



# Report of the Auditor General on the

## Management of Environmental Degradation Caused by Mining Activities in Zambia.

July 2014



Republic of Zambia





# FOREWORD

I have the honour to submit my performance audit report on the Management of Environmental Degradation Caused by Mining Activities in Zambia. The audit was conducted in accordance with the mandate as provided for under Article 121(2) of the Constitution of Zambia, the Public Audit Act No. 8 of 1980, the Public Finance Act No. 15 of 2004 and the INTOSAI Guidance for Supreme Audit Institutions on Auditing Mining.

During the last decade, in addition to the old mines, several new mines have been opened which has raised considerable interest for their potential to contribute towards economic growth and poverty alleviation. The mining sector has contributed to national economic growth through taxes, socio-economic infrastructural development, creation of employment and provision of education and health services among others.

However, the mining sector has faced challenges in achieving sustainable mining practices which cause minimum damage to the environment. Poor mining and mineral processing practices pollute the environment and their effects continue long after the mine has stopped operating. The environmental effects of mining and mineral resource activities affect all environmental media – land, air, water, and associated flora and fauna, and human health and safety.

It is therefore important that mining activities are managed in such a way that the negative impacts to the environment and humans are minimised.

The performance audit whose results are contained in this report was carried out to assess the effectiveness and efficiency of the regulatory bodies (Zambia Environmental Management Agency and Mine Safety Department) in carrying out their overall responsibilities of managing the environmental degradation caused by mining activities in Zambia.

I would like to thank the staff at the Ministry of Mines, Energy and Water Development, Ministry of Lands, Natural Resources and Environment Protection, ZEMA, MSD, ZCCM-IH and the fifteen large scale mining companies visited for their cooperation during the process of auditing.

Dr. Anna O Chifungula

**AUDITOR GENERAL**

## ACRONYMS

CCS	Chambishi Copper Smelter
CEP	Copperbelt Environmental Project
CEMP	Copper Environmental Management Programme
DA	Developmental Agreement
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
KCM	Konkola Copper Mine
MCM	Mopani Copper Mine
MEWD	Ministry of Mines, Energy and Water Development
MLNREP	Ministry of Lands, Natural Resources and Environmental Protection
MSD	Mine Safety Department
NFCA	Non Ferrous Coppermine Africa
OAG	Office of the Auditor General
TC <sub>Co</sub>	Total Cobalt
TC <sub>Cu</sub>	Total Copper
TD	Tailing Dams/Dump
TDS	Total Dissolved Solids
TFe	Total Iron
TMn	Total Manganese
TSF	Tailings Storage Facility
TSS	Total Suspended Solid
ZCCM	Zambia Consolidated Copper Mines
ZCCM-IH	Zambia Consolidated Copper Mines Investment Holding
ZEMA	Zambia Environmental Management Agency

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# Executive Summary

## 1. Introduction

Zambia has predominantly been a mining country and is endowed with a wealth of natural resources including metals such as copper, industrial materials such as lime, construction materials and energy materials such as coal. During the last decade, several mines have been opened. The mining sector has, therefore, evoked considerable interest for its potential to contribute towards economic growth and poverty alleviation.

On the other hand, the supply of metals and minerals is not without environmental and social costs. The effects of mining continue long after the mine has stopped operating. Poor mining and mineral processing practices poison the air, land and water and leave the environment to suffer a slow death. Many rivers have been pronounced biologically dead due to release of mine tailings (waste from the mine containing rocks, metals and poisons) into waterways resulting in aquatic plant and animal life being choked with toxic sediment. There are also several reported cases of loss of human life. The environmental effects of mining and mineral resource activities affect all environmental media – land, air, water, and associated flora and fauna – as well as the human environment – individual health and safety, local community lifestyles, cultural survival, social order and economic well-being.

Mining activities are in this respect, supposed to be managed with a view of reducing the negative impacts to environment and humans.

## 2. Motivation for the audit

The audit was motivated by a number of factors and these were:

### a) Public Interest

Several concerns have been raised by stakeholders who have cited issues such as lack of integrated mining policies, failure to disclose Developmental Agreements (DAs), failure by mines to mitigate effects of environmental degradation, air, land and water pollution, unfair resettlements, failure by government to pay back to the communities where the mining operations are taking place and lack of consultations with the communities/ stakeholders on mining projects, among other things.

### b) Maiden Performance Audit

There has been no performance audit carried out at the Ministry of Lands, Natural Resources and Environmental Protection and thus the audit could be categorised as a high risk audit.

### c) Parliamentary Concerns

Members of Parliament have also expressed their misgivings with regard to the adequacy of the Environmental Protection Fund. Further concerns were raised on Parliamentary order no 996 in which parliamentarians sought clarifications on whether environmental impact assessment studies are conducted in order to determine the effects of mining on the local communities.

### d) Changes in the legislation governing the mining sector.

The Mines and Minerals Act 1995 was repealed and replaced by the Mines and Mineral Development Act No. 7 of 2008. The EPPCA No 12 of 1990 was repealed and replaced by the Environmental Management Act No. 12 of 2011. Therefore, it is imperative to assess how the new laws are being administered by the relevant Ministries.

## 3. Audit Design for the Main-Study.

The objective of the audit was to assess the effectiveness and efficiency of the regulatory bodies in carrying out their overall responsibilities of managing the environmental degradation caused by mining activities in Zambia in order to reduce the negative environment impacts of mining activities on humans and the environment.

The audit involved collection of data at the ZEMA, CEP and MSD and a selected number of Mines. There are thirty one (31) mining companies in Zambia out of which fifteen (15) mines were visited. The mines selected were mining companies with large scale mining licences with a view of obtaining an understanding on how environmental degradation from mining activities is being managed. The list of mines visited is attached at **Appendix 1**.

The audit methodology involved examination of the records and activities of the ZEMA, CEP under ZCCM IH and selected mines.

In carrying out the audit answers to the following questions were sort;

- i. To what extent are the mining companies complying with the environmental rules, laws, regulations and environmental licensing conditions issued by Government in their responsibility for managing the environmental degradation from their mining activities?
- ii. What measures has the Government put in place to ensure that the environment degradations caused by mining activities are adequately managed?
- iii. How are the relevant Government Institutions collaborating in their responsibility for management of environmental degradation caused by mining activities?
- iv. What are the possible causes for failure to effectively and efficiently manage mining and environmental effects of mining companies?

The audit questions were answered by documentary review of board minutes, annual and quarterly reports, bi annual reports provided by mining companies to ZEMA showing air and water sampling test results conducted and averaged monthly, correspondence file between mining companies ZEMA and MSD, compliance monitoring reports, budgets and work plans, funding and releases, procurement records, environmental audit reports, environmental impact assessments reports, Staff establishment, staff returns, recruitment records, tools list, strategic plans, financial statements, bank statements, monitoring and evaluation reports among others with the view of obtaining documentary evidence on the management of environmental degradation caused by mining companies.

Structured interviews were held and in some instances questionnaires administered to key personnel in order to obtain detailed understanding of management of environmental degradation programmes in place. In addition, interviews were carried out to collect primary data used to assess the efficiency and effectiveness of managing environmental degradation. Interviews were also carried out to confirm information obtained from documentary review.

Physical inspections of the mines were carried out at all the selected mines in the company of ZEMA and Mine staff. Audit evidence was also collected through photographs. Data analysis of structured interviews and information collected from documents was carried out to answer the audit questions.

#### **4. Major Audit Findings**

##### **a) The mining companies are not complying with the environmental rules, laws, regulations and environmental licensing conditions set by Government.**

Examinations of bi-annual reports submitted by mines to ZEMA, correspondence files between ZEMA and the mines, the compliance monitoring reports, environmental audit reports from ZEMA and a physical inspection conducted on the facilities revealed the following mining companies are failing to produce monthly returns or biannual report on air emission to the environment. As a result, the contents of Sulphur Dioxide (SO<sub>2</sub>), dust from stack emissions, Arsenic (As), Copper (Cu) and Lead (Pb) in the air emitted to the environment was way above the minimum limits set by ZEMA.

In addition, the audit has also revealed that both surface and ground water are also being polluted. For instance the pH value was as low as 3 in some mines instead of the recommended 6 to 9. The means that the waster released to the environment was acidic. Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) and in cases sulphates in the effluent was also high. Dissolved solids are an indicator that the chemical content of the waste water released to the environment is high. This was in fact the case for some mines in that Total Copper (TCu), Total Cobalt (TCO), Total Manganese (TMn) and Total Iron (TFE) were very high in some instances.



The management of dumps and dams was also poor. Tailing Storage Facility(TSF), slag dumps, overburden dumps and waste rock dumps all had unrestricted access. In some dumps, there were no warning signs as required by law. Some mines did not carry out progressive re-vegetation of the embankments of the dumps while in the case of those that had started, the vegetation was sparse such that it did not provide adequate protection against erosion. The dumps were also polluting the surface water bodies and the underground water bodies or aquifers while some dumps' proximity to residential areas was below the required 500m. The close proximity of residential areas has exacerbated the problem of illegal mining and exposure to hazardous waste materials which in some instances has led to death.

Used oil storage facilities were equally poorly managed by some mining companies. According to the licensing conditions for storage of used oil, all hazardous waste shall be stored in an area with limited access to unauthorized personnel, a bunded and impermeable floor and adequate ventilation to avoid build-up of hazardous fumes. The licensing conditions stipulated that the hazardous waste shall be handled safely to avoid emergencies such as poisoning, fire, explosion, spills etc. The licensing conditions issued by ZEMA also stated that the storage facility shall be inspected periodically and the inspection results shall be recorded in a record book that shall always be kept within the storage facility for inspection by ZEMA Inspectors.

A review of compliance monitoring reports and physical inspections carried out revealed that licensing conditions that required that adequate warning and safety signs are visibly displayed were not adhered to and access to storages facilities was not restricted. It was also observed that there were oil spillages in storage facilities which were finding their way in the drainages and subsequently polluting the environment. Further, some mines had no periodic inspection records on site contrary to the licensing conditions.

**b) Measures Government has put in place to ensure that the environmental degradation caused by mining activities is adequately managed are not working effectively.**

Although government has put in place a comprehensive National Policy on the Environment that has domesticated a number of international conventions or protocols on protection and control of the environment, the Ministry responsible for the environment and ZEMA have not carried out any review to assess how well the policy is being implemented by various stakeholders including mining companies. ZEMA also stated that some of the conventions require costly technology to be put in place which is in fact a challenge for Zambia.

Strengthening of the regulatory framework has not been effectively carried out. Despite government providing resources through CEP to review the laws, only the principal legislation had been reviewed and replaced. The subsidiary legislation such as the statutory instruments on Environmental Impact Assessment (EIA), Water and Air Pollution Control regulations, Statutory Instrument no. 29 of 1997, the Mines and Minerals Act (Act no. 31 of 1995), the Mines and Minerals (Environmental) Regulations 1997, Statutory Instrument No. 102 of 1998, The Mines and Minerals Regulations (Environmental Protection Fund) Regulations 1998 had not been reviewed. ZEMA stated that as a result of failure to review the sub-regulations, the current laws were inadequate to provide guidelines and hence difficult to enforce. Furthermore, legislation on all producer responsibility for all companies generating waste had not been developed. The audit also revealed that there was no law on noise pollution and that segregated management of the various pieces of legislation by various government organisations was in fact one of the causes for a fragmented approach to management of the environment.

ZEMA had no standards on how to manage Uranium. Instead ZEMA relied on the Ionizing and Radiation Protection Regulations which were administered under the Radiation Protection Board as such it could not effectively enforce the management of Uranium.

The Environmental Protection Fund (EPF) put in place by Government has not worked effectively. Mining Companies are not complying with the EPF's regulations in that the majority are not paying the stipulated contributions. For those that have issued the bank guarantees and bonds, the bank guarantees or bonds were not validated by Bank of Zambia as per investment policy. The MSD has failed to enforce sanctions on defaulters to the Fund. The operation account was not functional and the hedging strategy put in place

to ensure time value of money for the Fund is maintained was also poor. Only bank interests have been used as a hedging strategy thus not taking advantage of the full array of options the Fund's the investment policy provides for. The MSD has also failed to appoint a competent External Fund Manager.

Monitoring and evaluation has also been ineffective as environmental monitoring activities were being carried out independently by various departments and there was no coordination in the collection of information and its storage.

Due to lack of capacity and resources, most institutions including ZEMA and MSD were unable to carry out monitoring regularly and consistently as they are mandated. Although equipment costing K880,847,632 was procured under CEP and delivered in 2009 for ZEMA to set up a laboratory, the laboratory was still not operational as of April 2013. Some of the reasons advanced for the laboratory not being operational were that the laboratory did not meet the criteria required to have certification, such as adequate and specialised equipment and lack of a laboratory technician primarily assigned to handle laboratory work. Some equipment such as the portable gas monitoring equipment and portable pH meter were not in working condition while other equipment needed calibration and standards for checking their performance and that the laboratory did not have its own procedures and methods for carrying out tests.

As a result of this ZEMA has had to rely on the test results provided by mining companies through bi annual reports a practice that renders the test results unreliable as ZEMA has no means of verifying them. ZEMA has on occasions used other organisations to carry out sampling and testing a practice that makes data collection very expensive and unsustainable. This was in fact one of the cause for mining companies to continue to release effluents and emissions that are higher than set limits.

Therefore the goal and overall objective of Government on environment and natural resources as set out in the National Policy on Environment of supporting Governments developmental priority of improving the quality of life of the people of Zambia through protection and management of the environment and natural resources in its entirety, balancing the needs for social and economic development and environmental integrity to the maximum extent possible, while keeping adverse activities to the minimum is not being achieved.

## **5. Recommendations**

The audit has revealed that there are many weaknesses in the management of environmental degradation caused by mining activities in Zambia. The OAG believes that these recommendations need to be considered if the deliveries of rehabilitation and reintegration services are to be better managed ensuring that efficiency is achieved in the use of public resources. Based on the findings mentioned above the OAG recommends as follows:

### **a) Air, Ground and Surface Water Pollution**

ZEMA should ensure that air released to the environment by mining companies does not exceed the standards prescribed and that companies that are polluting the air should be held accountable.

### **b) Management of Dumps/Dams**

ZEMA and MSD should ensure that dumps and dams are managed properly by ensuring that:

- **Restricted Access**

Tailings, slag and overburden dumps should be secured and access restricted to authorised personnel only. This will not only preserve the integrity and stability of the dumps thus reduce erosion, but will also safeguard the public from exposure to contaminants. In addition, illegal mining will be curbed.

- **Warning and Safety Signs**

All tailings slag and overburden facilities should have warning and safety signs displayed at appropriate places.

- **Disposal of waste other than tailings material**

Mines should be penalized for disposing waste other than tailings, slag and overburden material on dump sites to deter offenders / would be offenders except for those that seek prior authorization from ZEMA.

- **Progressive Re-vegetation**

Progressive rehabilitation, including vegetation management should be carried out regularly, in line with licensing conditions and other guidelines.

- **Proximity of residential areas to the dams/dumps**

In line with licensing conditions, there should be no residential areas within 500metres of tailings, slag and overburden dumps. In addition, the practice of communities cultivating vegetables on toe dumps should be halted forthwith.

- **Submission of Bi annual reports**

Mines should submit bi annual reports as stipulated in licensing conditions. ZEMA should ensure that bi annual reports are analysed promptly to ensure that polluting facilities are identified and correction take promptly.

#### **c) Used Oil Storage Facilities**

All used oil storage facilities should have bunded and impermeable floors, adequate ventilation, warning and safety signs and restricted access at all times. In addition, fire fighting equipment and fully stocked first aid kits should always be available at used oil storage facilities. Further, all storage facilities should be inspected periodically and inspection records readily available for inspection by regulatory authorities.

#### **d) Policy Formulation**

ZEMA and the ministry responsible for environmental protection should review the National Policy to assess its suitability for implementation in protecting the environment.

#### **e) Development and Enforcement of Legislation**

The statutory instruments on Environmental Impact Assessment (EIA), Water and Air Pollution Control regulations should be revised in line with changes in mining practices as a matter of urgency, given that the regulatory framework was supposed to have been revised in full by 31<sup>st</sup> December, 2008. Furthermore, legislation on all producer responsibility for all companies generating waste should be developed and implemented.

Sub-regulations of Statutory Instrument no. 29 of 1997, the Mines and Minerals Act (Act no. 31 of 1995), the Mines and Minerals (Environmental) Regulations, 1997 and Statutory Instrument No. 102 of 1998, The Mines and Minerals Regulations (Environmental Protection Fund) Regulations 1998 should be revised in order to address deficiencies identified in the current mining laws. The Government should also consider ZEMA administering this regulation to ensure that there is no duplication of work among government departments.

#### **f) Environment Protection Fund**

MSD should ensure that all mines that are required to contribute to the Fund are compelled to do so. Punitive action should be taken against erring companies. Particularly, the small scale mines should lodge bank guarantees. In addition, the committee should select new account signatories who must begin to work immediately.

All bank accounts held by EPF should be brought to the fore and reconciled by competent personnel. In addition, the Ministry of Mines should ensure that a qualified person is deployed to manage the funds on behalf of Mine Safety Department and the EPF committee as a matter of urgency.

The EPF funds should be invested in such a way as to ensure that the time value of money is maintained and the risk of the investments is diversified as per the investment policy.



# 1. INTRODUCTION

Zambia has predominantly been a mining country and is endowed with a wealth of natural resources such as copper, limestone and coal. During the last decade, several new mines have been opened which has raised considerable interest for their potential to contribute towards economic growth and poverty alleviation.

The mining sector has contributed to national economic growth through taxes, socio-economic infrastructural development, creation of employment and provision of education and health services among others.

However, the mining sector has faced challenges in achieving sustainable mining practices which cause minimum damage to the environment. Poor mining and mineral processing practices pollute the environment and their effects continue long after the mine has stopped operating.

The environmental effects of mining and mineral resource activities affect all environmental media – land, air, water, and associated flora and fauna, and human health and safety.

It is therefore important that mining activities are managed in such a way that the negative impacts to the environment and humans are minimised.

## 2. MOTIVATION FOR THE AUDIT

The audit was motivated by the following factors among others:

### 2.1. Public Interest

There have been concerns raised by the public who have cited issues such as lack of integrated mining policies, failure to disclose Developmental Agreements (DAs), failure by mines to mitigate effects of environmental degradation, air, land and water pollution, unfair resettlements and lack of consultations with the communities/stakeholders on mining projects, among other things

### 2.2. Parliamentary Concerns

During debates in the National Assembly, Members of Parliament have also expressed misgivings with regard to the adequacy of the Environmental Protection Fund as well as to whether environmental impact assessment studies are conducted in order to determine the effects of mining on the local communities and environment in general.

## 3. DESCRIPTION OF THE AUDIT AREA

The key players on issues relating to environmental management in the mining sector are the Ministry of Mines, Energy and Water Development, the Zambia Environmental Management Agency and the Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH) through the Copperbelt Environmental Project (CEP).



## 4. ROLES AND RESPONSIBILITIES OF KEY STAKEHOLDER

### 4.1. The Ministry of Mines, Energy and Water Development

The Ministry of Mines, Energy and Water Development is responsible for the management of the mineral resources in the country. It promotes and regulates the development of the mining sector in line with the Government policy and the formulation and enforcement of environmental regulations, among others. The Ministry discharges its environmental responsibility through the Mines Safety Department which is responsible for all aspects of safety, health and environment in the mineral exploration, mining and mineral processing operations.

### 4.2. Zambia Environmental Management Agency (ZEMA)

The ZEMA was established under the Environmental Management Act No. 12 of 2011. ZEMA plays advisory, regulatory, consultative, monitoring, coordination and information dissemination roles on all environmental issues in Zambia. The main objective is to provide for a clean and healthy environment for all by working with key players, from Government institutions to the individual. The functions of ZEMA are to:

- a) Draw up and enforce regulations related to water, air and noise pollution, pesticides and toxic substances, waste management and natural resources management.
- b) Advise the Government on the formulation of policies related to good management of natural resources and environment.
- c) Advise on all matters relating to environmental conservation, protection and pollution control, including necessary policies, research investigations and training.
- d) Identify projects, plans and policies that need environmental impact assessment.
- e) Request information on the quality, quantity and management methods of natural resources and environmental conditions in Zambia

### 4.3. Zambia Consolidated Copper Mines – Investment Holding (ZCCM-IH)

ZCCM-IH (“the Company”) is an investments holdings company which has a primary listing on the Lusaka Stock Exchange and secondary listings on London and Euronext Stock Exchanges. The Company has the majority of its investments held in the copper mining sector of Zambia. Its principal activities include managing the Zambian Government’s stake in the mining sector. Other activities include:

- a) Undertaking investment analysis and aligning company operations towards maximizing returns to shareholders;
- b) Ensuring effective representation on the boards of the investee companies; and
- c) Promoting Zambian ownership and management in mining assets.

#### 4.3.1. Functions of ZCCM-IH

In its transformed state as an investments holding company, the main functions of the Company are among others the following:

- a) To monitor the performance of the investee companies with respect to production and metal prices in order to ensure that commitments agreed upon relating to disbursements are fulfilled on a timely basis;
- b) To ensure that ZCCM-IH environmental obligations under the transaction documents are complied with;

- c) To ensure that environmental obligations continued to be attended to through different levels of participation; and
- d) To liaise with prospective greenfield investors in the mining and minerals industry who will enter into agreements with the Government. The Group has continued to liaise with Greenfield investors.

#### **4.3.2. Copperbelt Environmental Project (CEP)**

CEP was established by the Government through the ZCCM-IH, the World Bank and the Nordic Development Fund. On 14<sup>th</sup> April and 30<sup>th</sup> June 2003, the Government signed the agreements with the International Development Association and Nordic Development Fund respectively. The agreements were for five years and the total project amount was K248,798,000,000 (US\$52.6 million).

The principal activities of the project under the Development Financing Agreement was to assist the Government in addressing environmental liabilities and obligations associated with the mining sector following the privatisation of the mining assets of ZCCM and strengthening the capacity of its environmental regulatory institutions to improve future compliance of the mining sector with environmental and social regulations.

The project consisted of two (2) components, the Environmental Management Facility (EMF) and the Strengthening of the Environmental Regulatory Framework.

The first component, the EMF, was used as a primary mechanism for addressing environmental and social mitigation measures arising from the operations of ZCCM prior to privatisation. In addition, the facility was meant to finance the costs for implementation of priority mitigation measures to address public health issues or damage to ecological functions and supporting the preparation of a Consolidated Environmental Management Plan (CEMP).

The second component, the Strengthening of the Environmental Regulatory Framework, was aimed at strengthening the institutional capacity of the Environmental Council of Zambia (now ZEMA), MSD and delegated authorising agencies in reviewing environmental impact assessments, negotiating environmental management plans with private investors and ZCCM-IH, issuing licences, monitoring compliance with environmental standards in implementation of the EMPs, issuing pollution permits, collecting fees and other charges, etc.

## 5. AUDIT DESIGN

### 5.1. Audit Objective

The objective of the audit was to assess the effectiveness and efficiency of the regulatory bodies in carrying out their overall responsibilities of managing the environmental degradation caused by mining activities in Zambia.

### 5.2. Audit Scope

The audit was focused on the management of environmental degradation caused by mining companies and the measures that the government has put in place to mitigate the impact of such activities on humans and the environment. The audit covered the MSD under the Ministry of Mines, Energy and Water Development, ZEMA under the Ministry of Lands, Natural Resources and Environment Protection, ZCCM-IH and fifteen large scale mining companies on the Copperbelt, Southern and North-Western provinces and was for the period 2009 to 2012. Details of the mines visited are at Appendix 1.

### 5.3. Audit Questions

The audit questions were designed to seek answers to the following:

- a) What measures has the Government put in place to ensure that the environmental degradation caused by mining activities is adequately managed?
- b) How are the relevant Government institutions collaborating in their responsibilities for management of environmental degradation caused by mining activities?
- c) To what extent are the mining companies complying with the environmental laws and rules and regulations in their responsibility for managing the environmental degradation from their mining activities?
- d) What are the possible causes for failure to effectively and efficiently manage environmental effects caused by mining companies?

### 5.4. Audit Criteria

The sources of audit criteria were:

- a) National Policy on Environment 2007
- b) The Mines and Mineral Development Act No. 7 of 2008,
- c) Statutory Instruments No. 29 of 1997 – The Mines and Minerals Act (Environmental Regulations),
- d) Statutory Instruments No. 102 of 1998 – The Mines and Mineral Regulations, Vol. 13 Cap 213.
- e) Statutory Instruments No. 125 of 2001 – The Hazardous Waste Management Regulations,
- f) The Environment Protection and Pollution Control Act No. 12 of 1990 repealed and replaced by the Environmental Management Act No. 12 of 2011,
- g) EPPCA No. 12 of 1990, Air Pollution Control (Licensing and emission standards) Regulations 1996 (SI No. 141 of 1996)
- h) EPPCA No. 12 of 1990, Water Pollution Control (Effluent and Waste Water) Regulations 1996 (SI No. 72 of 1993)

- i) Strategic Plan for the Ministry of Mines, Energy and Water Development, 2008-2012 (Formerly the Ministry of Mines, Mineral Development and Natural Resources),
- j) Strategic and Business Plan 2007 – 2011 for ZEMA.

The specific audit criteria used in the audit was as follows:

**a) Formulation of Policies and Regulations**

- i. National Environmental Policy provides that;

The goal and overall objective is to have a national policy on environment that will support government's developmental priority to eradicate poverty and improve the quality of life of the people of Zambia. The specific objectives included;

- To promote the sound protection and management of Zambia's environment and natural resources in their entirety, balancing the need for social and economic development and environmental integrity to the maximum extent possible, while keeping adverse activities to the minimum;
- To accelerate environmentally and economically sustainable growth in order to improve the health, sustainable livelihoods, income and living conditions of the poor majority with better equity and self-reliance;
- To ensure broad based environmental awareness and commitment to enforce environmental laws and to the promotion of environmental accountability,
- To build individual and institutional capacity to sustain the environment,
- To regulate and enforce environmental laws, and
- To promote the development of sustainable industrial and commercial process having full regard for environmental integrity.

- ii. MEWD is responsible for among other things the following;

- Analysing and initiating the formulation of policies on the management of the environment and natural resources in order to contribute to the sustainable socio-economic development of the country;
- Reviewing existing and developing new legislation on the management of the environment and natural resources in order to ensure quality environmental management;
- Promoting and coordinating bilateral and multi-lateral cooperation projections and treaties in inter alia environment and natural resources management in order to promote Zambia's interest and meet international obligations;

- iii. To have ECZ legal and regulatory framework revised by December 31, 2008.

- EIA revised by 31st December 2007
- Water and Air Pollution Control regulations which have pollution loads incorporated developed by December 31st 2008
- Legislation on all producer responsibility for all companies generating waste developed and implemented by December 31st 2008
- EPPCA amended by December 2008.

- iv. According to the EMA Act, the functions of the Agency shall be among other things to;

- Establish and review land use guidelines;

- Establish standard for the conservation and protection of natural resources in consultation with the relevant appropriate authorities,
- Monitor dereliction or contamination of land and assess the nature of rehabilitation works required and;
- Do all such acts and things as are necessary to carry out the purposes of this division

#### **b) Monitoring by ZEMA**

ZEMA is responsible, for among other things, to regulate all aspects of the environment through the enforcement of regulations and standards.

- i. Monitoring trends in the use of natural resources and their impact on the environment.
- ii. Monitoring and improving the management of surface and ground water pollutions.
- iii. The Agency shall develop and enforce measures aimed at preventing and controlling pollution.
- iv. Monitoring, through sampling and other techniques, the components of biological diversity, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use.
- v. The Agency shall, in consultation with the relevant agencies or bodies, monitor:
  - All environmental phenomena with a view to making an assessment of any possible changes in the environment and their possible impacts ; or
  - The operation of any industry, project or activity with a view of determining its immediate and long term effects on the environment.
- vi. The Agency shall order or carry out investigations of actual or suspected air pollution including collection of data

#### **c) Air pollution**

- i. The Agency shall in accordance with the guidelines set out in the first schedule assess the quality of ambient air in order to safe guard the general health, safety or welfare of persons, animal life, plant life or property affected by workers, industrial or business activities undertaken by an operator.
- ii. Any person who intends to erect or install a new industrial plant, undertaking or process which is likely to cause air pollution shall register with the inspectorate at planning stage, apply for a licence within six months prior to commencement of operations.
- iii. The holder of the licence or permit shall;
  - Install, at holders cost, air measuring devices, collect such samples and conduct such analysis as the inspectorate may direct;
  - Submit monthly emissions returns submitted before or on the 9<sup>th</sup> day of the month.

#### **d) Water pollution**

- i. The licence to discharge effluent into the aquatic environment shall conform to the conditions and standards for chemical and physical parameters contained in the table of standards for effluent and waste water

- ii. The holder of a licence shall –
  - keep a record of the licensed activities;
  - submit the record referred to in paragraph (a) above to the Inspectorate every six months from the commencement of the licensed activities;
- iii. The Inspectorate may order the holder of a licence under these regulations to install at the expense of the holder of the licence, metering devices and to take samples and analyse them as the Inspectorate may direct.

#### **e) Mine Dumps**

- i. A developer shall submit a report to the Director of Mines which shall be prepared by a competent person and shall state the safety precautions and the other measures to be taken to protect the environment surrounding the dumping area, before dumping any material on that site.
- ii. A developer shall obtain a report from an independent competent person (every two years) on;
  - each active classified dump;
  - the condition of the ground between a dump and all surface intersections of vertical planes drawn from the boundaries of any mine workings less than one hundred metres from the nearest edge of the dump;
  - every matter which may affect the security or safety of the dump, ground or mine workings;
  - any significant impact on the environment not originally predicted; and
  - The progress made in implementing the environmental impact statement.
- iii. A copy of the report shall be kept at the office of a mine for inspection by an inspector and another copy sent to the Director - MSD.

#### **f) Environmental Protection Fund**

- i. There shall be paid from the Fund, monies required to carry out the objectives of the Fund which are to provide assurance to the Director (MSD) that the developer shall execute the Environmental Impact Statement in accordance with the mines and minerals (Environment Regulations 1997) and to provide protection to Government against the risk of having the obligation to undertake the rehabilitation of a mining area where the holder of the mining licence fails to do so.
- ii. A developer shall contribute to the Fund established under the Act.
- iii. The contributions to the Fund, shall be calculated depending on the performance of each developer, and shall be categorized as follows:
  - Category 1: action taken to rehabilitate
    - √ progressive rehabilitation carried out
    - √ whether the rehabilitation has been properly monitored; and
    - √ Whether the annual rehabilitation audits show progress to meet the target of the environmental impact statement to manage environmental pollution.



- Category 2: Environmental compliance capability
  - ✓ the financial capability to complete the rehabilitation of the mine area;
  - ✓ the materials in place for total mine area rehabilitation;
  - ✓ whether suitable expertise is provided for the organizational structure; and
  - ✓ Whether the developer or the person who holds a mining licence or permit has an approved environmental impact statement or project brief.
- Category 3: Basis operational and strategic environment protection requirements
  - ✓ An approved environmental impact statement or project brief;
  - ✓ discharges of mining operations are permitted or licensed;
  - ✓ post-mining land use and slop and profile design, allowing stable land rehabilitation within the mining or permit area; and
  - ✓ A water management system is in place or designed to contain, treat, discharge or dispose of contaminated water.
- iv.** The contribution shall be deposited with the Fund over a period of five years beginning the year the prospecting, exploration or mining operations are commissioned in the case of new operations, or when the developer submits an approved environmental impact statement in the case of existing mines or project briefs for prospecting and exploration projects.
- v.** The administrative expenses of operating the Fund shall not exceed 1.0 per centum of the total income of the Fund.
- vi.** All monies forming part of the Fund shall, pending the investment or application, therefore, in accordance with these regulations be paid or transferred into a dedicated bank account with a registered bank.
- vii.** The monies of the Fund shall be held in a hard currency account.
- viii.** Any monies in the fund that are not immediately required for the objectives of the Fund may be invested by the committee in any manner as may be authorised by the minister.

## 6. AUDIT METHODOLOGY

The audit involved examination of records, interviewing of officials at ZEMA, CEP, MSD and selected mines; and physical site inspections. Fifteen (15) out of thirty-one (31) mining companies operating in Zambia were visited (**Appendix 1**). The companies selected were mining companies with large scale mining licences with a view of obtaining an understanding on how environmental degradation from their activities was being managed.

The audit was conducted in accordance with the mandate as provided for under Article 121(2) of the Constitution of Zambia, the Public Audit Act No. 8 of 1980, the Public Finance Act No. 15 of 2004 and the INTOSAI Guidance for Supreme Audit Institutions on Auditing Mining.

The methods of data collection included:

### 6.1. Documentary Review

Documentary review of National Environmental Policy, Zambia's Mining Policy 1995, minutes of board meetings, annual and quarterly reports, reports submitted to ZEMA by mining companies; showing air and water sampling test results conducted and averaged monthly was conducted.

Other documents reviewed were files of correspondence between mining companies ZEMA and MSD, compliance monitoring reports, budgets and work plans, funding and releases, procurement records, environmental audit reports, environmental impact assessment reports, staff establishments, staff returns, recruitment records, asset register, strategic plans, financial statements, bank statements, monitoring and evaluation reports, among others.

### 6.2. Interviews and questionnaires

Structured interviews were used and in some instances questionnaires administered to key personnel in order to obtain detailed understanding of management of environmental degradation programmes in place. In addition, the interviews were carried out to collect primary data used to assess the efficiency and effectiveness of managing environmental degradation and to confirm information obtained from documentary review.

### 6.3. Physical Inspections

Physical inspections of the mines were carried out at all the selected mines in the company of ZEMA and Mine staff. Audit evidence was also collected through photographs.

### 6.4. Data Analysis

Data analysis of structured interviews and information collected from documents was carried out to answer the audit questions. Some of the analysis included the analysing of contribution to the EFP and monthly emissions and effluents to the environment. In the analyses maximum, minimum, average and median values were calculated. The details of these analyses are provided in the report and the appendices.

## 7. AUDIT FINDINGS

### 7.1. Inadequate Measures Put in Place by Government to Ensure that Environmental Degradation Caused by Mining Activities are Effectively and Efficiently Managed.

#### a) National Policy on Environment

Although ZEMA has no specific environmental policy on mining activities, there is a comprehensive national policy on environment which addresses environmental issues. The policy was launched in 2007 and has incorporated a number of international protocols and / or conventions that Zambia has signed and ratified on the management and protection of the environment.

However, ZEMA has not been able to fully implement this policy as some provisions and obligations under some of the international laws demanded costly technology and other technical resource requirements which were a major challenge. For instance, the destruction of certain types of hazardous waste and restoration to near natural conditions of craters and waste dumps left behind after many years of mining.

Further, despite the challenges that ZEMA has faced in implementing the policy, the Ministry has not reviewed the policy with the aim of assessing its suitability since its formulation in 2007.

#### b) Weak Regulatory Framework

##### i. ZEMA

The Strategic and Business Plan 2007-2011 identified four strategic imperatives namely; the revision of the EIA regulations by 31<sup>st</sup> December 2007, the development of Water and Air Pollution Control regulations which have pollution loads incorporated by 31<sup>st</sup> December 2008, the development of legislation for all producer responsibilities for companies generating waste by 31<sup>st</sup> December 2008 and the amendment of EPPCA by 31<sup>st</sup> December 2008.

However, as of May 2013, only the EPPCA had been repealed and replaced by the Environmental Management Act No. 12 of 2011. The other strategic imperatives had not been attained despite the availability of funding of K384million under the CEP. It was also observed that although ZEMA commenced working on reviewing and amending the EIA in 2009, the revised version was still awaiting consent from the Ministry of Justice and the inclusion of new concepts from the EMA of 2011. Furthermore, the water and air pollution regulations were still under review as of May 2013.

In addition, ZEMA had no standard on how to manage Uranium. Instead the Agency relied on the Ionizing and Radiation Protection Regulations which were administered under the Radiation Protection Board as such it could not effectively audit the waste rock dump under Barrick Lumwana Mine.

A review of the compliance monitoring report issued by ZEMA to Barrick Lumwana revealed that the waste containing uranium was not properly covered to avoid radiation leaks. It was observed that at Lumwana mine copper concentrates high in uranium were stockpiled in open grounds instead of a shed with impermeable floors. With regard to management of uranium, ZEMA stated they did not have the required financial and technical capacity to embark on the development of the standards at the moment.

##### ii. Failure to Review Regulations - Ministry of Mines Energy and Water Development

Although the principal legislation was reviewed, repealed and replaced in 2008, the Sub – regulations, Statutory Instrument No. 29 of 1997, the Mines and Minerals Regulation (Environmental Protection Fund) Regulations 1998 were not reviewed.

**c) Environmental Protection Fund put in place by Government has not worked effectively**

The Fund put in place to secure Government against future environmental liabilities that may arise in case the mines fail to meet the environmental liabilities at closure of business was not working effectively. A review of minutes of the EPF committee meetings revealed that the management of EPF moved from CEP to MSD on 31<sup>st</sup> March, 2011 and the EPF secretariat under CEP was dissolved on 12<sup>th</sup> September, 2011.

The following were observed:

**i. Failure to contribute to the Fund**

During the period under review amounts totalling US\$226,649,973 were due to the Fund from forty nine (49) mining companies (**Appendix 2**). However, as of 31<sup>st</sup> December 2012, only amounts totalling US\$50,402,334 had been contributed leaving a balance of US\$176,247,639 outstanding as shown in the table below:

**Table 1: Contributions to the Fund as 31<sup>st</sup> December 2012**

Category	Amount Due US\$	Amount Paid US\$	Amount Outstanding US\$
<b>Bonds/Guarantee</b>	214,848,683	40,036,247	174,812,436
<b>Cash</b>	11,562,406	10,366,087	1,196,319
<b>TOTAL</b>	<b>226,411,089</b>	<b>50,402,334</b>	<b>176,008,755</b>

*Source: Mines Safety Department*

According to existing arrangements, part of the contributions were supposed to be made in the form of bank guarantees or bonds validated by the Bank of Zambia while the balance was supposed to be made in cash. In this regard, contributions totalling US\$40,036,247 were received in the form of bank guarantees or bonds from six (6) large-scale mining companies namely Kagem, Kansanshi, Lumwana, Bwana Mkubwa and Muliashi Mines and one (1) small-scale mining company, Gemfields.

However, contrary to the laid down procedures, the bank guarantees/bonds were not validated by the Bank of Zambia.

**ii. Failure to apply penalties on defaulting companies**

Although the Director had power to enforce compliance which includes applying penalties such as charging interest at ruling bank rate to defaulters in line with Section 117(2) of the Mines and Minerals Development Act, no action had been taken against the defaulting mining companies as of 31<sup>st</sup> May 2013 (**Appendix 2**).

Failure by MSD to invoke the law on defaulting mining companies shows weaknesses in the operation of the MSD. This was not in the best interest of the country which may have to meet the cost of rehabilitation of the environment from the Government treasury should the defaulting mines fail to do so.

**iii. Failure to Appoint an External Fund Manager**

According to the resolution of the EPF committee, the EPF was supposed to contract an external fund manager or managers to advise on possible investment options in the market and monitor performance of the market.

Contrary to the resolution, MSD had not appointed an External Fund Manager and the Fund was being managed by an Engineer who had no formal training in

investment portfolio management. Consequently, despite the EPF being permitted to invest in various asset classes such as equities, Government securities (Treasury bills and bonds), corporate bonds, real estate and collective investment schemes, the EPF concentrated on cash and cash equivalents alone such as fixed deposit bank interest. Therefore, there is a risk that the time value of the funds was not adequately taken into consideration in the way the Fund was managed.

The EPF has both composite and investments bank accounts held with five (5) commercial banks. Composite bank accounts are used as collection points for EPF contributions while investments accounts are used as fixed deposits accounts.

A review of the account balances as of April 2012 revealed that the total balance of the investments and composite accounts stood at US\$8,989,048.66 which had accumulated interest of US\$140, 223.59. No proper reconciliation of the accounts was done. (**Appendix 3**)

**iv. Operational Account was Non Functional.**

After the management of the EPF Fund moved from CEP to MSD in March 2011, the operations account held at ZANACO was suspended. However, as of December 2012 the account was not operational and consequently, activities such as sensitisation of mines on the need to contribute to the EPF have not been carried out.

**d) Lack of monitoring capacity by ZEMA and MSD**

In order to build monitoring and evaluation capacity in ZEMA and MSD, the Government through CEP procured various monitoring equipment at a total cost of ZMW3,483,601 (Appendix 4) which was aimed at helping the institutions establish certified laboratories and a monitoring network countrywide covering both effluent and ambient monitoring.

However, the following were observed:

- i. Equipment costing ZMW27,611 delivered to ZEMA in 2009 had not been delivered to MSD as of 31<sup>st</sup> December 2012. See table below:

**Table 2: Equipment not delivered to MSD**

<b>Equipment not delivered to MSD</b>	
<b>Name of equipment/ accessories</b>	<b>Amount ZMW</b>
Kayak sediment corer	2,858
laboratory screens	2,842
laboratory furnace	7,015
Oven for drying samples	5,058
Konimeters x2	2,605
Spare parts for PTEA- electrode set for Cd,Pb,Cu,Mn and mercury film glassy carbon working electrodes,platinum counter electrode sets and reference electrode for measuring chromium and mercury .	2,476
chrome film glassy carbon working electrodes,platinum counter electrode sets and reference electrode for measuring iron, nickel and cobalt	2,476
Spare part chamber muffle furnace consisting of element and electrode	1,140
spare kit for high temperature oven comprising, fan motor and elements	1,140
<b>TOTAL</b>	<b>27,611</b>

Source: ZEMA

- ii. Despite the availability of the equipment, as of May 2013, the laboratory had not been certified as it did not meet the criteria such as:

Qualified laboratory personnel,  
Properly calibrated equipment,  
Operational standards,  
Testing procedures and methods,

- iii. The portable gas monitoring equipment and portable pH meter at ZEMA were not in working condition. No air and water sampling, testing and analysis were carried out by ZEMA

In the absence of properly equipped laboratories the results of their monitoring activities may be rendered unreliable. Consequently, ZEMA and MSD relied on results produced by the mining companies through bi-annual reports but such results could not be verified.

## 7.2. **Compliance with Environmental Regulations and Licencing Conditions by Mining Companies**

### a) **Air Pollution**

Contrary to the provisions of the EPPCA No 12 of 1990, Air Pollution Control (Licensing and Emissions Standards) Regulations 1996 (Statutory instrument No 141 of 1996) which stipulates, among others, that:

- i. The holder of a licence shall submit monthly emission returns to ZEMA,
- ii. The maximum amount of sulphur dioxide (SO<sub>2</sub>) a mine is allowed to emit from the smelter and convertors to the environment is 1000mg/Nm<sup>3</sup>.
- iii. The maximum amount of dust a mine was allowed to emit from the smelter and convertors to the environment was 50mg/Nm<sup>3</sup>.
- iv. The maximum amount of Arsenic (As) a mine was allowed to emit to the environment was 0.5mg/Nm<sup>3</sup>.
- v. The maximum amount of copper content in the air a mine was allowed to emit to the environment was 1.0mg/Nm<sup>3</sup>.
- vi. The maximum amount of lead (Pb) emission to the environment was set at 0.2 mg/Nm<sup>3</sup>;

The following were observed;

#### i. **Failure to Produce Monthly Returns on Air Emissions to the Environment.**

Two (2) out of the five (5) large scale mining companies selected, that had smelting facilities, did not comply with the requirement to submit monthly returns on air emitted into the environment for periods ranging from one (1) year to three (3) years as shown in Table 4 below:



**Table 3: Mining facilities that emitting air to the environment without producing returns.**

Mines	Facilities	Monthly Returns not Submitted
1. Chambishi Copper Smelter.	1. Chimney 1	January 2010 to December 2011.
	2. Anode Furnace	January to June 2010
		July to December 2011
	3. Slag Cleaning Furnace	January to June 2010
		July to December 2011
2. Ndola Lime	9. Horizontal Kiln	January 2009 to December 2011
	10. Vertical Kiln	January 2009 to December 2011
	11. Hydrator	January 2009 to December 2011

Source: Bi annual reports submitted by Mining companies to ZEMA

## ii. Sulphur Dioxide(SO<sub>2</sub>) Emissions

The audit revealed that the average value for Sulphur Dioxide released to the environment by four (4) out of the five (5) mining companies ranged from 358.6mg/Nm<sup>3</sup> to 86,155mg/Nm<sup>3</sup>. Further analysis showed that the mining companies' emissions were above the ZEMA statutory limits. Eight (8) mine facilities emitted between one (1) and thirty (30) times above the statutory limit out of the 36 months assessed. Mopani Copper Mine emitted up to 155,769mg/Nm<sup>3</sup> which was 155% higher than the set limit. **(Appendix 5)**

## iii. Dust from Stack Emissions

The average amount of dust that was emitted by the five (5) mines at eleven (11) facilities assessed was higher than the set limit ranging from 157.1mg/Nm<sup>3</sup> to 2,679.5mg/Nm<sup>3</sup>. The highest was recorded by Ndola Lime at 5,550mg/Nm<sup>3</sup> which was 111 times higher than the statutory limit of 50mg/Nm<sup>3</sup>. Further analysis conducted revealed that out of the 36 months assessed, all the mines emitted dust which was higher than the set limit for periods ranging from 4 to 28 months. The audit also revealed that Chambishi Copper Smelter did not assess the dust parameter for chimney 1 contrary to the air pollution regulations and licencing conditions set by ZEMA. **(Appendix 6)**

## iv. Arsenic(As)

The audit revealed that the average content of arsenic released to the environment ranged from 0.4mg/Nm<sup>3</sup> to 4.7mg/Nm<sup>3</sup>. Generally, out of 36 months assessed, four(4) out of five (5) mines released air high in arsenic for periods ranging from one (1) month to twenty-eight (28) months at seven of the facilities. The highest was recorded by Mopani Copper Mine at the converter slag-blow-stack with emissions up to 38.8mg/Nm<sup>3</sup> which was 77.6 times higher than statutory limit of 0.5mg/Nm<sup>3</sup>. Ndola Lime and Chambishi Copper smelter did not provide test result throughout the period under review at three(3) and one (1) of their facilities respectively. **(Appendix 7)**

## v. Copper (Cu)

While the requirement for copper content in the air emitted to the environment was set at 1.0mg/Nm<sup>3</sup>, the average copper content in the mine emissions were high ranging from 2.7 to 151.3mg/Nm<sup>3</sup>. The highest was recorded by Mopani Copper Mine at 854.2mg/Nm<sup>3</sup> which was 854 times higher than the set limit. Furthermore, the audit revealed that out of 36 months assessed, the mine emissions were higher than set limit for periods ranging from 9 months to 31 months. Ndola Lime and Chambishi Copper Smelters did not completely provide returns for copper while the other mines did not provide returns for some months from one (1) to three (3) years contrary to the air pollution regulation. **(Appendix 8)**

**vi. Lead(Pb)**

Analysis of data obtained from the bi annual reports revealed that the average value of lead content in the emissions ranged from 0.3 to 23.4mg/Nm<sup>3</sup>. Three(3) mines did not comply with the set parameters, at six (6) of their facilities, for periods ranging from 5 to 31 months out of the 36 months assessed. Mopani Copper Mine emitted up to 75.9mg/Nm<sup>3</sup> which was 379 times higher than the set limit of 0.2mg/Nm<sup>3</sup>. Chambishi Copper Smelter did not assess the lead parameter at Chimney 1, while Ndola Lime did not assess all the three stacks, contrary to the regulations. **(Appendix 9)**

**vii. Weaknesses in the Developmental Agreements**

On 31st March 2000, Government signed a developmental agreement with Mopani Copper Mine Plc under which the company took control of the Mopani Mine in Mufulira. The agreement provided for the following, among others:

**Text box1: Extracts of the Developmental Agreement**

**The MCM:**

- 1) Will negotiate in good faith with GRZ with a view of agreeing within six months of finalisation of the baseline environmental study (or such longer periods as the parties may agree) the detailed terms and condition of the Environmental plan.
- 2) Shall comply with and implement the environmental plan in accordance with the time tables contained therein and good mining practices and, without prejudice to the time table, the company shall achieve the objectives specified in the Environmental Plan no later than the last date specified therein for achievement.
- 3) Save as provided in clause 12.4 , GRZ hereby confirms that for the stability period it will not take any action and will procure no action is taken by any of its ministries, departments or agencies over which it has operational control acting on its behalf) under or in enforcing any applicable laws with the intent of :
  - Securing the company's earlier compliance with environmental laws other than that envisaged by the timetable and conditions set in the environmental plan.
  - Requiring the company to clean up and/or remove any stock of pollutants and/or remedy any other condition which was pre-existing as at the date of this agreement (other than in respect of areas of land or of water bodies identified by the company pursuant to clause 12.19(b)(ii)
  - Imposing fines or penalties upon the company payable under the environmental laws (or enacting new fines and penalties there under) which are the payable respect of the company's non-compliance with the such environmental laws and where the environmental plan provides for the remedy of the same in accordance with a specified timetable and the company is in material compliance with that timetable.
  - Imposing fines or penalties upon the company's breach of environmental laws in the case of penalties charged in respect of the emission of sulphur dioxide arising from the ongoing operation of the Mufulira smelter provided that the company remains in compliance with the measures and in material compliance with the timetables for implementing those measures set out in the environmental plan to reduce such omissions and as appropriate, for the construction of a new acid plant as set out in the environmental plan or,
- 4) Effecting any changes thereto or enacting new legislation and regulation or repealing existing laws or regulations which would prevent the company complying with environmental plan and time tables for contained therein without making provisions for the company to be exempted there from or material alter or affect the scope, enforcement or application of environmental laws regarding the establishment, maintenance or operation of the environmental protection fund.

*Source: Developmental Agreement*

In pursuance of the terms of the agreement above, MCM developed a plan as detailed below, in order to bring the smelter into compliance with the existing environmental legislations.

## Text box 2: Extracts of the Environmental Management Plan

### Phase One

Installation of the ISA Furnace to replace the existing electric furnace used for primary smelting  
Installation of the acid plant for treatment of the ISA smelt furnace off gasses, and  
Refurbishment and upgrade of the materials handling facilities

### Phase Two

Installation of the two new anode furnaces and  
Installation of twin new copper anode casting wheels

### Phase Three

- i. Installation of two new bigger 15 X 35 converters, refurbishing one existing converter and installations of water cooled hoods and off gas handling facilities, and
- ii. Installation of a second new acid plant with gas cleaning and cooling plant and associated equipment for the treatment of the converter off gas

Source: Smelter Upgrade Environmental Project Brief – MCM

In this respect, in their decision letter dated 7<sup>th</sup> December 2004, ZEMA approved the plan and MCM was required to implement the following:

## Text box 3: Extracts of ZEMA Decision Letter Issued to MCM

- i. To implement all the proposed mitigation measures provided in the project brief
- ii. To obtain a licence to emit air pollutants from the acid plant.
- iii. To meet the long term emission limit as stipulated in the third schedule (Regulation 4) of SI 141 of 1996 by June 2015 emissions from either the electric furnace stacks and/ or acid plant.
- iv. To conduct emission monitoring on a monthly basis for every point.
- v. Dilution of flue gases to achieve long term emission limits shall not be allowed and is punishable.
- vi. Mopani Copper Mine shall capture 55- 59% of the total sulphur dioxide generated at the 64% matte grader by December 2006.
- vii. MCM shall by December 2008 implement measures to capture the sulphur dioxide emissions from the converters. Detailed studies shall be conducted and approved by Mine Safety Department and Environmental Council of Zambia before the project is implement.
- viii. Compliance with environmental standards and/or specific limits of particular pollutants is the responsibility of the developer. Thus, compliance with ECZ recommended measures does not absolve the developer from responsibility if such measures do not achieve compliance with environmental control standards.
- ix. This approval does not exempt the developer from obtaining any other relevant authorisation.
- x. This decision letter does not exempt Mopani Copper Mine Plc from obtaining any other relevant authorisations and that permission can be withdrawn without notice should the developer fail to comply with laid down conditions.

Source: Decision Letter dated 7th December 2004

However, the following were observed:

### ● Total sulphur capture of 55- 59% has not been met:

Contrary to the agreement, MCM did not meet the 55 – 59% benchmark of the total sulphur dioxide emitted to the environment.

In this respect, in thirty (30) out of thirty-six (36) months assessed, the sulphur dioxide captured was below 55% as shown in the table below:

**TABLE 4: Sulphur Dioxide Capture**

Year	Month	Total Sulphur dioxide Capture (%)	Remark
2009	January	49.62	Below range
	February	51.98	Below range
	March	54	Below range
	April	50.58	Below range
	May	50.99	Below range
	June	48.62	Below range
	July	50	Below range
	August	47	Below range
	September	48	Below range
	October	48	Below range
	November	45	Below range
	December	47	Below range
2010	January	50	Below range
	February	46	Below range
	March	52	Below range
	April	46	Below range
	May	-	No results
	June	57	Within range
	July	52	Below range
	August	49	Below range
	September	50	Below range
	October	54	Below range
	November	54	Below range
	December	50	Below range
2011	January	51	Below range
	February	54	Below range
	March	49	Below range
	April	50	Below range
	May	59	Within range
	June	66	Above range
	July	51	Below range
	August	52	Below range
	September	58	Within range
	October	57	Within range
	November	51	Below range
	December	53	Below range

Source: Bi Annual Reports from Mopani.

#### ● Measures to capture the sulphur dioxide from the converter not implemented

Although the agreement required MCM to put in place measures to capture the sulphur dioxide from the converters by December 2008, the company did not implement the decision. As of May 2013, MCM had embarked on installing new converters. However, the converters were emitting sulphur dioxide, in the range, of 15,243 and 621,879 mg/Nm<sup>3</sup> per month compared to the statutory limit of 1,000 mg/Nm<sup>3</sup>. (**Appendix 5**).

Failure by MCM to implement the measures in the agreement has impacted negatively on the communities in close proximity to the mine. In particular, the community most affected is Kankoyo residential area which stretches, in a circular manner, from the eastern through to southern and western side of the plant. Some houses are less than 500m from the plant site fence.

In addition, a study carried out by Copperbelt Environmental Project (CEMP II) in 2005 revealed that the children in Mufulira (Kankoyo township) had higher respiratory infections, high lead and cadmium concentration in blood than those in Kitwe. Since the economic condition of Mufulira and Kitwe were similar, the study attributed the results to air pollution in Mufulira.

- **Failure by ZEMA to Enforce the Agreement**

Although MCM failed to meet its obligations under the agreement, in particular, to capture 55 – 59% of sulphur dioxide emissions by December 2006 and to put in place measures to capture the sulphur dioxide emissions from the converters by December 2008, ZEMA was unable to take any action against the company as clause 12.4 of the Developmental Agreement virtually gave the company immunity against any punitive measures by Government and any of its agencies during the stability period which ends in June 2015.

**b) Surface Water Pollution**

In order to assess the quality of water that the mines released to the environment after mining operations, twenty-eight (28) facilities in fifteen (15) large scale mining companies were selected based on the risk of pollution to the environment. (**Appendix 1**)

According to the licensing conditions issued by ZEMA and Section (7) of the Water Pollution Control (Waste Water and Effluent) Regulation 1993:

- i. The holder of a licence shall submit a record of all its licensed activities,
- ii. The waste water or effluent released to the environmental should have a pH value of 6 to 9,
- iii. Waste water or effluent released to the aquatic environmental should not have total suspended solids exceeding 100mg/litre
- iv. Total Dissolved Solids must not exceed 3000mg/litre and must not adversely affect surface water.
- v. The sulphate burden in the waste water or effluent released to the aquatic environmental must be reduced to 1500mg/l.
- vi. Copper compounds (TCu) should not exceed 1.5mg/L.
- vii. Total cobalt compounds in effluents discharged not to exceed 1.0mg/litre
- viii. Maximum limit of 1.0mg/Litre of total manganese (TMn)
- ix. Maximum contents of iron shall be 2.0mg/L

Examinations of bi-annual reports and other records submitted by mining companies to ZEMA, correspondence files between ZEMA and the mines, compliance monitoring reports and physical inspections conducted at the facilities revealed that mining companies released waste water and effluent to the environment with physical and chemical parameters above and/or outside the minimum limits set by ZEMA as follows:

**i. Submission of Waste Water Discharge Returns To ZEMA**

There were ten (10) mines out of sixteen (16), representing 62.5% which did not submit bi annual reports to ZEMA on twenty-two (22) facilities under their control that discharged waste water and effluents into the environment. (**Appendix10**)

**ii. pH Value.**

Bwana Mkubwa Mine and Maamba Collieries released water to the environment which was acidic with pH Values ranging from 3 to 4.

**iii. Total Suspended Solids (TSS).**

There were four(4) mines namely Non Ferrous Copper Mine, Mopani Copper Mine-Mufulira, Konkola Copper Mine Nchanga and Konkola IBU that continued after the privatisation of the mines to release water to the environment which was up to 48,069mg/l or 480% higher than the ZEMA authorised limit of 100mg/l. (**Appendix 11**)





*Sediments released in Nchanga and eventually Mushishima stream at Pollution Control Dam (PCD) by KCM Nchanga Division*



*Sediments from Muntimpa TSF reporting into Muntimpa stream*



*Solids reporting into Mushishima stream*



*Sediments on the embankments of the stream formerly known as Hippo pool*

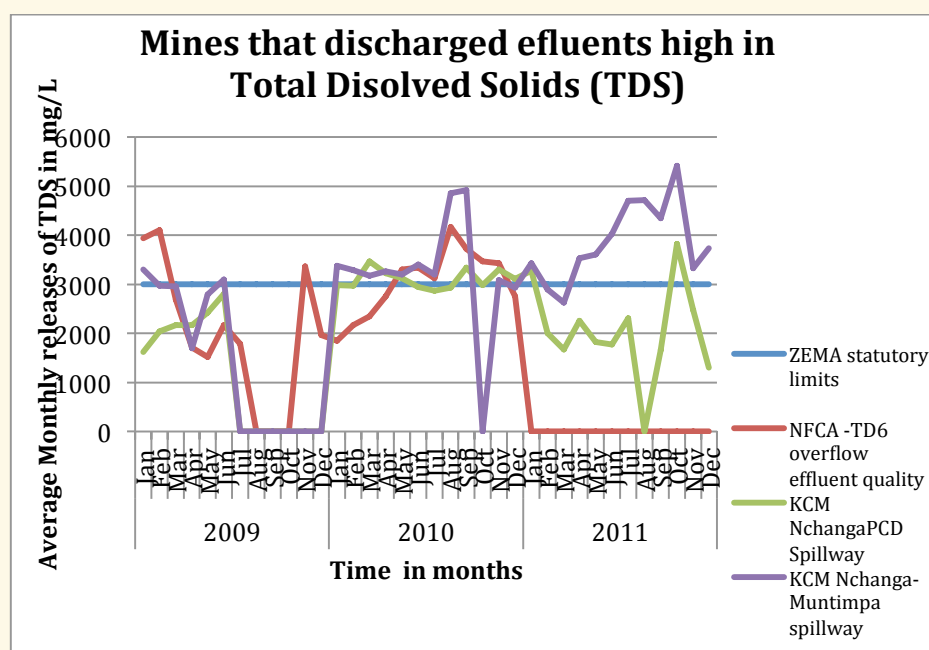
#### **iv. Total Dissolved Solids (TDS).**

There were two (2) mines that discharged waste water from three facilities to the aquatic environment that had total dissolved solids in excess of the authorised limit of 3,000mg/l. KCM Nchanga division, released waste water from Muntimpa Tailing Dump spillway that had a TDS content of up to 5,411mg/l. (**Chart 1**).

It was also observed that there were no test results for water released to the environment for the period from August to October 2009 and January 2011 to December 2011 for Non Ferrous Copper Africa Mining Plc (NFCA) while KCM had no test results for the period July 2009 to December 2009 contrary to the licences conditions issued by ZEMA that required that average monthly test results be sent to ZEMA in a bi-annual report.



Chart 1.



Source: Bi Annual Reports

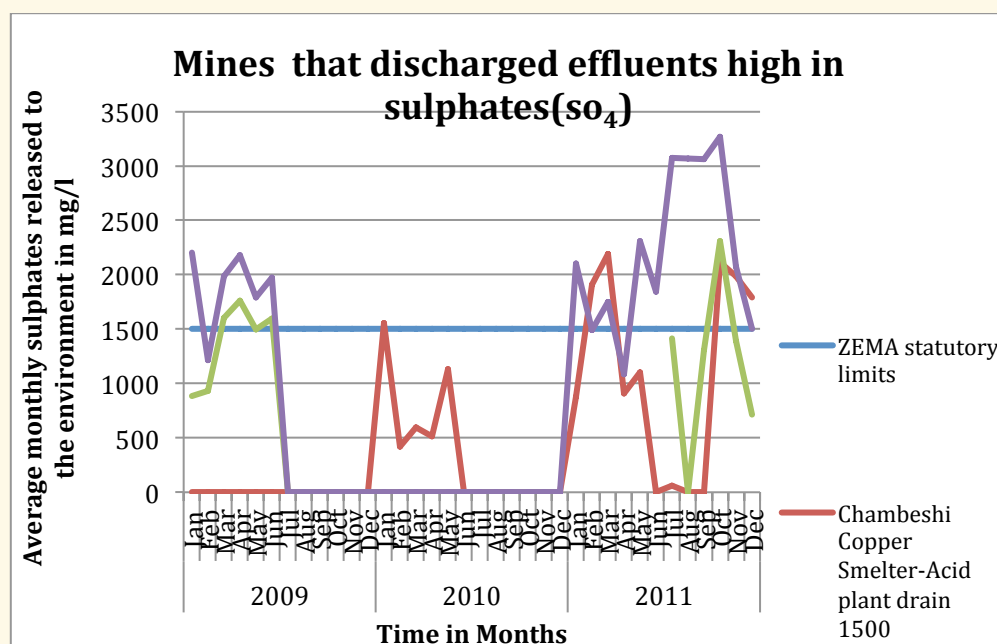
\* Other Mines not appearing were all below the statutory limits

#### v. Sulphates.

KCM Nchanga division discharged effluents with sulphates ( $\text{SO}_4$ ) contents of up to 3,270mg/l which was above the statutory limits of 1,500mg/l. There were no test results for PCD and Muntimpa spillways for the period from July 2009 to December 2010.

It was also observed that Chambishi Copper Mine discharged effluents with high sulphates in 2011 of up to 2,189mg/l while there were no test results for the months of June to November 2010 and June, August and September 2011 (**Chart 2**)

Chart 2.



Source: Bi Annual Reports

\* Other Mines not appearing were all below the statutory limits.

\*\* Between January and June 2009, Chambishi Copper Mine was still under Development.

**v. Total Copper (TCu).**

Seven(7) mines discharged waste water to the environment which had TCu content above the statutory limit of 1.5mg/l at fourteen (14)discharge facilities for periods ranging from three (3) to twenty-four (24) months out of the thirty-six (36)months assessed. The discharge of waste water above the statutory limits ranged from 1.6mg/L to 787mg/L of Total Copper(TCu) compounds with KCM – Pollution Control Dam (PCD) recording the highest pollutants in their discharged water; while four (4) mines did not submit test results for nine (9) licensed discharge facilities.(**Appendix 12**)

**vi. Total Cobalt (TCo).**

Five (5) mines namely Chambishi Metals, Non Ferrous Copper Mine, KCM Konkola, KCM Nchanga and MCM Mufulira mines released effluents to the aquatic environment at ten(10) licenced discharge points that had higher TCo content than the set limits by up to twenty-three (23) times. The highest recorded numbers above limit was 311mg/ litre by KCM Nchanga open pit which decants into the Nchanga stream. (**Appendix 13**)

**vii. Total Manganese (TMn)**

Four (4) mines namely Non Ferrous Copper Mine, KCM Nchanga and MCM Mufulira and MCM Nkana released effluents above the set limit of 1.0mg/l at ten (10) licensed discharge points with maximum TMn contents ranging from 4.0mg/litre to 201.1mg/ litre. (**Appendix 14**)

**viii. Total Iron (TFe)**

Four (4) mines namely KCM Nchanga, KCM Konkola, MCM Mufulira and MCM Nkana SBU released effluent with TFe content above the authorised limit 2.0mg/l to the aquatic environment at seven (7) discharge points with maximum values ranging from 6.3mg/l to 6,752mg/l. (**Appendix15**)

**c) Ground Water Pollution**

In order to assess the quality of ground water, bi annual reports submitted by mines to ZEMA were scrutinised. A sample of four (4) mines with seven(7) facilities were analysed as shown in Table 5 below:

**Table 5:Facilities Assessed for Ground Water Pollution**

Name of Mine	Name of Facility
1. Chambishi Copper Smelter	1. Sulphuric Acid Storage Facility.
2. Konkola Copper Mine - Nkana	2. Acid Loading Bay.
3. Mopani Copper Mine Mufulira-	3. Concentrate smelter shed borehole no. 9
	4. Acid Loading Bay.
	5. Borehole No. 18 between take house 5 and refinery change house.
4. Mopani Copper Mine Nkana -	6. Old CVW.
	7. Cobalt Plant – Deep.
	8. Cobalt Plant –Shallow.

Source: ZEMA

**i. Failure to provide Test Results**

Chambishi Copper Smelter did not submit bi-annual reports, Konkola Copper Mine - Nkana and Mopani Mufulira provided annual and quarterly test results respectively instead of monthly averages while some test results for other months were not provided as shown in the table below.

**Table 6: Mines that did not provide Monthly Test Results**

Name of mine	Name of facility	Period
1. Chambishi Copper Smelter	Sulphuric Acid Storage Facility	July 2009 to December 2011.
2. Konkola Copper Mine-Nkana	Acid Loading Bay	Annual averages provided instead of the monthly averages.
3. Mopani Copper Mine Mufulira-	Concentrate Smelter Shed borehole no. 9 both deep and shallow	Quarterly averages provided instead of the monthly averages.

*Source: Bi annual reports*

**ii. pH Value**

Water from Mopani Copper Mine seeping into ground water at two (2) of its facilities namely Old CVW, Cobalt plant both shallow and deep aquifer was highly acidic with an average pH Value of 3.4 to 5.0. There were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 16**)

**iii. Total Suspended Solids (TSS).**

Suspended solids at borehole No.18 of the Mopani Copper Mine-Mufulira were up to 10,563mg/l which was higher than the authorised level of 100mg/l. Mopani Copper Mine-Nkana did not provide test results for all the three facilities for suspended solids. In addition, there were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 17**)

**iv. Total Dissolved Solids (TDS).**

MCM Mufulira was compliant at both facilities while MCM Nkana was not compliant for some months with total dissolved solids recorded of up to 11,063mg/l high while some months had no test results. Furthermore, there were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 18**)

**v. Sulphates.**

The borehole test results for MCM Mufulira were compliant to the statutory limit while there was no evidence of testing at MCM Nkana and Chambishi Copper smelter as no test results were available for audit. (**Appendix 19**)

**vi. Total Copper (TCu).**

Borehole test results at five (5) discharge facilities at both MCM Mufulira and Nkana sites were higher than the set limit of 1.5mg/l. The highest was 118mg/l which was 118 times higher than the limit. There were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 20**)

**vii. Total Cobalt (TCu).**

MCM Nkana mines boreholes test results for the cobalt plant were up to 4,200mg/l for the deep aquifer and 2,781mg/l of the shallow aquifer as compared to the authorised limit of 1.0mg/l. There were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 21**)

**viii. Total Manganese (TMn)**

MCM Mufulira and MCM Nkana borehole test results were above the set limit at all the five (5) facilities with a record high of up to 235mg/l contrary to the set regulations. There were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 22**)

**ix. Total Iron (TFe)**

MCM Mufulira and MCM Nkana borehole test results were above the set limit at four (4) of its facilities with the maximum values ranging from 28.9 to 214 mg/l compared to the authorised limit of 2.0mg/l. There were no test results for Chambishi Copper Smelter while the quarterly averages as opposed to monthly averages were provided for MCM Mufulira concentrate shed. (**Appendix 23**)

There was no baseline data for the boreholes submitted by ZEMA for audit scrutiny.

**d) Management of Dump Sites**

Licensing conditions and Statutory Instrument No. 29 of 1997 – The Mines and Minerals (Environmental Regulations) of 1997 stipulate that:

- i.** All tailings dams and dumps should be secured and access restricted to authorised personnel only.
- ii.** TSF should have warning and safety signs displayed at appropriate places.
- iii.** Disposal of waste other than tailings material at TSF is prohibited except with the written consent of the Zambia Environmental Management Agency (ZEMA)
- iv.** The licensing conditions require that the dams/dumps are managed in such a way as to; ensure its stability and minimise accidents and other risks to other adjacent land uses; avoid polluting surrounding areas including surface and ground water bodies; and prevent soil erosion and encourage re-vegetation. In addition, the conditions state that the developers of the mines should ensure that they conduct progressive rehabilitation activities throughout the license period
- v.** Licensing conditions state that no residential areas should be within 500 metres from the dam/dump.
- vi.** All information relating to the operation and management of the tailings dam/dump including results of monitoring activities, quantities and characteristics of waste disposed of and the general operation of the site should be documented, maintained and submitted in two bi-annual six monthly reports.

- vii. Hazardous waste should be handled safely to avoid emergencies such as poisoning, fire, explosion, spills etc
- viii. Mines should maintain periodic inspection records

Contrary to the above, the following were observed:

**i. Tailings Storage Facility(TSF) (Appendix 24)**

● **Unrestricted Access**

Out of a total of nineteen (19) tailings facilities inspected, ten (10) facilities namely Musi, Lubengele, Muntimpa, Chibuluma South, Chibuluma TD 1, Chibuluma TD 2, NFCA TD 6, Luano, Musakashi and Chambishi Metals tailings storage facilities had unrestricted access. In some instances, illegal miners were seen on site while in other instances, community members were seen bathing, playing and fishing in the dump/dam sites. **(See pictures below)**



*Woman seen washing clothes in the Lubengele Tailings Dam- KCM Konkola*



*Teenagers playing on the Lubengele Tailings Dam- KCM Konkola*

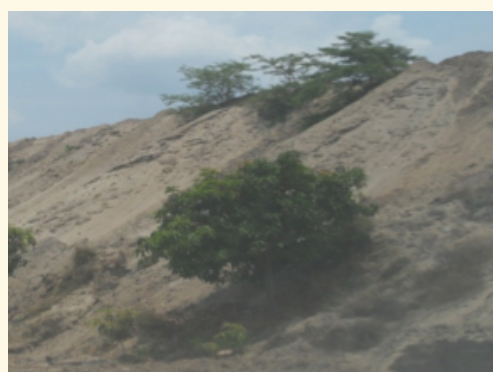
● **No Hazardous Warning and Safety Signs**

Out of nineteen (19) facilities, thirteen (13) facilities namely Bwana Mkubwa TD 5A, TD 5B and TD 4; Musi; Lubengele; Kansanshi sulphide and oxide, Muntimpa; Chibuluma South; Chibuluma TD 1; Chibuluma TD 2; NFCA TD 6, Luano and Musakashi TSF had no warning and safety signs displayed.

● **Progressive Re-vegetation**

Out of six (6) TSFs visited, three (3) facilities namely NFCA TD 6, Luano and Bwana Mkubwa TD 5A and 5B drainages were overgrown with grass.

It was also observed that while all the mines had started carrying out progressive re-vegetation of the TSF, fourteen (14) facilities had sparsely vegetated and bare sections of the embankments and top beaches. As a result of the sparsely vegetated and bare sections of the embankments and top beaches, there was evidence of erosion gullies and wind-blown dust from the bare tailings surfaces.



*Sparsely vegetated embankments of Mutimpa Tailings Facility- KCM Nchanga exposing loose particles that can easily be blown by wind.*



*Sparsely vegetated embankments of Chibuluma South Tailings Storage Facility exposing loose particles that can easily be blown by wind or eroded by rain water into the environment.*

- **Pollution of Surface Water Bodies**

Four (4) TSFs namely; KCM – Lubengele, Muntimpa TD, Chibuluma South and NFCA TD 6 showed pollution of surface water bodies in terms of Total Suspended Solids and in some instances Total Iron, Total Cobalt, Total Copper and Total Manganese. Lumwana Plc released water to the environment without ZEMA license between April 2009 and April 2010.

- **Pollution of Underground Water Bodies**

Four (4) TSFs namely; Bwana Mkubwa TD 5A, 5B and 4, KCM – Lubengele and Muntimpa TD showed evidence of pollution of underground water bodies with respect to Total Suspended Solids and in some instances Total Iron, Total Cobalt, Total Copper and Total Manganese.

- **Proximity of Residential Areas To The Dams/Dumps**

Two (2) TSFs namely Chibuluma South Tailings dump and NFCA Luano TD were less than 500 metres from the nearest settlements; and the communities were growing vegetables on the toe of the Luano TD.

- **Submission of Bi annual and Statutory Dump Reports**

Luanshya Copper Mine did not submit bi annual reports in the period 2009 - 2011. There were also no statutory dump reports for Copper Tailing dump site under Barrick Lumwana Plc contrary to the regulations.

## ii. **Slag Dumps (Appendix 25)**

- **Restricted Access**

MCM slag dump No.1, L.C.M – old and new slag dumps, KCM unlicensed slag dump and dump No 67, Nkana slag dump-Chambishi Metals Mine had unrestricted access.



(See picture/s below)



*Dug-out holes created by illegal miners on Nkana slag dump owned by Chambishi Metals mine*



*Illegal miners on old slag dump at LCM*

- **Lack of Warning And Safety Signs** MCM slag dump Nos. 1 and 2, LCM – old and new slag dumps, KCM unlicensed slag dump and slag dump No.67, Nkana slag dump-Chambishi Metals Mine had no warning and safety signs displayed.

- **Pollution of Surface and Underground Water Bodies**

Seepage of water at the toe of the new slag dump No.25 for KCM mine and borehole results for MCM slag dump Nos. 1 and 2 were not tested for potential pollutants and that runoff water had the potential to carry with it slag particles from the dump into the Chingola stream and subsequently the Kafue River.

- **Proximity of Residential Areas to the Dumps**

Roan Township was within 200 metres from the L.C.M old and new slag dumps.

- **Submission of Bi annual and Statutory Dump Reports**

Luanshya Copper Mine Plc. did not submit bi annual reports in the period under review while Chambishi Metals, Chambishi Copper Smelter and KCM unlicensed dump had no statutory dump reports from an independent competent person contrary to the environmental regulations.

### iii. **Overburden/ Waste Rocks Dumps (Appendix 26 and 27)**

- **Restricted Access**

Out of a total of eighteen (18) dumps inspected, thirteen (13) facilities namely; South and Southwest waste rock dumps No. 18 and 14 respectively - L.C.M, Waste rock dump No. 5, 17, 18 and 20 and OB 1 and 2 - NFCA, OB 1, 2, 22, 23- KCM Nchanga, Chibuluma Mine OB had unrestricted access. Illegal miners were also seen on site.





*Illegal miners seen ferrying waste rock – LCM*

- **Lack of Warning and Safety Signs**

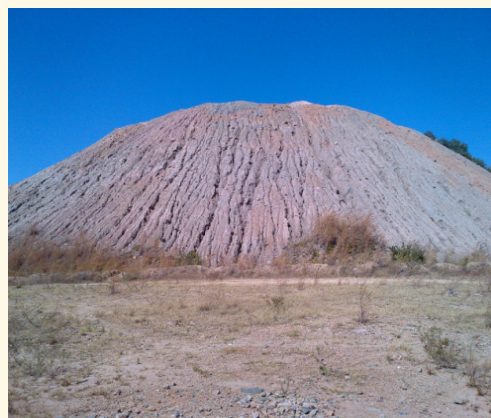
Out of nineteen (19), eleven (11) facilities namely South and southwest waste rock dumps No. 18 and 14 respectively – L.C.M, Waste rock dump No 5, 17, 18 and 20 and OB 1 and 2 – NFCA, OB 1, 2, 22, 23 – KCM Nchanga, Chibuluma mine OB had no warning and safety signs displayed.

- **Disposal of Waste other than Waste Rock or Overburden Material**

The dump site in Mopani Nkana was used as an illegal dump site for industrial waste without authorization from ZEMA.

- **Progressive Re-vegetation**

While most mines had started carrying out progressive re-vegetation of waste rock and overburden dumps, fourteen (14) facilities had sparsely vegetated and bare sections of slopes. As a result of the sparsely vegetated and bare sections of the slopes, there was evidence of erosion gullies and wind-blown dust from the bare slopes.



*Erosion gullies – OB dump- KCM Nchanga      Un - vegetated dump – Kansanshi Mine*

- **Pollution of Surface Water Bodies**

There were thirteen (13) facilities namely OB 1,2, 22,23 under KCM, Izuma A and B under Maamba Collieries and waste rock dump No.18 under NFCA which indicated pollution of surface water bodies in terms of Total Suspended Solids.

- **Proximity of Residential Areas to the Dumps**

Dumps namely MCM waste rock dumps Nos. 13 and 17, OB 23 – KCM, South waste rock dump No. 18 and South west rock dumps No 14 – LCM and Izuma B dump – Maamba Collieries which were located less than 500 metres from the nearest settlements.

- **Submission of Bi annual and Statutory Dump Reports**

Luanshya Copper Mine Plc did not submit bi annual reports in the period under review. It was also observed that Barrick Lumwana Mining Company did not submit Statutory Dump reports for its uranium stock pile, Mulundwe waste rock and overburden dumps while KCM did not submit Statutory Dump reports for waste rock dumps A and B contrary to the environmental regulations.

**e) Used Oil Storage Facilities (Appendix 28)**

All hazardous waste including used oil should be stored in an area with restricted access to unauthorized personnel, a bunded and impermeable floor and adequate ventilation to avoid build-up of hazardous fumes.

A review of compliance monitoring reports and the physical inspections carried out revealed that except for Maamba Collieries Limited light vehicle workshop, all the sixteen (16) mining sites visited had adequate bunded and impermeable floors and the storage facilities had adequate ventilation to avoid build-up of fumes.

It was however observed that Konkola Copper Mine – Nchanga SBU, Chibuluma South Copper Mine, Ndola Lime Company Ltd, Maamba Collieries Plc and Chambishi Copper Smelter oil storage facilities had not restricted access to the facilities.



*Oil storage facility well ventilated, restricted with adequate Safety and warning signs – MCM Mufulira*



*Chibuluma Mine - no restricted access.*



*Unrestricted access-Maamba Collieries Plc*



*Unrestricted access – Ndola Lime*



A review of compliance monitoring reports and a physical inspection revealed that Chambishi Copper Smelter, Maamba Collieries Plc. and Konkola Nchanga had no warning signs.



*KCM Nchanga - inadequate hazardous signage*

It was also observed that storage facilities for Chambishi Copper Smelter, Ndola Lime Co. Ltd, Chambishi Metals Plc., Luanshya Copper Mine, Maamba Collieries Ltd, Kansanshi, Chibuluma, Mopani Nkana Mine, Mopani Copper Mine - Mufulira and KCM - Nkana had oil spillages in or around their oil storage facilities. Chibuluma Mine storage facility had a wash bay nearby and the silt from the wash bay was mixing with the oil spills around the storage facility and ended up in unlined drainages and the environment outside the mining area. See pictures below.



*Oil- contaminated water from the wash bay released to the environment-Chibuluma Mine Plc*



*Spilled oil comingling with water from the Mine wash bay and eventually to the environment -Chibuluma Mining Plc*

*Oil Contaminated silts in the drainage from wash bay -Chibuluma Mining Plc*

All the mining facilities visited with the exception of Luanshya Copper Mine Plc, had fire fighting equipment. It was also observed that KCM- Nchanga, Lumwana Mining Co, Chambishi Copper Smelter and Chibuluma Mine had no first aid kits on site contrary to the provisions of regulations. It was further observed that Maamba Collieries Plc. had an empty first aid box. See picture below.



*Empty first aid kit-Maamba Collieries Plc*

The Chambishi Copper Smelter, Chibuluma, Chambishi Metals, Maamba Collieries Plc. Ndola Lime Co Ltd. Kansanshi, KCM Konkola, KCM – Nkana, KCM - Nchanga and Mopani - Nkana had no periodic inspection records on site contrary to the licensing conditions.

## 8. CONCLUSION

Mining is an important economic activity in Zambia. However, despite the numerous benefits derived from mining, with it also come serious environmental consequences such as air, land and water pollution both from surface water bodies and underground aquifers. The other environmental consequences arise from windblown dust and landslides due to instability of tailings, slag and overburden dumps. If not adequately managed, environmental damage has dire effects on not only the economy but the citizenry as well. Our audit findings presented above give us reasons to draw the following conclusions:

The goal and overall objective of Government on environment and natural resources as set out in the National Policy on Environment of supporting Governments developmental priority of improving the quality of life of the people of Zambia through protection and management of the environment and natural resources in its entirety, balancing the needs for social and economic development and environmental integrity to the maximum extent possible, while keeping adverse activities to the minimum is not being achieved.

### **8.1. Mining Companies are Polluting The Environment In Terms Of Air, Surface And Ground Water, And Land.**

#### **a) Air pollution**

Mining companies are not following the laid down laws and regulation set by Government with the aim of minimizing air pollution to the environment. For instance mining companies have not systematically produced test results on air emitted to the environment and submitted the statutory reports inform of bi annual reports to the regulatory authorities. In addition, air released to the environment was up to 155% higher than ZEMA minimum standards in terms of Sulphur dioxide emissions. Dust, copper, arsenic and lead emissions to the environment were higher than the standards prescribed by ZEMA.

#### **b) Surface and Ground Water Pollution**

Surface water bodies are also being polluted. For instance, waste water released to the environment was polluted in that the pH value of water released was outside the parameters set by government of 6 to 7 to as low as 3 to 4. In addition, total suspended solids, dissolved solids, sulphates and chemical contents such as Total Copper, Total Cobalt, Total Manganese and Total Iron were higher than minimum standards set by ZEMA. Five(5) mines did not submit the test results/biannual reports for some periods contrary to environmental laws.

#### **c) Management of Dumps/Dams**

##### **i. Failure to Subject the Dumps to Assessments by a Competent Independent Person.**

Contrary to the section 17(1)(a) to (e) of the mines and minerals (environmental) regulations, 1997 that require that the developer shall obtain a report from an independent competent person(s) on each active dump stating the condition of the of the ground between a dump and all surface intersections of vertical planes drawn from the boundaries of any mine workings less than one hundred metres from the nearest edge of the dump; every matter which may affect the security or safety of the dump, ground or mine workings; any significant impact on the environment not originally predicted; and the progress made in implementing the environmental impact statement. The audit revealed that some mining companies did not subject the dumps to independent assessments.

As a result there is no guarantee that the dumps in question are safe

## **ii. Restricted Access**

Some mines have not effectively restricted access to tailings, slag, waste rock and overburden dumps. This has had the direct impact of increasing illegal mining activities which has in some cases lead to death. Furthermore, illegal mining on dumps undermines the stability of dumps thus posing the risk of landslides and in turn polluting adjacent land. The unstabilised surfaces or embankments of the dumps also pose a risk of soil erosion from runoff rain water or windblown erosion. The eroded materials end up polluting the aquatic and other surrounding environment.

## **iii. Lack of Warning and Safety Signs**

Mining companies have not placed warning and safety signs on the dumps thus exposing the general public to potentially risky situations especially that some dumps are very close to the communities.

## **iv. Failure to Carry out Progressive Re-Vegetation of The Wastes Dumps.**

While some mines have started to carry out progressive re-vegetation of the dumps, other mines have not re-vegetated the embankments and top beaches of the dumps. As a result, the waste is blown off by wind to surrounding environments. In some cases the unvegetated embankments have suffered water erosions which have resulted in the silts being discharged into the surrounding environments.

## **d) Used Oil Storage Facilities**

Mining companies are not following the laid down licencing conditions for storing and maintaining the used oil storage facilities. Six (6) mining companies did not adequately restrict access to the storage facility, three (3) mines did not mount warning and safety signs, ten (10) mines had oil spillages in or around their storage facilities resulting dangerous slippery surfaces. In addition, one (1) mine had no fire fighting equipment in the oil storage facility while four (4) mines had no first aid kits contrary to the licencing conditions. It was also noted that while it was a requirement by ZEMA that oil storage facilities are inspected periodically to avoid polluting the environment and hazards and inspection results recorded in a book to be kept at the storage facility, ten (10) mining companies had no inspection records on the used oil storage sites contrary to the regulations.

The risks associated with human and other species exposure to hash organic and chemical content are as follows:

- i. pH (Potential Hydrogen)** - Low pH in water bodies means that the water is highly acidic and this presents several risks, some of which are death of aquatic species such as fish, tadpoles and crayfish. Plants and animals are also harmed when exposed to acidic environments.
- ii. TDS (Total Dissolved Solids)** - A high concentration of TDS is an indicator that harmful contaminants, such as iron, manganese, sulphate, bromide and arsenic, are present in the water. Some of the diseases that may result as a result of high exposure to the above minerals include cancer, lung disease and body poisoning.
- iii. TSS (Total Suspended Solids)** - High concentrations of suspended solids can lower water quality by absorbing light. Waters then become warmer and lessen the ability of the water to hold oxygen necessary for aquatic life. Because aquatic plants also receive less light, photosynthesis decreases and less oxygen is produced. The combination of warmer water, less light and less oxygen makes it impossible for some forms of life to



exist. Suspended solids affect life in other ways. They can clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. Particles that settle out can smother fish eggs and those of aquatic insects, as well as suffocate newly-hatched larvae. The material that settles also fills the spaces between rocks and makes these microhabitats unsuitable for various aquatic insects, such as mayfly nymphs, stonefly nymphs and caddis fly larva.

- iv. **SO<sub>4</sub>(Sulphates)** \_Health concerns regarding sulphate in drinking water have been raised because of reports of diarrhoea associated with the ingestion of water containing high levels of sulphates. Particularly vulnerable to the ingestion of high levels of sulphates are infants and children.
- v. **TCu (Total Copper)** \_Too much copper can be toxic. One can get too much copper from dietary supplements, from drinking contaminated water, and from exposure to fungicides that contain copper sulphate. Excess copper in the liver can overflow and build up in the kidneys, brain, and eyes. This excess copper can kill liver cells and cause neurological damage. Excess copper can also interfere with how the human body absorbs zinc and iron.
- vi. **TC<sub>o</sub>(Total Cobalt)** \_Excess cobalt consumption through contaminated drinking water for humans can have dire effects. When too much cobalt is taken into a human body, harmful health effects can occur. Serious effects on the lungs, including asthma, pneumonia, and wheezing and skin rashes have been reported in people exposed to higher levels of cobalt. Some cancers are also reportedly caused by exposure to cobalt.
- vii. **TMn** \_The high toxicity of manganese is well documented to have caused diseases such as Parkinson's and Wilson's diseases.
- viii. **TFe(Iron)** \_Despite being an essential element in human nutrition, excessive consumption of iron plays a role in degenerative brain diseases, such as Parkinson's and Alzheimer's disease. Iron compounds such as FeCl<sub>2</sub> and FeSO<sub>4</sub> can form in water and may have negative impact upon health than iron does by itself. Healthy people are rarely affected by iron overdose although the risks are increased with excessive supplementation and drinking water exceptionally high in iron.

From the problems identified above, it is clear that the minimum standards that Government has put in place to safeguard the environment are not being strictly adhered to by the mining companies. This means therefore, that the Government's goal of protecting and managing the environment and natural resources in its entirety, balancing the needs for social and economic development and environmental integrity to the maximum extent possible, while keeping adverse activities to the minimum<sup>1</sup> is not being achieved. Failure to meet the goals set means that environmental protection and management is ineffective.

## **8.2. Measures that Government has put in place to ensure that the environmental degradations caused by mining activities are adequately managed are not working effectively and efficiently.**

### **a) Failure to review the implementation of the National Policy on Environment**

Although there was no separate policy to deal with environmental issues associated with mining companies, there is a Comprehensive National Policy on the Environment issued in November 2007 that has addressed and domesticated a number of regional and international protocols, treaties or conventions that Zambia has signed and ratified that deal with air, water and land pollution.

<sup>1</sup> Environmental Protection Policy 2007



The policy has also included protocols on how to manage toxic substances. Despite the National Policy on Environment being in place, the audit has revealed that since its launch in 2007 about six (6) years ago, the policy have not been reviewed to ascertain its suitability in implementation of environmental protection and control.

A review of responses to the questionnaire sent to ZEMA revealed that some of the provisions and obligations under some of the international protocols that have been domesticated into the policy demand costly technology and other technical resources which are still a challenge.

The risk of not reviewing the policy to ascertain its suitability in the implementation of the environmental directives renders the policy to be a mere statement of intent.

#### **b) Failure to Regulate and Enforce the Law.**

The goal and overall objective of Government on environment and natural resources of supporting Government's developmental priority of improving the quality of life of the people of Zambia through regulation and enforcement<sup>2</sup> of the laws has not been achieved. For instance, although the principal Act, the Environmental Protection and Pollution Control Act (EPPCA) of 1990 had been replaced with the Environmental Management Act (EMA) of 2011, the subsidiary legislation such as the Environmental Impact Assessment, Water and Air pollution regulations have not been reviewed despite funds being available. Furthermore, although the ministry responsible for mines reviewed, repealed and replaced the principal legislation the Mines and Mineral Act in 2008, the subsidiary legislation, the Mines and Mineral (Environmental) Regulations of 1997 and Environmental Protection Fund Regulation of 1998 were not reviewed, repealed or replaced. Failure to revise laws relating to the environment has led to among other things; continued pollution of water bodies, improper handling of waste and out-dated environmental practices.

#### **c) Poor management of the Environmental Protection Fund**

The Environment Protection Fund put in place by Government to secure the environment against future environmental liabilities that may arise in case the mines, fail to meet the environmental liabilities at closure of business is not working effectively. The management of the Fund was characterised by failure by mining companies to fully contribute to the Fund, mining companies providing bank bonds or guarantees not validated by the Bank of Zambia as required by laid down procedures and failure by management to take action against defaulting companies. The audit also revealed that the current Fund manager has no financial skills to manage the Fund effectively. Consequently, the investment portfolio has been restricted to cash and cash equivalents such fixed bank deposits despite the Fund's investment policy clearly stating that the investment portfolio should be diversified to include other hedging strategies such as government securities.

Based on the findings above, it is clear that MSD has not effectively implemented the requirements of the Environmental Protection Fund.

#### **d) Poor Monitoring and Evaluation of Environment Degradation Caused By Mining Companies.**

The current monitoring can be considered to be ineffective and does not meet the information requirements of the country's environmental monitoring objectives. ZEMA and MSD do not carry out independent sample testing of the air emissions and waste water effluent that the mines are releasing to the environment as they had not set up and registered the laboratories to be used to test the samples collected. Instead, ZEMA and MSD have relied upon the test

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2 Environmental Protection Policy 2007

results that the mining companies have submitted to ZEMA through bi – annual reports despite Government having procuring the monitoring equipment. The audit also showed that some laboratory equipment had not been calibrated while some of the equipment was non-operational.

In some instances, bi-annual reports are not submitted by the mining companies as stipulated in the laws or licencing conditions. Both ZEMA and MSD lacked adequate staff to carry out effective monitoring and evaluation.

The implication of relying on biannual reports are that detection of the air and water pollution was left too late i.e. after six months after it has occurred and that the test results provided by mining companies may have been understated rendering them unreliable.

It is clear from the information above that the objectives as set by government in National Policy on the Environment of building individual and institutional capacity to sustain the environment are not being realised.

## 9. RECOMMENDATIONS

The audit findings and conclusions have revealed that there are many weaknesses in the management of mining activities in Zambia. Based on the findings mentioned above the Office of the Auditor General recommends as follows:

### 9.1. Air, Ground and Surface Water Pollution

ZEMA should ensure that air released to the environment by mining companies does not exceed the minimum set parameters. Companies that are polluting the air should be held accountable.

Mines should submit bi annual reports as stipulated in licensing conditions. ZEMA should carry out their own sampling, testing and analysis of emissions and effluences to confirm information provided by mining companies.

### 9.2. Management of Dumps/Dams

ZEMA and MSD should ensure that dumps and dams are managed properly by ensuring that:

#### a) Restricted Access

Tailings, slag and overburden dumps should be secured and entry restricted to authorised personnel only. This will safeguard not only the public from exposure to contaminated materials but also the integrity and stability of the dumps to avoid pollution of the environment from both air and water erosion of the loose particles. In addition, illegal mining will be curbed.

ZEMA should also sensitise the public on the dangers of accessing such restricted areas.

#### b) Lack of warning and safety signs

All tailings, slag and overburden facilities should have hazardous, warning and safety signs displayed at appropriate places.

#### c) Progressive Re-vegetation

Progressive rehabilitation, including vegetation management should be carried out regularly in line with licensing conditions and other guidelines.

#### d) Proximity of residential areas to the dams/dumps

In line with licensing conditions, there should be no residential areas within 500metres of tailings, slag and overburden dumps. In addition, the practice of communities cultivating vegetables on the toe of dumps should be halted forthwith. Where need arises, Government in collaboration with the mining companies should consider relocating affected communities.

### 9.3. Used Oil Storage Facilities

All used oil storage facilities should have bunded and impermeable floors, adequate ventilation, warning and safety signs and restricted access at all times. In addition, fire fighting equipment and fully stocked first aid kits should always be available at these facilities. These facilities should be inspected periodically and ensure that inspection records are readily available for inspection by regulatory authorities.

### 9.4. Policy formulation

ZEMA and the ministry responsible for environmental protection should review the National Policy to assess its suitability for implementation in protecting the environment.

### **9.5. Development and enforcement of legislation**

The statutory instruments on Environmental Impact Assessment (EIA), Water and Air Pollution Control regulations should be reviewed to address changes in mining practices. Furthermore, legislation on all producer responsibility for all companies generating waste should be developed and implemented.

### **9.6. Environment Protection Fund**

MSD should ensure that all mines that are required to contribute to the Fund are compelled to do so and necessary action should be taken against defaulters.

All bank accounts held by EPF should be brought to the fore and reconciled by competent personnel. In addition, the Ministry of Mines should ensure that a competent person is deployed to manage the funds on behalf of Mine Safety Department and the EPF committee as a matter of urgency.

The EPF funds should be invested in such a way as to ensure that the time value of money is maintained and the risk of the investments is diversified as per the investment policy.

# Appendix 1

## Name of Mines and Facilities Visited

Name of mine	List of facilities emitting air to the environment- Stack emissions	List of facilities discharging effluent to the environment -ground water	List of facilities discharging effluent to the environment – surface water
1. Bwana Mkubwa	Nil		1. Little Mukulungwe -Upstream Site SW2 2. Little Mukulungwe -Downstream Site SW3
2. Chambeshi Copper Smelter (CCS)	1. Chimney 1 2. Anode furnace 3. Slag cleaning furnace	1.Sulphuric Acid storage plant	3. smelter drain 4. Acid plant drain
3. Chambeshi Metals	Nil		5. New dam overflow -SW13
4. Chibuluma South Mine	Nil		6. Effluent Water 7. Musakashi dam effluent discharge
5. Non Ferrous Copper Mine Africa (NFCA)	Nil		8. Combined drain leading to TD6 9. TD6 overflow effluent quality 10. Water treatment ponds overflow 11. Water treatment ponds overflow drain effluent quality
6. Konkola Copper Mine (KCM) - Konkola	Nil		12. Lubengele dam into Lubengele stream 13. Engineering workshop overflow into Lubengele stream 14. Plant overflow into Kakosa Stream
7. Konkola Copper Mine (KCM)-Nchanga	4 Cobalt recovery furnace		15. PCD Spillway 16. Muntimpa spillway 17. Combined concentrator drain into Nchanga Stream 18. Nchanga open pit spillage into Nchanga stream
8. Konkola Copper Mine (KCM)-Nkana	Nil	2.Acid loading bay	19. South Uchi
9. Luanshya Copper Mine(LCM)	Nil		20. Musi dam into Luanshya stream
10. Maamba Collieries	Nil		21. Mine effluent 22. Downstream -Izuma stream
11. Mopani Copper Mine (MCM) - Mufulira	5 Converter slag blow 6. Converter copper blow 7. Matte settling furnace	3.Concentrate shed borehole no. 9 4.Acid loading bay 5. Borehole no. 18 between Tank house	23. TD 11 spillway 24. Mufurira west discharge
12. Ndola lime	8. Vertical Kiln 9. Horizontal Kiln 10. Hydrator		25. Chilanga 26. Kafubu
13. Mopani Copper Mine (MCM) - Nkana	11. Cobalt plant	6. Old CVW 7. Cobalt plant deep aquifer 8.Cobalt plant shallow aquifer	27. North Uchi
14. Kansanshi Mining	Nil		28. Concentrator
15. Lumwana Mining Company	Nil		
16. KONNOC	Still under development	Still under development	Still under development

## Appendix 2

### Environmental Protection Fund Performance Estimates As At 30 April 2012 (US\$)

Mine facility (Large Scale)	Category	Total Closure Cost US\$	Bank Guarantee US\$	Cash Contribution US\$	Lodged Cash US\$	Bank Guarantee Lodged US\$
Mbuva - Chibolele Emerald Project	2	221,493	208,203	13,290	13,290	-
Grizzly Mine	2	286,174	269,004	17,170	17,170	-
Kagem Mine	2	224,889	206,871	13,493	21,248	206,871
Kansanshi Mine	3	8,665,284	7,625,450	1,039,834	1,039,834	7,625,450
Konkola Mine	1	21,542,037	20,895,776	646,261	705,306	-
Nampundwe Mine	1	2,353,151	2,282,556	70,595	87,586	-
Nchanga Mine	1	73,953,947	71,735,329	2,218,618	1,983,587	-
KCM Nkana mine	1	19,947,100	19,348,687	598,413	628,389	-
Ndola & Lusaka plants	3	3,635,770	3,344,908	290,862	290,862	-
Lumwana Mining	1	10,468,483	10,259,113	209,370	314,055	10,259,113
Bwana Mkubwa Mine	2	1,404,640	1,292,269	84,278	112,371	1,348,454
Kafironda Factory	3	227,939	200,586	27,353	27,353	-
Chambishi Copper Smelter	2	1,636,191	1,538,020	98,171	98,171	1,505,296
Chambishi Metals	2	4,257,999	4,002,519	255,480	255,480	-
CLM Operations	2	7,974,293	7,495,835	478,458	348,009	14,499,401
CLM Decom & Classified	3	1,995,455	1,756,000	239,455	146,381	-
Muliashi Copper Project	2	5,963,988	5,606,149	357,839	155,875	-
Maamba Collieries	3	15,858,167	13,955,187	1,902,980	200,000	-
Chibuluma South Mine	2	967,244	909,209	58,035	58,035	-
Chibuluma East West Mines	3	1,369,147	1,204,849	164,298	164,298	-
Nkana Mine	2	14,667,797	13,787,729	880,068	1,300,534	-
Mufulira Mine	2	14,047,859	13,007,880	842,872	1,442,675	-
Ndola Lime	3	2,767,005	2,434,964	332,041	331,693	-
Chambishi Mine	2	5,024,500	4,723,030	301,470	301,470	-
Chambishi Factory & Sanfex	3	196,917	173,287	23,630	23,630	-
Kabwe Operations	2	453,461	426,253	27,208	27,208	-
Sino Metals Leach	3	460,000	404,800	55,200	55,200	-
Zambezi Portland Cement	3	2,118,361	2,033,627	84,734	84,734	-
Munali nickel mining project	1	2,397,689	2,325,758	71,931	71,930	-
Collum Coal Mining Industries.	2	234,538	220,466	14,072	4,692	4,522,050
<b>SUB-TOTAL</b>		<b>225,321,518</b>	<b>213,674,314</b>	<b>11,417,479</b>	<b>10,311,066</b>	<b>39,966,635</b>

**Source: Mine Safety Department**

## Appendix 2

(Cont)Environmental Protection Fund Performance Estimates As At 30April 2012 (US\$)

Mine facility (Small Scale)	Category	Total Closure Cost US\$	Bank Guarantee US\$	Cash Contribution US\$	Lodged Cash US\$	Bank Guarantee Lodged US\$
Calustone emerald mine	2	20,089	18,884	1,205	-	-
Zebesha mine	3	160,872	141,567	19,305	-	-
Demar emerald mine	3	95,592	84,121	11,471	7,648	-
Mununga Quarry	3	98,335	86,535	11,800	1,967	-
Hi-Qwalime mine	3	35,604	31,332	4,272	4,272	-
Scirocco Enterprises	3	50,336	35,138	6,040	15,198	-
Ebenezer mine	3	100,390	88,343	12,047	-	-
United Quarries	3	191,356	168,393	22,963	-	-
Santas emerald mine	3	35,298	31,062	4,236	-	-
Luwingu Quarry	3	82,100	72,248	9,852	3,284	-
Aggregates	2	74,199	69,747	4,452	4,308	-
Shimabala Quarry	3	18,130	15,954	2,176	725	-
Sinda quarry	3	89,400	78,672	10,728	3,576	-
Arius emerald mines	1	40,928	39,699	1,228	1,229	-
E & M Storti mine	3	107,162	94,303	12,859	9,244	-
Mapatizya Mine Site	3	40,417	37,184	3,233	1,617	-
Nkana General Dealers	3	20,089	18,482	1,607	834	-
Lions Group Quarries	3	32,860	30,231	2,629	-	-
Dabwisa Emeralds Mines	3	35,298	32,474	2,824	1,119	69,612
Gemfields						
<b>SUB-TOTAL</b>		<b>1,328,455</b>	<b>1,174,369</b>	<b>144,927</b>	<b>55,021</b>	<b>69,612</b>
<b>GRAND TOTAL</b>		<b>226,649,973</b>	<b>214,848,683</b>	<b>11,562,406</b>	<b>10,366,087</b>	<b>40,036,247</b>

Source: Mine Safety Department



## Appendix 3

### Bank balances as at April 2012

Bank	Account No	Period	Type	Status	Interest US\$	Bank Balance (US\$) Cr	Balance ZMW
Stanbic	0223035954400		Fixed Deposit	Dormant			
	0223035954401		Fixed Deposit	Active	36,562.22		188,295,433
	022303594402		Fixed Deposit	Dormant			
	022303594403		Fixed Deposit	Dormant			
	022303594404		Fixed Deposit	Active			
	0240035954401	As at 30 <sup>th</sup> April, 2012	Current	Active		4,032,729.29	20,768,555,840
Standard Chartered	8700212888000	As at 23 <sup>rd</sup> April, 2012	Current	Active		1,001,619	5,158,337,850
Investrust	80419252	As at 23 <sup>rd</sup> April, 2012	Fixed Deposit	Active	39,166.38	951,426.80	4,899,848,020
	80419252	As at 23 <sup>rd</sup> April, 2012	Fixed Deposit	Active	59,807.79	1,623,682.79	8,361,966,369
Barclays	01 – 1044778	As at 23 <sup>rd</sup> April, 2012	Treasury Deposit	Active	4,687.20	837,000	4,310,550,000
	01-1047467	As at 23 <sup>rd</sup> April, 2012	Current	Active		542,590.78	2,794,342,517
Total					140,223.59	8,989,048.66	46,293,600,600
Total in ZMW					722,151,488.5		

Source: Mine Safety Department

## Appendix 4

### Assets Procured under CEP in 2009

	NAME OF EQUIPMENT	QTY	AMOUNT ZMW
1	Opsis SM200 particulate Analyser for PM10 and PM 2.5	1	277,522
2	Teledyne - API Model 100E SO2 Analyser	1	76,065
3	Teledyne - API Model 200E NO2 Analyser	1	82,058
4	Teledyne - API Model 400E O3 Analyser	1	60,852
5	PCF Model 528 BTX Analyse	1	277,522
6	Zero Air Generator System for model 528	1	-
7	Opsis D256 Data logger	1	38,724
8	Meteorological measurement system	1	30,426
9	Contractor's Caravan to house equipment	1	132,307
10	Long Term water Quality and level monitor	1	49,723
11	Bottom Sample	1	40,556
12	Dust/Particulate sampling Kit	1	8,720
13	Hydro Carbon Analyser	1	54,532
14	Geiger Counter Radiation Meter	1	6,638
15	Refrigerant Identifier	4	68,228
16	Land Measuring wheel	3	4,949
17	Radiation Meter	2	3,603
18	Rotameter	1	1,288
19	PH Meter Case & PH Meter	1	1,542
20	DO Data meter	1	3,225
21	Conductivity meter	1	2,261
22	Sidekick Sample Pump	1	9,465
23	Turbidity meter	1	2,337
24	Ambient Sampling Machine	1	3,787
25	Ground Water Sampling Pump	1	45,275
26	Generator Yanmar	1	15,983
27	Trace Metals Analyser	2	137,072
28	Trace Metals Analyser	1	69,201
29	Deioniser	3	57,309
	compact balance	2	17,325
30	Magnetic stirrer	2	15,924
31	Portable monitoring system	2	28,980
32	Ambient Sampling Machine	2	313,344
33	Portable monitoring system	1	14,746
34	Ambient Sampler	2	22,721
35	Dust Detector	1	31,360
36	740 monitor	2	14,249
37	Water quality level meter	1	53,975
38	Multi parameter display system	1	6,783
39	Current flow meter	1	23,763
40	Gas monitoring Equipment	1	27,262
41	Multi parameter water Quality monitoring	1	19,881
42	Multiprobe System Data logger	1	11,076

## Appendix 4(cont)

Assets Procured under CEP in 2009

	NAME OF EQUIPMENT	QTY	AMOUNT ZMW
43	Out board Engine Evinrude	1	68,395
44	PH Meter Meter	1	1,542
45	Conductivity meter	1	2,261
46	Turbidity meter	1	2,337
47	Sound level meter	1	3,005
48	Do meter	1	5,687
49	GPS (ExTrex Summit)	1	2,071
50	land Measuring wheel	1	1,650
51	HP Laptop Computer	1	7,184
52	Cyanide Meter	1	1,619
53	Sulphate meter	1	1,635
54	Dota Data Meter	1	3,225
55	PH Meter (Portable PH Meter)	1	1,542
56	Conductivity meter	1	27,262
57	Turbidity meter	1	2,337
58	Generator Yanmar	1	15,983
59	Ground Water Sampling Pump	1	45,275
60	Trace Metals Analyser	1	68,536
61	Portable monitoring Equipment(Pertol Sensor)	1	14,746
62	Tur bidity 740 Monitor	1	7,124
63	Current flow meter	1	23,764
64	Gas monitoring Equipment	1	27,262
65	MultiProbe System Data logger(portable)	1	11,076
66	Opsis SM200 particulate Analyser for PM10 and PM 2.5	1	277,577
67	Teledyne- API Model 100E SO2 Analyser	1	76,065
68	Teledyne- API Model 200E NO2 Analyser	1	82,058
69	Teledyne- API Model 400E SO2 Analyser	1	60,852
70	PCF Model 530 BTX Analyser	1	277,522
71	Zero Air Generator System for model 530 BTX Analyser	1	-
72	Opsis DL256 Datalogger	1	38,724
73	Meteorological measurement system	1	30,426
74	Contractor's Caravan to house equipment	1	132,307
	<b>Total</b>		<b>3,483,601</b>

source: ZEMA

# Appendix 5

## Air Pollution - Sulphur dioxide (SO<sub>2</sub>)

	Name of mine and facility	Chambishi Copper Smelter- Chimney 1	Chambishi Copper Smelter-Anode Furnace	Chambishi Copper Smelter-Slag cleaning furnace	Konkola Copper Mine - Nchanga SBU- Cobalt recovery furnace	Mopani Copper Mine - Mufulira SBU-Converter slag blow	Mopani Copper Mine - Mufulira SBU-Converter copper blow	Mopani Copper Mine - Mufulira SBU-Acid plant	Mopani Copper Mine -Nkana - Cobalt plant
		mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>	mg/Nm <sup>3</sup>
ZEMA statutory limits		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2009	Jan	*Dev	Dev	Dev	Dev	26,676	20,007	6,773	No results
	Feb	Dev	Dev	Dev	Dev	38,109	33,345	6,574	No results
	Mar	Dev	Dev	Dev	Dev	46,112	28,582	6,860	No results
	Apr	Dev	Dev	Dev	Dev	Care and maintenance	Care and Maintenance	7,529	131,475
	May	Dev	Dev	Dev	Dev	17,149	17,149	7,834	52,161
	Jun	Dev	Dev	Dev	Dev	30,487	40,014	8,051	93,366
	Jul	Dev	Dev	Dev	Dev	72,407	40,014	7,731	96,835
	Aug	Dev	Dev	Dev	Dev	38,109	40,014	7,606	90,318
	Sep	Dev	Dev	Dev	Dev	28,582	60,021	8,832	102,894
	Oct	Dev	Dev	Dev	Dev	94,314	34,298	9,140	81,458
	Nov	Dev	Dev	Dev	Dev	28,582	83839	8,919	90,508
	Dec	Dev	Dev	Dev	Dev	47,159	36203	No results	57,163
2010	Jan	**No results	No results	No results	Dev	70,501	55,258	No results	62,880
	Feb	No results	No results	No results	Dev	28581.6	621879	8241	45,731
	Mar	No results	No results	No results	Dev	28,582	28,582	5,691	27,153
	Apr	No results	No results	No results	Dev	15,244	45,731	12,993	51,447
	May	No results	No results	No results	Dev	No results	No results	No results	51,447
	Jun	No results	No results	No results	Dev	69,739	34,298	8,017	96,034
	Jul	No results	25.72	No results	200.07	24,770	28,582	8,017	45,731
	Aug	No results	314.4	No results	1524.35	Care and maintenance	Care and Maintenance	12,566	51,447
	Sep	No results	0	No results	148.6	24,771	45,731	11,118	90,032
	Oct	No results	2544	No results	0	47,636	38,109	14,291	147,195
	Nov	No results	56.21	No results	785.99	47,636	38,109	475.4	90,508
	Dec	No results	2276.5	No results	161.96	27,152	36,203	3,263	131,475
2011	Jan	1137	72.88	41.92	89.56	35,727	47,160	9,520	135,286
	Feb	1332	2550.19	733.83	172.92	35,013	35,727	10,290	66,690
	Mar	1227	314.4	1313.8	1876.86	34,299	34,298	9,864	33,345
	Apr	1306	35.25	16.2	148.62	No results	No results	8,303	112,420
	May	1314	487.32	28.58	0	22,865	47,636	5,870	85,745
	Jun	No results	43.59	40.01	113.37	61,927	48,589	8,592	155,769
	Jul	No results	No results	No results	295.11	24,771	30,487	5,976	93,367
	Aug	No results	No results	No results	50.02	60,021	53,352	8,316	128,617
	Sep	No results	No results	No results	257.2	41,920	95,272	8,841	***Care and maintenance
	Oct	1045	No results	No results	122.9	95,272	57,163	8,963	Care and maintenance
	Nov	1030	No results	No results	148.6	66,690	47,637	9,370	Care and maintenance
	Dec	1070	No results	No results	No results	No results	47,636	No results	Care and maintenance
	Source: Bi annual reports submitted to ZEMA by the Mining Companies								
	*Dev- means that mine was under going development stage								
	** No results means that mine did not submit return or test results contrary to air pollution regulations								
	***Care and maintenance- means that mine facility was shut down for care and maintenance								
	**** Ndola lime did not analyse for Sulphur dioxide (SO <sub>2</sub> )								
	DATA ANALYSIS								
Minimum value		1030.0	0.0	16.2	0.0	15243.5	17149.0	475.4	27152.5
Median value		1182.0	193.6	41.0	148.6	36917.9	40014.0	8303.0	90317.9
Maximum value		1332.0	2550.2	1313.8	1876.9	95272.0	621879.0	14291.0	155769.0
Average value		1182.6	726.7	362.4	358.6	43470.9	62287.7	8311.4	86155.0
No returns/results		15	12	18	1	3	2	4	2
No. Above ZEMA limit		8	3	1	2	30	31	30	29
No Measurements		15	12	18	1	3	2	4	3
No. 30x above limit		0	0	0	0	19	27	0	28

# Appendix 6

## Air Pollution – Dust

Name of Mine	Chambishi Copper Smelter Chimney 1	Chambishi Copper Smelter Anode Furnace	Chambishi Copper Smelter Slag cleaning furnace	Konkola Copper Mine - Nchanga SBU Cobalt recovery furnace	Mopani Copper Mine - Mufulira Converter slag blow	Mopani Copper Mine - Mufulira Converter copper blow	Mopani Copper Mine - Mufulira Matte settling furnace	Mopani Copper Mine - Nkana Cobalt plant	Ndola Lime Vertical Kiln	Ndola Lime Horizontal Kiln	Ndola Lime Hydrator
ZEMA statutory limit	50	50	50	50	50	50	50	50	50	50	50
2009	Jan	**Dev	Dev	Dev	Dev	914	643	No Results	no results	No return	No return
	Feb	Dev	Dev	Dev	Dev	270	584	No Results	no results	No return	No return
	Mar	Dev	Dev	Dev	Dev	793	425	No Results	no results	No return	No return
	Apr	Dev	Dev	Dev	Dev	No Results	No Results	No Results	no results	No return	No return
	May	Dev	Dev	Dev	Dev	490	856	No Results	no results	No return	No return
	Jun	Dev	Dev	Dev	Dev	763	1,431	No Results	no results	No return	No return
	Jul	Dev	Dev	Dev	Dev	938	1,364	90	221	No return	No return
	Aug	Dev	Dev	Dev	Dev	526	527	176	216	No return	No return
	Sep	Dev	Dev	Dev	Dev	827	409	122	156	No return	No return
	Oct	Dev	Dev	Dev	Dev	275	357	173	260	No return	No return
	Nov	Dev	Dev	Dev	Dev	620	1,102	No Results	231	No return	No return
	Dec	Dev	Dev	Dev	Dev	240	892	No Results	239	No return	No return
2010	Jan	*	***No return	No return	Dev	727	539	248	1,242	1,868	No return
	Feb	*	No return	No return	Dev	2,140	1,658	No Results	490	2,076	No return
	Mar	*	No return	No return	Dev	646	698	101	550	2,817	No return
	Apr	*	No return	No return	Dev	496	409	262	162	2,096	No return
	May	*	No return	No return	Dev	no results	no results	no results	346	2,622	No return
	Jun	*	No return	No return	Dev	736	634	101	357	2,306	No return
	Jul	*	226	444	208	577	1,195	35	490	No return	No return
	Aug	*	192	190	1,955	Care and Maintenance	Care and Maintenance	33	162	No return	No return
	Sep	*	376	96	734	370	466	72	448	No return	No return
	Oct	*	165	46	73	500	367	68	791	No return	No return
	Nov	*	200	357	191	503	612	248	185	No return	No return
	Dec	*	204	434	1,413	450	232	63	332	No return	No return
2011	Jan	*	1,982	169	276	416	395	58	536	3,238	360 L
	Feb	*	162	445	288	598	485	197	211	3,190	180
	Mar	*	67	1,253	1,362	554	503	208	291	2,799	223
	Apr	*	4	13	94	-	-	644	410	2,852	142
	May	*	143	237	25	365	242	74	106	3,285	190
	Jun	*	584	358	957	323	999	169	533	3,005	196
	Jul	*	No return	No return	773.27	891	741	194	275	No return	No return
	Aug	*	No return	No return	256.9	1,185	1,353	24	1,027	No return	No return
	Sep	*	No return	No return	238.3	1,020	683	345	Care and maintainace	No return	No return
	Oct	*	No return	No return	302.7	1,068	1,959	118	Care and maintainace	No return	No return
	Nov	*	No return	No return	1442.4	636	505	153	Care and maintainace	No return	No return
	Dec	*	No return	No return	No return	no result	75	112	Care and maintainace	No return	No return
	Source: Biannual reports submitted to ZEMA by the Mining Companies										
	* Chambishi copper metals did not assess the dust parameter										
	**Dev - mine was under development										
	*** No return- Mine did not submit return contrary to air pollution regulations										
	Minimum value		4.0	13.1	24.8	239.7	75.1	23.8	105.5	1868.0	142.0
	Median value		196.0	297.0	288.3	598.0	598.0	119.8	311.3	2808.0	193.0
	Maximum value		1982.2	1253.2	1955.0	2140.4	1959.0	644.0	1242.1	3285.0	360.0
	Average value		358.8	336.8	622.9	672.9	729.4	157.1	394.8	2679.5	215.2

# Appendix 7

## Air Pollution – Arsenic (As)

Name of Mine		Chambishi Copper Smelter Chimney 1	Chambishi Copper Smelter Anode Furnace	Chambishi Copper Smelter Slag cleaning furnace	Konkola Copper Mine - Nchanga SBU Cobalt recovery furnace	Mopani Copper Mine - Mufulira Converter slag blow	Mopani Copper Mine - Mufulira Converter copper blow	Mopani Copper Mine - Mufulira Matte settling furnace	Mopani Copper Mine - Nkana Cobalt plant	Ndola Lime Vertical Kiln	Ndola Lime Horizontal Kiln	Ndola Lime Hydrator
<b>ZEMA statutory limits</b>		<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>
<b>2009</b>	Jan	Dev	Dev	Dev	Dev	2.25	0.38	no results	no results	No Return	No Return	No Return
	Feb	Dev	Dev	Dev	Dev	0.08	0.35	no results	no results	No Return	No Return	No Return
	Mar	Dev	Dev	Dev	Dev	0.11	0.07	no results	no results	No Return	No Return	No Return
	Apr	Dev	Dev	Dev	Dev	No Return	No Return	no results	no results	No Return	No Return	No Return
	May	Dev	Dev	Dev	Dev	1.61	1.42	no results	no results	No Return	No Return	No Return
	Jun	Dev	Dev	Dev	Dev	8.37	0.84	no results	no results	No Return	No Return	No Return
	Jul	Dev	Dev	Dev	Dev	2.08	0.54	No Results	no results	No Return	No Return	No Return
	Aug	Dev	Dev	Dev	Dev	2.03	0.51	0.97	no results	No Return	No Return	No Return
	Sep	Dev	Dev	Dev	Dev	1.80	0.28	No Results	no results	No Return	No Return	No Return
	Oct	Dev	Dev	Dev	Dev	0.67	0.56	0.64	no results	No Return	No Return	No Return
	Nov	Dev	Dev	Dev	Dev	0.55	0.66	No Results	no results	No Return	No Return	No Return
	Dec	Dev	Dev	Dev	Dev	1.09	1.51	No Results	no results	No Return	No Return	No Return
<b>2010</b>	Jan	No Return	No Return	No Return	Dev	37.01	20.4	1.13	1.3	No Return	No Return	No Return
	Feb	No Return	No Return	No Return	Dev	38.79	7.99	No Results	0.28	No Return	No Return	No Return
	Mar	No Return	No Return	No Return	Dev	0.63	0.14	No Results	0.15	No Return	No Return	No Return
	Apr	No Return	No Return	No Return	Dev	1.16	0.63	2.6	0.32	No Return	No Return	No Return
	May	No Return	No Return	No Return	Dev	No Results	No Results	No Results	0.096	No Return	No Return	No Return
	Jun	No Return	No Return	No Return	Dev	0.58	0.25	No Results	6.6	No Return	No Return	No Return
	Jul	*	0	****L	0	0.17	0.12	0.06	0.28	No Return	No Return	No Return
	Aug	*	0	L	0	Care & maintenance	Care & maintenance	0.09	0.32	No Return	No Return	No Return
	Sep	*	0	L	0	0.84	0.55	0.21	0.26	No Return	No Return	No Return
	Oct	*	0.47	L	0.07	1.18	0.71	0.33	0.23	No Return	No Return	No Return
	Nov	*	0.75	L	0.08	6.44	4.86	0.29	0.32	No Return	No Return	No Return
	Dec	*	4.19	L	0.7	3.16	2.54	0.72	0.25	No Return	No Return	No Return
<b>2011</b>	Jan	*	2.36	0.45	0.33	2.92	0.66	0.49	0.41	No Return	No Return	No Return
	Feb	*	3.31	0.31	0.22	2.08	0.96	8.51	0.27	No Return	No Return	No Return
	Mar	*	3.76	0.75	0.67	3.77	5.79	1.71	1.59	No Return	No Return	No Return
	Apr	*	0.22	0.07	0.04	No Results	No Results	1.17	1.02	No Return	No Return	No Return
	May	*	2.36	0.28	0.16	0.76	0.65	0.84	0.21	No Return	No Return	No Return
	Jun	*	9.59	0.42	5.89	1.06	0.3	0.45	0.42	No Return	No Return	No Return
	Jul	No Return	No Return	No Return	1.19	1.68	0.35	1.00	0.21	No Return	No Return	No Return
	Aug	No Return	No Return	No Return	0	7.29	1.59	0.25	no results	No Return	No Return	No Return
	Sep	No Return	No Return	No Return	No Result	4.36	1.92	1.48	Care and Ma	No Return	No Return	No Return
	Oct	No Return	No Return	No Return	0.44	7.11	1.54	1.5	Care and Ma	No Return	No Return	No Return
	Nov	No Return	No Return	No Return	0.16	5.49	5.46	0.38	Care and Ma	No Return	No Return	No Return
	Dec	No Return	No Return	No Return	No Return	no result	0.13	0.3	Care and Ma	No Return	No Return	No Return
Source: Bi annual reports submitted to ZEMA by the Mining Companies												
* Chambeshi copper metals did not assess the Arsenic (As) parameter												
**Dev - mine was under development												
*** No return- Mine did not submit return contrary to air pollution regulations												
****L- Means that the parameter was lower than set limit of 0.5mg/Nm <sup>3</sup>												
<b>Minimum value</b>			0.0	0.1	0.0	0.1	0.1	0.1	0.1	N/A	N/A	N/A
<b>Median value</b>			1.6	0.4	0.2	1.8	0.7	0.7	0.3	N/A	N/A	N/A
<b>Maximum value</b>			9.6	0.8	5.9	38.8	20.4	8.5	6.6	N/A	N/A	N/A
<b>Average value</b>			2.3	0.4	0.6	4.7	2.0	1.1	0.8	N/A	N/A	N/A
<b>No returns</b>			12	12	1	1	1	0	0	36	36	36
<b>No. Above limit</b>			7	1	4	28	22	12	4	N/A	N/A	N/A
<b>No. Measurements</b>			0	0	0	2	2	14	13	N/A	N/A	N/A



# Appendix 8

## Air Pollution – Copper (Cu)

			Chambeshi Copper Smelter Chimney 1	Chambeshi Copper Smelter Anode Furnace	Chambeshi Copper Smelter Slag cleaning furnace	Konkola Copper Mine - Nchanga SBU Cobalt recovery furnace	Mopani Copper Mine - Mufulira Converter slag blow	Mopani Copper Mine - Mufulira Converter copper blow	Mopani Copper Mine - Mufulira Matte settling furnace	Mopani Copper Mine - Nkana Cobalt plant	Ndola Lime Vertical Kiln	Ndola Lime Horizontal Kiln	Ndola Lime Hydrator
	ZEMA statutory limit		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2009	Jan	Dev	**Dev	Dev	Dev	Dev	54.21	1.147	No results	No results	No Return	No Return	No Return
	Feb	Dev	Dev	Dev	Dev	Dev	29.54	106.3	No results	No results	No Return	No Return	No Return
	Mar	Dev	Dev	Dev	Dev	Dev	2.98	3.515	No results	No results	No Return	No Return	No Return
	Apr	Dev	Dev	Dev	Dev	Dev	No results	No results	No results	1.04	No Return	No Return	No Return
	May	Dev	Dev	Dev	Dev	Dev	113	263.7	No results	0.88	No Return	No Return	No Return
	Jun	Dev	Dev	Dev	Dev	Dev	59.45	132	No results	0.303	No Return	No Return	No Return
	Jul	Dev	Dev	Dev	Dev	Dev	100.6	395.9	1.08	0.12	No Return	No Return	No Return
	Aug	Dev	Dev	Dev	Dev	Dev	89.3	219	3.15	0.71	No Return	No Return	No Return
	Sep	Dev	Dev	Dev	Dev	Dev	167	74.2	3.11	0.17	No Return	No Return	No Return
	Oct	Dev	Dev	Dev	Dev	Dev	130.0	854	4.23	0.23	No Return	No Return	No Return
	Nov	Dev	Dev	Dev	Dev	Dev	64.2	316.4	No results	0.23	No Return	No Return	No Return
	Dec	Dev	Dev	Dev	Dev	Dev	3.09	313.4	No results	0.38	No Return	No Return	No Return
2010	Jan	No Return	***No Return	No Return	No Return	No Return	145.2	77.8	3.71	4.5	No Return	No Return	No Return
	Feb	No Return	No Return	No Return	No Return	No Return	49.7	-	No results	5.7	No Return	No Return	No Return
	Mar	No Return	No Return	No Return	No Return	No Return	42.08	120.7	3.43	2.1	No Return	No Return	No Return
	Apr	No Return	No Return	No Return	No Return	No Return	49.79	58.32	4.86	1.88	No Return	No Return	No Return
	May	No Return	No Return	No Return	No Return	No Return	No results	No results	No results	0.51	No Return	No Return	No Return
	Jun	No Return	No Return	No Return	No Return	No Return	66.16	70.02	2.07	21.2	No Return	No Return	No Return
	Jul	*		0	0	0	20.84	195.2	0.56	5.7	No Return	No Return	No Return
	Aug	*		0	0	0	Care & Maintenance	Care & Maintenance	0.71	1.88	No Return	No Return	No Return
	Sep	*		0	0	0	32.36	94.35	0.83	0.17	No Return	No Return	No Return
	Oct	*		2.32	1.18	1.1	19.95	4.17	1.36	0.39	No Return	No Return	No Return
	Nov	*		18.12	31.3	8.41	24.97	7.86	1.66	1.83	No Return	No Return	No Return
	Dec	*		52.87	48.1	16.12	13.43	7.86	1.66	0.43	No Return	No Return	No Return
2011	Jan	*		732.2	13.08	10.94	15.49	24.9	1.81	0.93	No Return	No Return	No Return
	Feb	*		30.78	100.2	19.76	15.19	5.88	45.92	1.7	No Return	No Return	No Return
	Mar	*		13.35	219.3	199.5	24.57	14.49	2.98	5.07	No Return	No Return	No Return
	Apr	*		2.69	2.67	4.96	No results	No results	12.43	0.05	No Return	No Return	No Return
	May	*		32.51	49.19	2.38	16.12	33.38	2.99	1.88	No Return	No Return	No Return
	Jun	*		132.1	19.68	33.69	7.85	130.8	2.09	11.47	No Return	No Return	No Return
	Jul	No Return	No Return	No Return	No Return	199.2	1.24	1.25	2.1	1.06	No Return	No Return	No Return
	Aug	No Return	No Return	No Return	No Return	15.79	40.55	287.6	0.52	4.82	No Return	No Return	No Return
	Sep	No Return	No Return	No Return	No Return	87.66	16.35	18.73	4.56	Care and Ma	No Return	No Return	No Return
	Oct	No Return	No Return	No Return	No Return	38	61.8	844	2.23	Care and Ma	No Return	No Return	No Return
	Nov	No Return	No Return	No Return	No Return	51.8	19.00	4.61	2.17	Care and Ma	No Return	No Return	No Return
	Dec	No Return	No Return	No Return	No Return	No results	No results	3.62	2.38	Care and Ma	No Return	No Return	No Return
	Source: Bi annual reports submitted to ZEMA by the Mining Companies												
	* Chambeshi copper metals did not assess the copper (Cu) parameter												
	**Dev - mine was under development												
	*** No Return- Mine did not submit return contrary to air pollution regulations												
	****L- Means that the parameter was lower than set limit of 0.5mg/Nm <sup>3</sup>												
	Minimum value		0.0	0.0	0.0	0.0	1.2	1.1	0.5	0.1	N/A	N/A	N/A
	Median value		15.7	16.4	15.8	32.4	74.2	2.2	1.0	N/A	N/A	N/A	N/A
	Maximum value		732.2	219.3	199.5	167.0	854.2	45.9	21.2	N/A	N/A	N/A	N/A
	Average value		84.7	40.4	40.5	48.3	151.1	4.4	2.7	N/A	N/A	N/A	N/A
	No returns		11	12	6	0	0	0	0	36	36	36	36
	No. Above limit		9	9	14	31	31	22	15	N/A	N/A	N/A	N/A
	No. Measurements		0	0	1	4	3	10	3	N/A	N/A	N/A	N/A

# Appendix 9

## Air Pollution – Lead (Pb)

		Chambishi Copper Smelter- Chimney 1	Chambishi Copper Smelter- Anode Furnace	Chambishi Copper Smelter- Slag cleaning furnance	Konkola Copper Mine - Nchanga SBU-Cobalt recovery furnance	Mopani Copper Mine - Mufulira SBU- Converter slag blow	Mopani Copper Mine - Mufulira- Converter copper blow	Mopani Copper Mine - Mufulira- Matte settling furnance	Mopani Copper Mine - Nkana- Cobalt plant	Ndola Lime -Vertical Kiln	Ndola Lime - Horizont al Kiln	Ndola Lime - Hydrator
<b>ZEMA statutory li</b>		<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>	<b>0.2</b>
<b>2009</b>	Jan	Dev	Dev **	Dev	Dev	26.25	0.064	No results	No results	No Return	No Return	No Return
	Feb	Dev	Dev	Dev	Dev	11.55	13.17	No results	No results	No Return	No Return	No Return
	Mar	Dev	Dev	Dev	Dev	11.63	4.31	No results	No results	No Return	No Return	No Return
	Apr	Dev	Dev	Dev	Dev	No results	No results	No results	No results	No Return	No Return	No Return
	May	Dev	Dev	Dev	Dev	9.28	2.42	No results	No results	No Return	No Return	No Return
	Jun	Dev	Dev	Dev	Dev	18.15	10.11	No results	No results	No Return	No Return	No Return
	Jul	Dev	Dev	Dev	Dev	37.2	17.4	1.18	No results	No Return	No Return	No Return
	Aug	Dev	Dev	Dev	Dev	30.3	11.5	4.87	No results	No Return	No Return	No Return
	Sep	Dev	Dev	Dev	Dev	13.8	3.68	1.66	No results	No Return	No Return	No Return
	Oct	Dev	Dev	Dev	Dev	6.8	15	1.27	No results	No Return	No Return	No Return
	Nov	Dev	Dev	Dev	Dev	6.7	2.6	No results	No results	No Return	No Return	No Return
	Dec	Dev	Dev	Dev	Dev	13.2	35.8	No results	No results	No Return	No Return	No Return
<b>2010</b>	Jan	No Return	No Return	No Return	Dev	75.9	33.9	0.66	0.2	No Return	No Return	No Return
	Feb	No Return	No Return	No Return	Dev	20.97	28.5	No results	0.1	No Return	No Return	No Return
	Mar	No Return	No Return	No Return	Dev	1.38	0.9	4.83	0.3	No Return	No Return	No Return
	Apr	No Return	No Return	No Return	Dev	28.14	9.79	10.01	0.1	No Return	No Return	No Return
	May	No Return	No Return	No Return	Dev	No Results	No results	No results	1.0	No Return	No Return	No Return
	Jun	No Return	No Return	No Return	Dev	15.18	6.73	0.43	0.5	No Return	No Return	No Return
	Jul	*	0	0	0	59.1	24.05	0.31	0.03	No Return	No Return	No Return
	Aug	*	0	0	0	Care & maintenance	Care & maintenance	2.43	0.1	No Return	No Return	No Return
	Sep	*	0	0	0	10.53	6.97	1.26	0.04	No Return	No Return	No Return
	Oct	*	11.92	2.55	6.15	33.85	19.42	4.59	0.1	No Return	No Return	No Return
	Nov	*	0.12	5.69	0.19	25.66	33.8	1.98	0.2	No Return	No Return	No Return
	Dec	*	0.87	4.93	18.36	14.01	13.47	0.93	0.1	No Return	No Return	No Return
<b>2011</b>	Jan	*	0.79	6.91	5.9	42.33	3.57	1.81	No results	No Return	No Return	No Return
	Feb	*	0.48	7.73	14.05	9.55	2.89	30.08	No results	No Return	No Return	No Return
	Mar	*	0.48	15.83	10.12	38.5	17.4	0.71	No results	No Return	No Return	No Return
	Apr	*	0.66	3.52	2.78	No Results	No results	1.62	No results	No Return	No Return	No Return
	May	*	0.51	13.21	0.9	10.3	2.15	4.25	No results	No Return	No Return	No Return
	Jun	*	2.08	1.64	2.95	5.76	8.47	0.75	No results	No Return	No Return	No Return
	Jul	No Return	No Return	No Return	55.8	15.72	19.19	1.93	0.08	No Return	No Return	No Return
	Aug	No Return	No Return	No Return	21.9	25.65	15.48	0.45	1.46	No Return	No Return	No Return
	Sep	No Return	No Return	No Return	3.91	49.83	27.56	8.54	Cara and Ma	No Return	No Return	No Return
	Oct	No Return	No Return	No Return	12.05	35.7	10.1	2.77	Cara and Ma	No Return	No Return	No Return
	Nov	No Return	No Return	No Return	15	21.97	24.6	3.04	Cara and Ma	No Return	No Return	No Return
	Dec	No Return	No Return	No Return	no result	no result	0.04	2.18	Cara and Ma	No Return	No Return	No Return
Source: Bi annual reports submitted to ZEMA by the Mining Companies												
* Chambishi copper metals did not assess the lead (Pb) parameter												
Dev ** - mine was under development												
<b>Data analysis</b>												
<b>Min</b>		0.0	0.0	0.0	0.0	1.4	0.0	0.3	0.0	N/A	N/A	N/A
<b>Median</b>		N/A	0.5	4.2	5.9	18.2	10.8	1.9	0.1	N/A	N/A	N/A
<b>Max</b>		0.0	11.9	15.8	55.8	75.9	35.8	30.1	1.5	N/A	N/A	N/A
<b>Average</b>		N/A	1.5	5.2	10.0	23.4	13.3	3.6	0.3	N/A	N/A	N/A
No returns		12	12	12	0	0	0	0	0	36	36	36
<b>No. Above limit</b>		0	8	9	13	31	30	26	5	N/A	N/A	N/A
No. Measurements		0	0	0	0	3	3	10	18	0	0	0

# Appendix 10

## Mines that did not submit Bi annual reports for surface water monitoring.

Name of mine	Name of facility	Period
1. 1. Bwana Mukubwa Mine	Little Mukulungwe -Upstream Site SW2 Little Mukulungwe -Downstream Site SW3	Jan-June 2009
2. Chambishi Copper Smelter	Smelter Drain Acid plant Drain	July to December 2010
3. Chibuluma South	Effluent water	Jan – Dec 2009 July-Dec 2010 July to Dec 2011
4. Non Ferrous Non Ferrous Coppermine Africa	Musakashi dam effluent discharge Combined drain leading to TD6 TD6 overflow effluent quality Water treatment ponds overflow	January to December 2011
5. Konkola Copper Mine - Nkana	North Uchi	July to December 2010
6. Konkola Coppermine Nchanga	PCD Spillway Muntimpa spillway Combined concentrator drain into Nchanga Stream Nchanga open pit spillage into Nchanga stream	July to December 2009 July to December 2011
7. Luanshya Copper Mine	Luanshya river	January –December 2009 January –December 2010 January December 2011
	TD 24 also known as the ‘Old tailings dump’	January –December 2009 January –December 2010 January December 2011
	Musi TD	January –December 2009 January –December 2010 January December 2011
8. Mamba Collieries	Mine effluent	Jan-June 2011
	Downstream -Izuma stream	January –June 2011
9. Ndola Lime	Chilanga	January –December 2009 January –December 2010
	Kafubu	January –December 2009 January –December 2010
10. Kansashi Mine	All Facilities	January –December 2009 January –December 2010 January December 2011

# Appendix 11

## Surface Water Particles – TSS mg/l

		Zema limit	NFCA- Musakashi dam effluent discharge	NFCA- Combined drain leading to TD6	NFCA-TD6 overflow effluent quality	NFCA-Water treatment ponds overflow	KCM Konkola- Lubengele dam into Lubengele stream	KCM Konkola- Engineering workshop overflow into Lubengele stream	KCM Konkola- Plant overflow into Kakosa Stream	KCM Nchanga- PCD Spillway	KCM Nchanga- Combined concentrator drain into Nchanga Stream	KCM Nchanga- open pit spillage into Nchanga stream
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2009	Jan	100	31	19,513	1,469	400	39	-	156	9,953	3,440	
	Feb	100	71.50	3,477	1,419	429	1,036	-	157	26,448	5,521	1,930
	Mar	100	83	3,518	1,095	1,009	178	27	159	43,833	5,936	504
	Apr	100	65	2,905	1,161	460	332	-	179	21,539	3,137	111
	May	100	285	3,445	827	415	86	-	147	14,127	1,893	793
	Jun	100	146	8,826	6,220	427	32	-	147	27,218	1,802	233
	Jul	100	57	1,282	2,037	254	376	-	129	-	-	-
	Aug	100	40	1,685	-	951	193	-	340	-	-	-
	Sep	100	77	3,488	-	633	66	235	134	-	-	-
	Oct	100	63	537	-	283	8	2,121	183	-	-	-
	Nov	100	72	1,218	157	482	10	65	103	-	-	-
	Dec	100	70	2,597	144	255	18	170	381	-	-	-
2010	Jan	100	93	572	72	130	15	104	266	11,449	183	195
	Feb	100	122	1,959	158	295	2,741	104	208	2,972	324	1,193
	Mar	100	27	1,151	759	371	62	55	371	3,467	647	1,058
	Apr	100	56	885	379	300	37	48	240	3,229	2,443	184
	May	100	65	509	372	456	67	81	235	20,482	224	249
	Jun	100	333	921	50	621	53	80	166	8,976	2,942	11
	Jul	100	274	4,894	118	975	26	64	184	12,568	474	154
	Aug	100	81	1,275	179	239	70	13	229	5,102	112	-
	Sep	100	103	384	556	731	1,724	35	248	8,905	1,370	85
	Oct	100	98	1,009	366	255	2,873	29	277	6,901	396	-
	Nov	100	101	1,673	347	259	-	-	182	48,069	493	346
	Dec	100	49	4,328	1,058	351	-	-	152	4,922	677	361
2011	Jan	100	No Return	No Return	No Return	No Return	no flow	no flow	96	5,025	187	117
	Feb	100	No Return	No Return	No Return	No Return	no flow	no flow	120	6,537	896	1,055
	Mar	100	No Return	No Return	No Return	No Return	13	no flow	217	5,414	638	175
	Apr	100	No Return	No Return	No Return	No Return	16	no flow	191	4,068	1,118	223
	May	100	No Return	No Return	No Return	No Return	32	no flow	104	6,989	930	368
	Jun	100	No Return	No Return	No Return	No Return	13	no flow	151	1,153	975	167
	Jul	100	No Return	No Return	No Return	No Return	9	-	139	732	749	106
	Aug	100	No Return	No Return	No Return	No Return	17	-	130	no results	2,330	no results
	Sep	100	No Return	No Return	No Return	No Return	11	-	88	817	2,145	176
	Oct	100	No Return	No Return	No Return	No Return	14	-	67	255	1,393	58
	Nov	100	No Return	No Return	No Return	No Return	19	-	116	514	1,690	35
	Dec	100	No Return	No Return	No Return	No Return	25	-	80	782	1,909	198
Source: Bi annual reports submitted to ZEMA by the Mining Companies												
Data analysis	Data Analysis											
Min			26.7	384.3	0.0	130.3	0.0	0.0	67.0	0.0	0.0	0.0
Median			74.0	1,679.0	369.0	407.3	32.0	6.5	158.0	5,025.0	822.5	175.5
Max			333.0	19,512.7	6,219.5	1,009.3	2,873.0	2,121.0	381.0	48,069.0	5,936.3	1,929.7
Average			102.4	3,002.0	789.2	457.4	300.3	107.7	179.8	8,927.1	1,304.8	315.1
No returns			12	12	12	12	0	0	0	0	0	0
No. Above limit			7	24	19	24	8	5	32	29	30	22
No. Measurements			0	0	0	0	0	0	0	1	0	1
Source: Bi annual reports												

# Appendix 12

## Surface Water Pollution (Other Facilities) – TCu

Name of Facility		Chambishi Metals - New dam overflow - SW13	NFCA - Combined drain leading to TD6	NFCA - TD6 overflow effluent quality	NFCA - Water treatment ponds overflow	KCM Konkola - Lubengulube dam into Lubengulube stream	KCM Konkola - Engineering workshop overflow into Lubengulube stream	KCM Konkola - Plant overflow into Kakosa Stream	KCM Konkola - PCD Spillway	KCM Konkola - Muntimpa spillway	KCM Nchanga - Cobined concentrator drain into Nchanga Stream	KCM Nchanga - open pit spillage into Nchanga stream	Konkola Copper Mine - Nkana - South Uchi	Mopani Copper Mine - Mufulira west discharge	Mopani Copper Mine - Nkana - North Unchi
ZEMA statutory limit		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2009	Jan	0.1	103.6	32.4	0.4	<0.01	*	1.2	336.7	0.3	192.9	No results	YTD Ave	No Flow	1.34
	Feb	0.8	106.0	99.7	1.1	4.2	*	1.8	221.6	0.4	159.3	9.3	YTD Ave	No Flow	1.5
	Mar	0.3	41.5	60.1	4.4	0.7	<0.01	1.8	280.9	0.2	120.7	3.7	YTD Ave	No Flow	2
	Apr	0.3	17.1	38.7	3.6	2.1	*	1.3	273.9	0.2	102.8	3.4	YTD Ave	No Flow	2.3
	May	-	12.7	90.4	1.1	0.0	*	0.7	117.7	0.2	31.7	5.6	YTD Ave	No Flow	1.6
	Jun	-	11.2	34.8	1.3	0.4	*	1.9	252.5	0.3	29.0	22.1	YTD Ave	No Flow	2.3
	Jul	0.1	3.5	13.3	0.3	8.5	*	2.2	No results	No results	No results	No results	YTD Ave	0.1	1.5
	Aug	0.3	7.6	No flow	2.1	2.0	*	3.3	No results	No results	No results	No results	YTD Ave	0.1	1.0
	Sep	0.3	7.1	No flow	1.8	2.4	<0.01	0.9	No results	No results	No results	No results	YTD Ave	0.0	2.3
	Oct	0.3	3.0	No flow	0.7	0.1	17.0	2.1	No results	No results	No results	No results	YTD Ave	0.0	1.7
	Nov	-	2.3	2.6	1.1	10.3	1.7	14.1	No results	No results	No results	No results	YTD Ave	0.2	1.6
	Dec	0.6	46.5	2.3	0.6	1.7	1.4	8.3	No results	No results	No results	No results	YTD Ave	0.4	2.2
2010	Jan	0.9	45.2	10.4	0.4	3.0	1.1	7.9	272.0	0.3	106.0	5.7	7.5	0.4	1.3
	Feb	0.1	59.6	6.0	0.2	5.6	0.6	2.5	147.0	0.2	248.0	5.0	3.1	0.3	6.4
	Mar	1.6	24.1	3.9	0.4	2.7	0.0	1.4	787.0	0.1	36.0	1.9	2.8	55.5	0.5
	Apr	1.7	17.9	20.1	1.4	4.0	4.6	2.9	152.0	0.1	36.0	0.3	8.2	33.9	1.0
	May	0.1	1.7	2.6	1.6	0.9	1.0	1.4	161.0	0.2	502.0	5.3	0.8	24.6	2.7
	Jun	1.8	1.2	0.9	1.5	0.1	0.1	0.2	192.0	0.1	79.0	0.9	1.9	2.2	1.2
	Jul	1.0	6.8	0.4	1.8	0.2	*	3.1	144.2	0.6	9.1	2.2	No results	1.2	8.5
	Aug	0.8	1.9	0.7	0.4	0.9	*	1.5	218.4	2.3	0.1	-	No results	1.4	13.0
	Sep	0.5	0.9	0.2	0.6	9.8	*	4.5	108.1	0.1	45.7	0.3	No results	2.1	11.6
	Oct	0.3	2.6	0.9	0.5	17.6	*	2.2	251.3	-	9.0	-	No results	3.2	3.5
	Nov	1.3	3.4	0.8	0.6	*	*	1.6	55.6	0.1	5.1	0.0	No results	0.3	5.2
	Dec	0.2	63.0	12.6	0.7	*	*	1.1	283.2	0.0	0.7	0.0	No results	16	1.5
2011	Jan	0.2	No results	No results	No results	no flow	no flow	1.2	295.6	0.3	0.6	1.3	7.0	18.9	1.7
	Feb	0.1	No results	No results	No results	no flow	no flow	3.8	136.4	0.3	38.8	13.9	8.4	0.3	1.6
	Mar	0.2	No results	No results	No results	0.7	no flow	3.1	178.3	0.6	75.8	2.4	5.8	4.3	3.2
	Apr	0.1	No results	No results	No results	0.5	no flow	0.9	29.6	2.2	32.4	8.1	2.9	1.7	1.7
	May	0.1	No results	No results	No results	0.4	no flow	1.8	162.1	2.5	99.9	5.5	2.0	0.5	0.7
	Jun	0.1	No results	No results	No results	0.3	no flow	1.6	35.1	0.8	1.8	2.6	2.0	0.0	5.1
	Jul	0.5	No results	No results	No results	0.3	No results	4.2	51.1	0.5	76.9	3.8	5.8	6.8	0.625
	Aug	0.1	No results	No results	No results	0.1	No results	2.6	No results	1.7	109.7	No results	3.8	4.2	1.2
	Sep	0.6	No results	No results	No results	0.2	No results	0.5	170.2	0.4	82.4	4.5	4.0	2.4	1.3
	Oct	0.7	No results	No results	No results	0.2	No results	1.4	77.7	10.6	99.5	0.4	13.1	10.2	0.8
	Nov	0.6	No results	No results	No results	0.7	No results	1.8	29.5	1.2	36.1	0.5	3.0	18.2	0.95
	Dec	1.0	No results	No results	No results	0.8	No results	1.8	78.8	0.6	63.5	5.1	4.5	0.5	0.68
Source: Bi annual reports submitted to ZEMA by the Mining Companies															
* Other mines were below the limits.															
Data analysis															
Min		0.0	0.9	0.2	0.2	0.0	0.0	0.2	29.5	0.0	0.1	0.0	0.8	0.0	0.5
Median		0.3	9.4	6.0	0.9	0.8	1.1	1.8	162.1	0.3	54.6	3.6	3.9	1.6	1.6
Max		1.8	106.0	99.7	4.4	17.6	17.0	14.1	787.0	10.6	502.0	22.1	13.1	55.5	13.0
Average		0.5	24.6	20.7	1.2	2.6	3.1	2.6	189.6	0.9	81.0	4.4	4.8	7.0	2.7
No returns		0	0	0	0	0	0	0	0	0	0	0	0	0	0
No. Above limit		3	22	15	6	13	3	24	29	5	27	18	17	15	20
No. Measurements		0	12	12	12	0	6	0	7	6	6	8	6	0	0

# Appendix 13

## Surface Water Pollution (Other Facilities) – TCo

		ZEMA statutory limits	Chambishi Metals- New dam overflow-SW13	NFCA-Combined drain leading to TD6	NFCA-TD6 overflow effluent quality	KCM Konkola-Lubengele dam into Lubengele stream	KCM Konkola-Plant overflow into Kakosa Stream	KCM Nhanga - PCD Spillway	KCM Nhanga-Muntimpa spillway	KCM Nhanga-Cobined concentrator drain into Nchanga Stream	KCM Nhanga open pit spillage into Nchanga stream	MCM-North Uchi
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2009	Jan	1.0	2.4	51.5	19.7	0.0	0.0	3.6	1.8	4.1		0.7
	Feb	1.0	2.7	N/A	16.0	14.7	2.1	7.0	3.2	7.1	0.5	1.3
	Mar	1.0	2.0	6.5	14.3	2.1	2.2	7.7	1.8	1.9	0.5	0.9
	Apr	1.0	0.6	6.9	21.6	0.2	0.1	5.2	2.1	2.9	0.4	0.7
	May	1.0	0.8	2.0	25.5	0.0	0.0	5.1	0.6	6.3	0.6	0.5
	Jun	1.0	0.9	2.1	21.5	0.3	1.6	10.0	0.7	0.7	1.1	0.6
	Jul	1.0	0.3	2.8	10.6	5.1	2.6	No results	No results	No results	No results	3.7
	Aug	1.0	0.1	1.2	No flow	2.1	5.9	No results	No results	No results	No results	0.4
	Sep	1.0	0.1	0.9	No flow	0.1	0.1	No results	No results	No results	No results	0.5
	Oct	1.0	0.1	0.4	No flow	0.1	2.6	No results	No results	No results	No results	1.0
	Nov	1.0	0.1	1.4	6.2	1.3	12.2	No results	No results	No results	No results	0.8
	Dec	1.0	0.5	38.1	6.8	1.2	8.1	No results	No results	No results	No results	0.5
2010	Jan	1.0	2.1	9.8	15.4	0.2	0.1	5.8	1.0	0.7	*	1.0
	Feb	1.0	0.9	15.6	7.5	0.1	0.0	3.1	0.7	1.1	*	3.9
	Mar	1.0	0.5	11.3	7.7	0.0	0.1	1.5	0.4	0.8	*	2.9
	Apr	1.0	0.6	3.4	15.3	0.8	0.2	2.0	0.3	0.5	*	1.8
	May	1.0	0.8	0.7	16.9	0.1	0.3	1.9	0.5	0.7	*	3.7
	Jun	1.0	1.0	<0.01	9.5	<0.01	0.0	2.2	1.4	2.2	*	0.7
	Jul	1.0	1.1	0.7	10.2	<0.01	0.2	4.4	6.8	0.9	2.3	1.9
	Aug	1.0	0.7	0.7	10.2	0.1	0.1	4.0	6.3	0.2	-	3.5
	Sep	1.0	0.5	0.1	8.9	0.8	0.1	2.6	1.7	0.9	0.0	4.3
	Oct	1.0	0.4	0.3	7.2	1.3	0.1	9.7	-	0.5	-	4.0
	Nov	1.0	0.5	0.6	9.6	*	0.1	2.8	0.9	0.4	311.0	1.9
	Dec	1.0	0.8	20.1	23.2	*	0.0	2.4	1.5	0.3	81.0	1.9
2011	Jan	1.0	1.9	No results	No results	no flow	0.1	3.8	1.0	1.2	0.2	0.9
	Feb	1.0	1.4	No results	No results	no flow	0.5	2.4	0.6	1.1	0.7	0.8
	Mar	1.0	1.2	No results	No results	0.1	0.2	4.2	0.5	2.5	0.3	1.1
	Apr	1.0	0.1	No results	No results	0.0	0.2	0.9	0.4	1.2	0.4	3.4
	May	1.0	0.3	No results	No results	0.1	0.1	3.7	13.1	3.2	0.3	0.4
	Jun	1.0	1.0	No results	No results	0.8	0.9	1.3	2.8	1.8	0.4	2.4
	Jul	1.0	0.9	No results	No results	0.1	0.2	1.2	2.9	1.1	1.7	0.5
	Aug	1.0	0.9	No results	No results	0.0	0.1	No results	4.1	No results	4.1	1.1
	Sep	1.0	0.6	No results	No results	0.0	0.1	5.9	1.3	0.3	1.5	1.1
	Oct	1.0	0.8	No results	No results	0.3	0.3	3.8	1.4	0.1	3.5	1.0
	Nov	1.0	0.4	No results	No results	0.0	0.1	1.4	0.4	0.0	1.5	0.6
	Dec	1.0	1.0	No results	No results	0.1	0.1	3.1	0.4	0.2	2.8	0.6
Source: Bi annual reports submitted to ZEMA by the Mining Companies												
* Chambishi copper metals did not assess the lead (Pb) parameter												
Data analysis												
Min			0.1	0.1	6.2	0.0	0.0	0.9	0.3	0.0	0.0	0.4
Median			0.8	2.1	10.6	0.1	0.1	3.6	1.3	0.9	0.7	1.0
Max			2.7	51.5	25.5	14.7	12.2	10.0	13.1	7.1	311.0	4.3
Average			0.9	8.0	13.5	1.1	1.2	3.9	2.1	1.5	19.7	1.6



# Appendix 14

## Surface Water Pollution ( Other Facilities) - TMn

									Appendix 14			
Performance audit on environmental degradation caused by mining activities												
Surface Water Pollution (other facilities) - TMn												
Name of Facility		ZEMA statutory limits	NFCA Combined drain leading to TD6	NFCA TD6 overflow effluent quality	NFCA - Water treatment ponds overflow	KCM Nchanga - PCD spillway	KCM Nchanga - Muntimpa spillway	KCM Nchanga - Combined concentrator drain into Nchanga Stream	KCM Nchanga - open pit spillage into Nchanga stream	MCM Mufulira- TD 11 Spillway	MCM- Mufulira west discharge	MCM Nkana- North Uchi
2009	Jan	1.0	16.5	30.0	1.1	11.0	43.0	3.8		9.6	NO FLOW	1.6
	Feb	1.0	17.5	16.4	1.6	25.8	13.5	11.6	1.6	9.7	NO FLOW	1.1
	Mar	1.0	8.2	7.5	1.6	25.1	14.5	62.1	6.2	9.6	NO FLOW	2.0
	Apr	1.0	4.8	6.9	1.0	9.3	7.6	3.7	0.4	7.1	NO FLOW	2.3
	May	1.0	9.5	13.1	2.7	16.0	7.2	19.5	1.8	0.5	NO FLOW	1.7
	Jun	1.0	9.8	11.4	0.6	53.5	15.5	3.2	1.9	0.3	NO FLOW	2.0
	Jul	1.0	0.9	3.4	0.6	No results	No results	No results	No results	0.9	0.1	14.7
	Aug	1.0	1.9	No flow	4.0	No results	No results	No results	No results	0.6	0.1	1.1
	Sep	1.0	6.4	No flow	1.0	No results	No results	No results	No results	0.4	0.0	1.0
	Oct	1.0	1.3	No flow	0.4	No results	No results	No results	No results	1.1	0.0	4.4
	Nov	1.0	1.9	1.0	0.6	No results	No results	No results	No results	2.3	0.1	2.9
	Dec	1.0	47.9	2.4	0.2	No results	No results	No results	No results	4.0	0.1	1.0
2010	Jan	1.0	24.6	10.2	0.5	201.1	6.3	1.7	1.3	2.6	0.2	2.1
	Feb	1.0	43.5	17.4	0.4	6.2	8.7	2.8	1.0	2.6	0.1	5.6
	Mar	1.0	28.5	12.0	0.4	4.1	6.2	1.8	1.0	4.1	8.1	5.9
	Apr	1.0	10.8	16.7	0.9	6.1	6.1	3.8	0.5	1.9	2.3	3.2
	May	1.0	1.8	17.1	0.5	3.7	4.4	2.2	0.6	2.2	4.0	12.0
	Jun	1.0	1.0	20.2	0.5	4.2	24.5	5.0	0.9	1.6	0.7	3.0
	Jul	1.0	5.0	30.6	1.1	5.0	9.4	2.9	1.7	4.6	1.2	8.3
	Aug	1.0	1.4	21.8	0.6	6.0	73.9	0.4	-	3.2	1.6	5.5
	Sep	1.0	0.8	26.0	3.0	5.5	56.6	2.9	0.7	3.5	0.7	10.7
	Oct	1.0	1.6	12.9	0.3	63.2	-	1.5	-	3.4	1.5	4.0
	Nov	1.0	2.0	23.1	0.4	9.4	4.4	2.0	0.0	1.3	0.4	7.6
	Dec	1.0	49.5	29.3	0.7	7.4	11.1	3.9	0.0	0.3	0.4	0.9
2011	Jan	1.0	No results	No results	No results	7.3	8.7	6.0	1.2	4.5	0.2	2.5
	Feb	1.0	No results	No results	No results	13.7	8.2	6.4	6.4	3.9	0.4	1.2
	Mar	1.0	No results	No results	No results	16.6	8.7	7.0	1.3	2.6	0.6	2.5
	Apr	1.0	No results	No results	No results	3.8	10.9	2.9	1.7	1.3	0.5	1.0
	May	1.0	No results	No results	No results	14.0	23.5	7.2	0.8	1.3	0.6	0.7
	Jun	1.0	No results	No results	No results	10.1	31.6	8.0	5.5	1.0	0.7	3.5
	Jul	1.0	No results	No results	No results	9.2	53.8	5.6	5.5	2.3	2.1	2.5
	Aug	1.0	No results	No results	No results	No results	34.0	6.3	0.1	2.4	2.1	2.3
	Sep	1.0	No results	No results	No results	20.1	36.1	5.9	No results	2.0	1.8	2.9
	Oct	1.0	No results	No results	No results	28.7	37.5	9.4	1.0	2.5	14.0	0.7
	Nov	1.0	No results	No results	No results	10.6	18.1	3.5	0.3	0.9	4.1	1.1
	Dec	1.0	No results	No results	No results	7.9	11.5	6.4	0.8	0.7	0.5	0.5
Source: Bi annual reports submitted to ZEMA by the Mining Companies												
Data analysis												
Min			0.8	1.0	0.2	3.7	4.4	0.4	0.0	0.3	0.0	0.5
Median			5.7	16.4	0.6	9.4	11.5	3.8	1.0	2.3	0.6	2.4
Max			49.5	30.6	4.0	201.1	73.9	62.1	6.4	9.7	14.0	14.7
Average			12.4	15.7	1.0	20.8	20.5	7.0	1.7	2.8	1.6	3.5
No returns			0	0	0	0	0	0	0	0	0	0
No. Above limit			21	20	8	29	29	29	12	27	11	31
No. Measurements			12	12	12	7	6	6	7	0	0	

# Appendix 15

## Surface Water Pollution (Other Facilities) – TFe

Name of Facility		ZEMA statutory limits	Konkola Copper Mine - Konkola SBU-Plant overflow into Kakosa Stream	Konkola Copper Mine - Nchanga SBU-PCD SPILWAY	Konkola Copper Mine - Nchanga SBU-Muntimpa spillway	Konkola Copper Mine - Nchanga SBU-Combined concentrator drain into Nchanga Stream	Konkola Copper Mine - Nchanga SBU-open pit spillage into Nchanga stream	Mopani Copper Mine - Mufulira-Mufulira west discharge	Mopani Copper Mine - Nkana-North Uchi
<b>2009</b>	Jan	2.0	0.3	443.0	0.4	75.0		*	1.7
	Feb	2.0	0.2	305.9	1.6	226.3	10.8	No Flow	2.5
	Mar	2.0	0.5	381.4	6.4	191.3	11.8	No Flow	1.7
	Apr	2.0	1.6	320.4	1.0	114.2	6.0	No Flow	2.0
	May	2.0	1.1	109.2	1.4	46.6	19.6	No Flow	3.3
	Jun	2.0	0.3	382.8	0.8	15.1	80.6	No Flow	2.2
	Jul	2.0	0.4	No results	No results	No results	No results	0.1	1.2
	Aug	2.0	0.5	No results	No results	No results	No results	0.2	1.2
	Sep	2.0	6.6	No results	No results	No results	No results	0.0	1.9
	Oct	2.0	0.2	No results	No results	No results	No results	0.1	2.2
	Nov	2.0	0.6	No results	No results	No results	No results	0.1	0.9
	Dec	2.0	1.0	No results	No results	No results	No results	0.5	1.2
<b>2010</b>	Jan	2.0	3.1	155.0	0.4	119.0	10.8	5.1	1.2
	Feb	2.0	2.2	160.0	0.2	40.4	18.0	0.6	2.9
	Mar	2.0	1.6	295.0	0.5	365.0	3.2	4.7	0.9
	Apr	2.0	2.3	199.0	1.7	365.0	5.2	15.6	0.6
	May	2.0	1.4	237.0	1.6	115.0	5.5	35.2	1.2
	Jun	2.0	0.2	368.0	1.7	6,752.0	1.7	2.5	1.6
	Jul	2.0	3.9	2.3	1.4	9.7	2.8	2.6	0.8
	Aug	2.0	1.0	295.1	0.3	1.4	-	1.6	2.5
	Sep	2.0	5.4	216.7	0.2	47.7	3.3	0.7	4.9
	Oct	2.0	3.7	465.1	-	11.9	-	1.5	1.7
	Nov	2.0	2.5	64.4	0.6	5.1	0.0	0.4	2.2
	Dec	2.0	0.6	290.1	1.9	1.9	0.0	0.4	1.6
<b>2011</b>	Jan	2.0	1.9	300.8	1.7	1.3	1.2	2.0	2.1
	Feb	2.0	5.8	333.0	1.0	126.5	8.1	0.5	1.8
	Mar	2.0	4.5	262.7	0.8	189.2	13.6	0.7	1.5
	Apr	2.0	1.5	65.3	2.1	69.9	11.5	1.6	0.5
	May	2.0	3.2	165.0	8.7	128.9	25.1	1.2	1.0
	Jun	2.0	2.5	107.5	4.0	217.0	4.1	2.0	6.3
	Jul	2.0	6.5	135.0	1.8	155.7	5.5	3.4	1.1
	Aug	2.0	5.5	No results	1.7	104.5	No results	3.8	1.5
	Sep	2.0	7.0	418.8	1.3	176.9	17.4	21.1	0.3
	Oct	2.0	5.8	206.9	37.5	142.8	1.0	8.3	0.9
	Nov	2.0	2.1	47.0	0.8	53.6	1.0	8.6	0.7
	Dec	2.0	3.0	127.4	1.3	132.8	6.8	0.2	0.7
Source: Bi annual reports submitted to ZEMA by the Mining Companies									
<b>Data analysis</b>									
<b>Min</b>			0.2	2.3	0.2	1.3	0.0	0.0	0.3
<b>Median</b>			2.0	237.0	1.4	114.6	5.8	1.5	1.5
<b>Max</b>			7.0	465.1	37.5	6752.0	80.6	35.2	6.3
<b>Average</b>			2.5	236.5	2.9	333.4	10.6	4.2	1.7
No returns			0	0	0	0	0	0	0
<b>No. Above limit</b>			18	29	5	27	20	12	10
No. Measurements			0	7	6	6	7	0	0

# Appendix 16

## Underground Water Pollution (Other Facilities) – pH

Name of Facility		Chembeshi copper smelter Sulfuric acid storage facility	Konkola Copper Mine - Nkana SBU Acid loading Bay	Mopani copper mine mufulira Concentrate smelter shed borehole no. 9		Mopani copper mine mufulira Acid loading bay borehole no. 15	Mopani copper mine mufulira Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine -Nkana oldCVW	Mopani Copper Mine -Nkana cobalt plant	Mopani Copper Mine -Nkana cobalt plant
				Deep	Shallow				Deep	shallow
ZEMA statutory limits		6-9	6-9	6-10	6-11	6-9	6-9	6-9	6-9	6-9
2009	Jan	Dev	YTD Average	QTR Average	QTR Average	6.2	6.8	2.9	4.2	4.5
	Feb	Dev	YTD Average	QTR Average	QTR Average	6.2	6.4	3.3	5.7	5.4
	Mar	Dev	YTD Average	6.1	5.7	5.9	6.3	No Results	No Results	No Results
	Apr	Dev	YTD Average	QTR Average	QTR Average	7.2	7.6	5.4	6.3	5.7
	May	Dev	YTD Average	QTR Average	QTR Average	6.3	6.7	3.4	6.2	6.0
	Jun	Dev	YTD Average	6.3	6.7	No Results	No Results	2.9	6.3	5.9
	Jul	No Results	YTD Average	QTR Average	QTR Average	6.6	6.9	No Results	6.2	5.7
	Aug	No Results	YTD Average	QTR Average	QTR Average	6.2	7.0	3.1	6.2	5.7
	Sep	No Results	YTD Average	6.3	6.8	6.6	6.8	No Results	No Results	No Results
	Oct	No Results	YTD Average	QTR Average	QTR Average	5.9	6.4	No Results	6.4	5.9
	Nov	No Results	YTD Average	QTR Average	QTR Average	5.9	6.5	3.2	6.3	5.8
	Dec	No Results	YTD Average	Vandalised	Vandalised	6.4	6.4	3.5	4.7	5.1
2010	Jan	No Results	Discontinued	QTR Average	QTR Average	5.9	6.1	3.1	3.3	4.3
	Feb	No Results	Discontinued	QTR Average	QTR Average	6.0	6.4	3.0	4.2	3.7
	Mar	No Results	Discontinued	6.4	5.3	6.4	7.9	3.8	4.6	3.8
	Apr	No Results	Discontinued	QTR Average	QTR Average	6.5	6.7	3.0	3.0	4.3
	May	No Results	Discontinued	QTR Average	QTR Average	6.0	6.4	3.0	3.0	4.1
	Jun	No Results	Discontinued	6.5	6.1	6.8	6.8	3.2	3.4	4.7
	Jul	No Results	Discontinued	QTR Average	QTR Average	6.2	6.9	3.2	3.2	4.7
	Aug	No Results	Discontinued	QTR Average	QTR Average	6.7	7.2	3.2	3.2	4.3
	Sep	No Results	Discontinued	6.5	6.8	6.5	6.9	3.2	3.1	4.4
	Oct	No Results	Discontinued	QTR Average	QTR Average	7.7	8.1	3.7	3.2	5.1
	Nov	No Results	Discontinued	QTR Average	QTR Average	7.4	7.6	3.4	4.8	4.4
	Dec	No Results	Discontinued	6.5	7.1	6.6	6.8	3.5	4.7	3.7
2011	Jan	No Results	Discontinued	QTR Average	QTR Average	6.3	6.7	3.4	4.3	4.6
	Feb	No Results	Discontinued	QTR Average	QTR Average	6.5	6.5	3.2	3.2	4.6
	Mar	No Results	Discontinued	5.5	7.0	6.8	6.3	3.3	3.9	4.7
	Apr	No Results	Discontinued	QTR Average	QTR Average	6.5	6.5	3.5	5.4	6.0
	May	No Results	Discontinued	QTR Average	QTR Average	6.7	6.2	3.9	6.0	6.0
	Jun	No Results	Discontinued	5.6	6.5	7.2	7.2	5.7	6.1	6.0
	Jul	No Results	Discontinued	QTR Average	QTR Average	6.7	6.6	No Results	No Results	No Results
	Aug	No Results	Discontinued	QTR Average	QTR Average	6.4	6.4	3.2	3.5	4.4
	Sep	No Results	Discontinued	6.1	6.5	7.2	7.8	Not sampled	Not sampled	Not sampled
	Oct	No Results	Discontinued	QTR Average	QTR Average	7.6	7.2	3.2	3.3	4.4
	Nov	No Results	Discontinued	QTR Average	QTR Average	6.3	No flow	3.3	6.4	6.8
	Dec	No Results	Discontinued	5.7	6.3	6.5	No flow	3.2	3.5	4.7
Source: Bi annual reports submitted to ZEMA by the Mining Companies										
Minimum value		0.0	0.0	5.5	5.3	5.9	6.1	2.9	3.0	3.7
Median value		N/A	N/A	6.3	6.5	6.5	6.7	3.2	4.5	4.7
Maximum value		0.0	0.0	6.5	7.1	7.7	8.1	5.7	6.4	6.8
Average value		N/A	N/A	6.1	6.4	6.5	6.8	3.4	4.6	5.0

# Appendix 17

## Underground Water Pollution (Other Facilities) – TSS

Name of Facility		Chambeshi Copper Smelter- Supphiric acid storage facility	Konkola Copper Mine - Nkana SBU- Acid offloading bay	Mopani Copper Mine - Mufulira-Concentrate smelter shed borehole no. 9		Mopani Copper Mine - Mufulira-Acid loading bay borehole no. 15	Mopani Copper Mine - Mufulira-Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine - Nkana - old CVW	Mopani Copper Mine - Nkana - cobalt plant	Mopani Copper Mine - Nkana - cobalt plant
				Deep	Shallow				Deep	Shallow
ZEMA statutory limits		100	100	100	100	100	100	100	100	100
2009	Jan	Dev		QTR average	QTR average	24.0	396.0	No results	No results	No results
	Feb	Dev	YTD average	QTR average	QTR average	39.0	1,500.0	No results	No results	No results
	Mar	Dev	YTD average	286.0	82.0	12.0	2,400.0	No results	No results	No results
	Apr	Dev	YTD average	QTR average	QTR average	32.0	600.0	No results	No results	No results
	May	Dev	YTD average	QTR average	QTR average	15.0	300.0	No results	No results	No results
	Jun	Dev	YTD average	171.0	144.0	Not sampled	Not sampled	No results	No results	No results
	Jul	No results	YTD average	QTR average	QTR average	1.0	975.0	No results	No results	No results
	Aug	No results	YTD average	QTR average	QTR average	20.0	179.0	No results	No results	No results
	Sep	No results	YTD average	165.0	150.0	1.0	160.0	No results	No results	No results
	Oct	No results	YTD average	QTR average	QTR average	4.0	1,408.0	No results	No results	No results
	Nov	No results	YTD average	QTR average	QTR average	2.0	5,304.0	No results	No results	No results
	Dec	No results	YTD average	Vandalised	Vandalised	5.0	3,501.0	No results	No results	No results
2010	Jan	No results	No flow	QTR average	QTR average	2.0	736.0	No results	No results	No results
	Feb	No results	No flow	QTR Average	QTR Average	2.0	160.0	No results	No results	No results
	Mar	No results	discontinued	18.0	122.0	9.0	3,845.0	No results	No results	No results
	Apr	No results	discontinued	QTR Average	QTR Average	2.0	3,788.0	No results	No results	No results
	May	No results	discontinued	QTR Average	QTR Average	1,026.0	717.0	No results	No results	No results
	Jun	No results	discontinued	825.0	789.0	31.0	17.0	No results	No results	No results
	Jul	No results	discontinued	QTR Average	QTR Average	251.0	693.0	No results	No results	No results
	Aug	No results	discontinued	QTR Average	QTR Average	18.0	1,251.0	No results	No results	No results
	Sep	No results	discontinued	42.0	35.0	1,973.0	27.0	No results	No results	No results
	Oct	No results	discontinued	QTR Average	QTR Average	12.0	2,102.0	No results	No results	No results
	Nov	No results	discontinued	QTR Average	QTR Average	19.0	1,048.0	No results	No results	No results
	Dec	No results	discontinued	18.0	34.0	15.0	10,563.0	No results	No results	No results
2011	Jan	No results	discontinued	QTR average	QTR average	5.0	2,318.0	No results	No results	No results
	Feb	No results	discontinued	QTR average	QTR average	3.0	381.0	No results	No results	No results
	Mar	No results	discontinued	-	-	-	-	No results	No results	No results
	Apr	No results	discontinued	QTR average	QTR average	14.0	165.0	No results	No results	No results
	May	No results	discontinued	QTR average	QTR average	5.0	12.0	No results	No results	No results
	Jun	No results	discontinued	60.0	16.0	10.0	34.0	No results	No results	No results
	Jul	No results	discontinued	QTR average	QTR average	4.0	819.0	No results	No results	No results
	Aug	No results	discontinued	QTR average	QTR average	70.0	4,881.0	No results	No results	No results
	Sep	No results	discontinued	142.0	89.0	10.0	3,196.0	No results	No results	No results
	Oct	No results	discontinued	QTR average	QTR average	21.0	1,370.0	No results	No results	No results
	Nov	No results	discontinued	QTR average	QTR average	60.0	No flow	No results	No results	No results
	Dec	No results	discontinued	15.0	62.0	84.0	No flow	No results	No results	No results
Source: Bi annual reports submitted to ZEMA by the Mining Companies										
ANALYSIS										
Minimum value		N/A	N/A	15.0	16.0	1.0	12.0	N/A	N/A	N/A
Median value		N/A	N/A	101.0	85.5	13.0	897.0	N/A	N/A	N/A
Maximum value		N/A	N/A	825.0	789.0	1973.0	10563.0	N/A	N/A	N/A
Average value		N/A	N/A	174.2	152.3	111.8	1713.9	N/A	N/A	N/A
									N/A	

# Appendix 18

## Underground Water Pollution (Other Facilities) – TDS

Name of Facility		Chambeshi Copper Smelter-Supphiric acid storage facility	Konkola Copper Mine - Nkana Acid loading Bay	MCM Mufulira- Concentrate smelter shed borehole no. 9		MCM Mufulira- Acid loading bay borehole no. 15	MCM Mufulira- Borehole no. 18 between tank hse 5 and refinery change house	MCM Nkana-old CVW	MCM Nkanacolbalt plant	MCM Nkana-colbalt plant
				Deep	Shallow				Deep	Shallow
ZEMA statutory limits		3000	3000	3000	3000	3000	3000	3000	3000	3000
2009	Jan	Dev	YTD Average	QTR Average	QTR Average	63.0	1,820.0	1,135.0	2,457.0	1,859.0
	Feb	Dev	YTD Average	QTR Average	QTR Average	1,400.0	<0.1	1,769.0	2,198.0	1,876.0
	Mar	Dev	YTD Average	1400	108	61.0	<0.1	No results	No results	No results
	Apr	Dev	YTD Average	QTR Average	QTR Average	1,700.0	<0.1	1,031.0	1,795.0	1,697.0
	May	Dev	YTD Average	QTR Average	QTR Average	1,100.0	No results	1,431.0	2,196.0	2,089.0
	Jun	Dev	YTD Average	500	115	No results	No results	1,541.0	2,234.0	2,074.0
	Jul	No results	YTD Average	QTR Average	QTR Average	1,200.0	200.0	No results	2,234.0	1,993.0
	Aug	No results	YTD Average	QTR Average	QTR Average	800.0	400.0	1,476.0	2,227.0	1,997.0
	Sep	No results	YTD Average	480	87	1,000.0	1,246.0	No results	No results	No results
	Oct	No results	YTD Average	QTR Average	QTR Average	1,000.0	140.0	No results	2,161.0	1,882.0
	Nov	No results	YTD Average	QTR Average	QTR Average	1,200.0	300.0	1,336.0	2,048.0	1,794.0
	Dec	No results	YTD Average	640	266	1,100.0	200.0	1,423.0	2,470.0	1,770.0
2010	Jan	No results	Discontinued	QTR Average	QTR Average	1,400.0	1,000.0	1,543.0	9,694.0	1,893.0
	Feb	No results	Discontinued	QTR Average	QTR Average	2,000.0	1,200.0	1,551.0	1,822.0	7,629.0
	Mar	No results	Discontinued	1610	1600	1,103.0	2,130.0	1,480.0	1,901.0	10,116.0
	Apr	No results	Discontinued	QTR Average	QTR Average	2,144.0	561.0	1,612.0	11,063.0	2,046.0
	May	No results	Discontinued	QTR Average	QTR Average	0.1	400.0	1,455.0	10,567.0	2,310.0
	Jun	No results	Discontinued	<0.1	<0.1	1,010.0	312.0	1,560.0	10,582.0	2,149.0
	Jul	No results	Discontinued	QTR Average	QTR Average	1,782.0	312.0	No results	No results	No results
	Aug	No results	Discontinued	QTR Average	QTR Average	1,866.0	294.0	No results	No results	No results
	Sep	No results	Discontinued	1202	1434	1,943.0	637.0	No results	No results	No results
	Oct	No results	Discontinued	QTR Average	QTR Average	1,961.0	180.0	No results	No results	No results
	Nov	No results	Discontinued	QTR Average	QTR Average	4,230.0	752.0	1,436.0	1,599.0	3,641.0
	Dec	No results	Discontinued	2122	1186	2,959.0	2,576.0	1,366.0	2,199.0	5,098.0
2011	Jan	No results	Discontinued	QTR Average	QTR Average	2,699.0	2,422.0	1,465.0	3,870.0	1,553.0
	Feb	No results	Discontinued	QTR Average	QTR Average	2,005.0	101.0	1,602.0	1,729.0	9,775.0
	Mar	No results	Discontinued	1405	1518	1,922.0	1,988.0	1,482.0	5,831.0	1,649.0
	Apr	No results	Discontinued	QTR Average	QTR Average	288.0	561.0	1,513.0	2,113.0	1,662.0
	May	No results	Discontinued	QTR Average	QTR Average	1,369.0	543.0	No results	No results	No results
	Jun	No results	Discontinued	1357	614	1,767.0	277.0	1,699.0	2,213.0	2,236.0
	Jul	No results	Discontinued	QTR Average	QTR Average	1,977.0	285.0	No results	No results	No results
	Aug	No results	Discontinued	QTR Average	QTR Average	1,943.0	251.0	1,982.0	7,511.0	1,846.0
	Sep	No results	Discontinued	1425	1654	1,457.0	171.0	No results	No results	No results
	Oct	No results	Discontinued	QTR Average	QTR Average	1,103.0	152.0	2,033.0	10,190.0	1,970.0
	Nov	No results	Discontinued	QTR Average	QTR Average	1,442.0	No Flow	2,102.0	434.0	462.0
	Dec	No results	Discontinued	1377	1093	1,953.0	No Flow	2,064.0	809.0	1,567.0
Source: Bi annual reports submitted to ZEMA by the Mining Companies										
ANALYSIS										
Minimum value		N/A	N/A	480.0	87.0	0.1	101.0	1031.0	434.0	462.0
Median value		N/A	N/A	1377.0	1093.0	1442.0	400.0	1513.0	2213.0	1970.0
Maximum value		N/A	N/A	1377.0	1654.0	4230.0	2576.0	2102.0	11,063	10,116.0
Average value		N/A	N/A	1377.0	879.5	1512.8	738.3	1563.5	3931.4	2838.3
No returns		0	0	0	0	0	0	0	0	0
No. Above ZEMA limit		N/A	N/A	N/A	N/A	1	0	0	8	5
No Measurements		27	0	36	36	1	2	11	9	9

# Appendix 19

## Underground Water Pollution (Other Facilities) – SO<sub>4</sub>

Name of Facility		Chambishi Copper Smelter- Suphiric acid storage facility	Konkola Copper Mine - Nkana Acid loading bay	Mopani Copper Mine - Mufulira Concentrate smelter shed borehole no. 9		Mopani Copper Mine - Mufulira Acid loading bay borehole no. 16	Mopani Copper Mine - Mufulira Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine - Nkana old CVW	Mopani Copper Mine - Nkana cobalt plant	Mopani Copper Mine - Nkana cobalt plant
				Deep	Shallow				Deep	Shallow
<b>ZEMA statutory limits</b>		<b>1,500</b>	<b>1,500</b>	<b>1,500</b>	<b>1,500</b>	<b>1,500</b>	<b>1,500</b>	<b>1,500</b>	<b>1,500</b>	<b>1,500</b>
<b>2009</b>	Jan	Dev	YTD Average	QTR Ave	QTR Average	28.0	871.0	No results	No results	No results
	Feb	Dev	YTD Average	QTR Ave	QTR Average	853.0	786.0	No Results	No Results	No Results
	Mar	Dev	YTD Average	853	72	28.0	1,159.0	No Results	No Results	No Results
	Apr	Dev	YTD Average	QTR Ave	QTR Average	939.0	144.0	No Results	No Results	No Results
	May	Dev	YTD Average	QTR Ave	QTR Average	782.0	230.0	No Results	No Results	No Results
	Jun	Dev	YTD Average	316	32	Not sampled	Not sampled	No Results	No Results	No Results
	Jul	No Results	YTD Average	QTR Ave	QTR Average	545.0	96.0	No Results	No Results	No Results
	Aug	No Results	YTD Average	QTR Ave	QTR Average	423.0	214.0	No Results	No Results	No Results
	Sep	No Results	YTD Average	279	11	546.0	82.0	No Results	No Results	No Results
	Oct	No Results	YTD Average	QTR Ave	QTR Average	554.0	73.0	No Results	No Results	No Results
	Nov	No Results	YTD Average	QTR Ave	QTR Average	877.0	112.0	No Results	No Results	No Results
	Dec	No Results	YTD Average	321	23	584.0	99.0	No Results	No Results	No Results
<b>2010</b>	Jan	No Results	Discontinued	QTR Ave	QTR Average	720.0	584.0	No results	No results	No results
	Feb	No Results	Discontinued	QTR Ave	QTR Average	1,020.0	556.0	No Results	No Results	No Results
	Mar	No Results	Discontinued	759	712	544.0	1,179.0	No Results	No Results	No Results
	Apr	No Results	Discontinued	QTR Ave	QTR Average	1,247.0	307.0	No Results	No Results	No Results
	May	No Results	Discontinued	QTR Ave	QTR Average	80.0	173.0	No Results	No Results	No Results
	Jun	No Results	Discontinued	140	240	485.0	171.0	No Results	No Results	No Results
	Jul	No Results	Discontinued	QTR Ave	QTR Average	805.0	142.0	No Results	No Results	No Results
	Aug	No Results	Discontinued	QTR Ave	QTR Average	842.0	134.0	No Results	No Results	No Results
	Sep	No Results	Discontinued	545	645	877.0	290.0	No Results	No Results	No Results
	Oct	No Results	Discontinued	QTR Ave	QTR Average	884.0	81.0	No Results	No Results	No Results
	Nov	No Results	Discontinued	QTR Ave	QTR Average	38.0	344.0	No Results	No Results	No Results
	Dec	No Results	Discontinued	1038	581	1,336.0	1,185.0	No Results	No Results	No Results
<b>2011</b>	Jan	No Results	Discontinued	QTR Ave	QTR Average	1,215.0	1,090.0	No results	No results	No results
	Feb	No Results	Discontinued	QTR Ave	QTR Average	79.0	47.0	No Results	No Results	No Results
	Mar	No Results	Discontinued	636	686	869.0	897.0	No Results	No Results	No Results
	Apr	No Results	Discontinued	QTR Ave	QTR Average	807.0	256.0	No Results	No Results	No Results
	May	No Results	Discontinued	QTR Ave	QTR Average	-	-	No Results	No Results	No Results
	Jun	No Results	Discontinued	-	-	1,006.0	56.0	No Results	No Results	No Results
	Jul	No Results	Discontinued	QTR Ave	QTR Average	1,079.0	111.0	No Results	No Results	No Results
	Aug	No Results	Discontinued	QTR Ave	QTR Average	1,011.0	102.0	No Results	No Results	No Results
	Sep	No Results	Discontinued	864	959	656.0	77.0	No Results	No Results	No Results
	Oct	No Results	Discontinued	QTR Ave	QTR Average	722.0	71.0	No Results	No Results	No Results
	Nov	No Results	Discontinued	QTR Ave	QTR Average	652.0	no flow	No Results	No Results	No Results
	Dec	No Results	Discontinued	629	498	879.0	no flow	No Results	No Results	No Results
Source: Bi annual reports submitted to ZEMA by the Mining Companies										



# Appendix 20

## Ground Water Pollution (Other Facilities) – TCu

	Name of Facility		Chambishi Copper Smelter-Suphric acid storage facility	Konkola Copper Mine - Nkana SBU Acid offloading Bay	Mopani Copper Mine - Mufulira Concentrate smelter shed borehole no. 9	Mopani Copper Mine - Mufulira Acid loading bay borehole no. 16	Mopani Copper Mine - Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine - Nkana oldCVW	Mopani Copper Mine - Nkana colbalt plant	Mopani Copper Mine - Nkana colbalt plant
					Deep	Shallow			Deep	Shallow
ZEMA statutory limits			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	2009	Jan	Dev	YTD Average	QTR Ave	QTR Average	0.6	1.4	3.1	6.5
		Feb	Dev	YTD Average	QTR Ave	QTR Average	1.9	6.1	3.7	38.2
		Mar	Dev	YTD Average	11	5.8	0.9	5.6	No Results	No Results
		Apr	Dev	YTD Average	QTR Ave	QTR Average	0.7	2.2	2.1	0.4
		May	Dev	YTD Average	QTR Ave	QTR Average	0.4	0.9	4.4	1
		Jun	Dev	YTD Average	4.7	6.9	No Results	No Results	5.8	1.3
		Jul	No Results	YTD Average	QTR Ave	QTR Average	1.0	2.1	No Results	0.7
		Aug	No Results	YTD Average	QTR Ave	QTR Average	0.9	0.2	3.8	0.6
		Sep	No Results	YTD Average	4	7.1	4.2	1.9	No Results	No Results
		Oct	No Results	YTD Average	QTR Ave	QTR Average	10.0	1.5	No Results	0.9
		Nov	No Results	YTD Average	QTR Ave	QTR Average	10.0	3.5	0.9	0.7
		Dec	No Results	YTD Average	Vandalise	Vandalised	12.7	11.8	5.7	7.3
	2010	Jan	No Results	Discontinued	QTR Ave	QTR Average	7.0	3.0	5.5	52.8
		Feb	No Results	Discontinued	QTR Ave	QTR Average	7.5	0.5	4.5	8.4
		Mar	No Results	Discontinued	2.5	4.0	10.9	5.3	3.7	10.4
		Apr	No Results	Discontinued	QTR Ave	QTR Average	11.0	10.7	3.6	50
		May	No Results	Discontinued	QTR Ave	QTR Average	9.2	3.3	3.2	55.5
		Jun	No Results	Discontinued	3.7	3.7	11.5	1.7	3.3	60
		Jul	No Results	Discontinued	QTR Ave	QTR Average	7.5	1.1	3.2	58.5
		Aug	No Results	Discontinued	QTR Ave	QTR Average	9.8	2.7	2.1	118.0
		Sep	No Results	Discontinued	3.2	3.4	8.9	1.0	96.9	98.0
		Oct	No Results	Discontinued	QTR Ave	QTR Average	7.4	5.3	7.0	63.0
		Nov	No Results	Discontinued	QTR Ave	QTR Average	2.3	8.7	0.9	0.5
		Dec	No Results	Discontinued	4.5	2.6	4.1	19.0	1.0	0.8
	2011	Jan	No Results	Discontinued	QTR Ave	QTR Average		3.7	3.3	12.3
		Feb	No Results	Discontinued	QTR Ave	QTR Average	1.9	1.6	4.3	20.1
		Mar	No Results	Discontinued	2.9	5	0.7	1.9	2.8	20.8
		Apr	No Results	Discontinued	QTR Ave	QTR Average	0.3	0.8	4.9	3.4
		May	No Results	Discontinued	QTR Ave	QTR Average	0.4	0.5	7.8	0.4
		Jun	No Results	Discontinued	4.3	4.6	Not sampled	0.2	5.8	12.6
		Jul	No Results	Discontinued	QTR Ave	QTR Average	1.0	1.2	*	*
		Aug	No Results	Discontinued	QTR Ave	QTR Average	0.7	6.3	4.0	24.9
		Sep	No Results	Discontinued	7.5	6.5	0.2	4.7	*	*
		Oct	No Results	Discontinued	QTR Ave	QTR Average	<0.1	5.4	5.3	30.8
		Nov	No Results	Discontinued	QTR Ave	QTR Average	0.9	No flow	6.1	<0.1
		Dec	No Results	Discontinued	1.6	1.6	3.7	No flow	5.0	30.1
Source: Bi annual reports submitted to ZEMA by the Mining Companies										
No Bore Hole means the bore hole had not yet been sunk.										
No sample means that the mines did not submit test results										
YTD average means that the mine submitted the annual averages instead of the monthly averaages										
ANALYSIS										
Minimum value			N/A	N/A	1.6	1.6	0.2	0.2	0.9	0.4
Median value			N/A	N/A	4.0	4.6	3.0	2.2	3.9	12.3
Maximum value			N/A	N/A	11.0	7.1	12.7	19.0	96.9	118.0
Average value			N/A	N/A	4.5	4.7	4.7	3.8	7.1	25.4
No returns/results			N/A	N/A	0	0	1	1	4	2
No. Above ZEMA limit			N/A	N/A	11	11	19	22	27	21

# Appendix 21

## Ground Water Pollution (Dumps) – TCo

Name of Facility		Chambishi Copper Smelter Suphiric acid storage facility	Mopani Copper Mine - Mufulira Concentrate smelter shed borehole no. 9	Mopani Copper Mine - Mufulira Acid loading bay borehole no. 16	Mopani Copper Mine - Mufulira Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine -Nkana oldCVW	Mopani Copper Mine -Nkana colbalt plant	Mopani Copper Mine -Nkana colbalt plant	
			Deep	Shallow			Deep	Shallow	
ZEMA statutory limit		1.0	1.0	1.0	1.0	1.0	1.0	1.0	
2009	Jan	Dev	QTR Average	QTR Average	<0.1	<0.1	1.1	444.2	276.8
	Feb	Dev	QTR Average	QTR Average	<0.1	<0.1	1.3	130.0	110.0
	Mar	Dev	<0.1	<0.1	<0.1	<0.1	No Results	No Results	No Results
	Apr	Dev	QTR Average	QTR Average	<0.1	<0.1	0.9	16.3	33.4
	May	Dev	QTR Average	QTR Average	0.1	<0.1	1.3	13.6	14.4
	Jun	Dev	<0.1	<0.1	No Results	No Results	1.4	28.4	9.1
	Jul	No Results	QTR Average	QTR Average	0.1	0.1	No Results	7.9	21.2
	Aug	No Results	QTR Average	QTR Average	<0.1	<0.1	0.8	7.6	21.2
	Sep	No Results	<0.1	<0.1	0.1	<0.1	No Results	No Results	No Results
	Oct	No Results	QTR Average	QTR Average	<0.1	<0.1	No Results	6.3	47.5
	Nov	No Results	QTR Average	QTR Average	0.3	<0.1	0.4	5.8	56.0
	Dec	No Results	Vandalised	Vandalised	0.2	<0.1	1.6	290.3	93.6
2010	Jan	No Results	QTR Average	QTR Average	<0.1	<0.1	1.2	3,992.3	347.9
	Feb	No Results	QTR Average	QTR Average	0.1	0.1	1.0	295.1	1,780.7
	Mar	No Results	<0.1	<0.1	0.4	0.4	1.3	320.1	1,884.3
	Apr	No Results	QTR Average	QTR Average	0.4	0.2	0.9	2,200.0	183.0
	May	No Results	QTR Average	QTR Average	0.3	0.1	0.6	2,342.5	232.0
	Jun	No Results	<0.1	<0.1	0.2	<0.1	1.0	4,200.0	298.0
	Jul	No Results	QTR Average	QTR Average	0.3	<0.1	0.4	3,029.3	1,215.0
	Aug	No Results	QTR Average	QTR Average	0.5	<0.1	0.8	2,402.0	210.0
	Sep	No Results	<0.1	0.1	0.3	0.1	30.0	1,340.0	2,781.0
	Oct	No Results	QTR Average	QTR Average	0.2	0.1	1.8	515.0	160.0
	Nov	No Results	QTR Average	QTR Average	<0.1	<0.1	0.7	24.0	92.5
	Dec	No Results	<0.1	<0.1	<0.1	<0.1	0.7	2.9	90.9
2011	Jan	No Results	QTR Average	QTR Average	0.1	<0.1	0.6	320.0	151.0
	Feb	No Results	QTR Average	QTR Average	0.1	0.4	1.2	910.0	2.3
	Mar	No Results	<0.1	0.1	0.1	0.1	0.3	1,570.0	96.7
	Apr	No Results	QTR Average	QTR Average	<0.1	<0.1	1.2	75.4	9.4
	May	No Results	QTR Average	QTR Average	<0.1	<0.1	1.0	14.0	13.8
	Jun	No Results	<0.1	<0.1	<0.1	<0.1	0.8	157.0	34.9
	Jul	No Results	QTR Average	QTR Average	0.1	<0.1	No Results	No Results	No Results
	Aug	No Results	QTR Average	QTR Average	<0.1	<0.1	0.2	112.3	45.3
	Sep	No Results	<0.1	<0.1	<0.1	<0.1	No Results	No Results	No Results
	Oct	No Results	QTR Average	QTR Average	<0.1	<0.1	0.6	123.1	78.6
	Nov	No Results	QTR Average	QTR Average	0.1	No flow	0.6	<0.1	<0.1
	Dec	No Results	<0.1	<0.1	<0.1	No flow	0.5	58.6	51.7
Source: Bi annual reports submitted to ZEMA by the Mining Companies									
ANALYSIS									
Minimum value	N/A	N/A	0.1	0.1	0.1	0.2	2.9	2.3	
Median value	N/A	N/A	0.1	0.2	0.1	0.9	157.0	92.5	
Maximum value	N/A	N/A	0.1	0.5	0.4	30.0	4200.0	2781.0	
Average value	N/A	N/A	0.1	0.2	0.2	1.9	805.0	336.8	
No returns/results	N/A	N/A	0	1	1	6	4	4	
No. Above ZEMA limit	0	0	0	0	0	11	31	31	
No Measurements	0	0	0	0	0	0	0	0	
No. 30x above limit	0	0	0	0	0	0	21	24	

# Appendix 22

## Underground Water Pollution (Other facilities) – TMn

Name of Facility		Chambishi Copper Smelter Suphiric acid storage facility	Konkola Copper Mine - Nkana Acid loading Bay	Mopani Copper Mine - Mufulira Concentrate smelter shed borehole no. 9		Mopani Copper Mine - Mufulira Acid loading bay borehole no. 16	Mopani Copper Mine - Mufulira Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine - Nkana old CVW	Mopani Copper Mine - Nkana colbalt plant	Mopani Copper Mine - Nkana colbalt plant
				Deep	Shallow				Deep	Shallow
<b>ZEMA statutory limit</b>		<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>
<b>2009</b>	Jan	Dev	YTD Ave	QTR Ave	QTR Ave	0.6	0.6	3.2	18.9	10.4
	Feb	Dev	YTD Ave	QTR Ave	QTR Ave	0.7	0.7	5.9	6.5	6.0
	Mar	Dev	YTD Ave	1.7	0.4	1.4	1.4	No Resu	No Resu	No Resu
	Apr	Dev	YTD Ave	QTR Ave	QTR Ave	0.2	0.2	9.0	0.9	3.9
	May	Dev	YTD Ave	QTR Ave	QTR Ave	<0.1	<0.1	4.4	0.5	1.0
	Jun	Dev	YTD Ave	1.2	<0.1	No Resu	No Results	7.4	3.9	1.0
	Jul	No Return	YTD Ave	QTR Ave	QTR Ave	0.1	0.5	No Resu	0.6	2.1
	Aug	No Return	YTD Ave	QTR Ave	QTR Ave	<0.1	0.7	2.2	0.6	2.2
	Sep	No Return	YTD Ave	1.3	<0.1	1.4	0.1	No Resu	No Resu	No Resu
	Oct	No Return	YTD Ave	QTR Ave	QTR Ave	2.6	0.2	No Resu	0.9	3.5
	Nov	No Return	YTD Ave	QTR Ave	QTR Ave	2.6	0.4	0.8	0.9	4.2
	Dec	No Return	YTD Ave	Vandalise	Vandalise	3.5	4.4	3.1	15.1	5.4
<b>2010</b>	Jan	No Return	Discontin	QTR Ave	QTR Ave	0.5	1.5	3.1	178.0	12.7
	Feb	No Return	Discontin	QTR Ave	QTR Ave	3.0	0.3	1.1	11.3	123.6
	Mar	No Return	Discontin	0.3	0.3	3.8	0.9	0.9	12.6	157.3
	Apr	No Return	Discontin	QTR Ave	QTR Ave	0.1	3.7	1.7	180.0	9.6
	May	No Return	Discontin	QTR Ave	QTR Ave	2.9	1.1	2.5	235.8	19.9
	Jun	No Return	Discontin	0.9	<0.1	3.6	1.3	2.4	230.0	15.6
	Jul	No Return	Discontin	QTR Ave	QTR Ave	3.2	0.6	1.9	181.5	10.4
	Aug	No Return	Discontin	QTR Ave	QTR Ave	3.4	1.0	2.0	205.0	8.8
	Sep	No Return	Discontin	0.2	1.1	2.7	0.5	2.1	9.1	176.0
	Oct	No Return	Discontin	QTR Ave	QTR Ave	2.5	1.7	7.9	14.1	0.9
	Nov	No Return	Discontin	QTR Ave	QTR Ave	<0.1	2.2	3.0	9.0	51.0
	Dec	No Return	Discontin	<0.1	<0.1	<0.1	5.2	0.3	0.4	0.6
<b>2011</b>	Jan	No Return	Discontin	QTR Ave	QTR Ave	0.3	1.2	2.0	31.0	9.3
	Feb	No Return	Discontin	QTR Ave	QTR Ave	0.1	0.3	4.0	29.4	12.4
	Mar	No Return	Discontin	0.8	1.5	0.4	0.5	1.9	90.0	7.1
	Apr	No Return	Discontin	QTR Ave	QTR Ave	0.1	0.6	3.1	9.8	0.9
	May	No Return	Discontin	QTR Ave	QTR Ave	0.1	0.3	4.2	1.4	1.3
	Jun	No Return	Discontin	0.7	1.2	0.3	0.3	3.2	21.3	3.5
	Jul	No Return	Discontin	QTR Ave	QTR Ave	0.2	0.2	No Resu	No Resu	No Resu
	Aug	No Return	Discontin	QTR Ave	QTR Ave	0.2	2.3	1.8	40.0	12.3
	Sep	No Return	Discontin	1.0	1.7	0.2	1.7	No Resu	No Resu	No Resu
	Oct	No Return	Discontin	QTR Ave	QTR Ave	<0.1	1.4	3.3	18.1	10.1
	Nov	No Return	Discontin	QTR Ave	QTR Ave	<0.1	No flow	3.6	2.1	0.6
	Dec	No Return	Discontin	0.9	0.9	<0.1	No flow	2.2	50.1	11.9
Source: Bi annual reports submitted to ZEMA by the Mining Companies										
<b>DATA ANALYSIS</b>										
<b>Minimum value</b>		N/A	N/A	0.2	0.3	0.1	0.1	0.3	0.4	0.6
<b>Median value</b>		N/A	N/A	0.9	1.1	0.7	0.7	2.8	13.4	8.0
<b>Maximum value</b>		N/A	N/A	1.7	1.7	3.8	5.2	9.0	235.8	176.0
<b>Average value</b>		N/A	N/A	0.9	1.0	1.5	1.2	3.1	50.3	21.7
<b>No returns/results</b>		N/A	N/A	0	0	1	1	6	4	4
<b>No. Above ZEMA</b>		0	0	3	4	13	13	27	25	26

# Appendix 23

## Ground Water Pollution (Dumps) – TFe

Name of Facility			Chambishi Copper Smelter Sulfuric acid storage facility	Konkola Copper Mine - Nkana SBU Acid loading Bay	Mopani Copper Mine - Mufulira Concentrate smelter shed borehole no. 9		Mopani Copper Mine - Mufulira Acid loading bay borehole no. 16	Mopani Borehole no. 18 between tank hse 5 and refinery change house	Mopani Copper Mine - Nkana old CVW	Mopani Copper Mine - Nkana colbalt plant	Mopani Copper Mine - Nkana colbalt plant
					Deep	Shallow					
					2.0	2.0	2.0	2.0	2.0	2.0	2.0
	2009	Jan	Dev	YTD Average	QTR Ave	QTR Ave	1.0	1.6	6.9	1	4.7
		Feb	Dev	YTD Average	QTR Ave	QTR Ave	<0.1	0.3	14.1	1.5	2.4
		Mar	Dev	YTD Average	2.9	4.2	<0.1	28.8	No results	No results	No results
		Apr	Dev	YTD Average	QTR Ave	QTR Ave	<0.1	63.3	3.2	0.4	3.2
		May	Dev	YTD Average	QTR Ave	QTR Ave	<0.1	<0.1	4.3	0.9	1.6
		Jun	Dev	YTD Average	0.9	7.6	No results	No results	5.1	0.9	1.9
		Jul	Not sampled	YTD Average	QTR Ave	QTR Ave	0.2	12.5	No results	0.1	0.1
		Aug	Not sampled	YTD Average	QTR Ave	QTR Ave	<0.1	7.0	0.3	0.1	0.1
		Sep	Not sampled	YTD Average	1.7	0.7	0.4	2.0	No results	No results	No results
		Oct	Not sampled	YTD Average	QTR Ave	QTR Ave	0.1	5.8	No results	1.7	1.0
		Nov	Not sampled	YTD Average	QTR Ave	QTR Ave	0.7	28.1	1.6	1.8	11.7
		Dec	Not sampled	YTD Average	1.7	5	0.8	147.0	1.3	0.8	1.0
	2010	Jan	Not sampled	Discontinued	QTR Ave	QTR Ave	0.4	0.3	20.9	27.6	34.3
		Feb	Not sampled	Discontinued	QTR Ave	QTR Ave	0.7	5.0	28.9	2.3	14.1
		Mar	Not sampled	Discontinued	2.7	6.5	0.2	29.4	23.4	3.2	18.7
		Apr	Not sampled	Discontinued	QTR Ave	QTR Ave	<0.1	71.2	18.3	20.1	9.4
		May	Not sampled	Discontinued	QTR Ave	QTR Ave	<0.1	14.6	10.9	4.3	4.2
		Jun	Not sampled	Discontinued	0.1	6.5	0.2	10.4	5	2.2	12.9
		Jul	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	11.8	0.1	0.3	0.1
		Aug	Not sampled	Discontinued	QTR Ave	QTR Ave	1.0	14.8	0.3	2.1	0.4
		Sep	Not sampled	Discontinued	1.4	1.5	0.2	6.1	15.1	0.3	10.1
		Oct	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	29.4	0.3	0.2	0.1
		Nov	Not sampled	Discontinued	QTR Ave	QTR Ave	0.5	52.4	<0.1	<0.1	<0.1
		Dec	Not sampled	Discontinued	5.9	<0.1	0.9	214.0	<0.1	<0.1	<0.1
	2011	Jan	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	20.9	<0.1	1	0.9
		Feb	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	5.0	10.9	4.3	14.1
		Mar	Not sampled	Discontinued	0.5	0.7	0.1	6.7	<0.1	1.6	0.9
		Apr	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	1.8	0.3	0.2	0.2
		May	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	0.8	1.3	0.7	1.2
		Jun	Not sampled	Discontinued	0.5	0.3	0.8	1.0	<0.1	0.6	20.0
		Jul	Not sampled	Discontinued	QTR Ave	QTR Ave	0.3	4.7	No results	No results	No results
		Aug	Not sampled	Discontinued	QTR Ave	QTR Ave	1.8	41.6	<0.1	0.2	<0.1
		Sep	Not sampled	Discontinued	7.3	5	0.9	24.2	No results	No results	No results
		Oct	Not sampled	Discontinued	QTR Ave	QTR Ave	0.1	1.2	0.7	1.2	0.3
		Nov	Not sampled	Discontinued	QTR Ave	QTR Ave	3.5	No flow	0.3	0.5	1.6
		Dec	Not sampled	Discontinued	0.8	1.7	3.8	No flow	17.4	14.2	10.1
No of times higher - range											
Source: Bi annual reports submitted to ZEMA by the Mining Companies											
ANALYSIS											
Minimum value			N/A	N/A	0.1	0.3	0.1	0.3	0.1	0.1	0.1
Median value			N/A	N/A	1.6	4.2	0.4	11.1	4.7	1.0	1.9
Maximum value			N/A	N/A	7.3	7.6	3.8	214.0	28.9	27.6	34.3
Average value			N/A	N/A	2.2	3.6	0.7	27.0	8.0	3.2	6.3
No returns/results			N/A	N/A	0	0	1	1	6	4	4
No. Above ZEMA limit			0	0	4	6	2	24	14	9	14

# Appendix 24

## Assessment of Tailings Storage Facilities (Dumps/dams)

Name of Mine	Name of Facility	Dump status	Restricted access	Hazardous and warning signs	Drainages in good condition / No sinkholes / No tension cracks	Evidence of gullies	Evidence of vegetation	Pollution of surrounding areas e.g. dust	Illegal waste disposal	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
Bwana Mkubwa Mining Limited	Tailings Dam No. 5A and 5B	Active	Access is restricted	There are no hazardous and safety signs	There are lined drains. Some toe drainages have overgrown vegetation	Few gullies on the north eastern section of the dump.	Vegetation along the main eastern wall and the lower part of the western flank is emerging and establishing. However, the northern and other walls remain generally bare.	There are incidences of fugitive dust from the bare tailings surfaces.	None	There is no effluent discharge to the environment	The collected effluent from the plant including runoff is highly acidic and requires neutralization. The monitoring results from bore hole 2,5 and 10 showed instances of high acidity levels i.e. pH below minimum levels of 6,high TDS,DCu,DFe and DMn	Although the nearest community is said to be 5km away, there have been complaints of water pollution in the Mukulungwe stream by the residents of Mukulungwe farms.
	Tailings Dam No. 4	Reclaimed	Access is restricted	There are no hazardous and safety signs	Storm water diversion channels were seen.	The dam was reclaimed	Poorly vegetated	High possibility of dust due to sparse vegetation	None	There is no effluent discharge to the environment	The monitoring results from bore hole 4,9 and 13 showed instances of high acidity levels i.e. pH below minimum levels of 6,high TDS,TSS,DCu,DFe,EC and DMn	Although the nearest community is said to be 5km away, there have been complaints of water pollution in the Mukulungwe stream by the residents of Mukulungwe farms.
Luanshya Copper Mine Plc	Musi Tailings Dam	Active	Unrestricted access to the site	No safety and hazardous signs were seen	Lined drains were seen	Gully formation on the dam was pronounced.	Eastern wall of the dump is sparsely vegetated	Dust emissions were high as most parts of the dam are bare	None	No bi annuals submitted	Contrary to regulations, no ground water monitoring was conducted for the period 2010 - 2011	No residential areas within 500m radius.
Lumwana Mining Company	Copper Tailing Dump	Active	yes	yes	Dam had water that the mine was requesting ZEMA to release to the environment as it was compromising the stability of the dump	No	no dump still low(new)	No	No	according to ZEMA report Dated April 2010 water was released to Lumwana river without licence between April 2009 and April 2010.	No borehole results No statutory dump report	No but Lumwana river was accessed by locals
Chambeshi Metals Plc	Chambeshi Metals Tailings Storage Facility	Active	Access not restricted	Hazardous and safety signs were seen.	Drainages are underground and are in good condition	None	The walls are bare with very little vegetation in isolated places	No incidences of wind-blown erosion.	None	The effluent discharge from the tailings dam is sent to a return water pond and back to the plant.	Test results show that all parameters are compliant with statutory limits	None

# Appendix 24 (Cont)

## Assessment of Tailings Storage Facilities(Dumps/dams)

Name of Mine	Name of Facility	Dump status	Restricted access	Hazardous and warning signs	Drainages in good condition / No sinkholes / No tension cracks	Evidence of gullies	Evidence of vegetation	Pollution surrounding areas e.g. dust	Illegal waste disposal	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
Chambishi Copper Smelter	Slag Dump	Active	no	only at the entrance to the dump					None	No dump report	Dump discharges in lua stream	Approximately 700m are farms
Mopani Copper Mines Plc-Nkana	TD 15 A	active	has borrow pits caused by illegal mining and are	no adequate signage to keep away people	the piccolo dicant discharges into unlined drains	gullies on the access ramps	vegetated except for the western wall. The vegetation in the western wall are covered in	beaches that can not be revegetated as the dump is still active. No wind breaks erected. Dust is impacting the	no	Piccolo dicant drains into the Fikondo stream	Some element of high TMn in borehole test results	5km from kalulushi township. Squatter compound was found about 300m from the edge of the dump.
Mopani Copper Mines Plc-Mufulira	TD 11	active	yes	yes	ok	no	the south wall upto south west is largely bare but other areas are well vegetated	yes from the top beaches that can not be revegetated as the dump is still active. No wind breaks erected. Dust is impacting the surrounding vegetation.	no	Seepage from filters drain directly into the mufulira stream. Spillway dicants into the mufulira stream. Discharge from both spillway and seepage has evidence of High TMn and Tfe	test results from borehole has evidence of High TMn and Tfe.	Approximately 2km from the closest town ship.
Konkola Copper Mine Plc-Konkola IBU	Lubengele Tailings Dam Dump C		No restricted access to the dump. There was evidence of people fishing, bathing and washing.	There are no hazardous and warning signs displayed		few erosion gullies were observed	Downstream slopes are well vegetated however the flanks and upper slopes have patches of bare faces	Wind erosion has continued to affect the beach areas	None	• Instances of high elevation of total suspended solids, Total iron, Total Cobalt and Total Copper · Evidence of fine tailings silting the downstream areas.	Instances of pH and Total Copper being outside the approved parameters	None
Konkola Copper Mine Plc-Nchanga IBU	Tailings Dump No. 7		Not assessed	Not assessed		The bare slopes of the embankments are characterized with numerous gullies extending down to the toe area.	The top parts of the embankment are generally well vegetated with trees and grass while the rest of the slopes are generally bare with no vegetation cover.	Windblown dust is likely to be generated from bare exposed tailings surfaces but its impact on human settlements are deemed to be insignificant.	None	The dump material does not generate acidic drainage, and subsequently, metal leaching is not expected. No water pollution is expected from the current setting.	None	The dump is located approximately 3km north west of the nearest town ship.
	Kamana North Dump (TD3)		Not assessed	Not assessed		None	The top surface is well vegetated through natural colonization while the slopes are poorly vegetated.	None	None	None.	None	The dump is located over 2km West of the nearest farm settlement.
	TD4		Not assessed	Not assessed		Severe erosion gullies	Surfaces well established and no further re-vegetation required present pending reclamation	None The dump surfaces are well vegetated apart from a patch on the western side, and the setting and condition of the dump mean that there is little susceptibility to dust blows.	None	None	None	None
	Mutimpa Tailings Dam (TD 5)		No restricted access	No hazardous and warning signs		Evidence of gullies on the western side	Eastern side but western side was bare	Wind erosion has continued to affect the western side which is bare	None	Siltation of Mutimpa Stream was noticed. In addition effluent discharged from the Mutimpa Spillway to the Mutimpa Stream was non compliant with respect to TDS, Fe and Mn.	Out of the parameters monitored pH was non compliant	Confirm with dump reports
Kansanshi Mining Plc	Kansanshi Sulphide Tailings Storage		Yes	There are no hazardous and warning signs displayed		few erosion gullies were observed	Toe areas are well vegetated with grass and trees. The top surfaces where there is still deposition is bare.	Wind erosion has continued to affect the beach surface during dry season and dust generated along access roads.	None	The current setting of the TSF does not pose significant surface water pollution contamination risks.	The current setting of the TSF does not pose significant ground water pollution contamination risks.	None



# Appendix 24 (Cont)

## Assessment of Tailings Storage Facilities(Dumps/dams)

Name of Mine	Name of Facility	Dump status	Restricted access	Hazardous and warning signs	Drainages in good condition / No sinkholes / No tension cracks	Evidence of gullies	Evidence of vegetation	Pollution of surrounding areas e.g. dust	Illegal waste disposal	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
	TD4		Not assessed	Not assessed		Severe erosion gullies	Surfaces well established vegetation and no further re-vegetation required pending reclamation	None The dump surfaces are well vegetated apart from a patch on the western side and the setting and condition of the dump mean that there is little susceptibility to dust blows.	None	None	None	None
	Mutimpa Tailings Dam (TD 5)		No restricted access	No hazardous and warning signs		Evidence of gullies on the western side	Eastern side but western side was bare	Wind erosion has continued to affect the western side which is bare	None	Siltation of Mutimpa Stream was noticed. In addition effluent discharged from the Mutimpa Spillway to the Muntimpa Stream was non compliant with respect to TDS, Fe and Mn.	Out of the parameters monitored pH was non compliant	Confirm with dump reports
Kansanshi Mining Plc	Kansanshi Sulphide Tailings Storage		Yes	There are no hazardous and warning signs displayed		few erosion gullies were observed	Toe areas are well vegetated with grass and trees. The top surfaces where there is still deposition is bare.	Wind erosion has continued to affect the beach surface during dry season and dust generated along access roads.	None	The current setting of the TSF does not pose significant surface water pollution contamination risks.	The current setting of the TSF does not pose significant ground water contamination risks.	None
	Kansanshi Oxide Tailings Storage Facility		Yes	There are no hazardous and warning signs displayed		None	Dump is active and top surface cannot be rehabilitated. Progressive planting of self sustaining on the downstream faces of the earth hill embankment will commence.	None		None	None	None
Chibuluma Mine	Chibuluma South TailingsDump		No restricted access	Displayed		None	The toe area was well vegetated but the top embankments and bench were bare.	Large quantities of dust emanating from the dump and the most affected community is the Pwele village.	None	Settling pond highly silted hence overflow was not clear indicating presence of high total suspended solids		Pwele Village is within 100meters away from the dump.
	Chibuluma Tailings Dam No. 1		No restricted access	There are no hazardous and warning signs displayed		Eastern embankment highly eroded and vandalized by illegal stone crushers	No vegetation on the top beach	Too much dust and the town being affected is Kalulushi township		The dump is decommissioned and there was no water discharge	No ground water monitoring tests	Kalulushi township
	Chibuluma Tailings Dump No. 2		No restricted access-the waste rock buttresses was being illegally reclaimed thereby exposing the tailings to the environment	There are no hazardous and warning signs displayed		The dump walls were inaccessible as there was no road access.	No vegetation on the top beach	Too much dust and the town being affected is	There was illegal dumping of domestic waste.	The dump is decommissioned and there was no water discharge	No ground water monitoring tests	Kalulushi township
NFC Africa Mining Plc	Tailings Dump No. 6	Active	Access is not restricted	No warning and hazardous signs seen.	The toe drain is overgrown with grass and this may impede the design function. Unlined drains from the metallurgical processing plant are used to feed effluent into the dump.	The Northern part of the dump plateau is gullied	Vegetation on is beginning to take hold on eastern side and the dump surface is sparsely vegetated			Discharge from the decant into the Chambeshi stream was clouded with tailings material. This meant that the tailings are finding their way to the new dambo-the natural bio filter for the area.		There are no residential areas within the stated radius.
	Luano Tailings Dump(TD16)	Decommisioned	Access not restricted Vegetable gardens were seen at the toe of the dump	No warning and hazardous signs seen.	The toe drains are in good condition. However, the eastern ends require clearing of overgrown grass	None	The eastern side of dump is well with grass and occasional shrubs. The retaining walls are well vegetated with grass and some shrubs. The central and western parts have scanty vegetation.		There was illegal dumping of domestic waste.		No bi annuals	There are settlements within 500M of the dam. The dump was reclaimed on the eastern side by Sino metals .This reclamation has left burrow pits which are now filled with water. This is a health hazard to local children.
	Musakashi Tailings Dump (TD 19)	Active	Access not restricted	No warning and hazardous signs seen.	Spillway is lined	None	Vegetation has begun to take hold on the dam wall slopes	None		None	None	

# Appendix 25

## Assessment of Slag Dump

Name of Mine	Name of Facility	Status	Restricted access	Hazardous and warning signs	Evidence of gullies	Drainage is good/No tension cracks/No sink holes	Evidence of vegetation	Pollution of surrounding areas e.g. dust	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
Luanshya Copper Mine Plc	Old slag dump		Access is not restricted. Illegal miners were seen on site	Hazardous and warning signs were seen	Gullies were seen at the foot of the old slag dump	No drainage channels were seen	No vegetation	No evidence of dust pollution	The illegal miners are destabilizing the dump surfaces which may result in releasing of sediments into the nearby Luanshya river and stream		There is Roan township within 200KM radius from the dump
	New slag dump		Access is not restricted. Illegal miners were seen on site	Hazardous and warning signs were seen	Minor gullies were seen	No drainage channels were seen	No vegetation	No evidence of dust pollution	The dump was banded.		There is Roan township within 200KM radius from the dump
Chambishi Metals Plc	Nkani slag dump	not active	Access is not restricted. Illegal miners were seen on site	No	No	N/A	No	No statutory dump report	No statutory dump report	No statutory dump report	No statutory dump report
Chambishi Copper Smelter	No statutory dump report provided	Active	Access is not restricted. Illegal miners were seen on site	Hazardous and warning signs were not seen	no	No drainage channels were seen	No vegetation	No evidence of dust pollution	No statutory dump report	No statutory dump report	No statutory dump report
Mopani Copper Mines Plc-Nkama	reverb slag dump no. 68	inactive	evidence of trespassers due to footpaths	no	no	no	sparsely vegetated on upper surface	minimal wind erosion as the dump is capped	Luanshya stream receives the water. No problem	Not tested	2km from Kiwee and Chibuluma towns
Mopani Copper Mines Plc-Mufindi	Slag Dump No. 1	Active/reclaiming	None- Electric fenced Fence vandalised Illegal mining of reverb slag at the bottom of the dump despite police presence	There are no hazardous and warning signs	None	Line drains	No attempt has been made to revegetate the dump	Granulated slag not prone to windblown erosion	Slag material gets washed into the drains	No test results	Kankoyo township on the west
	Slag Dump No. 2	Active/ reclaimed	None- Electric fenced	There are no hazardous and warning signs	None	*No tension cracks or swallow holes - Toe Drainages are unfilled and overgrown with grass.	Not revegetated - slag being considered for reclamation.	Granulated slag not prone to windblown erosion	Slag material gets washed into the drains	No test results	About 500m north of Kankoyo township
Konkola Copper Mine Plc-Nkama IBU	Slag Dump No. 67	Being reclaimed	Illegal mining has increased despite security presence. There are numerous excavation holes on the top surfaces. The facility	There are no hazardous and warning sign posts around the facility	None	Drainages were okay except for a blocked culvert pipe on the eastern side of the dump.	Dump surfaces have no vegetation cover	None-except for the excavated portions the dump material is coarse and prone to windblown erosion.	None-except for the excavated areas the water from this dump flows into the Luanshya stream via Mufindi stream to Kafue river the particles are coarse and not easily eroded. The dump slag is chemically inert not easily susceptible to leaching.	None-except for the excavated areas. The dump slag is chemically inert not easily susceptible to leaching.	No human settlement nearby
Konkola Copper Mine Plc-Nchanga IBU	New Slag Dump No.25	Active	The dump is within the mine area near the plant	-	There were no erosion gullies and there was no evidence of materials being eroded to the toe.	Seepage was observed on the western side. The drainage system around the dump is not engineered.	None-no progressive re-vegetation has started.	None	The seepage water at the toe of the dump was not tested for any potential leachate. The runoff water has a potential of carrying with it slag particles from this dump and it may take the particles into Chingola stream and subsequently Kafue river.	The seepage water at the toe of the dump was not tested for any potential leachate	No community nearby
	Unlicensed slag dump	Decommissioned	Access to the dump is not restricted.	There are no warning sign posts around the facility	There were no erosion gullies and there was not evidence of materials being eroded to the toe.	No drainages around the dump	Progressive re-vegetation had started at the toe of the dump.	No statutory dump report	No statutory dump report	No statutory dump report	No community nearby though the regulator had asked the mine to relocate the dump to the new slag dump

# Appendix 26

## Assessment of Overburden Dumps

Name of Mine	Name of Facility	Status	Restricted access	Hazardous and warning signs	Evidence of gullies	Drainage is good/No tension cracks/No sink holes	Evidence of vegetation	Pollution surrounding areas e.g. dust	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
Lumwana Mining Company		Active	yes	No	No	No statutory dump reports	Partially some section were bare vegetated	No statutory dump reports	No statutory dump reports	No statutory dump reports	No
Konkola Copper Mine PLC-Nchanga IBU	Overburden No. 23		Access is not restricted.	There are no warning sign posts around the facility	Plain wall very steep Numerous gullies on the northern and eastern side. Active gully on the lower slope of the rump and the materials has been washed into the toe road and Nchanga stream diversion	There is no side drain beside the bund wall.	The toe and southern part are well vegetated. The northern and top surfaces are still bare.	Potential for generation of dust from fine materials and could potentially impact the township close to the dump namely Kabunda East and Kabuta/Kapisha townships and to the East of Muzabwela township.	The run off along the toe road s cutting new flow channels along the bund into the Nchanga stream. Suspended silt material polluting the Nchanga stream end up polluting the Kafue river.	None	North of Kabunda East and Kabuta/Kapisha townships and to the East of Muzabwela township
	Overburden dump No. 20		The dump is guarded	There are no hazardous and warning signs.	The eastern and western side has erosion gullies.	The drains on the southern side are good but there are tension cracks on the western wall.	Walls on the eastern side are relatively bare. The northern side is well vegetated.	The dump is within the mine and no exposure to any township.	Water is discharged into the open pit and forms part of the open pit dewatering.	Water is discharged into the open pit and forms part of the open pit dewatering.	The dump is within the mine and no exposure to any township.
	Overburden dump No. 22		There is illegal mining which causes which causes two (2) predominant gullies from the top to the bottom of the western wall. There also excavation pits on the western and on top surfaces that are affecting the stability of the	There are no hazardous and warning signs around the facility	Erosion gullies on the entire western length, the northern and the southern walls.	Drainages are desilted resulting into siltation of Chingola Stream	The dump is generally poorly vegetated. There is no vegetation cover on the western side due to erosion and illegal excavation.  The southern wall has sparse vegetation.	The top surfaces are bare and apart from polluting the surrounding area there are no human settlements nearby.	Surface run-off from the western fronts and northern fronts drains into western drains. There is build up of silt after the bund wall which eventually pollute the adjacent Chingola Stream and ultimately into the Kafue river.	None	No human settlements nearby.
	Overburden Dump No. 2		Towards the north western there is evidence of illegal reclamation activities	There are no hazardous and warning signs around the facility	Northern flank has several gullies and steep slopes. There are very large gullies further west of the dump and material have been washed to the toe. there is severe erosion compounded by lack of vegetation.	The dump has drains that discharge into Nchanga and Chingola stream both tributaries of the Kafue river.	Poorly vegetated	There is dust pollution especially from the exposed illegally excavated portions which may affect the surrounding environment but not humans	The dump has toe drains that collect rain surface water and discharges to Nchanga and Chingola Streams. The toe drains also convey suspended silts. There is also potential to eventually pollute the Kafue river.	None	No human settlements nearby.
	Overburden Dump No. 1		Illegal mining on the north eastern side	There are no hazardous and warning signs around the facility	Active gullies on the north eastern side and the walls are steep. A few gullies on the western and eastern walls.	Tension cracks on the southern access road. There is a drainage channel that passes through ORE and drains into the Chingola stream.	Northern, Western and Southern sides are well vegetated	Only on some selected portions that are not vegetated.	The Nchanga stream flows to the northern edge of the dump and there is high potential of silt to end up in the spoon.	None	No human settlements nearby.

# Appendix 26(cont)

## Assessment of Overburden Dumps

Name of Mine	Name of Facility	Status	Restricted access	Hazardous and warning signs	Evidence of gullies	Drainage is good/No tension cracks/No sink holes	Evidence of vegetation	Pollution surrounding areas e.g. dust	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
KCM Nchanga IBU	Overburden Dump No. 1		Illegal mining on the north eastern side	There are no hazardous and warning signs around the facility	Active gullies on the north eastern side and the walls are steep. A few gullies on the western and eastern walls.	Tension cracks on the southern access road. There is a drainage channel that passes through ORE and drains into the Chingola stream.	Northern, Western and Southern sides are well vegetated	Only on some selected portions that are not vegetated.	The Nchanga stream flows to the northern edge of the dump and there is high potential of silt to end up in the spoon.	None	No human settlements nearby.
Kansanshi Mining Plc	Kansanshi Overburden/Waste rock dumps complex		There is restricted Access	There are hazardous and warning signs are displayed	A few erosion gullies were observed at the top of the dump	Some cracks observed on the access road	The dumps are predominantly bare with no vegetation on the surfaces.	Dust mainly from the dust roads. However, there are no human settlements nearby.	Rain runoff from the dump surface drains into the water stream. Kamasasebende between South west dambo area, rock suspended silt and materials has potential to cause water pollution and incidences of siltation of high acidity dambo areas i.e. pH below 6. However there is a bund wall.	No human settlements nearby	No human settlements nearby
Chibuluma Mine	Chibuluma Mine Overburden dump		No restricted access. Only periodic patrols are done. Illegal mining was also taking place	There are no hazardous and warning signs displayed	Some gullies were noticed. The slopes of the dump were not re-profiled and re-vegetated.	Too not accessible as there were no access roads	Some re-vegetation has started on the lower bench for 400meters or 1 hectare out of 9 hectares	Prone to dust pollution on areas not re-vegetated and where fines are exposed	The nearest water source was Nselaki stream but the stream was inaccessible as there were no access roads.	No test results provided for ground water testing	Human settlement on the eastern side. However this could not be accessed as there were no access roads.
NFC Africa Mining Plc.	Overburden dump No 1	Decommissioned	No restricted access	There are no hazardous and warning signs displayed	Few gullies were seen	The dump drains into Chambeshi stream. The dump has drainage system and is banded	Fairly vegetated on the eastern side. However, the dump has some bare patches on top. The western side is partially vegetated with grass.	No evidence of dust pollution	Nearest water source is the Chambeshi River, however bund structures	No test results provided for ground water testing	No human settlements within the stated radius
	Overburden dump No 2	Decommissioned	No restricted access	There are no hazardous and warning signs displayed	Few gullies were seen	Storm water diversion channels were seen	Poorly vegetated	No evidence of dust pollution	Bund structures were in place	No test results provided for ground water testing	No human settlements within the radius stated
Source: Statutory Dump report and physical inspections											
No overburden dumps were assessed for Bwana Mkubwa, Luanshya Coppermine, Chambishi Metals, Chambishi Copper Smelter, Maamba Collieries and KCM Nkana											

# Appendix 27

## Assessment of Waste Rock Dumps

Name of Mine	Name of Facility	Status	Restricted access	Hazardous and warning signs	Evidence of gullies-soil erosion	Drainage is good/No tension cracks/No sink holes	Evidence of vegetation	Pollution of surrounding areas e.g. dust	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
Ndola Lime	South East waste rock dump	Decommissioned	Access is restricted	Sign posts was seen	There were no notable erosion gullies	There are no storm water diversion channels as all storm water goes directly to the quarry from the dump.	Sparsely vegetated dump	There was no evidence of dust pollution	No water is discharged to the environment	No results of ground water testing were provided	There are no human settlements within the stated radius.
Luanshya Copper Mine Plc	South Waste Rock dump No 18	Decommissioned	No restricted access There was evidence of illegal mining – Dug out holes	No warning and hazardous signs were seen	Huge erosion gullies were seen	• There are no storm water diversion channels • The dump was in the caving area as was evidenced by subsidence observed creating depressions on the dump surface	Sparsely vegetated dump surfaces. The dump surfaces are affected by illegal reclamation activities.	• Dust pollution due to illegal mining and Waste rock was seen at the dump.	There is no bund wall to limit release of solids to the environment.	No results of ground water testing were provided	There are human settlements a few metres away from the dumps Roan Mpatamatu
	South west waste rock dump No 14	Decommissioned	No restricted access There was evidence of illegal mining – Dug out holes	No warning and hazardous signs were seen	Huge erosion gullies were seen	• There are no storm water diversion channels	Sparsely vegetated dump surfaces. The dump surfaces are affected by illegal reclamation activities.	Dust pollution due to illegal mining and sparse vegetation	There is no bund wall to limit release of solids to the environment. The rivers closest to the dump are Luanshya river and Fisansa stream	No results of ground water testing were provided	There are human settlements a few metres away from the dumps
Lumwana Mining Company	Mulundwe waste rock dump -MR 1	Active	yes	No statutory dump reports	No statutory dump reports	No statutory dump reports	Partially vegetated at the toe	no	No statutory dump reports	No results of ground water testing were provided	no
	Mulundwe waste rock dump -MR 2	Active	Yes	No statutory dump reports	No statutory dump reports	No statutory dump reports	Partially vegetated at the toe	no	No statutory dump reports	No results of ground water testing were provided	no
Chambishi Metals Plc	N/A		N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Chambishi Copper Smelter	N/A		N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Mopani Copper Mines Plc-Nkana	waste rock no. 14	active		no	few small gullies northern side	no	no	reclamation and dumping was taking place and evidence of dust	dump is close to Mindolo stream. No test results	no test results	1km from Mindolo township

# Appendix 27 (Cont)

## Assessment of Waste Rock Dumps

Name of Mine	Name of Facility	Status	Restricted access	Hazardous and warning signs	Evidence of gullies-soil erosion	Drainage is good/No tension cracks/No sink holes	Evidence of vegetation	Pollution surrounding areas e.g. dust	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
	Waste Rock Dump No. 28	active	yes	no	need reprofiling	stable no sink holes	sparsely vegetated top surfaces	dust from reclamation pollute immediate surrounding only	no discharge to any water course	No results of ground water testing were provided	1.5km from nearest settlement
Mopani Copper Mines Plc-Mufulira	Waste rock 11	active	evidence of informal reclamation on several occasions that where affecting the stability of the dump	yes	no	drains and silt traps are available	no vegetation on the top surfaces and the slopes	no	no test results dump is 100m from the river	no test results	Kankoyo approximately 600m from the dump. Butondo sch approximately 500m
	Waste rock 13	active	yes	yes	minor gullies	no drainages	bare dump walls and top surfaces	dust from dumping activities and dry season and wind direction is from north east to south west(kankovo)	no direct drain to the stream	no test results	Kankoyo is the closest township
	Lufubu Waste rock dump 14/ reclaimed	Active	Being claimed by a private contractor	There are no warning sign posts around the facility	Excavated holes from the private contractor have emerged	Lined drainages are present	Not vegetated	Dust is generated from the crushing activities reclamation process discharge into and affect the surrounding environments-bushes	Effluent from the stream but run off into the Mufulira stream and are not monitored for TSS and other metals	No test results Not prone to acid rock drainage	800m away from Kankoyo township
	Waste rock 17	active	yes	yes	multiple gullies on the south west	unlined drains	no progressive rehabilitation has taken place	no significant dust concern	not close to the stream but run off water is directed to the stream from the drainage sumps	no test results	Kankoyo township is the closest township to the northeast
Maamba Collieries Plc	Izuma A	Decommissioned	There is restricted access	Hazardous and safety signs were seen.	There were notable gullies on the dump walls	The dump had unlined drainages	There was some vegetation on the eastern side of the dump. All other sides were bare	Despite efforts to reprofile the dumps with inert material, there was evidence of spontaneous combustion on the eastern side of the dumps. Combustion has an impact of releasing carbon monoxide and sulphurous gases into the atmosphere.	The Kanzinzi stream was diverted from its normal course by silt	Boreholes for water sampling and analysis purposes were not installed at the Kanzinzi stream	Sikimina village is about 500 M from the dump. However they depend on water from the Kanzinzi stream
	Izuma B	Active	There is restricted access	No hazardous and safety signs were seen.	No notable erosion gullies	The dump had unlined drainages	No vegetation	Despite efforts to reprofile the dumps with inert material, there was evidence of spontaneous combustion on the dumps. Combustion has an impact of releasing carbon monoxide and sulphurous gases into the atmosphere.	The Kanzinzi stream was diverted from its normal course by silt	Boreholes for water sampling and analysis purposes were not installed at the Kanzinzi stream	
	Izuma A infill	Active	There is restricted access	No hazardous and safety signs were seen.	No notable erosion gullies	The dump had unlined drainages	No vegetation	Despite efforts to reprofile the dumps with inert material, there was evidence of spontaneous combustion on the dumps. Combustion has an impact of releasing carbon monoxide and sulphurous gases into the atmosphere.	The Kanzinzi stream was diverted from its normal course by silt	Boreholes for water sampling and analysis purposes were not installed at the Kanzinzi stream	There were no human settlements within the stated radius.
Konkola Copper Mine Plc-Konkola IBU	Waste Rock dump A		Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided
	Waste Rock dump B		Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided	Dump report not provided



# Appendix 27(Cont)

## Assessment of Waste Rock Dumps

Name of Mine	Name of Facility	Status	Restricted access	Hazardous and warning signs	Evidence of gullies-soil erosion	Drainage is good/No tension cracks/No sink holes	Evidence of vegetation	Pollution surrounding areas e.g. dust	Pollution of surface water	Pollution of ground water	Residential areas within 500metres from the dam wall
Kansanshi Mining Plc	Kansanshi Overburden/Waste rock dumps complex		Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden
Chibuluma Mine	Chibuluma Mine Waste Rock dump		Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden	Complex report dealt with under overburden
NFC Africa Mining Plc	Waste rock dump No 5	Decommissioned	Unrestricted access	Warning and safety signs seen	Minor gullies were observed on the eastern side	There is subsidence in the caving area south of the open pit	Generally well vegetated with grass and shrubs. Some parts of the western wall are completely covered with vegetation	The dump poses no immediate environmental concerns in terms of fugitive dust			None
	Waste rock dump No 17	Decommissioned	Unrestricted access	Warning and safety signs were seen	Minor gullies were seen	There was evidence of tension cracks	Partially vegetated	No threat of dust pollution	The drainage channels water into the Chambeshi stream		None
	Waste rock dump No 18	Active	Unrestricted Access	Warning and safety signs were not seen	Minor gullies seen	No defined drainage system for the dump		The crushing plant produces crushed stone sludge which is flowing into the surrounding areas. However there are no incidences of fugitive dust	Part of the surface water is directed to Chambeshi stream on the eastern side. There are also reclamation activities on the eastern side.		
	Waste rock dump No 20	Active	Unrestricted access	Warning and safety signs were not seen	Minor gullies seen	Drainage is via surface run off and an open drainage channel leading to TD 6 on the eastern side of the dump	No vegetation as dumping is still ongoing	Possibility of dust pollution as the dump is not vegetated.			None

Source :Statutory Dump report and physical inspection

KONNOCO was under development – not assessed

# Appendix 28

## Assessment of used oil storage facilities

Name of Mine	Name of Facility	Restricted access	Bunded and Impermeable floor	Adequate ventilation	Adequate/ Appropriate warning and safety signs	Appropriate storage facilities to hold the waste	Proper handling of waste to avoid spills	Spills properly cleaned up	fire fighting equipment	first aid equipment	Internal Inspections of facilities
Ndola Lime		No restricted access	Yes	Yes	Yes	Yes	Oil spills were noticed on the floor	No	The firefighting equipment was stored in a place that was difficult to access i.e. separated by a wall fence	The first aid equipment was stored in a place that was difficult to access i.e. separated by a wall fence	There were no records of used oil inspections
Luanshya Copper Mine Plc	Concentrator	Yes	Yes	Yes	Yes	Yes	Oil spills were seen on the ground	No	There was no firefighting equipment seen	There was no first aid equipment seen	Yes
Lumwana Mining Company	Mulundwe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No first aid equipment was on site	Yes
Chambeshi Metals Plc	Zone A	Yes	Yes	Yes	Yes	Yes	Oil spills were seen on the ground	Sawdust was used to clean up oil spills	Yes	Yes	No internal inspection records for used oil
Chambeshi Copper Smelter		No restricted access	No bunded wall	Yes	No adequate warning signs	Yes	Yes	Yes	Yes	No first aid equipment was on site	No internal inspection records for used oil
	Near the smelter	Yes	Yes	Yes	Yes	Yes	Oil spills were noticed on the ground	No	Yes	Yes	No internal inspection records for used oil
Mopani Copper Mines Plc-Nkana	Salvage Yard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No internal inspection records for used oil
	Zone A	Yes	Yes	Yes	Yes	Yes	There were spillages	Sawdust was spread on top of the spillages	Yes	No first equipment	No internal inspection records for used oil
Mopani Copper Mines Plc-Mufulira		Yes	Yes	Yes	Yes	Yes	There were spillages on the ground	Yes	Yes	Yes	Yes
Maamba Collieries Plc	Contractors garage	No	Yes	Yes	No	The storage capacity was inadequate	Yes	Yes	Yes	First aid box was seen though it had no contents	
	Light vehicles workshop	No	No	Yes	No	No	No	No	No	No	No
Konkola Copper Mine Plc-Konkola IBU		Yes	Yes	Yes	Yes	Yes	Yes	Saw dust sprinkled on the spills	Yes	Yes	no
Konkola Copper Mine Plc-Nkana IBU		Yes	Yes	Yes	Yes	Yes	There was evidence of spills	Yes	Yes	Yes	No Inspection Reports carried out by Environmental department of the mine
Konkola Copper Mine Plc-Nchanga IBU		No restricted access-no gate	Yes	Yes	No hazardous and warning signs	Yes	Yes	Yes	Yes	No first aid kit	No
Kansanshi Mining Plc		Yes	Yes	Yes	Yes	Storage facility is surrounded by grass which may make it prone to fire	There was evidence of spills	Yes	Yes	Yes	No Inspection Reports carried out by Environmental department of the mine
Chibuluma Mine		No restricted access-oil storage facility also used as wash bay	Yes	Yes	Yes	Yes	There was evidence of spills	No · oil separator was not working · drainages were blocked · contaminated soil · mixture of water from wash bay and oils	Yes	No first aid	No inspection records
NFC Africa Mining Plc		Yes	The impermeable floor had cracks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

\*KONNOCO could not be assessed as it was still under development phase.

\*\*Source; ZEMA compliance monitoring reports and physical verification





