in many cases have been in the landfills.

After subjecting of wastes in the above mentioned methods, the remaining mineral fraction should be screened, so that the fraction of > 0.5 mm can be used for asphalt manufacture. For the fraction of < 0.5 mm there is no application, but new applications may be developed in the brick industry as proposed in the plan.

2.1.7 Other Supporting Facilities

There shall also be in place other supporting facilities including: cafeteria for the employees, security office at the gate, weighbridge just adjacent to security office by the gate, dueling station and repair/maintenance area for the plants, equipments and vehicles.

2.2 Site Location

At the time of the initial assessment to ascertain the proposed site location, seven decimal seven hectare (7.7 Ha) piece of land had been acquired and set for execution of the proposed project referenced as **L.R. No. Suna West/Wasimbete/1885** in Buhembu Suna West – Migori County in South Nyanza. Change of user had been obtained for the intended use i.e. from agricultural use to industrial use.

Electricity needs will be met from the KPLC grid running adjacent to the proposed site. In addition, the company will also employ the use of power generator to cater for the internal power needs in the station whenever supplementation is required especially during power outages. The main road access to the facility is an all weather murram road at the proposed gate to the premise. The proponent will improve the road to the site to ensure accessibility and safe delivery of materials taking into consideration of the envisaged increased traffic flow.

The site is expected to be designed such as to ensure optimal utilization of space, ensure minimal waste, easy and safe movement for the forklifts and other machines including transport vehicles. At full operations the plant is expected to help recycle a lot of waste from within the gold and other mineral mines whereas providing laboratory assistance for quality minerals. Wastes will be segregated and contained safely at specific locations around the premises. Spills, emissions and friable materials will be contained in the premises.

The proposed site

The proponent has planned to have six meters width along the fence to plant trees around the site to increase aesthetic value as shown above.

2.3 Site Characteristics

Soil type in the proposed site is sandy loam. There are shallow and stony with rock out crops especially towards the stream due to soil erosion activities and the land gradient.

Electricity needs will be met from the KPLC grid where applicable. However, before connection the company will employ the use of power generator to cater for the internal power needs in the station. The main road access to the facility is an all weather road that will be upgraded to serve the area. The proponent will improve the road to the site to ensure accessibility and safe deliver of raw materials and taking of finished products.

The site is expected to be designed such as to ensure optimal utilization of space, ensure minimal waste movement, easy and safe movement for the forklifts and other machines. At full operations the plant is expected to help recycle a lot of waste from within the country. Wastes will be segregated and contained safely at specific locations around the premises. Spills, emissions and friable materials will be contained in the premises.

2.4 Proposed site development

Tailings management facilities are often a key element in the rigorous environmental assessment and regulatory processes that should be employed in all levels of government (national or county) to ensure that the environmental effects of proposed mine projects are identified and that the significance of those effects are considered in project design prior to regulatory approval. It is a process that should be supported by environmental protection bodies including the National Environmental Management Authority and be monitored as expected to ascertain it's operation at all times.

While the general solid wastes management is being addressed through local authorities (direct services, out-sourcing, partnerships and privatizations) handling of hazardous wastes still remains a great challenge to the authorities as well as environmental and public Health fields since this sub-sector of waste management requires specialized handling. Among the options available for the management of hazardous wastes include incineration in accordance to the guidelines in the Environment Management and Coordination Act (Waste Management regulations), Gazette Notice No. 121 of September 2006). The proposed site is designed for waste reception and sorting of hazardous waste and minimal treatment as soil washing while giving recycling of waste a chance in the chain of environmental management and protection.

The integrated waste management facility is being designed to facilitate handling of hazardous wastes and will accommodate the following basic components;

2.4.1 Waste reception

It is intended that waste will be delivered to the site by tracks as desired. Delivery will also mainly by road but in compliance with regulations. The waste reception will comprise of;

(i) A service road from the offloading bay to the site capable of handling a forklift and 40ft.container at all weather conditions,

(ii) Offloading using forklift where appropriate since the wastes will be delivered using large tracks,

(iii) A container offloading bay will be provided at the site that will also be installed with safety measures environmental protection provisions.

(iv) Paring area from trucks and forklifts

2.4.2 Waste Sorting

The waste receiver may be mixed depending on sources. Parts of the waste may require varying handling options such as soil washing for contaminated soil, holding in bunkers or recycling. Sorting bay will therefore, be provided fitted with appropriate quantification facilities, documentation and holding zones. Necessary safety and environmental protection provisions will be provided.

2.4.3 Recycling yard

All recyclable materials will be moved to a yard for storage depending on nature and target re-users. Necessary management provisions will be part of the yard,

2.4.4 Incineration facility description

Incineration process will be part of waste management. The design, acquisition and final installation has been done and will be in conformity to the Waste Management Regulation, 2006, guidelines, criteria, procedures for installing/operating incinerators. In addition it has been proposed that the company regularly subject its operation to air quality measurements to ensure sound environmental management in its operation.

The solid waste container will include a $5m^3$ solid waste container, attached to a feed conveyor system for loading the materials into the screw hopper. The facility is installed to have a height efficiency steam generator for recovering heat from the resulting exhaust gases. The generator includes sufficient heat exchange surface to remove 65-80% of the available heat. The standard unit for solid waste uses a conservatively designed afterburner to assure maximum oxidation and minimal particulate emissions. The rotary system is sized based on operating with materials that require constant mixing, drying, and agitation.

The Rotary Kiln System is equipped with modulating Natural Gas or light oil burners with flame safety. The burners will be mounted to the outer shells of both chambers and are directed to assure maximum turbulence. Also included will be complete fuel trains. The ash drops out of the primary chamber once the proper burn time has elapsed. Directly below the opening is a collection container or an optional ash conveyor to an ash container. The ash shall be cooled with water spray prior to removal for emptying.

The incineration plant is fitted with constant air emission monitors that will provide a CEM including a draw sample system that will monitor O_2, CO, HCl, hydrogen fluoride, sulphur dioxide, NOx, particulate, and HC. This eventually regulates particulate matter to the atmosphere reducing air pollution.

2.4.5 Waste disposal

Waste water emanating from operation areas as well as surface run off from the premises will not be allowed into the natural drainage system. Due to the potential residuals of hazardous pollutants, the wastewater will be collected and channeled into stabilization ponds and

sedimentation lagoons that shall be established within the premise for proper management and to avoid contamination to the natural environment.

2.4.6 Water supply

There is no surface water source within the vicinity of the proposed site except of a seasonal stream at the back of the proposed site. This leaves sources options as rain water harvesting and groundwater for a project of the above magnitude, rainwater will not be adequate for the operations. As a result, a high capacity borehole is proposed to meet water needs in the facility.

2.4.7 Support services

The site will not be complete until support facilities are put into place. These will include;

(i) Offices,
(ii) Sanitation facilities (toilets, bathrooms, hydrants, wastewater drains,
(iii) Health and safety provisions (fire extinguishers, hydrants, signage, exits, first Aid points etc.,
(iv) Security arrangements deliverance

2.5 Site alternatives

The development of feasible alternatives, to meet the overall objectives of the proposal calls for technical knowhow and informed knowledge. During this process of alternatives review to the proposed project, reference is made to:

- **Available technology,**

The site is expected to be designed such as to ensure optimal utilization of space, ensure minimal waste movement, easy and safe movement for the forklifts and other machines. At full operations the plant is expected to help recycle a lot of waste from within the country. Wastes will be segregated and contained safely at specific locations around the premises. Spills, emissions and friable materials will be contained in the premises.

- **Policy objectives,**

The main objective of the proposed project is designed to meet the policy objective of The Environmental Management and Coordination Act in managing of all issues that pertains to clean and healthy environment since everyone is entitled to clean and healthy environment *(Section 3 of EMCA.* Policy for environmental management entails that there should be cleaner development mechanisms and this means that every development should have measures in place to ensure that produced waste is managed at source and that natural environment is not disturbed in a negative way.

- **Social attitudes,**

The proposed project should in line with the development of the surrounding areas and where not, the proponent should endeavour to get the necessary approvals before proceeding on with the project. Consultation to the local communities should be a mandatory process to the project implementation to ensure inclusivity in the project cycle. The local residents must be receptive to the project to ensure smooth running and coexistence. This ensures that the community's interests are taken care of. The process will therefore include publishing the proposed project in the local dailies and radio station to create awareness.

- **Environmental and site constraints and project economics**

Waste sorting requires enough space to ensure that there is no interference from all quotas. This has necessitated acquiring of enough space for the management of all waste necessitating the allocated seven point seven hectares of land in this area. For control of external access, the company will ensure that the land is condoned by fencing it all round having only one gate for the access to the site.

2.5.1 Alternative 1 (Existing Locations)

The proposed site for the waste transfer station is located at a rural area of Migori County in Buhembu Area with sparse settlement in the vicinity. This alternative entails that there be no disturbance of the proposed area which is absolute conservationist view. This will mean that the companies and individuals who require such facilities will be travelling to neighbouring country – Tanzania for the facility such as the proposed. This may pose public health challenge in case of any accident in transportation. It is, therefore, becoming increasingly important that the operations are relocated to a suitable site with minimal impacts to people's lives and the general environment.

2.5.2 Alternative 2 (Proposed Location)

Following the current scenario illustrated above on the current waste tailing management in the process of hazardous waste management, the proposed site is the only other location found suitable. This conclusion has been arrived at due to the following considered reasons;

(i) There are no facilities to support and manage mining and tailing waste in this area despite many mining sites in South Nyanza region

(ii) The land is legally allocated to the proponent by the county government making the development more feasible as planned,

(iii) Population distribution might not hinder such development as proposed and hence it will be possible to present a case of appropriate zoning in future to the Local Government Authorities to ensure minimal social impacts

(iv) There are no significant environmental sensitive features around the site (no surface water bodies except seasonal river located at the far end of the plot, no

forest cover, no wetlands, not sensitive habitats noted, etc.). It is, therefore, likely to have minimal environmental impacts,

(v) The proponent is ready to abide by the law for a long term suitability of the site.

2.5.3 PROJECT COSTS AND IMPLEMENTATION SCHEDULE

The projected will cost **Ksh.392, 200, 000** including the legal costs, land acquisition, borehole digging, security fence, personnel fees, management offices, power supply by generator, waste reception weighbridge, waste management and mobile plant equipment among other daily provisions for the running of the station.

CHAPTER THREE

3. POLICY, LEGAL ADMINISTRATIVE FRAMEWORK

3.1 Introduction

The Kenyan constitution acknowledges the need to conserve the environment and the need to take good care of environment which is of essence for the survival of human beings. The laws have intervened to and ensure that human beings are considerate, cautious and careful in their dealings with the environment. Kenyan constitution begins with acknowledging the need for cautionary dealings with the environment by a provision in its preamble that, "We the people of Kenya are RESPECTFUL of the environment, which is our heritage, and determined to sustain it for the benefit of future generations" The wording of the constitution in its preamble clearly suggests respect to sustainable development.

The Environmental Impact Assessment is a useful tool for protection of the environment from the negative effects of developmental activities. It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound. It is a condition of the Kenya Government for developers to conduct Environmental Impact Assessment on the development Projects.

There is an existing policy, legal and administrative framework regulating the proposed project. The government has established regulation to facilitate the process of EIA study and EA. The regulations are contained in the Kenya Gazette supplement No. 56, legislative No. 31, legal notice No. 101 of 13th June 2003. In addition, the government has a number of National Policies and statutes to enhance environment and sustainable development. Some of the policies and legal provisions are discussed below.

3.2 Policies

The policy formulation process began in 2007 but slowed down towards the end of 2008 after thorough stakeholder consultations. The promulgation of The Constitution of Kenya 2010 and the emergence of issues like climate change brought a new impetus not only to align the policy with the Constitution but also to address such emerging issues. The policy making process culminated into the Sessional Paper No. 6 of 1999 entitled Environment and Development. The legislative process gave forth the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 as Kenya's first framework environmental law. Both the Sessional Paper and the Act added to a large number of existing sectoral laws and policies on various facets of the environment such as water, forest and minerals. This has created a diffuse system of environmental laws and policies, some of whose provisions are not in harmony making them ill-suited to aid the pursuit of sustainable development objectives as set out in the Vision 2030

Developments and environment policies are being formulated by the respective ministries in consultation with relevant stakeholders. Government intentions in reducing air emissions has been on the rise ever since through initiatives of tree planting. This target will be realized through investments by government, private sector, civil society and individuals.

Policy formulation in this regard was meant to address environmental challenges within the country more so with the increasing development activities that have been witness since independence. Among other things, policy developments were to address:

i) Environmental governance

ii) Biodiversity loss

iii) Valuation of environmental and natural resource

iv) Rehabilitation and evaluation of environmentally degraded areas

v) Urbanization, waste management and pollution

vi) Climate change, energy, security and disaster management

vii) Public participation, environmental education and awareness

viii) Data and information

ix) Energy and

x) Chemical management

Environmental Impact Assessment (EIA) is a methodology used to identify the actual and probable impacts of the projects and programmes on the environment and to recommend alternatives and mitigating measures. The assessment is required at all stages of project development with a view to ensuring environmentally sustainable development for both existing and proposed public and private sector development ventures. The National EIA regulations were issued in accordance with the provisions of Environmental Management and Co-ordination Act (EMCA) of 1999. The EIA Regulations must be administered, taking into cognizance provisions of EMCA 1999 and other relevant national laws. The intention is to approve and license only those projects that take into consideration all aspects of concern to the public as they impact on health and the quality of the environment.

Policy development had the following objectives:

- ☞ Provide a framework for an integrated approach to planning and sustainable management of Kenya's environment and natural resources.
- ☞ Strengthen the legal and institutional framework for good governance, effective coordination and management of the environment and natural resources.
- ☞ Ensure sustainable management of the environment and natural resources, such as unique terrestrial and aquatic ecosystems, for national economic growth and improved livelihoods.

- ☞ Promote and support research and capacity development as well as use of innovative environmental management tools such as incentives, disincentives, total economic valuation, indicators of sustainable development, Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs), Environmental Audits (EA) and Payment for Environmental Services (PES).

- ☞ Promote and enhance cooperation, collaboration, synergy, partnerships and participation in the protection, conservation, sustainable management of the environment and natural resources.

- ☞ Ensure inclusion of cross-cutting and emerging issues such as poverty reduction, gender, disability, HIV&AIDS and other diseases in the management of the environment and natural resources.

- ☞ Promote domestication, coordination and maximization of benefit from Strategic Multilateral Environmental Agreements (MEAs).

Policy implementation was developed to be guided by the following principles:

(a) **Environmental Right**: Every person in Kenya has a right to a clean and healthy environment and a duty to safeguard and enhance the environment.

(b) **Right to Development**: The right to development will be exercised taking into consideration sustainability, resource efficiency and economic, social and environmental needs.

(c) **Ecosystem Approach**: An integrated ecosystem approach to conserving environmental resources will be adopted and enhanced to ensure that all ecosystems are managed in an integrated manner while also providing a range of benefits to the citizenry.

(d) **Total Economic Value**: The benefits that ecosystems generate will be integrated into the national accounting system, programmes and projects.

(e) **Sustainable Resource Use**: Environmental resources will be utilized in a manner that does not compromise the quality and value of the resource or decrease the carrying capacity of supporting ecosystems.

(f) **Equity**: The management of the environment and natural resources will ensure equitable access to resources for present and future generations.

(g) **Public Participation**: A coordinated and participatory approach to environmental protection and management will be enhanced to ensure that the relevant government agencies, county governments, private sector, civil society and communities are involved in planning, implementation and decision making processes.

(h) **Subsidiarity**: The management of the environment and natural resources will be through decentralization and devolution of authority and responsibilities to the lowest level possible

3.2.1 National Environmental Action Plan (NEAP)

The NEAP for Kenya was prepared in mid 1990s: It was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of societal decision-making.

Consolidation of NEAP resulted in the establishment of NEMA and other EMCA, 1999 institutions namely. National Environment Council, National Environment Tribunal, Public Complains Committee, National Environment Trust fund; Gazettement of District and Provincial Environment Committees whose responsibility is to oversee environmental management activities in their areas of jurisdiction; Development and implementation of various environmental management regulations such as. Environmental Impact Assessment and Audit Regulations, Waste Management and Water Quality Regulations, Biodiversity Regulations, Ozone Depleting Substances Regulations whereas regulations on Hazardous Chemicals, Air Quality and Noise are being developed in consultation with lead agencies and stakeholders. Other achievements include development of Biodiversity Strategy and Action Plan 1999; Development and implementation of National Action Programme (NAP) on combating desertification; Policy and Bill on Indigenous Knowledge (IK) is being finalized; Establishment of Kenya Environmental Information Network (KEIN); Development of wetlands policy, Management Plans for Lake Naivasha, Jipe and OlBollasat, prepared four State of the Environment Reports (2003, 2004, 2007 and 2006/07) among others.

3.2.2 The National Poverty Eradication Plan (NPEP)

The NPEP had the objective of reducing the incidence of poverty in both rural and urban areas by 50 percent by the year 2015; as well as the capabilities of the poor and vulnerable groups to earn income. It also aims to narrow gender and geographical disparities and a healthy, better educated and more productive population. This plan has been prepared in line with the goals and commitments of the World Summit for the Sustainable Development (WSSD) of 1995. The plan focuses on four WSSD themes of the poverty eradication; reduction of unemployment; social integration of the disadvantaged people and the creation of an enabling economic, political, and cultural environment. This plan is to be implemented by the Poverty Eradication Commission (PEC) formed in collaboration with Government Ministries, community based organizations and private sector.

Eighteen years after President Daniel Toroitich arap Moi of Kenya launched an ambitious plan to eliminate poverty in the East African former British colony in 1999, the National Poverty Eradication Strategy begs answers as the country seeks assistance from the international community to save three million food-insecure people from starvation. The development of this plan did not make things any better but worse since the developers of this

ambitious plan did not take into consideration of factors and forces which may rippled in the planned efforts.

The effectiveness of this plan is yet to be assessed to spell out the gains and fails.

3.2.3 National Policy on Water and Resources Management and Development

While the National Policy on water resource management and development (1999) seeks to enhance systematic development of facilities in all sectors for the promotion of the country's socio-economic progress, it also recognizes the by-product of this process as wastewater. It, therefore, calls development of appropriate sanitation systems to protect people's health and water resource from any source of pollution.

The main purpose of the reform is to separate water resources management and development from water services delivery, while the Ministry in charge of water affaires deals with policy and strategy formulation, mobilization of funds, coordination and monitoring. Although the separation of the sub-sectors is key the strong link between WRM, WSS and WSTF is recognized. This is particularly crucial for areas like pollution of raw water sources, issuing of extraction permits, clustering of WSS systems, etc. Consequently, the NWRMS and NWSS must be seen within one framework of the water sector. The distribution of roles in the WRM-sub sector is lined out in the NWRMS and for the WSS sub-sector in the present documents and as follows

Industrial and business development activities therefore should be accompanied by corresponding waste management systems to handle the waste water and other wastes emanating from such processes. The same project requires that such projects should also undergo comprehensive EIA studies that provide sustainable measures to be taken to ensure environmental resources and people's health in the immediate neighbourhood and further downstream are not impacted by the emissions. As a follow-up to this, EMCA 1999 requires annual environmental audits to be conducted in order to ensure that mitigation measures and other improvements identified during EIA study are implemented.

In addition, the policy provides charging levies on waste on basis of quantity and quality. The "polluter-pays-principle" applies in which case parties contaminating water are required to meet the appropriate cost of remediation. The policy provides for establishment of standards to protect water bodies receiving waste water, a process that culminated in the enactment of the environment Management and Coordination (Waste Management) Regulations 2006.

The key objectives of the policy include:

- To ensure that from the onset, all development policies, programs and projects takes environmental consideration into account.
- To ensure that independent environmental impact assessment (EIA) report prepared for any industrial venture or other development before implementation

- To come up with effluent treatment standards that will conform to acceptable guidelines. This has already been done by NEMA through the Environmental Management and Coordination Waste Management) Regulations 2006, and environmental Management and Coordination (water Quality) Regulations 2006.

3.3 Legal Aspects

The key National laws that govern the management of environmental resources in the country have been briefly discussed in the paragraph below. Note that whenever any of the laws contradict each other, the environmental management and coordination act prevails

3.3.1 The Environmental Management and Coordination Act, 1999

a) Background and administrative Structures

The environment Management and Coordination Act of 1999 received a presidential assent on January 6th, 2000 and was gazetted on January 14th, 2000.

The main objectives of the act are:

- Provide guidelines for the establishment of a legal and institutional framework for the management of environment in Kenya
- Provide a framework of legislation for over 77 statutes in Kenya that contain environmental provisions
- Provide guideline for environmental impact assessment, environmental audit and monitoring, environmental quality standards and environmental protection orders

In 2001, the government established the administrative structure to implement the act. The two main administrative structures are:

i. The National Environmental Council (NEC)

The National Environmental Council (the council) is responsible for policy formulation and directions for the purpose of the Act. The Council also sets national goal and objectives and determines policies and determines policies and priorities for the protection of the environmental.

ii. The National Environment Management Authority (NEMA)

The responsibility of the National Environment Authority, (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be principle instrument of government in the implementation of 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 the technical committee of NEMA known as the standards and Enforcement review Committee (SERC).

b) EMCA requirements for Environmental Impact Assessment and Audit

The Act aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with national objectives and the sustainable development goals enunciated in Agenda 21 of the Earth Summit held in Rio de Janeiro in 1992. The ultimate objective is to provide a framework for integrating environmental considerations into the country's overall economic and social development.

The second schedule of the Act lists the projects for which an EIA and/or EA must be carried out. Section 68 of the Act specifies that accurate records should be maintained and annual reports submitted to NEMA, as required.

This project report has been undertaken in accordance with the Environment (Impact Assessment and Audit) regulation 2003, which operationalize the Environment Management and Coordination Act EMCA) 1999. The report is prepared in conformity with the requirements stipulated in the (EMCA) and the Environmental Impact Assessment and Audit regulations 2003 regulation7 (1) and the second schedule. Part II of the said act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. In order to achieve the goal of a clean environment for all, new projects listed under the second schedule of Section 58 of EMCA No 8 0f 1999 shall undergo an environmental impact assessment. This includes development activities such as the installation of this new incineration plant. In additional to the legal compliance above, the following legal aspects have also have been taken into consideration

c) The Environment Impact (Assessment and Auditing) Regulations, 2003

Legal Notice No. 101 stipulates the ways in which environmental experts should conduct Environmental Impact Assessment and Audits in conformity with the stated requirements. It is concise in its report content requirements, processes of public participation, licensing procedures, inspections and any possible offences under the Act.

d) Environmental Management and Coordination (Waste Management) Regulation 2006

The Legal Notice No. 121 stipulates the responsibility of any waste producer. Part II section one states that: "No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. And that; any

person whose activities generate waste shall collect, segregate and dispose or cause to be disposed off such waste in the manner provided for under these Regulations". Subsection three of Part II highlights the way waste should be handles stating that, "any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose off such waste in a designated waste disposal facility".

Part III section 17 requires that, "every trade or industrial undertaking shall install at its premises anti-pollution technology for the treatment of waste emanating from such trade or industrial undertaking, anti-pollution technology installed pursuant to the aforesaid shall be based on the best available technology not entailing excessive costs or other measures as may be prescribed by the authority."

e) Environmental and Coordination (Water Quality) Regulations 20006

The regulations were gazetted in September 2006 and come into force in 1st April, 2007. The regulation details the waste management requirements and also requires application of a license to all those premises discharging the waste to the environment.

3.3.2 The Water Act 2002

The purpose of the Water Act is to provide the management, conservation and use and control of water resources and for the acquisition and regulations of use of water, to provide for the regulation and management of water supply and sewerage supply. Except for waters that are wholly situated in a private landowner's domain, the act vests the right over all surface and ground water in the state. This is only subject to the rights which users may acquire under license from time to time.

The overall power for the control for the control of every body of water is exercised by the minister. The minister has the duty to promote the investigation, conservation and proper use of water resources throughout Kenya.

The act provides for a water resource management authority whose functions include, *inter-alia,* developed principles and procedures for allocation for water resources, monitor national water resource management strategy, determine applications for permits for water use, regulate and protect water resources quality from adverse impacts, manage and protect water catchments, e.t.c. In addition, under the water (catchments board) rules promulgated by the minister, the country is divided into six catmint boards, vis-avis Tana Catchments board, Rift Valley Catchment's Board, Athi River Catchment's Board, Ewaso-Nyiro Catchment's Boar, Lake Victoria (North) Catchment's Board and Lake Victoria (South) Catchment's Board. But these boundaries are subject to variation depending on available hydrological information.

Under the act, the minister may declare an area to be a conservation area and direct that special measures be taken for the conservation for the ground water therein. Every person who has been using ground water in an area declared to be a conservation area and who desires to continue with the use must obtain a permit within six months of the order. It's an offence to disobey such an order.

Protection of water supply is clearly a critical issue under the act. Accordingly, whenever the minister is satisfied that special measures are necessary for the protection of a catchment area from each quarter is obtained; he may declare such an area to be a protected area. By order, the minister may regulate or prohibit the activities within that area which may be contrite to the requisite conservation goals.

An in-depth analysis of the new water Act reveals that the Act has created an integrated water resources management framework in Kenya which is participatory and likely to have a wider acceptance and implementation than the predecessors. Part II, section 18 of the act provides for the National monitoring and information systems on water resources. Following on this, sub-section 3, allows the water resource management authority to demand from any person or institution specified information documents samples or materials on water resources. Under these rules, specified information document, samples or materials on water resources may be kept by a water user and the information thereof furnished by the authority.

Section 73 of the Act allows a person with a license (licensee) to supply water and make regulations for purposes of protecting against degradation of water resources. Section 75 and Sub-section 1 allows the licensee to construct and maintain drains, sewers and other works for intercepting, treating or disposing any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

Section 94 of the Act makes it an offense through or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resources in such a manner as to cause or be likely to cause pollution of water resource.

Section 23 indicates that the authority shall approve community projects after they are approved by the persons owning or occupying at least two thirds of the particular area concerned in the project and that provision is made by the project for an adequate alternative supply of water when and if the available levels to other users is.

It also prohibits cancellation of a permit of a community project without the consent of the minister.

Section 24 requires all beneficiaries of a community project whose construction is funded in full or in part by the government, if the minister so determines, to pay a rate or charge for that benefit.

3.3.3 The Public Health Act cap 242

Part IX, Section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116, requires local authorities to take all lawful, necessary and reasonable practicable measures to maintain areas under their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health.

Such nuisance or conditions are defined under section 188 wastes, sewers, drains or refuse pits in such estate, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to human health. Noxious matter or waste flowing or discharged from any projects into a public street or into the gutter or side charnel or watercourse, irrigation channel or bed not approved for discharge is also deemed as a nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of medical officer of health is likely to harbor rats or other vermin.

On the responsibility or local authorities, Part XI section 129 of the Act states in part "it shall be the duty of every local authority to take all lawful, necessary and reasonable practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes……"

Part XII section 136 states that all collection water, sewage, rubbish, refuse and other fluids which permits or facilitates the breeding or multiplication of pests shall be deemed nuisance and are liable to be dealt with in the manor provided by this act.

3.3.4 The Physical Planning Act, Cap 286

The local Authorities are empowered under section 29 of the act to serve and maintain all land planned for open spaces, parks, urban forests and green belts, the same section therefore, allows for prohibition or control of the use and development of land and building in the interest of proper and orderly development of an area.

Section 30 states that any person who carries out development without permission will be required the land to its original state. It also states that NO licensing Authority shall grant land license for commercial or industrial use or occupational or any building without development permission granted by the respective local authority.

Finally, section 36 states that if in connection with a development application, local authorities is of the opinion that that the proposed development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application of the environmental impact assessment (EIA) report. EMCA, 1999 echoes the same by requiring that such an EIA is approved by the National Environmental Management Authority (NEMA) and should be followed by annual environmental Audits.

3.3.5 The penal Code Cap 63

Section 193 of the code states that any person or institution that voluntary corrupts or foils water for public springs or reservoir, rendering it less fit for its ordinary use is equally of an offence.

Section 192 of the same act states that a person who makes or vitiates the same atmosphere in any space to make it noxious of health of a person/institution in dwellings or projects in the neighbourhood or those passing along public way commits an offence

3.3.6 Occupational Safety and Health Act (OSHA) 2007

The Act requires all employers to register their workplaces by making an application to the Director of Occupational Health and Safety Services before they start any operations. The Act also sets minimum standards that are to be maintained in such workplaces to safeguard health, safety and welfare of workers. These are all aimed at elimination of hazardous wastes from workplaces. The act also requires that all workplaces to display the abstract of the act for all workers to read and remind themselves on how to protect themselves from hazard.

The act and its subsidiary legislation makes provision for health, safety and welfare persons employed in factories and other places of work such as in building construction and project operations are defined. The act prohibits emissions of dust, fumes or impurities into the atmosphere without proper treatment to prevent pollution or other ill effects to life and property. These provisions require that all practical measures be taken to protect all persons employed in a factory from air emission or impurities originating from any process within the factory.

The act also requires that no discharges should be made into the environment from factories and workplaces without proper treatment that requires them harmless to the environment.

The act also has specific measures that need to be taken to protect health, safety and welfare of workers and environmental conservation. The same act also requires all operation that fall under it to apply for registration as such to the Directorate of Occupational Health and Safety Services.

3.3.6.1 Safety and Health Committee Rules of 2004

The rule states that any employer/proponent/occupier who employs more than twenty persons must establish a committee to address health, safety and welfare of workers. The employer must also cause to be carried out a health and safety audit of all its operations in an annual basis by a registered health and safety advisor who should forward such a report to the Directorate of Occupational Health and Safety Services.

3.3.6.2 First Aid Rules

These have details on first aid requirements in terms of facilities and capacity building among residential workers. Workers during construction stage must also be provided with first aid facility to cater for any accident emergencies.

3.3.6.3 Hazardous Substances Rules

These regulate the handling, transportation and use of certain listed chemicals which may have negative effects on the body when one is expected. The act in addition prohibits exposure to carcinogenic, radioactive, mutagenic or teratogenic substances. Tasks that involve such shall be performed within an enclosed system so as to prevent any exposure of the workers to the substance. Where any of the processes may involve use of carcinogenic, radioactive, mutagenic or teratogenic substances, every employer shall ensure that such processes are automated or are conducted by use of remote controlled systems. As a means of safe operation to employees, contractors or visitor, every employer shall issue a permit to work certificate to any person carrying out maintenance and service of an enclosed system

3.3.6.4 Noise Prevention and Control Rules of 2005

These rules have set minimum and maximum exposure limits beyond which workers and members of the public should not be exposed to noise without adequate means of protection. The rules also have exposure limits for exposure out of workplaces. The rules have several recommendations on a comprehensive noise control program for workplaces that includes a requirement for medical examination of workers who are exposed to noise. The rules have also set the minimum noise levels that should emanate from a facility to public/neighbouring areas by day or by night.

3.3.6.5 Building Operations and Works of Engineering Rules

The rules guides health and safety matters in all building/construction and civil engineering works

These rules states clearly that it is the duty of the proponent to ensure health, safety and welfare of all workers are and authorized visitors to the site before commencement of operations, the proponent should notify the Director of Occupational Health and Safety Services of the intention so that from then on, the director advises and follows up on the necessary conditions to safeguard the health, safety and welfare of workers on site.

The rules also states that qualified and experienced persons must be appointed to act as safety supervisors by the proponent. These should supervise the enforcement of the standards to achieve the objectives mentioned above.

The rules have specific sections on excavation, transport, demolition, formwork and scaffolds, lifting and lifting equipment and other safety measures.

CHAPTER FOUR

4. BASELINE INFORMATION OF THE STUDY AREA

4.1 Introduction

Migori is a county in southern part Nyanza. Migori town is the capital of the county. The town is located 63 km south of Kisii and 22 km north of the Tanzanian border. The town has an urban population of 31,644 and total population of 46,576 (1999 census). Migori is connected by road to the Masai_Mara national park, but the road is in poor condition. Migori town is immediately after Awendo, (where the Sony Sugar Company is situated), Oyani, Stella and Kakrao areas. The road to Isebania is well tarmacked from Kakrao to Mwanza in Tanzania.

4.2 Geographical location

The Migori district is located in Migori County and is found between latitude 0'024' and 00 40" S and longitude 34^0 and 34^0 50" East. It borders Homabay County to the North, Kisii County and Trans Mara District to the East, Kuria and Republic of Tanzania to the South and Suba district to the West. The total area of the district is 1,167 Km2 including 475km2 of Lake Victoria. Operational data on county have not been published thus most of data in the report is based on previous district data apart from those updated through the 2009 census (which has also based its results on boundaries enacted before establishment of the counties). The district is further divided into eight administrative divisions as listed in table below. Lake Victoria occupies 475 Km2 and its shoreline runs along Muhuru, Nyatike, and Karungu divisions with Nyatike having the largest portion of it. List of divisions found in the Larger Migori county and there area of coverage

Name of Division	Area of Division (Km^2)
Rongo	217
Awendo	256
Uriri	379
Suba East	210
Suba West	283
Nyatike	502
Karungu	136
Muhuru	47

4.3 Land use

The land use in the district is varied with the largest proportion being used as agricultural land while the second largest portion is used for urban and rural settlements. Land is most regularly used for productive activities in the eastern part of the district while the western part is underutilized despite its potential.

Agricultural land	
Small Holdings	174,700
Large holdings	2400
Non Agricultural Land	
Gazetted forest	327
Urban Areas	11700
Trust Land	550

Land use category by size (acres)

Cultivated land awaiting plot the east of the site

Adjacent plot to the south of the site

4.4 Topography, Drainage and Hydrology.

Altitude ranges from 1,135m above sea level (asl) at the shore of lake Victoria to 1700m asl. The high altitude area has several undulating hills and plains stretching for about 20-70km. Some of the hills include Nyatike which is about 4,625m, Ogengo 4300m, God Sibuoche 1475m, God Kwer 1420m and Nyabisawa 1489m.

The main rivers in the project area are the Kuja, Migori and Riana. Other rivers found in the area include Ongeche, Oyani and Sare. River Migori and Ongeche join Kuja River which has a potential for electricity generation both for industrial and domestic purposes. The Rivers can support irrigation for horticultural production but at their downstream they often cause flooding to the communities there.

4.5 Soils and Geology

Soils here vary greatly according to the prevailing parent material. In higher regions, soils are dark red clays which are fertile and well drained. In the Kavirondo Gulf, soils are sandy loam formed from sedimentary rocks. Alluvial deposits of eroded material from uplands are common along flood plains of rivers such as Nyando, Yala, Nzoia, and Kuja. In plains such as the Yala and Kano plains, peat swampy soils and black cotton soils dominate. Volcanic soils interspersed with fertile peat swampy soils are found in the uplands. Soils in these regions are generally productive.

Rock formation is mainly granites. The soils vary in texture from one area to another. Volcanic soils are found to the north of river Migori, black cotton soil found in Karungu division and they contain adequate nutrients and are suitable for agriculture. Along river valleys and lakeshores are poorly drained soils of heavy clays that can only support pasture.

Sandy loam soil in the project area

Down ward cros-section of soil in the project site

Vertical soil structure at the site

4.6 Climatic conditions

Rainfall varies, ranging from 1308 to 2316mm annually, with the short rains occurring between March and May and long rains occurring between August and November. Climate is a mild inland equatorial type, modified by relief, altitudes and proximity to the lake. Nyatike, Karungu and Muhuru divisions have comparatively harsher climatic conditions than the rest of the district. The lake shore division's experiences unreliable and poorly distributed rainfall. The temperature ranges between 170c and 200c with the highest temperature in February and lowest in August. The district experiences a high humidity and a potential evaporation of 1800-2000mm per year.

4.7 SOCIO-ECONOMIC ENVIRONMENT.

4.7.1 Demographic and Population Profile

The population of Migori district is 335,873 as per the 2009 population census. It has risen from the previous census data due to subdivision of the larger district into several other districts.

4.7.2 Settlement pattern

Central Suna has the largest population followed by North Suna, South Kanyamkago in Uriri, while Kawere II B has the smallest population. The highest population density is in Central Suna followed by South Kanyamkago while Lower Suna has the least population density.

4.7.3 Education

The county is well served with education facilities such that there are four hundred and twelve (412) pre-primary schools, four hundred and ten (410) primary schools and fourty four (44) secondary schools. The enrolment rate is high for men and low for women while the drop rate is vise versa. There are enough teachers in secondary and primary schools with a ratio of 1:18 and 1:34 respectively, however, the number of pre-primary school teachers is still less. Other training institutions in the area include Teachers Training College (TTC), Institutions of technology, adult literacy centre and youth polytechnics.

4.7.4 Employment

The 2009 population and housing census covered in brief the labour status as tabulated below. The main variable of interest for inequality discussed in the text is work for pay by level of education. The other variables, notably family business, family agricultural holdings, intern/volunteer, retired/homemaker, fulltime student, incapacitated and no work are tabulated and presented in the table below up to ward level.

Overall Employment by education Levels in Migori County

Education Level	Work for pay	Family Business	Family Agricultural Holding	Intern/ Volunteer	Retired/ Homemaker	Fulltime Student	Incapacitated	No work	Number of Individuals
Total	12.3	13.5	49.3	1.0	4.8	14.2	0.5	4.5	**430,315**
None	8.6	12.4	63.0	2.1	5.7	0.8	2.1	5.3	**36,339**
Primary	8.8	13.6	54.9	0.8	4.9	12.6	0.4	4.0	**278,382**
Secondary +	22.0	13.4	31.4	1.2	4.0	22.2	0.3	5.6	**115,594**

In Migori County, 9% of the residents with no formal education, 9% of those with a primary education and 22% of those with a secondary level of education or above are working for pay. Work for pay is highest in Nairobi at 49% and this is twice the level in Migori for those with secondary level of education or above.

4.7.5 Health aspects

Malaria, Urinary Tract Infections (URTI) & diarrhea are the most prevalent diseases in the district. Malaria is common due to the high temperatures experienced in the district while diarrhea is as a result of poor sanitation in the district. About 60% of patients admitted in medical wards at the district hospital are suffering from HIVAIDS related ailments.

4.7.6 Poverty Analysis

Poverty in the district is identified in terms of food poverty; hardcore poverty and absolute poverty. 58% of the district population is in absolute poverty category while 51% experiences food poverty.

The major causes of poverty in the district include population growth, increases in prices for goods and services, retrogressive social-cultural practices and attitudes, harsh climatic conditions and HIV/AIDS pandemic. The most vulnerable members of the community are the fishing community those found along the lake; the peasant farmers; the orphans; widows; the elderly and population with physical disabilities. The table 5.2.5 below gives the general socio-economic indicators of the project area.

4.7.7 Economic activities

The main economic activities in the district is agriculture, tourism and industry sector has agreed potential for absorbing 50% of the district labor force and its ranked 2nd in terms of employment and income generation.

4.7.8 Tourism, Trades and Industry

Tourism is still under exploited. The district is strategically placed to benefit from Western Kenya and Northern Tanzania tourism circuits covering centers of Kisumu, Homabay, Mbita and Maasai Mara. Local attractions include Nyamgotho in nearby Suba district, Thim lich Ohinga, the scenic beauty of the islands and the Gogo falls among others.

There are three major agro-processing industries in the area namely Sony Sugar at Awendo and, two British American Tobbaco (BAT) leaf sorting factories at Rongo and Nyirongi. There are a few medium scale industrial undertakings in the area such as Prinsal Fish Processing Company; Hamm feed factory, Salah Bakery and Sisal Processing Factory. The county host a variety of formal commerce, trade and services activities which include animal and agricultural produce sale and, whole selling, fish trade, hotels, chemists, tailoring, bicycle and, motor garages, butcheries, bookshops, hospitals bars and lodges among others.

4.7.9 Infrastructure Development

Rural water supplies*:* rehabilitation of existing water facilities; training of community in sustainable use of water facilities; development of alternative water sources by drilling more boreholes, constructing pans and shallow wells especially in Manyatta, God Jope and the town centre.

Rural access roads

- Maintenance, upgrading and construction of roads to improve accessibility to high potential and resource rich areas.
- Transport and communication-expand communication facilities to ease information and goods and services flow in the interior to improve livestock marketing

- Provisions of business finance-to enhance employment and income creation out of livestock sector.

Community Development

- Strengthen early warning system and disaster management strategies in the district
- Environment; improved vegetation management by promotion of better grazing patterns and grazing reserves to mitigate impacts of droughts; promote afforestation and management of existing facilities
- Community health and nutrition- supplementary feeding programmes, HIV/AIDS awareness campaigns and control and immunization expansion

  Literacy campaigns and expansion of learning facilities to facilitate human resource development; expand adult education programmes and gender empowerment

4.7.10 Energy Sources

A great percentage of the population has no access to clean energy supply as electricity and gas. Electricity is majorly utilized in towns and few of the local residents who live along the grid supply line. Majority of the population use firewood and charcoal to meet their daily energy needs for cooking and heating within homesteads and kerosene for lighting. Small percentages of the population have taken to solar lighting and rechargeable lamps.

The nearest grid power supply passes through the proposed site. As a result electricity will be the main source of power supply for the proposed plant. In addition to the power from KPLC, the proponent will have its energy sources for power generator and finally the project will generate power to be utilized within the facility. Since many of the residents are not connected to power supply, wood fuel and charcoal are being used as the major sources of energy.

4.8 Road Network and Water supply

Road network distribution in the larger Migori District is presented in the table below according to the divisions

Division	Bitumen (Km)	Gravel (Km)	Earth (Km)
Suba East	15	71	45
Suba West		70	41
Rongo	36	72	100
Awendo	23	79	224
Uriri	12	52	71
Nyatike		121	119
Muhuru		12.5	42

Table 5.2.10: Road network per division

Due to the presence of Lake Victoria, the division doesn't suffer water scarcity. It is estimated that about four thousand three hundred and sixty four (4,364) households have access to piped water and another forty three thousand four hundred and two (43,402) have access to portable water. There are other water sources apart from the lake and these include rivers, wells, springs, boreholes and dams.

4.9 Noise Levels

No notable sources of noise in the area.

4.10 Sensitive Areas

There are no significant sensitive cultural features and/or areas in the vicinity of the site. However, it was noted that it falls within the northern outer fridges of the dispersal area of the corridor linking the Nairobi National Park and the Amboseli where only limited numbers of grazers are observed.

4.11 BIOLOGICAL ENVIRONMENT

4.11.1 Biological diversity – Flora and Fauna

4.11.2 Forestry

There are 327 ha. of gazette forest and 549 ha. of un-gazetted forest under trust land. The district is climatically favored for forestry, but, through settlement activities much of the forest cover has been reduced. Considerable exotic forest cover has been created through various programs and some of these existing exotic covers can be observed on the hilltops. Natural forest is used for herbal medicines, plant fiber for ropes, game and honey harvesting.

The project area, however, have no much large vegetative cover (trees) except short grass cover due to agricultural activities in the area and clearance to provide room for settlements. Though great area of the region including the proposed project area is under agriculture, some areas have been left for grazing of domesticated animals.

Some common trees include Bondo (*Euphorbia candelabrum*), Ochwoga (*Carissa edulis*), Mukinduri (*Croton megalocarpus*), Ngow (*Ficus nataliensis*), Onera (*Terminalia brownii*), Toona does well in the area but most trees are multi-branched, which may indicate bud borer trouble. *Terminalia catappa*, Cypress (*Cupressus lusitanica* variant) does well in the area and some pine has been grown successfully.

The birdlife in Migori is varied with many records of blue flycatcher, blue-spotted wood dove, harrier hawk, bat hawk, baglafecht weaver, tawny eagle, purple grenadier, beautiful sunbird, yellow-billed stork, hadada ibis, African citril, cape turtle dove, paradise flycatcher, yellow white eye, white-browed robin chat, black-headed gonolek, black kite among others.

Some of the tree found in the area

4.11.3 Environmental setting

Evaluation of the physical and biological environmental was undertaken through observations around the site, records and available literature. The following sub-sections provide an outline the existing status in this regard.

Proposed site from west to east

6.1 PUBLIC PARTICIPATION

Public participation was done in calling out the community together to form a public hearing in relation to the project. They community including those in local authority were in attendance during the hearing on the proposed project where all the concerns from the community was addressed. Attached at end of this report shows list and designation of those who attended the hearing. Additional public participation is expected during the advertisement period in the assessment process.

4.4.1 Consultation with interested and affected parties

The consultation process included to a large extent public consultation through structured meeting with interested and affected parties. Consultation to the county government of Turkana was done and as a result the county government issued an allotment to the company as a go-ahead with the proposed project.

4.4.2 The Questionnaire

Consultation and public participation was restricted to interviews and discussions with relevant authorities and local residents and property owners.

Interviews were carried out in the neighborhood on 14th July, 2017 by the use of questionnaires (attached), to find out all the views from the neighbors' towards the commercial development project. The people who were contacted for their opinion majorly were those who live in the neighborhood of project area, most of whom had no objection to the development of the proposed project.

Some of the observable concerns from the filled questionnaire administrated during the public participation process included:

- Increased spread of diseases including HIV/Aids due to influx of population into the area and increased earning
- Exposure to toxic/hazardous waste may cause ill health
- Increased air emissions hence air pollution
- Noise pollution from the ongoing activities
- Increased traffic flow to the facility
- Pollution to water ways

All these concerns have been addressed in the report and environmental management plan developed to help in maintaining safety both to the terrestrial and aquatic environment. The proponent has made an agreement to adhere to environmental protection and observe various laws as highlighted to proper manage the facility while creating environmental opportunities in the area and the within the county.

CHAPTER FIVE

5. ANTICIPATED IMPACTS AND MITIGATION MEASURES

5.1 Introduction

The proposed project will involve hazardous waste handling and treatment especially waste tailings from mining process and a precious metal recovery lab. This scenario implies potential linkages with the surrounding environment and ecological setting that require to be addressed during the construction and operation upon commissioning. The following sections outline these linkages as well as proposed corrective measures.

In determining the potential environmental impacts, the following areas were looked at:

5.1.1 The Natural Environment

- Land
- Surface and Ground water
- Air
- Flora and fauna

5.1.2 The Human Environment

- Human settlement in proximity to the project
- Existing land use
- Existing Infrastructure
- Social and cultural values

5.1.3 Uncertainties

Uncertainties arising from the prediction of impacts could arise from:

- ***Scientific uncertainty*** - Information collected regarding the ecosystem and community may not be sufficient. Some of the reference material is more than 10 years old.
- ***Data Uncertainty*** - Data used has been referred from other sources and methodology used to collect the information may have been insufficient.
- ***Policy Uncertainty*** - some documents referred to have recently been implemented and may be found to be flawed.

5.2 IMPACT IDENTIFICATION AND ANALYSIS

The significance of the predicted impacts depends on several factors including:

- Size of impacted area
- Number of people likely to be affected
- Nature and toxicity of the pollutants
- Probability of occurrence
- Whether the environment is degraded or sensitive
- Magnitude of impact
- Whether reversible or irreversible

The matrix shall be utilized in impact identification, where the interaction of each activity with the environmental factor is looked at in terms of magnitude and importance.

The potential Environmental Impacts of the project activities shall be analyzed in the context of the feasible mitigation measures. **Refer to Table VI for potential impacts.**

The matrix method has been for analysis of impacts because:

- It links action and Impact it gives a good display of results.

	Activity Effect on	Environmental Parameters				
		Land	Water	Air	Flora/fauna	Socio-economic
Construction Phase						
2	Mobilization to site camp		-Increased demand -Pollution of surface and ground water	-VOC Pollution	-	-Conflict of social values -Security enhancement -Creation of direct and indirect employment -Traffic congestion -Degradation of access roads
3	Site clearing	-Alteration of soil structure	-pollution of surface water	-VOC Pollution	-Loss of biodiversity	-creation of employment -Occupational hazards
4	Site excavation	-Alteration of soil structure -Contamination of soils	-Interference with drainage patterns -Contamination of water bodies	-Increased dust levels -Pollution from emission of VOCs	-Loss of biodiversity	-Noise nuisance -Occupational hazards
5	Transportation of workers and materials to site	-Land compaction -Oil contamination	-Contamination of water bodies	-Pollution from emission of VOCs	-	-Road congestion/accidents -Noise nuisance -Increased traffic flow
6	Construction of buildings	-Landscape distortion	-Increased demand -Increased surface run-off -contamination of surface water	-Dust pollution	-	-Occupational hazards -Noise nuisance -Creation of Employment -Economic growth -Improved aesthetics
7	Fabrication works	-Land pollution	-Pollution of surface and ground water	-	-	-Noise nuisance -Employment opportunities -Occupational hazards
8	Demolition of temporary structures	-Alteration of soil structure	-Pollution of surface and ground water	-	-	-Noise -Occupational hazards

9	Painting works	Land pollution	-Pollution of surface and ground water	-Air Pollution		-Occupational hazards
Operation phase						
1	Occupation and operation of facility	-pollution by solid and liquid wastes	-Increased demand -Pollution of surface and ground water	-	-	-Increased employment -Increased revenue collection by exchequer -Wealth creation -Increased property values -Increased traffic flow -Increased security -Noise nuisance -Strain on electricity -Conflict of social values -Privacy infringement
2	Operation and maintenance of plant and equipment	-contamination from petroleum products	-Pollution of surface and ground water	-Air pollution	-	- employment opportunities -occupational hazards -Economic growth
3	Maintenance of grounds	-Disturbance of eco-system -Soil contamination	-Pollution of surface and ground water	-	-	-Employment opportunities -Occupational hazards
4	Maintenance of buildings	-	-	-Dust pollution	-	-Employment opportunities
Decommissioning phase						
1	Evacuation of premises	-	-Ease on demand	-	-	-Loss of jobs
2	Demolition of buildings and other structures	-Soil Contamination	Pollution of surface and ground water	-Dust pollution	-	-Noise -Distortion of Scenic beauty
3	Dismantling of plant and machinery	-Soil contamination	Pollution of surface and ground water	-Air pollution	-	-Occupational Hazards
4	Carting away materials	-Soil dumping	-	-	-	-Increased traffic flow

5.3 IMPACT EVALUATION

Each environmental component and identified impacts were examined and evaluated using the South Africa impact significance criteria. Each of the impact parameters was weighted as shown below.

- **Magnitude/severity** (very high-10, high-8, moderate-6, low-4, minor-2, nil-0)
- **Duration of impact** (permanent-5, long term-4, medium term-3, short term-2, immediate-1)
- **Geographic extent** (global-5, national-4, regional-3, local-2, site only-1)
- **Probability of occurrence** (definite-5, highly probable-4, medium -3,

The significance of each environmental factor was calculated using the formula:

Significance = Consequence (Magnitude + Duration + Spatial scale) X Probability of occurrence.

The table below was then used to evaluate and rate the significance of the negative impacts identified. Significant impacts were found to be those affecting water, air and socio-economic setup during construction and operation phases.

Table 1: SA Impact Evaluation matrix

		ENVIRONMENTAL IMPACT				
ACTIVITY	**Environmental Component**	**Magnitude / severity**	**Duration**	**Spatial scale**	**Probability**	**Significance**
Mobilization to site	Land	2	1	1	2	8
	Water	2	1	1	2	8
	Air	2	1	1	2	8
	Flora/fauna	0	1	1	1	2
	Socio economic	4	1	1	1	6
Construction civil works	Land	2	1	1	5	20
	Water	**6**	**2**	**2**	**4**	**40**
	Air	4	2	2	4	**32**
	Flora/fauna	4	2	1	3	21
	Socio economic	**4**	**3**	**3**	**4**	**40**
Operation	Land	2	4	1	2	14
	Water	**6**	**4**	**2**	**5**	**60**
	Air	2	4	1	2	14
	Flora/fauna	2	1	1	2	8
	Socio economic	**8**	**4**	**3**	**5**	**75**
Maintenance of building, equipment and grounds	Land	4	1	1	2	12
	Water	4	1	1	3	18
	Air	2	1	1	2	8
	Flora/fauna	4	1	1	2	12
	Socio economic	4	1	1	2	12
Decommissioning	Land	6	2	1	3	27
	Water	2	1	2	2	10
	Air	2	1	2	2	10
	Flora/fauna	2	1	1	1	4
	Socio economic	4	2	2	3	24

Ranking scale: >75 – high environment and social impact; 50 – 75 moderate to high impact; 30 – 50 moderate impact; < 30 low impact; 0 - no impact.

5.4 Positive Impacts

The primary reason for the installation of the project is to provide a centralized service for the mining industry which is currently lacking in the entire project area. This will help in reducing the cost of mining by reducing transport cost to acquire laboratory facilities. Fully operational laboratory will aid research in relevant industry. The proposed handling and treatment of hazardous waste will have a positive impact in waste disposal. The realization of the proposed project will be a source of employment to many Kenyan populations who are currently not employed giving special preference to the local residents. In addition, the project will among other benefits provide:

i) An opportunity to screen waste prior to disposal

ii) Flexibility in selecting waste disposal options

iii) An opportunity to serve as a convenience center for public use especially laboratory services

iv) Creation of employment opportunities

v) Enhanced hazardous waste management

5.5 ANTICIPATED NEGATIVE IMPACTS

The proposed integrated waste management and recycling stations and laboratory that minimize environmental impacts requires careful planning, designing, and operation. This section focuses on neighborhood quality or public nuisance issues and offers "good neighbor practices" to improve the public's perception of the proposed project. Design and operational issues regarding traffic, noise, odors, air emissions, water quality, vectors, and litter are discussed below. Proper facility siting, design, and operation can address and mitigate these potential impacts on the surrounding natural environment and the community.

5.2.1 Construction phase

Particulate Matter

There is projected to be increased production of particulate matter during the project execution including construction of operation office, laboratory block, cafeteria, weighbridge, incineration go-down, waste sorting and storing bay and a soil washing bay, drain well and a site wall. Particulate matter will also be stirred from trucks transferring materials to the site

The main impacts of the dusty conditions are;

(i) Aesthetic and visual problems, though there are no notable settlements within the vicinity of the site,

(ii) Potential risks of health (mainly bronchial infections),

(iii) Deposition of dust on vegetation hampering development of the same,

(iv) Air pollution aspects including contribution towards climate change.

Noise Levels

Like dust emissions, construction hand tools and transport trucks will be a major source of noise to the surrounding areas. It was noted that the immediate project area are agricultural land with no human habitation except of one homestead at the south west and hence effects of noise during construction will not have any significant social implications.

Water Quality

There are no sources of surface water at the site vicinity such as springs, dams, rivers or lake; however, there is a seasonal river to the west of the site. No impacts, therefore, are anticipated on surface water quality. However, oil spills from the machinery and depositions at the construction site camp has the potential for contamination of surface runoff (that may eventually end up into surface water streams) or infiltrate into the groundwater sources. Water from contaminated soil washouts will be contained within the site to avoid any percolation thereby avoiding any underground water contamination.

Land Degradation

No significant impacts in this regard are anticipated since landscaping by planting of grass on open spaces and preserving of indigenous trees at the project site.

Health and Safety

The main concern in this regard is the occupational welfare of the construction workers from the effects of dust and emissions from the machineries. Health and safety concerns will eventually be addresses during the operation states of the station. The concerns are projected to come from the incoming waste handling process. Neighbouring residents are not likely to be affected since the construction site will be fenced off to keep off intruders. However, access by cattle herders will require to be addressed. It could be a point of high road safety risk in this regard.

Biodiversity

There will be little disturbance to biodiversity at the site location except for grass and some small patches of trees to pave way for construction activities.

Social Impacts

There are no displacements or direct interference with any social groups within and around the site since no settlements were found at the time of this assessment. Anticipated social impacts would be related to gaseous emissions, generation of dust and noise.

5.2.2 OPERATIONS

Air Quality

Major potential point sources of particulate matter (chemical residuals and dust) and gaseous emissions in and around the proposed premises are expected to be as follows;

(i) Holding areas for the hazardous waste materials as received will likely be sources of dust, particularly from the transfer process to the sorting areas. The hazardous wastes if obtained from a wide range of background with varying components and hence quality of related particulate matter discharged into the air. Particulate matter could contain chemical pollutants, organic pollutants, bacterial contaminants all of hazardous/toxic characteristics,

Impacts associated with the above air pollution would include;

(i) Health effects mainly bronchial infections, skin problems, visibility, etc. This is likely to affect the employees and the immediate residents and communities (at the moment there are few inhabitants in the immediate neighbourhood),

(ii) Soil quality degradation that may result from deposition of pollutants from the plant operations of carried to other areas through surface runoff,

(iii) Pollution of water sources through direct deposition, surface runoff and/or infiltration into groundwater aquifers,

(iv) Emissions of acetylene gas into the air have a potential to cause fire in the premises with far reaching implications on the neighbouring land users.

Noise Levels

The proposed plant operations are likely to generate high noise levels from deliveries of hazardous wastes, movement of hazardous materials from one point to another within the plant. This situation is likely to have occupational health and safety implications as well effects to the workers and the nearest neighbourhood. Currently, there are no settlements or other businesses in the immediate neighborhood, but any such future land use may imply that noise levels be maintained at the recommended levels. Measurements confirmed this as the existing baseline situation.

Environmental Pollution

The key environmental pollution anticipated from the site activities includes the following;

(i) Discharging wastewater into open drainage system around the premises that would subsequently be carried into public water sources through surface runoff. Pollutants in this case include hazardous residuals, heavy metals, suspended solids, oils and lubricant residuals as well as mixture of contaminants brought along the hazardous waste materials. This has potential impacts on people's health and the aquatic life,

(ii) Discharge of oil residuals into open drains from point sources (moving machine parts, storage areas, delivery bays, etc) are potential sources of environmental contamination,

(iii) Deposition of emitted particulate matter and dust on land affects the soil quality that and the effect could also compromise on the integrity of water sources (both the surface and ground aquifers). The area is generally dry and accumulation of pollutants on soil provide heavy pollution loads in storm water and consequently surface water sources,

(iv) Disposal of inert solid waste from the premises could become an extended environmental problem that would affect physical environmental quality, biodiversity and public health at points of disposal. Such waste including fry ash, drums, scrap metals and kiln tiles are notable potential waste requiring planned disposal strategy.

Health and Safety

The health of the plant workers varies from one section to another as outlined below;

(i) Health risks are found in the management of the hazardous waste holding areas, the transfer routes and preparation procedures. The risks including exposing the workers to a wide range of chemical poisoning, toxicity or long term health complications.

(ii) Personal accidents and risks of getting injured by falling objects to the workers and visitors while moving around the premises cannot be ignored. Heavy, corrosive and hot objects are among potential risks to safety anticipated in the proposed premises,

(iii) Accidents from waste transporting vehicles could also pose a challenge to those involves.

5.2.3 DECOMMISSIONING PHASE

The site is designed for a lifespan of between 50 – 100 years subject to effective maintenance. During this period, it is possible that necessary retrofications will be carried out on the equipment, plant layout could be reviewed and processes could be changed while major structural changes and expansions might be found necessary. At the end of the site life, a scheduled plant will be necessary to remove the site component, a process referred to as decommissioning.

The decommissioning process will require that the proponent contract an environmental decommissioning audit and to obtain necessary approvals from the county government together with the national environmental management authority.

5.3 MITIGATION MEASURES

Following are global mitigation measures while specific actions are presented in the matrix under Table 1 below.

5.3.1 MANAGEMENT MEASURES

Corporate Initiatives

While planning the site management, it will be necessary to consider the following basic aspects on environmental conservation;

(i) The health and safety of the workers, the neighbouring communities and on-site installations should of key importance and necessary mechanisms should be provided at all times during the project cycle,

(ii) Emissions into the environment (gaseous, particulate matter and noise) have undesirable off-site effects on public health, particularly those in the windward direction. In this regard it will be necessary to plan for a monitoring mechanism and maintenance of records on air quality profiles as part of the corporate capacity building plan,

(iii) Capacity building in environmental conservation will also be a necessary item in the site management such as to address the entire management structure as well as suppliers of goods and services including waste generators.

Site Operations

Appropriate financial and human resources will require to be provided for continuous improvement of the environmental performance at the premises and the surroundings. In this regard performance evaluations, reviews of management practices and assessment of material consumption and capacity of the workers are among the operational aspects that will require constant attention.

Infrastructural Maintenance

Management of environment at the active site cannot be complete until an effective monitoring and maintenance schedule is established. This includes a continuous performance improvement, integration of environmental issues in hygiene and sanitation, provision of basic "green" facilities (e.g. hazardous waste receptacles, safe in-house movement and performance evaluation from customers) are some of the continuous improvement tools that may be applied. Others important tools include;

(i) Carrying out regular operation performance appraisals,

(ii) Follow scheduled maintenance of equipment and facilities,

(iii) Documentation and record-keeping on resource utilization and conservation,

(iv) Observing good house-keeping at all times with specific focus on waste management,

(v) Regular review of site planning,

(vi) Contractual documents with customers and goods/service suppliers to reflective environmental responsibility,

(vii) Undertake scheduled monitoring and statutory annual environmental auditing.

Capacity Building

The environmental issues identified in this report require that the proponent shall establish appropriate technical and physical capacity to ensure sustainability and continuous improvement in environmental management. Capacity is required in;

(i) Documented guidelines on environmental conservation to enable the firm identify environmental issues and adopt appropriate action plan towards minimizing impacts to the environment, health and safety.

(ii) The guidelines should be established and formulated into a corporate policy statement, an environmental policy, environmental management programme, environmental management operational manuals, standard operation procedures, standard contractual documents for customers as well as goods and service suppliers and a legal register,

(iii) Physical infrastructure for environmental management at the site maintained at optimum performance levels. Among the basic structural features are in-house solid waste storage arrangements to prevent residuals reaching the external environments, waste water (leachate and wash water) drains and the related containment reservoirs,

(iv) Awareness and skills in environmental management for the operators, supervisors, support staff, customers and material suppliers,

(v) A qualified environmental officer to oversee all matters related to management and conservation aspects who would also take charge of health and safety issues including basic training on specific skills and technical understanding on environmental, health and safety to all workers, a general awareness to the customers, contractors and suppliers.

5.3.2 OPERATIONAL MEASURES

Hazardous Wastewater Management

The following are basic aspects for inclusion in the site design and the wastewater handled in accordance with waste regulations Legal Notice No. 120 of September 2006;

(i) Construct a concrete slab for holding of the scrap metals and other wastes coming from the field. The waste slab should also be fitted with surface runoff traps from which the leachate should be handled as hazardous wastewater,

(ii) Proper containment of all waste especially waste water from soil washing facility to ensure that there is no environmental contamination during the entire waste handling process,

(iii) Maintain appropriate records on wastewater quality for compliance evaluation and comparison with the gazetted standards on a continuous basis,

(iv) Isolate domestic wastewater from process wastewater for containment in septic tanks and regular exhaustion,

(v) Oil storage areas should be provided with slabs with surrounding bunds to contain any spilt oils. Runoff from the oil storage areas.

Hazardous Solid Waste Management

Handling of solid wastes at the site will require the following components and handled in compliance with the waste regulations Legal Notice No. 121 of September 2006;

(i) The waste slab should be provided with compartments for segregation of various categories of waste classified on source and physical nature that should also be handled separately,

(ii) Provide solid waste holding bins at strategic locations around the premises and install transfer stations and modalities of waste removal to approved dumping grounds. Hazardous materials should be handled through incineration,

(iii) Oils and grease from moving machine parts and other sources should be handled as hazardous wastes in accordance with the waste regulations,

Aerial Emissions

Gaseous and particulate matter is perhaps the most critical environmental aspect associated with the proposed operations. The following measures should be considered to reduce the elated impacts;

(i) Hazardous wastes holding yards require to be kept moist at all times to prevent dust emission into the atmosphere and the windward side of the site during deliveries, in-house movement or just in storage,

(ii) Reduce the resident time of waste within the site to reduce air emission as a result of solid waste degradation in the waste handling process,

Health and Safety

Attention should also be on the health and safety of the workers, visitors, customers and neighbouring community such as to include;

(i) All moving machine parts and high temperature areas should be fitted with guard rails and restrict access,

(ii) Provide all employees with personal protective gear and enforce application at all times within the place work,

(iii) Enhance waste segregation and sorting on sources basis and devise safe modes of handling each category with particular focus on those likely to be hazardous/toxic.

(iv) Training and induction of all employees and visitors on site to enhance safety.

5.4 MITIGATION MEASURES

Table 2: Impact – Mitigation Matrix

Development Stage	Environmental Aspects	Anticipated Impacts	Recommendations Mitigation Measures
Construction/ Installation	Environmental Pollution	▪ Emissions into the air of dust, ▪ Emissions from construction equipment and material deliver trucks, ▪ Public nuisance from construction equipment.	▪ Maintain construction site dump at all times, ▪ Construction equipment maintained a good working order at all times, ▪ Fence up the construction site to keep off intruders.
	Drainage	▪ Change in storm water regime around the site, ▪ Soil erosion creating siltation of natural drains during rains, ▪ Discharge of wastewater from the site into dry drainage system with risks of environmental pollution downstream.	▪ Consider surface contours and channel storm water appropriately, ▪ Link the site drainage with natural drainage pattern in the area.
	Social Issues	*Noise Levels:* ▪ High noise levels from construction machinery and materials' delivery trucks,	▪ Construction to take place only during the day, ▪ Maintain machinery in good working order.
		Health and Safety: ▪ Bronchial infections from dusts and other emissions, ▪ Risks to food based industry in the area, ▪ Water sources contamination, ▪ Risks to health an safety of the construction workers, e.g. HIV/AIDS.	▪ Keep dry construction materials dump at all times, ▪ Keep emissions from sources the lowest possible, ▪ Provide personal protective gear to the workers ad ensure application at all times, ▪ Fence up the construction site to keep off intruders, ▪ Install warning signage around the construction site,
		Cultural Values: ▪ Social interaction of construction workers with local communities, ▪ Moral effects (e.g. rise in prostitution, crime, etc.)	Sensitize workers and local communities on moral values and cultural integration.

Development Stage	Environmental Aspects	Anticipated Impacts	Recommendations Mitigation Measures
Operation	Waste Water Aspects	▪ Surface water contamination, ▪ Land and soil degradation ▪ Pollution from disposal of scrap oil, leachate and wastewater, ▪ Pollutants from hazardous wastes holding yard, ▪ Pollution from off-site solid waste dumping,	▪ Ensure acceptable solid waste collection systems from sources, storage arrangement and transfer, ▪ Develop appropriate documentation and waste manifest for hazardous waste movement, ▪ Ensure containment of solid waste leachate and runoff in the hazardous waste holding platforms, ▪ Establish engineered containments and pre-treatment for liquid effluents from all point sources, ▪ Install oil interceptors and grit traps along all the affected drainage system, ▪ Slab the hazardous wastes holding yard and install trapping arrangement for leachate and surface runoff there from.
	Air Quality	▪ Aerial emissions from the kilns and other stacks,– carbon dioxide, nitrogen oxides, hydrocarbons, water vapour, hydrogen chloride gas, ▪ Arial pollution from dust, emissions, etc., ▪ Particulate matter blown from waste holding yards,	▪ All stacks be fitted with appropriate facilities to intercept gaseous emissions, ▪ Maintain records of the air quality within and around the premises for continuous improvement, ▪ Collect and keep covered zinc and fly ashes from the furnaces to prevent blowing into the air,
	Noise Levels	▪ Occupational health and safety of the workers, ▪ Levels above the ambient noise levels the surrounding areas,	▪ Undertake noise level measurements a different locations around the plan, ▪ Carry out a noise mapping around the site precincts,
	Biological Diversity	▪ No signs of significant wild life in the area, ▪ Removal of grass cover, arid trees and shrubs, ▪ Related microorganisms associated with the scarce vegetation removed.	▪ Ensure solid refuse handlers dispose into approved grounds to avoid biodiversity degradation, ▪ Plant trees on the open spaces continuously, ▪ Externalize initiative for ecological conservation.

Development Stage	Environmental Aspects	Anticipated Impacts	Recommendations Mitigation Measures
Operations	Social Impacts	Income Generating Initiatives: No directly negative impact to income generation on the area. Positively affecting the local social and economy	▪ Enhance employment opportunities for the local community, ▪ Provide leadership on opportunity for collaboration with waste recyclers, ▪ Ensure sustainability through cost savings from waste minimization at sources and recycling options, ▪ Expand the scrap metal market and create more opportunities.
		Social and Cultural Issues: ▪ Social nuisance from pollution to physical environment such as land and air by emissions from the site, ▪ Social complaints and concerns on health and safety, ▪ Cultural intrusion from employee intrusion, ▪ Conflict on land use, ▪ Conflicts at off-site solid waste dumping areas, ▪ Potential of social diseases (HIV/AIDS, TB, etc.).	▪ Maintain efficiency in the emission reduction point sources and minimise external effects, ▪ Establish a public relation strategy with the neighbourhood for enhanced co-existence, ▪ Undertake statutory annual environmental audit for continuous improvement on social issues. ▪ Enhance monitoring system on social concerns, ▪ Sensitize workers and communities on protection against HIV/AIDS spread, ▪ Invest in social responsibility initiatives, ▪ Comply with labour laws and related regulations.
		Health and safety: ▪ Risk to workers' health from aerial emissions originating from the site operations, ▪ Risks from internal movements of workers and customers, ▪ Slippery surfaces, e.g. store rooms, ▪ Health infections from contamination of waterways and underground waste sources.	▪ Provide all workers with the necessary personal protective equipment and ensure application at all times, ▪ Enhance good hygiene practices to reduce exposure of the employees and customers to infections, ▪ Provide suitable signage for fire escapes and convenience directions, ▪ Develop a disaster management manual on a wide

			range of health, safety and security issues, among them fire accidents, ▪ Ensure diligence in waste handling especially soil washing to avoid any chance of contamination,
Operations	Solid Waste Management	▪ Risks to Health and safety, ▪ Risks to environmental pollution, ▪ Ground water quality degradation at off-site disposal sites, ▪ Aesthetic pollution in the site and neighbourhood (acetylene gas production residuals – calcium oxide slurry), ▪ Public nuisance at off-site disposal sites, ▪ Illegal waste dumping	▪ Develop a procedure for waste segregation on site, through provision of necessary containers for various waste categories, ▪ Contracts with external waste recyclers and/or handlers should include conditions on waste transfers and verification of final destination, ▪ Characterize all wastes and keep a record of types and quantities. Annual waste audit may be necessary.
	Compliance	▪ Penalties from non-compliance,	▪ Environmental compliance to be based on the provisions of EMCA, 1999 and the Waste Regulations thereof (Legal Notices 120 and 121 of September 2006), ▪ Undertake annual environmental audits as per the law, ▪ Establish environment compliant objectives for the specific operations in liaison of a legal expert,, ▪ Establish a corporate environmental policy, ▪ Establish an environmental management committee with a qualified team leader, ▪ Increase workers awareness on environmental policies and their responsibilities, ▪ Develop a legal register for continuous compliance self evaluation

CHAPTER SIX

6. ENVIRONMENTAL MANAGEMENT PLAN

The environmental impact assessment forms the basis for the EMP. The main purpose of the this EMP is to ensure that effective management measures are tabled, that will ensure, through the implementation thereof, that all potential impacts are either avoided, successfully managed or mitigated so that it does not result in environmental degradation or contamination

This environment management plan presents integrated scenarios with the environmental aspects, anticipated impacts during construction and operation as well as preventive (mitigation) action plans. Other issues covered include the responsibilities, costs implications, timeframes and parameters for monitoring of the trends. The EMP matrix is designed such that it is self-implementing and can be implemented.

6.1 The EMP Guiding Principles

The development and operation of the waste management plant would be expected to observe environmental conservation requirements in accordance to the national regulations. To realize this goal, acceptability and minimal effects to the physical environment as well as the wellbeing of the surrounding communities will require to be integrated in the completion of the project through constant consultations, evaluations and review of the design aspects and modes of operation throughout the project cycle. Among the factors that need to be considered in this project implementation and its post evaluation initiatives will include;

(i) Preservation of the natural beauty of the immediate surrounding areas,

(ii) Control of soil erosion and siltation of springs downstream as public sources of water,

(iii) Enhanced integration of environmental, social and economic functions,

(iv) Incorporation of safety provisions in the premises including easy accessibility to the road, adequate in-house signage and information systems among others.

(v) Enhancing the contractor's performance,

(vi) Realization of cordial relations among various community, economic, social and cultural groups as well as between the local community and the contractor,

(vii) Enhancing equity and maximizing social and economic benefits for the local community through income generation from employment,

6.2 Environment Management Policy

It is recommended that specific guidelines are developed to allow integration of environmental management considerations in the construction, commissioning as well as the use of public amenities and resources within site area. The guidelines will be a basis for compliance actions, responsible practices for the college residents and appropriate code of conduct for all stakeholders. Among the factors that need to be considered in this guideline will include;

(i) The contractor and other players in the construction activities be prevailed upon to implement this EMP,

(ii) The development should appreciate the interests of the neighbouring communities at all stages of the project,

(iii) Maintenance of the natural beauty of the countryside around the site area such as to include green belts and other beatification initiatives,

(iv) Enhanced integration of environmental, social and economic functions in the project design and implementation plans including safety provisions,

(v) A site specific environmental, health and safety plan is established soon after commissioned.

6.3 Specific Management Issues

6.3.1 Health and Safety

Safety Issues

Collaboration with relevant environmental and health related authorities, compliance to OSHA 2007 as well as appropriate experts would be necessary to provide necessary advice in this regard. At the site, appropriate safety measures would be observed, but it will also be necessary to involve the workers and neighboring communities on awareness and sensitization at all times, e.g. provision of personal protection equipments to all workers and non-interference by the neighbourhood.

Health Issues

Control emissions from the machineries as well as dusty conditions throughout the construction cycle and check operation points upon commissioning.

6.3.2 Site Operation

It will be necessary to monitor certain social and economic trends associated with the zone operations. Commissioning of the facility, it is anticipated that it will motivate increased traffic flow into the area, reduce vehicular speed at the entrance point and heavy commercial trucks accessing the zone. Road accidents would be expected to rise initially before taking a predictable trend and residents residing in the area will learn to live with the new surroundings. More economic activity opportunities will also appear leading to a larger shopping centers around the free zone area.

6.4 Management Responsibilities

In order to implement the management plan, it is recommended that a position is created for an appropriate expertise to oversee matters of environment and social management as well as enhanced safety and security measures within and around the site. The services of an environmental expert may be required to co-ordinate and monitor environmental management for

the site during construction and post monitoring audits. This would be done under the responsibility of the site contractor during construction.

The responsibility relationship is as follows;

(i) Northern Waste Management Services will be responsible for all coordination activities and liaisons, particularly in regard to issues of environment, social and safety issues,

(ii) The Project Manager is the Contactor's link with the occupier on matters of environmental and social nature and is responsible of implementing the environmental management plan established under this report,

(iii) It would also be recommended that a Public Relations Office (PRO) created on the basis of ability to directly interact with the local community for social sustainability. Upon commissioning, the Management should establish a PR office.

(iv) NEMA shall be responsible of surveillance of environmental and social aspects of the project implementation. It will be expected that their concerns are communicated to the ECCL.

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6.5 ENVIRONMENTAL MANAGEMENT PLAN

Table 3: EMP Matrix

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
Construction	Environmental Pollution	▪ Ensure contractor undertaking on environmental considerations, ▪ Monitor trends on health and safety of construction workers and neighbourhood, ▪ Contractor to maintain material balance records at all times	EASL and Contractor Continuous throughout construction period	Sustainable construction **No direct cost involved**	▪ Complaints from neigbourhood, ▪ Concerns from environmental authorities and local Municipal Council.
	Waste Management	▪ Disposal of waste be done in accordance to waste regulations, ▪ Contractor to undertake safe waste disposal, ▪ Verify legality of waste disposal destination	EASL and Contractor Continuous throughout construction period	Safe construction waste management	Compliance with waste management regulations especially Hazardous Waste Regulations

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
	Social Aspects	▪ Address concerns of neighbouring land users as per this report, ▪ Integrate public safety in the construction process, ▪ Utilize local labor for construction for enhance social harmony.	EASL and Contractor Initiate action with construction	Social harmony **No direct cost involved**	Residents complaint Public opinion
Commissioning	_	▪ Construction camp decommissioning on pre-planned schedule, ▪ File a completion report to NEMA for initial inspection	EASL Upon operation commencement	Identifiable baseline status of the plant	Fulfillment of the mitigation measures recommended
Operations	Environmental Pollution	▪ Equipment specifications to conform with environmental standards, ▪ Integrate environmental components in the site design (waste management, emission controls, etc.), ▪ Apply to the extent possible provisions of the waste management regulations, County Government laws and by-laws, Public Health Standards, etc., ▪ Enhance in-house awareness and sensitization on environmental	EASL Immediately and continuous	Integration of environmental components/ideas in the site operations.	▪ Discharges into the public drainage system, ▪ Emissions into the air, ▪ Related health effects to the site operators, ▪ Public complaints.

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
		protection initiatives,			
	Waste Management	▪ Maintain Isolation of surface storm water drains from those carrying oil/grease residuals, ▪ Enhance water recycling for conservation purposes, ▪ Compliance to waste management regulations (Legal Notice Nos. 120 and 121), ▪ In-house training on waste management options for managers and supervisors, ▪ Provide leadership in waste recycling and re-use.	EASL Immediately and continuous	Streamlined waste flow paths.	▪ Waste categories and separation, ▪ Mode of transfer ▪ Final destinations.
Operations	Air quality	▪ Dry materials shall be kept dump or covered at all time, ▪ Install gadgets to intercept the particulate matter as well as controlling gaseous emissions.	EASL Management managers Initial installation are design controlled	Reduced concentrations of aerial pollutants	Visibility of chimney emissions, Public complaint PM(50), SO_x(500), NO_x(750) As(0.1), Cd(0.05), Cu(0.05), Pb(0.5), Zn(1) – all in ppm.
	Vegetation cover	Introduction of vegetation (trees, shrubs and grass) on open spaces within and around the site. Indigenous species	EASL	Greening the compound and landscaping	Number of trees planted.

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
		would be preferred.	Upon commissioning	**KSh.500,000 over 5 years**	This action will develop a vegetated landscape that will also help contain dust originating from the site.
	Social Aspects	▪ Draw of-site contracts to enhance socially acceptable procedures, ▪ Involve more independent interested parties (waste collectors) in establishing options for collection and management,	EASL Upon commissioning then continuous	Social acceptability and co-existence.	Health problems and degradation of environmental resources, The public opinion, Satisfaction to the relevant authority.
	Health and Safety	▪ Constitute health and safety committee, ▪ Maintain safety reticulation (e.g. fire detection and fighting equipment), ▪ Train on HS issues and provide PPEs and enforce applications,	EASL. Immediately	Quick and effective response to emergencies. **Annual budget of KShs. 300,000**	▪ The security and safety of the neighbouring premises, ▪ Safety cases over a period of time, ▪ Response period on safety and medical aspects.
Operation	Noise levels	▪ Initiate a noise mapping programme and keep monitoring, ▪ Undertake a annual hearing survey of	EASL Supervisors. Upon commissioning	Compliance **KShs. 250,000**	Occupational levels of 70dBA, External receptors as defined

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
		all the workers, ▪ Train, provide ear muffs/corks and enforce application,	and continuous.	for equipment and professional guidance	under the EMCA regulations on noise and vibrations (2009)
	Compliance Aspects	▪ Develop an environmental policy, ▪ Establish a legal register on critical relevant environmental laws, ▪ Annual environmental audits as required by law, ▪ Develop Standard Operation Procedures focusing on environment, health and safety.	EASL Continuous	An all time compliance **About KShs. 250,000 per year**	A facility to ensure compliance with laid down guidelines at all times
	Institution Framework	▪ Adapt environmental aspects in administrative framework, ▪ Review the contracting arrangement at all levels of the operations, ▪ Establish a monitoring and reporting protocol on environmental conservation, ▪ Engage a professional to oversee environmental management.	EASL Continuous	Coordinated environmental management **No direct costs anticipated**	To ensure that all actions on environment are integrated in the future corporate business plans
Corporate	Capacity	▪ Establish an information resource point (for reference by the site		Sustainability	To provide necessary

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
Initiatives	Building (Documentation and human resources capacity	operators), ▪ Document in-house guidelines and procedures on environmental management, ▪ Develop a training programme for workers on safety, health, and environment, ▪ Engage a qualified staff to oversee environment, health and safety.	EASL	and sharing with others **No direct costs involved**	knowledge, tools and awareness to all workers for effective human resource capacity development.
	Physical infrastructural capacity	▪ Establish a waste collection, transfer and storage mechanisms, ▪ Characterize and identify all waste streams up to final destinations, ▪ Monitor the carrying capacity of the environmental infrastructure receiving the wastes, ▪ Install monitoring facilities along the waste pathways	Continuous		This provide organized system for the workers with respect to environment, health and safety protection
	Collaboration	Collaborate with other players on environmental protection, waste management programmes.	EASL	Sustained capacity building	Kenya Institute of Waste Management is recommended
Decommissioni	Composite	▪ Notify NEMA and other authorities on intension to stop operations at	EASL, NEMA,	Rehabilitated	Air quality and soil status in the

Development stage	Impacts Anticipated	Proposed Actions	Responsibility and Timeframe	Targets and Cost Estimates	Monitorable Indicators
ng	impacts	least 1 year in advance, ▪ Carry out a **decommissioning audit** and submit report to NEMA for review six months in advance, ▪ Close down equipment and participate in the plan for site inspection, ▪ Initiate removal following strictly recommendations of the decommissioning audit report. ▪ Initiate a programme to rehabilitate the site to near its original state, ▪ Monitor the site on related parameters for 1 year. ▪ **ALTERNATIVE:** Negotiate with a new operator BUT undertake an environmental liability audit.	Turkana County Government and environmental expert. Process to take 2 years on a pre-agreed schedule	site **Costs to be identified through the decommissioning audit repot**	area. Social and economic implications in the area Destination of waste material disposal.

CHAPTER SEVEN

7. CONCLUSION AND RECOMMENDATION

7.1 Conclusion

This Environmental Impact Assessment study presents a literature study regarding the purpose and the functionality of the project cycle from approvals seeking, construction, operation and decommissioning of the waste tailings management facility, laboratory and mineral recovery. The main focus of this study has been to: perform field evaluation of the project area, identify impacts and effects, assess environmental consequences, analyze alternative locations, propose mitigation measures and recommend a location, in addition to develop environmental management plan for the proposed project.

From the foregoing, it is concluded that the proposed waste tailings laboratory, precious minerals recovery plant and waste tailing management is in appropriate location in as far as land use and interactions with human social and economic setting is concerned, after obtaining change of use of the parcel of land from agricultural to industrial use. There are no minimal in the neighbourhood, no significant sensitive environmental features are found within the vicinity and the area is not fully zoned giving an opportunity to isolate the location for this purpose in future. The proposed development has been approved by Turkana County Government subject to compliance with all regulations while land transfers to the ownership of the proponent have been accomplished. However, there are certain social concerns that touch on general environmental pollution, groundwater contamination, health of the workers, attraction of human settlements in future and soil contamination. For this reason, appropriate preventive measures have been proposed in this report. The measures, if integrated in the site design and operations and maintained throughout the site lifespan, will ensure environmental and social sustainability of the facility.

7.2 Recommendation

It is recommended that the hazardous waste management (tailings), laboratory and associated facilities be licensed to allow the proponent to proceed on as proposed subject to full implementation of the environmental management plan in addition to observing the mitigation measures established for every impact identified, while operating within the relevant laws and regulations. Among the specific recommendations include,

(i) Ensure waste and wastewater management regulations are complied with through provision of appropriate facilities including wastewater treatment facility, solid waste collection bins and transfer arrangements. Hazardous waste holding units should be isolated from the external environment at all times,

(ii) Aerial emissions be controlled as proposed in the preceding chapter in this report, and be subjected to frequent audit

(iii) Safety measures for the workers and the neighbouring community shall be integrated in the entire project cycle,

(iv) Compliance with the existing laws and regulations shall be upheld at all times,

(v) The above environmental management plan shall be adopted and applied as the basis for addressing environmental and social aspects throughout the project cycle with necessary amendments as may found appropriate. In this connection, it will be the guiding tool for future audits and monitoring exercises.

(vi) The company to observe annual environmental audits as a compliance requirement and a monitoring tool to its performance in environmental protection

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