

ENVIRONMENTAL IMPACT ASSESSMENT

REPORT FOR

HWANGE COAL MINING ACTIVITIES

PREPARED BY



CENTRE FOR NATURAL RESOURCE GOVERNANCE

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EXECUTIVE SUMMARY

World over mining of coal negatively affects the livelihoods of many in communities, destroys animal habitats, and pollutes the environment whilst at the same time its burning significantly contributes to climate change. Many communities in developed countries have struggled against the impacts of coal mining. In the US coal has been condemned because in its every stage of its life, coal does serious damage. Coal is the top contributor to climate change, as well as a leading cause of pollution, and continues to adversely affect mining communities in untold ways. It is against this background that the Centre for Natural Resource Governance (CNRG) engaged Exclusive Environmental & Planning Services (EEPS) to carry out an environmental impact assessment in Hwange to evaluate the extent of the damage caused by coal mining on the environmental and socio-cultural set up of the area.

This study was meant to investigate the impacts of coal mining and power generation on the environment and humans as well as the contribution of Hwange coal projects to climate change. The study covered mining areas by Hwange Colliery Company, Makomo Mine, W&K Mine, Chilota Mine and Coal Bricks Mine. The study subsequently noted that there is severe air, land and water pollution due to coal mining and power generation in Hwange. Noise from blasting and operating plant machinery such as dump trucks and excavators is affecting near-by residents and wildlife, and diesel fumes from machinery and coal-transporting trucks affects the health of local communities.

There is also massive deforestation in all areas where the mining companies are operating for example at Chilota and Makomo mines. Massive discharge of fumes were noted at Zimbabwe Power Company (ZPC), these are the results of the burning of coal at the thermal power station. Well known by-products of burnt coal are sulphur dioxide, carbon monoxide and coal ash all which are both harmful to life. Studies have shown that exposure to dust and diesel fumes from heavy machinery on open cast coal mines can cause ill health in near-by communities and increases the prevalence of chronic obstructive pulmonary disease, certain cancers and asthma¹. Coal is the most carbon intensive of all fossil fuels. It is nearly all carbon, so it releases almost entirely carbon dioxide when burned. Coal is mainly burned for electricity generation and has become the largest source of Zimbabwe's greenhouse gas emissions. Coal and biomass fired power stations are more carbon dioxide intensive than any other type. These emissions can be significantly minimized by reducing the amount of coal that is currently being burned by ZPC. In addition to the summarised negatives above, open pits at Chilota and Makomo mines have been left in that open state after the decommissioning phase. This is posing danger to animals and people in the area since there is evidence of underground coal burning. It was also noted that the hydrology and underground water have been contaminated by mining chemicals and discharges from coal mining activities. This is particularly evident at Dheka river.

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¹ <http://coalaction.org.uk/why-not-coal/>

ABBREVIATIONS

EIA	Environmental Impact Assessment
EEPS	Exclusive Environmental & Planning Services
EMP	Environmental Management Plan
CNRG	Centre for Natural Resources Governance
EMA	Environmental Management Authority
ZPC	Zimbabwe Power Company

LIST OF TABLES

Table 1	Showing the coordinates/location of mining companies in Hwange	2
Table 2	Phase of mining with activities that impact negatively	12

List of Figures

Fig 1	Spatial Distribution Map Showing the Areas that were surveyed during the EIA.	2
Fig 2	Pollution from mining activities	6
Fig 3	Mining Equipment at Makomo mine	6
Fig 4	Black/Grey Smoke from the ZPC thermal power station	7
Fig 5	Sediments accumulation in Dheka River	8
Fig 6	Coal ash leaking from a pipe	9
Fig 7	Polluted Dheka River	10
Fig 8	Contaminated soil at Makomo mine	11
Fig 9	Unrehabilitated section at Hwange Colliery	13
Fig 10	Unrehabilitated section at Chilota mine	14
Fig 11	Stockpile of overburden at Chilota mine	15
Fig 12	The effects of underground fire on the public	16

TABLE OF CONTENTS

1.1	Introduction	1
1.2	Location of the Research Areas	1
2.0	Methodologies used in carrying the EIA	3
2.1	Introduction	3
2.2	Flora and fauna surveys	3
2.3	Vegetation and Plant Species Survey	3
2.4	Interviews	3
2.5	Spatial Analysis, Photography & Mapping	4
2.6	Soil Analysis	4
3.0	Analysis of findings of the EIA in Hwange- Identification of Impacts & Mitigation Measures	
3.1	Air Pollution	5
3.2	Greenhouse gas emissions	7
3.3	Surface and Groundwater pollution	8
3.4	Destruction of Wetlands	8
3.5	Aquatics at Dheka River	9
3.6	Soil Contamination	11
3.7	Impact Identification	11
3.8	Visual, Topography and Deforestation	13
3.9	Solid Waste	14
3.10	Noise and vibration	16
3.11	Underground Fires	16
4.0	Socio-economic impacts	18
4.1	Socio-economic impacts	18
4.2	Increased Social Pathologies	19
4.3	Safety Impacts	19
4.4	Occupational health	19
4.5	Radiation Exposure	20
4.6	Mitigation of occupational health and safety issues	20
4.7	Economic dependency on the project	21
4.8	Socio-economic Mitigation Measures	22
5.0	Environment Management Plan	23
5.1	Top soil management	23
5.2	Overburden management	23
5.3	Subsidence management	23
5.4	Clean Coal Technologies	24
	Conclusion & Recommendations	25
	References	26
	Web Sources	27

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1.1 INTRODUCTION

This Environmental Impact Assessment (EIA) report will comprehensively detail the natural and socio-cultural impacts associated with the mining and use of coal in Hwange and issues contributing to micro-climate change in and around the area. The EIA has been prepared to assess the overall environmental consequences of coal mining and its associated impacts derived from use in and around Hwange coal mining fields which are located in Western Zimbabwe. The environmental and socio-cultural information that will be used in this study was obtained from a careful assessment of the coal mining operations by Hwange Colliary Company, Makomo Mine, WMK Mine, Chilota Mine and Coal Bricks Mine. Other impacts on the environment will be drawn from the usage of coal for thermal power generation by the Zimbabwe Power Company (ZPC).

Exclusive Environmental & Planning Services (EEPS) was engaged by the Centre for Natural Resource Governance (CNRG) to assess the environmental impacts that are associated with the mining and usage of coal in and around Hwange District. Environmental impacts that emanate from coal mining processes and use will be presented in this report. Over the years coal mining in Hwange District has posed serious negative impacts on the physical, biological, and social aspects of the environment which have not been adequately addressed because of the 'purported' economic benefits which are associated with coal mining. However, some of the ecological impacts emanating from coal mining in Hwange include loss of habitat and deforestation. In addition, atmospheric impacts include dust generation and carbon emissions from the burning of coal. The negative environmental impacts resulting from coal mining and use observed in this study were adjudged to be significantly contributing to microclimatic changes in Hwange District. An EIA is a data management process which has three components. Firstly, the appropriate information necessary for a particular decision to be taken must be identified, recorded and, possibly, collected. Secondly, changes in environmental parameters resulting from implementation must be determined and compared with the situation likely to accrue. Finally, actual change must be recorded and analysed.²

1.2 Location of the Research Areas

Hwange is a town in Zimbabwe, located in Hwange District, in Matabeleland North Province, in northwestern Zimbabwe, close to the international borders with Botswana and Zambia.³ According to the 2012 National Census report, Hwange District had a total population of 62,670 people.⁴ It is

² Wathern, P (1988). Environmental Impact Assessments: Theory and Practice, London and New York: Routledge, p.17.

³ <https://en.wikipedia.org/wiki/Hwange>

located approximately 336km north of Bulawayo , the second largest city in Zimbabwe. The GPS coordinates for sites that were reviewed in this study are as follows;

Mine	Status	Coordinates
Makomo Mine	Fully operational	S 18° 21' 03.8" E 026° 32' 18.3"
WMK Mine	No longer operational	S 18° 19' 12.3" E 026° 28' 47.1"
Chilota Mine	Operational	S 18° 18' 54.0" E 026° 28' 51.2"
Coal Bricks Mine	Semi – operational	S 18° 18' 15.8" E 026° 29' 41.5"
ZPC Thermal Power Station	Fully operational	S 18° 22' 35.1" E 026° 28' 33.1"

WANKIE MAP EXTRACT OF 1826 A4

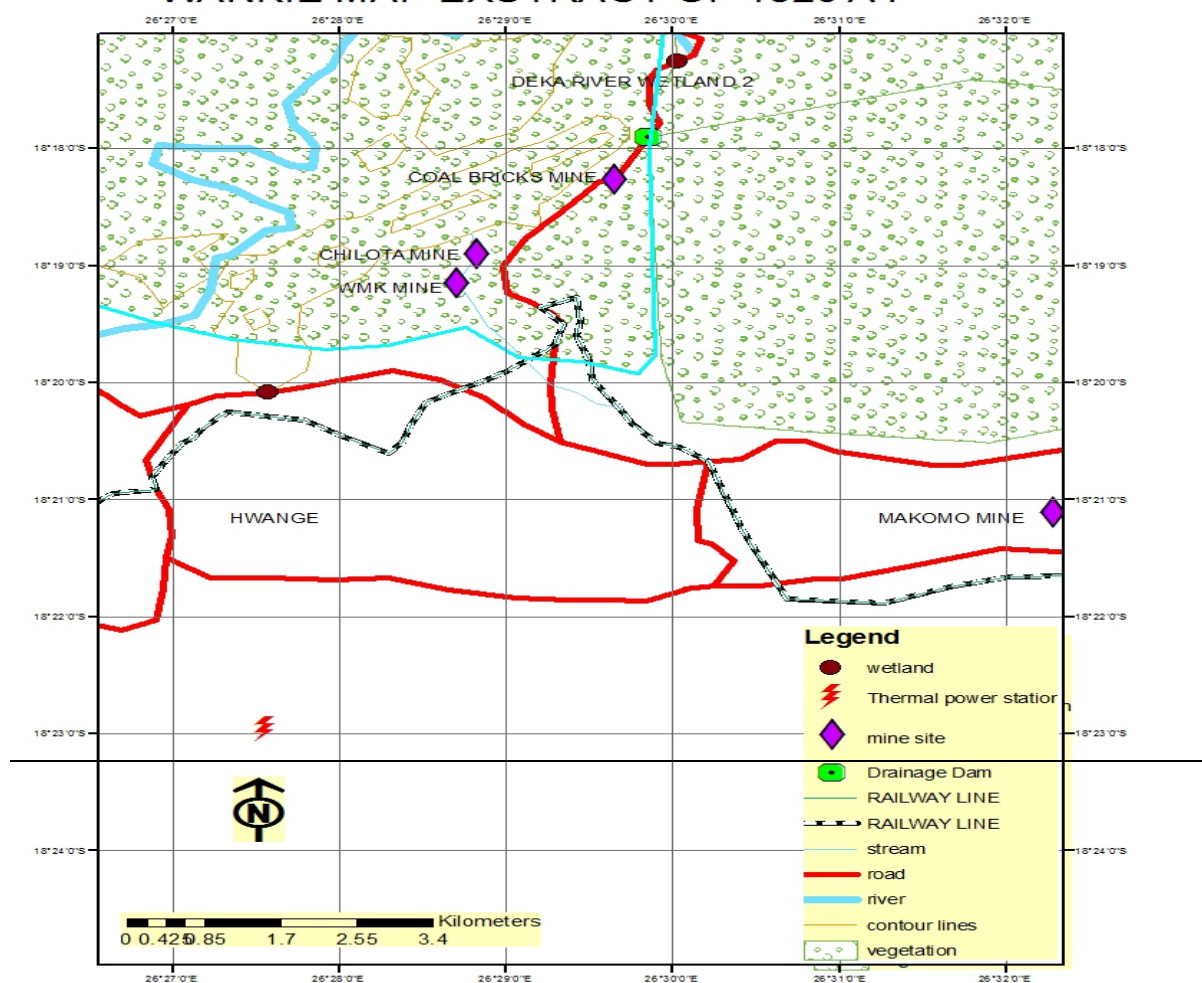


Fig 1 , The GPS coordinates and the spatial distribution map showing the coal mines

⁴ www.zimstat.co.zw

2.0 METHODOLOGY

2.1 Introduction

Several methods of obtaining biological information of an area during an EIA process or any other biological surveys are bound in literature. The first step was determining the due diligence of the EIA, followed by a desktop study that was subsequently corroborated with site visits from the 26th to the 30th of October 2016. To identify the impacts, methods such as the direct impact analysis approach, indirect impact analysis approach, cumulative analysis approach and the mitigation analysis approach were employed. Socio-cultural surveys were also carried out through conducting ethnographic interviews with Hwange community members. All these methods were supported by photography and spatial analysis done by mapping of the mining sites in order to establish the extent of the damage that each and every mine was posing to the environment. (see spatial distribution map on **Fig 1**). Impacts are also site- specific and determination of their spatial distribution is also important. Spatial aspects are usually considered more adequate than temporal ones.⁵

2.2 Flora and fauna surveys

Before the biological field surveys were conducted, a background review of the project area was done which entailed researching the records at the National Parks and Wildlife, Forestry Commission, WWF and IUCN offices to determine what biological surveys have previously been conducted in the project area. The objective was to determine whether there are species and habitats of particular importance within the project areas. Biological impact prediction is primarily based on habitat or land use changes.⁶ In addition, topographic, vegetation and hydrological maps were used during this survey.

2.3 Vegetation and Plant Species Survey

Vegetation surveys focused on vegetation types in the study area while plant species surveys aimed at providing information on plant species diversity and identifying plant species of conservation concern. Rare, protected and threatened plant species and other species of conservation concern were recorded.

2.4 Interviews

A number of interviews were carried out with community members living in Ingabula Village 4 and 5 townships of Hwange as well as some of the workers employed by the mining companies who gave out their views on the coal mining activities taking place in and around Hwange.

⁵ Wathern , P (1988). *Environmental Impact Assessments: Theory and Practice* , London and New York: Routledge, p.8.

⁶ Canter , L.W (1982). Environmental Impact Assessment , *Impact Assessment Journal* , 1:2 , 6-40.

2.5 Spatial Analysis , Photography & Mapping

By employing the spatial analysis model , the EIA study was able to identify the impacts of coal mining in relationship with water pollution at Dheka River, the destruction of wetlands and with the derelict gulleys that were left open after the mining. Spatial information was not only obtained from knowing the locational relationships of various items but also from tracing their relative movements and flow.⁷(see spatial distribution map on Fig 1). Photographing environmentally sensitive areas that have been affected by coal mining and the thermal power plant was also an essential research tool for this EIA. The mines were also mapped using a GPS in order to establish the spatial relationship between the derelict mining holes, the artificial overburden and waste materials that are generated.

2.6 Soil Analysis

The Munsell soil colour chat was used to analyse soil texture in relationship to the levels of contamination induced by coal mining activities on the soil.

⁷ Anjaneyulu ,Y & Manickam, V (2007). *EIA Methodologies 2nd Edition* , Hyderabad: BS Publications.

3.0 Analysis of findings of the EIA in Hwange- Identification of Impacts & Mitigation Measures

Introduction

Coal mining by Hwange Colliery , Makomo, Chilota, WMK & Coalbricks Mines have resulted in substantial and permanent changes in the landform. Some changes to the landscape are largely irreversible but however mitigation measures can be implemented that can make the post-mining landscape usable by the community in a less hazardous manner. This can be attained by the rehabilitation of the open cast pits soon after the decommissioning stages. The overall impacts that were noted at the coal mines under study will be discussed below;

3.1 Air Pollution

Atmospheric air has been affected by the emissions from the Zimbabwe Power Company (ZPC) furnaces. The continuous emissions will in the long run contribute to acid rain, ozone depletion and global environmental problems that can potentially lead to reduced rainfall and an increase in temperatures. The burning of coal by ZPC emits pollutants. These pollutants include particulate matter (PM) and ground-level ozone (O₃) — the key ingredients of smog - along with nitrogen oxides (NO_x), sulphur oxides (SO_x), volatile organic compounds (VOCs) and carbon monoxide (CO). As such the air in Hwange is heavily polluted and similar analysis of air in coal mining areas in other countries shows that these emissions comprise mainly of fugitive dust and gases including methane (CH₄), sulfur dioxide (SO₂) and oxides of nitrogen (NO_x).⁸ Much of the visually recognizable air pollutants which rise over the townscape of Hwange during day and night comes from the ZPC thermal power station (See **Fig 2 and Fig 4**). Mining machinery which include front end loaders and trucks transporting coal from the mining fields also add to dust levels into the air (See **Fig 3**). Operation of the internal combustion engines of the mining equipment at Makomo and Chilota mines emits exhaust gases as well. Furthermore the drilling, blasting, stockpiling of overburden, the loading of raw coal onto the trucks, coal transport along the haul road, screening, sizing and segregation of coal contributes to high dust levels. For example, a coal stock of 50,000 tonnes can generate 250 tonnes of fugitive dust even if assuming loss of only 0.5 per cent as fugitive dust.⁹

⁸ Anders S.G (2007). Global environmental impact assessment of the Pb-free shift , *Soldering & Surface Mount Technology* , Vol 19 Issue 2 , 18-28

⁹ Anders S.G (2007). Global environmental impact assessment of the Pb-free shift , *Soldering & Surface Mount Technology* , Vol 19 Issue 2 , 18-28



Fig 2; Air pollution from Hwange Power Station



Fig 3; Some mining equipment at Makomo coal mine, such machinery also significantly pollutes the air during operational times.

3.2 Greenhouse gas emissions

Coal fires are the largest contributor to the human-made increase of carbon dioxide in the atmosphere which can potentially trigger climatic changes. The ZPC burns an enormous quantity of coal which is used to generate thermal electricity. About 250,000 tonnes of coal are stockpiled on site.¹⁰ Thick dark grey/black smoke is always seen rising from the three thermal chimneys at the power plant (See **Fig 4**). Coal mining releases methane, a potent greenhouse gas. Methane is the naturally occurring product of the decay of organic matter as coal deposits are formed with increasing depths of burial, rising temperatures, and rising pressure over geological time.¹¹ A portion of the methane produced is absorbed by the coal and later released from the coal seam (and surrounding disturbed strata) during the mining process. Methane accounts for 10.5 percent of greenhouse-gas emissions created through



Fig 4: Black/Grey smoke emissions from Hwange power station

Mitigation

Capturing methane gas and producing energy will reduce greenhouse emissions into the atmosphere. Use of captured methane as fuel for electricity generation, onsite uses, or offsite

¹⁰ http://www.sourcewatch.org/index.php/Hwange_power_station#cite_note-hps-1

¹¹ Udosen, C. (2010). *Coal Mining and Environmental Concerns* , Lagos: Unwana Graphics.

gas sales. This will provide a local source of clean energy that can spur economic development. It can displace higher carbon dioxide and pollutant-intensive energy sources such as wood, coal, and oil. Finally, recovered methane can serve as a new sustainable and abundant energy source for Zimbabwe.

3.3. Surface and Ground Water Pollution

Open cast mining by the now disfunctional WMK mine affected ground water reserves through underground contaminations . This mine has since stopped operations leaving a trail of contaminated water sources as is shown in **Fig 5**. These contaminated water sources is posing a health hazard to people as well as animals. Acid mine drainage produced by the leaching of sulphide minerals present in the coal has had a direct impact on drinking water quality, aquatic life and corrosion of equipment and structures. The water will be too acidic and is not suitable for domestic use. The erosion of stockpiles at Chilota mine has also led to sedimentation at the nearby Dheka river. Water contamination is also caused by coal dust settling on the surface water environment as well as from leaching and toxic drainage of particulates



Fig 5; The accumulation of sediments deposited by Chilota mine is blocking the free flow of water in Dheka River

3.4 Destruction of Wetlands

Rainwater infiltrating through the overburden stockpiles and/or backfilled material and the underlying soils into the groundwater environment pollute the aquifers due to increased salt load and metals. This

has also lead to the destruction of environmentally sensitive areas such as the two assessed wetlands located on the edges of the Deka road (S 18° 20' 10.9" E 026° 29' 04.0" & S 18° 20' 04.5" E 026° 29' 05.3") – **See Fig 6**. A malfunctioning pipe carrying burnt coal ash leaked on the wetland thereby destroying it in the process.



Fig 6; Coal ash leaking from pipes and has settled on wetland along Deka road

3.5 Aquatics at Dheka River

The clearing of naturally occurring vegetation, levelling of land, creation of hard surfaces and the creation of compacted surfaces to make way for development of Chilota , WMK , Hwange Colliary and Makomo mines generated changes to the environment which caused alteration of normal drainage patterns. Vehicular movements/maintenance create the potential for substances such as oils and lubricants to leak into the surrounding environment. Once in the environment, these substances are carried into the aquatic ecosystem via water runoff. Aquatic life within the Dheka river has been affected by these pollutants. These substances drains into Deka river which is the main water source for local communities. See **Fig 7** ;



Fig 7: The water in Dheka river has changed color because of pollution.

We observed the following in the aquatic ecosystem within Deka River :

- Decreased water quality;
- Altered flow dynamics;
- Heavy metal bioaccumulation in plants and livestock as well as health risks to humans; and
- Negative impacts on biodiversity.

Mitigation of water pollution within Dheka River

- Prohibition of fuel and grease manipulation in the open cast mine.
- Controlled collection of surface waters from the surfaces of the working benches, collection and sedimentation in the sedimentation tank and waters drainage into the recipient after the treatment in the grease and oil separator.
- Apply erosion controls relative to possible soil erosion from vehicular traffic.
- Save topsoil removed during mining and decommissioning activities and use to reclaim disturbed areas.
- Avoid creating excessive slopes during excavation and blasting operations.
- Closely monitor activities near Dheka river recharge areas to reduce potential contamination of the water.
- Dispose of excess excavation materials in approved areas to control erosion and minimize leaching of hazardous materials.
- Reclaim or apply protective covering on disturbed soils as quickly as possible.
- Clean and maintain catch basins, drainage ditches, and culverts regularly.

- Limit pesticide use to nonpersistent, immobile pesticides.
- Backfill or recontour strip-mined or contour-mined areas with excess excavation material generated during construction.

3.6 Soil Contamination

It has been noted with great concern that soils are heavily contaminated due to disposal of chemicals from the mining activities. This has greatly affected the growth of plants hence no trees are growing perfectly well in the area. Vegetation has been greatly affected hence the change of the balance between the rainfall patterns and evapotranspiration. Soil contamination has shown that the pH of the soils are highly acidic - up to 76%. Using the munsell soil colour chart (See **Fig 8**) , we were able to differentiate between contaminated and non contaminated soil at Makomo mine



Fig 8 ; An illustration of the differences in contaminated soil colour & texture using the Munsell Soil Color Chart.

3.7 Impact identification

11

We used input-output model which serves to guide the assessor in assessing all the potential instances of ecological and socio-economic change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the

project.¹² This model was applied to all the mining sites we visited in Hwange. These activities are listed below:

Phase	Activity
Construction	<ul style="list-style-type: none"> ➤ Site Clearing: Removal of topsoil & vegetation ➤ Construction of any surface infrastructure e.g. haul roads, pipes, storm water diversion berms (including transportation of materials & stockpiling)
Operational	<ul style="list-style-type: none"> ➤ Operation and maintenance of Infrastructure ➤ Removal of overburden and backfilling when possible (including drilling/blasting hard overburden & stockpiling) ➤ Use and maintenance of haul roads (incl. transportation of coal to washing plant) Concurrent replacement of overburden, topsoil and revegetation
Decommissioning	<ul style="list-style-type: none"> ➤ Demolition & Removal of all infrastructure (incl. transportation off site) ➤ Rehabilitation (spreading of soil, re-vegetation & profiling/contouring) ➤ Installation of post-closure water management infrastructure

Table 2 *Phase of mining with activities that impact negatively*

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity.¹³ Negative impacts noted include gases, effluents, dust, noise, vibration, other pollution and changes to the bio-physical environment such as damage to habitats or reduction in surface water quantity. Positive impacts may include the removal of invasive vegetation, construction of infrastructure, skills transfer or benefits to the socio-economic environment. During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) was considered. During baseline surveys and ethnographic interviews, perceived impacts were identified. Reference was also made to existing literature on coal mining, its impacts and mitigation measures.¹⁴ We discuss below these impacts during the operation and decommissioning phases of the projects and ways to mitigate them.

¹² www.enviropaedia.com/topic/default.php?topic

¹³ Glasson, J , Therivel , R & Chadwick, A (2005). Introduction to EIA, 3rd Edition, London and NewYork: Routledge.

¹⁴ Ogola, A.F.P (2007) , Environmental Impact Assessment Global Procedures , paper presented at Short Course on Surface Exploration for Geothermal Resources, UNU-GTP, Lake Naivasha, Kenya (2-17 November , 2007).

3.8 Visual, Topography and Deforestation

The receiving environment has been negatively affected by the presence, operation and maintenance of the mining infrastructure, since the landscape character (within limited areas) was altered and the overall visual resource reduced. The visual landscape of Hwange has been severely compromised by the thick dark grey smoke that is emitted from the burning of coal at the thermal power station. In addition, many of the vegetated areas have been converted into mining fields. Therefore, large forest areas are cleared to make a way for large opencast coal mines. Subsidence of surface takes place due to extraction of coal by underground mining. Subsidence is exhibited by cracks on surface and lowering of land in the worked out areas compared to surroundings. Large areas of land were subject to opencast mining at Hwange Colliary, W&K , Makomo and Chilota Mines ; these areas will take a long time to rehabilitate and will very likely lead to landscape scarring as these expanses of land will be incompatible with the surrounding landscape (See **Fig 9**).



Fig 9; A large unrehabilitated open cast section at Hwange Colliary Company.



Fig 11; An open cast mine at Chilota also not rehabilitated

Mitigation

Hwange Colliary and Chilota Companies must rehabilitate affected areas and green the free surfaces. In addition to that, they should carry out the mining operations in accordance with the detailed mining designs. The surface is rehabilitated by dozing and sealing of cracks followed by plantation of trees. The subsided areas with medium-sized depressions are ideal for developing water pools and sustain green vegetation and also to meet the water needs of local people.¹⁵ The mined-out areas are to be backfilled and then rehabilitated for re-vegetation. The big pits created by open-pit mining are causing land degradation. The immediate process should be to restore disturbed surfaces as closely as possible to their original contour and revegetate them immediately after or contemporaneously with disturbance activities.

3.9 Solid Waste

Overburden of organic material and soil that overlie a mineral deposit forms solid waste at Chilota, WMK and Makomo mines. Overburden generation is denoted by stripping ratio which is the ratio of overburden that needs to be removed to the amount of ore removed. Low stripping ratio translates into low quantities of waste. Mining operations result in excavation of large quantities of top soil which is precious as it holds nutrients and is essential for successful rehabilitation and afforestation. Top soil management and its re-use are important for a healthy ecosystem. Poor storage can lead to run-off.

¹⁵ Geneletti, D. (2002). *Ecological Evaluation for Environmental Impact Assessments*, London and New York : Routledge.



Fig 10: Stock piles of overburden left at Chilota mine

Mitigation

- Save topsoil removed at the start of the project and use it to reclaim disturbed areas upon completion of mining activities.
- Reclaim or apply protective covering on disturbed soils as quickly as possible.
- Apply erosion controls relative to possible soil erosion from vehicular traffic and during mining activities (e.g., jute netting, silt fences).
- Avoid creating excessive slopes during excavation and blasting operations.
- Dispose of excess excavation materials in approved areas to control erosion and minimize leaching of hazardous materials.
- Clean and maintain catch basins, drainage ditches, and culverts regularly.
Reestablish the original grade and drainage pattern to the extent practicable.
- Stabilize all areas of disturbed soil using weed-free native shrubs, grasses, and forbs.
- Backfill or re-contour strip-mined or contour-mined areas, any foundations, and trenches, preferably with excess excavation material generated during construction.

3.10 Noise and vibration

Cumulative effect of mining activities by the Chilota, WMK , Makomo and Hwange Colliary produces high noise levels from blasting, drilling, crushing and movement of vehicles.¹⁶ Blasting results in ground vibrations and this has severely affected houses of people living in Ingagula villages 1, 3 and 5. Blasting also affects wildlife and livestock in the area.

Mitigation

- Enclosing crusher units in covered buildings to minimize sound propagation;
- Providing silencers or enclosures for noise generating machines such as compressors etc.
- Limit noisy activities (including blasting) to the least noise-sensitive times of day (weekdays only between 7 a.m. and 10 p.m.).
- Notify nearby residents in advance when blasting or other noisy activities are required.
- Whenever feasible, schedule different noisy activities (e.g., blasting and earthmoving) to occur at the same time, since additional sources of noise generally do not add a significant amount of noise. That is, less-frequent noisy activities would be less annoying than frequent less-noisy activities.
- To the extent feasible, route heavy truck and rail traffic supporting mining activities away from residential areas.

3.11 Underground Fires

At each gust of wind, dense plums of smoke rise up from the grey dumps created by the digging and are scattered around, as poisonous gases from volcanoes without craters. Trees and plants are dying because of the underground heat emanating from coal burial, whilst mining-induced subsidence, without adequate prevention or repair measures, often results in the abrupt sinking of the ground surface, destroying the ecosystem, roads and killing both humans and animals. Women and children walk along grey roads covered by a dense coat of coal dust, whose heaviness hardens the lungs, exacerbating the risks of cardiopulmonary and respiratory diseases.

This young boy (**Fig 11**) had his childhood made different from the rest of his peers, as the failure of the Hwange Colliery Mine to extinguish raging underground seam fires and alternatively to put danger warning signs on dangerous areas around the colliery resulted in the boy into underground fire whilst driving away cattle from his mother's field. As the boy was walking the ground suddenly gave in and the next minute half his body had sunk into the burning coal underground and he was severely burnt. Moreover the mine did nothing to compensate the boy and his family. It has been seven years since the

¹⁶Manoj, E.V & Prasannakumar , V. (2002). Environmental impact assessment and environmental management plan – a case study of magnesite and dunite mine , South India, *Bolemetim Paranaense* , 50,p.21-25, Editora UFPR

incident and it is hard for him to be outdoors at times because his skin cannot endure the already severe weather conditions. The boy now suffers psychological problems which include low self-esteem owing to his deformed limbs.



Fig 11: Showing the boy whose limbs were affected by the underground fires

Mitigation.

There is need for the mining companies to cordon off from all the areas that are known to have underground fires. This can be achieved by fencing and additionally putting up danger warning signs to alert the public. The areas must be also periodically filled up with a lot of sands which can reduce the amount of heat coming from the underground to the surface.

4.0 SOCIAL IMPACTS

Introduction

Hwange Town developed primarily due to coal mining. The colliery remains the life blood of Hwange, providing employment to over 3000 people. Thus other social and financial services such as schools, hospitals, and banks were established to offer services to colliery employees and their families. A significant number of the population was born and raised in the mining compound. Problems associated with inhaling gas and toxic gases are rarely mentioned by the community as they value the health of the company more than theirs. However of late Hwange Colliery has been in sharp decline owing to poor management following the take over of majority shares by the government.

The research team interviewed several workers and community members on the social impacts of coal mining and power generation on the community. The interviews revealed the significant changes in livelihoods in Hwange over time due to the scaling down of operations by the Colliery Company. Conflicting interests of other stakeholders in the area also contributed to job losses and increased unemployment rates. There was once a welfare department that was run by the Colliery Company providing for orphans, sponsoring social activities and giving out Christmas freebies each year. This however changed with the government's take over of the mine through the gradual introduction of the indigenisation policy.

4.1 Socio-economic impacts

The rising of ashes from the power generating plant are affecting the residents of Ingabula township most of whom are now suffering from the black lung disease.¹⁷ Haulage trucks carrying coal to the power plant also poses challenges to the residents because they hurl up enormous amounts of dust and puts children at risk of being run over by the trucks.¹⁸ Locals are usually employed on short term contract as general hand workers which does not give them any sense of job security. Furthermore, the contract workers are not paid on time and to date they haven't been paid in 6 months.¹⁹ The salary delays is caused by the contractors who are given tenders by ZPC to offer various other services at the power plant. Similarly, at Hwange Colliery Company, workers are not being paid and have gone for over 4 years without getting their salaries.²⁰ Failure by the companies to pay their workers has had a huge effect on the entire Hwange community, including the business sector.

¹⁷ Interview with anonymous worker 1 on 28.10.16 of Ingabula Township. She also works at ZPC as a general hand worker.

¹⁸ Interview with anonymous worker 1

¹⁹ Interview with anonymous worker 1

²⁰ Interview with anonymous worker 2 on 29.10.16 at Hwange Colliery. He has been working for the colliery company since 1992.

4.2 Increased Social Pathologies

An influx of job-seekers when the mine was commissioned led to an increase in various social pathologies, particularly theft, the incidence of prostitution, and a resultant increase in sexually transmitted diseases (STDs) and HIV/ AIDS.²¹ The growth of the population due to natural means has also stretched the capacity of the few and struggling companies remaining in Hwange. The absence of alternative livelihoods apart from coal has also meant either people are employed at companies where they don't get regular payments or they engage in anti-social behavior such as petty crime and prostitution. It was also observed during this ethnographic study that only a few locals are employed by both the power company and the coal mining companies. In most cases the companies were said to prefer outsourcing workers from as far as Harare and Bulawayo leaving the locals with no concrete job opportunities.²² This is the irony given that mining comes with promises of creating jobs for the locals. In fact job opportunities is used as a carrot to persuade communities to embrace a mining project.

4.3 Safety impacts

The transportation of coal via road and rail sections which are also used by private motorists pose a risk to the motorists' safety due to increased traffic volumes and the presence of heavy vehicles on the roads. There was a noticeable gradual deterioration of roads as a result of heavy vehicles movements that criss cross Hwange daily transporting coal. It should be noted that in some instances the safety impacts experienced may not necessarily be the actual increase of risk to one's safety, but the perceived increase of such a risk which has the potential to have a debilitating effect on the psychological well-being of the local populace.

4.4 Occupational health

The workers in the mines have high risk of chronic lung diseases like Pneumoconiosis²³ (black lung), severe lung problems and lung cancer, dust allergy and asthma due to inhalation of coal. Dust from the coal also settles on vegetation thus affecting both plant and animals which feed on these plants.²⁴ In one example An interviewed worker who requested anonymity explained that two workers employed by the colliary company have also stopped coming to work because of health deterioration after being diagnosed with pneumoconiosis. Excessive dust emission in Hwange from coal mining and use by the thermal power plant has contributed to pneumoconiosis, a general occupational lung disease which depends on the quantity and size distribution of airborne dust, period of exposure and the susceptibility

²¹ Interview with anonymous villager 1 on 29 .10.16 of Lwendulu Village (No. 1).

²² Interview with anonymous worker 1 on 28.10.16

²³ Interview with anonymous worker 3 on 28.10 .16 at Hwange Colliary. He is an underground miner working for the colliary company.

²⁴ Interview with anonymous worker 3.

of the individual subjected to exposure.²⁵ The companies do not have proper dust suppression models in place and as a result dust is hurled up in the air which end up reaching households in Ingagula 1, 3 & 5 townships and ultimately affecting residents.²⁶ The ash suppression machines which were used in the past to dispose the ash in the dams after burning the coal are now dysfunctional.²⁷ As a result, most residents in Hwange are being exposed to dust which can be more severe to residents who suffer from asthma attacks.²⁸ The dangers associated with fire are very high in the mine because of build-ups of hazardous gas known as damp:

- Black damp: a mixture of carbon dioxide and nitrogen which can cause suffocation. The anoxic condition results in depletion of oxygen in enclosed spaces, e.g. by corrosion.
- After damp: similar to black damp but forms after a mine explosion. It consists of carbon monoxide, carbon dioxide and nitrogen.
- Fire damp: consists of mostly methane, a highly flammable gas that explodes between 5% and 15% - at 25% it causes asphyxiation.
- Stink damp: so named for the rotten egg smell of the explosive hydrogen sulphide gas and is also very toxic.
- White damp: air containing carbon monoxide which is toxic, even at low concentrations

Firedamp explosions can trigger the much more dangerous coal dust explosions, which can engulf an entire pit. These dangers of fire can potentially affect communities around the mining site.

4.5 Radiation exposure

Coal also contains low levels of uranium, thorium, and other naturally occurring radioactive isotopes whose release into the environment may lead to radioactive contamination. Coal plants emit radiation in the form of radioactive fly ash, which is inhaled and ingested by people and incorporated into crops.²⁹

4.6 Mitigation of occupational health and safety issues

Workers health surveillance

- Provide dust masks to workers and other safety clothing;
- Health survey programmes for workers and local community;

²⁵ Manoj, E.V & Prasannakumar, V. (2002). Environmental impact assessment and environmental management plan – a case study of magnesite and dunite mine, South India, *Bolemetim Paranaense*, 50,p.21-25, Editora UFPR

²⁶ Interview with anonymous worker 3 on 28.10.16.

²⁷ Interview with anonymous worker 2 on 29.10.16 at Hwange Colliary. He has been working for the colliary company since 1992.

²⁸ Interview with villager 2 at 29.10.16 of Village No 5, Hwange Colliary.

²⁹ Udosen, C. (2010). *Coal Mining and Environmental Concerns*, Lagos: Unwana Graphics.

- Regular training and awareness of employees to be conducted to meet health and safety objectives;
- Conduct a safety assessment (site access, construction, work practices, security, transportation of heavy equipment, traffic management, emergency procedures, fire control and management, and issues specific to underground mines: potential for flooding, subsidence, oxygen deficiency) and how to mitigate them.
- Develop a health and safety program for workers and the public, addressing all of the safety issues identified in the assessment and all applicable safety standards set forth by the Mine Safety and Health Administration.
- Consult with local planning authorities regarding traffic. Address specific issues (e.g., school bus routes and stops) in a traffic management plan.
- Limit traffic to roads indicated specifically for the project. Limit use of unimproved roads to emergency use only.
- Instruct and require all personnel and contractors to adhere to speed limits to ensure safe and efficient traffic flow.
- Limit mine-related vehicle traffic on public roadways to off-peak commuting times to minimize impacts on local commuters.

4.7 Economic dependency on the project

The level of dependency of the community on the colliery is captured in a statement on the Hewange company website:

To speak of Hwange town is to speak of Hwange Colliery Company. It is a mining town, a Company town, a coal town, which, owing to its remote location, has developed a self-contained community with a population of about 55 000. All services associated with local and central government – from road maintenance to refuse collection, water and power reticulation, schools, health, housing, recreational facilities and sewage disposal – are provided by the Company. It also operates its own railway and road transport system, internal security and telephone system.³⁰

The prosperity and decline of the company is reflected in the welfare of the community. As the company started deteriorating in the past decade due to corruption and bad management by government, it began to cut social spending. Company infrastructure has been in perpetual decay since the early 2000s whilst community infrastructure has been neglected under the same period. In addition, the company resorted to retrenchments as it responded to its own internal crisis and the global economic slowdown of 2008 which led to reduced demand for minerals, including coal. Retrenched employees could not secure alternative employment resulting in loss of income.³¹ This has a spin-off effect resulting in increased social pathologies, such as crime and prostitution.

³⁰ <http://hwangecolliery.net>

³¹ Interview with anonymous villager 3 on 29.10.16 of Village no 5, Hwange. He was retrenched by Hwange Colliery Company in 2001 when it started to scale down its operations.

4.8 Socioeconomic Mitigation Measures

Hwange Colliery company in particular could work with tribal, state, and local agencies to develop community outreach programs that would help communities adjust to changes triggered by coal mining. Such programs could include any of the following activities:

- Establishing vocational training programs for the local workforce to promote development of skills required by the coal industry;
- Developing instructional materials for use in area schools to educate the local communities on the effects of the coal industry;
- Supporting community health screenings, especially those addressing potential health impacts related to the coal industry;
- Developing alternative livelihood options that are environmentally friendly and;
- Providing financial support to local libraries for development of information repositories on coal mining, including materials on the hazards and benefits of commercial development. Electronic repositories established by the operators

5.0 ENVIRONMENT MANAGEMENT PLAN

EMP is a framework for the implementation and execution of mitigation measures and alternatives. Ideally, EMP should cover all phases of project development i.e. Preconstruction, Operation of mine and Decommissioning of the mine. It is a documented plan containing details of impacts, recommended mitigation and monitoring measures etc and legal document based on which the performance is monitored. Below are some of the probable environmental management models that can be adopted by Chilota, WMK, Makomo and Hwange coal mining companies.

5.1 Top soil management

The best practices for topsoil management by the coal mining companies mentioned herein is to scrap the topsoil prior to drilling and blasting. Scraped topsoil should be used immediately for plantation/agriculture. If it is not possible to use the topsoil immediately, then it should be stacked at a designated area. Storage must be done in a pyramidal form, with garland drains all around.

5.2 Overburden management

If an external overburden dump is unavoidable, then it should be stabilized with biological reclamation. Excavation from a new pit should begin after an existing pit has been exhausted. This would ensure that the overburden and inter-burden generated is used for backfilling the exhausted pit, instead of being dumped elsewhere. Overburden should be compacted and stacked in specified locations in low-lying, non-mineralized zones within the lease area. Vegetation should be planted over the dump slopes as early as possible. The height and slope of the overburden dumps should be maintained to prevent slope failure. Sedimentation tanks should be constructed to treat run-off from external overburden dumps. For external overburden dumps, the bench height should not exceed 10 meters and the final dump height should not be more than 60 meters.

5.3 Subsidence management

Planned subsidence by considering surface structures and human lives, as in the case of long-wall mining. Preparation of a subsidence management plan and its approval by the regulatory agency. The plan should ensure the following:

- Simultaneous stowing of the de-coaled area;
- Compensation to and rehabilitation of the affected people;
- Fencing of the subsidence zone during active mining operation to prevent unintended entry into the affected area;
- Reclaiming the subsided area by afforestation;
- Regular monitoring and inspection of subsidence area to detect any subsidence and taking the necessary steps.

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- Preparing a subsidence monitoring programme that covers the impact of subsidence on surface and groundwater (quality and quantity) and its management.

5.4 Clean Coal Technologies

The Hwange District boasts of high quality coal deposits of thermal, industrial and coking coal. Zimbabwe has an estimated 26 billion tonnes of coal reserves suitable for power generation and at the current rate of extraction of 3 million tonnes per year this translates to 8 000 years of use. This means Zimbabwe will be home to perpetual carbon emissions for centuries to come, emitting toxic gases that include Sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon dioxide (CO₂), mercury which also contribute to acid rain. In addition, coal emissions have direct effects on human health through diseases such as lung cancer and cardiovascular disease. One way through which these deleterious effects can be minimized is the use of clean coal technologies which entails carbon capture and storage technologies to capture carbon dioxide from the flue gas. Carbon Capture and Sequestration (CCS) involves the capture carbon dioxide, its conversion to a dense liquid-like state, and storage underground. This ensures there is less impact on climate and humans. Although the technology has had a slow uptake by industry due to the costs involved, it holds the key to the threat of coal-induced global warming.

CONCLUSION AND RECOMMENDATIONS

This environmental impact assessment study has managed to reveal the hazardous levels of dust emissions that result from the mining of coal as well as its burning by the ZPC. Ashes from the thermal power station are blown into the air and are affecting residents living Ingagula , Lwendulu , No 3 & No 5 Villages. The largely negative environmental impacts that were presented in this study were also drawn from the baselines surveys that were undertaken at Makomo, Chilota & WMK mines together with the Hwange Colliary company itself although it has scaled down its operations. The report recommends that among other things the mining and use of coal in Hwange should be carried out in an environmentally friendly manner. This entails coming up with plans to protect the health and safety of the surrounding habitat and to contain all possible sources of pollution associated with the mining and use of coal. Furthermore, the use of mine seepage water (after treatment) for different purposes; construction of gabbion wall, garland drain, siltation pond (wherever appropriate) and coal stockpiles, overburden and topsoil should be selectively placed in a stable area which is less prone to erosion. On top of it all, there is need for the government of Zimbabwe to start development of alternative sources of energy that are eco-friendly. Awareness raising on solar energy is highly recommended so that dependency on coal is diminished.

REFERENCES

- Anders S.G (2007). Global environmental impact assessment of the Pb-free shift , *Soldering & Surface Mount Technology* , Vol 19 Issue 2 , 18-28
- Anjaneyulu ,Y & Manickam, V (2007). *EIA Methodologies 2nd Edition* , Hyderabad: BS Publications.
- Canter , L.W (1982). Environmental Impact Assessment , *Impact Assessment Journal* , 1:2 , 6-40.
- Duinker, P.N & Greig , L.A , (2006). Scenario analysis in environmental impact assessment:improving explorations of the future, *Elsevier; Environmental Impact Assessment Review* 27 (2007) 206-219.
- Geneletti, D. (2002).*Ecological Evaluation for Environmental Impact Assessments* , London and NewYork : Routledge.
- Glasson, J , Therivel , R & Chadwick, A (2005). *Introduction to EIA*, 3rd Edition, London and NewYork: Routledge.
- Manoj, E.V & Prasannakumar , V. (2002). Environmental impact assessment and environmental management plan – a case study of magnesite and dunite mine , South India, *Bolemetim Paranaense* , 50,p.21-25, Editora UFPR.
- Ogola, A.F.P (2007) , Environmental Impact Assessment Global Procedures , paper presented at Short Course on Surface Exploration for Geothermal Resources, UNU-GTP, Lake Naivasha, Kenya (2-17 November , 2007).
- Udosen, C. (2010). *Coal Mining and Environmental Concerns* , Lagos: Unwana Graphics.
- Wathern , P (1988). *Environmental Impact Assessments: Theory and Practice* , London and New York: Routledge.

WEB SOURCES

www.enviropaedia.com/topic/default.php?topic

<https://en.wikipedia.org/wiki/Hwange>



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