ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY REPORT

For

THE PROPOSED BAMBURI CEMENT NAIROBI GRINDING PLANT (NGP) CAPACITY INCREASE PROJECT ON PARCELS L.R. NOs. 18696/26; 18696/27; 18696/28; 18696/29; 18696/30; 18696/31 AND 18696/56 OFF NAIROBI-MOMBASA HIGHWAY IN ATHI RIVER, MACHAKOS COUNTY

Proponent: BAMBURI CEMENT LTD

Bamburi cement Part of you. From the start	P.O. Box 10921 - 00100 Nairobi

Prepared By: PURIFIED CONSULTANTS LTD

NEMA REG. No.: **2866**
P.O. Box 106-00204
Athi-River

2016

Report Title: Environment Impact Assessment (EIA) Study Report for Bamburi Cement Nairobi Grinding Plant (NGP) Capacity Increase Project.

Firm of Experts:

Purified Consultants Ltd (Reg. 2866)

P. O. Box 106 - 00204

Athi-River, KENYA

+254 722 580 237

Signed: .....

Douglas M. Mwagwi

Lead ESIA Expert 2278

Proponent:

Bamburi Cement Limited

P.O. Box 10921 - 00100
Nairobi, Kenya

Signed: .....

Bernard Mwaura

For: **Bamburi Cement Limited**

Disclaimer:

This Environmental Impact Assessment Study Report is strictly confidential to Bamburi Cement Ltd (the Proponent) and any use of the materials thereof should be strictly in accordance with the agreement between the Proponent and Purified Consultants Ltd (the firm of expert). It is, however, subject to conditions in Legal Notice No. 101 section 4 of the Environmental (Impact Assessment and Audit) Regulation 2003.

ACKNOWLEDGEMENTS

The successful completion of this EIA Study Report was made possible by several individuals, establishments and institutions. The Expert acknowledges the input of the proponent in terms of providing resources, documentation and logistical support that was necessary for data collection as well as compile this EIA Study Report.

To obtain baseline information on the project site, the firm of experts relied on site visits, literature review of information available from government offices and previous EIA studies undertaken by lead consultants.

The firm of experts thanks the neighbors for their input during the public consultation process for accepting to participate in informal meetings and interviews as well as responding to the questionnaires on the possible impacts associated with the proposed project development.

The Lead Expert (Reg. No. 2278) facilitated the preparation of this report through the administration of questionnaires, collection of data and information; and in printing and binding of this report.

LIST OF ACRONYMS

AP	Affected Persons
BOD	Biochemical Oxygen Demand
CBD	Central Business District
COD	Chemical Oxygen Demand
DEC	District Environment Committee
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
ERP	Emergency Response Plans
GoK	Government of Kenya
KEBS	Kenya Bureau of Standards
NEC	National Environment Council
NEMA	National Environment Management Authority
NET	National Environment Tribunal
NGOs	Non-Governmental Organizations
NGP	Nairobi Grinding Plant
O & M	Operation and Maintenance
PCC	Public Complaints Committee
PEC	Provincial Environment Committee
PPE	Personal Protective Equipment
SERC	Standards and Enforcement Review Committee
SS	Suspended Solid
T-N	Total Nitrogen
W.H.O	World Health Organization

EXECUTIVE SUMMARY

Introduction and Study Objectives

Purified Consultants Ltd, herein referred to as a firm of experts registered by NEMA (NEMA Reg. No. 2866), was contracted by **Bamburi Cement Limited**, a limited company which was first incorporated under the Companies Ordinance (Cap 288) laws of Kenya on the 20th day of July One Thousand Nine Hundred and Fifty One (Certificate No. 2343) as British Standard Portland Cement Company Limited. This was later changed to Bamburi Cement Limited on the 7th day of December One Thousand Nine Hundred and Ninety Five. This Company is herein thereafter referred to as the proponent intends to carry out an impact assessment and Environmental Impact Assessment for the proposed **Nairobi Grinding Plant (NGP) Capacity Increase Project**. The firm of experts relied on qualified and competent staff to conduct the environmental assessment and write this EIA Study report. The proponent is required to present this EIA Study Report to NEMA in order to comply with the Environment Management Co-ordination Act 1999 and in particular part II of the Environmental (Impact Assessment and Audit) Regulations, 2003. This EIA Study was deemed relevant after the Proponent had submitted an EIA Project Report **(NEMA/PR/5/2/16,448**) to NEMA for review. This was to allow for in-depth analysis of environmental and social impacts of the proposed project. This Study Report has provided a summary statement of the likely environmental and social effects of the proposed project.

The investigation examined the potential impact of the project on the immediate surroundings with due regard to all the phases of the project. The investigation encompassed all aspects relating to the physical, ecological, socio-cultural, health and safety conditions at the site and its environs; during and after the project operations. The assessment strictly adhered to the relevant legislative frameworks and regulations. Reference was made to past EIA reports dealing with similar projects. Where possible, this EIA Study Report has provided annexes such as the Land Title Deeds, Project Layout Plan, company's tax PIN, Certificate of incorporation, e.t.c. to support the findings and show the depth of its investigations. The Study Report has also provided photos of the proposed site. The proponent of the proposed project has proposed to follow the laid down regulations, standards and laws as put out and as proposed by the relevant authorities and professionals respectively. This assessment's conclusion is that the project is important for the reduction in the cost of production through the reduction in the cost of fuel and has balanced environmental considerations. The Study Report has suggested measures to mitigate the negative impacts and has also proposed an Environmental Management Plan (EMP), which the proponent should adhere to in the entire life cycle of the project to ensure its sustainability.

An Environmental Impact Assessment is a tool for environmental protection & conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) No.8 of 1999 second schedule 9 (1), and Environmental (Impact Assessment and Audit) Regulation, 2003, such projects as the

proposed project must be subjected to an EIA process . The report of the same must be submitted to National Environment Management Authority (NEMA) for approval and issuance of EIA Licence. This is necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development with due consideration to the environment.

Impacts and Mitigation Measures

There are both positive and negative impacts associated with the proposed **Nairobi Grinding Plant (NGP) Capacity Increase Project**. In general the following positive impacts are associated with the proposed development;

a) Several job opportunities shall be created during the construction/installation and Operational phases;
b) Much needed building and construction materials (cement) and raw materials (clinker) for cement manufacture shall be availed to several individuals/companies within and without Kenya;
c) Gains in the local and national economy;
d) Optimal use of land;
e) Permanent investment opportunity for the project proponents.
f) The same site zoned for Industrial development being used for expansion
g) Use of same proven/tested mitigation measures for negative impacts

The negative Impacts associated with the proposed project are:

a) Increased water demand;
b) Air pollution through dust and vehicle emissions;
c) Solid waste generation;
d) Workers accidents and hazards during construction and/or installation of equipment;
e) Increased pressure on the existing infrastructure such as roads;
f) Increased electricity consumption;
g) Noise pollution during construction/installation and operational phases of the project;
h) Increased traffic during construction and operation

In order to mitigate on the negative impacts associated with the project, the proponents shall put in place the following measures suggested in the table below:

Summary of Environmental Management/Monitoring Plan

ENVIRONMENTAL IMPACT	**PROPOSED MITIGATION MEASURES**
Sulphur (Sox) gases	• Inherent scrubbing, oxygen control (increase), fuel substitution (lower total sulfur), raw material substitution (lower sulfide sulfur), raw material alkali/sulfur balance, in-line raw mill, preheater upper stage hydrated lime injection, calcined feed

	recirculation, cement kiln dust internal scrubber, preheater upper stage trona injection and calcium-based internal scrubber
NOx Emissions	• O_2 (decrease), indirect firing, low-NO_X burner, mid-kiln firing, process improvements, process control improvements, low-NO_X calciner, staged combustion, semi-direct firing, mixing air fan and cement kiln dust insufflation
CO Emission	• Good combustion practice
CO_2 Emission	• Improved thermal efficiency, Clinker substitution, improved electrical efficiency, raw material substitution and mineralizers
Ammonia Emission	• Raw material substitution and tailpipe scrubber technologies
Solid Waste Management and Disposal	• Recycle and reuse where applicable; • Segregate for appropriate disposal; • Process& Technological improvement to minimize waste generations; • Material substitution to minimize waste generation; • Waste disposal as provided for in the Environmental Management and Coordination (Waste Management) Regulations, 2006; • Provide appropriate waste handling receptacles; • Safe disposal of electronic waste.
Wastewater	• Adaption of water conservation opportunities; • Sedimentation for suspended solids reduction using settling basins or clarifiers; • Multimedia filtration for reduction in non settleable suspended solids. • Segregation of wastewater streams; • Treatment to meet national standards for sanitary wastewater discharge
Storm Water	• Storm water should be separated from process and sanitary wastewater streams; • Runoff should be minimized and the peak discharge rate be reduced (e.g. by using vegetated swales and retention ponds); • Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.
Dust	• Good housekeeping and maintenance; • Use of air–conditioned, closed cabins; • Dust extraction and recycling systems;

	• Air ventilation (suction); • Ensure de-dusting system is always efficient; • Workers to use appropriate PPE; • Strict enforcement on PPE use; • Ventilation at workplace to be sufficient;
Heat	• Shielding surfaces; • Using personal protective equipment; • Minimizing the work time required in high temperature environments by implementing shorter shifts; • Use of air- or oxygen supplied respirators.
Noise and vibrations	• Noise barriers; • Personal hearing protection • Developing and implementing an effective noise control and hearing conservation programme; • Carrying out periodic noise measurements; • Fitting noisy machines with noise reduction devices; • Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A); • Posting notices and signs in noisy areas; • Carrying out audiometric test by a designated medical practitioner to all workers exposed to noise levels above 85dB(A); • Educating all workers on importance of marking correct use of PPE provided to protect them against high noise levels.
Physical Hazards	• Good housekeeping; • Ensure surfaces are not slippery; • Clearly mark all uneven surfaces; • Guarding of machine moving parts; • Provide and mark safe passages and exits; • Spills to be promptly cleaned.
Occupational Health and Safety	• PPE use; • Appropriate handling as per material safety data sheets; • Training and sensitizations; • Medical examination of exposed workers
Vehicular traffic along Nairobi-Mombasa and	• Liaise with the Kenya National Highway Authority for permission to construct an acceleration/deceleration lane for safe entry and exit of the highway;

Nairobi-Namanga Roads	• Liaise with Kenya National Highway Authority to ensure that appropriate road signs before the exit/entry junction area erected; • Drivers to strictly observe the Highway Code; • Speed limits to be strictly observed
Parking outside the Factory premises	• Provide sufficient space for internal parking of lorries awaiting to deliver material or to collect material
Demolition Waste	• Use of an integrated solid waste management system; • recycled/reused recyclable solid waste where possible; • All foundations must be removed and recycled, reused or disposed of at a licensed disposal site; • Where recycling/reuse is not possible, waste should be taken to a licensed waste disposal site; • Donate re-usable demolition waste to charitable organizations, individuals and institutions.
Site Restoration	• Implement an appropriate re-vegetation programme to restore the site to its original status; • Consider use of indigenous plant species in re-vegetation; • Trees should be planted at suitable locations so as to interrupt slight lines (Screen planting), between the adjacent area and the development.

Conclusion

It is quite evident that the construction, installation and operation of the proposed **Nairobi Grinding Plant (NGP) Capacity Increase Project** will have more positive than the negative impacts at the project site including creation of employment, economic growth, optimum utilization of the land, e.t.c., hence maximum returns, availing building and construction materials for various individuals/companies/developers, improved economy, improved security, and increase in revenue base to the project proponent, among others. However, although the project is highly regarded in terms of positive impacts, it is anticipated that there will be negative impacts such as those listed in the above table. On the basis of the above and taking cognisance of the fact that the proponent has proved financially and environmentally credible, it is our recommendation that the project be allowed to go on provided the mitigation measures outlined in this report are adhered to and the Environmental Management Plan (EMP) is implemented to the latter.

TABLE OF CONTENTS

CHAPTER 1: BACKGROUND INFORMATION

1.1 Introduction

The proponent, **Bamburi Cement Ltd**, has proposed to undertake a **Nairobi Grinding Plant (NGP) Capacity Increase Project** off Nairobi-Mombasa Highway in Athi River, Machakos County. This Project is to be undertaken on plots LR Nos. 18696/26; 18696/27; 18696/28; 18696/29; 18696/30; 18696/31 and 18696/56 whose coordinates are **1^0 26'0.579"S 36^0 57' 32.921"E** and at an altitude of about **1515 metres** above sea level. The site of the project is about 500 metres off Nairobi Mombasa Highway and Nairobi-Namanga road, and is accessible via Old Mombasa Road which connect to Nairobi-Namanga Road at the Shalom Junction. The site of the proposed project is on a parcel of land owned by the Bamburi Cement Ltd. The EIA Study Report for proposed development has been compiled by **Purified Consultants (PUCO) Ltd**.

Environmental concerns need to be part of the planning and development process and not an afterthought. Cement Industry is categorized as a heavy industry with a lot waste in form of heat energy, dust and other product materials and requires project affected (PA) persons to be consulted through the EIA process. The participation of the project neighbors is critical to avoid and future concerns which could be sorted out during the EIA process. It's having this in mind that the proponent undertook this EIA Study report and incorporated environmental concerns as advised by the experts. Finally, a comprehensive Environmental Management/Monitoring Plan (EMP) is mandatory for a project of this magnitude and nature to guide during construction, operation and Decommissioning periods.

1.2 Need for the Project

It is a well-known fact that the rate of development keeps growing as is evidenced by the multi-billion shillings projects being undertaken in Kenya such as infrastructural and housing developments. The construction of such humongous developments needs readily available construction materials in large quantities. Such materials include cement and cement products. It is against this backdrop and the proponent's need to increase cement grinding capacity from the current 1,500,000 tonnes per year to 2,300,000 tonnes per year on the existing site in Athi-River that the proponent intends to undertake the Nairobi Grinding Plant (NGP) Capacity Increase project. The conceived project is designed to satisfy the current and future development trends' demands of Cement in the country which is critical for Industrial development and attainment of flagship projects under the vision 2030.

1.3 Scope, Objective and Criteria of the Environmental Impact Assessment Study

1.3.1 Scope

The scope of this Nairobi Grinding Plant (NGP) Capacity Increase Project will involve the installation of a 130 tonnes per hour Vertical Cement grinding Mill and its auxiliary equipment such as materials (Clinker, Pozzolana, Limestone and Gypsum) feed hoppers, transport conveyors

and cement storage silos. A new 130 tph cement packing machine will also be installed. To ensure supply of adequate power to run the new mill, a new 12.5 mVA transformer will be also installed as part of the project. The existing materials receiving gate will be relocated to create room for the storage of additional materials and improve on the circulation of trucks delivering materials into the Plant. A new l road constructed to link the truck yard directly with the packing plant.

1.3.2 Objective of the Environmental Impact Assessment

The objective of the proposed Nairobi Grinding Plant (NGP) Capacity Increase project for Bamburi Cement's Factory is to increase the cement grinding capacity from the current 1,500,000 tonnes per year to 2,300,000 tonnes per year on the existing site in Athi River, Machakos County.

1.4 Terms of Reference (TOR) for the EIA Study Process

The scope of the assessment covered implementation works of the proposed Nairobi Grinding Plant (NGP) Capacity Increase development which included demolition, ground preparation, and construction and/or installations as well as associated utilities required by the project. The output of this work was a comprehensive Environmental Impact Assessment Study report for the purposes of applying for an EIA licence. The main objective of the assignment was to assist the project proponent to prepare an EIA Study report for the proposed project and take into consideration appropriate measures to mitigate any adverse impacts to the environment. The assessment identified existing and potential environmental impacts and possible concerns that interested and/or affected parties have with the development, as well as the associated prevention and mitigation measures for the negative impacts as stipulated in the Environmental Management Plan (EMP) proposed.

The consultant on behalf of the project proponent conducted the assessment by incorporating but not limited to the following terms of reference:-

- Location of the proposed project site;
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- The objectives of the proposed project;
- The technology, procedures and processes to be used, in the implementation of the project;
- The materials to be used in the construction, installations and implementation of the project;
- The products, by-products and waste to be generated by the project;
- A description of the potentially affected environment;
- The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;
- Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes;
- Analysis of alternatives including project site, design and technologies;

- An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures;
- Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the cause of carrying out development activities;
- Propose measures to prevent health hazards and to ensure security in the working environment for the employees, residents and for the management in case of emergencies;
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information;
- An economic and social analysis of the project;
- Such other matters as the Authority may require.

1.5 Data Collection Procedures

First, the Consultant undertook environmental screening and scoping to avoid unnecessary data. The data collection was carried out through consultations with the proponent representatives, administration of questionnaires, observations and photography, site visits, desktop environmental studies and scientific tests, where necessary in the manner specified in Part V (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003.

1.6 EIA Organization and Structure

The EIA was carried out to full completion under the guidance of the lead expert who coordinated the day-to-day functions and any related institutional support matters. Otherwise, all requirements by NEMA with regard to the assessment were formally communicated to the project proponent.

1.7 Reporting and Documentation

An Environmental Impact Assessment Project report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted by the project proponent for consideration and approval. The consultant ensured constant briefing of the client during the exercise. Drawing plans and relevant documentations are part of the appendices.

1.8 Responsibilities and Undertaking

The team undertook to meet all logistical costs relating to the assignment, including those of production of the report and any other relevant material. The consultant arranged for own transport and travels during the exercise. On the site of the proposed commercial development, the proponent provided a contact person(s) to provide information required by the team. The proponent also provided site plans layout and the actual sizes of the site, future development plans, operation permits, baseline data, land-ownership documents and estimated project cost.

The output from the consultants includes the following: An Environmental Impact Assessment Study Report comprising of an executive summary, study approach, baseline conditions,

anticipated impacts and proposed mitigation measures. An Environmental Management Plan outlines which also forms part of the report recommendations.

1.9 Methodology Outline

Since the proposed site is located within an Industrial zone, with no rich natural resources whose total effect to the surroundings could not be adverse and noting that the intended development and use of the facility will be in line with what exists in the surrounding areas, an environmental Study report would be seen to be adequate. The general steps followed during the assessment were as follows:

1.9.1 Environmental Screening

This step was applied to determine whether an environmental impact assessment study was required and what level of assessment was necessary. This was done in reference to requirements of the EMCA, 1999, and specifically the second schedule. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

1.9.2 Environmental Scoping

The scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects.

1.9.3 Desktop Study

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others. It also included discussions with the proponent's representatives and design engineers as well as interviews with neighboring communities.

1.9.4 Site Assessment

Field visits were meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts. It also included further interviews with random members of the surrounding.

1.9.5 EIA Public Participation

To ensure adequate public participation in the EIA process, questionnaires were administered as well as face-to-face interviews were carried out to seek public views towards the proposed project and any anticipated effects of the project to the surrounding. The information gathered was subsequently synthesized and incorporated in the EIA Study report.

1.9.6 Reporting

In addition to constant briefing of the client, this environmental impact assessment Study report was prepared. The contents were presented for submission to NEMA as required by law.

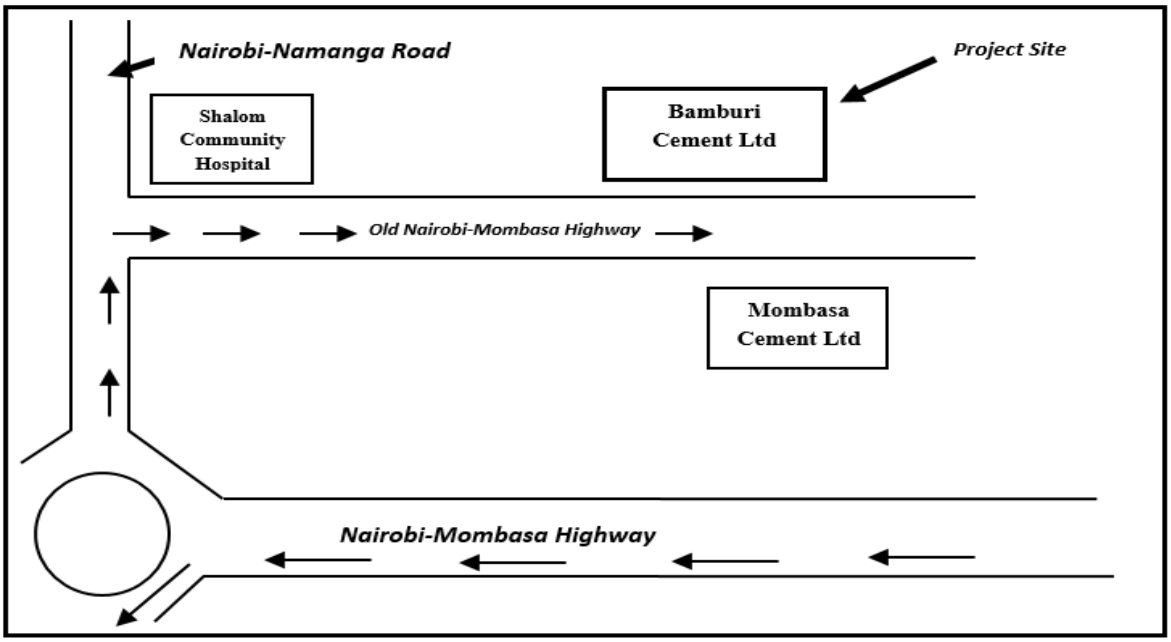
CHAPTER 2: DESCRIPTION OF THE PROJECT

2.1 Introduction

Bamburi Cement Ltd, is a subsidiary of Lafargeholcim, one of the World largest manufacturer of cement. In East Africa, Bamburi Cement is the largest producer of cement with two sites in Kenya, namely, an integrated Plant in Mombasa (1 million tonnes per year of clinker) and a 1,500,000 tonnes per year grinding station in Athi-River. Nairobi Grinding Plant was commissioned in 1998 with an annual grinding capacity of 1,000,000 tonnes per year. However in 2009, the company invested in a Pozzolana drier and carried out a series of optimization actions that improved its grinding capacity to the current level of 1,500,000 tonnes per year. The Bamburi Cement Ltd intends to increase its cement grinding capacity from the current 1,500,000 tonnes per year to 2,300,000 tonnes per year on the existing site in Athi-River through its proposed Nairobi Grinding Plant (NGP) Capacity Increase project. It is about 53.3% capacity increase of the current NGP.

2.2 Location and size of the project

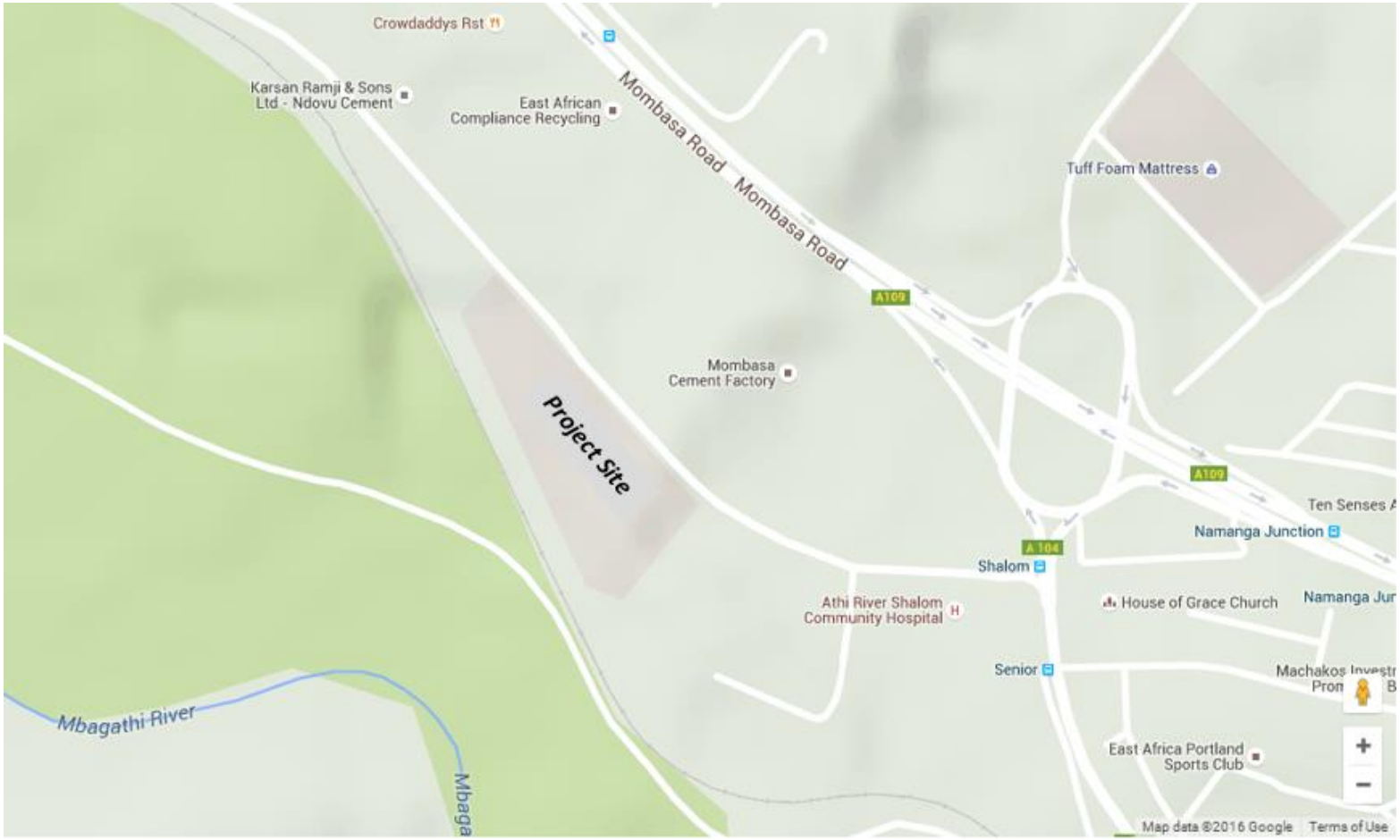
The proposed **Nairobi Grinding Plant (NGP) Capacity Increase Project** site is off Nairobi-Mombasa Highway in Athi River, Machakos County on plots LR Nos. 18696/26; 18696/27; 18696/28; 18696/29; 18696/30; 18696/31 and 18696/56 whose coordinates are **1^0 26'0.579"S 36^0 57' 32.921"E** and at an altitude of about **1,515 metres** above sea level. The site of the project is about 500 metres off Nairobi Mombasa Highway and Nairobi-Namanga road, and is accessible via Old Mombasa Road which connect to Nairobi-Namanga Road at the Shalom Junction. The site of the proposed project is on a parcel of land owned by the Bamburi Cement Ltd.



Directional Map to the Project Site

2.1.1 Neighbourhood

The proposed project is located in a majorly industrial area zone having major industrial facilities such as Mombasa Cement, ARM Cement Ltd, Portland Cement Ltd, Alfa Rama tannery, a steel Industry and Savannah Cement. There are other facilities such as Shalom Hospital and food kiosks within the vicinity. The project also neighbours Nairobi National park.



Map of the project neighbourhood

2.1.2 Roads

Nairobi-Mombasa highway is the main road that bisects the immediate Project Area. Other road in the immediate area to the Project includes Nairobi-Namanga Road and the Old Nairobi-Mombasa road. All these roads apart from the Old Nairobi-Mombasa road are tarmacked and in good condition.

2.2 Current status of the Project Site

The EIA expert found that no construction or installation works have commenced on the project site. However, the precast section of Bamburi Special Products has been relocated elsewhere to pave way for the proposed project.

The following activities are expected to be carried out at the site:

- Relocation of some of the existing structures;
- Delivery of construction material (sand, ballast and cement), machines and equipment at the site,
- Site excavation and digging of trenches for foundations laying,
- Foundation laying for the proposed Plant and the accompanying structures,
- Hoarding of the site by using iron sheets or any other means deemed fit and appropriate,
- Construction and installation of the Plant and associated facilities;
- Erection of silos for cement storage.

2.3 Objectives of the Project

The motivation for the proposed project is to construct and install the Nairobi Grinding Plant (NGP) Capacity Increase project to increase the cement production capacity by 53% that will allow Bamburi Cement Ltd the opportunity to stamp its authority in the cement manufacturing industry in Kenya and regionally.

2.4 Design of the Proposed Project

The Bamburi Cement Ltd's Nairobi Grinding Plant (NGP) Capacity Increase project is a Brownfield project that aims to increase cement grinding capacity from the current 1,500,000 tonnes per year to 2,300,000 tonnes per year on the existing site in Athi-River. Additional space will be required to accommodate the new equipment and therefore the precast section of Bamburi Special Products has been relocated elsewhere to pave way for the proposed project. The project will involve the installation of 130 tonnes per hour Vertical Cement Grinding Mill and its auxiliary equipment such as materials (Clinker, Pozzolana, Limestone and Gypsum) feed hoppers, transport conveyors and cement storage silos. A new 130 tonnes per hour cement packing machine will also be installed. The new expansion will use the same materials as is current in making cement i.e. Clinker, Pozzolana, Limestone and Gypsum.

To ensure supply of adequate power to run the new mill, a new 12.5 mva transformer will be also installed as part of the project. The existing materials receiving gate will be relocated to create room for the storage of additional materials and improve on the circulation of trucks delivering materials into the Plant. Movement of empty trucks to collect cement from the packing plant will be re-engineered with a new l road constructed to link the truck yard directly with the packing plant.

In general, the design of the project will tend to essentially optimize the use of best available technology to prevent or minimize potentially significant environmental impacts associated with the project and to incorporate efficient operational controls together with trained staff, to ensure high level business and environmental performances.

Cement manufacturing consumes large quantities of non-renewable raw materials: minerals and fossil fuels. It is also an important source of CO_2 emissions. In response to this environmental challenge, Bamburi Cement Limited has taken up the challenge from the Group towards the path of industrial ecology. This approach is inspired by the cycles of creation, destruction and recycling that occur in nature. By rethinking industrial processes from start to finish, one industry's waste products can become another industry's resources.

Bamburi Cement Ltd is aware of the impact of its activities on the environment. As a result, Bamburi started thinking at a very early stage about ways of reconciling industrial imperatives with the preservation of ecosystems. Adding value to waste by using it as alternative fuel or raw material enables Bamburi to: limit greenhouse gas emissions by reducing the use of nonrenewable raw materials and fossil fuels (oil, coal, etc.), diversify energy resources and reduce energy costs by limiting dependence on traditional fuels, serve the community by recycling waste that would otherwise need to be processed and eliminated. Industrial ecology practices are, therefore, beneficial for the community and the environment and also have benefits for Bamburi.

The company uses used tyres, classified as non-hazardous material, and biomass as alternative fuels in cement kilns. The potential impacts from the open-air burning and landfilling from residual ashes or landfilling of whole tyres and biomass are thereby avoided. Tyres and biomass are introduced at different points of the process depending on the type of kiln.

2.5 Description of the project's Construction and Installation activities

2.5.1 Pre-construction investigations and Demolition Works

The implementation of the project's design and construction phase will start with thorough investigation of the site, soil, chemical and physical properties and water table level determination. To accommodate the new equipment and therefore the precast section of Bamburi Special Products has been relocated elsewhere to create to pave way for the proposed Nairobi Grinding Plant (NGP) Capacity Increase project.

To ensure supply of adequate power to run the new mill, a new 12.5 mva transformer will be also installed as part of the project. The existing materials receiving gate will be relocated to create room for the storage of additional materials and improve on the circulation of trucks delivering materials into the Plant.

2.5.2 Construction Materials and Equipment

Greater emphasis will be laid on procurement of construction materials and equipment from within the local area, which will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials and equipment to the project site through reduced distance of travel by the materials transport vehicles. These materials and equipment will be transported to the project site from their extraction, manufacture, and/or storage sites using trucks. The construction materials to be used in construction of the project will be sourced from Nairobi and the surrounding areas. Some of the specialized equipment will be imported from outside Kenya.

2.5.3 Storage of Materials

Provision for storage of construction materials and equipment will be provided on site. Bulky materials such as rough stones, ballast, sand and steel will be carefully piled on site. To avoid piling large quantities of materials on site, the project proponent will order bulky materials such as sand, gravel and stones in quotas. Materials such as cement, paints and glasses; and equipment will be stored in storage structures which are already within the project site for this purpose.

2.5.4 Excavation and Foundation Works

At the proposed project site, excavation works will be carried out to set up foundation for the silos and equipment. This will involve the use of heavy earthmoving machinery such as tractors and bulldozers.

2.5.5 Masonry, Concrete works and related activities

The construction of the foundations, structural frames, pavements, drainage systems, perimeter fence, among other components of the project will involve a lot of masonry work and related activities. General masonry and related activities will include concrete mixing, plastering, slab construction, construction of foundations, and erection of structural frames and curing of fresh concrete surfaces. These activities are known to be labour intensive and will be supplemented by machinery such as concrete mixers.

2.5.6 Electrical work

Electrical work during construction of the proposed development will include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets among others. In addition, there will be other activities involving the use of electricity such as welding and metal cutting.

2.5.7 Landscaping

To improve the aesthetic value or visual quality of the site once construction ceases, the proponent will carry out landscaping. This will include establishment of flower gardens and flourishing grass lawns and will involve replenishment of the topsoil. It is noteworthy that the proponent will use plant species that are available locally preferably indigenous ones for landscaping.

2.5.8 Project Budget

The total cost of the proposed project is estimated to cost Nine Hundred and Two Million Kenya Shillings (KShs. 902,000,000). This amount will be distributed to various project activities that include; builders work, electrical services installations, mechanical service installations, external works, water reticulation and drainage services, site installations, preliminaries and contingencies.

2.6 Description of the Project's Operational Activities

2.6.1 Nairobi Grinding Plant (NGP) Capacity Increase project

The new expansion project will use the same materials used by the current manufacturing facility to produce cement, i.e. Clinker, Pozzolana, Limestone and Gypsum. Imported clinker as well as local one will be used. Local clinker is sourced from our integrated Plant in Mombasa.

Pozzolana will be supplied by 3rd party contractors and will be sourced from Ngunrunga, Lukenya and Kataani areas whereas Limestone will be sourced from Kajiado Area and supplied by 3rd Party Contractors. On the other hand, Gypsum is sourced from Konza and Garrisa and supplied by 3rd Party Contractors.

2.6.2 Sustainability Technologies at Bamburi Cement Ltd

Cement manufacturing consumes large quantities of non-renewable raw materials: minerals and fossil fuels. It is also an important source of CO_2 emissions. In response to this environmental challenge, Bamburi Cement Limited has taken up the challenge towards the path of industrial ecology, an approach inspired by the cycles of creation, destruction and recycling that occur in nature. By rethinking industrial processes from start to finish, one industry's waste products can become another industry's resources.

Bamburi Cement Ltd is aware of the impact of its activities on the environment and as a result, it started thinking at a very early stage of ways to reconcile industrial imperatives with the preservation of ecosystems. Adding value to waste by using it as alternative fuel or raw material enables Bamburi to: limit greenhouse gas emissions by reducing the use of nonrenewable raw materials and fossil fuels (oil, coal, etc.), diversify energy resources and reduce energy costs by limiting dependence on traditional fuels, serve the community by recycling waste that would otherwise need to be processed and eliminated. Industrial ecology practices are, therefore, beneficial for the community and the environment and also have benefits for Bamburi.

The company uses used tyres (classified as non-hazardous material) and biomass as alternative fuels in cement kilns. The potential impacts from the open-air burning and landfilling from residual ashes or landfilling of whole tyres and biomass are thereby avoided. Tyres and biomass are introduced at different points of the process depending on the type of kiln.

2.6.3 Emissions and Controls

Particulate matter, consisting primarily of cement, Clinker, Pozzolana, Limestone and Gypsum dust but including some aggregate and sand dust emissions, is the primary pollutant of concern. In addition, there are emissions of metals that are associated with this particulate matter. All but one of the emission points are fugitive in nature. The only point sources are the transfer of cement and pozzolan material to silos, and these are usually vented to a fabric filter or "sock". Fugitive sources include the transfer of raw materials, truck loading, vehicle traffic, and wind erosion from sand and aggregate storage piles. The amount of fugitive emissions generated during the transfer of sand and aggregate depends primarily on the surface moisture content of these materials.

Types of controls used may include water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, central duct collection systems, and the like. A major source of potential emissions, the movement of heavy trucks over unpaved or dusty surfaces in and around the plant, can be controlled by good maintenance and wetting of the road surface. The project proponent will provide facilities for handling solid waste generated within the Plant. A licenced garbage collector will be contracted by either the residents or the County Government. There will be dust bins/skips/receptors for temporarily holding waste within the premises before final disposal at the city's designated dumping site. Waste water from the offices will be directed into the sewer system.

2.6.4 Cleaning

The proponent will be responsible cleaning of the plant, the parking areas and the compound among other areas. Cleaning operations will involve the use of substantial amounts of water, disinfectants and detergents.

2.6.5 General repairs and maintenance

The proposed Nairobi Grinding Plant (NGP) Capacity Increase project and associated facilities will be repaired and maintained regularly during the operational phase of the project. Such activities will include repairs of silos and machinery, repairs and maintenance of electrical gadgets and equipment repairs.

2.7 Description of the project's decommissioning activities

2.7.1 Demolition works

Upon decommissioning, the project components including equipment, silos, pavements, drainage systems, parking areas and perimeter fence will be demolished. This will produce a lot of solid

waste, which will be reused for other construction works, and those not reusable will be disposed of appropriately by a licensed waste disposal company.

2.7.2 Dismantling of equipment and fixtures

All equipment including electrical installations, furniture, finishing fixtures partitions, pipe-work and sinks among others will be dismantled and removed from the site on decommissioning of the project. Priority will be given to reuse of these equipment in other projects. This will be achieved through resale of the equipment to other contractors.

2.7.3 Site restoration

Once all the waste resulting from demolition and dismantling works is cleared from the site, the site will be restored through replenishment of the topsoil and re-vegetation using indigenous plant species.

CHAPTER 3: BASELINE INFORMATION

3.1 Introduction

This section describes the major elements of the project area's environment, encompassing the physical, biological and social environment as well as the condition of the proposed project site. The information presented in this section is based on observation of the project area by the consultants as well as information from secondary literature.

3.2 Description of the Project Environment

3.2.1 Bio-physical

The proposed **Nairobi Grinding Plant (NGP) Capacity Increase Project** site off Nairobi-Mombasa Highway in Athi River, Machakos County on plots LR Nos. 18696/26; 18696/27; 18696/28; 18696/29; 18696/30; 18696/31 and 18696/56 whose coordinates are **1^0 26'0.579"S 36^0 57' 32.921"E** and at an altitude of about **1515 metres** above sea level. The site of the project is about 500 metres off Nairobi Mombasa Highway and Nairobi-Namanga road, and is accessible via Old Mombasa Road which connect to Nairobi-Namanga Road at the Shalom Junction. The proposed project area is found in the newly found ATHI RIVER District in Machakos County which boarders Kajiado and Nairobi Counties.

3.3 Climate

Athi River, just like many parts in Machakos County experiences a bimodal rainfall pattern. The short rains fall between October and December while the long rains fall between mid-March and May. Annual rainfall is influenced by altitude with a mean annual rainfall of 800 mm. The climate is humid highland subtropical in character with seasonal dry and wet periods. Temperatures vary with altitude rising from the lowest 10^0C in to the highest are 27^0C

3.4 Infrastructure

The area of the Project has both tarmac and all-weather road networks connecting it to major towns like Nairobi, Kitengela and Machakos Town. The roads in the immediate neighbourhood are in good conditions though.

3.4.1 Road

The major roads in the district follow the north-south axis and are connected to the Nairobi-Mombasa Road.

3.4.2 Energy

Energy in its various forms is used to varying degrees, but by far the most important is electricity supplemented by wood and paraffin. Majority of the project area is occupied by industries/Factories which use electricity as a major source of energy to run their processes.

3.4.3 Geology and Soils

3.4.3.1 Geology

Athi River area predominantly comprises of tertiary rocks (Ngong volcanic) overlaying pre-Cambrian basement rocks, which is exposed in small area in upper reaches of the Kitengela River. In the north, from Nairobi national park and eastwards are the Nairobi phonolites, in the west are the Mbagathi Phonolite Trachytes and to the East are Athi tuffs. These rocky basements are usually very important for providing strong foundations for buildings.

3.4.3.2 Soils

The soils covering the area have greatly been influenced by the underlying basement rock system. Most parts of the area are covered by thin black cotton soils which is a great impediment to urban development and construction in particular. On the site of the proposed project, the soil is sandy to clay soils. This can comfortably support the proposed project development.

3.4.4 Climate

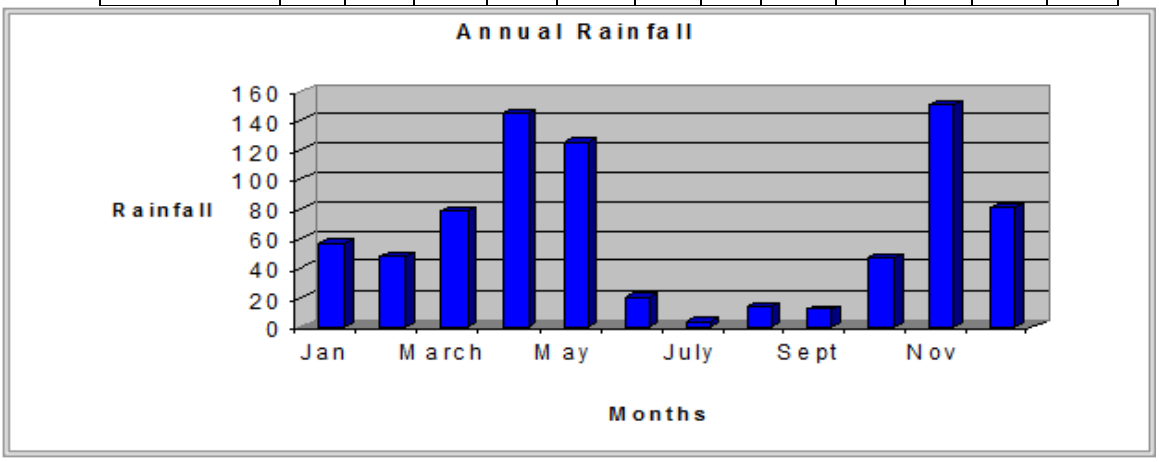
The various elements of climate include rainfall, temperatures, winds and even sunshine.

3.4.5 Rainfall

Statistics from the meteorological department of Kenya indicates that Athi River has two rainfall maximums: long rains fall between February to May and short spells occur between the months of October to December. The rain is preceded by two dry spells. The table below shows the amount of rainfall per month for Machakos

Table 1.2: Average monthly rainfall

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	57	48	79	145	125	20	4	4	2	47	150	81

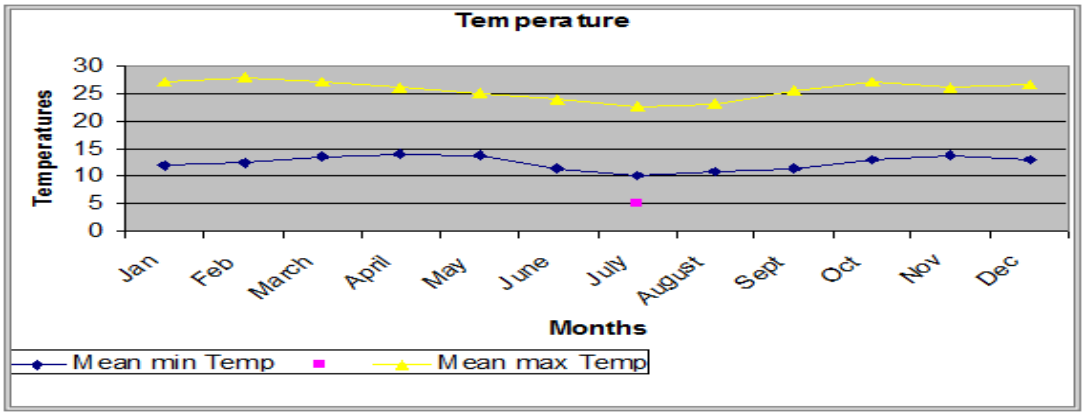


3.4.6 Temperatures

The temperatures of Athi River are very high between the month of January March. The mean maximum temperatures ranges between 23^0C – 28^0C while the mean monthly minimum temperatures range between 11^0C – 15^0C. The table below indicates the temperature records of Athi River town in Mavoko Municipality in 1983.

Table: Average Monthly rainfall

Months	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Mean min Temp	12	12.5	13.5	14.2	13.8	11.5	10.5	11	11.3	13	13.8	13
Mean max Temp	27	28	27	26	25	24	22.5	23	25.5	27	26	26.5



Source: Meteorology Department of Kenya Temperature records (1983)

3.4.7 Winds

The area experiences very strong winds during the months of August to October and of January to March. The winds flow from the Indian Ocean and are usually dry. The wind direction is in the southwest direction from November to May particularly across the area.

3.4.8 Vegetation/Flora

The site is devoid of major physical developments or structures. The uncultivated land has short grass and bushes. The property is open and not fenced. Since the parcel has already been surveyed, there exist beacons at the four corners of the parcel. The owners intend to fence off the property to discourage encroachment. Very little animal activity is noted within the site. The wildlife that may occasionally be found within the site includes birds, insects, rodents and butterflies.

3.5 Infrastructural Services

The status in respect of various services is as outlined herein under:-

3.5.1 Storm Water Drainage and Effluents Management

The topography of the site is such that there is a gentle slope southwards towards a seasonal storm drain flowing towards River Athi. The storm water therefore drains naturally into the stream on the southern side of the factory. The area is therefore not prone to floods making it habitable. The site is connected to the Mavoko water and sewerage company public sewer and it's functional.

3.5.2 Electricity and Telephone Services

The area is served with electricity power line serving the area. The area is also well served by the Telkom, Safaricom and Celtel telephone providers. The site is closer to Kenya power and lightening national grind.

3.5.3 Archaeological and Cultural Heritage

The project site, being completely established in an industrial area it has no major archaeological and cultural complications.

3.5.4 Noise levels

The noise assessment was undertaken at Bamburi cement Nairobi plant between 11:30am and 2:30pm on 14th July 2015 to fulfil rules 6 10 (I) of the legal requirements and to establish noise exposure levels and patterns in the workplace due to factory operations and to obtain data that can be used to form basis for planning the control measures to eliminate or control noise exposure to the workers.

Table: Measured Noise Levels

LOCATION	Measured noise levels (Equivalent continuous) Leq dBA	Cycle period time in Min: seconds	Max noise produced dBA	Min noise produced	TLV	Standard Noise levels (Equivalent continuous) Leq dBA	No. of persons exposed	Comments	Recommendations NOTE: For Leq values higher than 85dBA carry out noise control and hearing conservation program (NCP)
OFFICES									
Reception	57.7	1 min	61.7	53.9	90	60	100	Noise level constant	
Plant manager's office	53.6	1 min	59.6	51.3	90	60	1	Noise level constant	
Otimization manager's office	54.5	1 min	55.5	52.7	90	60	1	Noise level constant	
Conference room	69.8	1 min	74.7	67.3	90	60	30	Noise level constant	
Sales office	52.1	1 min	57.2	46.6	90	60	20	Noise level constant	
Electrical workshop	61	1 min	65.6	58.4	90	60	10	Not constant. Depends on activities	
CCR	59.1	1 min	64.0	56.9	90	75	15	Noise level constant	
Laboratory	64.7	1 min	80.7	57.7	90	75	6	Not constant. Depends on activities	
Lab crusher	88.1	3 mins	90.9	80.8	90	90	1	Not constant. Depends on activities. Taken during machine operation	NCP
Sample preparatory room	79.2	1 min	86.3	73	90	75	1	Not constant. Depends on activities. Taken during machine operation	
Maintenance office	70.5	1 min	77.5	67.9	90	75	1	Not constant. Depends on activities	
Corridor entrance to canteen	59	1 min	61.3	57.1	90	75	5	Noise level constant	
Canteen	64.2	1 min	75.3	58.2	90	75	30	Noise level constant	
PLANT AREA									

Palletizing shed	73.8	1 min	82.6	67.1	90	75	10	Noise level constant	
Packing plant no. 3	83	1 min	89.8	76.1	90	90	8	Noise level constant	
Packing plant no.2	84.9	1 min	93.9	79.9	90	90	8	Noise level constant	
Packing plant office	68	1 min	80.3	57.9	90	75	8	Noise level constant	
Silo 1 staircase	78.1	1 min	80.4	76.3	90	90	2	Noise level constant	
Silo 1 blower	73.9	1 min	77.3	75	90	90	10	Noise level constant	
Silo 2 blower	91.5	1 min	92.1	91.2	90	90	20	Noise level constant	NCP
Mill no. 1	95	1 min	96.2	94.4	90	90	10	Noise level constant	NCP
Mill no. 2	92.1	1 min	93.3	91.2	90	90	20	Noise level constant	NCP
Between mill 1 and 2	95.5	1 min	96.3	94.9	90	90	10	Noise level constant	NCP
Raw material stockpile	74.9	1 min	80.2	69	90	75	3	Noise level constant	
Clinker intake	75.4	1 min	81	73.2	90	75	1	Noise level constant	
Raw material clerks office	67.3	1 min	80.5	53.4	90	75	1	Noise level constant	
Below CCR staircase	87.1	1 min	87.9	86.5	90	90	20	Noise level constant	NCP
PLANT COMPOUND									
Fire cabinet 7	65.3	1 min	79.8	54.7	90	75	1	Noise level constant	
Fire point no. 5	62.5	1 min	69.8	55.4	90	75	1	Noise level constant	
Wagon loading bay	75	1 min	86.4	72.6	90	75	1	Noise level constant	
Inside compressor room	93	1 min	94.4	92.3	90	90	1	Noise level constant	NCP
Outside compressor room	82.6	1 min	83.7	81.6	90	90	5	Noise level constant	
Car washing bay	62.4	1 min	63.4	61	90	75	5	Noise level constant	
Car park	58.1	1 min	59.3	56.4	90	75	20	Noise level constant	
Customer services office	70.3	1 min	78.1	65	90	75	20	Noise level constant	
Boundary fence next to railway line	65.3	1 min	66.7	64.3	90	75	3	Noise level constant	
Outside the main gate	63.2	1 min	68.5	60.7	90	75	5	Noise level constant	
Wagon winch	81.7	1 min	87.8	81	90	75	2	Noise level constant	
Clinker hall	76.6	1 min	79.8	69.5	90	75	1	Noise level constant	
Workshop hand grinder	99	1 min	107.7	88.9	90	90	3	Depends on grinder operation and feed.	NCP

Welding bay	76.4	1 min	87.6	64.6	90	90	4	Depends on activities	
Raw materials fire assembly point	70.7	1 min	75.2	59.9	90	75	3	Noise level constant	
Raw material smoking zone	68.4	1 min	73.1	59.9	90	75	5	Noise level constant	
Fire point no. 8	59.1	1 min	59.5	58	90	75	1	Noise level constant	
Outside main store	60.6	1 min	62.8	59.2	90	75	5	Noise level constant	
Bore hall no. 1	62.0	1 min	77.6	57.2	90	75	1	Noise level constant	
Packing plant truck area	65.6	1 min	70.6	57.7	90	75	100	Depends on machine operation	
Packing plant assembly area	61.9	1 min	66.1	60.2	90	75	100	Depends on machine operation	
Siren at packing hall	84.2	1 min	89.3	77.7	90	140	8	Only during operation	
AF Feeding area	83.6	1 min	84.9	82.5	90	90	8	Noise level constant	

Table: Levels at Different Frequencies in areas where Leq is above 85 dBA

POINT	LOCATION	NOISE IN dB at different frequencies (Octave band mode)										dBA
		31.5Hz	62.5Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz	16KHz	
1	MILL 1	83.2	86.2	91.0	97.8	93.2	91.0	85.9	79.0	67.3	51.6	95.6
2	BETWEEN MILL 1 AND 2	85.2	90.6	93.6	97.0	95.1	89.2	84.8	78.4	65.3	51.1	95.5
3	MILL 2	99.2	88.4	90.6	93.0	92.3	86.2	79.9	73.2	60.3	47.5	
4	BELOW CCK STAIRCASE	85.0	82.9	88.2	86.2	81.3	73.8	66.2		88.5	96.0	86.8
5	BENCH GRINDER	76.9	69.8	68.4	79.9	86.8	86.3	90.3	94.4	98.6	89.7	102.0
6	HAND GRINDER	73.3	70.0	67.3	70.7	82.6	91.1	96.1	94.2	90.4	82.4	100.6
7	SILO 2 BLOWER	77.6	80.1	76.6	79.7	84.0	82.6	84.4	84.4	83.1	74.8	91.0
8	INSIDE COMPRESSOR ROOM	80.3	78.4	84.5	87.9	90.2	87.7	86.5	82.4	70.4	62.1	92.5

The noise survey results depicted by the tables above indicate that there are some noisy areas within the factory. The following areas and activities registered noise above 85dB (A): Mill 1, Between Mill 1 and 2, Mill 2, Below CCK Staircase, Bench Grinder, Hand Grinder; Silo 2 Blowers, and Inside Compressor Room.

However, Bamburi Cement (Nairobi grinding plant) has an elaborate noise conservation programme that include and not limited to strict usage of the hearing protectors in noisy areas, proper usage of these protectors, posting of safety signs at the noisy areas, safety talks, annual noise surveys and audiometric examinations to workers exposed to noise above 85.0dB(A). This goes a long way in ensuring health and safety of the workers.

3.5.5 Air Quality

Air quality analysis and emission testing was done on eight NGP factory locations in 2015 for determination of air pollutants in ambient air using a gas monitor to measure O_2, CO_X, NO_X, H_2S, SO_X, and Dust using the ambient air quality standards shown below:

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		National Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.075 ppm (147 µg/m^3)		
Respirable Particulate Matter (PM10)[8]	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		—		
Fine Particulate Matter (PM2.5)[6]	24 Hour	—	—	35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	12.0 µg/m^3	15 µg/m^3	
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 mg/m^3)	—	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	—	
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	
Nitrogen Dioxide (NO_2)[9]	1 Hour	0.18 ppm (339 µg/m^3)	Gas Phase Chemiluminescence	100 ppb (188 µg/m^3)	—	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)		0.053 ppm (100 µg/m^3)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[10]	1 Hour	0.25 ppm (655 µg/m^3)	Ultraviolet Fluorescence	75 ppb (196 µg/m^3)	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	—		—	0.5 ppm (1300 µg/m^3)	
	24 Hour	0.04 ppm (105 µg/m^3)		0.14 ppm (for certain areas)[10]	—	
	Annual Arithmetic Mean	—		0.030 ppm (for certain areas)[10]	—	
Lead[11,12]	30 Day Average	1.5 µg/m^3	Atomic Absorption	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	—		1.5 µg/m^3 (for certain areas)[12]	Same as Primary Standard	
	Rolling 3-Month Average	—		0.15 µg/m^3		
Visibility Reducing Particles[13]	8 Hour	See footnote 13	Beta Attenuation and Transmittance through Filter Tape	• No National Standards		
Sulfates	24 Hour	25 µg/m^3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride[11]	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

The following parameters were analyzed as shown in the table below:

Table: Average Analyzed Parameters

Parameter	Measured Value	Ambient Air Quality Tolerance Limits (NEMA)		Remarks
		Time weighted average	*Industrial area limits*	
RAW MATERIALS YARD				
O_2 concentration (%)	20.8	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.3	8 hours	5.0	***Accepted***

NO_X concentration ($\mu g/m^3$)	3.2	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	1.5	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	4.0	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	46.8	Annual	360	***Accepted***
RAW MATERIALS WEIGHING BRIDGE				
O_2 concentration (%)	20.8	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.2	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	2.4	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	1.5	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	3.2	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	43.2	Annual	360	***Accepted***
MILL SHOP				
O_2 concentration (%)	20.6	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.4	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	4.8	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	7.5	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	5.6	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	79.2	Annual	360	***Accepted***
STACK-CEMENT MILL 1				
O_2 concentration (%)	20.6	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.6	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	7.2	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	13.5	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	4.8	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	68.4	Annual	360	***Accepted***
STACK-CEMENT MILL 2				
O_2 concentration (%)	20.7	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.5	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	8.8	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	18.0	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	8.0	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	82.8	Annual	360	***Accepted***
PACKING PLANT				
O_2 concentration (%)	20.9	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.1	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	1.6	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	1.5	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	1.6	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	57.6	Annual	360	***Accepted***
PACKING PLANT OFFICE				
O_2 concentration (%)	20.9	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.1	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	0.8	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	3.0	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	0.8	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	21.6	Annual	360	***Accepted***
TRUCK PARKING YARD				

O_2 concentration (%)	20.8	N/A	21.0	***Accepted***
CO_X concentration (mg/m^3)	0.1	8 hours	5.0	***Accepted***
NO_X concentration ($\mu g/m^3$)	0.8	Annual	80	***Accepted***
H_2S concentration ($\mu g/m^3$)	1.5	24 hours	150	***Accepted***
SO_X concentration ($\mu g/m^3$)	0.8	Annual	80	***Accepted***
Dust concentration ($\mu g/m^3$)	25.2	Annual	360	***Accepted***

The above results for air quality analysis are within the stipulated standards.

CHAPTER 4: RELEVANT LEGISLATIVE AND REGULATORY FRAMEWORKS

This chapter of the EIA Study Report highlights the relevant legal provisions which govern the process of EIA under which this proposed project falls. These provisions are broadly categorized as policies, legislations, regulations and administrative frameworks.

4.1 Policy Framework

This sub-section highlights the relevant environmental policies established by the Government of Kenya (GOK) for purposes of environmental protection towards the process of sustainable development. The GOK, through the ministry of environment, has established environmental policies which broadly aim at:

- Encouraging respect for the environment by all and being mindful and taking care of the same;
- Ensuring environmental issues are integrated with economic matters to attain sustainable development;
- Reviewing and evaluating development plans to ensure they follow the set environmental guidelines/policies;
- Encouraging the public to take part in environmental matters so as to enlighten them on the same hence improve on environmental performance.

The following are the environmental policies set by the GOK through the Ministry of Environment and Natural Resources to ensure the environment is safeguarded in all development aspects:-

4.1.1 The National Environmental Action Plan (NEAP)

Established in 1990, this policy addresses the issue of social, economic and industrial activities and their impacts on the ecosystem as opposed to environmental sustainability. This policy also emphasizes environmental concerns to be accounted for in socio-economic developments. The EIA process was established in line with this policy and the key players in this were local authorities and other development partners.

4.2 Legislative Framework

This sub-section explains the various legal provisions which govern the processes of EIA and EA. Some environment related acts that have been created deal with specific areas of the environment such as water pollution, soil erosion, air pollution, resettlement among others. Before the establishment of Environmental Management and Coordination Act (EMCA) of 1999 and Environmental Impact Assessment and Environmental Audit regulations of 2003, environmental strategies were implemented through local authorities' acts and policy statements. The EMCA Act led to establishment of NEMA which coordinates all environmental issues in the country and enforces environmental laws. The following is a highlight of some legal frameworks that govern this project.

4.2.1 Environmental management and coordination Act (EMCA) 1999

Established in 1999, this Act is the most comprehensive Act of parliament pertaining to environmental protection, conservation and management. This Act states that each and every individual is entitled to a clean environment and should therefore safeguard the same. This Act goes ahead to stipulate that, all development activities and projects must undergo an EIA so as to achieve the target of a clean environment for all. The EMCA is currently under review and could be amended in the National Assembly.

An EIA report provides information on how to manage the environment better by identifying the significant impacts that emanate from a given project and proposing appropriate mitigation/management and monitoring measures. The EIA study report also includes an environmental management plan which provides an action plan for impact management and monitoring. Therefore, the EIA process is very essential since it ensures proper environmental management towards the process of sustainable development. The proponent will have to adhere to all impact management and mitigation measures highlighted and thereon implement the environmental management and monitoring plan and all other relevant measures as required in this Act while undertaking the project to ensure proper and effective environmental management.

4.2.2 Physical Planning Act 1999

This Act provides for the preparation and implementation of physical development plans for connected purposes. It establishes the responsibility for the physical planning at various levels of Government in order to remove uncertainty regarding the responsibility for regional planning. It provides for a hierarchy of plans in which guidelines are laid down for the future physical development of areas referred to in specific plan. The ostensible intention is that the three tier order plans, the national development plan, regional development plan, and the local physical development plan should concentrate on broad policy issues.

The Act also promotes public participation in the preparation of plans and requires that in preparation of plans, proper consideration be given to the potential for economic development, socio-economic development needs of the population, the existing planning and future transport needs, the physical factors which may influence orderly development in general and urbanization in particular, and the possible influence of future development upon natural environment. The innovation in the Act is the requirement for Environmental Impact Assessment (EIA). Any change of use of the actual development without authority constitutes an offence.

4.2.3 The Factories and other places of work Act

This Act of Parliament makes provisions for health, safety and welfare of persons employed in factories and other places of work. On health, the Act stipulates the need for cleanliness, ventilations, drainages and provision of sanitary services in places of work. On safety, the Act elaborately deals with safety requirement, which include fencing of moving parts of machinery, encasement of machinery that require encasement and proper storage of dangerous liquids. Noise

prevention and control rules are also spelt in this Act as well as a description of the permissible noise levels, offences, and penalties relating to noise.

4.2.4 Land planning Act cap 303

This Act addresses such issues as land allocation and development procedures and it is administered by the Ministry of Lands. This Act also advocates for efficient utilization and management of the land resources available. The department of lands is mandated to keep records of all lands, collect revenues emanating from lands, demarcation of boundaries, solving any arising land disputes, issuing land ownership title deeds and monitoring on development undertakings on the land. Under this Act, the local authority before submitting any plans to the Minister at the time for approval, the owners of such land affected should be incorporated into the process. The land owner's opinions should be forwarded so as to minimize conflict. The proponent should obtain a legal land title deed from the ministry of lands. In the case of this project the land where the project is undertaken belongs to the project proponent.

4.2.5 Public Health Act (Cap 242)

The Public Health Act (Cap 242) aims at protecting and promotes human health and the prevention, limitation or suppression of infectious, communicable or preventable diseases within Kenya. It also aims to advise and direct local authorities in regard to matters affecting public health and to promote or carry out researches and investigations in connection with the prevention and treatment of human diseases. This Act provides the impetus for a healthy environment and gives regulations to waste management, pollution and human health.

Section 119 states that a medical officer may require the owner of dwelling causing nuisance to remove the nuisance in the dwelling failure to which legal proceedings may be taken against the owner of the dwelling and penalties. Under section 126 the act includes The Public Health (Drainage and Latrine) Rules which in section 63 deals with sewerage and prohibits the disposal of solid or liquid sewage or sewage effluent in such a manner or in such a position as to cause or be likely to cause dampness in any building or part thereof, or to endanger the purity of any water supply, or to create any nuisance.

The main contractor will be required to provide sanitary facilities and solid waste containers for use by the construction workers on site during construction phase. A licensed solid waste transporter will also be contracted to collect all solid waste from the site for dumping at approved sites. Waste water from the proposed project during its operational phase will be discharged into the sewer system in the serving the project area.

4.2.6 The Mining Act (Cap 306)

This is an Act of parliament that consolidates the law relating to mining. The Act spells out licensing conditions set by the government and duties of the licencees. This Act will specifically apply to the cement plant because of mining the raw materials.

4.2.7 Building code 2000

Sewers and waste management are addressed in this Code. It directs that applications to the local authority before connecting to a sewer line whenever it exists must be made. All waste water is required to be discharged into public sewers. This code as well prohibits any constructions on sewer lines.

4.2.8 The Water Act, 2002

This Act provides the guidelines for proper management of water, conservation and control of water resources to ensure the water resources are sustainable. Under this Act waste water, storm water, sewage systems and drainages are supposed to be put in design drawings in the building plan; This Act also prohibits water pollution by a developer in his/her area of jurisdiction.

Though the site has no stream or river, the proponent will ensure that appropriate measures to prevent pollution of underground and surface water resources are implemented throughout the project cycle. The proponent shall also seek the necessary approvals from Mavoko Water and Sewerage Company before seeking other alternative sources of water supply to the proposed project site throughout the project cycle.

4.2.9 Occupational Safety and Health Act, 2007

This is an Act of parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. According to Section 3 (1), this legislation shall apply to all workplaces where any person is employed, whether permanently or temporarily. Under Section 3 (2), the purpose of this Act is to: -

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

Under Section 6 (1), every occupier shall ensure the safety, health and welfare at work of all persons working in his workplace. Under section 6 (3), every occupier shall carry out appropriate risk assessments in relation to the safety and health of persons employed, and on the basis of these results, adopt preventive and protective measures to ensure that under all conditions of their intended use, all chemicals, machinery, equipment, tools, and process under the control of the occupier are safe and without risk to health and comply with the requirements of the safety and health provisions in this Act.

Under Section 47 (1), every workplace shall be kept in a clean state, and free from effluvia arising from any drain, sanitary convenience or nuisance. In accordance with section 52 (1), sufficient and suitable sanitary conveniences for the persons employed in the workplace shall be provided, maintained and kept clean, and effective provision shall be made for lighting the conveniences; and where persons of both sexes are or are intended to be employed (except in the case of

workplaces where the only persons employed are members of the same family dwelling there), such conveniences shall afford proper separate accommodation for persons of each sex.

4.3 Administrative Framework

In 2001 various administrative structures were established for purposes of monitoring and evaluation of the various environmental laws and regulations existing. These administrative frameworks enforce environmental rules, laws, regulations and policies that exist with an aim of protecting and managing the environment effectively. They include;

4.3.1 National Environmental Council

The council which is headed by the Minister for Environment is mandated to formulate environmental policies, draft the national environmental goals and objectives that aim at proper environmental management.

4.3.2 The National Environment Management Authority (NEMA)

NEMA was established after the EMCA Act of 1999 and its main role is to coordinate and supervise all environmental matters in the country. All set environmental policies and goals are implemented by the Ministry of Environment through NEMA. The EMCA Act also provides for establishment of a technical committee (Standards and Enforcement Review Committee (SERC)) to enforce quality environmental standards.

4.4 Regulatory Framework

This sub-section outlines the various rules and regulations which have been established to safeguard the environment. Some of these regulations are as follows:-

4.4.1 Environmental Impact Assessment and Audit Regulations 2003

Established in 2003 these regulations provide the objectives and guidelines for carrying out an EIA and an EA. These regulations which apply hand in hand with the EMCA Act of 1999 requires any project proponent before commencement of the project activities to have an EIA done on the same and a license awarded by NEMA so as to ensure sound and effective environmental management. Under the same regulations, regulation 4(1) prohibits project proponents implementing projects with negative environmental impacts. The Environmental Impact Assessment and Audit Regulations state in Regulation 3 that 'the regulation shall apply to all policies, plans, programmes, and activities specified in Part IV, V and the Second schedule of the Act.

4.4.2 The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009

Part II of the general prohibition of this regulation state that except as otherwise provided for in this regulations, no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of

others and the environment. Part (2) of the general prohibitions stated that in determining whether noise is loud, unreasonable, unnecessary or unusual the following factors may be considered:-

- Time of the day;
- Proximity to residential area;
- Whether the noise is recurrent, intermitted or constant;
- The level and intensity of the noise;
- Whether the noise has been enhanced in level or range by any type of electronic or mechanical means; and
- Whether the noise can be controlled without much effort or expense to the person making the noise.

Part 2 of section III states that any person wishing to operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning apparatus or similar mechanical device or engage in any maisionettes or industrial activity which is likely to emit noise or excessive vibrations shall carry out the activity or activities within relevant levels prescribed in the first schedule to these regulations. Part III section 13 (1) states that except for the purpose specified in sub-Regulation (2)… no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the second schedule of the regulations.

4.4.3 Solid Waste Management Legal Notice No. 121

The Environmental Management and Coordination Legal Notice No 121 on (waste management) provides for the responsibility of waste generator, cleaner production methods, segregation of waste by generator, waste transportation license, responsibility of a waste transporters, transportation of waste by licensed transporters, license for disposal facility, waste treatment by operators of disposal sites, requirement for environmental audit and re-use and recycling plants. The legal notice further provides mitigation measures to industrial wastes and their treatment. The hazardous and toxic wastes have been specified by the legal notice that also provides for various requirements of EIA.

The proponent will use private companies to collect and dump all the solid waste generated from the proposed development. Temporal solid waste handling containers will be provided on site and protected from rain and animals where residents will collect their solid waste before it is dumped to the city's designated dumpsite once or twice a week.

4.4.4 The Environmental Management and Co-Ordination (Air Quality) Regulations, 2009

These regulations apply to:-

a) all internal combustion engines,
b) all premises, places, processes, operations, or works to which the provisions of the Act and Regulations made thereunder apply, and
c) Any other appliance or activity that the Minister may by order in the Gazette, specify.

The fourteenth schedule to the regulations lists Portland cement plants (clinker plants included) among controlled facilities where these regulations apply. Part VIII of the Fifth schedule to these regulations gives Guidelines on sources of fugitive emission air pollutants. The following are listed as the sources of fugitive emissions: construction activities; storage and handling, including loading and unloading, of materials such as bauxite, alumina, gypsum, or Portland cement or the raw materials therefore; mining and quarrying activities; haul roads; haul trucks; tailings piles and ponds; demolition activities; blasting activities; sandblasting operations; wind breaks; the paving of roads and conveyor belts. The fourth schedule to these regulations gives a table of guidelines on air pollution monitoring parameters from stationary sources.

CHAPTER 5: PUBLIC PARTICIPATION

The broad objective of the Public Consultation Process was to provide the local population, statutory bodies, local organizations and interested parties with the opportunity to identify issues, concerns and opportunities regarding the proposed development. This allowed the EIA Study team to explain to the public and others how the project might affect them and receive feedback on particular concerns that they might have in order that subsequent studies undertaken and actions could reflect those concerns.

In conforming to the environmental legislation, public consultations were conducted using interviews, questionnaire survey and consultative meetings to inform project affected people that the project is being undertaken, to record and understand any concerns, and to allow the project to be designed and the EIA scoped so as to reduce any adverse impacts to an acceptable level; and on completion of EIA, to inform people of the outcome of the EIA to communicate how issues/concerns have been addressed; and to record, and where necessary act upon any further issues/concerns. Neighboring the site are developments of the same character as the proposed development project.

5.1 Public Consultation Findings

During the Public Participation process, a majority of those consulted did not object to the proposed project being undertaken as proposed. The general feeling was that the proposed project would have positive impacts such as the creation of job opportunities; provision of construction materials; improving livelihoods through CSR projects. However, there were a number of environmental concerns that were raised by the respondents. They included:

- Noise pollution and Vibration due to construction and operation activities;
- Air Pollution due to dust emissions from construction and operational activities;
- Clearing of vegetation and loss/displacement of biodiversity;
- Soil and Water pollution;
- High water demand;
- Damage to road network

5.1 Analysis of the Public Consultation findings

5.1.1 Noise and Vibrations

Since this project will be within an already developed setup, there is concern over the possibility of high noise levels and vibrations; and increased dust levels during the project's construction and/or installation and operational phases. The sources of noise pollution and vibrations are likely to be transport vehicles, construction machinery, metal grinding and cutting equipment during the construction phase; and operation of machinery.

A noise assessment was undertaken at the existing Bamburi Cement Nairobi Plant between 11:30am and 2:30pm on 14th July 2015 to fulfil rules 6 10 (I) of the legal requirements and to establish noise exposure levels and patterns in the workplace due to factory operations and to obtain data that can be used to form basis for planning the control measures to eliminate or control noise exposure to the workers. There were some noisy areas within the factory which registered noise levels above 85dB (A) such as Mill 1, Between Mill 1 and 2, Mill 2, Below CCK Staircase, Bench Grinder, Hand Grinder; Silo 2 Blowers, and Inside Compressor Room.

However, Bamburi Cement (Nairobi grinding plant) has an elaborate noise conservation programme that include and not limited to strict usage of the hearing protectors in noisy areas, proper usage of these protectors, posting of safety signs at the noisy areas, safety talks, annual noise surveys and audiometric examinations to workers exposed to noise above 85.0dB(A). This goes a long way in ensuring health and safety of the workers. These same measures and best regulation standards and techniques will be applied in controlling noise levels at the proposed NGP Capacity Increase Project.

5.1.2 Air Pollution

Dust emissions due to project activities are likely to cause air pollution. The company however carried out Air quality analysis and emission testing on eight NGP factory locations in 2015 for determination of air pollutants in ambient air using a gas monitor to measure O_2, CO_X, NO_X, H_2S, SO_X, and Dust using the ambient air quality standards. The results indicated that the air quality analysis were within the stipulated standards. However, with the proposed project, there is likelihood of heightened air pollution which will require to be controlled.

5.1.3 Water demand and Waste water management

Issues of increased water demand were raised in the public participation exercise. The neighbours expressed concern about the supply of water within the area is likely to be affected due to the large quantities of water being needed to undertake the proposed project. Concern was also raised about the waste water management with some suggesting that the sewer system be upgraded and expanded to adequately serve the ever increasing capacity.

5.1.4 Clearing of vegetation and Loss/displacement of biodiversity

To create room for the construction and installation of the proposed project, there is going to be clearing of vegetation which will lead to displacement and/loss of biodiversity and habitat. However, the impact will be minimal.

5.1.5 Soil and Water pollution

Some of the proposed project's activities may lead soil and water pollution. Some of the waste such as waste oil, chemical waste and cement dust may negatively impact on the soil and water. These, however, may not be a problem if the correct measures are put in place.

5.1.6 High water demand & Damage to road network

The proposed project means that there is going to be more water needed to run the project activities. There is also going to be an addition of strain on the access roads due to additional tonnes of raw materials and cement to and from the site of the project. This may lead to damage on the road network if the correct tonnage levels are not observed.

5.2 Positive impacts

According to the Economic Survey of the Kenya Bureau of statistics of 2014, cement production registered an accelerated growth of 7.8 per cent in 2013 compared to a growth of 4.8 per cent in 2012. This translated into 5,059.1 thousand tonnes in 2013. Cement consumption and stocks also increased from 3,991.2 thousand tonnes in 2012 to 4,266.5 thousand tonnes in 2013 as a result of increased construction activities. For a second consecutive year, imports of cement declined to stand at 34.4 thousand tonnes in 2013. Total exports of cement to Uganda and Tanzania, which had decreased in 2012, reversed to record 594.0 thousand tonnes in 2013.

Implementation of the proposed NGP Capacity Increase Project for Bamburi Cement in Athi River may results in positive impacts. Potential positive impacts likely to result from the proposed project may include:

5.2.1 Increased exploitation of common minerals used in cement production

The proposed NGP capacity increase project of Bamburi Cement factory at Athi River will likely result in increased mining and exploitation of common minerals used in cement production. Such common minerals include coral limestone which is the bulk raw material used in cement production. Other minerals whose exploitation is likely to increase as a result of the expansion may include shale, bauxite and iron ore.

5.2.2 Increase in cement production in Kenya

The proposed NGP capacity increase project of Bamburi Cement factory at Athi River seeks to increase the cement grinding capacity from the 1,500,000 tonnes per year to 2,300,000 tonnes per year. This if achieved will effectively contribute to significant increase in cement production in Kenya.

5.2.3 Reduction in cement imports

The proposed NGP capacity increase project of Bamburi Cement factory at Athi River will mean there will be more cement in Kenya than before. This will mean previous cement deficit will be farther narrowed. There will thus be less need for cement importation. Reduced cement importation will translate to reduced spending of foreign currencies; this will mean there will be more foreign currency reserves due to reduced cement importation.

5.2.4 Increase in Cement exports

The proposed NGP capacity increase project of Bamburi Cement factory at Athi River will result in production of more cement and clinker. This will mean that there will be more cement and clinker

available for export than was previously. Increased export of cement and clinker will translate to increased foreign exchange earnings for the county.

5.2.5 Employment opportunities

The proposed NGP capacity increase project of Bamburi Cement factory will provide opportunities for employment for more people to work in the expanded factory. It is envisaged that the workforce may double to cater for the expansion needs.

5.2.6 Support of local businesses

Services of local businesses such as transporters will be required to cater for the expanded factory. This will contribute to growth and development of such businesses. Other businesses may start or be farther developed to cater for the needs of the expanded factory such businesses likely to grow my include housing to cater for the increased workforce, hospitals, schools, shops among others.

5.2.7 Increased revenue to government

The proposed NGP capacity increase project of Bamburi Cement factory will translate to increased tonnage of cement and clinker that will be produced. This will translate to increased tonnage of sales of clinker and cement translating to increased profits to the company. Increased profits will translate to increased taxes hence increased revenue to government. The expansion will translate to increased use of raw materials this will result to increased cess to the Machakos County Government among other taxes.

CHAPTER 6: POTENTIAL ENVIRONMENTAL IMPACTS

6.1 Introduction

This chapter outlines the potential negative and positive impacts that will be associated with the proposed Nairobi Grinding Plant Capacity Increase project. The impacts will be related to activities to be carried out during construction/installation phase of the project; the operational phase impacts of the project will be associated with the cement manufacturing activities carried out by the proponent. In addition, closure and decommissioning phase impacts of the project are also highlighted. The impacts of the project during each of its life cycle phases (construction/installation, operation and decommissioning) can be categorized into: impacts on the biophysical environment; health and safety impacts; and socio-economic impacts.

6.2 Potential Negative Impacts of the Project

Potential negative impacts that may result from the implementation of the proposed NGP Capacity Increase Project of the Bamburi Cement Limited Athi River factory may include: -

- Increased gaseous emissions
- Increased dust emissions
- Increased noise disturbance
- Occupational injuries and or accidents
- Waste (liquid and solid) related pollution
- Negative impacts on local fauna
- Negative impacts on local flora
- Negative impacts on avifauna

6.2.1 Gaseous Emissions

There are three main sources of gaseous emissions from a cement production system namely raw materials, the fuel, and the process itself. Gases produced from the clinker production process include carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, and ammonia.

6.2.1.1 Carbon dioxide

Carbon dioxide results from the combustion of fuel and the calcination of the limestone component of the raw material mix, an essentially unavoidable and fixed consequence of clinker manufacture. Of the total amount of CO_2 emitted from a cement kiln, about half of the CO_2 originates from the raw material while the other half originates from the combustion process.

6.2.1.2 Carbon monoxide

CO is a product of incomplete combustion of carbonaceous fuel resulting from insufficient oxygen at the combustion site, insufficient mixing of oxygen and fuel at the combustion site, and/or rapid cooling of the combustion products to below the ignition temperature of CO prior to its complete oxidation. CO can be formed unintentionally at any of the combustion sites in the pyroprocessing system. The emission of CO usually represents partially burned and underutilized fuel.

6.2.1.3 Nitrogen oxides

There are four mechanisms of NO_X formation in cement kilns of which thermal and fuel NO_X formation is the most important. Thermal NO_X results from the oxidation of molecular nitrogen in air at high temperature. This phenomenon occurs in and around the flame in the burning zone of a cement kiln at a temperature greater than 1200ºC. Fuel NO_X results from the oxidation of nitrogen in the fuel at any combustion temperature found in the cement process. Because of the lower combustion temperature in the calciner and some sites of supplemental fuel combustion, the formation of fuel NO_X often exceeds that of thermal NO_X at these locations.

6.2.1.4 Sulfur dioxide

Sulfur dioxide results from the oxidation of sulfide or elemental sulfur contained in the fuel during combustion. In addition, sulfide or elemental sulfur contained in raw materials may be roasted or oxidized to SO_2 in areas of the pyroprocessing system where sufficient oxygen is present and the material temperature is in the range of 300-600°C. In addition, sulfates in the raw mix can be converted to SO_2 through localized reducing conditions in the kiln system.

6.2.1.5 Ammonia

Trace quantities of NH_3 in the exhaust gas from the rotary kiln gas result from the pyrolysis of nitrogenous compounds in coal and raw materials. In addition, atmospheric reactions occur just outside of the stack between NH_3 and the oxides of sulfur or HC_l that produce ammonium sulfate, ammonium bisulfate, or ammonium chloride as very fine particulate matter (PM).

6.2.2 Dust Emissions

Dust can be defined as an aerosol and disperse system that consists of small solid particles suspended in a gaseous medium. Separate particles and particle aggregates-from ultra-microscopic particles to those visible with the naked eye-have various shapes and compositions. In most cases, dust is formed as a result of the dispersion of solid bodies. It consists of particles that range in size from 10^{-7} to 10^{-4} m and that carry an electrical charge or are electrically neutral. Dust concentration, or dust content, is expressed by the number of particles or their total weight per unit volume of gas (air). Dust is unstable; its particles adhere during Brownian motion or during sedimentation. Dust from cement or more appropriately cement particulate matter, at a cement plant is typically caused by physical attrition, combustion particle burnout, or nucleation. Physical attrition occurs as particles abrade against each other. Particles generated by physical attrition range from less than 10 micrometers in size to more than 1,000 micrometers. Combustion particle burnout refers to the residues remaining from the pyro process. These particles are typically in the 1 to 100 micrometer range. Nucleation particles are generated when materials that are in a vapor form condense. These particles are truly very small, usually between 0.1 and 1.0 micrometers.

6.2.2.1 Potential sources of dust

Likely sources of dust from the proposed expansion of the cement plant could include the following;-

- Crushing of limestone at the limestone crusher
- Pre-blending of crushed limestone
- Handling and mixing of additives
- Blending of raw mill
- Moving of raw mill along production line
- Handling of generated clinker.
- Cement grinding and packaging.

6.2.2.2 General health effects of cement dust

Health effects of cement dust may include occupational lung disease, skin irritation, conjunctivitis, stomach ache, headache, fatigue and carcinoma of lung, stomach and colon. A brief explain on these health effects is as follows.

- The aerodynamic diameter of cement particles range from 0.05 to 5.0 micrometer in diameter. These particles are respirable in size hence Portland cement is important as a potential cause of occupational lung disease;
- This particle size distribution would make the tracheobronchial respiratory zone, the primary target of cement deposition;
- The main route of entry of cement dust particles in the body is the respiratory tract and / or the gastrointestinal tract by inhalation or swallowing respectively.
- Both routes, especially the respiratory tract are exposed to numerous potentially harmful substances in the cement mill environment. The physical properties that are of importance include particle size and density, shape and penetrability, surface area, electrostatic charge, and hygroscopicity. Among the more important chemical properties influencing the respiratory tract‘s response is the acidity or alkalinity of the inhaled agent. The deposition of inhaled material is primarily dependent on particle size and is best described in forms of an aerodynamic diameter. All particles with an aerodynamic diameter in excess of 10mm are deposited on the mucous membrane in the nose and pharynx and particles between 3 and 10mm in diameter can be deposited throughout the tracheobronchial tree. Particles between 0.1 and 3mm in diameter are mostly deposited within the alveoli and particles smaller then 0.1mm remain in the air stream and are exhaled. The pathogenesis is most probably due to its irritating, sensitizing and pneumoconiosis properties;
- High concentration and / or prolonged inhalation of cement dust in cement industry workers can provoke clinical symptoms and inflammatory response that may result in functional and structural abnormalities;
- Clinical features of cement mill workers exposed to cement dust in cement mill could include chronic cough and phlegm production, impairment of lung function, chest tightness, obstructive and restrictive lung disease, skin irritation, conjunctivitis, stomach ache, headache, fatigue and carcinoma of lung, stomach and colon.

6.2.2.3 Potential negative impacts of cement dust

Potential negative impacts of exposure to cement dust would include:

- Lung infection resulting from inhaling of cement dust;
- Skin irritation;
- Itching of the skin;
- Irritation of the eyes;
- Chronic cough;
- Reduced visibility;
- Choking of plants.

6.2.3 Increased Noise disturbance

6.2.3.1 Introduction

Noise can be defined as any undesirable sound that is intrinsically objectionable or that may cause adverse effects on human health or the environment {EMC (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009}. Noise can be either intermitted or intrusive. Intermitted noise is noise whose level suddenly drops to several times the level of background noise, on the other hand; intrusive noise is external or noise from another part of the building which penetrates the structural defenses of a room or building. Noise can also be defined unwanted or undesirable sound derived from sources such as industrial set up and operations, road traffic or construction works that interferes with normal activities such as conversation, sleep or recreation.

6.2.3.2 Noise generation/sources

Industrial machinery and processes are composed of various noise sources such as rotors, stators, gears, fans, vibrating panels, turbulent fluid flow, impact processes, electrical machines, and internal combustion engines among others. The basic mechanism of noise generation can be due to mechanical noise, fluid noise and/or electromagnetic noise. Sound fields in the workplace are usually complex, due to the participation of many sources which may include propagation through air (air-borne noise), propagation through solids (structure-borne noise), diffraction at the machinery boundaries, reflection from the floor, wall, ceiling and machinery surface, absorption on the surfaces among others. The mechanisms of noise generation depend on the particularly noisy operations and equipment including crushing, riveting, blasting (quarries and mines), shake-out (foundries), punch presses, drop forges, drilling, lathes, pneumatic equipment, tumbling barrels, plasma jets, cutting torches, sandblasting, electric furnaces, boiler making, machine tools for forming, dividing and metal cutting, such as punching, pressing and shearing, lathes, milling machines and grinders, pumps and compressors, drive units, hand-guided machines, self-propelled working machines, in-plant conveying systems and transport vehicles.

6.2.3.3 Health Effects of noise

Noise health effects are the health consequences of elevated sound levels. Elevated workplace or other noise can cause the following health effects, hearing impairment, hypertension, ischemic heart disease, annoyance, bowel movements and sleep disturbance. Noise exposure has also been

known to induce tinnitus, hypertension, vasoconstriction and other cardiovascular impacts. Elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression.

6.2.3.4 Potential negative impacts of noise

- Continuous exposure of workers at the work place to high noise levels for a long time may result in noise induced hearing loss;
- Extremely laud noise at the work place can result in immediate lasting damage to the worker‘s hearing mechanism;
- Exposure of workers to laud noise will result in reduction of productivity and efficiency of the workers at the work place, this will ultimately translate to overall reduction of productivity in the workplace and hence reduced output;
- Exposure of a worker to laud noise can upset the sense of balance and cause blood vessels to constrict, this will result in a rise in blood pressure hence reduction in the volume of blood flow;
- High noise levels at the work place can result in fatigue, headache, nervousness, irritability and high pretension; this will increase the likelihood of accidents at the workplace;
- Exposure of a worker to high noise levels will result in stressing the worker and thus result in reduced concentration.

6.2.4 Occupational injuries and or accidents

The most significant occupational health and safety impacts occurring during the construction and operational phase of cement manufacturing plant include, dust, heat, noise and vibrations, physical hazards, radiation, chemical hazards and other industrial hygiene issues.

6.2.4.1 Dust

Exposure to fine particulates is associated with work in most of the dust-generating stages of cement manufacturing, but most notably from raw material handling, and clinker / cement grinding. Exposure to active (crystalline) silica dust (SiO2), when present in the raw materials, is a relevant potential hazard in the cement manufacturing.

6.2.4.2 Heat

The principal exposures to heat in cement manufacturing occur during operation and maintenance of kilns or other hot equipment, and through exothermic reactions.

6.2.4.3 Noise and Vibrations

Exhaust fans and grinding mills are the main sources of noise and vibrations in cement manufacturing plants.

6.2.4.4 Physical hazards

Injuries during cement manufacturing operations are typically related to slips, trips, and falls; contact with falling / moving objects; and lifting / over-exertion. Other injuries may occur due to

contact with, or capture in, moving machinery (e.g. dump trucks, front loaders, forklifts). Activities related to maintenance of equipment, including crushers, mills, mill separators, fans, coolers, and belt conveyors, represent a significant source of exposure to physical hazards.

6.2.4.5 Radiation

An X-ray station is sometimes used to continuously monitor the, raw material mix on the belt conveyor feeding the raw mill. Operators of this equipment should be protected through the implementation of ionizing radiation protection measures.

6.2.4.6 Chemical Hazards and other Industrial Hygiene Issues

Chromium may contribute to allergic contact dermatitis among workers handling cement. Prevention and control of this potential hazard includes a reduction in the proportion of soluble chromium in cement mixes and the use of proper personal protective equipment (PPE) to prevent dermal contact.

6.2.5 Waste related pollution

6.2.5.1 Solid waste

Sources of solid waste in cement manufacturing can be of three categories namely process waste, domestic waste and office waste. Process waste includes clinker and cement production waste, mainly composed of spoil rocks, which are removed from the raw materials during the raw meal preparation. Another potential waste stream involves the kiln dust removed from the bypass flow and the stack, if it is not recycled in the process. Limited waste is generated from plant maintenance (e.g. used oil and scrap metal). Other waste materials may include alkali or chloride/fluoride containing dust buildup from the kiln. Domestic waste include waste from canteen and other eating places within the plant and waste from dwelling houses of staff such waste include food left offers, wastepaper. Office waste includes wastepaper, electronic waste and sweepings. Potential negative impacts of solid waste include:

- Air pollution especially from kiln dust;
- Skin irritation when in contact;
- Water pollution;
- Production loss;
- Irritation of eyes;
- Chocking of plants;
- Odor from decomposing food leftovers from the canteen;
- Blockage of drainage system by scrap and other non-decomposing solid wastes;
- Some electronic office waste such as used toner cartridges and absolute office electronic equipment contain hazardous substances.

6.2.5.2 Liquid waste

Liquid waste generated from cement manufacturing process includes industrial process wastewater, sanitary wastewater, storm water and waste oil. Wastewater is generated mainly from

utility operations for cooling purposes in different phases of the process (e.g. bearings, kiln rings). Wastewater is also generated from sanitary facilities from the plant, from cleaning of floors and other surfaces and from tools and equipment cleaning such as motor vehicles. Process wastewater with high pH and suspended solids may be generated in some operations. Techniques for treating industrial process wastewater in this sector include flow and load equalization with pH adjustment; sedimentation for suspended solids reduction using settling basins or clarifiers; multimedia filtration for reduction in non settleable suspended solids. Waste oil is generated from servicing of machines and equipment. Handling of the waste oil includes water separation for reuse, selling to recyclers and burning in incinerators. Potential negative impacts of wastewater generation include:

- Water shortage due to high use;
- Water contamination due to high dissolved solids and other contaminants;
- Contamination of ground water if untreated contaminated wastewater is discharged into the environment;
- Odor from untreated contaminated wastewater;
- Degradation of the quality of water of the receiving water body if contaminated wastewater is discharged into aquatic environment prior to treatment;
- Contamination of soils if contaminated wastewater is discharged into the ground prior to treatment.

6.2.6 Negative impacts on local flora

Implementation of the proposed NGP Capacity Increase will have a direct negative impact on local vegetation. This is because the vegetation on site will have to be cleared to pave way for the construction of clinker and cement plant, other associated components and opening up more areas for quarrying to obtain raw material. The result impact of vegetation clearance will include the following:

- Diminishing of local carbon sink resulting in reduced area capacity of carbon sequestration;
- Overall reduction of flora in the area and overall loss and/or reduction of ecological and economic services derived from the lost vegetation;
- Reduction in local greenery.

6.2.7 Negative impacts on local fauna

6.2.7.1 Mammals and Herpetofauna

Based on the knowledge on hazards, ecological hazards in terrestrial ecosystem can be coined to be any biological, chemical, mechanical, environmental or physical agent that is likely to cause harm to other organisms and damage to habitats and ecological processes in the environment in the absence of their control. Potential risks that would likely occur when project is implemented.

Ecological risk/impact assessment focused on the sensitive issues within the project footprint. The total area of the project footprint and the potential new project area. Fauna diversity and population in the area is low. Clinker and cement plant construction and acquisition of more raw materials

through quarrying would potentially affect movements of these animals across the landscape. Due to low population of this group in the area, chances of interference would also be low.

6.2.8 Negative Impacts on Avifauna

The implementation of the proposed project will lead to negative impacts to avifauna in the area. The project has the potential to affect the avifauna of the project area from the associated activities. This is mainly through ecological disturbance leading to displacement or exclusion of birds. For some of the species, there will be complete annihilation of their habitats. This is because the project activities are likely to cause site-specific negative impacts on the biophysical environment of the project area which will affect avifauna in various ways including increased pressure and/or loss of habitat and essential resources for food and nesting for birds.

The following are the potential impacts on avifauna at the proposed site

- The impacts of direct habitat loss due to annihilation of the species habitats.
- The impacts of habitat modification due to changes in land management.
- The impacts of indirect habitat loss due to the displacement of birds as a result of construction, and maintenance activities,

As a wintering/feeding ground for some of the migrants, it is also possible that the species will have to find alternative sites. The effects of the proposed project on birds are highly variable and will depend on a wide range of factors including:

- Specification of the development – how expanse and level of the transformation,
- Topography of the surrounding land,
- Habitats affected
- Number and species of birds present.
- Land uses within the surrounding matrix and availability of alternative sites for these species

6.2.8.1 Loss of avifauna habitats

Potential negative impacts on avifauna population were quantitatively assessed against the set criteria. Activities associated with the project during construction will involve; movement of works of project components. Bird habitats are expected to be affected through various processes and activities including:-

- Construction activities will result in destruction of bird habitats at the construction sites;
- Equipment activity at the proposed project site may result in trampling on habitats of ground dwelling birds, including bird nests;
- Project implementation may result in bird habitat fragmentation making the habitat less attractive to bird;
- Disturbance of birds may occur during all phases of the project as a result of increased on-site human activities during site preparation, and plant operation activities.

6.2.8.2 Habitat Modification from associated project activities

Implementation of the proposed project may result in modification of habitats for avifauna at the proposed project site and its environs. Vegetation clearance to pave way for project implementation will destroy bird feeding grounds, bird nesting ground and complete interfere with the daily routine of the birds. The results of habitat modification to local avifauna will include:

- Disruption on breeding patterns which will results on diminished bird population;
- Migration and relocation of the affected bird species from the area which will affect the local food chain;
- Loss of ecological services associated with birds such as pollination;
- Destruction of migration route for migrant bird species;
- Destruction of foraging grounds of local resident species.

6.3 Proposed Mitigation Measures

6.3.1 Proposed mitigation measures of gaseous emissions

6.3.1.1 Mitigation of Sulfur Dioxide Emissions

Emission of sulfur dioxide from clinker production process can be mitigated by using the following technologies; inherent scrubbing, oxygen control (increase), fuel substitution (lower total sulfur), raw material substitution (lower sulfide sulfur), raw material alkali/sulfur balance, in-line raw mill, preheater upper stage hydrated lime injection, calcined feed recirculation, cement kiln dust internal scrubber, preheater upper stage trona injection and calcium-based internal scrubber.

6.3.1.2 Mitigation of Nitrogen Oxides Emission

Emission of Nitrogen Oxides from clinker production process can be mitigated by using the following technologies; oxygen control (decrease), indirect firing, low-NOX burner, mid-kiln firing, process improvements, process control improvements, low-NO_X calciner, staged combustion, semi-direct firing, mixing air fan and cement kiln dust insufflation.

6.3.1.3 Proposed mitigation of Carbon Monoxide Emission

Emission of carbon monoxide from clinker production process may be mitigated using the following technologies; good combustion practice, excess air (increase), raw material substitution, pyroprocessing system design and mixing air fan.

6.3.1.4 Mitigation measures of Carbon Dioxide Emission

Emission of carbon dioxide from clinker production process can be controlled using the following technologies; improved thermal efficiency, clinker substitution, improved electrical efficiency, raw material substitution and mineralizers.

6.3.1.5 Mitigation of Ammonia Emission

Emission of ammonia from clinker production process can be mitigated through raw material substitution and tailpipe scrubber technologies.

6.3.2 Proposed mitigation measure of exposure to cement dust

6.3.2.1 Dust removal

Exposure to cement dust can be mitigated by removing the cement dust being generated. Three dust removal technologies to remove dust from the clinker production line namely water sprinkling, bag filters and electrostatic precipitators can be employed to remove the generated dust. Water sprinkling to remove dust can be done in three areas of the limestone crusher section namely at the limestone hopper, dump hopper and belt conveyor system. The bag filter technology can be used in the plant to suck out dust generated. The system can be used in the following sections limestone crusher, limestone pre-blending stockpile, additive storages, raw material hoppers, raw mill building, blending silo, pre-heater tower, coal mill, clinker storage and dispatch station, cement mill and cement packaging and dispatch. Electrostatic precipitator technology can employed at the clinker crusher section.

6.3.2.2 Dust removal by use of bag filter technology

High efficiency fabric filters are used for controlling dust emissions from cement production material handling and product bagging systems. The bag filters system range in number depending on the size and production capacity of the cement plant. Separate fabric filter control systems ranging in size from 30 actual cubic meters per minute capacity to more than 100,000 actual cubic meters per minute capacity. Fabric filter operation can be described in three sequential steps:

- Filtration of particles from the gas stream
- Gravity settling of the dust cake
- Removal from the hopper

6.3.2.3 Cement dust management

Keeping in view the hazards of cement dust it is advisable therefore, the cement industry management, their workers and health officials should work together to adopt technical preventive measures, such as well-ventilated work areas and workers should wear appropriate personal protective equipment. It is also suggested that cement mill workers must undergo pre-employment and periodic medical surveillance tests. These measures would help to identify susceptible workers in due time and improve the technical preventive measures that will decrease the risk of occupational hazards in the cement industrial workers.

Potential negatively impacts likely to a result from exposure to cement dust can be mitigated in the following ways among others:

- Proper maintenance of the de-dusting systems i.e. water sprinkling, bag filters and electrostatic precipitators to ensure efficiency in dust collection;
- Workers to undergo pre-employment and periodic medical surveillance tests by a designated medical practitioner;
- Workers working in dusty area should wear appropriate Personal Protective Equipment all the time;

- Management to ensure strict enforcement on the use of personal protective equipment by all workers;
- Management to ensure that the workplace is always well ventilated;
- Workers to be trained on the importance of making proper use of personal protective equipment provided.

6.3.3 Proposed mitigation measures of increased noise

6.3.3.1 Management of noise effects

Management of the noise risks can be done in six steps namely:-

- Assessing the risks;
- Protecting employees;
- Maintaining and equipment use;
- Training and sensitizing of workers;
- Health surveillance;
- Work reviews

Assessing of noise risks involves identification of noise hazards at the work place and developing the appropriate action plans. Employee protection involves elimination or controlling noise risks to acceptable legal limits by use good practice, appropriate engineering controls and employee protection. Equipment use and maintenance involves appropriate use of all noise control equipment and appropriate use of hearing protection. Training and sensitization of workers involves employee accessing information and training on noise risks, control measures and hearing protection. Health surveillance involves hearing checks for exposed workers and using result to improve on protection of the workers. Work reviews involve constant review of work practice, changes in noise exposure and new ways to reduce risks.

6.3.4 Proposed measures to mitigate against solid waste generation

Measures that can be put in place to mitigate solid waste generation may include appropriate management practices and deliberate innervations aimed at minimization of waste generation.

6.3.4.1 Management practices

Some of the management practices that can be put in pace to mitigate waste generation include:-

- Establishing waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences;
- Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes;
- Avoiding or minimizing the generation waste materials, as far as practicable;
- Where waste generation cannot be avoided but has been minimized, recovering and reusing waste;

- Where waste cannot be recovered or reused, treating, destroying, and disposing of it in an environmentally sound manner;
- Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition;
- Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner;
- Definition of opportunities for source reduction, as well as reuse and recycling;
- Definition of procedures and operational controls for onsite storage;
- Definition of options / procedures / operational controls for treatment and final disposal.

6.3.4.2 Waste generation prevention

The cement production processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes;
- Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls;
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off specification, contaminated, damaged, or excess to plant needs.

6.3.5 Proposed measures to mitigate wastewater generation

6.3.5.1 Utilities operations wastewater management

Utility operations such as cooling tower and demineralization systems may result in high rates of water consumption, as well as the potential release of high temperature water containing high dissolved solids, residues of biocides, residues of other cooling system and anti-fouling agents. Recommended water management strategies for utility operations include:

- Adoption of water conservation opportunities for facility cooling systems;
- Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations;
- Minimizing use of antifouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose

applied should accord with local regulatory requirements and manufacturer recommendations;

- Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling water prior to discharge.

6.3.5.2 Sanitary Wastewater management

Sanitary wastewater includes effluents from domestic sewage, food service, and laundry facilities serving site employees. Miscellaneous wastewater from laboratories, medical infirmaries, water softening plant. Recommended sanitary wastewater management strategies include:

- Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage);
- Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into the environment;
- Treatment to meet national standards for sanitary wastewater discharges;
- Sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet Environmental Management and Coordination (Water Quality) Regulations, 2006, standards for sanitary wastewater discharges;
- Sludge from sanitary wastewater treatment systems should be disposed in compliance with Environmental Management and Coordination (Water Quality) Regulations, 2006.

6.3.5.3 Storm water management

Storm water includes any surface runoff and flows resulting from precipitation, drainage or other sources. Typically storm water runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated storm water, also degrades the quality of the receiving water by eroding stream beds and banks. In order to reduce the need for storm water treatment, the following principles should be applied:

- Storm water should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge;
- Surface runoff from process areas or potential sources of contamination should be prevented;
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff;
- Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should be reduced (e.g. by using vegetated swales and retention ponds);
- Where storm water treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of storm water runoff where the majority of potential contaminants tend to be present;
- When water quality criteria allow, storm water should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;

- Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas;
- Sludge from storm water catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with the Environmental Management and Coordination (Water Quality) Regulations, 2006.

6.3.6 Proposed mitigation measures of occupational injuries and accidents

Methods to prevent and control exposure to dust include the following:-

- Control of dust through implementation of good housekeeping and maintenance;
- Use of air–conditioned, closed cabins;
- Use of dust extraction and recycling systems to remove dust from work areas, especially in grinding mills;
- Use of air ventilation (suction) in cement-bagging areas;
- Use of PPE, as appropriate (e.g. masks and respirators) to address residual exposures following adoption of the above-referenced process and engineering controls;
- Use of mobile vacuum cleaning systems to prevent dust buildup on paved areas.

Recommended prevention and control techniques against exposure to heat include the following:

- Shielding surfaces where workers' proximity and close contact with hot equipment is expected;
- Using personal protective equipment (PPE), as needed (e.g. insulated gloves and shoes);
- Minimizing the work time required in high temperature environments by implementing shorter shifts at these locations;
- Making available and using, as needed, air- or oxygen supplied respirators;
- Implementing specific personal protection safety procedures in the process to avoid potential exposure to exothermic reactions.

Control of noise emissions may include the following:

- Use of silencers for fans.
- Room enclosures for mill operators.
- Noise barriers and attenuators.
- Personal hearing protection.

The potential accidental contact with chemicals such as CaO / CaOH on skin / eyes / mucous membranes is a specific hazard in clinker/ cement production that needs to be assessed, prevented, and mitigated through emergency procedures and equipment. The presence of moisture may result in burns. Facilities for immediate washing of the affected body surface should be available, including eyewash facilities. The handling areas should be covered and enclosed, if possible, to avoid generation of a dust hazard.

CHAPTER 7: ANALYSIS OF PROJECT ALTERNATIVES

In considering the development options, four alternatives can be considered. These are:

- The 'No Project Alternative'
- The proposed development
- The proposed development with modifications
- The proposed development in another location

7.1 'No Project' Alternative

The selection of the 'No Project option' would mean the discontinuation of the proposed project's implementation and this would result in the existing form. There are physical, biological and socio-economic implications of this alternative. This option is likely to have the greatest implication on the socio-economic environment of the area and its environs. Due to the proposed quality of the project, it is anticipated that it would provide a major opportunity for employment, revenue, benefits associated with the mining industry and cement manufacturing in Kenya. In addition, a project of this caliber will add to the community's ability to develop. Increased community conflicts which would promote insecurity and a negative image of the area would repel potential investors. If this alternative is adopted, the proponent would need to find an alternative site for the development. This is likely to hinder development and slow Industrial Development in the Country.

7.2 The Proposed Development

This proposal would see the construction/installation of the proposed NGP Capacity Increase Project as proposed by the proponent and as outlined in this EIA Study report. This option has good support by the persons who would be most affected by its implementation. Therefore, community support is anticipated for the development.

Generally, it is believed that this alternative will provide positive benefits to the proponent, Kenyans (business entities, contractors and developers) and the Government through generation of revenue. These include benefits such as employment opportunities, cement and cement-based products' availability, source of income, e.t.c. The proposed development is being designed and undertaken to meet and/or exceed the national and international standards and regulations as concerns such projects.

7.3 The Proposed Development with modifications

If there are issues concerning the project that may be enhanced, changed or modified to increase the acceptability of the project, then these issues should be considered. At this time based on public views in the project area, it appears that there are no major issues and once these minor issues are solved amicably through modification or compromise; the support for the development would further increase. These include, but are not limited to: Damage to the road network, Solid waste generation, Noise pollution and vibrations, Air pollution, and Waste water management. These

issues and others are easily resolvable through either modification or compromise and we do not foresee these issues resulting in disapproval of the development by interested groups and regulatory agencies. The proponent has resolved to operate an efficiently run project that will be the pride of all involved. This alternative retains the same positive benefits as with maintaining the proposed development option.

CHAPTER 8: IMPACTS MITIGATION AND MONITORING PLAN

8.1 Introduction

The proponent will incorporate mitigation measures into the activities of the Proposed NGP Capacity Increase Project and will ensure that mitigation measures highlighted in this report are implemented. Once the project becomes operational, the Health and Safety issues as well as environmental considerations will be handled by the proponent. The proposed project should be implemented in such a way that will include issues of environmental considerations and issues affecting the project, implementation of environmental management plan, project management, health risks and their prevention. Others include the following:

- Organizational practices.
- Project management.
- Socio-economic issues relating to access and use of road and natural resource.
- Financial management.

TABLE 8.1: PRE-CONSTRUCTION, CONSTRUCTION & OPERATION PHASES ENVIRONMENTAL ANAGEMENT/MONITORING PLAN (EMP)

ACTIVITY	POTENTIAL ENVIRONMENTAL & HEALTH IMPACT	PROPOSED MITIGATION MEASURES	MONITORING	RESPONSIBLE PERSON	TIME FRAME	COST ESTIMATES (KShs)
Release of Sulphur gases SOx	• Pollution of upper atmosphere that result in the formation of smog, Acid rain effect on plant, wildlife and property; • Precursor of fine particulate soot, which poses a significant health threat; • Respiratory illness, alterations in the lungs' defences and aggravation of existing cardiovascular disease.	• Inherent scrubbing, oxygen control (increase), fuel substitution (lower total sulfur), raw material substitution (lower sulfide sulfur), raw material alkali/sulfur balance, in-line raw mill, preheater upper stage hydrated lime injection, calcined feed recirculation, cement kiln dust internal scrubber, preheater upper stage trona injection and calcium-based internal scrubber	• Monitoring of atmospheric SO_2 using UV fluorescence or other sensors; • Measurement of emission standards; • Continuous checking of clinker and cement production technology and related processes	Plant Head Bamburi Cement Ltd Factory Athi River	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	400,000
NOx Emissions	• Formation acid rain which may negatively plant and animal life; • visibility impairment through formation of brown cities; • eutrophication that is, explosive algae growth which can deplete oxygen in water bodies; • It contributes to global warming; • respiratory illness in young children and harm lung function in	oxygen control (decrease), indirect firing, low-NO_X burner, mid-kiln firing, process improvements, process control improvements, low-NO_X calciner, staged combustion, semi-direct firing, mixing air fan and cement kiln dust insufflation	Compliance with international national ambient air quality, emission standards and meeting of NOx air quality index	Plant Head Bamburi Cement Ltd Factory Athi River	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	150,000

	people with existing respiratory illnesses; • increased susceptibility to respiratory infection and alterations in the lung, nausea, irritated eyes and/or nose, fluid forming in lungs and shortness of breath; • formation of ozone of fine particulate soot in the lower atmosphere					
CO emission	• CO contributes to the formation of smog, ground-level ozone, which can trigger serious respiratory problems; • Greenhouse gas hence contribution to global warming; • Formation of acid rain potentially damaging to plants, animals and property; • Harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues; • Central Nervous System Effects	• Good combustion practice, excess air (increase), raw material substitution, preprocessing system design and mixing air fan.	• Adopting Direct control Carbon monoxide (CO) monitor; • Using NEMA accredited laboratories to measure emission standards; • Continuous checking of coal production technology and related processes	Plant Head Bamburi Cement Ltd Factory Athi River	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	150,000
CO2 Emission	• Formation of acid rain, weak carbonic acid; • Major source of greenhouse gas; • Causes global warming	• Improved thermal efficiency, Clinker substitution, improved electrical efficiency, raw material substitution and mineralizers	Continuous checking of production technology and related processes	Plant Head Bamburi Cement Ltd Factory Athi River	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed	150,000

					project, be sustained throughout the project cycle ensuring continuous improvement	
Ammonia emission	• Both gaseous and particulate ammonia contribute to eutrophication of surface waters; • Soil acidification; • Fertilization of vegetation; • changes in ecosystems; • smog and decreased visibility in cities and pristine areas; • Irritation of respiratory track	• Raw material substitution and tailpipe scrubber technologies	• Regular checking of tailpipe scrubber; • Ammonia gas detector; • Ammonia sensors; • Ammonia test kits; • Dissolved ammonia monitoring	Plant Head Bamburi Cement Ltd Factory Athi River	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	150,000
Clinker and cement dust pollution	• Occupational illness (lung infection, itching skin, eye irritation, coughing, to workers and other people exposed to the cement dust; • Reduced visibility; • Chocking of plants	• Ensure de-dusting system is always efficient; • Workers to use appropriate PPE; • Strict enforcement on PPE use; • Ventilation at workplace to be sufficient;	• Dust surveys Results of periodic dust surveys within the production line, packaging line and the neighbourhood of the facility to determine dust levels from time to time; • Medical severance Results of medical tests of workers likely to be exposed to cement dust	• Plant Head Bamburi Cement Ltd Factory Athi River; • Bamburi Cement Ltd workers County Occupational Safety and Health Officer; • District Environmental Officer; • Neighbours and; • The general public	• Dust surveys should be carried preferable every six month; • Medical severance should be carried out every twelve months	450,000
High noise level at the workplace	• Noise induced hearing loss; • Poor concentration at the workplace; • Reduced productivity	• Developing and implementing an effective noise control and hearing conservation programme;	Reduction of noise levels at the workplace to the stipulated legal limits	• Plant Head Bamburi Cement Ltd Factory Athi River;	The proposed mitigation measures to be implemented from the beginning of the	400,000

		• Carrying out periodic noise measurements; • Fitting noise machines with noise reduction devices; • Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A); • Posting notices and signs in noisy areas; • Carrying out audiometric test by a designated medical practitioner to all workers exposed to noise levels above 85dB(A); • Educating all workers on importance of marking correct use of PPE provided to protect them against high noise levels.		• Bamburi Cement Ltd staff	implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	
Process solid waste management and disposal	• Air pollution especially from kiln dust; • Skin irritation when in contact; • Water pollution; • Production loss; • Irritation of eyes; • Chocking of plants	• Recycle and reuse where applicable; • Segregate for appropriate disposal; • Process improvement to minimize waste generations; • Material substitution to minimize waste generation; • Technological improvement to minimize waste generation	• Quantity of process waste generated	• Plant Head Bamburi Cement Ltd Factory Athi River;	From the onset of the production process and then throughout the operational life of the plant	450,000 per year
Domestic waste management and disposal	• Odor from decomposing food leftovers; • Blockage of drainage system	• Sorting of waste at source; • Waste disposal as provided for in the Environmental Management and Coordination (Waste Management) Regulations, 2006;	• Regular checking of handling areas; • Waste disposal records.	• Bamburi Cement Ltd top management, other workers and the General public	From the onset of the production process and then throughout the operational life of the plant	250,000 per year

		• Provide appropriate waste handling receptacles.				
Office waste management and disposal	Some electronic office waste such as used toner cartridges and absolute office electronic equipment container hazardous substances	Absolute electronic equipment and other electronic waste to be returned to manufacturers for safe disposal	• Records of disposal	• Bamburi Cement Ltd top management, other workers and the General public	From starting of operation of the plant and then be sustained throughout the operational life of the plant	100,000 per year
Utilities operations wastewater	• Water shortage due to high use; • Water contamination due to high dissolved solids and other contaminants	• Adaption of water conservation opportunities; • Minimizing use of antifouling and corrosion inhibiting chemicals; • Testing for residual biocides and other pollutants of concern; • pH adjustment; • Sedimentation for suspended solids reduction using settling basins or clarifiers; • Multimedia filtration for reduction in non settleable suspended solids.	Sampling and testing for conformity with Water quality standards before discharge	• Plant Head Bamburi Cement Ltd Factory Athi River;	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	1,000,000 per year
Sanitary Wastewater	• Contamination of ground water; • Odor	• Segregation of wastewater streams; • Treatment to meet national standards for sanitary wastewater discharge	Sampling and testing for conformity with Water quality standards before discharge	• Bamburi Cement Ltd top management, employees, NEMA, Public Health	The proposed mitigation measures to be implemented from the beginning of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement	1,000,000 per year
Storm Water	• Degradation of the quality of water of the receiving water body; • Contamination of soils;	• Storm water should be separated from process and sanitary wastewater streams in order to reduce the	Sampling and testing for conformity with Water quality standards before discharge	• Bamburi Cement Ltd top management, employees,	The proposed mitigation measures to be implemented from the beginning	1,800,000 per year

	• Erosion	volume of wastewater to be treated prior to discharge; • Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should be reduced (e.g. by using vegetated swales and retention ponds); • Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.		NEMA, WRMA, Public Health	of the implementation of the proposed project, be sustained throughout the project cycle ensuring continuous improvement.	
Dust	• Lung infection; • Itching skin; • Eye irritation; • Coughing, to workers and other people exposed to the cement dust.	• Good housekeeping and maintenance; • Use of air–conditioned, closed cabins; • Dust extraction and recycling systems; • Air ventilation (suction)	• Dust survey every six months; • Visual observations; • Medical examination of workers exposed to dust	Bamburi Cement Ltd top management, workers, General Public	Proposed mitigation measures to employed before start of plant operations and be sustained and improved on throughout the functional life of the plant	5,000,000 per year
Heat	• Physical burns of workers exposed to heat; • Burning and damage to process equipment.	• Shielding surfaces; • Using personal protective equipment; • Minimizing the work time required in high temperature environments by implementing shorter shifts; • Use of air- or oxygen supplied respirators.	• Periodic Heat Measurements	• Bamburi Cement Ltd top management, workers,	Proposed mitigation measures to employed before start of plant operations and be sustained and improved on throughout the functional life of the plant	500,000 per year

Noise and vibrations	• Noise induced hearing loss; • Poor concentration at workplace; • Reduced productivity.	• Use of silencers for fans; • Room enclosures for mill operators; • Noise barriers; • Personal hearing protection	• Noise survey at the workplace every twelve months; • Audiometric test for workers exposed to high noise levels	• Bamburi Cement Ltd top management, workers,	Proposed mitigation measures to employed before start of plant operations and be sustained and improved on throughout the functional life of the plant	1,000,000 per year
Physical Hazards	• Slip; • Trips; • Falls; • Contact will falling/moving parts	• Good housekeeping; • Ensure surfaces are not slippery; • Clearly mark all uneven surfaces; • Guarding of machine moving parts; • Provide and mark safe passages and exits; • Spills to be promptly cleaned.	• Physical checking/inspections of all workplaces at short intervals	• Bamburi Cement Ltd top management, workers,	Proposed mitigation measures to employed before start of plant operations and be sustained and improved on throughout the functional Proposed mitigation measures to employed before start of plant operations and be sustained and improved on throughout the functional	500,000 per year
Occupational Health and Safety	• Physical burns; • Sickness; • Disease/ill health	• PPE use; • Appropriate handling as per material safety data sheets; • Training and sensitizations; • Medical examination of exposed workers	Spot checks at workplaces on appropriate handling	• Bamburi Cement Ltd top management, DOSH, NEMA, workers,	Proposed mitigation measures to employed before start of plant operations and be sustained and improved on throughout the functional life of the plant	500,000

Increased vehicular traffic along Nairobi-Mombasa and Nairobi-Namanga Roads	• Potential delays at the junction as traffic enters and exits the highway; • More traffic on the said road may translate to increased use of the road and hence increased wear and tear; • Likelihood of accidents, incidents and mere misses at the said turnoff from the highway	• Liaise with the Kenya National Highway Authority for permission to construct an acceleration/deceleration lane for safe entry and exit of the highway; • Liaise with Kenya National Highway Authority to ensure that appropriate road signs before the exit/entry junction area erected; • Drivers to strictly observe the Highway Code; • Speed limits to be strictly observed	• Plant Head Bamburi Cement Ltd Athi River Factory	• Records of traffic number in and out of the project site; • Flow of traffic in and out of the plant during construction phase; • Record of vehicular accidents and incidents	Implementation of the proposed mitigation measures to be put in place during the proposed project implementation phase and to be sustained and improved on throughout the lifecycle of the project	1,700,000 for construction of an acceleration/ decoration lane
Parking of lorries outside Bamburi Cement Ltd Athi River Factory premises	Inconvenience to other motorists and other road users	Provide sufficient space for internal parking of lorries awaiting to deliver material or to collect material	• Plant Head Bamburi Cement Ltd Athi River Factory	Checking of available space provided for parking of lorries within the plant premises	Provision of internal parking of lorries should be implemented within the first six months of project implementation	500,000 for construction and paving of lorry parking yard internally

CHAPTER 9: DECOMMISSIONING PHASE

It is necessary to outline some basic mitigation measures that will be required once all operational activities of the Proposed Nairobi Grinding Plant Capacity Increase project have ceased. The following will be necessary during this phase of the project:

- Appropriate vegetation and crops re-planted on open spaces (landscaping).
- All solid waste to be collected and disposed of appropriately by licenced garbage handlers.
- All efforts should be made to ensure that all excavated sites are restored to as near as possible to the state in which they were before the project was undertaken. This is according to EMCA's section 108.

The necessary objectives, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project are outlined in table below.

Table 8.2: Decommissioning Phase EMP for the Proposed

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (KShs)
1. Demolition waste management				
Demolition waste	Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling.	Project Manager & Contractor	Once-off	850,000
	All buildings, machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible	Project Manager & Contractor	Once-off	
	All foundations must be removed and recycled, reused or disposed of at a licensed disposal site	Project Manager & Contractor	Once-off	
	Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site	Project Manager & Contractor	Once-off	
	Donate reusable demolition waste to charitable organizations, individuals and institutions	Project Manager & Contractor	Once-off	
2. Rehabilitation of project site				
	Implement an appropriate re-vegetation programme to restore the site to its original status	Project Manager & Contractor	Once-off	

Site degradation	Consider use of indigenous plant species in re-vegetation	Project Manager & Contractor	Once-off	350,000
	Trees should be planted at suitable locations so as to interrupt slight lines (Screen planting), between the adjacent area and the development.	Project Manager & Contractor	Once-off	

CHAPTER 10: CONCLUSIONS AND RECOMMENDATIONS

If the proposed mitigation measures are incorporated during construction and operation stage, the proposed Nairobi Grinding Plant Capacity Increase project is good for the industrial development of Machakos County. In addition to that, the project will provide construction materials (cement and cement-based products) for Kenyans hence helping in offsetting the county's need for such services.

CHAPTER 11: AUXILLIARY INFORMATION

11.1 The Project Cost

The project cost has been estimated at **KShs. 902,000,000.00** (Kenya Shillings Nine Hundred and Two Million only). **NEMA fee 0.1% of the cost of the project is KShs. 902,000**

11.2 Monitoring Guidelines

Continuous observations and assessment is essential so that if foreseen safety dangers are noticed, alternatives must be sort for. Risk assessment of fire outbreaks, and others should be ignored in the construction plan. Waste management on the project site should be strictly followed. Mitigation measures of storm water management are essential. Safety standards should constantly be maintained, in brief, monitoring guidelines could be based on the following parameters;

- Flora and Fauna life including the species of either that is in the surrounding
- Health and safety measures using such standards as ISO 14000 and EMS and the laid down regulatory framework.
- Waste management
- Examine the changing land use patterns including those of residential, ecological and economic purposes
- Accidents and risk assessment arising from the use of water, roads, electricity and or any other amenity.

11.3 Reporting

Constant reporting by the site contractor to the architect is necessary to ensure the project is executed as per the architectural drawings. The safety officer should always remain on site to report any safety concerns for urgent mitigation measures. He should also at all times enforce safety requirements as per the relevant legislations. The contractor must consult the architect to maintain a clear understanding of all the aspects of the project.

11.4 Conclusion and recommendations

During the preparation of this report for the development of the proposed Nairobi Grinding Plant (NGP) Capacity Increase project it was observed and established that most of the negative impacts on the environment are rated low and short term with no significant effect. The positive impacts are highly rated and will benefit all stakeholders of this project. The project proponent has proposed to adhere to prudent implementation of the environmental management plan and is obtaining all the necessary permits and licenses from the relevant authorities, has qualified and adequate personnel and has proposed adequate safety and health mitigation measures as part of the relevant statutory requirements.

The proponent should therefore be licensed to implement this project subject to adherence to the Environmental Management Plan proposed in this report and the statutory requirements.

11.5 APPENDICES

a. Certificate of Incorporation;

b. Company PIN Document;

c. Land Ownership documents;

   - Title Deeds

d. Firm of Experts' NEMA Practicing Licence

e. Terms of Reference;

f. NEMA Letter directive letter for undertaking EIA Study;

g. Public interview questionnaires;

h. Air Quality Report 2015;

i. Noise Survey Report 2015

11.6 REFERENCES

1. Kenya gazette supplement Acts 2000, Environmental Management and Coordination Act number 8 of 1999. Government printer, Nairobi
2. Kenya gazette supplement Acts Building Code 2000 by government printer, Nairobi
3. Kenya gazette supplement Acts Land Planning Act (cap 303) government printer, Nairobi
4. Kenya gazette supplement Acts Local Authority Act (Cap 265) government printer, Nairobi
5. Kenya gazette supplement Acts Penal Code Act (Cap 63) government printer, Nairobi
6. Kenya gazette supplement Acts Physical Planning Act, 1999 government printer, Nairobi
7. Kenya gazette supplement Acts Public Health Act (Cap 242) government printer, Nairobi
8. Kenya gazette supplement Acts number 56. Environmental Impact Assessment and Audit Regulations, 2003. Government printer, Nairobi
9. Nairobi District Development plan (2004-2008). Ministry of planning and National Development. Government printer. Nairobi.