# Contents

## Acronyms

1. **Introduction** 1-1
   1.1 *Project Proponent* 1-1
   1.2 *Background* 1-1
   1.3 *Terms of Reference* 1-1
   1.4 *Purpose of the Project* 1-2

2. **Project Rationale** 2-1
   2.1 *Energy Production and Consumption in Zambia* 2-1
      2.1.1 *Energy Production* 2-1
      2.1.2 *Energy Consumption* 2-2
   2.2 *Zambia’s Current Energy Deficit* 2-3
   2.3 *Electricity Imports/Exports* 2-4
   2.4 *Zambia’s Energy Development Goals* 2-5
      2.4.1 *Vision 2030* 2-5
   2.5 *Future Investment to Meet Power Objectives* 2-5
   2.6 *Conclusion* 2-8

3. **Detailed Description of the Project Indicating the Various Project Components** 3-1
   3.1 *Introduction* 3-1
   3.2 *Project Location* 3-1
      3.2.1 *Muchinga HPP* 3-1
      3.2.2 *Access Road between Muchinga HPP and Mulungushi HPP* 3-2
      3.2.3 *Transmission Line between Muchinga HPP and Mulungushi HPP* 3-2
   3.3 *Project Description* 3-6
      3.3.1 *Muchinga HPP* 3-6
      3.3.2 *Access Road between Muchinga HPP and Mulungushi HPP* 3-11
      3.3.3 *Transmission Line between Muchinga HPP and Mulungushi HPP* 3-11
      3.3.4 *Proposed Permanent and Temporary Access Roads* 3-11
      3.3.5 *Additional Project Infrastructure* 3-12
   3.4 *Waste Management* 3-14
      3.4.1 *Waste Types and Quantities Generated from the Construction Activities* 3-15
      3.4.2 *Waste Management Plans and Procedures* 3-16
4.1 **PHYSICAL ENVIRONMENT** 4-1
   4.1.1 Climate 4-1
   4.1.2 Air quality 4-5
   4.1.3 Geology 4-5
   4.1.4 Soils 4-7
   4.1.5 Topography 4-8
   4.1.6 Hydrology 4-9
4.2 **BIOLOGICAL ENVIRONMENT** 4-15
   4.2.1 Fauna 4-15
   4.2.2 Flora 4-19
4.3 **SOCIAL ECONOMIC ENVIRONMENT** 4-23
   4.3.1 Introduction and Geographic Context 4-23
   4.3.2 Land Tenure 4-25
   4.3.3 Population Demographics 4-26
   4.3.4 Economy and Livelihoods 4-28
   4.3.5 Employment and Unemployment 4-32
   4.3.6 Household Income and Expenditure 4-33
   4.3.7 Utilisation of Forest Resources 4-33
   4.3.8 General Infrastructure and Services 4-37
4.4 **CULTURAL AND HERITAGE** 4-44

5 **INSTITUTIONAL FRAMEWORK AND REVIEW OF LEGAL AND OTHER STANDARDS APPLICABLE TO THE PROJECT** 5-1
   5.1 **INTRODUCTION** 5-1
   5.2 **INSTITUTIONAL FRAMEWORK** 5-1
      5.2.1 Ministry of Tourism, Environment and Natural Resources 5-1
      5.2.2 Ministry of Energy and Water Development 5-4
      5.2.3 Other Line Ministries 5-6
   5.3 **ZAMBIAN ENVIRONMENTAL AND SOCIAL LAWS AND REGULATIONS** 5-7
      5.3.1 Environmental Legislation 5-7
   5.4 **ZAMBIAN DEVELOPMENT POLICIES** 5-11
      5.4.1 Zambia Vision 2030 5-11
      5.4.2 Sixth National Development Plan: 2011 – 2015 5-12
      5.4.3 Central Province Regional Development Plan: 2011 - 2015 5-12
   5.5 **INTERNATIONAL TREATIES, CONVENTIONS AND PROTOCOLS** 5-13
   5.6 **INTERNATIONAL GUIDELINES AND STANDARDS** 5-14
      5.6.1 World Bank Group Operation Policies 5-14
      5.6.2 The International Finance Corporation 5-16
      5.6.3 IFC Environmental, Health and Safety (EHS) Guidelines 5-19
      5.6.4 World Commission on Dams 5-20
      5.6.5 International Hydropower Association (IHA) Sustainability Guidelines 5-22
      5.6.6 Hydropower Sustainability Assessment Protocol 5-23
SUMMARY OF PUBLIC PARTICIPATION PROCESS

6.1 CONSULTATION PROCESS
6.1.1 Objectives of Public Consultation
6.2 SCOPING PHASE CONSULTATION
6.3 APPROACH AND METHOD
6.3.1 Identification of and Selection of Stakeholders
6.3.2 Consultation Method
6.4 NOTIFICATION OF STAKEHOLDERS
6.4.2 Public/Community Meetings Held
6.4.3 Issues and Concerns Raised
6.5 ESIA PHASE CONSULTATION
6.5.1 Approach and Method
6.5.2 Notification of Stakeholders
6.5.3 Meetings Schedule
6.5.4 Summary of Issues and Concerns Raised During Consultation
6.6 NOTIFICATION OF ZEMA’S DECISION

7 DETERMINATION OF THE POTENTIAL IMPACTS OF THE PROPOSED PROJECT

7.1 POTENTIAL ENVIRONMENTAL IMPACTS
7.1.2 Air Quality
7.1.3 Noise
7.1.4 Topography
7.1.5 Soils
7.1.6 Environmental Flow - Hydrology
7.1.7 Impoundment and Downstream Water Quality - Hydrology
7.1.8 Geohydrology
7.1.9 Terrestrial and Aquatic Flora
7.1.10 Terrestrial and Aquatic Fauna
7.1.11 Terrestrial and Aquatic Habitats
7.1.12 Summary
7.2 POTENTIAL SOCIAL IMPACTS
7.2.1 Physical and Economic Displacement
7.2.2 Surrounding Landuse
7.2.3 Loss of Land and Natural Resources
7.2.4 Disruption to Social Networks and Cultural Change
7.2.5 Pressure on Social Infrastructure
7.2.6 Impacts on Community Health
7.2.7 Impact on the Local Economy
7.2.8 Impacts on Fishing (Upstream and Downstream)
7.2.9 Disturbance Due to Dust, Noise and Safety Hazards from Traffic
7.2.10 Loss of Cultural Heritage
7.2.11 Summary
7.3 SECONDARY IMPACTS
7.4 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY
7.4.1 Aim of the Environmental Impact Assessment
7.4.2 Assessing Significance
7.5 MITIGATION POTENTIAL AND RESIDUAL IMPACTS
8 ANALYSIS OF ALTERNATIVES

8.1 PREVIOUS INVESTIGATIONS UNDERTAKEN
8.2 RFP CONCEPTUAL SCHEME
8.2.1 Phase 1: Tolomba
8.2.2 Phase 1: Muchinga HPP
8.2.3 Phase 2: Mkushi HPP
8.3 KEY BENEFITS AND DRAWBACKS OF THE RFP SCHEME, AND COMPARISON WITH THE SP SCHEME

9 PLAN OF STUDY AND EXPERTISE REQUIRED FOR THE STUDY

9.2 SPECIALIST INVESTIGATIONS
9.2.1 Soils
9.2.2 Terrestrial Flora
9.2.3 Terrestrial Fauna
9.2.4 Environmental Flows
9.2.5 Aquatic Ecology
9.2.6 Impoundment and Downstream Water Quality
9.2.7 Socio-economic
9.2.8 Cultural and Heritage
9.3 THE STUDY TEAM
9.3.1 Details and Expertise of the Environmental Assessment Practitioners
9.3.2 The Project Proponent:

10 CONCLUSION
Figure 6.6  Issues per Category in Percentages  6-15
Figure 8.1  RFP Conceptual Scheme: Phase 1  8-5
Figure 8.2  RFP Conceptual Scheme: Phase 2  8-6

TABLES

Table 2.1  Breakdown of Energy Consumption by Sector in 2010  2-2
Table 3.1  Principle Characteristics and Components of the Muchinga HPP  3-9
Table 4.1  Summary of Total Rights and Rights Types  4-12
Table 4.2  Average Flows  4-15
Table 4.3  Amphibians in the Project Area  4-16
Table 4.4  Reptiles in the Project Area  4-17
Table 4.5  Mammals Most Likely Occurring in the Project Area  4-18
Table 4.6  Red Data Plant Species Potentially Occurring in the Site and Villages Located Downstream of the Project  4-24
Table 4.7  Villages in close Proximity to the Project Footprint and Villages Located  4-24
Table 4.8  Population Characteristics of Central Province  4-27
Table 4.9  Population in the Project Area  4-27
Table 5.1  Summary of Relevant Zambian Environmental and Social Legislation  5-9
Table 5.2  Dates of Ratification of International Conventions  5-13
Table 5.3  International Finance Corporation (IFC) Performance Standards  5-17
Table 5.4  World Commission on Dams Strategic Priorities  5-21
Table 5.5  Hydropower Sustainability Assessment Protocol Topics by Section  5-25
Table 6.1  Stakeholders Selected for Consultation  6-4
Table 6.2  Public Consultation Methods to be Used  6-7
Table 6.3  Stakeholders to be engaged during the Draft ESIA  6-16
Table 7.1  Defining the Nature of the Impact  7-19
Table 7.2  Significance Criteria  7-20
Table 7.3  Example of Significance Rating Matrix for Positive and Negative Impacts  7-21
Table 7.4  Colour Scale for Ratings  7-21
Table 7.5  Significance Definitions  7-21
Table 8.1  Key Structure of Tolomba Phase 1  8-3
Table 8.2  Key Structures of Muchinga Phase 1  8-4
Table 8.3  Key Structures of Mkushi Phase 2  8-4
Table 8.4  Benefits and Constraints of the Alternative Schemes  8-7
Table 8.5  Basic Economic parameters of the RFP Schemes vs. the SP Scheme  8-8
<table>
<thead>
<tr>
<th>ACRONYMS</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEC</td>
<td>Copperbelt Energy Corporation plc</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental Assessment</td>
</tr>
<tr>
<td>ECZ</td>
<td>Environmental Council of Zambia</td>
</tr>
<tr>
<td>EHS</td>
<td>Environment Health and Safety</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessments</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statements</td>
</tr>
<tr>
<td>EMPs</td>
<td>Environmental Management Plans</td>
</tr>
<tr>
<td>EPFIs</td>
<td>Equator Principles Financial Institutions</td>
</tr>
<tr>
<td>EPPCA</td>
<td>Environmental Protection and Pollution Control Act</td>
</tr>
<tr>
<td>ERB</td>
<td>Energy Regulation Board</td>
</tr>
<tr>
<td>ERM</td>
<td>Environmental Resources Management Southern Africa (Pty) Ltd.</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>FPI</td>
<td>Framework and Package of Incentives</td>
</tr>
<tr>
<td>HPP</td>
<td>HydroPower Project</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>IHA</td>
<td>International Hydropower Association</td>
</tr>
<tr>
<td>IPP</td>
<td>Independent Power Producer</td>
</tr>
<tr>
<td>KNBC</td>
<td>Kariba North Bank Company</td>
</tr>
<tr>
<td>LHPC</td>
<td>Lunsemfwa Hydro Power Company Limited</td>
</tr>
<tr>
<td>L&amp;FS</td>
<td>Life and Fire Safety</td>
</tr>
<tr>
<td>MPC</td>
<td>Muchinga Power Company Limited</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organisations</td>
</tr>
<tr>
<td>PCDP</td>
<td>Public Consultation Disclosure Plan</td>
</tr>
<tr>
<td>PCR</td>
<td>Public Consultation Report</td>
</tr>
<tr>
<td>RCC</td>
<td>Roller Compacted Concrete</td>
</tr>
<tr>
<td>SADC</td>
<td>Southern African Development Community</td>
</tr>
<tr>
<td>SAP</td>
<td>Sustainability Assessment Protocol</td>
</tr>
<tr>
<td>SGs</td>
<td>Sustainability Guidelines</td>
</tr>
<tr>
<td>SNDP</td>
<td>Sixth National Development Plan</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>WCD</td>
<td>World Commission on Dams</td>
</tr>
<tr>
<td>ZEMA</td>
<td>Zambia Environmental Management Agency</td>
</tr>
<tr>
<td>ZESCO</td>
<td>Zambian Electricity Supply Corporation</td>
</tr>
</tbody>
</table>
1 INTRODUCTION

1.1 PROJECT PROPOONENT

The Muchinga Power Company Limited (MPC) (a joint venture between Lunsemfwa Hydro Power Company Limited (LHPC), and Agua Imara AS (formerly SN Power Africa) is considering developing a 240-330MW hydropower project (Muchinga HPP) on the Lunsemfwa and Mkushi Rivers in the Mkushi District, located in the Central Province of Zambia, approximately 70km to the east of Kabwe (Figure 1.1). The Muchinga HPP will consist of the development, financing, construction, operation, management and maintenance of a new electricity generation hydropower station.

1.2 BACKGROUND

A Scoping Report and Terms of Reference was submitted to the Zambian Environmental Management Authority (ZEMA) in June 2011, and approved by ZEMA on 2 September 2011.

Since then the scope of the Muchinga HPP has been extended by MPC. For more detail on the key components of the extended Muchinga HPP, please refer to Section 3.1. For more detail on the extended public consultation process throughout the Project as a result of the extended scope please refer to Chapter 6.

The following now constitute the key components of the extended Muchinga HPP project:

- Muchinga HPP;
- Access road between Muchinga HPP and Mulungushi HPP;
- Powerline between Muchinga HPP and Mulungushi HPP;
- Proposed permanent and temporary access roads (immediately east of the Lunsemfwa River); and
- A proposed quarry, the proposed spoils area, the proposed construction and batching camps, the proposed crushing area, the proposed Adits, and the proposed accommodation camps (see Figure 3.3).

This report is an update of the Scoping Report and Terms of Reference approved by ZEMA in 2011 to include the extended Muchinga HPP scope as described above.

1.3 TERMS OF REFERENCE

Elements of the project constitute scheduled activities in terms of the Environmental Protection and Pollution Control Act (No. 12 of 1990). As such,
an Environmental and Social Impact Assessment (ESIA) is required. In addition to Zambian legal requirements, the ESIA will also need to conform to international standards and best practices, in particular the requirements of the World Bank Group, International Finance Corporation (IFC) and the Equator Principles. The ESIA will also conform with other international guidelines and standards directly applicable to dam-building and hydropower projects such as the World Commission on Dams (WCD) and the International Hydropower Association (IHA).

Environmental Resources Management Southern Africa (Pty) Ltd. (ERM) in partnership with African Mining Services (AMC) was appointed by MPC to facilitate the environmental licensing process, in accordance with both national and international requirements.

1.4 PURPOSE OF THE PROJECT

The ESIA process is being conducted in accordance to the Zambian Environmental Management Act (Act No. 12 of 2011), the World Bank Safeguard Policies and the IFC performance standards.

The environmental scoping study (this report – otherwise known as the Terms of Reference for the study) is the first phase of the overall ESIA process. The purpose of the scoping study is to identify the environmental consequences of the proposed project, and to consider input from stakeholders. The study aims to provide the relevant authorities with enough information to make a decision regarding the project, or the need for further biophysical or socio-economic studies. The main objectives of this study are therefore to –

- present the ESIA process and the relevant national legislation and international obligations that will be adhered to;
- present a description of the proposed project;
- present the alternatives assessed and the rationale behind the preferred alternative;
- present the biophysical and socioeconomic conditions of the study area;
- present the issues raised during the initial public consultation;
- identify the environmental and social issues related with this project, on which the ESIA Study shall be focused; and
- present an outline of the terms of reference for the various specialist studies that will address the identified environmental and social issues.

The Scoping Report does not present the assessment of the environmental impacts or other definitive answers that shall be presented in the ESIA Report.
Figure 1.1: Muchinga Hydropower Project
PROJECT RATIONALE

ENERGY PRODUCTION AND CONSUMPTION IN ZAMBIA

2.1 Energy Production

The public energy utility in Zambia is known as the Zambia Electricity Supply Corporation (ZESCO). Lunsemfwa Hydro Power Company Ltd (LHPC), which operates Lunsemfwa and Mulungushi Hydropower Stations, and the Copperbelt Energy Corporation Plc (CEC), are additional utilities that are responsible for the generation, transmission and distribution of energy to Zambia (CORE, 2004).

ZESCO is a public utility owning the majority of generation, transmission and distribution infrastructure in Zambia. LHPC is a private company and is an Independent Power Producer (IPP). This company runs two hydropower stations with a joint installed capacity of 56MW (31MW from the current Mulungushi Hydropower Station and 25MW from the Lunsemfwa Power Station) (ERB, 2010). ZESCO has a formal agreement with this IPP to purchase all of its generated electricity (CORE, 2004). The LHPC delivered a total of 410GWh in 2011, an increase of 25 percent from 329GWh in 2010 (Pers. Comm., 2013). CEC is an electricity utility company operating on the Copperbelt Province of Zambia. The company is privately owned and controls transmission and distribution infrastructure in the Copperbelt Province. In 2008, CEC had an installed capacity of 80MW, although only 26MW of actual generation capacity was utilised. However, in 2010, CEC posted a significant increase in sales output, attributing the positive growth to the increase in mining operations (ERB, 2010). The company’s core business involves the supply of power to mines and power transmission for local power producers ZESCO and Société Nationale d’Électricité (SNEL) in the Democratic Republic of Congo (ERB, 2008).

Hydropower Stations

The three major Zambian hydropower plants, namely Kariba North Bank, Kafue Gorge, and Victoria Falls, are owned and operated by ZESCO. Furthermore, ZESCO owns and operates four Mini Hydropower Plants. These mini plants include Lusiwasi, Musonda Falls, Chishimba Falls and Lunzua River. These plants were initially developed as power sources for independent power networks in rural areas of Zambia. In the year 2010, major hydropower plants contributed 11, 007GWh of all the electricity generated (ERB, 2010).

Coal Fired Power Stations

Coal accounts for 5 percent of national energy requirements. The largest consumer is the mining industry, followed by the manufacturing sector.
Maamba Collieries Limited is Zambia’s largest coal supplier, followed by Collum Coal Mines. Currently Maamba Collieries operates two open cast mines in the Kanzize and Izuma Basins in the Southern Province. However, due to the paralysis of mine operations, the Zambian government transferred its 100 percent stake in the company to ZCCM Investment Holdings Plc (ZCCM). ZCCM is expected to revamp operations at the coal mine and transform it into a viable business entity thus improving coal supply for enhanced industrial production (ERB, 2008).

**Diesel Generators**

According to the ERB (2010), Diesel Power Plants contributed 14,155MWh in 2010. The following are Diesel Power Stations owned and operated by ZESCO:

- Mwinilunga;
- Kabompo;
- Zambesi;
- Mufumbwe;
- Kaoma (abandoned due to the area being linked with the National Grid);
- Luangwa;
- Lukulu;
- Chavuma;
- Chama (decommissioned in 2007 after the town was connected to the Malawi grid); and
- Kaputa.

### 2.1.2 Energy Consumption

The mining sector is currently the largest energy consumer in Zambia, consuming a total of 47 percent of energy produced in 2010. The Services sector is the second largest, consuming 35.5 percent of energy produced in 2010 (ERB, 2010). Table 2.1 shows the breakdown of sector energy consumption in 2010.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Units Consumed in MWh</th>
<th>Percentage of Total Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>193,786</td>
<td>2.5</td>
</tr>
<tr>
<td>Construction</td>
<td>9,265</td>
<td>0.1</td>
</tr>
<tr>
<td>Energy &amp; Water</td>
<td>90,645</td>
<td>1.2</td>
</tr>
<tr>
<td>Finance &amp; Property</td>
<td>338,108</td>
<td>4.3</td>
</tr>
<tr>
<td>Others</td>
<td>138,527</td>
<td>1.8</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>418,807</td>
<td>5.4</td>
</tr>
<tr>
<td>Mining</td>
<td>3,658,113</td>
<td>47.0</td>
</tr>
<tr>
<td>Services</td>
<td>2,768,227</td>
<td>35.5</td>
</tr>
</tbody>
</table>

Table 2.1 Breakdown of Energy Consumption by Sector in 2010

<table>
<thead>
<tr>
<th>Sector</th>
<th>Units Consumed in MWh</th>
<th>Percentage of Total Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade</td>
<td>151,894</td>
<td>2.0</td>
</tr>
<tr>
<td>Transport</td>
<td>21,470</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,788,843</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>


2.2 ZAMBIA’S CURRENT ENERGY DEFICIT

There is evidence of a major power supply deficit in the Southern African Development Community (SADC) and Zambia is no exception (MEWD, 2006 and ERB, 2010). The region has an average annual regional electricity demand growth of about 4.6 percent per annum (ERB, 2010). According to the 2007 Energy Sector Report published by the ERB of Zambia (ERB, 2007), the estimated total installed generation capacity in Zambia stood at 1,750MW; of this, only 1,200MW was, however, available on the national grid. During the same period, electricity demand was approximately 1,450MW, indicating a deficit of approximately 250MW (ERB, 2007).

The peak energy supply and demand forecasts (Figure 2.1) indicated that post 2011, the power deficit in the country will widen if additional capacity is not installed (ERB, 2008).

The energy deficit in Zambia directly affects this country’s economy. According to the Zambian Position Paper on Electricity (2009), this deficit is as a result of poor energy infrastructure and a lack of ongoing rehabilitation. In a quest to improve operations and infrastructure, and in attempting to try and narrow this deficit, ZESCO has made attempts to increase electricity tariffs over the last few years. In addition, increased power deficits have resulted in an increase in the rate of power load shedding. Load shedding, together with increased electricity tariffs, will result in reduced industry production, which in turn will affect company profits, which may quite possibly contribute to unemployment.

Unlike many other SADC countries, in the past Zambia has only experienced a gradual increase in the use of energy for commercial purposes. Between the years 1971 and 2000, the use of energy for commercial purposes has increased by only approximately 2 percent (Republic of Zambia, 2006); this has drastically constrained the rate of commercialisation in Zambia.
In addition, during this 29 year time period, the percentage of the population that has had access to electricity has remained at a constant 20 percent (Zambian Position Paper on Electricity, 2009). Currently it is estimated that only 25 percent of the population have access to electricity(1). Those portions of the population that do not have access to electricity derive their sources of energy primarily from wood fuels from Zambian indigenous forests, either as firewood or as charcoal. Although forests comprise over half of Zambia’s land cover, the use of wood from forests as a source of energy is a major environmental concern. During the period 1990 to 2000, the national forested land cover has reduced from 53 percent to 42 percent. This rate of depletion is now currently accelerating (Republic of Zambia, 2006).

2.3 ELECTRICITY IMPORTS/EXPORTS

Due to the power deficit that is currently being experienced in the country, ZESCO currently only exports excess off-peak and low voltage power. ZESCO recorded a reduction of 2 percent in electricity exports in 2010, as compared to the major increase of 515 percent in 2009. The 2009 increase is attributable to exports to Namibia following the commissioning of the 220kV transmission line between Victoria Falls and Katima Mulilo (Namibia) via Sesheke.

ZESCO recorded an increase of 30 percent in electricity imports in 2010, as compared to the reduction of 96 percent in 2009 (ERB, 2010).

2.4 ZAMBIA’S ENERGY DEVELOPMENT GOALS

2.4.1 Vision 2030

Zambia has recently set a vision for the year 2030 (Republic of Zambia, 2006). This vision is to have a strong and dynamic middle-income industrial nation that provides opportunities for improving the well being of all its citizens. Further, the nation aims to have an economy which is competitive, self-sustaining, dynamic and resilient. According to Vision 2030, energy is one of the important driving forces behind the development of the Zambian economy, as it cuts across most economic and social activities (see Section 5.4 for more detail on Vision 2030).

2.4.2 The Sixth National Development Plan: 2011 – 2015

The Sixth National Development Plan (SNDP) aims to materialise the aspirations of Vision 2030 and contains sector plans that aim to assist in achieving the targets and goals listed in Vision 2030 (Republic of Zambia, 2011) (see Section 5.4 for more detail on the Sixth National Development Plan: 2011-2015).

2.5 FUTURE INVESTMENT TO MEET POWER OBJECTIVES

Zambia committed to a planned electrification programme to increase access to electricity by at least 10 percent per year over five years from 2006 - 2011 (MEWD, 2006). In order to meet such commitments, a concerted effort to mobilise financial resources was required from both the public (the Zambian Government) and private sectors. The capacity for key implementing institutions such as ZESCO to deal with this requirement is, however, limited. As such, the private sector is key to meeting the commitments of the SNDP (MEWD, 2006).

The Zambian Government has considered establishing a power interchange between other southern African power producers. The ratio of power supply versus demand in other southern African countries is, however, at an equal or worse deficit. Future power developments in these countries are also lagging due to factors such as a lack of funds. In addition, there is a lack of clarity with respect to future prices associated with power interchange, and it is not certain whether a dependence on interchange would be coupled with cost savings. Reliance on power interchange between other southern African power producers therefore entails a high risk (MEWD, 2010).

Fossil fuels used in the generation of electricity include coal- and diesel-fired power stations. The generation of electricity through the use of diesel is not considered economically viable, as the cost of diesel is constantly on the increase (ERB, 2008) and furthermore, fossil fuels are not deemed a sustainable option for future power investment (Rural Electrification Master Plan Study, 2007). As a result, ZESCO is considering replacing diesel power stations with
renewable energy sources such as hydro-power (Rural Electrification Master Plan Study, 2007).

Solar power generation is a renewable option of electrification that is also being considered, especially for isolated rural areas where any connection to the national grid is costly. Currently, solar energy’s contribution to improving the electrification rate in Zambia is minor as pilot projects have only recently been set up (Rural Electrification Master Plan Study, 2007).

Hydropower stations in Zambia have recorded a significant increase in generation capacity over the period year 2006 to 2008. Current installed resource capacity is 1,788MW\(^1\); however, resource potential is approximately 6,000MW (Vision 2030, 2006). As such, there is considerable potential for future hydropower development. In addition, hydropower plants provide a cleaner, more efficient renewable energy source that will potentially enable enough energy generation for national consumption and potentially export. Furthermore, hydropower is able to assist in meeting the goals associated with the reduction in the use of indigenous wood as a fuel for energy.

As a result, the Zambian Government has embarked on a number of hydropower development and refurbishment projects (MEWD, 2006). Some of these developments include:

- **Itezhi- Tezhi** - This project is being executed under a Public-Private Partnership on a 50/50 basis between ZESCO and TATA Africa Holdings. A Special Purpose Vehicle (SPV) called Itezhi Tezhi Power Corporation Ltd (ITPC) has since been formed (MEWD, Energy White Paper, 2010).

- **Kariba North Bank Hydro-Power Station Extension** - The Kariba North Bank Extension Power Company (KNBEPC) is an SPV wholly owned by ZESCO. The project will increase the existing capacity of the power station by constructing a 360MW peaking plant. The total cost of the project is estimated to be US$420 million. Civil works of the station commenced with 65 percent of the excavations being completed by the end of 2010 (ERB, 2010).

- **Kafue Gorge Lower Hydro Project** - The Government of Zambia and the Government of the Peoples’ Republic of China signed a Memorandum of Understanding to develop the Kafue Gorge Lower Hydro Project in August 2010. The 750MW power plant is expected to cost about US$1.5 billion (excluding financing costs). The project is being executed through an SPV owned by Sino hydro, China Africa Development Fund (CADFund) and ZESCO Ltd on a Build Operate and Transfer (BOT) basis. The plant is designed as a base load station with an initial installed capacity of 600MW with provision for an additional 150MW during future expansion (ERB, 2010).

- **Kabompo Hydro-Power Project** - CEC is developing the Kabompo hydro power project on the Kabompo River in North Western Province, a 40MW underground power plant. The project cost is estimated to be US$150 million and is estimated to be completed in 2015. Power from Kabompo is intended to be introduced in the CEC system to supplement power from ZESCO. The plant may also be used to operate as a peaking plant, in addition to the existing CEC 80MW Gas Turbine Alternators (GTAs) (ERB, 2010).

- **Kalungwishi Hydro Power Project** - At the end of 2008 the Government was expected to finalise negotiations for the project implementation agreement for the construction of this 210MW project. However, such finalisations did not take place due to unforeseen circumstances. The power station will cost US$780 million to develop. It is planned to be built by the Lunzua Power Company, a consortium of local and foreign investors (ERB, 2008). Kalungwishi would mainly supply power to copper mines in Zambia and the eastern parts of the Democratic Republic of Congo (DRC) as well as to the planned Luena sugar plantation in Luapula Province.

- **Shiwang’andu Mini Hydro Power Project** - Shiwang’andu mini-hydro is a GRZ/UNIDO coordinated project ZESCO is expected to develop. The mini-hydro plant will produce 1MW. Total project cost is estimated at US$ 4.15 million. The contractor, IC-SHP of China, set up temporary site accommodation and offices in May 2010 and a 4km access road has been constructed for mobilization (ERB, 2010).

- **West Lunga Hydro Power Project** - This project site is situated in North-western Zambia in Mwinilunga with an estimated capacity of 2.5MW and is estimated to cost approximately US$2.7 million. This project is being spearheaded by the private sector and is at the stage of financing and completing the Power Supply Agreements.

- **Mulungushi Hydropower Upgrade Project** - The Lunsemfwa Hydro Power Company Limited (LHPC) is considering developing a 80-100MW hydropower project (HPP) on the Mulungushi River. The Mulungushi HPP will consist of the development, financing, construction, operation, management and maintenance of a new electricity generation hydropower station that will replace the existing but outdated ~30MW Mulungushi hydropower station. The existing Mulungushi Dam will provide the reservoir of water required for the updated Mulungushi HPP, i.e. no new impoundment is necessary.

The government of Zambia has now recognised that attracting private sector participation in the power industry, particularly hydropower, requires an appropriate framework which clearly outlined the concessions and incentives offered. The Framework and Package of Incentives (FPIs) was designed to fulfil this requirement. The FPIs aim to tap into domestic markets to raise
financing for power generation and bulk transmission. The main characteristics of the FPIs are:

- Internationally competitive terms;
- Reduction in local currency investment requirements;
- Simplification of procedures; and
- Steps to create and encourage a domestic corporate debt securities market.

This package has been developed in a way that it will provide for a competitive environment comparable with other developing countries seeking private power investment (Minister of Energy and Water Development, 1998). This FPI package together with other liberalisation measures (such as the privatisation of state owned enterprises such as mines), makes Zambia an attractive country for private investment into the power sector.

2.6 CONCLUSION

Investment in energy is a prerequisite to achieving commercial and industrial development in Zambia. The use of solar power is favourable in providing rural areas with access to power; however, if Zambia is to achieve those targets and goals detailed in its Vision 2030 and other complimentary plans, the country will require private sector investment in base-load energy technology that is efficient, sustainable and reliable. The generation of energy through hydropower is a proven technology that is sustainable and which is actively being promoted at a national level in Zambia. With a hydropower energy potential of approximately 6,000MW, hydropower is considered the most feasible and reasonable electrification option for Zambia.

The development of the Muchinga HPP as a modernised hydropower facility is thus in accordance with Zambia’s national development and sustainability objectives, and is aligned with regional electricity security imperatives.
3 DETAILED DESCRIPTION OF THE PROJECT INDICATING THE VARIOUS PROJECT COMPONENTS

3.1 INTRODUCTION

This Chapter provides a general overview of the technical features of the proposed extended Muchinga Hydropower Project (Muchinga HPP). The information in this chapter was sourced from the Muchinga HPP Phase 1 Feasibility Conceptual Schemes Report (2010), the Muchinga Hydropower Project Technical Feasibility Study (2013) and additional project information provided by MPC. The following constitute the key components of the extended Muchinga HPP project:

- Muchinga HPP;
- Access road between Muchinga HPP and Mulungushi HPP;
- Powerline between Muchinga HPP and Mulungushi HPP;
- Proposed permanent and temporary access roads (immediately east of the Lunsemfwa River); and
- Proposed quarry, the proposed spoils area, the proposed construction and batching camps, the proposed crushing area, the proposed Adits, and the proposed accommodation camps.

3.2 PROJECT LOCATION

3.2.1 Muchinga HPP

The proposed Muchinga HPP is located in the Central Province of Zambia, approximately 70km to the east of Kabwe (Figure 3.1). The Project sits within the three chieftdom areas of Kanyenshya, Mukonchi, and Chembe that preside over these areas (see
Figure 3.2). The proposed Muchinga HPP is located at the southern limits of the Mita Hills, Mkushi and Lunsemfwa Catchments (Figure 3.1); these three catchments drain an area of approximately 11,180km². The proposed Muchinga HPP is situated on the Lunsemfwa River, approximately 35km downstream of the Mita Hills Dam and approximately 25km downstream of the existing Lunsemfwa Hydropower Station.

3.2.2 Access Road between Muchinga HPP and Mulungushi HPP

MPC intends to construct a new permanent road between the new Muchinga HPP and the Mulungushi HPP (see Figure 3.3). From the Mulungushi village, the new road will run south-east on the plateau and then down the escarpment along switchbacks. Once below the escarpment the road will follow the foot of the escarpment in an east direction until it crosses the Lunsemfwa River and reaches the Muchinga HPP.

3.2.3 Transmission Line between Muchinga HPP and Mulungushi HPP

MPC intends to construct a new 330kV transmission line from the Muchinga HPP to the Mulungushi HPP. The transmission line will be installed from the Muchinga HPP just below the escarpment, and will run in a westerly direction past the Mulenge village, will cross the proposed new access road as described in Section 3.2.2 above, and follow in a westerly direction climbing the escarpment just south of Lunsia, and finally end at the Mulungushi HPP (see Figure 3.3 and Figure 3.4).
Figure 3.1: Location of the Muchinga Hydropower Project

Legend
- Roads
  - National Roads
  - Major Roads
  - Secondary Roads
  - Tertiary Roads
- Rivers
- Proposed Muchinga Dam
- Hills & Indel Reservoirs
- Location of Chief's palace
- Points of Interest
  - Chief Mukoncha's Farm
  - Chief Kanyenshya Farm
  - Chief Chikupili's Palace
  - Mita Hills Reservoir
  - Proposed Muchinga Hydropower Dam
  - Muchinga Hydropower Plant

Administrative Boundaries
- Chibombo Province
- Chongwe Province
- Kabwe Province
- Kapiri Mposhi
- MPongwe Province
- Lusaka Province
- Luapula Province
- Mazabuka Province
- Mbeya Province
- Malawi Province
- Mokola Province
- Mumbwa Province
- Muchinga Province
- Musanze Province
- Mzimba Province
- Northern Province
- South Luangwa Province
- Tsholotsho Province
- Western Province
- Zambia

Study Area
- MUCHINGA POWER COMPANY LIMITED
- 0 5 10 15 20 25 30 Kilometres

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073
Figure 3.3 Proposed Project Infrastructure for the Muchinga HPP

Source: Mott MacDonald, 2013.
3.3 PROJECT DESCRIPTION

3.3.1 Muchinga HPP

The Project layout is provided in Figure 3.3. The Muchinga HPP is proposed in the 25km stretch of river starting from the existing Lunsemfwa weir. The Lunsemfwa River flows, regulated by the upstream Mita Hills dam, will be transferred to the Mkushi Reservoir through a Transfer Tunnel, adding to the volume of water being drained from the Mkushi Basin. The preliminary survey carried out as part of the conceptual schemes report suggests that the canal be replaced by a tunnel due to the increased severity of the morphology of the area. An access Adit has been envisaged for the Transfer Tunnel, to be excavated with drill and blast methodology, substantially reducing the construction periods.

The new Mkushi dam is to be located on the Mkushi River, approximately 6km upstream of the Mkushi and Lunsemfwa River confluences, thus avoiding the Wonder Gorge which is situated within close proximity to this confluence. The Wonder Gorge is a national monument due to its geomorphological features and was thus avoided from the outset.

The proposed dam site is located in a steep gorge (Figure 3.5), which will create a dam reservoir of approximately 80-90Mm³ in volume, but only 5km²
in areal extent, where the Lunsemfwa inflows will join the Mkushi inflows. For maximum generation the scheme will be operated to maintain as high reservoir level as possible (to maintain the generating head), but low enough to provide sufficient storage to minimize spillage. In practice the reservoir level will be maintained at about 995m, taking into account weather forecasts to predict the likely runoff and drawdown of the reservoir to avoid spilling water. To mimic this behavior in the energy modeling, it is assumed that the reservoir has an operating range of 5m from the maximum water level (live storage of 22Mm³). For example, for maximum reservoir level of 995m, the scheme is assumed to operate between 990m to 995m.

**Figure 3.5 View of the Proposed Dam Site**

The Mkushi dam is envisaged as a rigid structure, gravity or arch-gravity type, approximately 85-90m in height. Alternatively, the dam can be a rockfilled dam with asphaltic core or a concrete dam. Due to the features at the dam site (ie steep slopes and situated in a valley), a gravity/arch-gravity Concrete dam is proposed. During operation, the spillway is currently envisaged as an overflow type on the dam crest. The dam type is as yet still not concluded.

The flows from the Mkushi dam will then be transferred to a further Headrace Tunnel, of approximately 7.8km in length. Two further Adits have been envisaged for the Headrace Tunnel, to be excavated with drill and blast methodology. At the end of the Headrace Tunnel, water is transferred to three penstocks for the surface powerhouse solution. If the powerhouse will be underground, the water will continue in the Headrace Tunnel through a dropshaft and inclined pressure tunnel to the powerhouse cavern. Making use of the hydraulic head provided by the Muchinga escarpment, water drops from an elevation of 995m to about 500m (a hydraulic head of 495m). The
The powerhouse is planned with three Francis units. The installed capacity is not yet decided, but each unit will be in the range of 80-110MW. This gives an installed capacity of 240-330MW. The powerhouse is located on the eastern bank of the Lunsemfwa River at the toe of the Muchinga escarpment (see Figure 3.7).

The existing Lunsemfwa HPP (Figure 3.6), which comprises of a diversion weir, a canal and a penstock to a surface powerhouse, currently generates 25MW to the national grid (sold to ZESCO on a contractual basis). The future of the Lunsemfwa HPP is not decided. One possibility is to decommission the power plant after some years of operation of the Muchinga HPP, another possibility is to continue to operate it, because:

- The maintenance of ecological discharges to the Lunsemfwa River downstream of the off take point to the proposed scheme; and
- Production during spillage (excess water) and maintenance periods to the Muchinga HPP.

Figure 3.6 Lunsemfwa Hydropower Project

A 66km long 330kV transmission line will be required to connect the Muchinga powerhouse to the national grid. This transmission line is proposed to run from the Muchinga HPP to the Mulungushi HPP (see Section 3.3.3).

Muchinga HPP Components

The principal components of the proposed Muchinga HPP are outlined in Table 3.1, and illustrated in Figure 3.7.
### Table 3.1  
**Principle Characteristics and Components of the Muchinga HPP**

<table>
<thead>
<tr>
<th><strong>Project Facility</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mkushi Dam Wall</strong></td>
<td></td>
</tr>
<tr>
<td>Dam Type</td>
<td>Not as yet decided. Either a Rockfilled dam or Arch-gravity Concrete Dam</td>
</tr>
<tr>
<td>Wall Height</td>
<td>85-90m</td>
</tr>
<tr>
<td>Crest Height</td>
<td>995 m.a.s.l</td>
</tr>
<tr>
<td>Crest Length</td>
<td>350m</td>
</tr>
<tr>
<td><strong>Mkushi Reservoir</strong></td>
<td></td>
</tr>
<tr>
<td>Reservoir Volume</td>
<td>83 Mm³</td>
</tr>
<tr>
<td>Reservoir Area (elevation 580)</td>
<td>5 km²</td>
</tr>
<tr>
<td><strong>Spillway</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Not as yet decided. Overflow spillway is normal.</td>
</tr>
<tr>
<td><strong>Headrace Canal - Lunsemfwa – Mkushi</strong></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>3km</td>
</tr>
<tr>
<td><strong>Headrace Tunnel</strong></td>
<td></td>
</tr>
<tr>
<td>Length: Upstream</td>
<td>11.6km</td>
</tr>
<tr>
<td>Length Downstream</td>
<td>7.8km</td>
</tr>
<tr>
<td>Diameter</td>
<td>42 m² for transfer tunnel and 60m² for Headrace Tunnel</td>
</tr>
<tr>
<td><strong>Powerhouse</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Open Air or underground</td>
</tr>
<tr>
<td>Number of Turbines</td>
<td>3</td>
</tr>
<tr>
<td><strong>Turbines</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Francis</td>
</tr>
<tr>
<td>Unit rated Capacity</td>
<td>240-330MW</td>
</tr>
<tr>
<td><strong>Energy Studies</strong></td>
<td></td>
</tr>
<tr>
<td>Design Flow</td>
<td>60m³/sec</td>
</tr>
<tr>
<td>Geodetic Head</td>
<td>495m</td>
</tr>
<tr>
<td>Average Head:</td>
<td>488</td>
</tr>
<tr>
<td>Installed Capacity:</td>
<td>240-330MW</td>
</tr>
<tr>
<td>Annual average energy production:</td>
<td>130GWh/year</td>
</tr>
<tr>
<td>Cost Index:</td>
<td>65 M$/year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Costs (Million USD)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil construction</td>
<td>300</td>
</tr>
<tr>
<td>HSS</td>
<td>20</td>
</tr>
<tr>
<td>EM</td>
<td>136</td>
</tr>
</tbody>
</table>
Figure 3.7  Key Components of the Muchinga HPP

Source: MPC, 2013.
3.3.2 Access Road between Muchinga HPP and Mulungushi HPP

MPC intends to construct a new permanent road from the Muchinga HPP to the Mulungushi HPP, as discussed above in Section 3.2.2. This will be a permanent road providing access to the Muchinga HPP. Aggregate for the road is planned to be sourced from a quarry site and tunnelling excavations.

3.3.3 Transmission Line between Muchinga HPP and Mulungushi HPP

The nearest point of connection to the national grid for the Muchinga HPP and the Mulungushi HPP is the 14 Miles Substation, located approximately 23km east of Kabwe. This substation is serviced by 66kV, 88kV and 330kV connections. In order to minimise transmission losses due to the total generation capacity, it is proposed that the power is exported via a 330kV transmission line. Therefore as part of the Muchinga HPP, a new single circuit 330kV transmission line is proposed to be installed between the Muchinga HPP and the Mulungushi HPP (see Figure 3.4).

3.3.4 Proposed Permanent and Temporary Access Roads

The civil works for the road access for the Project will include (see Figure 3.3):

- Rehabilitation of existing roads; and
- Construction of temporary and permanent bridges, river crossings and access roads.

Access from Kabwe to the existing schemes is generally along unmetalled (1) roads, which are poorly maintained. Access requirements for the Project are as follows:

- All weather roads to the Muchinga powerhouse;
- Access during construction to transport major electrical and mechanical equipment to the Muchinga powerhouse;
- All weather access to the new Mkushi dam and transfer tunnel intake at Lwambulu;
- Access along tunnel routes and to Adits;
- Access to camps, quarries and plants at the three main project sites – Lunsemfw, Mkushi dam and Muchinga powerhouse;
- Construction access to the penstocks; and
- Improvement to the condition of existing public roads.

Access to the Project Area will be via the national D421 road. It has been proposed that the D421 be repaired to enable access. The upgrade of access roads to the Muchinga powerhouse, Mkushi dam left and right banks and the accommodation camps will comprise the upgrade of approximately 84km of existing trails to gravel road fit for construction.

---

(1) Roads that are made in the absence of cement, concrete and tar.
There are currently well established trails which have been successfully used by Project contractors. These trails will be upgraded to gravel construction roads. Access will also be required to Project sites such as tunnel Adit entrances, quarry, accommodation camps and plants. It is further proposed that new permanent access roads be constructed to the Transfer Tunnel outlet, the Headrace Tunnel inlet, the Mkushi dam abutments and to the Muchinga powerhouse from both Mulungushi and the airstrip in the Luano Valley.

Total length of trail to be upgraded as part of the preliminary Project is approximately 84km. The length of proposed new permanent access roads including access from Mulungushi is approximately 44km. A further 25km of new temporary access roads are predicted to be constructed to facilitate access to various Project sites such as the Transfer Tunnel and Headrace Tunnel Adits. In addition, about 40km of construction road will need to be refurbished at the end of the main contract works to allow these roads to be adopted as permanent access roads.

Spoil from construction works is likely to be used in the construction, repair and refurbishment of roads as the Project progresses. However, this would depend upon the grade of the material being excavated.

Currently there are no bridges on any of the existing roads or trails. Provision for a temporary river crossings and a permanent bridge over the Lunsemfwa River at the powerhouse site has been proposed. The proposed Mkushi crossing is temporary as once the Mkushi dam is constructed, there will be access across the valley over the crest of the dam wall. The exact location of the permanent bridge has not been identified at this time and will be decided upon at a later stage.

3.3.5 Additional Project Infrastructure

Construction Facilities

Sites identified for the construction facilities are located near the Mkushi dam and in the valley in close proximity to the Muchinga powerhouse. The accommodation camp which will serve the Mkushi dam construction crew will be located near the Mkushi dam site and in close proximity to the quarry. The camp will be dismantled after construction work is completed, therefore all services will be temporary and will be removed once the Project has been completed, with the exception of a few houses and small offices required for maintenance staff at the Mkushi dam.

The accommodation camp located in the valley near the proposed Muchinga powerhouse will be constructed with the intent to serve as the housing estate for the Muchinga powerhouse after the completion of the Project. It must be noted that much of the infrastructure at this site will be permanent and designed to suit the site and require minimal on-going maintenance.
At this stage the location and number of concrete batching and mixing plants, stores and workshops for the Muchinga HPP is unknown. It is envisaged that there will be construction facilities at Lunsemfwa, Mkushi dam right bank and close to the Muchinga powerhouse, and that each of these construction facilities will include a concrete batching and mixing plant, main stores (covered and uncovered) and a workshop for maintenance of Project equipment.

The main camp including offices and temporary quarters for staff will be located near the Mkushi dam site. The Muchinga powerhouse camp will include a site office and permanent quarters to be used at a later stage as the offices and residence for staff operating the Muchinga Power Station. There are also additional areas available near each Adit for the construction facilities at each portal.

It is currently proposed that the Project headquarters be located at the Mkushi dam site, and will include Project offices and residential accommodation for Project staff.

The non-residential facilities for the Project will include:

- Parking and general storage areas (covered and uncovered);
- Storage facilities for cement, steel and other materials including chemicals;
- Storage and delivery of fuel;
- Explosive magazines;
- Maintenance workshop for heavy earth moving equipment and transport vehicles;
- Workshop for fabrication (eg steel linings);
- Testing laboratory;
- Accommodation for support staff;
- Recreation centre including club and auditorium;
- Guest houses;
- Provisions for market;
- Clinic and ambulance station;
- Site security post; and
- Communication masts

Additional amenities such as fire station, police station, bus stand and other public utilities may be provided in the Muchinga powerhouse camp in anticipation of future use once the Muchinga HPP is operational.

*Water Supply and Sewage Treatment*

In the Mkushi camp the source of water will be the Mkushi River, the water treatment will be modular treatment in container form. Water will be pumped from a pump station at the river to the treatment works. Water will be pumped to overhead tanks for gravitation and into the distribution system. The sewerage treatment will also be of a modular form, with the sewerage collection system being a piped system.
At the Muchinga powerhouse camp the source of water will be from the Lunsemfwa River. The water treatment will use slow sand filters with some pre-sedimentation treatment. The water will be pumped from the river by a pump station to the treatment works. Water will be pumped to overhead tanks for gravitation and into the distribution system. The sewerage treatment works will be in form of an oxidation pond, with the sewerage collection system being a piped system.

3.3.6 Construction Materials

The following construction materials will be required by the Project:

- Cement
- Sand, aggregates
- Steel
- Bricks, tiles
- Timber, aluminium, glass and plastics
- Paints and chemicals, mineral products
- Fixtures and fittings

The construction material such as cement, structural steel, reinforcement steel, rock bolts, bricks, paints and timber will be procured directly from sources approved by MPC. The fine and coarse aggregate required for the preparation of concrete is planned to be made available from a suitable quarry site located northwest of the Mkushi dam (see Figure 3.3) and/or spoil from tunnel excavation.

Rock Quarries

A survey to identify suitable quarry locations was undertaken. The aim of the survey was to identify sites which could potentially provide the quantity and quality of aggregates required at a location as close to the major project components as possible, in order to reduce transportation costs and minimise environmental impacts. The major aggregate requirement is for the concrete required for the Mkushi dam. Therefore the most efficient location for the main quarry would be near the Mkushi dam. Geological and topographical constraints, and logistical and access considerations indicated that a quarry on the south side (left bank) of the Mkushi River is not feasible.

On the right bank of the Mkushi River the metavolcanics sequence of the Muva Group is interspersed with bands of mica schists which are likely unsuitable for producing aggregate. From the limited field study undertaken it seems that the amphibole schist and/or greenstone rocks in this sequence may be suitable. However, this would need to be verified by further investigations. On the basis of information to date, it is considered that provided the mica schists are avoided, the right bank seems most likely to afford a suitable quarry site. Other quarry locations may be required but are unknown at this stage.
Batching and Crushing Plants

Concrete batching plants are planned at the Lunsemfwa powerhouse and the Mkushi dam powerhouse. Additional batching plants also require further investigation.

A crushing plant is planned just south of the identified quarry site, with a spoils area to the west (see Figure 3.3).

3.4 Waste Management

All Project generated wastes will need to be managed and disposed of in a manner to prevent potential impacts on the environment and risks to human health. A Project specific Waste Management Plan (WMP) will be developed by the Principal Contractor to comply fully with the requirements of the Outline ESMP in Chapter 9 of the ESIA Report. This will follow the principles of waste minimisation at source, segregation for reuse, recycling, treatment or disposal.

All wastes produced from activities in the field will be temporarily stored in designated waste storage areas. Waste streams will be generated from logistical activities associated with construction activities and activities at the construction camps accommodating personnel.

3.4.1 Waste Types and Quantities Generated from the Construction Activities

All wastes generated from the Project will be categorised as either non-hazardous or hazardous following an assessment of the hazard potentials of the material in line with Zambian and MPC requirements. The main sources of waste will result from the canteens at the construction camps, the construction activities and the logistical support services. One of the main sources of non-hazardous wastes will be the domestic type solid waste from the workers living at the construction camps. These wastes will be produced daily and comprise of the following:

- Domestic type waste, such as mixed waste from kitchens/canteen or living quarters:
  - residual packaging and food wastes
  - metal cans (from food and drinks)
  - plastics drinks bottles
  - glass jars and bottles
- Wooden pallets and cartons;
- Paper and cardboard; and
- Grey water - from showers.

The following hazardous wastes will also be produced from survey activities:
- Batteries (including large lead acid type);
- Medical/clinical wastes - from the camp clinic;
- Oily rags and absorbents;
- Used oil and oil filters - from generators or vehicle maintenance;
- Contaminated water - slops and oily water from drip trays; and
- Sewage from toilets.

All wastes produced from construction activities in the field will be transferred to the Waste Management Areas at the construction camps. Solid wastes will be segregated to facilitate reuse and recycling of specific materials. Waste bins will be fitted with lids which are emptied manually into a waste collection vehicle. Selected wastes will be disposed of at the construction camps, and all wastes that cannot be managed will be removed to appropriate waste treatment sites determined by Kabwe City Council Waste Management Unit. The Principal Contractor will be responsible to have waste removed to an MPC approved facility.

Sewerage and grey water will be treated at the construction camps in sewerage and wastewater treatment plants. All liquid wastes will be treated prior to the surface discharge of effluent. Where necessary, additional wastewater treatment capacity will be provided at the construction camps to allow the processing of the sewage from the additional workers. Ablution facilities will be provided for at the construction camps, and mobile ablution facilities will be provided in the field for personnel. Personnel will only use the provided ablution facilities. The Principal Contractor will install approved septic tanks for toilets at the new Muchinga Power Station.

The Principal Contractor will install incinerators for disposal of medical and clinical wastes.

Contaminated oil will be prevented with the use of oil-water separators, which have been installed near Transformer banks. Dip trays have been provided for oil leakages from turbines and the Principal Contractor will procure oil spill kits for oil spill management. Used oil is filtrated by MPC and Copper Belt Energy Cooperation (CEC), and stored in drums for reuse.

Organic biodegradable wastes from food preparation and leftovers will be disposed of to a burial pit, in the short term. Small quantities of paper and cardboard packaging will be disposed of in burn pits at the construction camps.

3.4.2 Waste Management Plans and Procedures

A detailed WMP will be developed and implemented for all stages of the Project to ensure wastes are managed in line with MPC’s requirements. The WMP will follow current good practice and will include procedures for tracking the transfer of wastes from source to end point and the environmental audit of all third party facilities receiving wastes. The WMP will include information on the practices for minimisation, handling, storage
and treatment and disposal of all Project wastes. The WMP will adopt the principles of the 'waste hierarchy' to ensure that waste generation is reduced and reuse and recycling is maximised.
This Chapter provides a description of the environmental and social baseline of the proposed Muchinga HPP, focusing on the proposed Project Area, as described in Section 3.2. This baseline is based primarily on a review of available secondary information.

It is important to gain an understanding of the physical, biological and socio-economic attributes of the Project Area and surrounds, as this will allow for a better understanding of the environment in which the project is being considered. Consideration of the receiving environment is a prerequisite for the identification of potential environmental and social impacts.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

The climatic data for the Central Province indicates that there are distinct dry (May to October) and wet (November to April) seasons. Rainfall frequently occurs in heavy thunderstorms producing a range of precipitation events from 20 to 40mm.

Climate data revealed that the annual mean climatic conditions for the Province are as follows:

- Mean Annual Temperature during the period 1976-2006 was 20.2°C;
- Mean Annual Precipitation during the period 1977-2004 was 877mm; and
- Mean Annual Wind Speed during the period 1981-2005 was 5.2 knots.

Rainfall and Evaporation

Daily rainfall data for the period 1977 to 2004, obtained from the Kabwe Meteorological Station indicates that the Mean Annual Precipitation (MAP) is 877mm, with the lowest recently recorded annual rainfall being 603mm in 1988 (indicated in red in Figure 4.1). The highest recorded MAP was 1,444mm in 1978 (indicated in blue in Figure 4.1). The wettest months in the Central Province are December and January.

The average maximum precipitation in Kabwe measured over 24hrs, is 67mm.
Zulu Burrow Limited Consulting Engineers (2007) (1) illustrated a ten year moving average rainfall for the Mita Hills Dam (indicated by the yellow line in Figure 4.2). This illustration shows that there is no clear trend in rainfall data; however, it does indicate that over the last 90 years, Mita Hills Dam experienced three rainfall peaks in 1960, 1985 and 1993 where MAP exceeded 900mm, and that in 1989, the MAP was below 700mm.

Zulu Burrows (2007) also provided a catchment rainfall map (Figure 4.3), which illustrates a MAP of 1,010mm at Mita Hills Dam and a range of 970-1,010mm in the vicinity of the proposed Project area. It must be noted however, that only six of the 15 stations which were used to produce the model in Figure 4.3 were available and located in the actual catchment. The most useful of these only had five years of data and the other five sources are grouped into two small areas of the catchment.

Source: AMC (2009)

The daily evaporation rate in the area ranges from 3 to 10mm. In the warmer months (September and October), evaporation reaches a peak of 13mm. The lowest evaporation rates occur in the month of February towards the end of the wet season (AMC, 2009).

**Temperature**

Temperatures, like rainfall are defined by the two seasons, cool and dry (May to September) and warm and wet (October to April) (Figure 4.4). Lower temperatures occur during the dry season, with the lowest temperatures occurring in June. The highest temperatures occur in October with the average monthly maximum temperature of 32°C as shown in Figure 4.4.

**Humidity**

Humidity data indicates Mean Annual Humidity in the Province to be between 33 and 59%. Mean humidity levels vary from a minimum of 29% in the cool dry season to a maximum of 89% in the wet season.
**Figure 4.3** Catchment Rainfall Map

Source: Zulu Burrow Limited (2007)

**Figure 4.4** Mean Monthly Rainfall and Temperatures

Source: AMC (2009)
Sunshine

Mean Annual Sunshine in the Province ranges from approximately 4.5 to 7.9 hours per day. There is more sunshine during the dry season than during the wet season (Figure 4.5). Sunshine hours decrease from December to March and then start to increase in April and May.

Figure 4.5  Mean Annual Sunshine (hours/day) in the Central Province

Source: AMC (2009)

Wind

The predominant wind direction in the Central Province is from the northeast, east and southeast. During the wet summer months, and particularly during storm activity, wind direction may temporarily shift to the west and northwest.

4.1.2  Air quality

In general, ambient air quality of any given area is affected by the presence of industry, transport routes and/or agricultural activities. Given the rural nature of the Project Area and the total lack of any heavy industry, ambient air quality in the area is good, with levels of industrial pollutants very likely to be below detection limits. Windblown dust from exposed areas of land is the only likely source of any emissions to air in the Project area.

4.1.3  Geology

The Project Area is located in a fold and thrust belt named the Irumide belt, a northeast-trending Mesoproterozoic structural province stretching from central Zambia to the Zambia–Tanzania border and northern Malawi (1).

The main tecto-stratigraphic units comprise the Paleoproterozoic Basement Supergroup that consists of granitoids and gneisses intruded by Mesoproterozoic granitoids, and the Muva supergroup: an extensive quartzite–metapelite interlayered with tuffs succession that tectonically overlies the Basement (1).

The Irumide belt is bordered to the south by the Muchinga escarpment that divides the chain from the lower elevated plain. Here the alluvial deposits of the Lunsemfwa River overlie the sandstones and gravels belonging to the Karoo Supergroup (2).

The belt had undergone an overall NW tectonic direction, the Lunsemfwa River probably flows (NNW-SSE) along a tensional fracture parallel to the direction of the tectonic stress, which is orthogonal to the axis of the folds. The foliation, the jointing and the drainage pattern is influenced by such tectonic scheme (3).

The geo-structural cross section illustrated in Figure 4.6 shows the double vergence of the southwestern Irumide Belt.

*Figure 4.6*  
*Geological Cross Section of the Project Area*

Source: SP Consulting Engineers (2010)


In the upper reaches of Wonder Gorge the Lunsemfwa River has cut deeply into a series of metamorphic rocks, which are of granular texture and are composed of quartz, biotite and feldspar. Gneiss of granitic composition was found in the vicinity of the existing power station and extending downstream for approximately 350m towards the confluence with the Luambula River where it grades into a quartz/biotite/microgranite. Strong jointing in the gneiss strikes at 191 degrees, and dips to the west at 85 degrees. Below this, the gneiss grades into a quartz/biotite/granulite occasionally intruded by small quartz/feldspar/mica pegmatites.

Soils

According to Mukalay (2011) (1), soils in the Project Area are characterised as comprising Acrisols. Acrisols are strongly weathered, acid soils, that have a low cation exchange capacity (CEC) and a low base saturation. In addition, the following soils, which are associated with Acrisols, can be located along the Lunsemfwa mountainous landscapes:

- **Ferralsols** - deeply weathered soils that have low CEC and are virtually devoid of weathered minerals.
- **Regosols** - very weakly developed mineral soils in unconsolidated materials.
- **Leptosols** - shallow soil over hard rock.
- **Cambisols** - soils with the beginning of horizon differentiation evident from changes in colour or structure, young soil on foot slope of mountain.

**Fluvisols**, which are soils developed in alluvial deposits and which show stratification or other evidence of recent sedimentation, occur along the watersheds of the Mkushi and Lunsemfwa Rivers.

The majority of agricultural subsistence activities take place on Acrisols in the Project Area. Acrisols have little weatherable minerals left compared with Ferralsols and the clay fraction consists almost entirely of well-crystallised kaolinite with some gibbsite. Acrisols have constraints of low nutrient levels (low inherent fertility) and the presence of exchangeable aluminium, which acts either through its intrinsic toxicity properties, its acidifying power, or its adsorption capacity of phosphates in the soil. Acrisols lose nitrogen and elements such as boron and magnesium through leaching or run-off under high rainfall. Nutrient reserves in these soils are concentrated in the surface horizon and their maintenance depends on the continuous recycling of the surface horizon through vegetation or through the addition of fertilisers.

Most inhabited areas within the Project Area have deep to moderately deep, undulating and rolling Ferric, humic and orthic Acrisols. Perennial crop production of maize, groundnuts, tobacco and cotton is suitable on these soils, but the addition of fertilizers is required in order to have a good harvest.

Acrisols are also sensitive to erosion due to a less than favourable structure in the surface layer and the decrease of permeability in a subsequent horizon. Short-term surface water logging may occur during heavy rains on these soils. Acrisols are easily damaged by compaction and loss of surface soils through erosion is possible when heavy equipment is used for deforestation or tillage operations. With adequate management, the presence of the argillic subsequent horizon in Acrisols is an asset for moisture retention.

---

(1) J. Mukalay - the Soil Specialist appointed for the Mucniga HPP ESIA
4.1.5 Topography

The Project area is situated just north of the Muchinga Escarpment, an extension of the Great Rift Valley. The difference in elevation between the crest and toe of this escarpment is approximately 500m (Figure 4.7). The Lunsemfwa River has created a deep gorge, approximately 17km in length, which starts approximately 35km to the south of the Mita Hills Dam and has a maximum depth of approximately 500m at the Muchinga Escarpment. The Mkushi River channel is not as defined as the Lunsemfwa channel and flows into the Lunsemfwa River from the east (Figure 4.8).

The topography of the Project Area consists of levelled terraces to the east and the west, which lead into densely vegetated rocky gorges of the Lunsemfwa River. The following land systems are evident in the Project Area:

- Deep cut river gorges or the main river and tributaries;
- Mkushi and Lunsemfwa riparian zones; and
- The Mkushi and Lunsemfwa Rivers.

An image of the typical topography of the Project Area, showing the Lunsemfwa and Mkushi River gorges at a point close to the confluence of these two rivers, is indicated in Figure 4.9.

Figure 4.7 Topography of Project Area – Towards the East

Source: Google Earth Pro
4.1.6 Hydrology

The proposed Muchinga HPP is located at the southern limits of the Mita Hills, Mkushi and Lunsemfwa Catchments. These three catchments drain an area of approximately 11,180km². The proposed Muchinga HPP is situated on the Mkushi and Lunsemfwa Rivers, approximately 35 km downstream of the Mita Hills Dam and 25 km downstream of the existing Lunsemfwa Hydropower Station.

A catchment map, showing these three catchments is provided in Figure 4.10. Of interest to note, is the extent of agricultural activity upstream of the Mita Hills Dam, to the south of the town of Mkushi. The information below is drawn from an updated Hydrology study undertaken by Mott MacDonald in July 2013.
Figure 4.9 Lunsemfwa and Mkushi River Gorges
The Lunsemfwa River and Mita Hills Dam catchment

Zulu Burrow (2007) provides information relating to water abstraction from the Lunsemfwa catchment for agriculture purposes. Figure 4.11 indicates that abstraction from the Lunsemfwa River has substantially increased over the last few years. Water abstraction has increased from approximately 13,000ML per year in 1997 to 66,000ML per year in 2006 (Figure 4.11).
In terms of current water rights for abstraction from the Lunsemfwa Catchment, Zulu Burrow (2007) noted that hydro power has the highest rate of allowable abstraction (2,452,054 m$^3$/day) followed by agricultural and industrial use (479,173 m$^3$/day and 3,227 m$^3$/day respectively; Table 4.1).

### Table 4.1 Summary of Total Rights and Rights Types

<table>
<thead>
<tr>
<th>Usage Type</th>
<th>Quantity (m$^3$/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro Power</td>
<td>2,452,054</td>
</tr>
<tr>
<td>Agriculture</td>
<td>479,173</td>
</tr>
<tr>
<td>Industrial</td>
<td>3,227</td>
</tr>
<tr>
<td>Municipal</td>
<td>1,200</td>
</tr>
<tr>
<td>Total dam Rights</td>
<td>2,502,904</td>
</tr>
<tr>
<td>Run of river Rights</td>
<td>432,750</td>
</tr>
<tr>
<td>Agricultural Dam Rights</td>
<td>46,423</td>
</tr>
<tr>
<td>Agricultural Run of River Rights</td>
<td>432,750</td>
</tr>
</tbody>
</table>

Source: Zulu Burrow Limited Consulting Engineers (2007)

According to Zulu Burrow (2007), the figures provided in Table 4.1 represent a maximum rate of abstraction, and an unused right from one day is not allowed to be carried forward to any other day. For hydropower, the calculation of the annual water right is based on 365 days per year, whereas the annual water rights for irrigation purposes are based on 183 days per annum, as this is representative of the irrigation season. Figure 4.12 below shows a recent analysis of water abstraction from the upper Mita Hills catchment area.
Mita Hills Inflow

The analysis of the Mita Hills inflow involved the assessment of long term averages, trends and previously derived series compared with an inflow series for the recent period derived by Mott MacDonald using available operational data at the Mita Hills Dam (see Table 4.2).

The Muir series (1961-2010) was selected for use in further analyses over other available series principally because the degree of variability displayed in this
series in comparison to the other series was considered to be more realistic. Additionally, the Muir series had a closer match to the Mott MacDonald derived flows in the past 5 years.

However, there was still a clear difference in dry season flows, with derived inflows much lower than the previous series. Therefore a dry season adjustment was applied to the Muir series to account for the impact of abstractions. The adjustment was a reduction in flows by 3 m³/s from June to November.

The Muir inflow series at Mita Hills is in monthly time-steps and for power and energy modelling a daily inflow series is required. Therefore, a daily series for modelling was derived from the monthly values by referencing to available daily flow data in regional gauges (Great North Road and Kafue). The daily patterns at these gauges were used while maintaining the monthly average from the adjusted Muir series.

*Mkushi Inflows*

The derivation of flows at the Mkushi Dam utilised available flow information from a recently installed gauge on the Mkushi River (Old Mkushi Road Bridge), located upstream of the proposed dam and has just over two years (Sep 2010 to Oct 2012) of flow data (see Table 4.2).

The derivation of flows at the dam site involved the development of a HYSIM catchment model at the gauge location using available hydrometric and physical information. The model simulation indicated that the long term average flow was slightly lower than the 9.2 m³/s average (1961-2010) obtained by Muir using a similar methodology (rainfall-runoff approach). However, the result was much lower than his alternative series based on regional analysis.

However, although the modelling exercise at Mkushi produced reasonably good results, there are still uncertainties in applying this model over the longer term. These uncertainties are based on the premise that climatic factors (particularly rainfall) over the period used in catchment modelling may not be representative of long term conditions.

In order to overcome this uncertainty, it was decided that the Muir flow series from the rainfall-runoff model be retained in further analysis. As with the Muir series at Mita Hills, the flow series at Mkushi had a monthly time-step and needed to be transformed to a daily series for use in power and energy modelling. This was achieved by adopting a similar approach as with Mita Hills, by using the daily pattern obtained from HYSIM modelling as a reference.
Summary of Average Flows

The average flows for the various catchments contributing to the scheme are shown in Table 4.2 below. The lower average runoff for the Mkushi catchment reflects that the average rainfall in the catchment is lower than for the Mita Hills catchment.

Inflows from the diversion dam and Lwambulu catchment area was also estimated.

Table 4.2 Average Flows

<table>
<thead>
<tr>
<th>Area (km²)</th>
<th>m³/s</th>
<th>million m³/y</th>
<th>Runoff (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mita Hills 7525</td>
<td>26.12</td>
<td>824</td>
<td>110</td>
</tr>
<tr>
<td>Diversion dam 994</td>
<td>3.45</td>
<td>109</td>
<td>110</td>
</tr>
<tr>
<td>Mkushi 3562</td>
<td>9.17</td>
<td>289</td>
<td>81</td>
</tr>
<tr>
<td>Lwambulu 84</td>
<td>0.22</td>
<td>7</td>
<td>81</td>
</tr>
<tr>
<td>Muchinga Total 12165</td>
<td>38.97</td>
<td>1230</td>
<td>101</td>
</tr>
</tbody>
</table>

Source: Mott MacDonald, 2013.

Box 4.1 Summary of Physical Environmental Sensitivities that will Potentially Influence Project Design

- A distinct dry season (from May to October) and a wet season (from November to April).
- Mean Annual Precipitation for the Central District of 877mm, varying from 1,444mm in 1978 to 603mm in 1998, over the period 1978 to 2004.
- Given the rural nature of the Project area and the total lack of any heavy industry, ambient air quality in the area will be good, with levels of industrial pollutants very likely to be below detection limits.
- The majority of agricultural subsistence activities take place on Acrisols in the Project area. These soils are low in nutrients and require the addition of fertilizers. Furthermore, these soils are very sensitive to erosion and are easily damaged by compaction.
- The topography of the Project area is very favourable for hydropower generation; the Muchinga escarpment represents a change in elevation of approximately 500 metres.
- Hydrological flows are concentrated in the wet season; approximately 80% of the annual flows occur in the wet season between January and April.
- There is considerable variation in flow in any one year; maximum flow rates are up to 4.5 times those of minimum flow rates.
- The growing demand for water by agricultural activities upstream of the Mita Hills Dam.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Fauna

Aquatic Fauna

Although there are no records of commercial fishing in the area, the two rivers have a rich diversity of fish species which make for subsistence and sport fishing, due mainly to their large populations of tiger fish (*Hydrocynus vittatus*) and bream species. Bream species are dominated by *Pseudocrenilabrus*...
philander, Tilapia rendalli, T. sparmani, Oreochromis machrochir and Serranochromis thumbergi) (Camerapix, 1996). (1)

The Lunsemfwa and Mkushi Rivers also contain Mormyrus lacerda and Schilbid species around the confluence, while minnows such as Barbus species and Alestes species have a very significant presence in the Project site. Labeo congoro and Labeo altivellis have also been recorded. Some of these species are migratory, and their presence shows that the two rivers are ecologically significant in ensuring a rich fish biodiversity.

According to the IUCN red list, no fish species are endangered. As fish species such as tigerfish are mostly targeted by anglers, this is a species of concern in Zambia (Simbotwe and Mubamba, 1995).

Herpetofauna (Amphibians and Reptiles)

Little information is available on amphibians and reptiles for the Project Area and immediate surrounds. According to Miyauchi (1996), the following amphibian and reptile species may still exist in the Project area (Table 4.3 and Table 4.4).

### Table 4.3 Amphibians in the Project Area

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>IUCN Red Data Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Tree Frog</td>
<td>Leptopelis cymnamomeus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Dark Ridged Frog</td>
<td>Ptychadena obscura</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Dark-sided Toad</td>
<td>Bufo melanopleura</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Darlings White-lipped Frog</td>
<td>Amnirana darlingi</td>
<td>Least Concern</td>
</tr>
<tr>
<td>De Witte’s Spiny Reed Frog</td>
<td>Afrivalus wittei</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Dwarf Puddle Frog</td>
<td>Ptychadena parvulus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Five-striped Reed Frog</td>
<td>Hyperolius quinquetrinitatis</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Grandison’s Ridged Frog</td>
<td>Ptychadena grandisonae</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Greater Reed Frog</td>
<td>Hyperolius major</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Kachalola Reed Frog</td>
<td>Hyperolius kachaloleae</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Keiling’s Ridged Frog</td>
<td>Ptychadena keilingi</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Kuvangu Kassina</td>
<td>Kassina kaeangensis</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Lemaire’s White-lipped Frog</td>
<td>Amnirana lemairii</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Peters’ Platanna</td>
<td>Xenopus petersii</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Plain Squeaker</td>
<td>Schoutedenella XOenochirus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Powers Rain Frog</td>
<td>Brevicps poweri</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Rough Ridged Frog</td>
<td>Ptychadena bunderma</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Rough Sand Frog</td>
<td>Tomopterna tuberculosa</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Sooty Toad</td>
<td>Bufo fuliginatus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Spotted Ridged Frog</td>
<td>Ptychadena subpunctata</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Steindachner’s Reed Frog</td>
<td>Hyperolius steindachneri</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Upemba Ridged Frog</td>
<td>Ptychadena upemba</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Yellow-bellied Ridged Frog</td>
<td>Ptychadena guibei</td>
<td>Least Concern</td>
</tr>
</tbody>
</table>

Source: Miyauchi (1996)

Table 4.4  Reptiles in the Project Area

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>IUCN Red Data Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchieta’s Cobra</td>
<td>Naja anchietae</td>
<td>*Least Concern</td>
</tr>
<tr>
<td>Angola Rough-scaled Lizard</td>
<td>Ichnotropis bivittata</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Angolan Dwarf Gecko</td>
<td>Lygodactylus angolensis</td>
<td>*Least Concern</td>
</tr>
<tr>
<td>Angolan Rock Monitor</td>
<td>Varanus albicularis angolensis</td>
<td>*Vulnerable</td>
</tr>
<tr>
<td>Dwarf Hinged Terrapin</td>
<td>Pelusios nanus</td>
<td>*No Data Available</td>
</tr>
<tr>
<td>Elongate Quill-snouted Snake</td>
<td>Xenocalamus mechowii</td>
<td>*Least Concern</td>
</tr>
<tr>
<td>Gunther’s Garter Snake</td>
<td>Elapsoidea guentheri</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Heenen’s Dwarf Gecko</td>
<td>Lygodactylus heeneni</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Katanga Purple-glossed Snake</td>
<td>Amblyodipsas katangensis</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Katanga Worm Snake</td>
<td>Leptotyphlops kafubi</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Ornate Green Snake</td>
<td>Philothamnus ornatus</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Schmidt’s Blind Snake</td>
<td>Rhinotyphlops schmidtii</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Seydel’s Snake-eyed Skink</td>
<td>Afroablepharus seydelii</td>
<td>No Data Available</td>
</tr>
<tr>
<td>South-western Forest Marsh Snake</td>
<td>Natriciteres bipostocularis</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Striped Beaked Snake</td>
<td>Ramphiophis acutus</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Two-striped Night Adder</td>
<td>Causus bilineatus</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Zambian Snake Lizard</td>
<td>Chamaesaura miopropus</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Zambian Spitting Cobra</td>
<td>Naja crawshay</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Zambian Whip Lizard</td>
<td>Tetradactylus ellenbergeri</td>
<td>No Data Available</td>
</tr>
</tbody>
</table>


Of the species listed in Table 4.3, there are no known species that are listed as being threatened or rare (IUCN, 2011).

The IUCN do not have the red data status for those species listed in Table 4.4; however, Griffin (2008) has listed the Angolan Rock Monitor as being vulnerable in Namibia; its status in Zambia is not known.

*Mammals*

Ansell (Mammals of Zambia, 1978) (1) documented small and large mammal species existing in the Central Province, particularly the Wonder Gorge area. Ansell (1978) reported more than 42 mammal species in this area in the late 1970’s, with the more significant mammal species including Sable Antelope, African Wild Dog, Lion, Waterbuck, Common Reedbuck, Impala and Black Rhinoceros.

The majority of large mammal populations may, however have since been decimated; recent anecdotal reports show that the mammal compositions in the area reflect a high degree of change due to hunting and the destruction of suitable habitats since 1978. As a result, remaining mammals will most likely comprise mainly small mammals; mammals potentially existing in the Project area and the immediate surrounds are listed (together with their conservation status) in Table 4.5 below:

---

**Table 4.5 Mammals Most Likely Occurring in the Project Area**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status in Project area</th>
<th>IUCN Red Data Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ant Bear</td>
<td>Orycteropus afer</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>African civet</td>
<td>Civettictis civetta</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>African Wild Cat</td>
<td>Felis libya</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Bush Baby</td>
<td>Galago crassicaudatus</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Bushbuck</td>
<td>Tragelaphus scriptus</td>
<td>Rare; locally threatened</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Lesser Cane rat</td>
<td>Thyromys gregorianus</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Chacma Baboon</td>
<td>Papio ursinus jubileus</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Common duiker</td>
<td>Syleiscapra grimmia</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Flying squirrel</td>
<td>Anomalurus derbianus</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Klipspringer</td>
<td>Oreotragus oreotragus</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Leopard</td>
<td>Panthera pardus</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Giant Mole Rat</td>
<td>Cryptomys mechowi</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Oribi</td>
<td>Oreobia orebi</td>
<td>Rare</td>
<td>Lower Risk</td>
</tr>
<tr>
<td>Sharpe’s grysbok</td>
<td>Raphicerus sharpie</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Side-striped Jackal</td>
<td>Canis adustus</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Spring hare</td>
<td>Pedetes capensis</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Sun squirrel</td>
<td>Heliosciurus nubifer</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Moloney’s Monkey</td>
<td>Cercopithecus albogularis</td>
<td>Rare</td>
<td>-</td>
</tr>
<tr>
<td>Vervet Monkey</td>
<td>Cercopithecus pygerythus</td>
<td>Common</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Wart hog</td>
<td>Phacochoerus aethiopicus</td>
<td>Rare</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Zambian Molerat</td>
<td>Cryptomys anselli</td>
<td>Common</td>
<td>Near Threatened</td>
</tr>
</tbody>
</table>

Of the mammals potentially remaining in the Project area, none are listed as critical or threatened by the IUCN.

**Birds**

The Wonder Gorge area is a valuable sanctuary for many different bird species (Binghum, 2003) (1). The area is associated with rock loving bird species such as black eagles, taita falcon which is believed to breed from within the area, mocking chat, rock loving Cisticola, Striped pipit, Red-winged starling, Lappet faced vultures, etc. The surrounding miombo holds a good number of Zambezian endemics and near-endemics such as the Pale-billed hornbill, Miombo rock thrush, central bearded Scrub robin, Arnot’s chat, Red-capped crombec, Rufous-billied tit and Souses shrike.

**Invertebrates**

According to Dr. Harris Phiri (2011), common invertebrate fauna that are typically found in the Project Area included mayflies (mainly *Baetidae*), blackflies (*Simuliidae*), cased caddisflies (mainly *Leptoceridae* and *Helopsychidae*), freshwater crabs (*Potamonautidae*), riffle beetles (*Elmidae*), stoneflies (*Perlidae*) and non-biting midges (*Chironomidae*) (*Corixidae*, *Notonectidae* and *Pleidae*).

---

(1) Binghum, M. (2003); Birds of Central province, Ornithorlogical Society of Zambia.
According to the IUCN red list, none of the invertebrate species in the area are endangered; however, the majority of invertebrate species are sensitive to habitat modification.

4.2.2 Flora

Aquatic Flora

According to Dr. Harris Phiri (2011), aquatic flora in the Project area are dominated by emergent plants (*Typha* and *Cyperus papyrus*), and Euhydrophytes (*Nymphaea* and *Potamogetons*). Surface floating flora are rare but conspicuous. Blue-green algae are common in the slow flowing water. Aquatic weeds have also been reported in the diversion dam at Lunsemfwa Hydro-power Station.

Terrestrial Flora

The vegetation of the Project Area is principally made up of Miombo Woodland. Miombo Woodland constitutes one of six eco-regions in Zambia and is the most extensive; covering approximately 65% of the country (Phiri, 2005) (1). The Miombo Woodland is further subdivided into Central Zambezian and Southern Miombo woodlands. The Central Zambezian Miombo Woodland covers the northern Zambian plateau including the northern part of the Central province of Zambia (Malambo & Syampugani, 2008) (2). The major defining land feature in the area is the Muchinga Escarpment, which is an extension of the Great Rift Valley. The Miombo woodland covers the escarpment, and extends into the gorges formed by the Lunsemfwa and Mkushi Rivers. The vegetation of the proposed Muchinga HPP area can be subdivided into escarpment, hill and rocky outcrops Miombo woodland subtypes.

Other vegetation types characterising the proposed Muchinga HPP area include Termitaria vegetation, which is found on termite mounds, scattered along valley escarpments and hillsides. Riparian Gallery Forest vegetation and wetland areas fringe both the Lunsemfwa and Mkushi Rivers, forming an extensive belt of evergreen vegetation. Grassland can also be found in the area. These occur in patches subdivided into treeless, mountainous and watershed grasslands (Edmonds, 1976) (3).

Miombo Woodland

The dominant Miombo Woodland covers the majority of central Zambia’s undulating terrain with the canopy layer at 15-20m in height (*Figure 4.13*). The sub-canopy layer comprises small trees or shrubs ranging between 3-12m in height, and the bottom canopy comprises a grassy layer, which in most years is subjected to fire (ILUA 2005-2008). The dominant species within the

---

Miombo woodland include *Brachystegia*, *Julbernardia* and *Isoberlinia* with co-dominants that include *Anisophyllea boehmii*, *Combretum collinum*, *Faurea intermedia*, *Parinari curatellifolia*, *Pericopsis angolensis*. *Pterocarpus angolensis*, and *Marquesia macroura*. (Fanshawe, 1971) (1).

**Figure 4.13** Miombo Woodland in the Proposed Project Area

Riparian Vegetation

The Riparian Gallery Forest is the second most common type of vegetation after the Miombo Woodland in the northern part of Central Zambia. It is a well developed and localized forest type generally found above seepage areas in gorges or fringing river banks. The vegetation is evergreen, semi-evergreen or sometimes deciduous depending on its proximity to water (Fanshawe, 1971) (2). Where rivers form shallow pools of slow moving water, Raphia palms can be found. The common canopy trees include *Adina microcephala*, *Bridelia micrantha*, *Craiba affinis*, *Faurea saligna*, *Parinari excelsa*, *Sysygium cordatum*, *S. guineense* and *S. owariense*. *Parinari excelsa* is usually the defining canopy tree attaining a height of between 18-22m on undisturbed sites. Small trees are normally abundant below the canopy layer, with climbers such as *Artabotrys monteiroae*, *Cassysba filiformis*, *Smilax kraussiana* and *Strychnos lucens* being frequent in undisturbed areas. On valley alluvial soils, Munga or Acacia woodland is common with the composition restricted to mainly Acacia species (Smith, 2003 (2); Van de Velde & De Waele, 1998 (3)). This vegetation can be

found dominating the peripheries of the Mkushi and Lunsemfwa Rivers and other perennial streams leading into the rivers.

**Figure 4.14  Riparian Vegetation in the Proposed Project area**

*Termitaria Woodland*

Within the Miombo Woodland, Termitaria Woodland can be found on low, mostly inactive termite mounds. Anthills can also be found on Dambo margins and on alluvial valley floors. Due to their higher fertility and organic matter levels, termite mounds tend to carry a distinctly different vegetation type compared to the surrounding woodland (Fanshawe, 1971). The common trees on termite mounds include *Combretum molle, Erythrina abyssinica, Euphorbia candelabrum*, and *Markhamia obtusifolia*. Shrubs include *Dichrostachys cinerea, Diospyros lycioides, Euclia schimperi, Securinega virosa* and *Oxytenanthera abyssinica*.

*Grassland Patches*

On the woodland floor, and sometimes in open areas within the woodland, various grasses can be found (*Figure 4.15*). These grasslands (and the area they inhabit) are largely defined by frequency of fire, drainage, canopy cover and soil type. Grasslands vary in terms of the species makeup and can be classified as either being associated with woodlands, pan depressions, riverine habitat and floodplain habitat (Smith, 2003). Potential species common to the Project area include: *Echinochloa spp., Hyparrhenia spp., Loudetia spp., Phragmites spp., Typha spp.*, a variety of Sedge species, and *Vossia spp.* Depending on the ecosystem in which they are found, grasses are subjected to annual fire,
usually set by local people, in the dry season when conditions are dry and fire intensity is high (Chidumayo, 1997) (1).

**Figure 4.15** Grassland Patch within Miombo Woodland Situated in the Project area

---

Red Data List Plant Species Listed for Central Zambia

The following Southern African Red Data plant species can be found in the Central Province of Zambia (Golding, 2002, Edits) (2), and could potentially be found in the Project area (refer Table 4.6).

**Table 4.6** Red Data Plant Species Potentially Occurring in the Site

<table>
<thead>
<tr>
<th>Family</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euphorbiaceae</td>
<td><em>Euphorbia debilispina</em> L.C. Leach</td>
<td>Endemic</td>
</tr>
<tr>
<td></td>
<td><em>Jatropha seineri</em> Pax var. tomentella Radcl. Sm.</td>
<td>Endemic</td>
</tr>
<tr>
<td></td>
<td><em>Monadenium friesi</em> N.E.Br</td>
<td>Endemic &amp; Vulnerable</td>
</tr>
<tr>
<td></td>
<td><em>Phyllanthus zamibicus</em> Radcl. –sm</td>
<td>Locally rare</td>
</tr>
<tr>
<td>Fabaceae</td>
<td><em>Dalbergia melanoxylon</em> Gaill. &amp; Perr.</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td><em>Hypoxis iridifolia</em> Baker</td>
<td>Endemic</td>
</tr>
<tr>
<td></td>
<td><em>Hypoxis villosa</em> L.F</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Iridaceae</td>
<td><em>Gladiolus serenjensis</em> Goldblatt</td>
<td>Endemic &amp; Vulnerable</td>
</tr>
<tr>
<td>Orchidaceae</td>
<td><em>Disa roepercharoides</em> Kraenzl</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td><em>Habenaria humilior</em> Rchb.f</td>
<td>Locally rare</td>
</tr>
<tr>
<td>Meliaceae</td>
<td><em>Khaya anthotetica</em> (Welw.) C.DC.</td>
<td>Locally rare</td>
</tr>
<tr>
<td>Poaceae</td>
<td><em>Eragrostis fimbriata</em> Cope</td>
<td>Endemic</td>
</tr>
<tr>
<td>Rubiaceae</td>
<td><em>Hallea stipulosa</em> (D.C.) Leroy</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td><em>Rytignyria adenodonta</em> (K.Schum) Robyns Subsp</td>
<td>Vulnerable</td>
</tr>
</tbody>
</table>


Box 4.2  
**Summary of Biological Environmental Sensitivities that will Potentially Influence Project Design**

- There are no endangered fish species in the Mkushi and Lunsemfwa River; however, sport angling species such as tiger fish are vulnerable to over-exploitation.
- At present the aquatic community is characterised by species which have specific flow and habitat requirements, and is thus considered sensitive.
- There are no known red data listed amphibian species in the Project area. With respect to reptiles, the Angolan Rock Monitor may be vulnerable owing to its known status in other countries.
- With respect to mammals, the majority of larger mammal species have disappeared due mainly to poaching and habitat destruction. Of the mammals potentially remaining in the Project area, none are listed as critical or threatened.
- There are no threatened invertebrate species; however, invertebrates are sensitive to habitat modification.
- With respect to terrestrial flora, there are a number of endemic, locally rare and vulnerable terrestrial plant species that will need to be taken into consideration during project planning and design.
- Aquatic flora are present in the area, of concern for hydropower generation are the presence of aquatic weeds and blue-green algae (which may manifest itself in the planned impoundment).
- The vegetation on the plateau is fairly uniform Miombo Woodland, while the vegetation below the escarpment is more diverse.
- Soils in the area (particularly) on the escarpment are highly erodible.
- Access to the project area is currently fairly limited, however the project road infrastructure will greatly increase access into the area.

4.3  
**SOCIAL ECONOMIC ENVIRONMENT**  

4.3.1  
**Introduction and Geographic Context**

This baseline section provides a demographic, cultural and economic overview and also describes the physical infrastructure and services available at national, provincial and Project Area.

Zambia is a landlocked country in Southern Africa. It is bordered by the Democratic Republic of Congo (north), Tanzania (north-east), Mozambique, Zimbabwe, Botswana and Namibia (south) and Angola (west). The country is divided into nine Provinces, namely Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, North-Western, Southern and Western. The capital city is Lusaka which is located in Lusaka Province. The proposed Muchinga Hydropower Project is located in Central Province and is bordered by all the country’s Provinces. Central Province is divided into six Districts namely Chibombo, Kabwe, Kapiri-Mposhi, Mkushi, Mumbwa and Serenje. The Provincial capital city is the town of Kabwe. The Project Area is situated within the Mkushi and Kapiri Mposhi Districts on the Lunsemfwa and Mkushi Rivers. It lies approximately 70km east of the Kabwe District, 35 km

(1) Dr. Mitulo Silengo - Socio-economic Specialist for the ESIA
downstream of the Mita Hills Dam, 10km downstream of Mulungushi Dam and 25km downstream of the existing Lunsemfwa Hydropower station. The Project sits within the three chiefdom areas of Kanyenshya, Mukonchi, and Chembe that preside over these areas under customary law.

Project Affected Area

As mentioned above, the Project is situated in three Chiefdoms Kenyanshya, Mukonchi and Chembe. The Project area is rural, with a very dispersed settlement pattern due to farming activities undertaken by all households in the area. The homesteads are located between three and five kilometres apart. The population reside in homesteads formed by extended family members and farm the land together or separately.

The zone of influence is an area likely to be disturbed by the Project activities during the pre-construction, construction and operation phases. The effects can be positive or negative, short or long term, direct / and in-direct. For the purpose of this Project the directly and indirectly affected area/ and people are defined below as related to the socioeconomic environment.

These will include areas immediately adjacent to the Project footprint (i.e. the inundation area, the dam wall, the new power station, the transmission line, the pipelines, canal/water ways, quarries/borrow pits) and access routes within which a zone of disturbance will be created through increased noise, traffic, human presence and social disruption. The river reach downstream of the dam wall and inundation area affected by altered flow releases (extending up to 60 km downstream) causing potential impacts on fishing and flood plain cropping, and which may affect communities residing downstream from the river.

The majority of the Project infrastructure lies within the Chief Kanyenshya and Chief Mukonchi chiefdoms and the closest downstream dwellers are found in the Chief Chembe chiefdom approximately 60 km down the Luano Valley. Chief Chembe’s villages are bordered by the Lunsemfwa River to the south-east. Table 4.7 provides a list of villages that are closest to the Project footprint as well as known villages downstream.

Table 4.7 Villages in close Proximity to the Project Footprint and Villages Located Downstream of the Project

<table>
<thead>
<tr>
<th>Chiefdom</th>
<th>Villages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenyanshye (tunnel, dam, new roads, quarries, and other)</td>
<td>Lutampo</td>
</tr>
<tr>
<td></td>
<td>Shipili</td>
</tr>
<tr>
<td></td>
<td>Kamukwamba</td>
</tr>
<tr>
<td></td>
<td>Saka</td>
</tr>
<tr>
<td></td>
<td>Chipempele</td>
</tr>
<tr>
<td>Mukonchi (Roads to site along D421)</td>
<td>Kalungeleka</td>
</tr>
<tr>
<td></td>
<td>Mulenge</td>
</tr>
<tr>
<td>Chembe and Mukonchi (escapment towards Mulungushi HPP)</td>
<td>Celemente</td>
</tr>
<tr>
<td></td>
<td>Sipaida</td>
</tr>
<tr>
<td></td>
<td>Chimika</td>
</tr>
</tbody>
</table>

Table 4.7 provides a list of villages that are closest to the Project footprint as well as known villages downstream.
<table>
<thead>
<tr>
<th>Chiefdom</th>
<th>Villages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chembe (Downstream incl. powerstation, worker’s village, transmission line and road)</td>
<td>Chembe Central</td>
</tr>
<tr>
<td></td>
<td>Chitambe</td>
</tr>
<tr>
<td></td>
<td>Chibukula</td>
</tr>
<tr>
<td></td>
<td>Chibulula</td>
</tr>
<tr>
<td></td>
<td>Mumbaka</td>
</tr>
<tr>
<td></td>
<td>Nkausu</td>
</tr>
<tr>
<td></td>
<td>Mubaka</td>
</tr>
<tr>
<td></td>
<td>Chafunga</td>
</tr>
<tr>
<td></td>
<td>Lungula</td>
</tr>
<tr>
<td></td>
<td>Kalimba</td>
</tr>
<tr>
<td></td>
<td>Supuni</td>
</tr>
<tr>
<td></td>
<td>Malungual</td>
</tr>
<tr>
<td></td>
<td>Mulus</td>
</tr>
<tr>
<td></td>
<td>Chisakulo</td>
</tr>
</tbody>
</table>

4.3.2 Land Tenure

The Zambian Lands Act No. 27 of 1995 classifies land into two types, namely state land and customary land. All state land is vested in the President and he holds the right to consent to a person, who wishes to sell, transfer or assign any land. The Commissioner of Lands administers state land for agricultural, commercial, industrial and residential purposes. Most of the land in Zambia (61 percent) is owned and managed by customary authorities. Of the total customary land, 63 percent (approximately 31 million hectares) is forestland, 24 percent is state owned, and approximately five percent of forestland is privately owned (1).

Customary land is administered by the Chiefs and the headmen acting with the consent of the communities. Customary land may, however, be expropriated by the State if it is required for public works and the affected community/household will be compensated by the State for the land lost. This is undertaken in line with the local customary law on land tenure and in consultation with the affected Chief and the local authority within the area.

One key aspect of customary tenure is that it allows free access to land for all members of a community. In customary areas in Zambia individual ownership, concurrent interests, and communal interests are recognised (2). Land can be acquired in the following ways: by land take of unoccupied land, as a gift, sale of (improvements on the) land; transfer of land in exchange for goods and transfer of land in exchange of services, inheritance and by marriage. A stranger to the area must obtain the Chief or headman’s permission to settle in the area before he can be assigned a piece of land. Similarly, a Chief can prohibit an individual from cultivating in a grazing area.

(1) ILUA, 2009
(2) Individual ownership means that the landholder or occupant has more rights and interests in the land than any other person. The individual owns the land for as long as he wishes. Concurrent interests occur where persons, other than the landholder, can go onto someone’s land and use it for their own purposes. Communal interests involve the use of certain tracts of land, which are not individually owned
The security of tenure provided under customary laws is almost equivalent to the security provided under freehold. Any individual who establishes residence in a village can acquire customary rights over the land, although nobody can lay a claim to land over which another individual has established rights. The rights are permanent unless they are extinguished by abandonment or death.

Land in the Project Area is an important asset and the backbone of the local economy. Land for agricultural purposes and housing is readily available for households. Permission to acquire land is obtained from the local Chief, through the headmen. Normally the land acquired stays within the family and may be passed on to adult dependants on the passing of the father of the household. Depending on the headman, a land seeker may be required to make a payment, this is for the headmen’s time and travel cost where applicable. A portion of the money paid to the headman is given to the Chief.

Each family unit (Project Affected households) owns between five and 50 ha of land. Of the total land owned by the household approximately 20 percent of the land is used for farming activities (crops and livestock grazing), five percent for household infrastructure, and 75 percent is woodlands.

### 4.3.3 Population Demographics

#### Population Size and Distribution

In 2010, Zambia had an estimated population of 13,046,508, with an annual average growth rate of 2.8 percent (see Figure 4.16). The population density in the country was estimated to be 17.3 persons per km². The country has a fairly young population with almost half the population (47 percent) below the age of 15 years (1).

![Projected Population Growth in Zambia](image)


(1) Zambian Household Population Census, 2010
The Provincial population was estimated at 1,267,803 in 2010, with an annual average growth rate of 2.3 percent. The population density was an estimated 13.4 persons/km². Amongst the Province’s districts, the Mkushi District had the highest population growth rate of four percent, followed by the Mumbwa District at 3 percent. During the same period, Chibombo District had the largest share of the Provincial population (23 percent), followed by Kapiri Mposhi District (19 percent). The Mkushi District had the least share of the Province’s population (12 percent), see Table 4.8 below.

<table>
<thead>
<tr>
<th>District</th>
<th>Total (No.) 2000</th>
<th>Ave Annual Population Growth Rate 2000-2010 (%)</th>
<th>Total (No.) 2010</th>
<th>Population Share of Province (%)</th>
<th>Population Density (/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chibombo</td>
<td>241,612</td>
<td>2.0</td>
<td>293,765</td>
<td>23.2</td>
<td>21.9</td>
</tr>
<tr>
<td>Kabwe</td>
<td>176,758</td>
<td>1.4</td>
<td>202,914</td>
<td>16.0</td>
<td>129.1</td>
</tr>
<tr>
<td>Kapiri-Mposhi</td>
<td>194,752</td>
<td>2.1</td>
<td>240,841</td>
<td>19.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Mkushi</td>
<td>107,438</td>
<td>3.5</td>
<td>151,803</td>
<td>12.0</td>
<td>8.6</td>
</tr>
<tr>
<td>Mumbwa</td>
<td>158,861</td>
<td>3/2</td>
<td>218,328</td>
<td>17.2</td>
<td>10.3</td>
</tr>
<tr>
<td>Serenje</td>
<td>132,836</td>
<td>1.9</td>
<td>160,152</td>
<td>12.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Central Province</td>
<td>1,012,257</td>
<td>2.3</td>
<td>1,267,803</td>
<td>100.0</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Source: CSO 2010 Census of Population and Housing Preliminary Report – 1

In the Project Area, the Mukonchi Chiefdom has a large population (82,939) compared to the Kanyenshya Chiefdom which has a population of 2,376 (including the population that Chief Mukonchi looks after) and Chembe Chiefdom with a population of 2,108. The large population in the Mukonchi Chiefdom may be attributed to the concentration of agricultural activities in the area. Table 4.9 below shows the population size, the number of households and number of people per household within the Chiefdoms.

<table>
<thead>
<tr>
<th>Chiefdom</th>
<th>Population Size</th>
<th>Number of Households</th>
<th>Average Persons/ Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kanyenshya</td>
<td>2,376</td>
<td>360</td>
<td>7</td>
</tr>
<tr>
<td>Chembe</td>
<td>2,108</td>
<td>360</td>
<td>6</td>
</tr>
<tr>
<td>Mukonchi</td>
<td>82,939</td>
<td>15,289</td>
<td>5</td>
</tr>
</tbody>
</table>

Ethnicity and Language

Zambia has seven broad ethnic groupings; namely Bemba, Tonga, North-Western, Barotse, Nyanja or Eastern, Mambwe and the Tumbuka (1). All the ethnic groups in Zambia belong to one of these broad groupings; there are 73 ethnic groups (often referred to as tribes) in total. The most dominant ethnic groups in the country are Bemba (18 percent), Tonga (13 percent), Chewa (seven percent), Lozi and Nsenga (each six percent, Tumbuka and Ngosi (each

(1) Zambian Population Census 2000
four percent), Lala, Kaonde and Lunda (North-Western) (each three percent) of the total population. These groups account for two-thirds of the national population (66 percent); the remaining third is formed by minor ethnic groups and foreign nationals.

In the Province, the most widely spoken languages are Bemba, Ila, Kaonde, Lala, Lenje, Nyanja, Sala, Swaka, and Chitonga.

The population in the project affected Districts comprise of Tonga as the dominant ethnic group. The Tongas migrated into the area over 30 years ago during the droughts in the Southern Province; they chose the area because of its agricultural potential and availability of land. The original inhabitants of the Districts are the Bemba, Lala, Ndebele, Shona and seZulus. The dominant language used in the Districts is Lala; followed by Swaka, Shona, Ndebele, Tonga and Bemba.

In the Project Area, the population is comprised of the mainly Swaka, Lala and Tonga (Kanyenshya and Mukonchi Chiefdoms) while in the Chembe Chiefdom the population is comprised of Swaka and Lala. The main languages spoken amongst the population in the Project Area are Chiluano (which is a mixture of Lala, Swaka and Nyanja), Bemba, Chitonga, Swaka and Lala.

Religion

The majority of the Zambian population are Christians. The main denominations include the Catholic Church, Seventh Day Adventist, Pentecostal Assemblies of God, United Church of Zambia and the Jehovah’s Witnesses. There are also other independent evangelical denominations. In the Central Province, Christianity is dominant, followed by Hinduism and Islam. Christianity in the Project Area is the most widely practiced religion along with traditional beliefs (ancestral spirits). The main denominations found are Roman Catholics, Pentecostals and followers of the United Church of Zambia.

4.3.4 Economy and Livelihoods

In 2010, the Zambian economy was dominated by three sectors: retail and commercial services, followed by industry (including mining) and agriculture, as shown in Figure 4.17.
Mining is an important subsector within the industrial sector and accounted for 9.1 percent of GDP between 2006 and 2009 and further accounted for 8.5 percent of the country’s formal employment (1). During 2012, the mining sector’s contribution to foreign exchange earnings amounted to 80 percent (which was driven mainly by copper mining) (2).

The Zambian Government has recognised that there is a lack of diversity in its economy and has outlined targets in the Zambian Vision 2030 to create more diverse opportunities. The plan involves continued development of the existing strong sectors, such as industry and tourism. In addition, emphasis is placed on modernising the agricultural sector, improving efficiency and productivity of the services sector and growing the mining sector (3).

Agriculture remains a key livelihood activity, particularly in rural areas, where over 80 percent of the population depends on agriculture-related activities for their livelihood (4). The government acknowledges the challenges facing the agricultural sector which include:

- Low capacity utilisation with farming activities being undertaken mainly for subsistence purposes and minimal export value;
- Agricultural activities have high production costs further impounded by limited access to long-term financing and/ credit services; and
- The sector suffers from a shortage of skills, particularly for veterinary and extension services.

As part of addressing the above challenges and growing this sector the government is planning to improve resource allocation and investments in agriculture infrastructure as well as crop diversification;

---

(1) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011
(2) African Economic Outlook- Zambia, 2012
(3) Zambia Vision 2030
The economy in the **Central Province** is dominated by both subsistence and commercial agriculture (1), which contributes an estimated 70 percent of the Provincial economy. Other economic sectors that form part of the provincial economy include fisheries, tourism, forestry, mining, civil service, and trade and industry (2). In the 1990s, the mining and industrial sectors formed an important part of the provincial economy; however, with the privatisation of the Zambian Consolidated Copper Mines (ZCCM), Zambia Railways and Kabwe Industrial factories, these sectors have declined (3).

Livelihoods in the Project Area are mainly dependent on small-scale commercial and subsistence agricultural activities. Even in households where the head of household is permanently employed in the public or private sector, intensive farming is still undertaken by the women, children and extended family. The main cash crops planted are maize and cotton; these are sold to the Food Reserve Agency (FRA) and Donavant, respectively. Secondary cash crops are soya beans, groundnuts and sunflower. Subsistence food crops comprise of maize, sorghum, soya beans, groundnuts, millet and cotton).

*Figure 4.18* shows agricultural activities undertaken in the Project Area.

*(Figure 4.18) Agricultural Activities in the Project Area*

---

(1) The agricultural sector is also the largest employer in the Central Province, providing employment to approximately 80 percent of the population.

(2) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011

(3) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011
Livestock: goats and cattle

Vegetable Fields near streams/river during the dry season

Trading

There are two market centres in the area, one in Mukonchi Chiefdom (the Mukonchi Market Centre) another in Kenyanshya Chiefdom. The market mainly sells household goods such as candles, soap, sweets, batteries, pots, vegetables, clothes, amongst other goods. Most trading at the market is done in stalls on the sides of the main road; there are a limited number of shops. The traders at the market are mainly from the local area. Most of the goods sold at the market are purchased in Kabwe, while fruit and vegetables are grown by the traders. In the Chembe Chiefdom, there are no markets at all - only small stalls that sell a limited selection of household goods. All goods are purchased in Kabwe or Mkushi Town.

Small shops and stalls are found all across the Project Area (see Figure 4.19). Operators of these small shops purchase their goods in Kabwe, however, these shops close down when they run out of stock and re-open when they are re-stocked. Bars/ taverns are also found along the roads in the Project Area.
4.3.5 Employment and Unemployment

The total number of people employed as a percentage of the total labour force is estimated at 85 percent. Informal sector employment accounted for 60 percent of the labour force, while the formal sector accounts for only 26 percent. Approximately 14 percent of the population are unemployed. In the formal sector between 2005 and 2008, male employment accounted for 71 percent, compared to 29 percent for females (1).

The main employment sectors in the country are agriculture (85 percent), service (nine percent) and industry (six percent) (2). In the rural areas over 80 percent of the population are employed in the agricultural sector and the remaining 20 percent in service, industry and mining.

Although the Province is considered an urban Province, the agricultural sector serves as an important source of employment for 80 percent of the population. The civil service is also a major employer in the Province, particularly the ministries of defence, education, agriculture, health services and community development. This is followed by mining, manufacturing and industries as well as tourism. All these sectors are still in their infancy and offer very few employment opportunities.

(1) SNDP, 2010
Formal employment levels in all the Chiefdoms are very low and the majority of the population is dependent on agricultural activities and to a limited extent the power station. The dependency on agricultural employment means that there is seasonal unemployment in the Chiefdoms as well as low income levels. Government departments, Chimbolo Mine and LHPC in Kenyanshya and Mukonchi Chiefdoms are the main providers of formal employment. In the Chembe Chiefdom, mining is the only source of formal employment. Typical government jobs offered across the Project Area include teaching, nursing, civic works and others, whereas non-civil service formal employment is provided by private companies and entrepreneurs such as traders.

Other people work within the informal sector, mainly trading at the local markets. The majority of the skills found in the villages are related to agricultural services.

4.3.6 Household Income and Expenditure

For the majority of the urban households in Zambia derive income from formal waged employment and informal trading. The informal sector accounts for the income of a large proportion of the urban population.

In the rural areas household cash income is derived from the sale of agricultural produce. Because of the seasonality of agricultural production cash income also fluctuates seasonally. This fluctuation accounts, to a large degree, for the inability of many households to meet the costs of essential non-food items, and for their poor access to essential services such as education and health. Income is primarily used to purchase food items. Other expenses include education, health care, energy, transport, housing and clothing.

The majority of the households in the Project Area are dependent on income generated from the sale of maize and cotton. These are mainly sold in the months of June and July. This means that the majority of the households live on irregular income. Households in the Chembe and Mukonchi Chiefdoms also earn an income from small scale fishing activities. However, households in Chembe suffer the disadvantage of being located far away from markets.

A significant portion of household income is spent on education, food items and occasionally clothing (usually second hand). None of the households have banking account.

4.3.7 Utilisation of Forest Resources

The use of forest resources is an important part of the economy in the rural parts of Zambia. They provide a supplementary income for a number of households especially in the Central, Copperbelt, and Northern Provinces. According to a study on the reliance of forest resources in Zambia, 35 percent of household income in some rural communities is derived from the collection and sale of forest resources. The main income generating resources are
firewood (charcoal) production or sale. This is followed by ants, caterpillars, wild honey and mushrooms.

Although about 66 percent of Zambia’s land area is under some form of forest cover, evidence of continuing deforestation is common. Such trends have compelled the government to institute measures to protect the forests by implementing a policy and legal framework for forest management. Thus, a new wildlife and forestry law was enacted the Forest Act of 1999, which conferred the responsibility of controlling and managing the forests and forest reserves on the Forest Department, under the Ministry of Tourism, Environment, and Natural Resources. The policies established under this law were intended to strengthen the management of natural resources and the environment. Although all these policies are in place, the over exploitation of forest products is still high, this is attributed to the lack of frequent monitoring by District officers due to lack of mobility. For example, in the Kapiri-Mposhi local forest the Chief approved the construction of a technical high school inside a forest reserve, the same chief had previously approved that a hospital to be built in the same forest reserve.

Non Timber Forest Products (NTFPs)

In the Project Area several NTFPs are collected by the population, these include tree bark, roots, thatch, tubers, leaves, fruits, flowers, seeds, resin, honey, mushrooms and medicinal roots and plants. The collection of non-timber forest products (NTFPs) in the area is mainly for household use and consumption. Men generally collect NTFPs with the exception of thatch and firewood which are collected by women. Thatch is used to construct temporary housing structures and to build small shops, roofing and it is also sold (see Figure 4.20). The edible forest products are mainly collected at the start of the rainy season, a time when most rural households are experiencing low food stocks. Where livestock is reared, grasslands are used for pasture including those along all river banks.
Wood:

Wood collected from the surrounding forest area serves many purposes in the household, namely:

- the main source of energy for cooking and heating;
- used to make charcoal, which is used by the household or sold to neighbours;
- used to make furniture (chairs, benches and tables);
- wood is used to build dugout canoes (Chembe Chiefdom); and
- used to build houses and storage structures, see Figure 4.21.

Deforestation is evident across the Project Area, where huge tracks of woodlands are being cut down at an unsustainable rate.
Rivers and Streams:

The Project Area has several rivers and streams passing through it, these include the Lunsemfwa and Mkushi Rivers and the local streams are Chisalaya, Kalungaleka, Tandalwe, Mingomba, Luambulu and Chimbolo. The Lunsemfwa River is a very important natural resource for all households in the Project Area, but more so for the Chembe Chiefdom. Most of the stream banks are used to grow vegetables and in some cases maize. Vegetables are grown along the river/ stream banks throughout the year. The rivers and streams are used as the main sources of drinking water, as well as for bathing and clothes washing. In the Chembe Chiefdom, people cross the Lunsemfwa River in order to access the villages on the other side and Chongwe town (see Figure 4.26).
**Fishing:**

Villagers undertake small scale fishing in the Lunsenfwa River. Fishing nets and fish traps are used to catch fish. The majority of the fish catch is used for household consumption and a small amount sold to neighbours. Some of the fish species caught include *Pseudocrenilabrus philander*, *Tilapia rendalli*, *Tilapia sparmanii*, *Oreochromis machrochir* and *Serranochromis thumbergi*, tigerfish (*H. vittatus*), *Clarias ngamensis* or *Clarias gariepinus*, *Distichodus Schenga*, *Brycinus imberi* or *Brycinus lateralis*, *Brycinus imberi* or *Brycinus lateralis*, *Labeo congoro* and *Labeo altivelis*.

### 4.3.8 General Infrastructure and Services

This section provides information on public infrastructure and services at national and project area level.

**Power and Energy**

In Zambia, wood accounts for about 70 percent of the total national energy demand while electricity, petroleum and charcoal account for 14 percent, 12 percent and two percent respectively and other sources account for two percent. Hydroelectric plants represent 99 percent of electricity production in the country with the major sources being Kafue Gorge, Kariba North Bank and Victoria Falls power stations, which produce 900MW, 600MW and 108MW, respectively. The country’s hydropower resource potential stands at an estimated 6,000MW while the installed capacity is closer to 1,700MW.

The main consumers of electricity in the country are mining (68 percent), households (19 percent), government and services (seven percent), commerce and industry (four percent) and agriculture and forestry (two percent).

At provincial level only 12 percent of households have access to electricity. A significantly smaller portion of rural households have electricity (four percent) compared to urban households (48 percent) (1). Electricity is provided by Zambia Electricity Supply Corporation (ZESCO).

All three Chiefdoms have limited to no access to electricity. In the Kanyenshya and Chembe Chiefdoms electricity is only available in and around the LHPC, the Lunsemfwa Rural Health Centre, Mita Hills Dam and the Lunsemfwa Power Station Basic School. The majority of people are solely dependent on candles and battery powered lanterns. For lighting and for cooking purposes, households use firewood and charcoal. A few households in Mukonchi Chiefdom use solar energy as a source of power.

---

(1) Sixth National Development Plan, 2011 - 2015
Education System

All primary education in Zambia is free. The Zambian education system is a dual schooling system, which consists of basic and high school. Basic education consists of nine years of schooling while high school consists of six and half years of schooling. The net school enrolment of children in the country was 80 percent in 1990, it has subsequently increased by 22 percent, especially at basic school level (1). This can be attributed to government building more schools in the country as well as the re-entry policy (which allows pregnant pupils (over 15 years of age) to return to school (2)). Adult illiteracy is also continuing to decline in the country, with the results showing 79 percent adult illiteracy in 1990, and 70 percent illiteracy in 2004. The national drop-out rate is 17 percent.

The majority of the schools in the Province are state funded, and there are some private schools run by faith-based organisations, private institutions and individuals. The quality of government run schools is dependent on their location (rural or urban school). The majority of the urban schools tend to be relatively well resourced with equipment, materials and teachers. Rural schools are generally under resourced and are largely community schools (run by voluntary and untrained teachers) and receive minimal support from the state. Figure 4.22 shows some of the schools in the Project Area.

Figure 4.22 Schools Closest to the Project Area

Lunsemfwa Basic School
Chembe Basic School
Chombolo Community School
Mukonchi High School

(2) UNDP, 2011
Health Care System

Health care services in Zambia are comprised of a three-tier structure, which includes Rural/Urban Health Centres, District Hospitals, and General Hospitals. The Rural/Urban Health Centres provide preventive and curative health services at village and township levels, while District hospitals cater to the medical needs of the District population. General Hospitals are referral hospitals, treating only the severe cases that cannot be treated elsewhere. In Central Province there are five District hospitals, one for each District Council (Chibombo, Kapiri Mposhi, Mkushi, Mumbwa, and Serenje). All referral cases within the Province are referred to the Kabwe General Hospital (approximately 70km from the Project).

Malaria remains a leading cause of mortality and morbidity especially amongst pregnant women and children below the age of five years. Tuberculosis (TB) is also highly prevalent, especially amongst those living with HIV/AIDS. According to the Zambian National Aids Council, the adult (1) HIV prevalence rate has declined from 23 percent in 1991 to 14 percent in 2007; this was attributed to the increased public awareness of HIV. According to the Council 283,863 HIV/AIDS patients were receiving ART by 2008.

Figure 4.23 below shows the health care facilities in the Project Area.

Figure 4.23 Health Centres Closest to the Project Area

(1) Adults refers to people aged between 15 and 59 years.
Road Infrastructure and Transport

The major urban centres in Zambia are connected by road and railway transport. The main trunk roads include the Great North Road, which runs from Lusaka through the Central, Northern and Muchinga Provinces, up to the Tanzania border town of Tunduma. The Great East Road runs from Lusaka through the Eastern Province up to the Malawian border. Other trunk roads include the Lusaka-Livingstone road and Lusaka-Chirundu border post road. Road passenger transport is operated by private companies.

The province is connected to the rest of the country by the Great North Road which runs from Lusaka through Chibombo, Kabwe, Kapiri Mposhi, Mkushi, Serenje and onward to the Nakonde-Tunduma border. In general, the road infrastructure is poorly maintained and requires rehabilitation. This contributes to slow economic growth and slow socioeconomic development due to the lack of access to rural areas.

Railway infrastructure includes the Tanzania-Zambia Railways (TAZARA), which runs from Kapiri Mposhi and traverses through Mkushi and Serenje, terminating at the port city of Dar es Salaam in Tanzania. The national railways which are operated as a concession by Railway Systems of Zambia stretch from Livingstone in Southern Province through Lusaka to the Copperbelt town of Kitwe. Both the TAZARA and Railway Systems of Zambia operate freight and passenger transport.

There are no tarred roads in the Project Area. All roads to the Project site are narrow, gravel/sandy and in certain sections grassy and pass through several streams. They are full of potholes due to a lack of drainage system rendering them impassable during the rainy season (see Figure 4.24). The majority of the road sides are lined with cotton and maize fields as well as trees and grass. A river pontoon is found on the upper Lunsemfwa River enabling river crossing.
There are no public transportation services in the area. People use ox drawn carts to transport goods and produce as well as the sick to the nearby clinics (see Figure 4.25 below). The majority of the population walk to their destinations from ten to 147km. Those travelling to Kabwe walk to the current power station to get lifts. The trucks travelling to Kabwe leave the power station at eight in the evening and arrive in Kabwe at midnight. The people sleep on the side of the road until the shops open and the trucks leave Kabwe at four in the afternoon, reaching the station at seven in the evening.
In the Chembe Chiefdom the villagers also use small home-made boats to cross the Lunsemfwa River, see Figure 4.26 below.

**Figure 4.26 River Crossing on Lunsemfwa River at Chembe Chiefdom**

Water Supply and Sanitation

In Zambia, more than one third of the population does not have access to potable water and more than half lack access to proper sanitation facilities. Water and sanitation facilities in basic schools are generally poor (25 percent). Not having access to clean and safe water leads to diseases such as diarrhoea and cholera, among others. In the urban centres water supply and sanitation
is reticulated, however, the infrastructure in many of the towns is old and outdated from pre-independence. This has led to the systems being overstretched and not fully able to meet the demands of population growth.

Households in the Project Area rely on nearby streams and rivers for water. These include the Chisalaya, Kalungaleka, Tandalwe, Mingomba, Luambulu, Lunsemfwa, and Chimbo. Many households that are located far away from the hand-pumps draw their water from the streams which run in the vicinity of the Project Area or from the shallow wells in the dambos \(^{(1)}\) or plains; see Figure 4.27.

**Figure 4.27 Sources of Water: Hand Pump and Shallow Well**

For sanitation purposes, the population uses pit latrines or the bush. The lack of sanitation facilities is further exaggerated by a lack of a piped water and sewage system in the area.

*Telecommunications*

The telecommunications infrastructure is fairly well developed and the national coverage is good. This includes land based telephones and cellular phone services provided by ZAMTEL, Airtel and MTN. In the rural areas cellular phone and domestic satellite communication systems are used to improve the connection of telephone services. Internet services are also widely available, with very small aperture terminal \(^{(2)}\) (VSAT) networks being managed by private service providers.

The state-owned Zambia National Broadcasting Corporation (ZNBC) operates as the principal public broadcaster. It operates two television and some radio stations. There are several private TV stations accessible in the country including Digital Satellite Television (DSTV). In Lusaka and the Copperbelt,

---

\(^{(1)}\) Dambo is a word used for a class of complex shallow wetlands in central, southern and eastern Africa (in Zambia and Zimbabwe). Dambos are generally found in higher rainfall flat plateau areas, and have river like branching.

\(^{(2)}\) Vsat is a two way satellite ground station which is commonly used to transmit narrowband data or broadband data or mobile maritime communications.
communities can also access international broadcasters such as the BBC World Service and RFI.

Similar to the national level, mobile phone services are provided by Airtel, MTN and Zamtel in the Project Area, with the exception of the Chembe Chiefdom where there is no cellular phone reception or landline phones. There is no access to the internet in most of the villages with the exception of the Mukonchi farming block. However, internet access may be available to people with web-enabled or smart phones.

4.4 CULTURAL AND HERITAGE

No specific cultural and heritage sites are known in the proposed inundation area (the proposed Mkushi Dam). Cultural and Heritage sites are, however known to occur in the Project Area (1). These include the following sites:

- Lunsemfwa Bell Point (or Lunsemfwa Wonder Gorge);
- Lunsemfwa River A;
- Lunsemfwa River B; and
- Mkushi Girls Camp.

The Lunsemfwa Wonder Gorge (Figure 4.28) is the only known national monument recorded in the Project Area and lies at the confluence of Lunsemfwa and Mkushi Rivers (Figure 4.29 and Figure 4.30). It was declared a national monument due to its geomorphological features.

Figure 4.28 Wonder Gorge

(1) National Heritage Conservation Commission Heritage Profile for East Central Region 2008
The Lunsemfwa River A is a Late Stone Age site and has no coordinates. The Lunsemfwa River B site is a Late/Later Iron Age site, its location is shown in Figure 4.30 (1).

The Mkushi Girls Camp is a historical site whose significance is premised on its association with the liberation struggle for Zimbabwe. In the late 1970s, the camp was used by female liberation non-combatant freedom fighters. The camp was ambushed by Rhodesian Forces and many of the camps occupants were killed and the equipment destroyed (2). The site is located east of the present Lunsemfwa Hydro Power station, and this stage, its exact coordinates is not known.

Figure 4.29 Location of the Archaeological Site in Relation to Wonder Gorge

(1) NHCC East Central Region Heritage Profile 2008
(2) Report on Zimbabwe Liberation War Sites in Zambia, 2000
Box 4.3  Summary of Social Environmental Sensitivities that will Potentially Influence Project Design

- The Project area falls within the Mkushi District, within the Central Province. The District Administration for the Mkushi District is located in the town of Mkushi.
- In rural Zambia, leadership is vested in traditional chiefs. Chiefdoms applicable to the Project Area include Chief Chembe, Chief Chikupili and Chief Kanyenshya
- At a District level, the local economy is largely dependent on subsistence crop and livestock production.
- Population within the Project area is relatively sparse. Within Chief Kanyensha’s chiefdom there are 360 households, each with an average of seven person per household (i.e. approx. 2,520 persons).
- Education and health services within the Project area are not well developed. Only one school and health clinic are present in the Project area. These services are basic.
- The health and education status of the Project area is likely to mirror that for Zambia as a whole; a low life expectancy (47.3 years), the prevalence of malaria, tuberculosis and HIV/AIDS as the leading causes of morbidity, low education levels (25% of the population with a lower primary education; only 2% of the population with a higher education).
- Infrastructure in the form of roads, access to electricity, treated water and public transport is limited in the Project area.
- Cultural and heritage sites are known to occur in the Project area. None are known for the inundation area. The Lunsemfwa Wonder Gorge is a National Monument.
5 INSTITUTIONAL FRAMEWORK AND REVIEW OF LEGAL AND OTHER STANDARDS APPLICABLE TO THE PROJECT

5.1 INTRODUCTION

This chapter sets out the relevant legal and policy standards applicable to this Project. Specifically, this chapter summarises the following:

- The relevant institutional framework in Zambia involved in the regulation of this Project;
- Relevant Zambian environmental and social laws and Regulations that are applicable to the Project;
- International treaties, conventions and protocols relevant to the Project and to which Zambia is a signatory;
- Environmental and social guidelines and standards developed by international organisations such as the International Finance Corporation (IFC) and the World Bank to which the Project will need to comply; and
- Other international guidelines and standards directly applicable to dam-building and hydropower projects, which are considered international best practice.

5.2 INSTITUTIONAL FRAMEWORK

5.2.1 Ministry of Tourism, Environment and Natural Resources

The Ministry of Tourism, Environment and Natural Resources (MTENR) is responsible for providing guidance on tourism, environment and natural resources issues in Zambia. MTENR’s main focus is to ensure the provision of an appropriate legislative and policy framework that guides the management and development of these three sectors. The following statutory bodies fall under this Ministry:

- Zambia Environmental Management Agency (ZEMA);
- Zambia Wildlife Authority (ZAWA);
- National Heritage Conservation Commission (NHCC);
- National Museum Board (NMB);
- Zambia Tourism Board (ZTB); and
- Tourism Training Institute Trust (TTIT).

The function of each of these statutory bodies is discussed below, where relevant to this Project.
The Zambia Environmental Management Agency

The Zambia Environmental Management Agency (ZEMA), previously known the Environmental Council of Zambia (ECZ) (1) is the umbrella environmental institution in Zambia and the main lead agency on matters pertaining to environmental impact assessments (EIA). It is empowered by the Environmental Management Act (No. 12 of 2011) (EMA) to identify projects, plans and policies for which an EIA is necessary.

The general functions of the ZEMA are to ensure the sustainable management of natural resources, the protection of the environment, and the control of pollution, as provided under Article 9(1) of the EMA. However, more specifically, the ZEMA serves inter alia to:

- Co-ordinate the implementation of activities of all government ministries, appropriate authorities and conservancy authorities in matters relating to the environment;
- Develop standards and guidelines relating to the protection of air, water, land and other natural resources;
- Provide for environmental monitoring and auditing as well as establishing and managing of the environmental fund;
- Develop and enforce measures aimed at preventing and controlling pollution;
- Advise the government on the formulation of policies on all aspects of the environment and make recommendations for the sustainable management of the environment;
- Advise on all matters relating to environmental conservation, protection and pollution control, including necessary policies, research investigations and training;
- Initiate, conduct and promote research, surveys, studies, training and investigations in environmental management;
- Identify projects, plans and policies that need environmental impact assessments;
- Monitor trends of natural resources, their use and impact on the environment and make necessary recommendations to the appropriate authority;
- Undertake general education programmes for the purpose of creating public awareness on the environment;
- Provide for public consultation in environmental decision – making and access to environmental information;

(1) The Environmental Council of Zambia (ECZ) was a statutory body created under an Act of Parliament, the Environmental Protection and Pollution Control Act (EPPCA) of 1990, Cap 204 of the Laws of Zambia. The EPPCA has since been repealed and replaced by the Environmental Management Act (No. 12 of 2011) (EMA). Under the EMA, the ECZ has been renamed as the Zambian Environmental Management Agency (ZEMA).
• Request information on proposed projects and advise stakeholders on projects, programmes, plans and policies for which environmental assessment is necessary; and
• Facilitate the implementation of international environmental agreements and conventions to which Zambia is a party.

The services provided by the ZEMA specifically in relation to EIA studies include:

• Assisting the developer to determine the scope of EIA studies;
• Reviewing project briefs, terms of reference, and environmental impact statements (EIS) and decision-making;
• Disclosure of the EIS to the public through the media;
• Holding public hearing meetings to discuss the EIS with stakeholders;
• Conducting verification surveys of the affected environment;
• Monitoring the project once implemented;
• Conducting compliance audits of the project between 12 and 36 months after implementation; and
• General administration of all the Regulations under the EMA.

The ZEMA has a number of units which control various aspects of environmental pollution planning and environmental management. These have been organised under two departments:

• The Pollution Control Inspectorate, which is responsible for all pollution and regulation issues pertaining to waste, emissions and toxic substances. This inspectorate also has a dedicated unit responsible for EIAs.
• The Planning and Information Management Department, which comprises units in charge of planning, monitoring, education, communication, information, documentation and data management.

The proposed Muchinga HPP will be required to submit an EIA to the ZEMA and will require approval from the ZEMA to undertake the proposed Project.

The Zambia Wildlife Authority

The Zambia Wildlife Authority (ZAWA) is a corporate body established by the Zambia Wildlife Act of 1998.

The primary objectives of ZAWA are:

• to improve the quality of life amongst communities in wildlife estates and maintenance of sustainable biodiversity in national parks and game management areas;
• to reverse the decline in wildlife resources;
• to improve wildlife resource management to a level which will secure a sustainable flow of benefits from such wildlife resources; and
• To considerably improve the wildlife resource base investment in co-operation with the private sector and local communities.

The National Heritage Conservation Commission

The National Heritage Conservation Commission (NHCC), formally known as the Commission for the Preservation of Natural and Historical Monuments and relics (National Monuments Commission), is the national institution mandated to manage and conserve Zambia’s cultural and natural heritage resources, including significant:

• historic/architectural/buildings;
• historic sites;
• anthropological sites;
• archaeological sites;
• geomorphological sites;
• geophysical sites;
• paleontological site; and
• ecological and other sites.

The National Museum Board

The National Museums Board of Zambia (NMB) is a corporate body which has the principal role of preserving the nation’s history and movable heritage. The Board is mandated to collect, document, present to the public and to preserve for posterity Zambia’s movable heritage.

5.2.2 Ministry of Energy and Water Development

The Ministry of Energy and Water Development (MEWD) is responsible for the management of energy and water resources in Zambia. The Ministry comprises two Departments, namely; the Department of Energy and the Department of Water Affairs (DWA).

The functions of the Department of Energy are:

• to develop, articulate and implement a Policy on Energy;
• to formulate programmes for the development of the Energy sector;
• to ensure that there are efficient and reliable supplies of energy for socio-economic development;
• to integrate the Energy sector into Zambia’s national and regional development strategies; and
• To regulate the Energy sector through appropriate legislation including the development of new laws and bye-laws.
The functions of the DWA include the following:

- To oversee and control activities of water resource development and management in order to prevent the indiscriminate tapping of water resources;
- the provision of sufficient and reliable data on water resources availability and demand in the country, to allow for effective planning;
- utilisation and management of water resources; and
- The development and management of water conservation.

The DWA is comprised of a Groundwater Resources Section, a Surface Water Resources Section and a Water Resources Management Section.

In addition to these two departments, the MEWD supervises the following statutory/parastatal bodies:

- The Energy Regulation Board (ERB);
- The Zambia Electricity Supply Corporation (ZESCO);
- The Water Development Board; and
- The Office for Promoting Private Power Investment (OPPPI).

*The Energy Regulation Board*

The Energy Regulation Board (ERB) has the mandate of regulating the energy sector in line with the provisions of the Energy Regulation Act of 2003. The ERB has the responsibility of ensuring that power generating utilities earn a reasonable rate of return on their investments that is necessary to provide a quality service at affordable prices to the consumer.

In order to carry out this role, the ERB, among other functions, ensures that all energy utilities in the sector are licensed, monitors levels and structures of competition, and investigates and remedies consumer complaints.

The unit price of that electricity generated by the Muchinga Power Project and sold to the national grid will be regulated by the ERB.

*Zambia Electricity Supply Corporation Limited*

Zambia Electricity Supply Corporation Limited (ZESCO) is a parastatal, with the main function of producing power in Zambia. ZESCO produces approximately 80% of the electricity consumed in the country and has historically been the main player in the generation, transmission and distribution of electricity in Zambia. In addition, ZESCO represents Zambia in the Southern African Power Pool. Due to the ever increasing demand for electricity both in Zambia and in the region, ZESCO is currently being forced to source more electricity from independent power producers (IPPs).
The Water Development Board

The increase in the population, the demand for water for power generation, direct consumption and other uses of water has increased in Zambia. As such, the Water Development Board was developed in response to these often conflicting demands for water. The Water Development Board is essentially an executive wing of government that provides necessary information for the control of abstractions of water resources from water bodies in Zambia. Any person who wishes to store or divert water from public streams and waterways for primary, secondary, or tertiary use must obtain permission from the Water Board.

Office for Promoting Private Power Investment

The Office for Promoting Private Power Investment (OPPPI) is responsible for promoting private sector investment in the power generation industry. Its function is to provide an independent assessment of projects and to interface with government authorities and the project developer in terms of ensuring government support to projects.

Through project development, OPPI assists the project developer to address any issues that the project encounters, as such the Muchinga HPP, as an IPP will need to engage with the OPPPI through all phases of project development.

5.2.3 Other Line Ministries

Environmental and social issues cut across a wide variety of sectors and there are a number of government institutions and agencies which are involved in environmental and social management. Some of the ministries, sectoral agencies and authorities that may also need to be consulted as part of the Muchinga HPP include:

- Ministry of Fisheries and Livestock;
- Ministry of Agriculture;
- Ministry of Mines and Minerals Development;
- Ministry of Health;
- Ministry of Lands;
- Ministry of Education; and
- Ministry of Local Government and Housing.
5.3 ZAMBIAN ENVIRONMENTAL AND SOCIAL LAWS AND REGULATIONS

5.3.1 Environmental Legislation

The Environmental Management Act

The Environmental Management Act (EMA) (Act 12 of 2011) is the principle law on integrated environmental management in Zambia. The EMA was enacted in April 2011 to repeal and replace the Environmental Protection and Pollution Control Act (EPCCA) (CAP 204) and its Amendments.

The EMA is divided into twelve parts under the following headings:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Preliminary</td>
</tr>
<tr>
<td>II</td>
<td>The Zambia Environmental Management Agency</td>
</tr>
<tr>
<td>III</td>
<td>Integrated Environmental Management</td>
</tr>
<tr>
<td>IV</td>
<td>Environmental Protection and Pollution Control</td>
</tr>
<tr>
<td>IV</td>
<td>Division 1 - Pollution Control</td>
</tr>
<tr>
<td>IV</td>
<td>Division 2 - Water</td>
</tr>
<tr>
<td>IV</td>
<td>Division 3 - Air</td>
</tr>
<tr>
<td>IV</td>
<td>Division 4 - Waste Management</td>
</tr>
<tr>
<td>IV</td>
<td>Division 5 - Pesticides and Toxic Substances</td>
</tr>
<tr>
<td>IV</td>
<td>Division 6 - Noise</td>
</tr>
<tr>
<td>IV</td>
<td>Division 7 - Ionising Radiation</td>
</tr>
<tr>
<td>IV</td>
<td>Division 8 - Natural Resources Management</td>
</tr>
<tr>
<td>V</td>
<td>International Matters</td>
</tr>
<tr>
<td>VI</td>
<td>Environmental Information</td>
</tr>
<tr>
<td>VII</td>
<td>Public Participation</td>
</tr>
<tr>
<td>VIII</td>
<td>The Environmental Fund</td>
</tr>
<tr>
<td>IX</td>
<td>Enforcement Provisions</td>
</tr>
<tr>
<td>X</td>
<td>Reviews and Appeals</td>
</tr>
<tr>
<td>XI</td>
<td>Environmental Offences</td>
</tr>
<tr>
<td>XII</td>
<td>General Provisions</td>
</tr>
</tbody>
</table>

The Environmental Impact Assessment (EIA) Regulations, which provides the framework for conducting and reviewing environmental impact assessments for any project, fall under the EPCCA (Statutory Instruments No. 28 of 1997). The Regulations enacted under the EPCCA are still in force until the Minister enacts new Regulations under the EMA (Act, No 12 of 2011).

The EIA process to be undertaken for this Project is shown in Figure 5.1 below.
Other Relevant Environmental Legislation in Zambia

Environmental issues cut across a wide variety of sectors, as such there are numerous pieces of legislation in Zambia which have a bearing on the environment and should be considered in EIA decision-making.

Table 5.1 presents a summary of the most relevant national legislation that may be applicable to the Project.
<table>
<thead>
<tr>
<th>Issue/Component</th>
<th>Applicable Legislative Instrument</th>
<th>Description of Legislative Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Resources and Heritage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Resources</td>
<td>• Water Resources Management Act, No 21 of 2011</td>
<td>Provides for the management of water resources within Zambia.</td>
</tr>
<tr>
<td></td>
<td>• National Water Policy, 1994</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water Pollution Control (Effluent and Waste Water) Regulations, 1993</td>
<td>Provides for licensing of liquid waste discharge to the environment and also provides for statutory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>discharge limits for respective parameters.</td>
</tr>
<tr>
<td></td>
<td>• Water Supply and Sanitation Act, No 28 of 1997</td>
<td>Provides for the supply of clean water and adequate sanitary conditions.</td>
</tr>
<tr>
<td>Wildlife and Natural Resources</td>
<td>• Zambia Wildlife Act, No. 12 of 1998</td>
<td>Provides for the establishment, control and management of National Parks; conservation and protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of wildlife and objects of interest in National Parks; the establishment of Game Management Areas;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the licensing of hunting; control of possession of trophies and control of bush fires.</td>
</tr>
<tr>
<td></td>
<td>• Forests Act, Cap 199</td>
<td>Provides for the establishment and management of National and Local forests, Conservation and protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of forests and trees, and licensing and sale of forest products.</td>
</tr>
<tr>
<td>Waste Management</td>
<td>• The Waste Management Regulations (SI 71 of 1993)</td>
<td>Provides for licensing of solid non-hazardous waste transportation and operating/owning of a non-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hazardous waste disposal site.</td>
</tr>
<tr>
<td>Fisheries and Wetlands</td>
<td>• Fisheries Act, No 22 of 2011</td>
<td>Provides for the protection and sustainable utilization of fish in natural water bodies and control of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fish farming.</td>
</tr>
<tr>
<td></td>
<td>• National Policy on Wetlands Conservation, September 2001</td>
<td>Provides for the protection of wetlands.</td>
</tr>
<tr>
<td>Noise &amp; Vibration</td>
<td>• Part IV of EMA,No.12 of 2011</td>
<td>Provides for noise emission standards to be established and requires permits to exceed said emissions.</td>
</tr>
<tr>
<td></td>
<td>• Explosives Act (No 10 of 1974) Regulations are in draft stage.</td>
<td>Provides for the handling, storage and general management of explosives used for blasting in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mining and construction industry.</td>
</tr>
<tr>
<td>Air</td>
<td>• Air Pollution Control (Licensing and Emission Standards) Regulations, 1996, made in terms of</td>
<td>Provides for licensing of gaseous waste emission to the environment and also provides for statutory</td>
</tr>
<tr>
<td></td>
<td>Part IV of EMA, 2011</td>
<td>discharge limits for respective parameters.</td>
</tr>
<tr>
<td>Energy</td>
<td>• Energy Regulation Act, Cap 436, 1995</td>
<td>Provides for the control in the pricing of energy products in the country as well as the quality.</td>
</tr>
<tr>
<td></td>
<td>• The Petroleum Act, (No. 8 of 1995)</td>
<td>The areas of the Petroleum Act of relevance to this project are regulations for the conveyance and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>storage of petroleum, inflammable oil and liquids.</td>
</tr>
<tr>
<td></td>
<td>• The Electricity Act, 1995</td>
<td>Regulate the transmission, distribution and supply of electricity.</td>
</tr>
<tr>
<td>Socioeconomic, Archeology and Cultural Heritage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issue/Component</td>
<td>Applicable Legislative Instrument</td>
<td>Description of Legislative Instrument</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Health</td>
<td>• Public Health Act, No 22 of 1995</td>
<td>Provides for the prevention of diseases, drainage, latrine and disposal of sewerage and treatment systems.</td>
</tr>
<tr>
<td>Archaeological, Historical and Cultural</td>
<td>• National Heritage and Conservation Act, 1989</td>
<td>Provides for the conservation of ancient cultural and natural heritage, relics and other objects of aesthetic, historical, pre-historical, archeological or scientific interest.</td>
</tr>
<tr>
<td>Land use planning issues</td>
<td>• Town and Country Planning Act, Cap 283, 1962, as amended.</td>
<td>Provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land.</td>
</tr>
<tr>
<td></td>
<td>• Lands Conversion of Titles Act</td>
<td>Provides for alienation, transfer, disposition and charge of land.</td>
</tr>
<tr>
<td></td>
<td>• Lands and Deeds Registry Act, Cap 174</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lands Act, Cap 173, 1995</td>
<td>The Act guarantees peoples’ right to land while enhancing development. The Act recognises the holding of land under customary tenure and the Chief’s role has been legally recognised, such that land cannot be converted or alienated without approval of the chief.</td>
</tr>
<tr>
<td></td>
<td>• Land Acquisition Act No. 2 of 1970</td>
<td>The Act sets out regulations for compulsory acquisition of land and property and compensation for such acquisition.</td>
</tr>
<tr>
<td></td>
<td>• The Local Government Act, No 13 of 2010</td>
<td>Provides for the establishment of Councils or Districts, the functions of local authorities and the local government system. Some of these functions relate to pollution control and the protection of the environment in general.</td>
</tr>
<tr>
<td>Investments, Energy Regulation, and Development</td>
<td>Tourism</td>
<td>• Tourism and Hospitality Act, No 23 of 2007</td>
</tr>
<tr>
<td></td>
<td>Investment and Taxes</td>
<td>• Public – Private Partnership Act, No 14 of 2009</td>
</tr>
<tr>
<td></td>
<td>• Zambia Development Agency Act No 11 of 2006</td>
<td>An Act to foster economic growth and development by promoting trade and investment in Zambia through an efficient, effective and coordinated private sector led economic development Strategy.</td>
</tr>
<tr>
<td></td>
<td>• The Zambia Revenue Authority Act (No. 28 of 1993 and all amendments);</td>
<td>The Act provides for the taxation system in Zambia for various goods and services.</td>
</tr>
<tr>
<td></td>
<td>• Investment Act of 1998</td>
<td>Provides a legal framework for investment in Zambia. The Act relates to the environment by encouraging investment that is not detrimental to the environment.</td>
</tr>
<tr>
<td></td>
<td>• Standards Act, Cap 416</td>
<td>Provides for the adherence to prescribed standards in all works.</td>
</tr>
<tr>
<td></td>
<td>Employment and Compensation</td>
<td>• Citizens Economic Empowerment Act No 9 of 2006</td>
</tr>
<tr>
<td>Issue/Component</td>
<td>Applicable Legislative Instrument</td>
<td>Description of Legislative Instrument</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td></td>
<td>The Employment Act Cap 268</td>
<td>Provide for the employment of persons on contracts of service and for the form of and enforcement of contracts of service, appointment of officers of the Labour Department and for the conferring of powers on such officers and upon medical officers and protection of wages of employees as well as control of employment agencies.</td>
</tr>
<tr>
<td></td>
<td>Compensation Act (No 10 of 1999)</td>
<td>Provides for the establishment and administration of a Fund for the compensation of Workers disabled by accidents to, or diseases contracted by, such Workers in the course of their employment, and for the payment of compensation to dependants of Workers who die as a result of such accidents or diseases.</td>
</tr>
</tbody>
</table>

### Zambian Development Policies

The development policies for Zambia at a national level that are of applicability to this Project are briefly outlined below.

#### Zambia Vision 2030

Vision 2030 expresses Zambia’s aspirations in growing the economy, good governance and most importantly developing its people. One key basic principle of Vision 2030 is sustainable development. The vision sets key goals (which are relevant to the Project) that by the year 2030:

- Zambia’s rural and urban population has universal access to clean, reliable and affordable energy by the use of alternative, renewable energy sources such as hydropower. The goal is to reduce the heavy reliance on wood fuel, decrease the rate of deforestation and increase the probability for rehabilitation of forest reserves with an overall reduction in the “cost to the Zambian environment”.
- There is an upgrade of existing and construction of new infrastructure by developing and implementing private-public partnerships with both local and international industries. By achieving this goal, connectivity is increased and thus an increase in the GDP contribution.
- Zambia’s biodiversity is protected in numerous national parks and local forest reserves. By developing, rehabilitating and maintaining these tourist-related infrastructures, Zambia can protect its natural reserves in a sustainable manner that is mutually beneficial to the biodiversity as well as the Zambian economy through tourism.
- There is maintenance of a productive environment and well conserved natural resources to facilitate sustainable socio-economic development.
- There is effectively in the utilisation of fresh water resources for a variety of purposes whilst maintaining the quality of the source.
5.4.2 Sixth National Development Plan: 2011 – 2015

The Sixth National Development Plan (SNDP) aims to materialise the aspirations of the Vision 2030. The objectives of the SNDP are: (i) infrastructure development; (ii) economic growth and diversification; (iii) rural investment; and (iv) poverty reduction and the enhancement of human development.

The SNDP contains sector plans that aim to assist in achieving these objectives. The sector plans most relevant to the Project and their objectives are summarised below.

Energy Sector Plan

- To increase electricity generation capacity by at least 1,000MW and build appropriate transmission lines.
- To increase electrification levels in rural areas of Zambia to 15%, particularly in the Central Province.
- To expand the use of renewable and alternative energy in the country’s energy mix.
- To reduce greenhouse gas emissions from the energy sector and strengthen adaptation and resilience to climate change related stresses.

Water Sector Plan

- To achieve sustainable water resource development for social and economic development.
- To develop innovative approaches and appropriate technologies for the effective management of the nation’s water resources.

5.4.3 Central Province Regional Development Plan: 2011 - 2015

The Central Province Regional Development Plan (as set out within the SNDP) provides for a variety of sector specific strategies and programmes to be achieved in the SNDP period. The objectives of some of these strategies and programmes applicable to the Project include:

- Infrastructure development for the movement of goods and services.
- To increase electricity generation capacity and the construction of proper transmission lines.
- To provide water for productive use (water supply infrastructure eg dams, weirs, hydropower plant schemes).
- To promote sustainable use of natural resources such as water, wood for energy, marine resources etc.
- To promote environmentally friendly technologies for income generation and economic growth.
- To promote reforestation of depleted forests and to maintain the protected reserves.
- To provide rural electrification.
5.5 **INTERNATIONAL TREATIES, CONVENTIONS AND PROTOCOLS**

Zambia is a signatory to a number of international conventions and agreements relating to industry, environmental management and energy. In certain cases these have influenced policy, guidelines and regulations. These conventions must be complied with during the planning, construction and operations phases of the proposed development.

*Table 5.2* lists the relevant international conventions and protocols to which Zambia is signatory.

**Table 5.2**  
**Dates of Ratification of International Conventions**

<table>
<thead>
<tr>
<th>Date of Ratification</th>
<th>Name of Convention</th>
</tr>
</thead>
</table>
The Basel Convention governs the generation, collection, storage, transportation, pre-treatment, treatment, disposal, export, import and trans-boundary movement of hazardous waste. |
| 04/06/1984           | *The Convention Concerning the Protection of the World’s Cultural and Natural Heritage*  
The Convention provides for the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage which are of outstanding universal value from the point of view of history, art or science. |
| 28/05/1993           | *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)*  
CITES is an international agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten their survival. |
| -                    | *International Union for the Conservation of Nature and Natural Resources (IUCN)*  
Zambia recognises the statutes of the IUCN, an international organisation that encourages the preservation of wildlife, natural environments, and living resources and promotes research in the preservation of threatened species, ecology, sustainable development, and environmental law, education, and training. |
| 08/05/1993           | *United Nation Convention to Combat Desertification (UNCCD)*  
Zambia recognises the need to control any form of desertification that may arise as a result of anthropogenic activities. The statutes of the UNCCD, encourages the control of desertification as a result of man’s activities. |
| 19/09/1996           | *United Nations Framework Convention on Climate Change (UNFCCC)*  
UNFCCC is an international agreement for the control of climate change. |
| 07/07/2006           | *Convention Concerning the Protection of Workers against Occupational Hazards in Working Environments due to Air Pollution and Noise Vibrations*  
Zambia recognises the need to protect workers against hazards in working environments. |
| 19/08/1980           | *African Convention on the Conservation of Nature and Natural Resources*  
Zambia recognises the need to contribute to the conservation of nature and natural resources at a continent level. |
5.6 INTERNATIONAL GUIDELINES AND STANDARDS

International guidelines and standards of applicability to this Project, especially with regards International Finance Institutions (IFIs) include the following:

- World Bank Safeguard Policies;
- The IFC performance standards;
- World Commission on Dams (WCDs); and
- The International Hydropower Association (IHA) Sustainability Guidelines and Sustainability Assessment Protocols.

5.6.1 World Bank Group Operation Policies

The World Bank has ten environmental and social “Safeguard Policies” that are used to examine the potential environmental and social risks and benefits associated with World Bank lending operations. These safeguard policies include the following:

1. Environmental Assessment;
2. Natural Habitats;
3. Forestry;
4. Pest Management;
5. Cultural Property;
6. Indigenous Peoples;
7. Involuntary Resettlement;
8. Safety of Dams;
9. Projects in International Waters; and
10. Projects in Disputed Areas.

The policies of relevance to the proposed Muchinga HPP are summarised below:

Environmental Assessment

*Operational Procedure 4.01 Environmental Assessment (EA)* evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimising, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

Natural Habitats

*Operational Policy 4.04 Natural Habitats* promotes the conservation of natural habitats. The World Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats. The Bank encourages borrowers to incorporate into their development and environmental strategies analyses of any major natural habitat issues, including identification of important natural
habitat sites, the ecological functions they perform, the degree of threat to the sites, and priorities for conservation.

The Bank expects the borrower to take into account the views, roles, and rights of groups, including local non-governmental organizations and local communities, affected by any project involving natural habitats, and to involve such people in planning, designing, implementing, monitoring, and evaluating such projects. Involvement may include identifying appropriate conservation measures, managing protected areas and other natural habitats, and monitoring and evaluating specific projects.

Forestry

Operational Policy 4.36 – Forests, involves the management, conservation, and sustainable development of forest ecosystems and their associated resources to ensure lasting poverty reduction and sustainable development, whether located in countries with abundant forests or in those with depleted or naturally limited forest resources. The objective of this policy is to assist borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests. In accordance with operational procedure 4.01, Environmental Assessment, the environmental assessment (EA) must address the potential impact of the project on forests.

Cultural Property

Operational Policy 4.11 – Cultural Property addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community. Any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes are to take cognisance of this policy in the EA.

Involuntary Resettlement

The World Bank’s Operational Policy 4.12: Involuntary Resettlement is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimise and mitigate its adverse social and economic impacts.

It promotes participation of displaced people in resettlement planning and implementation, and its key economic objective is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement.
The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.

Safety of Dams

Operational Policy 4.37: Safety on Dams requires that experienced and competent professionals design and supervise construction, and that the borrower adopts and implements dam safety measures through the project cycle. The policy also applies to existing dams where they influence the performance of a project. In this case, a dam safety assessment should be carried out and necessary additional dam safety measures implemented.

Operational Policy 4.37 recommends, where appropriate, that Bank staff discuss with the borrowers any measures necessary to strengthen the institutional, legislative, and regulatory frameworks for dam safety programs in those countries.

5.6.2 The International Finance Corporation

Performance Standards

The International Finance Corporation (IFC), a division of the World Bank Group that lends to private investors, has recently released a Sustainability Policy and set of Performance Standards on Social and Environmental Sustainability (in force from July 2006) (see Box 5.1). These Standards replace the prior safeguard policies and are used to evaluate any project seeking funding through the IFC. The Equator Principles(1) which reflect the application by major international banking institutions of IFC-inspired environmental and social best practice guidelines in the financing of large projects have been revised to adhere to the new IFC Performance Standards. However, the Equator Principles Financial Institutions (EPFIs) do not use the IFC’s Sustainability or Disclosure Policy, as these were not adopted by the banks. The EPFIs have their own sustainability and disclosure policies, and take the same approach, eg the borrower’s/client’s project must comply with the Performance Standards and the applicable Environment Health and Safety (EHS) Guidelines.

---

(1) The Equator Principles are a financial industry benchmark for determining, assessing and managing social & environmental risk in project financing. As of 01/01/20011, they had been adopted by 70 major banking institutions. The Equator Principles reflect a common set of international, IFC-inspired best practices guidelines to manage social and environmental risks related to the financing of large projects.
Box 5.1  
**IFC Performance Standards**

- Performance Standard 1: Social and Environmental Assessment and Management System;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

The Performance Standards underscores the importance of managing environmental, social and health issues throughout the life of a project. They identify the need for an effective social and environmental management system that is dynamic and continuous, “involving communication between the client, its workers, and the local communities directly affected by the Project’. They require ‘thorough assessment of potential social and environmental impacts and risks from the early stages of project development and provides order and consistency for mitigating and managing these on an ongoing basis” .

The Performance Standards reinforce the importance of effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them.

Through the Performance Standards, the IFC requires clients to engage with affected communities through disclosure of information, consultation, and informed participation, in a manner commensurate with the risks to, and impacts on, the affected communities.

The IFC Performance Standards, and each of their objectives, are outlined in Table 5.3, below.

Table 5.3  
**International Finance Corporation (IFC) Performance Standards**

<table>
<thead>
<tr>
<th>Performance Standards</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| Social and Environmental Assessment and Management System Performance Standard 1 | • *Impact identification and assessment*. To identify and assess social and environmental impacts, both adverse and beneficial, in the project’s area of influence.  
• *Mitigation*. To avoid, or where avoidance is not possible, minimise, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment.  
• *Stakeholder engagement*. To ensure that affected communities are appropriately engaged on issues that could potentially affect them.  
• *Effective management*. To promote improved social and environment performance of |

(1) IFC, 2006.
<table>
<thead>
<tr>
<th>Performance Standards</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labour and Working Conditions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Performance Standard 2</strong></td>
<td>• To establish, maintain and improve the worker management relationship.</td>
</tr>
<tr>
<td></td>
<td>• To promote fair treatment, non-discrimination and equal opportunity of</td>
</tr>
<tr>
<td></td>
<td>workers, and compliance with national labor and employment laws.</td>
</tr>
<tr>
<td></td>
<td>• To protect the workforce by addressing child labour and forced labor.</td>
</tr>
<tr>
<td></td>
<td>• To promote safe and healthy working conditions, and to protect and promote</td>
</tr>
<tr>
<td></td>
<td>the health of workers.</td>
</tr>
<tr>
<td><strong>Pollution Prevention and Abatement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Performance Standard 3</strong></td>
<td>• To avoid or minimise adverse impacts on human health and the environment</td>
</tr>
<tr>
<td></td>
<td>by avoiding or minimizing pollution from project activities</td>
</tr>
<tr>
<td></td>
<td>• To promote the reduction of emissions that contribute to climate change</td>
</tr>
<tr>
<td><strong>Community Health, Safety and Security</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Performance Standard 4</strong></td>
<td>• To avoid or minimise risks to and impacts on the health and safety of</td>
</tr>
<tr>
<td></td>
<td>the local community during the project life cycle from both routine and</td>
</tr>
<tr>
<td></td>
<td>non-routine circumstances</td>
</tr>
<tr>
<td></td>
<td>• To ensure that the safeguarding of personnel and property is carried in</td>
</tr>
<tr>
<td></td>
<td>a legitimate manner that avoids or minimises risks to the community’s</td>
</tr>
<tr>
<td></td>
<td>safety and security</td>
</tr>
<tr>
<td><strong>Land Acquisition and Involuntary Resettlement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Performance Standard 5</strong></td>
<td>• To avoid or minimise adverse impacts on human health and the environment</td>
</tr>
<tr>
<td></td>
<td>by avoiding or minimising pollution from project activities</td>
</tr>
<tr>
<td></td>
<td>• To promote the reduction of emissions that contribute to climate change</td>
</tr>
<tr>
<td>**Biodiversity Conservation and Sustainable Natural Resource</td>
<td></td>
</tr>
<tr>
<td>Management**</td>
<td>• To protect and conserve biodiversity</td>
</tr>
<tr>
<td><strong>Performance Standard 6</strong></td>
<td>• To promote the sustainable management and use of natural resources</td>
</tr>
<tr>
<td></td>
<td>through the adoption of practices that integrate conservation needs and</td>
</tr>
<tr>
<td></td>
<td>development priorities</td>
</tr>
<tr>
<td><strong>Indigenous Peoples</strong></td>
<td>• To ensure that the development process fosters full respect for the</td>
</tr>
<tr>
<td><strong>Performance Standard 7</strong></td>
<td>dignity, human rights, aspirations, cultures and natural resource-based</td>
</tr>
<tr>
<td></td>
<td>livelihoods of Indigenous Peoples</td>
</tr>
<tr>
<td></td>
<td>• To avoid adverse impacts of projects on communities of Indigenous</td>
</tr>
<tr>
<td></td>
<td>Peoples, or when avoidance is not feasible, to minimise, mitigate, or</td>
</tr>
<tr>
<td></td>
<td>compensate for such impacts, and to provide opportunities for</td>
</tr>
<tr>
<td>Performance Standards</td>
<td>Objectives</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>development benefits, in a culturally appropriate manner</td>
</tr>
<tr>
<td></td>
<td>• To establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project</td>
</tr>
<tr>
<td></td>
<td>• To foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples</td>
</tr>
<tr>
<td></td>
<td>• To respect and preserve the culture, knowledge and practices of Indigenous Peoples</td>
</tr>
<tr>
<td>Cultural Heritage</td>
<td>to promote equitable sharing of benefits from the use of cultural heritage in business activities</td>
</tr>
<tr>
<td>Performance Standard 8 recognises the importance of cultural heritage for current and future generations</td>
<td>to protect cultural heritage from the adverse impacts of project activities and support its preservation</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.6.3 *IFC Environmental, Health and Safety (EHS) Guidelines*

The EHS Guidelines are technical reference documents that address IFC’s expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to Performance Standard 3: Pollution Prevention & Abatement, as well as certain aspects of occupational and community health and safety.

When host country (Zambia) regulations differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

There are no industry specific guidelines for Hydropower Projects, although guidelines do exist for electrical power transmission and generation.

General EHS Guidelines also exist which contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors are listed in *Box 5.2.*
Box 5.2  IFC General EHS Guidelines

<table>
<thead>
<tr>
<th>General EHS Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Environmental</td>
</tr>
<tr>
<td>1.1 Air Emissions and Ambient Air Quality</td>
</tr>
<tr>
<td>1.2 Energy Conservation</td>
</tr>
<tr>
<td>1.3 Wastewater and Ambient Water Quality</td>
</tr>
<tr>
<td>1.4 Water Conservation</td>
</tr>
<tr>
<td>1.5 Hazardous Materials Management</td>
</tr>
<tr>
<td>1.6 Waste Management</td>
</tr>
<tr>
<td>1.7 Noise</td>
</tr>
<tr>
<td>1.8 Contaminated Land</td>
</tr>
<tr>
<td>2. Occupational Health and Safety</td>
</tr>
<tr>
<td>2.1 General Facility Design and Operation</td>
</tr>
<tr>
<td>2.2 Communication and Training</td>
</tr>
<tr>
<td>2.3 Physical Hazards</td>
</tr>
<tr>
<td>2.4 Chemical Hazards</td>
</tr>
<tr>
<td>2.5 Biological Hazards</td>
</tr>
<tr>
<td>2.6 Radiological Hazards</td>
</tr>
<tr>
<td>2.7 Personal Protective Equipment (PPE)</td>
</tr>
<tr>
<td>2.8 Special Hazard Environments</td>
</tr>
<tr>
<td>2.9 Monitoring</td>
</tr>
<tr>
<td>3. Community Health and Safety</td>
</tr>
<tr>
<td>3.1 Water Quality and Availability</td>
</tr>
<tr>
<td>3.2 Structural Safety of Project Infrastructure</td>
</tr>
<tr>
<td>3.3 Life and Fire Safety (L&amp;F5)</td>
</tr>
<tr>
<td>3.4 Traffic Safety</td>
</tr>
<tr>
<td>3.5 Transport of Hazardous Materials</td>
</tr>
<tr>
<td>3.6 Disease Prevention</td>
</tr>
<tr>
<td>3.7 Emergency Preparedness and Response</td>
</tr>
<tr>
<td>4. Construction and Decommissioning</td>
</tr>
<tr>
<td>4.1 Environment</td>
</tr>
<tr>
<td>4.2 Occupational Health and Safety</td>
</tr>
<tr>
<td>4.3 Community Health and Safety</td>
</tr>
</tbody>
</table>

5.6.4  World Commission on Dams

The World Commission on Dams (WCD) was established in May 1998 in response to the escalating local and international controversies over large dams, with the mandate to:

i) review the development effectiveness of large dams and assess alternatives for water resources and energy development; and

ii) develop internationally acceptable criteria, guidelines and standards for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams. (1)

The WCD framework puts forward seven strategic priorities which are widely acknowledged as a framework for dialogue (see Table 5.4). These seven strategic priorities are each based on a set of policy principles. A set of 26

(1) World Commission on Dams (2000a)
guidelines for good practice lay out specific actions for complying with the strategic priorities at five key stages of the project development process.

**Table 5.4 World Commission on Dams Strategic Priorities**

<table>
<thead>
<tr>
<th>Strategic Priority 1 - Gaining Public Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In order to develop water and energy resources in an equitable and sustainable manner, it is essential that there is public acceptance of such initiatives. This entails recognising the rights, addressing the risks and safeguarding the entitlements of all interested groups, by ensuring that they are informed about the issues at stake, able effectively to participate in decision-making processes, and that there is demonstrable acceptance of key decisions. Particular care should be taken to include the most vulnerable parties, such as women, the poor and certain indigenous groups, and that decision-making processes are guided by their free, informed and prior consent.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategic Priority 2 - Comprehensive Options Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The most appropriate development initiatives for a particular area can only be identified by assessing food, water and energy needs and clearly defining programme objectives. The full range of policy, institutional and technical options, which may well include alternatives to dams, should then be comprehensively assessed in a participatory process that accords the same significance to social and environmental considerations as to economic and financial factors. This process of assessment should continue throughout the planning, development and implementation of the project.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategic Priority 3 - Addressing Existing Dams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dams and the context in which they operate are not static over time. Their benefits and impacts may be transformed by changes in priorities for water use, physical and land use changes in the river basin, technological developments, and changes in public policy expressed in environmental, safety, economic and technical regulations. Management and operational practices should be continuously assessed and adapted to changing circumstances, in order to optimise the benefits, address social issues and improve measures to limit and restore damage to the environment. This process should extend beyond the life of the project, so that the performance, benefits and impacts of all existing large dams can be monitored and evaluated on a long-term basis, and appropriate action taken to improve all aspects of their service delivery.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategic Priority 4 - Sustaining Rivers and Livelihoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dams transform the landscapes they inhabit, with potentially irreversible effect. It is essential to understand, protect and restore ecosystems at river basin level, in order to minimise their negative impact, limit and mitigate harm to the health and integrity of the river system and those dependent upon it, and promote equitable human development and the welfare of all species. These are key issues when selecting sites and designing projects. Governments should develop national policies for maintaining in their natural state selected rivers with high ecosystem functions and values, and look for alternative sites on tributaries when assessing proposals for dams on undeveloped rivers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategic Priority 5 - Recognizing Entitlements and Sharing Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rather than benefiting from them, many of those affected by dams are aware only of their negative impacts. To redress the balance, a process of joint negotiation with such groups is required, based on recognition of rights and assessment of risks. The aim of these negotiations is to agree on legally enforceable mitigation and development provisions, which recognise entitlements that improve livelihoods and quality of life. States and developers are responsible for resettling and compensating all affected people, and satisfying them that their livelihoods will be improved by moving from their current situation. Legal means, such as contracts and accessible recourse at national and international levels, should be used to ensure that responsible parties fulfil their commitments to agreed mitigation, resettlement and development provisions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategic Priority 6 - Ensuring Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In order to win and maintain public trust and confidence, governments, developers, regulators and operators must meet their commitments for planning, implementing and operating dams. Compliance with applicable regulations, criteria and guidelines, and project-specific negotiated agreements should be ensured at all critical stages of project planning and</td>
</tr>
</tbody>
</table>
implementation. A set of regulatory and non-regulatory mechanisms, incorporating incentives and sanctions, and flexible enough to accommodate changing circumstances, is needed to enforce social, environmental and technical measures. A clear, consistent and common set of criteria and guidelines to ensure compliance should be adopted by sponsoring, contracting and financing institutions, and compliance subjected to independent and transparent review. Legislation, voluntary integrity pacts, debarments and other instruments should be used to eliminate corrupt practices.

**Strategic Priority 7 - Sharing Rivers for Peace, Development and Security**

The storage and diversion of water on transboundary rivers can cause considerable tension within and between countries. As specific interventions for diverting water, dams require constructive co-operation, and states or political units within countries need to agree on the use of resources in order to promote regional co-operation and peaceful collaboration. Rather than focusing on allocating water as a finite resource, states need to work on sharing rivers and their associated benefits. This will involve negotiating a wide range of issues, and making provision in national water policies for basin agreements in shared river basins. These agreements should be based on the principles of equitable and reasonable use, no significant harm, prior information and the Commission's strategic priorities.

If an objection by a riparian state to a proposal for a new dam on a shared river is upheld by an independent panel, construction should not be carried out. Furthermore, where a government agency plans the construction of a dam on a shared river in contravention of the principle of good faith negotiations between riparians, external financing bodies should withdraw their support for projects and programmes promoted by that agency.

Source: World Commission on Dams (2001)

The WCD dissolved in 2001 having undertaken its assigned activities. The WCD framework, however, has become a key benchmark in international dam building. The World Bank, export credit agencies and the International Hydropower Association, while critical of specific recommendations, have endorsed the WCD’s strategic priorities.

5.6.5 International Hydropower Association (IHA) Sustainability Guidelines

The IHA Sustainability Guidelines (SGs), were published in February 2004, with the aim to promote greater consideration of environment, social, and economic sustainability in the assessment of:

- new energy projects;
- new hydro projects; and
- the management and operation of existing hydropower facilities.

The principles set out in the SGs encompass a number of elements; these include:

- The role of governments;
- The decision making processes;
- Hydropower - environmental aspects of sustainability;
- Hydropower - social aspects of sustainability; and
- Hydropower - economic aspects of sustainability.

The IHA has put forward policy and sustainability criteria which encourage good governance within each country and collaboration between governments at an international level to ensure sustainable hydropower
development prerequisites are met. According to the IHA, it is the responsibility of governments to:

- Have in place national and/or regional energy policies, which should:
  - clearly set out energy development strategies.
  - include a Strategic Assessment (SA) process that involves an assessment of cumulative impacts, determination of land use and environmental priorities, as well as goals for poverty alleviation and economic growth.
  - be framed in the context of the global need to reduce greenhouse emissions.
  - incorporate the three elements of sustainability -- economic, social and environmental -- in energy planning.
  - be a participatory, streamlined process, focused on major issues, using common sense and readily available information, and with short and definite time limits for its completion.
- Evaluate alternative energy options using key sustainability criteria, prescribed by the IHA; and
- Evaluate hydropower project alternatives using key sustainability criteria, prescribed by the IHA.

In order to facilitate decision making and to ensure the sustainability of hydropower projects, the IHA’s policy position is that Environmental Assessments (EAs) should be applied at the project level from the pre-feasibility stage to the post-construction auditing stage. The IHA encourages governments and project proponents, through the use of key criteria, to ensure appropriate management of environmental and social issues throughout the life of the project by adopting strategies to maximise positive outcomes and reduce the severity or avoidance of negative social, economic and environmental impacts.

To support the IHA SGs, the IHA has also developed the Hydropower Sustainability Assessment Protocol, which was released in 2006 and updated in November 2010, to assist in assessing performance against the criteria set out in the IHA SGs.

5.6.6 Hydropower Sustainability Assessment Protocol

The IHA Hydropower Sustainability Assessment Protocol (the Protocol) is a sustainability assessment framework for hydropower development and operation. The intention of the Protocol is to enable the production of a sustainability profile for hydropower projects through the assessment of performance against sustainability topics. The sustainability of a hydropower project is assessed through the use of assessment tools. These tools are framed by underlying principles of sustainability, as set out in Box 5.3, below.
Box 5.3  **Principles Underlying the IHA Sustainability Assessment Protocol**

The principles underlying the Protocol stipulate that:

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Sustainable development embodies reducing poverty, respecting human rights, changing unsustainable patterns of production and consumption, long-term economic viability, protecting and managing the natural resource base, and responsible environmental management.
- Sustainable development calls for considering synergies and trade-offs amongst economic, social and environmental values. This balance should be achieved and ensured in a transparent and accountable manner, taking advantage of expanding knowledge, multiple perspectives, and innovation.
- Social responsibility, transparency, and accountability are core sustainability principles.
- Hydropower, developed and managed sustainably, can provide national, regional, and local benefits, and has the potential to play an important role in enabling communities to meet sustainable development objectives.

The Protocol comprises of four assessment tools for the different stages of the project life cycle, as shown in Figure 5.2.

**Figure 5.2  Protocol Assessment Tools and Major Decision Points**

These four assessment tools – Early Stage, Preparation, Implementation, and Operation, are designed to be stand-alone assessments applied at particular stages of the hydropower project life cycle.

The **Early Stage** assessment tool is a preliminary screening tool to assess the strategic environment from which proposals for hydropower projects emerge. It identifies project risks and opportunities at an early stage, in order to identify the challenges and management responses to proceed with a more detailed project investigation.

The **Preparation** assessment tool assesses the preparation stage of a hydropower project, during which investigations, planning and design are undertaken for all aspects of the project. This project stage is normally subject to national regulatory processes regarding project-specific Environmental and
Social Impact Assessment (ESIA) requirements as well as project management processes.

The **Implementation** assessment tool assesses the implementation stage of a hydropower project, during which construction, resettlement, environmental and other management plans and commitments are implemented.

The **Operation** assessment tool assesses the operation of a hydropower facility. This Protocol assessment tool can be used to inform the view that the facility is operating on a sustainable basis with active measures in place towards monitoring, compliance and continuous improvement.

*Table 5.5,* provides a list of topics for each assessment tool. These topics, when taken together, provide a list of issues that must be considered to confidently form a view on the overall sustainability of a hydropower project at a particular point in its life cycle. Within each topic, criteria are utilised for the scoring of each topic – these criteria include:

1. Assessment;
2. Management;
3. Stakeholder Engagement;
4. Stakeholder Support;
5. Conformance/Compliance; and
6. Outcomes.

These criteria allow the assessment of both the processes in place to ensure sustainability of the project or operation, and the performance of that project or operation on that particular sustainability topic.

<table>
<thead>
<tr>
<th>Table 5.5</th>
<th>Hydropower Sustainability Assessment Protocol Topics by Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Stage</strong></td>
<td><strong>Preparation</strong></td>
</tr>
<tr>
<td>Demonstrated Need</td>
<td>Communications &amp; Consultation</td>
</tr>
<tr>
<td>Options Assessment</td>
<td>Governance</td>
</tr>
<tr>
<td>Policies &amp; Plans</td>
<td>Demonstrated Need &amp; Strategic Fit</td>
</tr>
<tr>
<td>Political Risks</td>
<td>Siting &amp; Design</td>
</tr>
<tr>
<td>Environmental Issues &amp; Risks</td>
<td>Asset</td>
</tr>
<tr>
<td>Early Stage</td>
<td>Preparation</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Economic &amp; Financial Issues &amp; Risks</td>
<td>Infrastructure Safety</td>
</tr>
<tr>
<td>Financial Viability</td>
<td>Financial Viability</td>
</tr>
<tr>
<td>Project Benefits</td>
<td>Project Benefits</td>
</tr>
<tr>
<td>Economic Viability</td>
<td></td>
</tr>
<tr>
<td>Procurement</td>
<td></td>
</tr>
<tr>
<td>Project Affected Communities &amp; Livelihoods</td>
<td>Project Affected Communities &amp; Livelihoods</td>
</tr>
<tr>
<td>Resettlement</td>
<td>Resettlement</td>
</tr>
<tr>
<td>Indigenous Peoples</td>
<td>Indigenous Peoples</td>
</tr>
<tr>
<td>Labour &amp; Working Conditions</td>
<td>Labour &amp; Working Conditions</td>
</tr>
<tr>
<td>Cultural Heritage</td>
<td>Cultural Heritage</td>
</tr>
<tr>
<td>Public Health</td>
<td>Public Health</td>
</tr>
<tr>
<td>Biodiversity &amp; Invasive Species</td>
<td>Biodiversity &amp; Invasive Species</td>
</tr>
<tr>
<td>Erosion &amp; Sedimentation</td>
<td>Erosion &amp; Sedimentation</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Water Quality</td>
</tr>
<tr>
<td>Waste, Noise &amp; Air Quality</td>
<td></td>
</tr>
<tr>
<td>Reservoir Planning</td>
<td>Reservoir Preparation &amp; Filling</td>
</tr>
<tr>
<td>Downstream Flow Regimes</td>
<td>Downstream Flow Regimes</td>
</tr>
</tbody>
</table>
As discussed in Chapters 1 and 3, the scope of the Muchinga HPP was extended by MPC. For more detail on the key components of the extended Muchinga HPP, please refer to Section 3.1. As part of the old Project scope a public consultation process was undertaken by ERM and AMC for the Scoping Phase of the Project between March and April 2011. The findings of the Scoping Phase for the old Project scope were documented in the Scoping Report and Terms of Reference submitted to ZEMA in August 2011.

However, due to the change in the scope of the Project, the ESIA process along with the public consultation process were re-started in June 2013 as to adhere to international good practise which recommend integrated ESIA processes. This Chapter provides a summary of the public participation process (PPP) to be undertaken as part of the changed scope of the Project as well as outline the preliminary findings of the public participation process undertaken during the Project re-Scoping.

Supporting documentary proof is provided within Annex B (Consultation Materials) under the following headings:

- Annex B1: Background Information Document (BID);
- Annex B2: Proposed Consultation Schedule;
- Annex B3: Development Presentation (given at community meetings);
- Annex B4: Issues and Concerns Log;
- Annex B5: Proof of Consultation: Photolog and Attendance Registers from Authority and Community Consultations;
- Annex B6: Proof of Advertisements;
- Annex B7: Proof of Site Notices; and meeting minutes.

6.1 CONSULTATION PROCESS

The public consultation process was designed to comply with the Zambian regulatory requirements set out in the EMA of 2011 (see Chapter 5, Section 5.2.1). The process was further designed to adhere to international best practise set out by the International Finance Corporation (IFC): Performance Standard 1, Social and Environmental Management and Assessment Systems. The IFC PS1 require that consultation be carried out in two stages; namely during Scoping Phase and Draft ESIA Phase.

Even though the in-country legislation does not require consultation during the Draft ESIA Phase, the ESIA consultants will engage the communities as part of international good practise.
6.1.1 Objectives of Public Consultation

The main objectives of the Scoping Phase public consultation process were:

- to re-introduce the proposed Project to stakeholders;
- to inform stakeholders about the change in the scope of the Project;
- to allow stakeholders to provide comments and raise issues/concerns regarding the proposed Project;
- to gather and record the communities’ initial issues and concerns about the Project and ESIA process; and
- to assist the LHPC to build and strengthen their relationship with the key and other stakeholders.

The public consultation process for the Project was designed around three phases within the ESIA Phases, namely scoping, draft ESIA and Announcement of ZEMA’s decision regarding the project. These phases and activities planned in each phase are shown in Figure 6.1 below.

Figure 6.1 Consultation Process for Muchinga HPP

Detailed information regarding the activities undertaken as part of scoping consultations are described below as well as the next steps.

6.2 SCOPING PHASE CONSULTATION

This section describes the consultation activities undertaken for the purposes of Project re-Scoping. The description provided below includes:
6.3 **Approach and Method**

This section provides the approach and method used to identify, select and engage stakeholders.

6.3.1 **Identification of and Selection of Stakeholders**

Stakeholder identification took place through a social scan followed by stakeholder recording and categorisation. During the stakeholder identification or social scan the individuals, groups and local communities that may be interested and affected by the project as well as the broader stakeholders who may be able to influence the outcome of the project were identified. The elected and non-elected community representatives and leaders were also identified. Care was taken to include consultation with vulnerable groups such as the elderly and women.

Some of the key criteria for the identification of stakeholders included:

- Proximity to Project site, and infrastructure;
- Proximity to Project activities (e.g., roads that are going to be used to transport goods and services to and from the Project site);
- Downstream dwellers/ users;
- Provincial and District levels leaders;
- Traditional leadership in the Project Area(s);
- Commenting authorities; and
- Energy related parastatals.
Based on these criteria, stakeholders identified were placed into the following categories:

- **National government**: these stakeholders are of primary national political importance to the project and the ESIA process.
- **Provincial government and District Authorities**: these stakeholders are of Provincial and local importance to the Project.
- **Traditional Authorities**: The chiefs and elders were consulted.
- **Villages/communities**: communities at local level that will directly impacted (positive and/or negative) by the project.

*Table 6.1* provides a list of stakeholders were identified and selected for consultation by stakeholder category.

**Table 6.1  Stakeholders Selected for Consultation**

<table>
<thead>
<tr>
<th>Stakeholder Category</th>
<th>Stakeholder/s</th>
<th>Reason for Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Level</td>
<td>National Heritage and Conservation Commission</td>
<td>Custodians of the national archaeological and heritage resources of the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Ministry of Energy &amp; Water Development: Department of Water Affairs</td>
<td>Department mandated with the management and regulation of water resources in the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Office for Promoting Private Power Investment (OPPPI)</td>
<td>Parastatal mandated to promote private sector involvement in power generation and transmission in the country.</td>
</tr>
<tr>
<td></td>
<td>Energy Regulation Board (ERB)</td>
<td>Parastatal mandated to regulate the country’s energy. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Ministry of Energy &amp; Water Development: Director of Energy</td>
<td>Department mandated to manage and regulate the energy sector in the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Zambian Environmental Management Agency (ZEMA)</td>
<td>Agency responsible for the management of the country’s environmental resources and grants environmental authorisation for the undertaking of large scale developments.</td>
</tr>
<tr>
<td></td>
<td>Zambia Wildlife Authority (ZAMA)</td>
<td>Guardian of Zambian wildlife Affected Party (due to the proximity of the project to the Luano GMA) ESIA commenting authority.</td>
</tr>
<tr>
<td>Provincial Level</td>
<td>Central Province’s Permanent Secretary</td>
<td>Assists the Deputy Minister in the management of the Province; ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Provincial Planner</td>
<td>Responsible for Provincial planning activities (infrastructure and social development)</td>
</tr>
<tr>
<td>District Level</td>
<td>Kapiri- Mposhi: District Commissioner</td>
<td>Head of the project affected District. Responsible for planning activities in the District, and head of education in the District (there are several schools along the road to the Project Site).</td>
</tr>
</tbody>
</table>
## Stakeholder Selection

<table>
<thead>
<tr>
<th>Stakeholder Category</th>
<th>Stakeholder/s</th>
<th>Reason for Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mkushi District:</td>
<td>District Commissioner, District Planner, Education Board Secretary (DEBS)</td>
<td>Head of the project affected District. Responsible for planning activities in the District, and head of education in the District (there are several schools along the road to the Project Site)</td>
</tr>
<tr>
<td>Traditional Leaders</td>
<td>HRH Chief Mukonchi, HRH Chief Chembe, HRH Chief Kanyanshye</td>
<td>Project affected Traditional Leaders (direct I&amp;APs)</td>
</tr>
<tr>
<td>Villages and Headmen/women</td>
<td>Lutampo Shipili, Kamukwamba, Saka, Chipempele, Spaida village, Celemente village, Chimika village, Sawo, Bowa, Sipesha, Chibi, Kasanga, Mankubwa, Kapusula, Chimbe, Chimoko, Mwale, Mbomba, Monga, Kalasela, Chief Chembe Villages (Downstream Dwellers/ Users): Chembe Central, Chitambe, Chibukula, Chibulula, Mumbaka, Nkausu, Mubaka, Chafunga, Lungula, Kalimba, Supuni, Malungual, Muluso, Chisakulo</td>
<td>Proximity to the Project infrastructure and activities Project affected communities</td>
</tr>
</tbody>
</table>

See Annex B5 (Proof of Consultation) and see Annex B2 (Consultation Schedule).

### 6.3.2 Consultation Method

Four consultation methods were used to engage stakeholders for the purpose of this Project; namely:
- Community/Public meetings;
- Focus Group Discussions;
- Household Surveys; and
- One-to-one meetings.

Table 6.2 below highlights some of these methods and lists advantages of using them.
### Table 6.2 Public Consultation Methods to be Used

<table>
<thead>
<tr>
<th>Consultation Method</th>
<th>Objective of Consultation</th>
<th>Justification for Methodology</th>
<th>Target Audience</th>
</tr>
</thead>
</table>
| Community/ Public Meeting (specifically selected community) | • Share information about the proposed project.  
• Provide opportunity for stakeholders to raise issues and concerns about the proposed project.  
• Provide responses to project related questions.  
• Record stakeholder comments and concerns for consideration in the ESIA. | • Increased ownership by participants  
• Allows for wider consultation and debate related to selected issues and topics.  
• Allows issues to be verified, tested and solutions developed | Cross-section of community/ villages within the Project affected areas |
| Focus Group Discussions (FGD)           | • To provide information about the Project.  
• To allow community members to raise issues and concerns related to the project.  
• Allow issues to be verified, tested and solutions developed.  
• To gather socio-economic baseline information about the community. | • Increased ownership by participants  
• Allows for wider consultation and debate related to selected issues and topics.  
• Smaller forum encourages participation of all present stakeholders without intimidation or fear (especially people who will not normally speak out in large gatherings).  
• Allows issues to be verified, tested and solutions developed  
• Allows for the gathering of socio-economic baseline data and recording of further issues and concerns for inclusion into the ESIA. | • Men and traditional Leaders (in-depth knowledge of the socio-economic characteristics of the community).  
• Women (in depth knowledge of household characteristics in the community).  
• 10 to 15 participants is the ideal number for FGDs. |
<table>
<thead>
<tr>
<th>Consultation Method</th>
<th>Objective of Consultation</th>
<th>Justification for Methodology</th>
<th>Target Audience</th>
</tr>
</thead>
</table>
| Household Surveys           | • Standardised survey or questionnaire for collecting qualitative or quantitative information from a sample of a population.  
• Identify stakeholder issues and assess community needs  
Obtain an objective overview of a group of stakeholders to a particular issue or potential impact. | • Provides detailed data on specific issues  
• Assuming an appropriate sample is gathered, this technique provides good insight into the extent to which an issue is significant within the local area  
• Widely known and acceptable method, particularly in developed countries | Cross-section of community/village members within the Project affected areas, mainly head of households (men and women) |
| One-to-One Meetings and Group Meetings | • To provide information about the project activities.  
• To allow key informants to raise issues and concerns about the project.  
• To verify some of the information provided by the communities. | • Allows for follow up on issues and unexpected information.  
• Consultation by invitation only, so it is easier to predict and prepare for the types of issues that are likely to be raised.  
• Allows issues to be verified, tested and solutions developed. | National Authorities; Provincial Authorities; District Authorities; Parastatals; and Chiefs |
6.4 **NOTIFICATION OF STAKEHOLDERS**

Stakeholders were notified of the public meetings and one-to-one meetings in several ways, including invitation letters, distribution of the Background Information Document (BID), site notices, newspaper advertisement, and through informing various headmen/women of the meetings. These methods are described further below:

*Formal Letters of Invitation*

Formal letters (and electronic mail) of invitation were sent to the various national, provincial, district authorities as well as to the Chiefs informing them of the consultation process and proposing a date and time for a meeting with the relevant people. Copies of the invitation letters sent to the government and traditional authorities; see *Annex B5* (Proof of Consultation).

*Background Information Document*

In addition to the formal letters of invitation, a background information document (BID) was prepared in English and Bemba and distributed at all authorities, public and one-to-one meetings as well as during the FGDs and whilst administering household surveys. The BID provides a description of the proposed project, an overview of the ESIA process and contact details in order for stakeholders to provide comments on the project. Approximately 1,500 BIDs were printed and approximately 1,000 were distributed to stakeholders and the remainder were left at the Lunsemfwa Power Station; see *Annex B1* (BIDs).

*Newspaper Advert*

An advertisement (in English) notifying stakeholders of the start of the ESIA process was published in the *Zambia Daily Mail* on the 17th July 2013, see *Figure 6.2* as well as *Annex B6* for the copy of the advert in the publication.
Site Notices

Site notices in English and Bemba were placed at the following places:

- Provincial Office;
- Mkushi and Kapiri-Mposhi District Offices;
- Lunsemfwa Power Station (Local Shop and Tarven);
- Lunsemfwa Power Station Clinic;
- Chembe Central (clinic and court);
- Informal Market in Mwale;
- Cememente Community School; and
- Road Side to Lunsemfwa Power Station; see Figure 6.3 and Annex 7 (Proof of Site Notices).

**Figure 6.3 Site Notices**

- Provincial Office
- Mlenge Informal Market
- Lunsemfwa General Store
- Road to Lunsemfwa HPP and Project Site
- Chembe Health Centre
- Clemente Community School
Project Website

A Project website was set up at the outset of the ESIA process. The purpose of this website is to keep stakeholders updated on the Project progress; to allow stakeholders to access information on the ESIA process; and to provide the contact details of the ESIA project management team. The BID (English and Bemba) has been uploaded on the website. The Project website can be accessed at http://www.erm.com/MuchingaESIA.

6.4.2 Public/ Community Meetings Held

An estimated 650 people were consulted during the Scoping Phase of the Project. Of this total, approximately 300 people are located upstream of the Project footprint and approximately 325 people downstream and the remainder government and traditional leaders. Figure 6.4 provides the percentage breakdown of the meetings held with stakeholders from the 15th July to 26th of July 2013; half (50 percent) of the meetings held were with communities and 19 percent with traditional and district authorities, respectively.

Figure 6.4 Distribution of Meetings Held

Attendance registers were kept for each of the community meetings as they formed the basis of the consultation activities (Annex B5). The consultation schedule is provided in Annex B2 as well as the photo records of all the village/community meetings (some photos of the community meetings are shown Figure 6.5).
The following need to be noted:

- The **joint national authorities meeting**, only a limited number of invitees were able to attend, due to various reasons, even though they had confirmed that they would be present. A follow up e-mail will be sent to these authorities with a copy of the BID and notice of the availability of the Scoping Report on the Project website once the report has been submitted.

- The **Provincial Permanent Secretary**, and the **District Commissioner of Mkushi and Kapiri Mposhi** were not consulted directly as they were not available on the day of the proposed meetings. BIDs were left at their offices for their perusal and the planners who were engaged were asked to pass on the message to them.
• At village level, the population of Sipaida was not consulted as the consultation team was told by the Headman that it took three days to gather people for meetings and the team was due to depart a day later. The Project was presented to the Headman, his advisers and about ten people (during the administration of the household surveys). A representative from the LHPC is planning to visit the village/community to present the Project at a later date. In addition, only four people from Chimika village were consulted, including the Headman who came to the meeting at Celemente village, due to access issues.

• At Chembe, the consultants requested the Chief to call various Headmen to the main village (Chembe Central) for the meeting due to access issues. Approximately ten Headmen accompanied by some of their villagers (from across the Lunsemfwa River) were present at the meeting, along with those that reside closest to Chembe Central. These Headmen represented the following villages Masambani, Chafunga, Chindebele, Kapeta, Ntinisha, Mubaka, Masombwe, and Supunu.

6.4.3 Issues and Concerns Raised

Some of the recurring issues and concerns raised by the stakeholders are listed below:

• Concerns over potential resettlement and loss of agricultural land;
• Ensure limited impacts on the river system and maintain current river flow regime;
• Ensure that the local people receive benefits from this Project, including electricity;
• Request from Provincial and District authorities to visit the Project site;
• Concerns related to the contamination of water during construction, especially downstream;
• Community benefits related to the project implementation and CSR; and
• Creation of employment opportunities, i.e. distribution of opportunities, nepotism, criteria for recruitment, and labour and working conditions.

See Figure 6.6 for the percentage recurrence of issues and concerns.
All issues and concerns raised by stakeholders were captured into the Issues Log (Annex B4) and Meeting Minutes (Annex B8).

6.5 **ESIA PHASE CONSULTATION**

The purpose of the ESIA phase consultation will to:

- inform stakeholders about the findings of the specialists reports;
- gather comments and concerns regarding the potential impacts;
- identify potential mitigation measures that might have been missed; and
- further strengthen relationships with the stakeholders.

6.5.1 **Approach and Method**

Formal stakeholder meetings will be held. The plan will be to engage mainly with government (national, provincial, and district) and traditional authorities (Chiefs and Headmen/headwomen). Should the Project impacts be expected to significantly affect the local communities, then communities will also be engaged.

6.5.2 **Notification of Stakeholders**

Stakeholders will be notified of the meetings by e-mail (government officials), letters and phone calls for other stakeholders with the assistance of the Chiefs and Headmen. E-mail communication and follow up phone calls will be sent directly by the ERM team, while letter will be distributed by on-site personnel from the LHPC.

The ESIA report will be available on the Project website; hard copies and other electronic copies will be available on request by stakeholders.
6.5.3 **Meetings Schedule**

Stakeholders consulted as part of the Scoping Phase will all be engaged as part of the Draft see Table 6.3.

**Table 6.3 Stakeholders to be engaged during the Draft ESIA**

<table>
<thead>
<tr>
<th>Stakeholder Category</th>
<th>Stakeholder/s</th>
<th>Reason for Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>National Level</strong></td>
<td>National Heritage and Conservation Commission</td>
<td>Custodians of the national archaeological and heritage resources of the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Ministry of Energy &amp; Water Development: Department of Water Affairs</td>
<td>Department mandated with the management and regulation of water resources in the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Office for Promoting Private Power Investment (OPPPI)</td>
<td>Parastatal mandated to promote private sector involvement in power generation and transmission in the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Energy Regulation Board (ERB)</td>
<td>Parastatal mandated to regulate the country’s energy. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Ministry of Energy &amp; Water Development: Director of Energy</td>
<td>Department mandated to manage and regulate the energy sector in the country. ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Zambian Environmental Management Agency (ZEMA)</td>
<td>Agency responsible for the management of the country’s environmental resources and grants environmental authorisation for the undertaking of large scale developments.</td>
</tr>
<tr>
<td></td>
<td>Zambia Wildlife Authority (ZAMA)</td>
<td>Guardian of Zambian wildlife. Affected Party (due to the proximity of the project to the Luano GMA) ESIA commenting authority.</td>
</tr>
<tr>
<td><strong>Provincial Level</strong></td>
<td>Central Province’s Permanent Secretary</td>
<td>Assists the Deputy Minister in the management of the Province; ESIA commenting authority.</td>
</tr>
<tr>
<td></td>
<td>Provincial Planner</td>
<td>Responsible for Provincial planning activities (infrastructure and social development)</td>
</tr>
<tr>
<td><strong>District Level</strong></td>
<td>Kapiri-Mposhi: District Commissioner District Planner Education Board Secretary (DEBS)</td>
<td>Head of the project affected District. Responsible for planning activities in the District, and head of education in the District (there are several schools along the road to the Project Site).</td>
</tr>
<tr>
<td></td>
<td>Mkushi District: District Commissioner District Planner Education Board Secretary (DEBS)</td>
<td>Head of the project affected District. Responsible for planning activities in the District, and head of education in the District (there are several schools along the road to the Project Site).</td>
</tr>
<tr>
<td><strong>Traditional Leaders</strong></td>
<td>HRH Chief Mukonchi HRH Chief Chembe HRH Chief Kanyanshye</td>
<td>Project affected Traditional Leaders (direct I&amp;APs)</td>
</tr>
<tr>
<td>Stakeholder Category</td>
<td>Stakeholder/s</td>
<td>Reason for Selection</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Villages and Headmen/women</td>
<td>Lutampo Shipili, Kamukwamba, Saka, Chipempele, Spaida village, Celemente village, Chimika village, Sawo, Bowa, Sipesha, Chibi, Kasanga, Mankubwa, Kapusula, Chimbe, Chimoko, Mwale, Mbomba, Monga, Kalasela</td>
<td>Proximity to the Project infrastructure and activities, Project affected communities</td>
</tr>
<tr>
<td>Chief Chembe Villages (Downstream Dwellers/Users):</td>
<td>Chembe Central, Chitambe, Chibukula, Chibulula, Mumbaka, Nkausu, Mubaka, Chafunga, Lungula, Kalimba, Supuni, Malungual, Muluso, Chisakulo</td>
<td></td>
</tr>
</tbody>
</table>

Minutes will be prepared for each of the above mentioned meetings and a proposed template for the meeting minutes is presented in Annex B6.

6.5.4 Summary of Issues and Concerns Raised During Consultation

This section will provide a summary of issues and concerns raised by the stakeholders. A full list of issues and concerns will be provided in the Issues Log Annex B4.

Mitigation measures proposed by authorities and any other stakeholder will be worked into the relevant section of the ESIA once the Proponent has agreed to adhere to them. These will be included in the Issues Log.
6.6 **NOTIFICATION OF ZEMA’s DECISION**

Notice of the record of decision by ZEMA will be communicated to the authorities via letters, posting on the Project website and telephonically (where necessary). Communities will be informed via Chiefs and Headmen/women.
This *Chapter* describes potential social, physical and biological impacts that are associated with the proposed Project. The issues identified stem from those aspects investigated and presented in *Chapter 4* of this document. Each significant issue identified will be investigated further during the impact assessment phase of this Project.

Furthermore, this *Chapter* will describe the methodology that will be used in the ESIA phase to indicate how environmental and social impacts, arising from both the construction and operations phase of the Project, will be assessed and mitigated.

### 7.1 Potential Environmental Impacts

This section describes the potential impacts to the environment as a result of the dam’s inundation area, as well as both upstream and downstream of the dam site. Potential environmental impacts are presented both for the construction and operations phases of the proposed Muchinga HPP.

#### 7.1.2 Air Quality

*Potential Impacts*

Given the rural nature and the total lack of any heavy industry in the Project Area, ambient air quality in the Project Area is not likely to be affected. Furthermore, the proposed Project Area is relatively far removed from any sensitive receptors (such as villages, clinics, schools etc.). Although dust from construction activities will need to be managed and mitigated, a hydropower development will not contribute to air quality impacts during its operation. As such, it can be expected that the impacts associated with air quality will be negligible.

*Further Studies Required in the EIA Phase*

There are no adverse impacts arising directly from the air quality in the area. As such, *no air quality specialist studies during the ESIA are deemed necessary.*

#### 7.1.3 Noise

*Potential Impacts*

During the construction phase the conventional drill and blast method will be adopted. Blasting will likely be required for some of the rock masses for excavation. Conventional excavators will be used on surface rock material.
and where suitable. The drilling and blasting activities will produce a higher level of noise than the ambient noise level. Considering the Project site is in a rural area the daytime ambient noise level is expected to be 45 dBA or less. Therefore the blasting and drilling noise level will be significantly higher than the ambient noise level, for a temporary impact on a local extent. The degree of potential impact is determined by the possible receptors of the increased noise levels.

Further Studies Required in the EIA Phase

There is the potential for noise impacts on sensitive receptors in the Project Area. As such, socio-economic and fauna specialist studies will take into account potential noise impacts on social and faunal receptors.

7.1.4 Topography

Potential Impacts

There are no adverse impacts arising from the topography in the Project Area and surrounds (apart from slope angles influencing the erodibility of soils; this is discussed separately under Section 7.1.5). Local topography will influence the local wind patterns and subsequently the dispersion of potential noise and airborne emissions from the proposed Project, particularly during construction activities. In addition, local topography will influence the visibility of the proposed Project from outside of the Project Area.

Air and noise impacts are not likely to be significant, as the proposed Project is far removed from receptors (such as communities) sensitive to such impacts. In addition, the proposed site for the Mkushi dam is approximately 6km upstream of Bell Point, a National Heritage site. As such the proposed Project is not visible from this point due to the deeply incised valley of the Mkushi River. In addition, much of the project is also located underground, in particular the tunnels transporting water from the Lunsemwa River to the Mkushi Dam, and from the dam to the penstocks.

Local topography has in fact been exploited for hydropower generation given the 500m difference in elevation posed by the Muchinga escarpment.

Further Studies Required in the EIA Phase

There are no adverse impacts arising directly from the topography in the area. As such, no Visual Impact Assessment specialist study is proposed for the ESIA.
7.1.5 Soils

Potential Impacts

Construction Phase

Construction activities associated with the proposed Project could lead to significant soil disturbance at a number of locations, including the dam site, the power house, aggregate quarry site, the workers’ camps and construction and other access roads. Of particular concern is the new proposed access road between Muchinga and Mulungushi. The current road route makes two very steep inclines up onto the escarpment, on very unstable soils. Given that the majority of soils in the Project Area are acrisols which are susceptible to erosion, soils in the Project Area could be exposed to an increased risk of soil erosion and degradation (e.g. through compaction) and subsequent increased turbidity and sedimentation of water courses. These risks should all be mitigated by the effective implementation of industry-standard practices for soil conservation on construction sites.

In addition, communities in the Project Area are largely reliant on subsistence agriculture. Arable soils may be lost to these communities as a result of Project construction activities. To avoid areas of high land productivity, a land capability map will be produced to guide appropriate Project planning.

Operational Phase

In the reaches immediately downstream of dams, sediment supply is usually reduced due to the trapping of sediment in the upstream reservoir. Hydropower plants may also alter sediment transport very far downstream through alteration of the hydrology (and therefore the energy to move sediments), and this can be further exacerbated by peak daily releases (associated with peaking power generation). This may have a significant impact on the river morphology downstream of the dam, whereby patterns of erosion, transport and deposition along the river downstream to the proposed Muchinga HPP may gradually shift until a new status quo is established over time. This changing morphology could have consequent affect river water turbidity and flow velocities, and potentially impact hence on riverine ecosystems.

Further Studies Required in the EIA Phase

There is the potential for adverse impacts arising directly from the soils in the area. As such, a soils specialist has been appointed to undertake soil specialist studies during the ESIA process.
7.1.6 Environmental Flow - Hydrology

Potential Impacts

Construction Phase

The flow in the Mkushi River will be diverted around the main dam construction site, resulting in localised changes and disruption to existing drainage patterns for the duration of the construction period. This may have consequent impacts on riverine habitats and water users in the vicinity of the construction site, although these impacts may be very localised and taken within the context of the overall disturbance caused by the construction activities themselves, are unlikely to be significant. In addition, the downstream flow regime in the river could remain largely unchanged since the releases that are being proposed during construction do not provide any significant impoundment to the flow or create any significant storage that would affect the flood hydrograph.

During Operation

There could be significant pressure to fill the Mkushi reservoir as quickly as possible after construction, and so it is likely that a significant flow volume in the river may be captured in the reservoir until filling is complete and turbine operation has commenced. Unless there are adequate compensation flow releases downstream during this filling period (for all water users, including ecological) then this could have a severe impact on environmental conditions downstream of the dam, not only downstream in the Mkushi River, but also downstream of the power house in the Lunsemfwa River. The impact analysis could therefore consider this issue and make recommendations for a suitable release regime based on international best practices.

During normal operation of the dam, and especially that the proposed hydropower plant may be most suitable for peaking generation, the regulation of flows through the turbines could create a modified flow regime (including low flows, both large and small floods and flow variability) in the river(s) downstream, which may have a major impact on aquatic and riverine habitats downstream (as discussed elsewhere in this report), affecting aspects such as bed sediments, fish and macro-invertebrates, water quality and riparian vegetation.

Further Studies Required in the EIA Phase

There is the potential for the Project to have adverse impacts to environmental flow of the system. As such an assessment of downstream environmental flows will be undertaken as part of the ESIA. The environmental flow assessment could provide information that could allow for an optimisation of flows to minimise downstream environmental impact, once a particular option for the hydropower plant has been selected.
7.1.7 Impoundment and Downstream Water Quality - Hydrology

Potential Impacts

Construction Phase

The main water quality risks that occur from dam construction relate to the potential spillage of fuels, lubricants and chemicals at the construction site, and the inadequate treatment and disposal of waste and wastewater from worker compounds. These should all be mitigated by the effective implementation of industry-standard practices for safe environmental management and pollution control on construction sites.

Operational Phase

Water quality problems may occur in the reservoir and downstream in the receiving river due to a range of factors. While the main use of reservoir water is for hydropower generation, possible water quality impacts could affect aquatic habitats and may affect downstream subsistence fishing and/or water supplies.

Potential problems are as follows:

- Insufficient clearance of vegetation at the reservoir site prior to inundation may lead to the widespread decomposition of organic matter on the reservoir bed, which subsequently could result in the generation of methane gas and possible depletion of oxygen levels in the water, such that fish kills may occur.
- Depending on the stratification patterns and the depth of the euphotic zone in the new impoundment (i.e. the depth of the water in a dam that is exposed to sufficient sunlight for photosynthesis to occur), temperature, dissolved oxygen, turbidity and nutrient concentrations may change drastically when compared to the previous flowing river environment. These changes could determine which species could adapt, which could die out and which may take on pest proportions in the impoundment.
- The timing of water releases downstream and the depth from which these releases are made, may affect the temperature, oxygen concentration, sediment loads and nutrient concentrations in the release water that could in turn, potentially impact on the river downstream and on what lives there.

Further Studies Required in the EIA Phase

There is the potential for the Project to affect water quality and as a result have adverse impacts to downstream users; however, the extent to which the above problems occur could depend on a number of factors, including in particular the hydraulic conditions within the reservoir and the degree to which circulation or thermal stratification takes place. To some extent water quality downstream of the impoundment can be mitigated by careful “mixing” of the water released from the epilimnion (upper oxygen rich, warmer, less dense
water layer richer in algae) and the hypolimnion (lower, oxygen poor, colder, denser, nutrient-rich water layer). The incorporation of a suitable tower structure in the design of the dam to allow for simultaneous releases from different depths should be further investigated in the ESIA.

7.1.8 Geohydrology

Potential Impacts

Construction Phase

Apart from a localised depression in the water table due to any dewatering that could be necessary to construct the dam foundations, there are unlikely to be any significant impacts on groundwater levels as a direct result of construction activities.

Due to the remoteness of the site and the lack of any significant settlements downstream of the proposed dam location, it is unlikely that there are any existing water supply wells or boreholes in the immediate vicinity of the construction sites which would be affected by the above mentioned dewatering.

Operational Phase

The proposed Mkushi reservoir could raise the water table upstream of the dam. The geology of the area (specifically faults and fracture zones) surrounding the dam could influence the extent to which changes are experienced in the groundwater regime downstream and in the area of inundation of the dam.

Further Studies Required in the EIA Phase

Changes to groundwater in the proposed Project area and surrounds will unlikely result in any social and/or environmental impacts, as the proposed Project area is located within a deeply incised river valley and is relatively far removed from any human habitation. As a result, the likelihood of any impacts to sensitive receptors such as boreholes in the Project area is low. As such, no groundwater specialist studies during the ESIA are deemed necessary.

7.1.9 Terrestrial and Aquatic Flora

Potential Impacts

Construction Phase

Construction of the main dam wall and associated infrastructure could involve large equipment operations, material storage areas, and administrative space (i.e. construction camps etc.), which could remove and/or disturb vegetation in affected areas. This may primarily affect riparian habitats and hill-slope vegetation. Construction of new and rehabilitation of
existing construction access roads could remove and/or disturb riparian and other vegetation. In addition, the construction of a way-leave for the transmission line will also result in vegetation clearance.

The new proposed road between Muchinga and Mulungushi will increase the accessibility of the area. As a result an increase in flora harvesting is likely to take place.

Inundation and Operational Phase

Inundation of the reservoir may result in the direct loss of vegetation, primarily riparian vegetation as well as hill-slope vegetation, and vegetated woodland.

Once inundation of the reservoir is complete, new wetlands and riparian vegetative communities should establish along its shoreline (littoral zone). Operation of the reservoir, including peaking and ponding operations and water level draw-downs, could define the vegetation communities that establish in the new littoral zone of the reservoir. Should the reservoir alter the flooding regime of the river, alien vegetation may establish itself along the riparian zone. Relatively stable water levels should result in a relatively homogenous aquatic vegetation and/or wetland community along the reservoir shoreline. Significant daily or weekly fluctuations in water levels could allow for a more diverse shoreline wetland community that thrives with periodic water level changes. The presence of the reservoir could alter the groundwater table in the area immediately surrounding the reservoir (the new riparian zone), which could also affect vegetation composition and density in the vicinity of the reservoir. The magnitude and direction of this effect may depend on soils and topography, as these factors could influence the capacity for new vegetation species and/or communities to colonise the area.

Operation of the dam could reduce the amount of flow received by riparian systems downstream of the dam, which could alter the composition of riparian vegetation. River flow delivers critical nutrients, sediment, coarse debris, and other critical ecosystem components to riparian habitats. Also, riparian wetlands could become uplands due to the lack of flow.

Reservoirs often experience eutrophication, which can increase primary producers (phytoplankton and zooplankton) and spur the growth of aquatic vegetation including nuisance or ‘sudd’ plants. Aquatic weed species can degrade aquatic ecosystems by growing and spreading rapidly, forming dense floating mats of vegetation that overwhelm native vegetation, restricting light to the underwater environment, and depleting oxygen levels in the water.

The breakdown of organic matter (i.e. woody vegetation) in the reservoir could result in emissions of greenhouse gases, particularly carbon dioxide and methane. The amount of these gases that could be produced could depend on the amount of vegetation that is inundated by the reservoir, the total surface area of the reservoir, and the flux rate.
Further Studies Required in the EIA Phase

There is the potential for adverse impacts arising directly from both terrestrial and aquatic flora in the area. As such, a terrestrial flora and an aquatic flora specialist have been appointed to undertake specialist studies during the ESIA process.

7.1.10 Terrestrial and Aquatic Fauna

Potential Impacts

Construction Phase

The noise, dust and human activity from construction activities could affect disturbance-sensitive animals and potentially result in their temporary displacement from current habitats. The construction of new roads to enable access to construction areas may cause fragmentation of terrestrial habitats, also causing wildlife disturbance and displacement. Displaced fauna may be subject to increased hunting pressure. In addition, poachers could have easier access to the area via the newly constructed Project-related roads. Of particular concern will be the increased access to the project area afforded by the new proposed road between Mulungushi and Muchinga.

Inundation and Operational Phase

Reservoir inundation may result in displacement or drowning of terrestrial fauna from flooded riparian forest and open woodland habitats. Mortality due to drowning is likely to be more prevalent in ground-dwelling animals and smaller animals with limited mobility. If inundation occurs during the dry season when reptiles are aestivating (which is a state of dormancy similar to hibernation), these individuals could face mass drowning.

Inundation could cause a change in habitat conditions from riverine to lacustrine, which may increase the abundance of zooplankton, and have a subsequent impact on both aquatic and terrestrial fauna. The number and diversity of riverine aquatic species (riverine fish and macro-invertebrates) may decrease and conversely, the abundance and diversity of lacustrine species (phytoplankton, zooplankton, lacustrine fish and macro-invertebrates) could increase. The presence of the reservoir may also cause a shift in the terrestrial wildlife species assemblage from riparian to lacustrine. For example, the reservoir could reduce habitats for wildlife species that require flowing water (some insectivorous birds and bats) but increase foraging habitat for wildlife that prefers still or slow-moving waters such as water birds. Also, the reservoir may increase the perimeter of the existing river shoreline, and may increase the littoral habitat for wildlife.

Inundation could submerge tree trunks and other vegetation, which could significantly increase the habitat available for macro-invertebrates, molluscs, snails and mussels, and generate nutrient material into the food chain for fish.
Bird populations may be affected by loss of breeding and foraging habitat, primarily in the cliff/rocky outcrop habitats at the dam site and in the riparian habitats that could be inundated by the reservoir.

The presence of the dam may potentially reduce or eliminate downstream floods, potentially reducing riparian wetlands and the aquatic and terrestrial fauna that spawn, rear, and/or breed in these habitats. Migration patterns of fish and other aquatic species may be blocked by the dam, potentially causing disruption to spawning and foraging, which could lead to a possible decrease in gene flow and genetic variation in the river.

Further Studies Required in the EIA Phase

There is the potential for adverse impacts arising directly from terrestrial and aquatic fauna in the area. As such, a terrestrial fauna and an aquatic fauna specialist have been appointed to undertake specialist studies during the ESIA process.

7.1.11 Terrestrial and Aquatic Habitats

Potential Impacts

Construction Phase

Effects on terrestrial habitats during construction relate to the loss or disturbance of riparian and other vegetation in the immediate vicinity of construction activities, as is described in Section 7.1.9. The loss or disturbance of riparian vegetation could cause increased river bank erosion in the vicinity of the construction activities. Large equipment operations and equipment laydown could remove and/or disturb vegetation, potentially facilitating erosion of disturbed soils and compacting soils, thus increasing runoff velocity and erosion of down-gradient habitats.

Effects on aquatic habitats during construction of the Project relate to the diversion of surface flows, increased sedimentation and the direct loss and disturbance of in-stream aquatic habitats in the immediate vicinity of construction activities. These construction-related effects on aquatic habitats should be localised and smaller in magnitude compared to the operational effects of the Project.

During Inundation and Operation

Impoundment of the river could replace existing hydrographically distinct riverine habitat units that are characterised by a range of flow velocities and depths with a relatively homogenous reservoir. This habitat conversion may alter the species assemblage in the reservoir by displacing aquatic fauna that require riverine (flowing) conditions with habitat generalists (i.e. species that are not restricted to specific conditions or a specific food species) and species that thrive in lacustrine (dam) conditions. Although the new lacustrine
habitats in the reservoir could differ from existing riverine habitats, the reservoir could provide more aquatic habitat than the river and may support a larger total population of fish than the river does under current conditions.

Alterations of depth and flow regimes may alter the surface water temperature within and downstream of the affected reach. Increased water temperature can affect the suitability of aquatic habitats for fish and macro-invertebrates and potentially cause a shift in species composition to more generalist species that are tolerant of a wide range of temperature conditions.

Natural flow regimes are important factors in determining the morphological characteristics, and thus the habitat value, of natural river channels. Habitat-forming flows often correspond to high-volume flows during flood events. Operation of the dam (i.e. flow releases) could limit the magnitude or duration of downstream high flow events and this could retard the natural progression of aquatic habitat formation in the river and potentially result in changes in species composition, density, and diversity of aquatic fauna downstream of the dam.

Operation of the dam may also interrupt natural sediment transport mechanisms, especially for coarse gravel and cobble, and the availability of course substrate downstream of the dam could decline. The depletion of coarse substrate reduces fish spawning habitat and substrate for invertebrates (macro-invertebrates, molluscs, and crustaceans).

Further Studies Required in the EIA Phase

There is the potential for adverse impacts arising directly from both terrestrial and aquatic habitats in the area. As such, the appointed terrestrial flora, terrestrial fauna and an aquatic flora and fauna specialists have been appointed to undertake specialist studies during the ESIA process.

7.1.12 Summary

In summary, the following environmental affects and/or potential negative environmental impacts associated with the proposed Muchinga HPP are deemed to be the most significant and will need to be assessed further in the ESIA process:

- A potential change in downstream river morphology due to sediment transport, which in turn could consequently affect river water turbidity and flow velocities, and hence potentially impact on riverine ecosystems.
- A modification to downstream flow volumes may have a major impact on aquatic and riverine habitats downstream from the proposed inundation. Downstream flow volumes will be modified, as upstream flows will be captured in the reservoir.
- There is the potential for the Project to affect water quality and as a result have adverse impacts to downstream users.
Potential impacts to terrestrial and aquatic fauna as a result of disturbance and displacement during the construction and operational phase of the proposed Project.

Inundation will potentially result in a change in habitat conditions from riverine to lacustrine, which will have a subsequent impact on both aquatic and terrestrial fauna and fauna.

Habitat conversion, which may alter the species assemblage.

Impacts to soils and subsequent impacts to downstream water quality as result of increased turbidity and sedimentation as well as to land capability and the communities reliant on these soils for subsistence agriculture.

Increased access afforded by major new roads will likely increase the flora harvesting and fauna poaching in the area.

There may be potential noise impacts to social and faunal receptors within the Project Area.

7.2 POTENTIAL SOCIAL IMPACTS

This section describes the potential impacts to the social and socio-economic environment as a result of the construction and operation of the Project. Potential social and socio-economic impacts are presented both for the construction and operations phases of the proposed Muchinga HPP.

7.2.1 Physical and Economic Displacement

Potential Impact

The project will potentially result in physical and economic displacement of several households due to the following:

- The upgrade/expansion of existing roads to the project site; and
- The proposed new road and 330Kv transmission line from Muchinga HPP to Mulungushi HPP.

The potential displacement of households linked to the project will be permanent. The land that will potentially be acquired for the project include land currently used for agricultural purposes and household infrastructure. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process. The findings of the SIA will inform the Resettlement Policy Framework (RPF). This document will be an annexure to the ESIA Report.

7.2.2 Surrounding Landuse

Potential Impacts

The proposed Muchinga HPP and ancillary infrastructure (roads, transmission lines) has the potential to affect current landuse practices within the proposed Muchinga HPP Project area and surroundings. These include shifting cultivation practices, burning for grazing and grazing and charcoal burning.
activities. Furthermore, the proposed Project has the potential to impact on community subsistence farming practices; it is anticipated that the impact will be minimal as the proposed area for the Project is far removed from any known communities.

**Further Studies Required in the EIA Phase**

There is the potential for the proposed Project to impact on surrounding landuse. As such, a **socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.**

### 7.2.3 Loss of Land and Natural Resources

#### Construction Phase

Although unlikely, there is a small possibility that land may be lost due to the construction and presence of the following Project components:

- **Construction camp and associated infrastructure.** The precise location of the construction camp and associated infrastructure and the amount of land required for this has not been confirmed.

- **Quarries and borrow pits for dam construction material.** This may result in the loss of productive land unless they are sited within the proposed area for inundation. It is currently unclear exactly where they could be situated.

- **Transmission line corridors.** During construction of transmission lines, vegetation will be cleared within the transmission line way-leave. The precise routes of the transmission lines are yet to be determined.

Furthermore, the construction of the dam is likely to require large numbers of skilled, semi-skilled and unskilled workers, many of whom are likely to come from communities surrounding the Project area due to a lack of locally skilled labour. The size and make-up of this workforce is not yet determined. However the presence of large numbers of workers in the area may result in an increased demand for firewood, bush meat, fish, charcoal, and other natural resources from the surrounding riparian forests, open woodlands and rivers.

#### Operational Phase

Once the dam construction is complete and the reservoir begins to fill, all land in the inundation footprint will be affected. Impacts due to inundation may include:

- Complete submergence of any potential homesteads in the area (this is unlikely as the area proposed for inundation is far removed from all known communities and households);
• The potential submergence of lands that are used for common access to natural resources, including riparian forests and woodlands and grazing land.

Households that lose a significant proportion of their land could require resettlement. The extent to which the proposed Project could potentially cause communities to lose control over their land and resources is unclear at this stage and needs to be understood.

Further Studies Required in the EIA Phase

There is the potential for loss of land and natural resources arising directly from the footprint of the proposed and ancillary Projects. As such, socio-economic and flora specialists have been appointed to undertake specialist studies during the ESIA process.

7.2.4 Disruption to Social Networks and Cultural Change

Construction and Operational Phase

The influx of large numbers of outsiders, who could owe little allegiance to local tradition (and who may have much more money than local people) may result in significant social tension and change.

No data or assessments exist that can be used to approximate the extent to which the construction and operation of the proposed Muchinga HPP is likely to accelerate this change and/or cultural erosion. This gap needs to be filled to supply realistic information about the likely levels of influence as well as to design mitigation measures to limit these potential influences, especially during the construction phase of the dam.

Local fears related to this centres around the influence on children, the introduction of more socio-cultural heterogeneity into the area, intermarriage between members of local communities and people from outside, and influence on the effective local/traditional institutional structures. These fears stem from the perceived influence of improved accessibility to the area, the large number of workers that could come into the area during construction, the possibility that many of them could stay behind after construction and compete for resources etc.

Further Studies Required in the EIA Phase

There is the potential for cultural change and for social networks to be disturbed as a result of the proposed Project. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.
7.2.5 **Pressure on Social Infrastructure**

**Construction Phase**

Communities surrounding the Project area suffer from inadequate schooling and health facilities, a shortage of potable water and transport facilities, and an inadequate road network. The influx of large numbers of people could place a greater strain on these already limited facilities and infrastructure.

**Further Studies Required in the EIA Phase**

There is the potential for social infrastructure to be negatively impacted on as a result of the proposed Project. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.

7.2.6 **Impacts on Community Health**

**During Construction**

Key communicable and other diseases that may be affected by the presence of the Project during construction are:

- Acute respiratory infections and tuberculosis (TB);
- HIV/AIDS, Hepatitis B and C, and other sexually transmitted infections; and
- Malaria.

There is a risk that the workforce employed during the construction period of the Project could impact the local communities’ health status. Groups vulnerable to health impacts would include young children, the elderly, the socio-economically deprived, and groups with chronic health conditions. The origin, size and health status of the workforce (a large percentage of which could be recruited outside of Zambia), and their cultural norms, could influence the nature and severity of these risks. For example, case studies of large construction Projects elsewhere in the world have shown that the presence of a large number of single males in the construction workforce has increased demand for casual sex. Measures to manage the interaction between the local community and the workforce would need to be developed and implemented.

A significant increase in traffic levels combined with a number of factors including poor current road conditions, uneven surfaces and the limited understanding of road safety among local drivers and pedestrians is likely to increase the number of accidents.

**Operational Phase**

In some respects, dam Projects can improve the well-being of populations around the dam area (e.g. new infrastructure and better access to health care), and potentially increase the food supply (as a result of improved transport
infrastructure). However, there are risks that health and nutrition may worsen, particularly in young children.

Communicable diseases may appear or increase in incidence owing to the influx of migrants to the area. Sexually-transmitted infections and HIV/AIDS are a particular problem.

An increase in the numbers of insects particularly mosquitoes and blackfly may also have harmful effects on populations adapting to the new environment. There are also likely to be socio-demographic changes associated with changes in reproductive behaviour and women's activities. The location and nature of new homes and infrastructure (e.g. schools, health centres and roads) also contribute to the success or failure of dam Projects.

Further Studies Required in the EIA Phase

There is the potential for community health to be negatively impacted on as a result of the proposed Project. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.

7.2.7 Impact on the Local Economy

Construction Phase

Many people consulted during the public participation process have high expectations with regards the benefits that they expect could accrue from the presence of large numbers of waged workers to whom they could sell goods and services. The potential impacts are summarised below.

- Employment during construction: The construction of the Project could take place over several years, requiring a potentially large workforce. It is not clear at this stage neither what skill types could be required, nor the extent to which employment opportunities could be created in the Project area. The benefits to the local community from jobs could be dependent on the extent of local recruitment.

- Increase in the local prices: There could probably be a significant, though short-term improvement in the local economy (for example due to local procurement of supplies and services by the camp). However, there could also be an increase in the price of local goods, which could make life more difficult for those vulnerable sectors of society that are unlikely to benefit from the construction phase and are already finding it difficult to get by.

- Elite Capture: The likelihood of elite capture of potential benefits from the Project by external more knowledgeable and more powerful parties.
Further Studies Required in the EIA Phase

There is the potential for the local economy to be negatively impacted on as a result of the proposed Project. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.

7.2.8 Impacts on Fishing (Upstream and Downstream)

Operational Phase

From the experience of other dams around the world, it is probable that the existence of a permanent lake upstream of the dam wall would create a reservoir fishery that is more productive than the current riverine fishery. In the case of many man-made dams, high fish yields were recorded during the first few years after dam construction but dropped as the reservoir matured.

The change in the flow regime of the river downstream could result in a decline in fish resources. The impact of declining fish stocks on food security in the area is however unlikely to be significant, given that the directly affected communities downstream of the proposed dam do not commonly utilise fish as a main source of food.

Further Studies Required in the EIA Phase

There is the potential for local fishing to be negatively impacted on as a result of the proposed Project. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.

7.2.9 Disturbance Due to Dust, Noise and Safety Hazards from Traffic

Construction Phase

The construction of the dam could require large quantities of building material and other supplies (fuel, supplies to the construction village etc.), some of which could be delivered to the site by trucks that are likely to pass by homesteads (although the exact access routes to site are yet to be defined). The road to the site is unpaved and the traffic through these homesteads could result in significant disruption from dust and noise from passing traffic. Due to the rural nature of potential homesteads, they would have experienced little traffic so far, increasing their susceptibility to disturbance. Safety could also be an important issue for residents who are unused to much traffic.

Further Studies Required in the EIA Phase

There is the potential for local communities to be negatively impacted on as a result of the proposed Project. As such, a socio-economic specialist has been appointed to undertake specialist studies during the ESIA process. Dust and noise issues associated with traffic will be mitigated as much as possible through the careful routing of access roads and inclusion of appropriate measures in the relevant EMP and detailed Management Plans. As such, and
as already mentioned, specialist air quality and noise studies are not deemed a requirement.

7.2.10 Loss of Cultural Heritage

Construction Phase

Should the detailed cultural and heritage study identify any significant cultural and/or heritage resources, these heritage aspects will need to be considered in detail and mitigation measures negotiated with directly affected communities or households.

Further Studies Required in the EIA Phase

There is the potential for cultural and/or heritage resources to be lost as a result of the proposed Project. As such, a cultural and heritage specialist has been appointed to undertake specialist studies during the ESIA process.

7.2.11 Summary

In summary, the following potential negative and positive socio-economic impacts associated with the proposed Muchinga HPP are deemed to be the most significant and will need to be assessed further in the ESIA process:

- Potential physical and economic displacement of several households and potential loss of land (arable land etc.)
- Potential loss of natural resources (firewood, bush meat, fish charcoal, and other natural resources from the surrounding riparian forests, open woodlands and rivers).
- Potential impacts from migrants to surrounding communities with respect to their local traditions. This may result in significant social tension and change.
- Potential impacts associated with greater strains on already limited facilities and infrastructure, due to a potential influx of people into surrounding communities.
- The potential impact to surrounding communities in that the workforce employed during the construction and operational period of the project could impact the local communities’ health status.
- Potential positive impacts arising directly through employment during the construction phase of the proposed Project.
- Potential impacts to surrounding communities associated with a potential increase in food prices as a result of increased demand.
- Potential positive and negative impacts to individuals utilising the Mkushi and Lunsefwa River (downstream from the Mkushi and Lunsemfwa confluence) for fishing.
- Potential affects to cultural and heritage resources.
7.3 Secondary Impacts

There are a number of potential secondary impacts from the Project that need to be considered in the ESIA, these include the following:

- With increased access and the development of a dam, the proposed Muchinga HPP has the potential to promote tourism in the area (particularly with improved access to Bell Point), which would require improvements to infrastructure necessary for tourism (e.g. transportation, utilities, accessible energy, accommodation etc.). Such infrastructure improvements could result in habitat loss, wildlife disturbance, and habitat fragmentation and extend the effects of the Project over a larger geographic area.
- The above mentioned tourism infrastructure improvements may change the ‘sense-of-place’ of the area, which could detract from its present wilderness appeal favoured and sought after by tourists to the Region.

7.4 Environmental and Social Impact Assessment Study

All potentially significant environmental impacts (physical, biological, socio-economic and cultural and heritage) associated with the proposed Project have been identified in the Scoping Study and (where applicable) will be further investigated and assessed within the ESIA study through specialist studies. Where required, mitigation measures will be proposed.

The ESIA will suitably investigate and address all environmental issues in order to provide competent authorities with sufficient information to make an informed decision regarding the proposed Project.

7.4.1 Aim of the Environmental Impact Assessment

The ESIA will aim to achieve the following:

- Provide an overall assessment of the physical, biological, socio-economic and cultural and heritage environments affected by the proposed Project;
- Assess the Project Area in terms of its environmental criteria;
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- Undertake a fully inclusive public participation process.

The adequate assessment and evaluation of the potential impacts and benefits that will be associated with the proposed Project necessitates the development of a scientific methodology that will reduce the subjectivity involved in making such evaluations. A clearly defined methodology is used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment. For this the proposed Project must be considered in the context of the area and the people that will be affected.
Nonetheless, an impact assessment will always contain a degree of subjectivity, as it is based on the value judgment of various specialists and EIA practitioners. The evaluation of significance is thus contingent upon values, professional judgement, and dependent upon the environmental and community context. Ultimately, impact significance involves a process of determining the acceptability of a predicted impact to society.

The purpose of impact assessment is to identify and evaluate the likely significance of the potential impacts on identified receptors and resources according to defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise, reduce or compensate for any potential adverse environmental effects, and to report the significance of the residual impacts that remain following mitigation.

There are a number of ways that impacts may be described and quantified. An impact is essentially any change to a resource or receptor brought about by the presence of the proposed Project component or by the execution of a proposed Project related activity.

The nature of the Project may determine whether one needs to assess both routine and non-routine impacts. Non-routine impacts generally relate to accidents and could include oil/chemical/fuel spills, emergency venting of noxious gases, etc. In most cases, it would be sensible to have separate chapters for the assessment of routine and non-routine impacts.

The types of impacts and terminology to be used in the assessment are outlined in Table 7.1.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact nature</strong></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>An impact that is considered to represent an improvement on the baseline or introduces a positive change.</td>
</tr>
<tr>
<td>Negative</td>
<td>An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.</td>
</tr>
<tr>
<td><strong>Direct impact</strong></td>
<td>Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptors (eg. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).</td>
</tr>
<tr>
<td><strong>Indirect impact</strong></td>
<td>Impacts that result from other activities that are encouraged to happen as a consequence of the Project (eg. in-migration for employment placing a demand on resources).</td>
</tr>
<tr>
<td><strong>Cumulative impact</strong></td>
<td>Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.</td>
</tr>
</tbody>
</table>

(1) The assessment of cumulative impacts is qualitative and is often discussed in a separate chapter in the ESIA Report. One should remember to include the assessment of cumulative impacts in the terms of reference to specialists.
7.4.2 Assessing Significance

There is no single accepted definition of ‘significance’ and its determination is, therefore, somewhat subjective. However, it is generally accepted that significance is a function of the magnitude of the impact and the likelihood of the impact occurring. It is widely accepted that Impact Magnitude (or Severity) is a function of the extent, duration and intensity of the impact.

The criteria used to determine significance are summarised in Table 7.2. These criteria (specifically Extent and Duration) should be customised to suit individual Projects.

**Table 7.2 Significance Criteria**

<table>
<thead>
<tr>
<th>Impact magnitude – the degree of change brought about in the environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-site</strong> – impacts that are limited to the site boundaries.</td>
</tr>
<tr>
<td><strong>Local</strong> – impacts that affect an area in a radius of XX km around the site.</td>
</tr>
<tr>
<td><strong>Regional</strong> – impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.</td>
</tr>
</tbody>
</table>

**Extent**

| National – impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences. |
| **Transboundary/International** – impacts that affect internationally important resources such as areas protected by international conventions. |

<table>
<thead>
<tr>
<th><strong>Duration</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary</strong> – impacts are predicted to be of short duration and intermittent/occasional.</td>
</tr>
<tr>
<td><strong>Short-term</strong> – impacts that are predicted to last only for the duration of the construction period.</td>
</tr>
<tr>
<td><strong>Long-term</strong> – impacts that will continue for the life of the Project, but ceases when the Project stops operating.</td>
</tr>
<tr>
<td><strong>Permanent</strong> – impacts that cause a permanent change in the affected receptor or resource (eg. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Intensity (1)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BIOPHYSICAL ENVIRONMENT:</strong> Intensity can be considered in terms of the sensitivity of the biodiversity receptor (ie. habitats, species or communities).</td>
</tr>
<tr>
<td><strong>Negligible</strong> – the impact on the environment is not detectable.</td>
</tr>
<tr>
<td><strong>Low</strong> – the impact affects the environment in such a way that natural functions and processes are not affected.</td>
</tr>
<tr>
<td><strong>Medium</strong> – where the affected environment is altered but natural functions and processes continue, albeit in a modified way.</td>
</tr>
<tr>
<td><strong>High</strong> – where natural functions or processes are altered to the extent that it will temporarily or permanently cease.</td>
</tr>
</tbody>
</table>

Where appropriate, national and/or international standards are to be used as a measure of the impact. Specialist studies should attempt to quantify the magnitude of impacts and outline the rationale.

---

(1) The frequency of the activity causing the impact also has a bearing on the intensity of the impact, ie. the more frequent the activity, the higher the intensity.
SOCIO-ECONOMIC ENVIRONMENT: Intensity can be considered in terms of the ability of Project affected people/communities to adapt to changes brought about by the Project.

**Negligible** - there is no perceptible change to people’s livelihood

**Low** - People/communities are able to adapt with relative ease and maintain pre-impact livelihoods.

**Medium** - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support.

**High** - Those affected will not be able to adapt to changes and continue to maintain pre-impact livelihoods.

<table>
<thead>
<tr>
<th>Impact likelihood – the likelihood that an impact will occur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likely</td>
</tr>
<tr>
<td>Definite</td>
</tr>
<tr>
<td>Unlikely</td>
</tr>
</tbody>
</table>

Once a rating is determined for magnitude and likelihood, the matrix in **Table 7.3** can be used to determine the impact significance.

**Table 7.3 Example of Significance Rating Matrix for Positive and Negative Impacts**

<table>
<thead>
<tr>
<th>SIGNIFICANCE RATING</th>
<th>LIKELIHOOD</th>
<th>Unlikely</th>
<th>Likely</th>
<th>Definite</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGNITUDE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Negligible</td>
<td>Minor</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
<td>Moderate</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
<td>Major</td>
<td>Major</td>
<td></td>
</tr>
</tbody>
</table>

A colour scale for negative and positive ratings is given in **Table 7.4**.

**Table 7.4 Colour Scale for Ratings**

<table>
<thead>
<tr>
<th>Negative ratings</th>
<th>Positive ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Minor</td>
<td>Minor</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Major</td>
<td>Major</td>
</tr>
</tbody>
</table>

**Table 7.5 Significance Definitions**

<table>
<thead>
<tr>
<th>Significance definitions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible significance</td>
<td>An impact of negligible significance is where the magnitude is negligible, low or medium and the likelihood of the impact occurring is unlikely or likely.</td>
</tr>
</tbody>
</table>
An impact of negligible significance is where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels.

<table>
<thead>
<tr>
<th>Significance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
<td>An impact of minor significance is where the magnitude of the impact is low but the likelihood is high or where the magnitude is high but the likelihood of occurrence is unlikely or likely.</td>
</tr>
<tr>
<td></td>
<td>An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.</td>
</tr>
<tr>
<td>Moderate</td>
<td>An impact of moderate significance is where the magnitude is medium to high and the likelihood of the impact occurring is likely or definite.</td>
</tr>
<tr>
<td></td>
<td>An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that “moderate” impacts have to be reduced to “minor” impacts, but that moderate impacts are being managed effectively and efficiently.</td>
</tr>
<tr>
<td>Major</td>
<td>An impact of major significance is where the magnitude of the impact is medium to high and the likelihood of the impact occurring is also likely or definite.</td>
</tr>
<tr>
<td></td>
<td>An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the Project.</td>
</tr>
</tbody>
</table>

Once the significance of the impact has been determined, it is important to qualify the degree of confidence in the assessment. Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence can be expressed as low, medium or high.

**Mitigation Potential and Residual Impacts**

It is expected that for the identified significant impacts, the Project team will work with the client in identifying suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the Project design in order to avoid or reduce the negative impacts or enhance the positive impacts will be developed. A description of these mitigation measures should also be included within the EMP.

Residual impacts are those impacts which remain once the mitigation measures have been designed and applied. Once the mitigation is applied, each impact is re-evaluated (assuming that the mitigation measure is effectively applied) and any remaining impact is rated once again using the process outlined above. The result is a significance rating for the residual impact.
The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Box 7.1.

**Box 7.1 Mitigation Hierarchy**

<table>
<thead>
<tr>
<th>THE MITIGATION HIERARCHY FOR PLANNED PROJECT ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Avoid at Source; Reduce at Source</strong></td>
</tr>
<tr>
<td>Avoiding or reducing at source is essentially ‘designing’ the Project so that a feature causing an impact is designed out (e.g. a waste stream is eliminated) or altered (e.g. reduced waste volume). Often called minimisation.</td>
</tr>
<tr>
<td><strong>Abate on Site</strong></td>
</tr>
<tr>
<td>This involves adding something to the basic design to abate the impact - pollution controls fall within this category. Often called ‘end-of-pipe’.</td>
</tr>
<tr>
<td><strong>Abate at Receptor</strong></td>
</tr>
<tr>
<td>If an impact cannot be abated on-site then measures can be implemented off-site - an example of this would be to use the stand-by vessel to help control the level of interference with fishing activity.</td>
</tr>
<tr>
<td><strong>Repair or Remedy</strong></td>
</tr>
<tr>
<td>Some impacts involve unavoidable damage to a resource, e.g. land disturbance. Repair essentially involves restoration and reinstatement type measures, such as base camp closure.</td>
</tr>
<tr>
<td><strong>Compensate in Kind</strong></td>
</tr>
<tr>
<td>Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate.</td>
</tr>
</tbody>
</table>
8 ANALYSIS OF ALTERNATIVES

This Chapter briefly discusses the various hydropower alternatives investigated to date in the Lunsemfwa River catchment, and provides background to the various layout, site and technology alternatives explored. This Chapter also presents the two most recent alternatives that were considered for the proposed Muchinga HPP, and provides a motivation for choosing the preferred alternative.

8.1 PREVIOUS INVESTIGATIONS UNDERTAKEN

Since 1929, investigations by Kanthack (1931) (1), Ayer (1935) (2), and Kanthack (1957) (3) have been undertaken to examine the feasibility of exploiting the water resources of the Lunsemfwa and Mita Hills catchments for hydropower generation. These studies led to the development of the existing Mita Hills Reservoir and Lunsemfwa Hydropower Station, constructed in the 1950s.

In 2005, the LHPC initiated further studies (Thomasson 2005) (4) in order to assess the potential of expanding these hydropower facilities on the Lunsemfwa River downstream of the existing Lunsemfwa Power Station, and to incorporate the hydropower potential of the Mkushi River, a tributary to the Lunsemfwa River.

The studies undertaken in 2005 identified alternative options for the development of the available generating head of the lower Lunsemfwa and Mkushi Rivers. The various options studied included the following:

- Lunsemfwa River
  - Option L1 - A new scheme that bypasses the existing Lunsemfwa Power Station and which utilises the available generating head in the next 7km of the river downstream of the station to form a single project. Two sub options were examined comprising Option L1a with a surface powerhouse and Option L1b with an underground powerhouse.
  - Option L2 - A cascade development, comprising a new scheme located downstream of the existing Lunsemfwa Power Station which utilises the available generating head in the next 7km of the River downstream.

(1) Kanthack and Partners (1931). Lunsemfwa Gorge, Hydroelectric Power Scheme, Northern Rhodesia
(3) Kanthack and Partners (1957). Lunsemfwa Hydroelectric Scheme, Report on the Construction of a 50m underground Power Station in the Lunsemfwa Gorge
- Mkushi River
  - **Option M1** - An independent hydropower development located on the Mkushi River with an outfall near the confluence with the Lunsemfwa River.
  - **Option M2** - A diversion scheme that would transfer water from the Mkushi River to the Lunsemfwa catchment, in order to enhance the flow through the Lunsemfwa Power Stations.

Additional studies undertaken in 2008 (Thamasson, 2008)\(^{(1)}\) extended these options by examining the following:

- The potential for commanding the entire head of the Lunsemfwa and Mkushi Rivers down to Bell Point, as a single power scheme;
- A variation of the single Lunsemfwa and Mkushi Scheme, comprising the same headworks but with a tailrace outfall located at the base of the Muchinga escarpment, thereby commanding an increase in head;
- A single variation of the separate Mkushi scheme extending to the base of the Muchinga escarpment;
- Options for raising the full supply of the Mita Hills Dam;
- Options for raising the diversion weir located downstream of the Mita Hills Dam, which feeds the existing Lunsemfwa Power Station;
- The addition of a fourth unit at the existing Lunsemfwa Power Station\(^{(2)}\).

These studies concluded that a new project utilising the remaining hydropower potential of the Lunsemfwa River and possibly combining the hydropower potential of the Mkushi River, would be the most attractive option. As such, two further conceptual schemes were developed by Studio Pietangeli (SP), who were contracted by the Muchinga Power Company to undertake a conceptual schemes feasibility study (SP Engineers, 2010)\(^{(3)}\). These two alternatives include the SP and the RFP Scheme, discussed in further detail below. Further to Studio Pietangeli’s work, the Muchinga Power Company subsequently contracted Mott MacDonald to undertake a Final Feasibility Study for the Muchinga HPP. This study built on the SP Scheme, adding an additional road and powerline to Mulungushi, and resulted in the further alternative which is the current project description, as discussed in detail in Chapter 3.

### 8.2 RFP CONCEPTUAL SCHEME

The RFP conceptual scheme proposed the utilisation of the river stretch downstream of the existing structures of the Lunsemfwa HPP. This scheme is

---


\(^{(2)}\) A fourth turbine, which will generate an additional 6MW, will be installed in the existing Lunsemfwa power house by 2012.


a particularly complex scheme which would include the synchronisation of three independent hydropower plants, together with the existing Lunsemfwa HPP. The three plants (including Lunsemfwa) would operate in a cascade on the main river course while operating independently (Figure 8.1).

Due to the Mkushi plant being less attractive than the other three plants, the RFP scheme has been divided in two phases:

- Phase 1 – Tolomba and Muchinga HPPs (Figure 8.1); and
- Phase 2 – Mkushi HPP (Figure 8.2).

This phased approach allows for a more attractive scheme for the first investors. The Tolomba and Muchinga power plants on the Lunsemfwa River have thus been designed to allow for the completion of the scheme during Phase 2.

It is worthwhile observing that most of the civil works, including the two powerhouses, are envisaged underground and not far from the slopes of the River. This may possibly increase uncertainties during the construction of the project and may increase the cost of construction.

8.2.1 Phase 1: Tolomba

The proposed Tolomba plant would be located on the Lunsemfwa River (Figure 8.1), which would harness the hydropower potential of approximately 11.5 km (km 37 to km 48.5 downstream of Mita Hills dam) of the River. This would allow for installed power of 60MW from this plant. The proposed structures for this plant are detailed in Table 8.1.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolomba Weir:</td>
<td>Height: 10m (RCC)</td>
</tr>
<tr>
<td>Headrace Tunnel:</td>
<td>Q = 28 m3/s, L = 8 km, D = 4.5 m</td>
</tr>
<tr>
<td>Penstock + shaft:</td>
<td>Height: 190 m</td>
</tr>
<tr>
<td>Underground Powerhouse:</td>
<td>2 Francis turbines</td>
</tr>
<tr>
<td>Tailrace tunnel:</td>
<td>D = 5 m, L = 1 km</td>
</tr>
</tbody>
</table>

8.2.2 Phase 1: Muchinga HPP

The proposed Muchinga plant would be located on the downstream stretch of the project (Figure 8.1) and will derive the return flows from the Tolomba (Phase 1) and Mkushi (Phase 2) powerhouses. The plant will harness the hydropower potential of a stretch of approximately 11 km (km 49 to km 60 downstream of the Mita Hills Dam) of the River. This would allow an installed capacity of 58MW. The proposed structures for this plant are detailed in Table 8.2.
### Table 8.2 Key Structures of Muchinga Phase 1

<table>
<thead>
<tr>
<th>Structure</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kandulwe Weir</td>
<td>Height: 10m (Gravity type)</td>
</tr>
<tr>
<td>Headrace Tunnel</td>
<td>$Q = 42 \text{ m}^3/\text{s}, \text{L} = 11 \text{ km}, D = 5 \text{m}$</td>
</tr>
<tr>
<td>Penstock + shaft</td>
<td>Height: 140 m</td>
</tr>
<tr>
<td>Underground Powerhouse</td>
<td>2 Francis turbines</td>
</tr>
<tr>
<td>Tailrace tunnel</td>
<td>$D = 5 \text{m}, \text{L} = 1 \text{Km}$</td>
</tr>
</tbody>
</table>

### 8.2.3 Phase 2: Mkushi HPP

The proposed Mkushi phase (Phase 2) would derive flows from the Mkushi River (Mkushi Reservoir) while capturing water from the Lunsemfwa River. The proposed structures for this plant are detailed in Table 8.3.

### Table 8.3 Key Structures of Mkushi Phase 2

<table>
<thead>
<tr>
<th>Structure</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mkushi Dam</td>
<td>Height: 120 m, (Gravity type)</td>
</tr>
<tr>
<td>Headrace Tunnel</td>
<td>$Q = 9 \text{ m}^3/\text{s}, \text{L} = 8 \text{ km}, D = 4 \text{m}$</td>
</tr>
<tr>
<td>Penstock + shaft</td>
<td>$H = 300 \text{ m}$</td>
</tr>
<tr>
<td>Underground Powerhouse</td>
<td>1 Francis turbine</td>
</tr>
<tr>
<td>Tailrace tunnel</td>
<td>$D = 5 \text{m}, \text{L} = 1\text{Km}$ (in common with Tolomba)</td>
</tr>
</tbody>
</table>
Figure 8.1  RFP Conceptual Scheme: Phase 1
8.3 **KEY BENEFITS AND DRAWBACKS OF THE RFP SCHEME, AND COMPARISON WITH THE SP SCHEME**

A comparative analysis has been undertaken for the two alternative schemes, as well as for the SP scheme. A summary of the key benefits and drawbacks of each scheme is presented in Table 8.4, and discussed below.

It should be noted that this analysis is based on the results of initial conceptual studies, and may be refined as the feasibility studies progress.

**Table 8.4 Benefits and Constraints of the Alternative Schemes**

<table>
<thead>
<tr>
<th>RFP Scheme</th>
<th>Benefits</th>
<th>Drawback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Allows for a phased development following available financing.</td>
<td></td>
<td>• Lunsemfwa and Mkushi basins are not connected, thus this option requires complex reservoir operating rules to reduce water losses.</td>
</tr>
<tr>
<td>• Is not reliant on the construction of the Mkushi Dam.</td>
<td></td>
<td>• This alternative includes four independent powerhouses resulting in:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Complex synchronization of the powerhouses;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Significant operating and maintenance costs;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Lower operating flexibility; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Lower availability of firm energy during maintenance and drought periods.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construction of the access roads to the three projects requires higher costs and will need to be constructed over a longer duration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Most works are underground and closer to the river slopes, which equates to higher costs and a longer construction duration.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SP Scheme</th>
<th>Benefits</th>
<th>Drawback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Lunsemfwa and Mkushi River Basins would be connected through a waterway, resulting in:</td>
<td></td>
<td>• It would not be convenient to develop the SP scheme in phases.</td>
</tr>
<tr>
<td>o Higher operating flexibility;</td>
<td></td>
<td>• The SP scheme is reliant on the construction of the Mkushi Dam, without it, the scheme would not be viable.</td>
</tr>
<tr>
<td>o Efficient exploitation of the Mkushi hydropower potential; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Higher energy production.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The scheme includes one powerhouse, therefore there is:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Simple standard operating rules;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Higher operating flexibility;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Lower construction costs; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Higher availability of firm energy.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The proposed SP Scheme which now forms part of the current project description (*Chapter 3*) with the interconnection of the Lunsemfwa and Mkushi River catchments and only one powerhouse is more advantageous than the RFP scheme as it would be able to produce energy at a reduced cost (*Table 8.5*), whilst being more convenient both for construction and operational reasons *(1)*.

### Table 8.5  *Basic Economic parameters of the RFP Schemes vs. the SP Scheme*

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>RFP Scheme</th>
<th>SP Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Phase 1</td>
<td>Phase 2</td>
</tr>
<tr>
<td>Power Generation</td>
<td>MW</td>
<td>120</td>
<td>155</td>
</tr>
<tr>
<td>Energy Production</td>
<td>GWh/Year</td>
<td>1050</td>
<td>1350</td>
</tr>
<tr>
<td>Revenue</td>
<td>M$/Year</td>
<td>42</td>
<td>54</td>
</tr>
<tr>
<td>Construction Costs</td>
<td>M$</td>
<td>210</td>
<td>360</td>
</tr>
<tr>
<td>Construction Period</td>
<td>Years</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Energy Value</td>
<td>$/kWh</td>
<td>0.023</td>
<td>0.033</td>
</tr>
</tbody>
</table>

The RFP scheme should be adopted only if financial constraints suggest the development of the project in phases. The Tolomba and Muchinga plants (the RFP scheme: Phase 1) alone are economically attractive, even if slightly less so than the SP scheme. However, the hydropower development of the Mkushi River flows with this proposed scheme would not be fully utilised and the construction and operational costs (complex scheme with 4 powerhouses to be synchronized) is not attractive.

The SP scheme is therefore technically more viable and financially attractive for investors and is thus the preferred alternative. It is this alternative that forms the key project component (the Muchinga HPP) of the preferred alternative put forward by Mott MacDonald. In addition to the Muchinga HPP project component, the Mott MacDonald preferred alternative incorporates an additional permanent access road and powerline from Muchinga to Mulungushi. It is this Mott Mac Donald scheme that is covered in this Scoping report, and for the ESIA going forward.

As per Chapter 7, Sections 7.1 and 7.2, it is anticipated that the following key environmental and social aspects will be impacted by the proposed Project:

- Soils;
- Terrestrial and aquatic flora;
- Terrestrial fauna;
- Environmental flows and associated impacts to downstream aquatic ecology;
- Water quality, both within the impoundment (on the Mkushi River) and downstream;
- Socio-economic impacts; and
- Cultural heritage.

These aspects will be further investigated and assessed within the ESIA phase through specialist studies. The ESIA will suitably identify, investigate and address all environmental and social issues in order to provide the authorities with sufficient information to make an informed decision regarding the proposed project.

After this scoping phase, it is proposed that potential air quality and noise impacts resulting from the Project would be insignificant, primarily as a result of the Project location (its isolation) and the lack of any sensitive receptors in the Project Area. In addition, visual impacts associated with the proposed project will not be significant, as the proposed reservoir is far removed from any human inhabitation and the Lunsemfwa Bell Point (or otherwise known as the Lunsemfwa Wonder Gorge). As a result, it is proposed that air quality, noise and visual aspects be scoped out of the ESIA at this early stage.

As per the requirements of the EMA (Act 12 of 2011) Regulations (No. 28 of 1997), this Chapter also introduces the Project Proponent, who will be the applicant on behalf of the proposed Muchinga HPP for environmental authorisation for the Project. The ESIA team, responsible for the next phase of the study (namely, the ESIA phase), are also presented in this Chapter.

9.2 SPECIALIST INVESTIGATIONS

Information obtained through available secondary data provided an overview of the environmental and socio-economic aspects of the Project Area. The objective of specialist input at this scoping stage is to validate the secondary data obtained, to identify any gaps in data, and to suggest a plan of study for the ESIA. This plan of study is aimed at addressing any data deficiencies that exist in order that comprehensive specialist studies may be carried out to properly assess and address those environmental and social impacts identified.
The following specialist studies are proposed during the EIA phase of the proposed Muchinga HPP:

9.2.1 Soils

This study is set out to identify and determine the presence, distribution and extent of soil types in the Project Area. The objectives relate directly to land capability while land use aspects will be covered primarily by the socio-economic study.

This study will consist of field observations on a chosen grid supported by a predictive soil mapping technique. The following data will be captured at identified sites:

- Soil form, classified according to the Food and Agriculture Organization of the United Nations (FAO) Soil Classification System;
- Soil depth;
- Estimated texture;
- Current land use; and
- Land capability.

Soil properties will be evaluated and categorized into land capability classes, using a best practice approach. The extent of all land use practices will be surveyed and mapped. This process will be facilitated by aerial photography available for the immediate Project Area.

9.2.2 Terrestrial Flora

During the baseline assessment, information will be drawn from existing secondary data and preliminary field work to produce a vegetation community map. This map will aid the study in determining field sites for the analysis of vegetation types and the estimate of biomass loss in the area of inundation.

The extent and composition of vegetation types will be verified using Braun-Blanquet type surveys, on plots standardised to 20 x 50m. The riparian vegetation downstream of the dam at accessible sites will also to be sampled in order to determine potential impacts of altered flow regimes. The data will be analysed using multivariate techniques both for classification and ordination (1). Once classified, the above data collected in the field will enable the preparation of an updated vegetation community map.

From the survey data and additional observations and collections from the area, a species list will be compiled, with an estimate of the relative abundances of the species. In this way, the potential impact on especially rare

---

(1) Ordination and classification (or clustering) are the two main classes of multivariate methods that community ecologists employ. Ordination is the collective term for multivariate techniques that arrange sites along axes on the basis of data on species composition.
and endangered species, endemics and near-endemics, as well as protected species can be highlighted. Rescue missions for such specific species can then be incorporated into the recommended mitigation measures in the ESMP, if applicable.

Using the vegetation map and other additional data collected, a vegetation sensitivity map of the Project area and its surrounds will also be compiled. This will be used to inform the ESMP in terms of sensitive areas to be avoided, and will assist in planning the layout of infrastructure, in particular access roads, construction camp location, location of borrow pits (if applicable) and the routing of transmission lines.

9.2.3 Terrestrial Fauna

The preliminary inventory of the major habitats identified by the terrestrial flora will be used to aid the fauna specialist’s study (1). The aim of the study is to provide an updated list of species known and likely to occur in the Project Area with respect to their global, national and local status. Endemic, migrating and Red Data species occurring in the Project Area will be identified and the impact of the proposed development on their local and global status assessed. The possible changes to the faunal diversity and abundance and the possible conservation and operational impacts of the proposed dam and its associated infrastructure on fauna will also be assessed. Whether the proposed development is likely to pose any significant threat to any species will also be assessed.

9.2.4 Environmental Flows

There is no standard definition for environmental flows, however a good general description is provided by the International Union for Conservation of Nature’s (IUCN) pre-release to the 3rd World Water Forum in Kyoto, as follows:

“An ‘environmental flow’ is the provision of water within rivers and groundwater systems to maintain downstream ecosystems and their benefits, where the river or groundwater system is subject to competing water uses and flow regulation.”

Environmental flows are therefore more than minimum flows defined on the basis of hydrological conditions. Rather, they are flows that are optimally designed to allow for the multipurpose use of water, including water’s ecological functions and the integrity of river systems and wetlands. These functions, or ‘ecosystem services’, include the provision of clean drinking water, biodiversity conservation, aquatic food sources, flood protection, and various other recreational, cultural or religious based uses. This proposed Project, which involves the regulation of flow by infrastructure, should therefore avoid significantly altering flow regimes and preventing water resources from fulfilling these important functions and services.

(1) Faunal assemblages will include avifauna, mammals, amphibians and reptiles and invertebrates.
Although there are various methods for undertaking Environmental Flow Assessments (EFAs), they fall into four discrete groups, namely hydrological index methods, hydraulic rating methods, habitat simulation methods, and holistic methodologies (Acreman and Dunbar, 2004).

The chosen EFA method should incorporate an integrated assessment of environmental, social and economic effects and benefits. The EFA methodology to be adopted should be scoped according to the levels of environmental and/or socio-economic risk, available data and expertise, and time and budget constraints. This selection process should be undertaken as part of this scoping process to allow for an open and transparent process of stakeholder engagement and discussion.

The EFA for the Muchinga HPP will consider the present ecological state and the ecological extent of existing hydrological impediments. The recommended approach will be risk based and will not produce the typical discharge recommendations associated with an EFA. The main objective of the recommended approach will be to assess the impacts on aquatic ecology caused by discharge variations induced by the proposed development. This approach will include two main components:

- **Species attributes** - Identification of species (fish, aquatic macroinvertebrates, periphyton, riparian vegetation) sensitive to alteration in hydrology; and
- **Habitat availability** - Quantitative assessment of available instream habitat as is expressed by substrate, cover and hydraulic units (i.e. fast, slow, shallow, deep).

The presence of sensitive species will be used to assess impact severity, while the loss of habitat supporting sensitive species will be used to assess impact probability.

This methodology is selected at this phase of the Project and is deemed acceptable based both on an initial understanding of environmental and social risks, the relative lack of readily available flow data at present from the Muchinga Catchment, and the fact that the Muchinga Catchment is already regulated by the Lunsemfwa Dam.

### 9.2.5 Aquatic Ecology

The objective of this specialist study is to determine the baseline aquatic ecological status of the Project area. This data will be used to assess the ecological health of the Lunsemfwa and Mkushi Rivers within the Project area, against which future monitoring can be carried out in order to quantify those impacts as a result of the Project. The study will include the following:
**Determination of Aquatic Biota**

Aquatic macro-invertebrates live on the bottom of rivers and are for most of their lives immersed in water. The quality of the water will therefore have an impact on their health and survival. Natural adaptations ensure different tolerance and reactions to disturbance and pollution. The composition of an in-stream community can therefore be used as an indicator of the water quality and more specifically the ecological condition or health of the river at a specific site.

A suitable method to sample aquatic macro-invertebrates will be identified by the specialist. This method will measure the changes in the benthic community in response to changing water quality and other conditions in the river. It will therefore be a direct measure of the effects of changing conditions in the invertebrate community.

Suitable sites will be selected in-field and sampled using the identified methodology. Sites will be sampled to determine baseline conditions prior to the Project development.

**Determination of Fish Species**

Fish species are internationally recognised as one of the most important indicators of river health. An assessment of the biological integrity of a river is often based on indices that make use of attributes of fish assemblages, such as diversity of species and abundance. This kind of assessment, in combination with the assessment of other groups of biota, contributes to an understanding of the current ecological state of the river. Fieldwork will include identifying species and will be supplemented with information from local data available. The presence/absence of fish species of importance will be highlighted.

**Determination of Habitat Integrity**

The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale. These conditions are comparable to the natural characteristics and habitats of a region. The habitat integrity assessment is approached from an in-stream habitat and riparian zone habitat perspective. The assessment is based on an interpretation of the deviation from the reference condition. Information on changes to reference conditions are interpreted in terms of modification and relate to the drivers of the system; namely hydrology, geomorphology and physico-chemical conditions.

The In-stream Habitat Integrity Assessment will be based on five metric groups, namely:

- Hydrological modification
  - Base flow;
  - Zero flow; and
  - Floods.
• Physico-chemical modification
  o pH;
  o Nutrients;
  o Water temperature;
  o Water clarity;
  o Oxygen concentration; and
  o Toxics.
• Bed modification
  o Sedimentation; and
  o Benthic growth (algal).
• Bank modification
  o Marginal characteristics; and
  o Non-marginal characteristics.
• Connectivity modification
  o Longitudinal; and
  o Lateral.

The Riparian Zone Habitat Integrity will be based on three metric groups, namely:

• Habitat modification
  o Baseflow;
  o Zero flow;
  o Moderate flows and freshes; and
  o Floods.
• Bank structure
  o Marginal; and
  o Non-marginal.
• Riparian zone connectivity
  o Lateral; and
  o Longitudinal.

The Habitat Integrity Category will be determined (ie unmodified or natural to critically modified). Baseline conditions will be established against which future assessments could be compared.

Diatom Sampling

Where aquatic biota sampling is not suitable due to habitat constraints, diatom samples will be collected. Specific diatom species occupy habitats described by specific physico-chemical and biological attributes. Diatoms have also shown to be reliable indicators of specific water quality problems. Samples will be collected through “brushing off” substrates. Samples collected will be sent away for laboratory identification to species level, and the community composition will be analysed, and an assessment of river health assessed.
Determination of Odonata Assemblages

Adult Odonata (Dragon- and damselflies) are recognised world-wide as indicators of habitat quality in ecosystems. Baseline data collection will include gathering information of species present and their habitat preferences will be noted. Species will be collected for laboratory verification where field identification is not possible.

9.2.6 Impoundment and Downstream Water Quality

Based on the calculated residence time of water in the impoundment and the quality of water inflows, the likely nutrient status within the impoundment will be discussed.

In addition, and based on datasets such as local meteorology, the quantity of river in-flows (and other in-flows from the SP scheme) and outflows, and the characteristics of the proposed dam site, the likely levels of stratification within the impoundment will be calculated, using recognised empirical equations. On this basis, the presence of anoxic conditions and temperature stratification within the proposed impoundment will be calculated. This information will be used in determining release strategies for water downstream of the proposed impoundment.

9.2.7 Socio-economic

The objective of this specialist study is to characterize the existing socio-economic conditions of the Project Area, thus providing the initial setting to predict change during project construction and operation, as well as determining the affected population’s sensitivity to disturbance, and ability to withstand any such disturbance. This will enable the identification and assessment of potential impacts arising from the Project and the establishment of measures to mitigate potential negative impacts and to enhance the potential positive impacts.

Secondary data will be validated and substantiated by the undertaking of socio-economic surveys in the Project area. Field surveys will include verification of rural communities, households, relevant socio-economic landmarks and household interviews.

The objectives of the Social Impact Assessment can be summarised as follows:

- To define the area affected by the Project and people associated with these areas;
- To provide a detailed description of the people living and working in the project affected area, including all demographic information;
- To describe all economic and livelihood activities in the project affected area;
• To thoroughly describe the specific land ownership structures and land uses, including a description of all land users e.g. residential, farming, renters, farm workers;
• To count the number of directly affected households living and/or working (formally and informally) in the directly affected Project area;
• To describe the status of education, including levels of education, skills, literacy, and type, quantity and quality of education facilities;
• To describe the status of health, including common diseases, causes of diseases, and type, quantity and quality of health care facilities;
• To provide an overview of all infrastructure in the Project area;
• To identify social and economic impacts that will result from the Project; and
• To propose appropriate mitigation measures for addressing the impacts identified.

A methodological process will be defined that is rigorous, defendable and appropriate to the local context, objectives of the study and target audience (e.g. a combination of household surveys and focus groups). The sampling method to be used to select respondents will be outlined and appropriate survey tools prepared.

9.2.8 Cultural and Heritage

The archaeological specialist study will determine the presence (or otherwise) of sites of archaeological or cultural significance in the Project Area, in order to ensure that the proposed project will not result in the destruction of these sites.

Areas identified in the baseline assessment as having a cultural and/or heritage significance will be surveyed in order to identify and document the presence of structures or artefacts of archaeological interest, and areas of cultural significance.

Identified sites (if applicable) will be GPS marked for later mapping. Lithic materials and/or other relevant materials will be collected in order to create a reference collection. Any collected materials will be registered, studied and described, with clear reference to respective collection unit and site. Collected archaeological remains from every collection unit will be separately processed, according to type of material (stone, bone, pottery, metal, etc.).

Each new location yielding artifacts will be carefully identified, and the site will be accurately plotted on a map. Sites will also be systematically photographed. Records will contain, at least, the following data:

• Descriptive memoir of sites and their immediate surroundings at environmental level;
• Technical design of sites limits and layout, photographic and cartographic records and GPS references. Photographic records will be organised by site
and collecting unit (i.e. National Heritage and Conservation Commission); and

- Fieldwork (strategy, soil, site dispersion) will be cartographically described. Maps should be produced at a 1:50 000 scale.

The photographic record will include an image database illustrating sediments, soils, environmental niches and relevant features of the Project area, thus building up a comprehensive archaeological database for the area.

A procedure for dealing with chance-finds during project construction will be produced, as per the requirements of IFC Performance Standard 8.

9.3 **THE STUDY TEAM**

9.3.1 Details and Expertise of the Environmental Assessment Practitioners

*Environmental Resources Management*

Environmental Resources Management Southern Africa (Pty) Ltd. (ERM) has been appointed by the Project Proponent to undertake the Environmental Scoping and Impact Assessment Study for the proposed Project.

ERM as a consulting firm, and more specifically the project team selected on this project, possesses all the relevant expertise and experience to undertake this ESIA.

ERM is a leading global provider of environmental, health and safety, risk, and social consulting services and is committed to providing a global service that is consistent, professional and of the highest quality. ERM has been involved in numerous projects in Africa over the past 30 years and in 2003 established a permanent presence in the region to meet the growing needs of our clients. ERM Southern Africa is one of the largest totally focused environmental consulting firms in the region. With over 120 dedicated staff involved in environmental and social projects throughout the continent, ERM offers clients effective solutions using experienced local and global expertise.

The key ERM project team associated with the Muchinga HPP is as follows:

*Mike Everett* (Partner and Project Director) holds a Masters degree in Hydrology and has 20 years experience in a range of environmental impact assessment projects. He has been involved, either as lead consultant or as co-ordinator, in a number of projects throughout Africa, including South Africa, Namibia, Botswana, Mozambique, Zambia, Tanzania and Malawi. He is a registered Environmental Assessment Practitioner in South Africa, as certified by the Interim Certification Board. (EAPSA Certified) (*Annex A*).

*Zoe Daniel* (Principal Consultant and Project Manager) holds a Masters degree in Environmental Assessment and Evaluation and has 10 years
experience in a wide portfolio of high profile and large-scale projects in a
range of industry sectors working with private sector, government and donor
clients. She has strong experience working in Africa but has also worked in
Southeast Asia, North America, Latin America, and CEE/NIS. She is a
registered Environmental Assessment Practitioner in Uganda, as certified by
the National Environmental Management Authority (Annex A).

Janet Mkhabela (Socio-economic and Stakeholder Engagement specialist) hasive years’ experience in the field of stakeholder consultation, social impact
assessments and research. She has working mainly in the oil and gas,
renewable energy (wind and solar) transport sectors (passenger trains,
airports and freight rail). Janet has managed and coordinated numerous
stakeholder engagement processes. She has also been involved in designing
and implementing stakeholder engagement processes related to large
infrastructure developments and oil and gas projects. In addition, she has
completed numerous high level desk-based researches and desk-based social
impacts assessments. Furthermore, Janet is a Public Policy Partnership (PPP)
fellowship member, an organisation that is dedicated in educating and
training student who are interested and passionate about public sector
excellence (Annex A).

Michiel Jonker (Freshwater Ecologist) is a partner at Ecotone Freshwater
Consultants CC since 2008. Michiel has been involved in a number flow
related ecological assessments both nationally and abroad. These assessments
ranged from proposed alteration in channel morphology, water quality and
hydrology and mainly aimed at relating risks to aquatic responders such as
diatoms, marcoinvertebrates and fish. Flow related projects include pipeline,
power line, road, railway, silt and litter trap, treated waste water discharge
and dam projects. Project localities include South Africa, Mozambique,
Tanzania and Congo (Annex A).

Warren McCleland (Terrestrial Ecologist) has 15 years’ experience in
conducting baseline surveys, data analysis and report writing in various
biomes in southern Africa, particularly savannah, forest and grassland
biomes. He has five years’ experience in game reserve management
(KwaZulu-Natal, Mpumalanga) and is the co-author of the authoritative Field
Guide to Trees and Woody Shrubs of Mpumalanga & Kruger National Park,
Jacana Publishers, 2002. Warren has specialist knowledge of identification of
plants, mammals, birds, reptiles and frogs. He has experience in reporting
according to IFC Performance Standards for numerous international projects
in Sierra Leone, Democratic Republic of the Congo, Republic of Guinea,
Tanzania, Malawi, Mali, Mozambique and Zambia. Furthermore Warren is
accredited with the discovery of three new plant species: *Gladiolus diluvialis*
Goldblatt & Manning (Fish River Canyon, Namibia), *Streptocarpus
sekhukhunensis* ms Stoffberg, Mpumalanga and *Asclepias sp.nov.*
(Steenkampsberg Mts, Mpumalanga) (Annex A).
African Mining Consultants

ERM contracted African Mining Consultants Limited (AMC), a Zambian based environmental consultancy, to assist in the Environmental Scoping Study for the proposed project. The AMC Project team associated with the Muchinga HPP was as follows:

Geoffrey Siame (Senior Consultant) - Geoffrey Siame holds a Masters degree in Environmental Engineering and has six years’ experience in carrying out Environmental Impact Assessments, risk assessment, environmental audits, development of waste minimisation programmes and contaminated land management. He is a member of Engineers Registration Board of Zambia and Engineers Institution of Zambia. He is a certified environmental auditor in Zambia (Annex A).

Gomo Benard (Environmental Engineer) - Benard is the holder of an Environmental Engineering degree and has three years’ experience in conducting environmental assessments and carrying out air and water quality monitoring. He is a certified environmental auditor in Zambia (Annex A).

Contact Person:
Geoffrey Siame
1564/5 Miseshi Road
P. O. Box 20106, Kitwe
Zambia
Fax: +26 (0)21 221 1104
Tel: +26 (0)21 221 1108
Email: gsiame@amc-africa.com
Environmental Specialists

As part of the ESIA, AMC appointed and managed the following specialists (CV’s attached in Annex A):

Joseph Mukalay (Soils Specialist) - Joseph holds a Masters degree in land evaluation/classification and soils management. He is a renowned Congolese national who has conducted several soils surveys in DRC and Zambia. He is currently studying for his PhD in soil science.

Lishomwa Mulongwe (Vegetation and Biodiversity Specialist) – Lishomwa holds a Masters degree in Ecology and has more than ten years’ experience in carrying out research on bio-indicators, environmental degradation and on the rehabilitation of degraded ecosystems in Zambia. He has carried out ecological surveys and biodiversity studies for Environmental Impact Assessments of various projects in the DRC and Zambia and has extensive knowledge about central and southern African plant species.

Chuma Simukonda (Terrestrial Fauna Specialist) - Chuma, has six years of extensive background and work experience in Animal Management and Protection. He has carried out several fauna studies with the Zambia Wildlife Authority and has a good understanding of wildlife existing in several Southern African countries.

Dr. Harris Phiri (Aquatic Flora and Fauna Specialist) - Harris has a Doctorate in Aquatic Ecology and specialises in Biostatistics, Fish Stock Assessment, Fish Population Dynamics, Natural Resource Management, Conservation Methodologies, Community based resource management, Project planning, management, monitoring and evaluation.

Dr. Mitulo Silengo (Socio-economic Specialist) - Dr. Silengo specialises in social impact assessment and resettlement planning. He has conducted socio-economic studies and assessments of mining projects in the DRC and Zambia. His expertise in natural resource management together with his public consultation experience enables him to accurately evaluate the socio-economic and cultural impacts of a mining project.

Victor Syatyoka (Cultural and Heritage Specialist)

Kaizen Consulting International

For additional work to be undertaken in the Scoping Phase Kaizen Consulting International was contracted by ERM. Kaizen Consulting International (KCI) is a Zambian environmental consultancy with extensive locally and international expertise. KCI provides a range of consultancy services to government, private sector institutions and non-governmental organizations which include Environmental Impact Assessments and Environmental Management Plans, solid waste management master plans, sustainable rural
livelihood and strategic urban development plans, natural resource management and institutional capacity building, strategies for provision of water supply, training in Cleaner Production, EMS standards and ISO 14001 implementation and human resource development issues.

KCI is able to provide services to complex projects, due to its access to specialists from a wide range of disciplines ranging from socio-economics, natural resource management, environmental impact assessment, sociology, project design, project implementation, monitoring and evaluation, capacity building and training, environmental engineering, environmental economics, civil engineering, hydrology, geology and environmental economics.

KCI is formally registered in Zambia with the Zambian Environmental Management Agency (ZEMA), as an environmental consulting practice that is certified to undertake ESIAs. The key coordinator for KCI is Jacob Chishiba.

**Jacob Chishiba** (Zambian Project Co-ordinator) holds a Master of Science Degree in Environmental Management and Policy from Lund University, Sweden with concentrations in Ecology, Policy and Law, Sustainable Development, Environmental Management System and ISO 14001 Implementation, Cleaner Production, Environmental Economics, Environmental Technology and Environmental Impact Assessment. In addition to this Jacobs holds a Bachelor of Science Degree in Natural Sciences from the University of Zambia, and has attended a postgraduate course in Criminal Procedure and Prosecution from Zambia Institute of Advanced Legal Education. Jacob has over 20 years working experience in environment and sustainable development assignments, working as a Team Leader on assignments for major hydropower projects. Jacob has also worked for the United Nations Office for Projects (UNOP), Kenya, involving Environmental Impact Assessment (EIA) of Small Earth Dams and Development of Guidelines for Zambia Rural Small Works Programmes for Water and Food Security. Jacob has worked as an Environmental Management Specialist and Team Leader for the Ministry of Energy and Water Development involving development of the Environmental and Social Management Framework and the Resettlement Policy Framework for the project on Increased Access to Energy and ICT Services funded by World Bank (*Annex A*).

**Contact Person:**
Jacob Chishiba
P.O. Box 33526
Lusaka Zambia
Tel: +(260)-977-758591 / +(260)-967-758591
Email: jchishiba@gmail.com
9.3.2 The Project Proponent:

The proponent in the application is:

*Lusemfwa Hydro Power Company*
Plot No. 5047,
Main Mine Road,
Kabwe,
Zambia

*Contact Person:*
Hanne Haukenes
Tel: +47 6671 7007
Hanne.haukenes@aguaimara
Lilleakerveien 8, 0283 Oslo, Norway
CONCLUSION

It is evident that with increasing electricity demands in the Southern African Development Community (SADC) in general and in Zambia specifically, coupled with current regional and local energy supply deficits, that there is a need for investment in energy generation in this Region. The peak energy supply and demand forecasts for Zambia indicate that post 2011, the power deficit in the country will widen if additional capacity is not installed (ERB, 2008).

Investment in energy is a prerequisite to achieving commercial and industrial development in Zambia. If Zambia is to achieve those targets and goals stated in its Vision 2030, and detailed in the SNDP, the country will require private sector investment in energy technology that is efficient, sustainable and reliable. The generation of energy through hydropower is a proven technology that is sustainable and which is actively being promoted at a national level in Zambia. With a hydropower energy potential of approximately 6,000MW, hydropower is considered the most feasible and reasonable energy generation option for Zambia. It is for this reason that the Zambian government are for such development.

In the light of this scenario, the Muchinga Power Company Limited (MPC) (a joint venture between Lunsemfwa Hydro Power Company Limited (LHPC), Agua Imara AS (formerly SN Power Africa) and eleQtra (InfraCo) Ltd.), is considering developing a 255MW Hydropower Project (HPP) on the Lunsemfwa and Mkushi Rivers in the Mkushi District, located in the Central Province of Zambia. The proposed Muchinga HPP will consist of the development, financing, construction, operation, management and maintenance of a new electricity generation hydropower station.

As part of the proposed Muchinga HPP, MPC are required to obtain environmental authorisation prior to construction of the Muchinga HPP. As such, ERM and AMC have been appointed as the independent Environmental Assessment Practitioners to facilitate the environmental approval process in accordance with Zambia’s Environmental Management Act (EMA) (Act 12 of 2011).

The environmental scoping study (this report – otherwise known as the Terms of Reference for the EIA study) is the first phase of the overall ESIA process being undertaken for the proposed Muchinga HPP. The purpose of the scoping study was to identify the potential environmental and social impacts resulting from the proposed Project, based on a review of available data (baseline) and from the issues and concerns of Interested and Affected Parties (I&APs), raised during a series of stakeholder meetings held during this scoping phase, and described in detail in the Public Consultation Report (provided in Annex B).
As discussed in Chapter 7, it is anticipated that the following key environmental and social aspects will be impacted by the proposed Project:

- Soils;
- Terrestrial and aquatic flora;
- Terrestrial fauna;
- River flows and associated impacts to downstream aquatic ecology;
- Water quality, both within the impoundment (on the Mkushi River) and downstream;
- Socio-economics; and
- Cultural Heritage.

Based on the initial assessment of the potentially significant issues, it is concluded that there are no environmental fatal flaws which would prevent the development of this Project. However, the impacts presented in this report will be further investigated and assessed within the ESIA phase. For this purpose, Terms of References for each specialist investigation identified and required for the ESIA, have been drafted.

The ESIA will suitably identify, investigate and address all environmental and social impacts in order to provide stakeholders with information on the impacts (both positive and negative) resulting from the Project, and to provide the authorities with sufficient information, so as to make an informed decision regarding approval of the proposed Project.