ZESCO

Powering The Nation

PLANNING AND PROJECTS DIRECTORATE

ENVIRONMENTAL IMPACT STATEMENT FOR THE SIAVONGA 200MWac SOLAR PV PROJECT IN SIAVONGA DISTRICT, SOUTHERN PROVINCE

Prepared by

ZESCO Limited
For

JIGSCO ENERGY CORPORATION LIMITED

June 2025

ACKNOWLEDGEMENTS

JIGSCO Energy Corporation Limited wishes to tender its indebtedness to His Royal Highness Chief Simamba, the Bagande Royal Establishment and the local communities for the support rendered during the Environmental and Social Impact Assessment (ESIA) process for the Project. The Corporation further wishes to extend gratitude to the Heads of Government Departments, local authorities, Nongovernmental Organisations (NGOs) and other stakeholders for availing valuable information for the successful undertaking of the studies. Lastly, but not the least, we wish to express our appreciation to all participants for their valuable contributions, without which the process would not have been a success.

EXECUTIVE SUMMARY

The Government of the Republic of Zambia (GRZ) seeks to achieve universal access to clean, reliable, and affordable energy at the lowest economic, financial, social, and environmental cost, as outlined in the Country's long-term Vision 2030 and medium-term Eighth National Development Plan (8NDP). Given the abundant and largely untapped renewable energy resources in the Country, renewable energy is expected to contribute significantly to Zambia's future energy mix, drive National socio-economic development and contribute to the achievement of the United Nations Sustainable Development Goals (SDGs).

As an executing arm of the Government, ZESCO Limited aims to increase power generation capacity, diversify the energy mix, and address the impact of climate change on hydropower energy production, which has resulted in extended hours of load shedding. Solar energy presents a promising solution as solar radiation levels in Zambia are among the highest in the world, with annual Global Horizontal Irradiation translating into a yearly PV electricity output in the range of 1,550 - 1,700MW, suitable for both small- and large-scale applications.

In line with ZESCO's ambitious plan to expand its power generation mix, to include at least 800MW of solar energy over the next 10 years, as espoused by the ZSECO Strategic Plan, the Corporation proposes the development of the Siavonga 200MWac Solar PV Power Project (SPP). This initiative builds on a 2019 feasibility study conducted by PowerChina, which investigated key aspects such as topography, geomorphology, engineering geology, grid connection, site access, flood control, and construction power and water supply. The study concluded that the Siavonga SPP is technically feasible, paving the way for its implementation.

To facilitate the development of this Project, Jigsco Energy Corporation Limited has been established as a Special Purpose Vehicle (SPV), with ownership shared between Jigsaw Investments Limited and ZESCO Limited. This partnership underscores the collaborative effort between the private sector and public institutions to deliver sustainable energy solutions.

The Siavonga 200MWac Solar PV site is located approximately 15km from Siavonga 330/132/33 kV Substation. The land earmarked for this project is 250ha, with the planned solar PV installed capacity of 200MWac. The Project will be implemented in two phases, each with a capacity of 100MWac. The availability of stable power supply will drive economic and social development in the Country, contributing to poverty alleviation and attracting meaningful investment. The total investment cost for the Project is estimated

at **USD 100,000,000** (Hundred Million United State Dollars Only), with construction expected to take 15 months and an anticipated operational lifespan of 25 years.

Objectives

The objective of this project is to avail additional generation capacity in the Zambian Integrated Power System and diversify the generation mix, reducing the reliance on hydropower. The Country is currently experiencing load management due to low water levels in the reservoirs as a result of insufficient rainfall, induced by climate change. This Project therefore, aims to increase electricity access, security of supply and improve power supply quality throughout the Country.

Project description and design

The Siavonga 200 MWac SPP will include the installation of photovoltaic (PV) solar modules and the construction of approximately 18km of 132kV overhead transmission line. This line will evacuate power from a 33/330kV substation to be established at the proposed solar plant site to the Kariba Hydropower Plant (HPP) Substation Switchyard.

The Siavonga SPP has a rated power output of 110.0 MWac and a peak power output of 110.0 MWdc, resulting in a DC/AC ratio of 1.00. The Project will utilize the JAM72D42-630/LB bifacial solar module model, manufactured by JA Solar. Each module has a peak power output of 630.0W and is based on monocrystalline silicon (Si-mono) cell technology. To maximize energy generation, the solar modules will be mounted on single-axis trackers. These trackers will adjust the orientation of the PV modules throughout the day to minimize the angle of incidence between the incoming sunlight and the surface of the modules, thereby optimizing energy capture.

Other infrastructure will include a complex building, parking area, internal paths and access roads, and utilities. The Project design does not include dedicated worker accommodations for the operational phase, as the permanent workforce requirements will be minimal.

Project Alternatives

The Project evaluated a range of alternatives across key areas to ensure optimal planning and implementation. Site location alternatives were carefully assessed, taking into account factors such as topography, geomorphology, engineering geology, grid connection feasibility, site access, flood control, construction power and water supply, and alignment with the social and environmental context of the area. The proposed site was selected for its strategic location near the Kariba North Bank HPP. This proximity is a significant advantage, as one of the primary objectives of the Project is to strengthen

Zambia's energy resilience by addressing climate-related risks to hydropower generation. By integrating the solar PV plant with the existing hydropower infrastructure, the Project will enhance operational flexibility. This hybrid approach leverages the complementary nature of solar and hydropower, where solar energy can offset reduced hydropower generation during periods of low rainfall. Additionally, the preferred site for Solar will not result in any physical displacement, save for loss of agricultural fields and trees of economic value.

Solar energy generation design and technology alternatives were also evaluated to identify the most efficient and cost-effective solutions. This included assessing photovoltaic modules, inverters, and tracking systems to optimize energy output and Project viability.

Additionally, transmission line route alternatives were analyzed to determine the most viable pathways for connecting the Solar Power Plant to the grid. Key considerations included technical feasibility, environmental and social impact, and cost efficiency. Three route alternatives were assessed. The preferred route is approximately and runs south, existing 330kV wayleave from points P1 to P2,it then continues to run parallel to the existing 330kV wayleave in a south-west direction between points P2 and P3 before crossing the existing 330kV wayleave between P3 and P4 running north-east, it then turns to run in south-east direction crossing the M15 road (Siavonga -Lusaka Road) between P4 and P5, the line then turns in a south-west direction to the Siavonga 330/132/33kV Substation crossing the M15 road (Siavonga – Lusaka Road) again between points P5 and P6. This shall be a 132kV power line and is thus expected to have a wayleave width of 32m (16m on either side of the power line). Unlike the other two alternatives, this route will traverse entirely through customary land, avoiding private land. It is also the shortest route, making it the most practical and cost-effective option.

The Identified Significant Environmental and Social Impacts of the Project

It is a requirement in the Environmental Management Act (EMA) No.12 of 2011 as amended by the Environmental Management Act No 8 of 2023, read together with Section 3 (1) of Statutory Instrument (SI) No. 28 of 1997 that, "A developer shall not implement a project for which a Project Brief or Environmental Impact Statement is required under these Regulations, unless the Project Brief or an Environmental Impact Statement has been concluded in accordance with these Regulations and the Zambia Environmental Management Agency (ZEMA) has issued a Decision Letter". The Project under consideration requires an Environmental Impact Statement (EIS).

The proposed Project falls within the Second Schedule "Electricity generation station" and thus requires an EIS. The Environmental and Social Impact Assessment (ESIA) for this proposed Project has been conducted in order to comply with the provisions of this SI.

The ESIA has identified potential impacts and recommended measures to mitigate adverse effects while enhancing positive outcomes. This ensures that the Project aligns with Sustainable Development Goals and maximizes its benefits for the local community and the Nation as a whole.

The Project will affect the general physical, biological and socio-economic environments in the immediate Project area, through the works associated with construction and operation of the Solar Plant.

The 250 hectares of land required for the Solar Plant and associated 18km, transmission line route will affect eleven households and affected property owners will be adequately compensated. However, no agricultural fields and trees of economic value will be affected. Other negative social impacts include;

- Increased in-migration due to an influx of job seekers into the area, leading to social cohesion and strain on the available social amenities such as medical facilities; and
- Potential for increased incidence of communicable diseases including acute respiratory infections (ARI) and tuberculosis (TB), as well as Sexually Transmitted Infections (STIs), including HIV/AIDS.

Major anticipated biophysical negative impacts include:

- Visual intrusion from the clearing of vegetation and introduction of infrastructure into the landscape;
- Air quality deterioration from dust and exhaust emissions during construction;
- Noise and vibration due to heavy machinery, blasting and the presence of workers at the site;
- Soil erosion and contamination from the removal of vegetation, operation and movement of heavy-duty vehicles and machinery as well as from excavation of the soil;
- Change in quality of water resources as a result of siltation from soil erosion, leakages or spills of chemicals and oils, improper waste management and abstraction of water for domestic and construction purposes;

- Loss of vegetation as a result of vegetation clearance at the Solar Plant site and along the transmission line wayleave;
- Habitat fragmentation and edge effects from wayleave and Solar Plant site vegetation clearance;
- Introduction of invasive species from the continual movement of heavy vehicles into the Project area;
- Mortality of avifaunal and terrestrial species due to habitat disturbance potential and poaching incidences by construction workers; and
- Disturbance to aquatic ecosystems from water quality changes and potential illegal fishing by construction workers.

Nonetheless, the Project has significant positive impacts over and above those realized by the primary Project objective. In the long term, the Siavonga SPP is expected to deliver significant trickle-down National economic benefits. These include generating profits through electricity trade, enabling business growth and household benefits by providing reliable power, and creating increased employment opportunities through spin-off economic activities.

Additionally, JIGSCO, in collaboration with the Bagande Royal Establishment, will enter into a Corporate Social Responsibility (CSR) Memorandum of Understanding (MoU). Under this agreement, JIGSCO will allocate a portion of its annual profits to fund a CSR program for communities in the project area focused on key areas such as education, health, electrification, environmental management, climate change, water and sanitation, agriculture, skills development, cultural heritage, sports development, and women's enterprise development. This initiative aims to ensure meaningful and sustainable benefits for the local community, throughout the operational lifespan of the Solar Plant.

In the short term, there will be skilled and unskilled employment opportunities at the local level, as well as potential for skills enhancement that will be created, directly and indirectly by the proposed Project.

Mitigation and Enhancement Measures

To mitigate the anticipated adverse impacts and to enhance the opportunities available, mitigation and enhancement measures have been proposed and shall be operationalized through the implementation of the Environment and Social Management Plan (ESMP).

Vegetation loss and land degradation will be minimized by cutting trees at stump height instead of uprooting, along the transmission line route, preserving root systems for soil

conservation. At the Solar Plant site, vegetation clearance will be limited to the footprint of infrastructure development.

Soil erosion and siltation will be controlled through appropriate drainage systems, protection of excavated soil materials, and promoting the use of existing access roads. To reduce soil compaction, heavy machinery with floating tires will be prioritized. Surface and groundwater contamination risks will be mitigated through the safe storage and disposal of construction waste, oils and lubricants, and wastewater.

Air quality will be protected by employing dust suppression techniques, such as water spraying, and ensuring that construction equipment is well-maintained to limit exhaust emissions. Noise pollution will be controlled by fitting mufflers on equipment, restricting activities to daytime hours, and providing ear protection for workers.

Solid waste from construction activities will be sorted, collected, and disposed of at approved facilities, while hazardous materials like oils and lubricants will be managed to prevent spills.

Wildlife and aquatic ecosystems will be protected by planning construction activities to avoid critical habitats, minimizing disturbances to small fauna, and using sediment traps and buffer zones to prevent water contamination and safeguard aquatic life.

Additionally, environmental awareness campaigns shall be carried out for the construction team to introduce conservation measures necessary to minimize environmental degradation including, a ban on illegal hunting/fishing, good waste management and appropriate vegetation control/clearance.

Social and health impacts will be addressed through compensation for affected structures and livelihoods, as well as awareness campaigns on HIV/AIDS, sexually transmitted infections (STIs), Gender Based Violence (GBV), and Sexual Exploitation, Abuse, and Harassment (SEAH). Additionally, occupational and community health and safety awareness will be conducted for to promote safe and healthy responsible practices throughout the project. This will be guided by the Health and Safety Management Plan (HSMP) that will be developed for the Project.

These measures aim to ensure that the Project is developed sustainably and responsibly, minimizing negative impacts on the environment and surrounding communities.

Conclusion

The proposed Project is critical for the improvement of National electricity supply, while pursuing a low-carbon, climate-resilient developmental pathway. Correspondingly, improved electricity supply will support the development of various sectors of the economy such as mining, manufacturing, agriculture, tourism, and social infrastructure (such as health centers, schools, police posts, Government institutions and community social facilities).

The need for the proposed Siavonga 200MW Solar PV Project cannot be overemphasized. The Project meets the demands of the sustainable development principles and its favorable consideration will greatly benefit not only local development but the Nation and the Region at large.

In this regard, the proposed Project is recommended for implementation.

OTTO KHOZA
DIRECTOR - JIGSCO ENERGY CORPORATION LIMITED

NON-TECHNICAL SUMMARY

The Siavonga 200MW Solar PV Project (SPP) is a key and immediate initiative by the Zambian Government, in its quest to add 1000MW of solar power to the National grid by the end of 2025, to address the current power challenges the Country is facing. This intervention, among others, aims to diversify the portfolio of renewable energy projects, and reduce reliance on hydropower, which is vulnerable to climate change. The Project is expected to improve the electricity network performance, thereby driving National socio-economic development and contribute to the achievement of the United Nations Sustainable Development Goals (SDGs).

The construction of the Solar Plant is earmarked on a parcel of land measuring 250 hectares in Simamba village, Siavonga District. The said land is customary, under the stewardship of Her Royal Highness Chieftainess Sikoongo.

For the purpose of developing this Project, JIGSCO Energy Corporation Limited has been incorporated, as a Special Purpose Vehicle, with shareholding between Jigsaw Investments Limited and ZESCO Limited.

To address environmental and social issues that may arise from the proposed solar project, a comprehensive Environmental and Social Impact Assessment (ESIA) study has been undertaken in accordance with the Environmental Management Act, No.12 of 2011 as amended by the Environmental Management Act No. 8 of 2023 – The Environmental Impact Assessment Regulations (Statutory Instrument No.28 of 1997). The ESIA study identifies potential impacts and recommends measures to mitigate adverse impacts while enhancing positive impacts.

The Project will affect the general physical, biological and socio-economic environments in the immediate project area through the works associated with construction and operation of the Project. The Project has significant positive impacts over and above those realized by the primary project objective. In the long term the Siavonga 200MWac Solar PV Project is expected to deliver significant trickle-down National economic benefits. These include generating profits through electricity trade, enabling business growth and household benefits by providing reliable power, and creating increased employment opportunities through spin-off economic activities.

JIGSCO is partnering with the Bagande Royal Establishment to establish a comprehensive CSR program. Through a formal CSR MoU, the JIGSCO will dedicate a percentage of annual profits to fund sustainable community development initiatives ensuring broad-based benefits for local communities. The CSR interventions will be implemented with a

focus on the following the thematic areas: health, education, electrification, social welfare, environmental management, climate change, water and sanitation, agriculture, skills development and entrepreneurship, cultural heritage, sports development, and women's enterprise development.

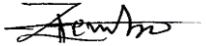
Negative impacts associated with the bio-physical conditions addressed by this Environmental Impact Statement (EIS) include impacts on: wildlife; water quality ; soil; vegetation; air quality; noise quality, and ecosystem functions and services. Negative impacts associated with the socio-economic conditions include social cohesion, potential strain on local resources and social services due to an influx of people, loss of access to farmland, and potential spread of communicable diseases such as HIV/AIDS and waterborne diseases.

Accordingly, the EIS has proposed enhancement and mitigation measures for positive and negative impacts, respectively, to ensure that positive impacts are maximized while negative impacts are prevented or minimized, as much as possible. Enhancement measures for positive impacts include prioritizing the local community for employment, sourcing building materials locally, and ensuring the successful implementation of the project. Mitigation measures for negative impacts include soil erosion control, waste management plans, dust suppression techniques, noise reduction strategies, fishing regulations, resettlement and livelihood restoration and measures to prevent the spread of communicable diseases.

The Siavonga SPP represents a significant step toward leveraging Zambia's abundant solar resources to strengthen energy security and support economic growth. Beyond power generation, the Project's commitment to environmental stewardship and community development through targeted social programs will create lasting benefits at both local and National levels. It is therefore recommended for approval and implementation**.**

ESIA STUDY TEAM

Table 1: List of ESIA authors

Name	Qualification	Role	Signature
Bonje M. Muyunda	BSc Biological Sciences, MSc Environmental Science *IAAZ*	Team Lead – E&S Project Management	
Brian Kanyanga	MBA General Management, BEng	Project Manager	
Muzipasi Phiri	BEng	Survey expert	
Ziye Tembo	BEng	Renewable Energy Engineer	
Kandi Shikabi	BA Development studies	Lead RCAP coordinator	
Andrew Mabula	MSc Hydropower development BSc Civil Engineering	Hydrologist	
Bertha Musonda	MSc Environmental and Natural Resources Management BSc Forestry *IAAZ*	ESIA team Coordinator, Environmental Safeguards Specialist	

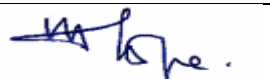
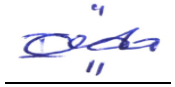
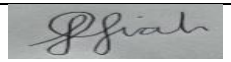
Saviour Kambole	BSc Wildlife Management BBA *IAAZ*	Environmental Safeguards Specialist	
Ireen Chilando	B.A. Demog. & Dev. Studies *IAAZ*	Social Safeguards Specialist, RCAP	
Manyika Ngwengwe	BSc Environmental health *IAAZ*	Environmental Safeguards Specialist	
Joseph Palangwa	*BEng Geomatic Engineering* *IAAZ*	Route planning, Wayleave and land acquisition Expert	
Francescellah Bwalya Offiah	*BEng*	Electrical Engineer	

Table of Contents

ACKNOWLEDGEMENTS I
EXECUTIVE SUMMARY II
NON-TECHNICAL SUMMARY IX
ESIA STUDY TEAM 11
1 INTRODUCTION 1
1.1 BACKGROUND OF THE PROJECT 1
1.2 Summary description of the project including project rationale 2
1.3 Objectives the project 2
1.4 Brief description of the location 2
1.5 Particulars of Shareholders/Directors 2
1.7 The developer's physical address and the contact person and his/her details 3
1.8 Track Record/Previous Experience of Enterprise Elsewhere 4
1.9 Total Project Cost/Investment 6
1.10 Proposed Project Implementation Date 6
2 POLICY, INSTITUTIONAL AND ORGANISATIONAL FRAMEWORK 7
2.1 Policy Framework 7
2.2 Organisational/ Administrative Framework 11
2.3 Regulatory and Legal Framework 15
2.4 Institutional framework 17
2.5 Organisational Framework 22
2.6 International Agreements and Conventions 23
2.7 International Standards and Good Practice 24
3 PROJECT DESCRIPTION 31
3.1 Location 31
3.2 Nature of the Project 34
3.2.1 Raw materials (including hazardous materials and their storage on site) 34
3.2.2 Products and by-products 35
3.2.3 Production capacity 37
3.2.4 Schedule and life time of the project 37
3.3 Main activities 37

3.3.1 Preparation phase 37
4 PROJECT ALTERNATIVES 41
Existing Developments in the Project Area 44
5 ENVIRONMENTAL BASELINE STUDY 48
5.1 Climate 48
5.2 Air quality 49
5.3 Geology 49
5.4 Hydrology 50
5.5 Topography 50
5.6 Soils 50
5.7 Land use and land tenure 51
5.8 Built Environment 51
5.9 Noise and vibration 51
5.10 Fauna 52
5.10.1 Mammals 52
5.10.2 Reptiles 52
5.11 Avifauna 52
5.11.1 Fish 53
5.12 Flora 53
5.12.1 Protected Areas 55
5.13 Archaeological and cultural environment 55
5.14 Social-economic set up 56
5.14.1 Population 56
5.14.2 Growth rate, population density and distribution 56
5.14.3 Administration 56
5.14.4 Social services and amenities 57
5.14.4.1 Market availability on various commodities 57
5.14.5 Literacy levels, health and gender equity 57
5.14.6 Traditional and religious practices and rites 59
6.1 Sources of Impact 60
6.2 Impact Identification and Assessment Methodology 61
6.3 IMPACTS 66
6.3.1 Bio-Physical Environmental Impacts 72
6.3.1.1 Visual Intrusion and Change in Landscape 72

6.3.2 Air Pollution 73
6.3.3 Noise and Vibration 75
6.3.4 Soil Erosion and Contamination 77
6.3.5 Change in Quality of Water Resources 80
6.3.6 Loss of Vegetation 83
6.3.7 Habitat Fragmentation and Edge Effects 85
6.3.8 Introduction of Alien Invasive Species 86
6.3.9 Mortality of Avifaunal Species 88
6.3.10 Mortality of Terrestrial Fauna 91
6.3.11 Disturbance to Aquatic Habitats and Mortality of Aquatic Species 92
6.4 socio-economic and Cultural Impacts 94
6.4.1 National and Local Economic Benefits 94
6.4.2 Local Employment Opportunities 96
6.4.3 Local Procurement of Goods and Services 98
6.4.4 Physical Displacement 99
6.4.5 Economic Displacement of Land Based Livelihoods 101
6.4.6 Project Induced In-migration 103
6.4.7 Health and Safety Risks 106
7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN 117
7.1 Objectives of the ESMP 117
7.2 Management Arrangements 117
7.3 Environmental Awareness and Training 121
7.4 Monitoring, Auditing and Reporting 122
7.5 Preventative & Corrective Action 124
7.6 Review and Update of the ESMP 125
7.7 Environmental and Social Monitoring Plan 126
7.7 Environmental and Social Management and Monitoring Costs 138
8.0 DECOMMISSION AND REHABILITATION 142
9.0 DECLARATION OF AUTHENTICITY 147
10.0 REFERENCES 148
11.0 APPENDICES 149

LIST OF TABLES

Table 1: List of ESIA authors xi
Table 2: Legal and Institutional framework 17
Table 3: International agreement and coventions 23
Table 4: Application of relevant standards 25
Table 5: Coordinates of solar site 31
Table 6: Coordinates of 132kV transmission line 31
Table 7: Project Raw Materials 34
Table 8: Coordinates of transmission line and remarks 44
Table 9: Power evacuation alternative evaluation 45
Table 10: Air quality Results-Gases 49
Table 11: Air quality results-Dust 49
Table 12: Noise quality results 52
Table 13: Predominant diseases in the district from 2022 to 2024 58
Table 14: Sources of impacts 60
Table 15: Types of impacts 62
Table 16: Criteria for determining impact magnitude 62
Table 17: Impact Magnitude definitions 63
Table 18: Receptor sensitivity definitions 64
Table 19: Definition of impact significance 65
Table 20: Evaluation of significance of impacts 66
Table 21:Key for rating impact significance 71
Table 22: ESMP 127
Table 23: Environmental monitoring activities and costs 139
Table 24: Decommissioning activities 143

LIST OF FIGURES

Figure 1: Proposed site plan for the solar PV plant....32
Figure 2: Proposed site plan two....33
Figure 3: Google image of solar site and evacuation routes....34
Figure 4: Zambia's Agro ecological zones....48
Figure 5: Geology in the project area....50
Figure 6: bird nesting in the project area....53
Figure 7: ecoregions of Zambia (www.en.Wikipedia.org/wiki/File:Map of Eco regions of Zambia)....54
Figure 8: vegetation in the project area....55

ABBREVIATIONS

^{0}C	Degrees Celsius
AIDS	Acquired Immune Deficiency Syndrome
CITES	Convention on International Trade on Endangered Species
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
GMAs	Game Management Areas
GRZ	Government of the Republic of Zambia
HFO	Heavy Fuel Oil
HIV	Human Immune Virus
Ha	Hectares
IAPs	Interested and affected Parties
Km	Kilo Metres
kW	Kilo Watts
MWac	Mega Watts Alternating Current
MW	Mega Watts
O&M	Operations and Maintenance
PAPs	Project Affected Persons/Parties
RCAP	Resettlement and Compensation Action Plan
8NDP	Eighth National Development Plan
STIs	Sexually Transmitted Infections
ToRs	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
ZEMA	Zambia Environmental Management Agency

1 INTRODUCTION

1.1 Background of the project

The Government of the Republic of Zambia (GRZ) seeks to achieve universal access to clean, reliable, and affordable energy at the lowest economic, financial, social, and environmental cost, as outlined in the Country's long-term Vision 2030 and medium-term Eighth National Development Plan (8NDP). Given the abundant and largely untapped renewable energy resources in the Country, renewable energy is expected to contribute significantly to Zambia's future energy mix and drive National socio-economic development and contribute to the achievement of the United Nations Sustainable Development Goals (SDGs). This approach promotes a low-carbon, climate-resilient developmental pathway, while enhancing socio-economic development.

As an executing arm of the Government, ZESCO Limited aims to increase power generation capacity, diversify the energy mix, and address the impact of climate change on hydropower energy production, which has resulted in extended hours of load shedding. Solar energy presents a promising solution as solar radiation levels in Zambia are among the highest in the world, with annual Global Horizontal Irradiation translating into a yearly PV electricity output in the range of 1,550- 1,700MW, suitable for both small- and large-scale applications (GRZ 2022).

The Siavonga Solar 200MW Solar PV Project (SPP) is in line with the developmental strategies adopted by the Government in harnessing the renewable energy potential and to promote the much-needed generation mix in Zambia. The Project was conceptualized as a mitigation measure in response to the hydrological risk associated the impact of climate change on hydropower generation.

For the purpose of developing this Project, JIGSCO Energy Corporation Limited has been incorporated, as a Special Purpose Vehicle, with shareholding between Jigsaw Investments Limited and ZESCO Limited.

In 2019, PowerChina conducted investigations (topography, geomorphology, engineering geology, grid connection, site access, flood control, construction power supply and water supply) to assess the project feasibility. The study conducted by PowerChina in August 2019 concluded that 200 MW Siavonga Solar PV project is technically feasible. In 2020, ZESCO conducted a Grid impact study for the Project that concluded, and augmented the PowerChina findings. It further established that with proposed 200MW Solar PV injection into the National grid from the Siavonga SPP and considering 616MW of other Solar PV, the Integrated Power System (IPS) would not experience any loading or voltage violation under normal and contingency conditions.

Commencement of Project implementation has previously been delayed due to challenges in sourcing for finances. The secured financing and the incorporation of the SPV now presents an opportunity to actualise the Project. The target market comprises of residential, agriculture, manufacturing, mining, and industrial customers in Zambia.

1.2 Summary description of the project including project rationale

As part of ZESCO's ambitious plan to expand its power generation mix to include at least 800MW of solar energy over the next 10 years, as espoused by the ZESCO Strategic Plan, the Corporation proposes the development of the Siavonga SPP. Further, to address the current power challenges the Country is facing, the Government has instituted an immediate initiative to add 1000MW of solar power to the National grid by the end of 2025.The Project will be implemented in phases, with an initial 100MW developed and commissioned in the first phase, followed by the subsequent 100MW in the second phase. The Project represents a significant step in leveraging Zambia's natural resources to enhance the Country's energy security and support economic growth, while upholding the tenets of environmental and social sustainability.

1.3 Objectives the project

The objective of this project is to avail additional generation capacity in the Zambian Integrated Power System and diversify the generation mix, reducing the reliance on hydropower. The Country is currently experiencing load management due to low water levels in the reservoirs as a result of insufficient rainfall, induced by climate change. This Project therefore, aims to increase electricity access, security of supply and improve power supply quality throughout the Country.

1.4 Brief description of the location

The Siavonga 200MWac Solar PV site is located approximately 15km from Siavonga 330/132/33 kV Substation. The land earmarked for this project is 250ha, with the planned solar PV installed capacity of 200MWac. At the Solar Plant, the 132/33kV Kariba Solar Substation will have an outgoing 18.5km, 132kV transmission line that terminates at the Siavonga 330/132/33kV Substation. Figure 1 below shows proposed siting of the Solar Plant and the power evacuation routing.

1.5 Particulars of Shareholders/Directors

- **Corporate Profile**

Jigsco Energy Corporation Limited is a company incorporated in 2025 as a Special Purpose Vehicle, with shareholding between Jigsaw Investments Limited and ZESCO Limited, pursuant to the provisions of the Companies Act No.10 of 2017, for the construction of a power plant, to generate electrical power by conventional and non-conventional methods including coal, gas lignite, oil, biomass, waste, thermal, solar, hydel, geo-hydel, wind and tidal waves.

The affairs of Jigsco Energy Corportion Limited are managed by a Board of Directors, listed hereunder:

i Otto Khoza– Board Chairperson;
ii Mrs. Joyce Muwo' Mwansa;
iii Deolinda Guilherme Langa Wicht;
iv Florence Kabati;
v Justin Loongo;
vi Racheal Inonge Zekko; and
Viii Choice Corporate Services Limited - Board Secretary.

1.6 Percentage of Shareholding by each Shareholder

Shareholding between Jigsaw Investments Limited and ZESCO Limited in JIGSCO Energy Corporation Limited is as follows.

- Jigsaw Investment Limited: 70%
- ZESCO Limited: 30%

1.7 The developer's physical address and the contact person and his/her details

Physical Address
JIGSCO Energy Corporation Limited
Stand No. 3509/No.7
Matandani Close
Rhodespark
P.O. Box 32565
Lusaka

Mr. Otto Khoza

Director
JIGSCO Energy Corporation Limited
Stand No. 3509/No.7
Matandani Close
Rhodespark
Email:choicecorp@zamnet.zm
Tel: +20955834322

1.8 Track Record/Previous Experience of Enterprise Elsewhere

ZESCO Limited, a shareholder of JIGSCO Energy Corporation Limited, has conducted numerous Environmental and Social Impact Assessment (ESIA) studies over the past 29 years for various generation, transmission, and distribution projects, including but not limited to;

- **Chisamba 200MW Solar PV Project** – Currently under construction, the objective of the Project is to create a green alternative to hydropower generation and address the challenges faced by hydropower generation such as low water levels caused by climate change. The Solar Plant is Located in Chisamba District and about 25km southeast of Kabwe Town and is currently under Construction. The Project involves construction of a 100MW power station and 2km transmission line to the Kabwe 330/88/66kV Substation.

- **The Power Rehabilitation Project (PRP)** - The Zambia Power Rehabilitation Project's (PRP) overall objective was to support the Government's objectives of enhancing the ability of the country's electricity supply industry to provide electricity at least cost and in an efficient and sustainable manner to stimulate more and inclusive growth in the economy. The works involved rehabilitation of generation, transmission and distribution infrastructure that included power line repairs and replacements, and reinforcement of substations. Upon the rehabilitation works at the power stations, there was an additional 210MW added to the total generation capacity.

- **Kafue Gorge Lower Hydro Power Project (750 MW) -** The Kafue Gorge Lower (KGL) Hydro Power Project with a capacity of 750 MW is currently being implemented. The project will include constructing a 330kV transmission line from the KGL power station into the National Grid.

- **Kariba North Bank Extension Project (360 MW) -** The project was aimed at increasing the capacity of Kariba North Bank power station by adding two generating units of 180MW each to the existing four units. A dam with sufficient capacity exists and provision for the addition of two machines to the existing four was made.

- **Kariba North Bank Extension 330kV Transmission Line** - The project involved constructing a 130km long line from the Kariba North Bank Extension power station to the existing Kafue West Substation. The objective of the project was to transmit the 360MW to be generated by the new power station.

- **Optic Fibre Communication Project** - The state-of-the-art optic fibre is aimed at replacing the existing ground wire on the high voltage power lines. The fibre has been installed on strategic line networks. The optic fibre offers better clarity, has a higher bandwidth, and thus offers a better channel of communication for the various services that ZESCO uses. The project has resulted in improved overall corporate effectiveness and efficiency in ZESCO.

- **Itezhi Tezhi 330kV Transmission Line** - The project is aimed at constructing a 273 km long line from the Itezhi Tezhi Power Station to the existing Lusaka West Substation, through the proposed Mumbwa 220kV/330kV Substation. The objective is to transmit the 200MW to be generated by the new power station into the national grid.

- **Muzuma Upgrade 220kV- 330kV Transmission Line** - The project involves upgrading the existing Livingstone – Kafue Town 220kV transmission line to a 330kV line. The objective of the project is to increase the line's voltage capacity in order to transmit more power.

- **Leopards Hill – Luangwa 132kV Transmission Line** - The project involves constructing a 187km long 132kV line from the existing Leopards Hill Substation to the proposed 132/33kV Chitope substation in Luangwa District, through a 132/33kV substation in Rufunsa District. The Project will also include a 33kV reticulation line in Rufunsa and another 33kV line from the Chitope substation to Luangwa Town (62km) and to the Great East Road turn off (25km). The objective of the project is to connect Rufunsa and Luangwa Districts to the National Grid. The Project will also lead to the decommissioning of the less environmentally friendly Luangwa diesel powered power plant.

- **Pensulo - Mansa 330kV Transmission Line -** The project involves constructing a 400km long line from the existing Pensulo substation in Serenje to the proposed Mansa Substation, through the proposed 330/66kV Substation in Mpika. The project is aimed at extending the 330kV network in order to provide reliable supply to Luapula, Muchinga and Northern Provinces.

- **Pensulo – Chipata 330kV Transmission Line** - The project involved constructing a 285km long line from the existing Pensulo substation in Serenje to the proposed Chipata 330kV substation, through the proposed 330kV substation in Msoro. The Project aimed at extending the 330kV network to Chipata in order to provide reliable supply to the Eastern Province.

- **Luano – Kansanshi - Lumwana Mine 330kV Transmission Line** - ZESCO Limited constructed the Luano – Kansanshi Mine 330kV and the Kansanshi Mine – Lumwana Mine 330kV transmission lines in order to support economic activities in the mineral rich North-Western Province. ZESCO also constructed the Victoria Falls – Katima Mulilo 220kV transmission line.

- **Masen/ ZESCO – 100MW Kanona Solar PV Power-** This project is yet to be implemented, however, the project was approved by ZEMA and the decision letter was obtained. The Project is aimed at increasing access to electricity, improving power supply, quality and security via alternative renewable energy in Serenje District and surrounding areas.

To ensure environmental compliance in all its projects and operations, ZESCO Limited established the Environment and Social Analysis Unit in 1996. Over the last 27 years, the Unit has evolved into a department and undertaken numerous ESIA studies for generation, transmission, and distribution projects, some of which are mentioned above.

1.9 Total Project Cost/Investment

The project is estimated to cost **USD 100,000,000** (Hundred Million United State Dollars Only). The cost of the project has been allocated for both constructions works and implementation of safeguard requirements.

1.10 Proposed Project Implementation Date

The Project shall be implemented over a period of 15 months upon obtaining approval for the Environmental Impact Statement (EIS) from the Zambia Environmental Management Agency (ZEMA), in addition to other regulatory requirements.

2 POLICY, INSTITUTIONAL AND ORGANISATIONAL FRAMEWORK

2.1 Policy Framework

2.1.1 Zambia Vision 2030

The National Long-Term Vision 2030 (Vision 2030) is Zambia's first comprehensive long-term development plan, outlining the Nation's aspirations for the year 2030.

For the energy sector, the vision is to achieve "universal access to clean, reliable, and affordable energy at the lowest total economic, financial, social, and environmental cost, in alignment with national development goals by 2030".

This vision is supported by key goals including:

i. Abundant and reliable supply of affordable energy to both urban and rural areas;
ii. Increased renewable alternative sources of energy;
iii. Export led energy industry; and
iv. Reduce the share of wood fuel to 40 percent by 2030.

The Vision is operationalized through five-year national development plans, currently the Eighth National Development Plan (8NDP) for 2022 to 2026.

2.1.2 Eighth National Development Plan

The 8NDP is the Country's medium-term blueprint designed to unlock the potential in all sectors of the economy for sustainable, holistic and inclusive National development. It introduces strategic interventions anchored on Economic Transformation and Job Creation, Human and Social Development, Environmental Sustainability and Good Governance Environment.

Energy is one of the important driving forces behind the development of an economy as it cuts across most economic and social activities. However, the Project aims to directly contribute to the following Strategic Development Area's:

- Strategic Development Area one (1) which focuses on the attainment of economic transformation that will be marked by advancements in industrialisation and economic diversification for sustained growth driven by agriculture, mining,

manufacturing and tourism. Specifically, Strategy Six (Enhance Generation, Transmission and Distribution of Electricity) which focuses on increasing electricity generation capacity and promotion of alternative green and renewable energy sources.

- Strategic Development Area Three (3) which emphasizes development that is anchored on sustainable environment, ecosystems and natural resource management principles.

2.1.3 National Energy Policy (2019)

The overall objective of the Policy is to achieve an optimal energy resources utilization to meet Zambia's domestic and non-domestic needs at the lowest total economic, financial, social, environmental and opportunity cost and establish Zambia as a net exporter of energy. Among its primary objectives is to steer the development of electricity generation, transmission, and distribution capacity and to encourage the growth and implementation of renewable and alternative energy sources. Placing a strong emphasis on sustainable sector development and increased access to clean and efficient energy.

The Project directly supports the policy's objective of achieving optimal energy resource utilization by leveraging Zambia's abundant solar energy potential, to meet domestic energy needs and reduce reliance on hydropower, which is vulnerable to climate change. The Project will generate 200MW of solar energy, contributing to Zambia's goal of improving the energy mix.

2.1.4 National Policy on the Environment (2007)

The National Policy on the Environment was developed in 2007 to safeguard the environment and ensure the sustainable use of natural resources. The purpose of the policy is "to create an umbrella policy for the welfare of the Nation's environment so that socio-economic development will be achieved effectively without damaging the integrity of the environment or its resources".

The Policy emphasizes that it is the duty of any institution, Government or Non-Governmental Organisation (NGO), any community group or people's organisation or any individual that uses or otherwise carries out activities that affect the environment in any way, to exercise appropriate control to maintain the productivity and integrity of the environment.

The policy emphasizes the responsibility of all stakeholders to maintain environmental integrity, which is reflected in the Project's commitment to conducting a comprehensive Environmental and Social Impact Assessment (ESIA).

2.1.5 National Forestry Policy (2014)

The Policy provides for a multi-sectoral approach that underpins the principle of local community and private sector participation in sustainable forest management. Further, it emphasizes equity and justice that vigorously motivates responsible sustainable forest management. It also provides for the domestication of international environmental agreements on the premise that forests play a key role in improving the global environment and sustainability. These include the United Nations Framework Convention on Climate Change (UNFCCC), Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), the Convention on Wetlands of International Importance, the Convention on Biological Diversity (CBD), the Convention to Combat Desertification and other relevant international agreements to which Zambia is a party.

While the Project is not directly related to forestry management, it supports the policy's broader goals of environmental sustainability and climate resilience by promoting renewable energy and reducing deforestation pressures associated with alternative energy sources like biomass. Further, the Project will ensure that any loss of biological resources is mitigated through sustainable practices.

2.1.6 National Policy on Climate Change (2016)

The vision of the 2016 National Policy on Climate Change is to attain a prosperous climate resilient economy by 2030. One of the policy objectives is to promote and implement sustainable land use management practices in order to contribute to reducing the Green House Gas (GHG) emissions from Forest and Land Use and Land Use Change and Forestry (LULUCF). Some of the identified measures to reduce emissions from forests are through reduction of forest degradation and loss of forest ecosystems and, strengthening fire management and soil conservation efforts.

The Project aligns with the policy's vision of a climate-resilient economy by promoting renewable energy and reducing greenhouse gas emissions.

2.1.7 Zambia's National Resettlement Policy (2015)

Involuntary resettlement involves the displacement of people arising from development projects which encroach on their productive assets, cultural sites and income sources viz, land, grazing fields, other assets, etc.

The National Resettlement Policy was adopted with the overall objective of establishing and protecting resettlement schemes that are economically productive, socially secure and environmentally sustainable for persons settled voluntarily or involuntarily.

Section 5 of the Policy sets out a number of guiding principles, including:

- The right to alternative land, which is safe, secure, accessible, affordable;
- Legal title to land to which people are resettled;
- The need to provide basic services;
- Involuntary resettlement should be in line with the international human rights and humanitarian law;
- Displaced people should be compensated and assisted, so that their economic and social future would be generally as favourable as it would have been in the absence of the project or better; and
- Involuntary resettlement should be conceived and executed as part of the project.

Lastly, the full cost of resettlement and compensation should be included in the presentation of project costs and benefits.

The Project is expected to impact agricultural fields; therefore, a Resettlement and Compensation Action Plan (RCAP) has been developed in accordance with relevant policy guidelines to address these impacts.

2.1.8 National Gender Policy (2023)

The National Gender Policy aims to accelerate the achievement of gender equity and equality in the Country.

Gender considerations will be mainstreamed across all Project activities, including but not limited to employment, stakeholder engagement, grievance redress mechanisms, resettlement, and compensation.

As part of this commitment, the Project team conducted community engagement campaigns to educate local residents about the project's objectives, benefits, and

potential impacts. These efforts ensured that both women and men received information equitably and had the opportunity to express their concerns or ask questions.

Additionally, two local focal point persons—one male and one female—were selected to be part of the grievance redress mechanism (GRM), ensuring that community concerns are effectively addressed in a gender-inclusive and transparent manner throughout the Project implementation.

During Project implementation, ZESCO Limited and its contractors will endeavour to provide equal employment opportunities for women and men throughout the Project lifecycle. This involves fair recruitment processes, training programs, and promoting a work environment that is free from gender-based discrimination.

2.2 Organisational/ Administrative Framework

2.2.1 Ministry of Green Economy and Environment

The Ministry is responsible for facilitating and coordinating the development and implementation of policies, programmes and projects on the environment to ensure sustainable management and conservation of the environment. The proposed Project will interact with the following Departments/Agencies under the Ministry, listed hereunder.

(A) Zambia Environmental Management Agency

The general functions of the Zambia Environmental Management Agency (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 of the Constitution of Zambia.

The responsibility of environmental impact assessment is vested in ZEMA, which administers the Environmental Management Act (EMA) No. 12 of 2011 as amended by the EMA No. 8 of 2023, Statutory Instrument No. 28 of 1997 – The Environmental Impact Assessment (EIA) Regulations. By administering the EMA, ZEMA is the lead agency on environmental management in Zambia.

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

- Assisting the developer to determine the scope of ESIA studies;

- Reviewing project briefs, terms of reference, and environmental impact statements (EIS) and decision making;
- Disclosure of environmental and social safeguard instruments to the public through the media and/or via public hearing meetings;
- 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.

As prescribed by SI No. 28 – The EIA Regulations, JIGSCO, as the developer of the Siavonga 200MW Solar PV Power Generation Project, "may have an effect on the environment" is required to submit an EIS to ZEMA for approval before "undertaking" this Project and is required to abide to the "conditions compulsory by the ZEMA in that approval".

(B) Forestry Department

The Forestry Department (FD) is established under the Forests Act No. 4 of 2015. The Department is responsible for managing, protecting and conserving forests in order to ensure their sustainable utilization and management for socio-economic development. Whilst the Project does not directly affect any protected areas, the Forestry Department was engaged in identifying potential impacts on forest resources and proposing mitigation measures. A reconnaissance survey of the proposed site and transmission line route was undertaken, and a biomass assessment study shall be conducted by the Department, for the issuance of a tree felling Permit for the loss of trees in the affected by the Project.

2.2.2 Ministry of Tourism

(A) Department of National Parks and Wildlife

Established under the Zambia Wildlife Act, No. 14 of 2015 to manage and conserve Zambia's wildlife estate comprising 20 National Parks, 36 Game Management Areas and one bird sanctuary, which cover 31 percent of the Country's land mass. The functions of the Department of National Parks and Wildlife (DPNW) include; to control, manage, conserve, protect and administer National Parks, Community Partnership Parks, bird and wildlife sanctuaries and Game Management Areas and coordinate activities in these areas; and issue licenses, certificates and permits.

The local forest closest to the project area is Lukwechele P 184, however, it is not affected. There is one (1) private GMA in the project area. It is important to note that some parts of the site serve as a corridor for Elephants crossing from Zimbambwe into Zambia and vice versa, hence, the DNPW has been engaged to carry out a biodiversity assessment in order to evaluate potential ecological impacts and ensure compliance with conservation requirements. Furthermore, all wildlife that may be encountered during the project implementation phase will be protected as prescribed in the Act.

(B) The National Heritage Conservation Commission

The National Heritage Conservation Commission (NHCC), formerly 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 sites; and
- Ecological and other sites.

NHCC is a key stakeholder in the review of the Project's potential cultural and heritage impacts. While there are currently no known sites or artifacts in the Project area, the Commission will manage the handling of any chance finds as prescribed in the Chance Finds Procedure (Appendix 1).

2.2.3 The Ministry of Energy

The Ministry of Energy (MoE) is responsible for the development and management of energy resources in a sustainable manner for the benefit of the people. The mandate and portfolio functions of MoE, as outlined in the Government Gazette Notice No. 836 of 2016, are as follows:

- Development of Renewable Energy Sources;
- Electricity;
- Energy Policy;

- Nuclear Energy Policy;
- Oil Pipeline and Refineries;
- Petroleum; and
- Petroleum Storage and Pricing.

In executing its mandate, the Ministry supervises the Energy Regulation Board (ERB) and ZESCO Limited.

(A) The Energy Regulation Board

The ERB has the mandate of regulating the energy sector in line with the provisions of the Energy Regulation Act of 2019. 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 license to operate the proposed Project will be approved by ERB.

(B) ZESCO Limited

ZESCO is a shareholder in JIGSCO Energy Corporation, the Project developer. A parastatal under the MoE, ZESCO Limited was formed in 1970 after the Zambia Electricity Supply Act was passed in Parliament. This Act brought together the electricity undertakings that were previously managed by the local authorities. ZESCO Limited is a vertically integrated electricity utility, which generates, transmits, distributes and supplies electricity in Zambia. It is a public utility, owned by the Government of Zambia (GRZ), through the Industrial Development Corporation (IDC) as the sole shareholder. ZESCO is committed to providing safe and reliable electricity to improve the quality of life for all.

ZESCO Limited 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 Limited is among the utilities that represents Zambia in the Southern African Power Pool (SAPP), which is a cooperation of the national electricity companies in Southern Africa, under the auspices of the Southern African Development Community (SADC). SAPP has created a common power grid among its 12

member countries and a common market for electricity in the SADC region due to the increasing demand for electricity.

2.2.4 Other Ministries and Authorities

Environmental and social issues cut across a wide variety of sectors and as such, there are a number of Government institutions and agencies which are involved in environmental and social management. Some of the ministries, sectorial agencies and authorities that will interact with the proposed Siavonga SPP include:

- Ministry of Labour and Social Security;
- Ministry of Health;
- Ministry of Community Development and Social Services;
- Ministry of Water Development and Sanitation (Water Resource Management Authority (WARMA), Department of Water Affairs);
- Ministry of Local Government and Rural Development (Department of Chiefs and Traditional Affairs and Chirundu Town Council);
- Ministry of Agriculture;
- Ministry of Livestock and Fisheries;
- Road Development Agency (RDA); and
- The Sikoongo Royal Establishment

2.3 Regulatory and Legal Framework

The principle environmental legislation in Zambia is the EMA No. 12 of 2011 as amended by the EMA No. 8 of 2023. This legislation sets out a framework for Environmental Impact Assessments (EIAs) as well as establishing ZEMA as the regulatory body charged with overseeing the application of the environmental legislation. It also provides for integrated environmental management and the protection and conservation of the environment and the sustainable management and use of natural resources.

JIGSCO Energy Corporation will ensure that it adheres to the principles of sustainable development in the utilization of natural resources during all phases of project development. This shall be done by ensuring that all the identified negative impacts are minimized in accordance with the mitigation measures to be stipulated in the EIS and the Environmental and Social Management Plan (ESMP).

The Environmental Management Act No.12 of 2011 as amended by the EMA No. 8 of 2023, Statutory Instrument No. 28 of 1997 instructs that "A developer shall not implement a project for which a Project Brief or Environmental Impact Assessment is required under these regulations, unless the project brief or environmental impact statement have been concluded in accordance with these regulations and the Zambia Environmental Management Agency (ZEMA) has issued a decision letter". In the category of electrical infrastructure, the types of projects that require project briefs and environmental impact statements include: electric generation stations and transmission lines more than 1km long. The project under consideration falls within the second schedule, and thus requires an Environmental Impact Statement (EIS).

The environmental impact assessment for this proposed Project has been conducted in order to comply with the provisions of this SI.

Table 1 below presents relevant National legislation which are applicable to the Project.

2.4 Institutional framework

Table 2: Legal and Institutional framework

Legal Instrument	Main Provisions	Responsible Institutions	Relevance	Compliance
	Environment and Natural Resources Management			
Environmental Management Act No.12 of 2011	To protect the environment and control pollution, so as to provide for the health and welfare of persons, animals, plants and the environment in totality. The Act covers water, air, waste, pesticides and toxic substances, noise, ionizing radiation and natural resources, etc.	Ministry of Water Development and Sanitation Zambia Environmental Management Agency.	Environmental Impact Statement (EIS) approval is necessary for project implementation. Environmental monitoring to continue throughout the project phases.	ZESCO shall adhere to this by formulating the necessary documentation i.e. for submission to ZEMA prior to the implementation of the project.
	Heritage and Cultural Aspects			
National Heritage Conservation Act No. 13 of 1994	To conserve and protect both natural and cultural heritage and other resources within the boundaries of the site for the benefit of the present and future generations.	Ministry of Tourism National Heritage and Conservation Commission.	This is relevant to the project in case of discovering by chance artifacts or cultural heritage sites within the project area. Taking note that it is not the entire country that has been surveyed for historic and heritage sites.	There are no known historical/cultural sites or artefacts in the project area. However, should there be any chance finds, ZESCO shall comply by seeking clearance from the National Heritage Conservation Commission.
	Electricity Industry			
Energy Regulation Act No. 12 of 2019	The Act established the Energy Regulation Board (ERB) and defines its functions and powers. The Act is relevant to the proposed project because it	Ministry of Energy. Energy Regulation Board.	The performance and efficiency of the solar project will be monitored under this Act to ensure	All associated project activities shall be done in accordance with this Act.

Legal Instrument	Main Provisions	Responsible Institutions	Relevance	Compliance
	also provides for the licensing of undertakings for the production of energy.		conformity with its provisions.	
Electricity Act No. 11 of 2019	An Act to regulate generation, transmission, distribution and supply of electricity; provide for the sale and purchase of electricity within and outside the Republic; facilitate the achievement of efficient, effective, sustainable development and operation of electricity	Ministry of Energy. Energy Regulation Board.	It is the governing Act for the operations of the power generating station.	The implementation of the project will be in accordance with the provisions of the Act such as land and wayleave acquisition and management for the solar plant and evacuation line.
	Water Resources Development and Management			
The Water Resources Management Act, No. 21 of 2011	To provide for ownership, control and use of water. Provides for management, development, conservation, protection and preservation of the water resource and its ecosystems	Ministry of Water Development and Sanitation through (WARMA).	The Act established WARMA and regulates the use of public water including protection against pollution.	Any permits or approvals that will need to be acquired in this respect shall be adhered to.
	Lands Management			
The Lands Act, No. 20 of 1996 (Cap 292, Cap 289, Cap 288)	The Department of Lands administers the Land Act, 1996 (Cap 292, Cap 288) and the Lands Acquisition Act, 1996 for the allocation and alienation of land under statutory leaseholds. The Department is also responsible for the administration of lands and deeds registration and land surveys and mapping.	Ministry of Lands, Natural Resources.	Section 8 Part II on Administration of Land. Section 8 (2) states that "the conversion of rights from a customary tenure to a leasehold tenure shall have effect only after the approval of the chief and the local authorities in whose area the land to be converted is situated, and	This governs the acquisition of the land to be used for various developmental activities. The Lands Act shall be complied with where necessary, throughout project implementation. The proposed project will

Legal Instrument	Main Provisions	Responsible Institutions	Relevance	Compliance
			in the case of a game management areas (GMAs), and the Director of National Parks and Wildlife Service, the land to be converted shall have been identified by a plan showing the exact extent of the land to be converted."	be located on land which is under customary tenure. However, the process of converting it into leasehold tenure has commenced and to this effect, consent from his royal highness Chief Simamba has already been obtained.
Urban and Regional Planning Act, No 3 of 2015	This Act provides for the development, planning and administration principles, standards and requirements for urban and regional planning processes and systems. Although most of the Act's provisions may not be relevant to the project, Section 3 (1) C of the Act is relevant. It states that "planning procedures shall incorporate environmental standards and requirements specified in any law relating to the environment and natural resources."	Ministry of Local Government and Rural Development Ministry of Housing and Infrastructure Development. Local Authorities.	Relevant planning approvals shall be obtained prior to project implementation.	This act governs the approvals of construction and development plans within a locality. The Act shall be complied with before and throughout project implementation.
Local Government Act No. 2 of 2019.	Provides for the establishment of Councils in 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.	Ministry of Local Government and Rural Development. Ministry of Housing and Infrastructure Development.	The Local Government Act is relevant to the proposed project because it allows local authorities such as the Siavonga District to implement environmental protection and natural resources management	The act is relevant to the project as some pollution control and environmental protection functions are handled by the local Council.

Legal Instrument	Main Provisions	Responsible Institutions	Relevance	Compliance
		Local Authorities.	functions that include prevention of pollution of water sources.	
Employment and Labour Management				
Workers Compensation Act No. 10 of 1999	Legislation on compensation of workers for disabilities suffered or diseases contracted during the course of employment.	Ministry of Labour and Social Security	To provide for the payment of compensation to workers who are injured or die as a result of accidents or diseases on site.	The project will have workers that will be employed by the contractor, including the contractor who shall be guarded and directed by the Acts respectively.
Employment Act No. 20 of 2017	Provides legislation relating to the employment of persons.	Ministry of Labour and Social Security	To make provisions for the engagement of person on contracts of service.	
Occupational Health and Safety Act No. 36 of 2010	Provides for the establishment of the Occupational Health and Safety Institute and its functions; establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work; the duties of manufacturers, importers and suppliers of articles, devices, items and substances for use at work; the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work; and related matters.	Ministry of Labour and Social Security / Ministry of Health	The act is relevant because it will serve as a guide to the employer and also protect the wellbeing of the employees.	The Act will guide the contractor on occupational health and safety of employees and themselves.
Anti-Gender Based Violence Act No. 1 of 2011	Provides for protection of victims of gender-based violence, constitutes the anti-	Ministry of Community	The project is expected to employ both male and female.	The project will not discriminate on the basis of gender.

Legal Instrument	Main Provisions	Responsible Institutions	Relevance	Compliance
	gender-based violence committee, establish the anti-gender-based violence fund, and provides for matters connected with or incidental to the foregoing.	Development and Social Welfare		
Forestry Resources Management				
Forest Act No 4 of 2015	Provides the establishment and declaration of National Forests, Local Forests, joint forest management areas, private forests and community forests. The Act also provides for the participation of local communities, local authorities, traditional institutions, non-governmental organisations and other stakeholders in sustainable forest management; provides for the conservation and use of forests and trees for the sustainable management of forests ecosystems and biological diversity; and provides for the implementation of United Nations Framework Convention on Climate Change (UNFCCC).	Ministry of Lands and Natural Resources	This legislation is relevant because the little existing vegetation is natural forest which is a habitat to a range of fauna within the area.	The project will help preserve the remaining forest from depletion particularly by charcoal producers who indiscriminately cut forests. This ultimately will contribute to sustainable forest management in the area.

2.5 Organisational Framework

ZESCO SHEQ Policy (2022)

The ZESCO SHEQ Policy establishes a sense of direction and set principles of the standards it subscribes to. The Policy is an integration of the following ZESCO Procedures:

Waste Management Procedure (2023)

Hydrocarbon Management Procedure (2023)

Snake Management Procedure (2022)

Management of Chemicals (2023)

ESMP Procedure (2016)

Management of PCB's Procedure (2023)

Resettlement and Compensation Action Plan Procedure (2016)

Environmental and Social Impact Assessment Procedure (2016)

Water Quality Monitoring (2023)

The Policy is appropriate to the purpose of ZESCO and includes a commitment to the following:

- Protection of the environment;
- Prevention of injury and ill health;
- Adhering to applicable legal and other requirements to which the organization subscribes;
- Establishing and reviewing of safety, health, environmental, ICT and quality objectives; and Consultation and participation of workers

Relevance: This SHEQ Policy is relevant as it establishes environmental protection procedures that shall be upheld during project implementation.

Compliance: The ZESCO SHEQ Policy commits to the protection of the environment in all its tenets during all project activities. Therefore, during project implementation these environmental protection tenets shall be upheld.

2.6 International Agreements and Conventions

Table 3: International agreement and coventions

International agreements, conventions and/or treaties	**Relevance to the proposed development**	**Compliance**
Convention on Biological Diversity. This Convention was adopted in 1992 and aims at encouraging and enabling all countries to conserve biodiversity and use its components sustainably in support of National Development.	The project will traverse habitat of both flora and fauna.	Biodiversity will be preserved in line with the provisions of the convention by avoiding indiscriminate destruction of habitat.
Statutes of the International Union for the Conservation of Nature and Natural Resources (IUCN), 2016**.**	The project will impact on nature: soil, flora, fauna and avifauna.	Sustainable implementation of the project to prevent or minimise adverse impacts.
Basel Convention (1994) which regulates trans-boundary movements of hazardous wastes.	There will be importation of equipment and material for implementation of the project.	It shall be ensured that no contaminated material (e.g., Polychlorinated Biphenyls (PCBs)) is imported. Adequate licensing shall be obtained from ZEMA for the storage and disposal of hazardous waste, if any will be generated.
Convention dealing with the **Protection of the World Cultural and Natural Heritage** (1972), ratified by Zambia in 1984.	There could be chance find of cultural site or artefacts in the project area during the project implementation.	The Zambia National Heritage Commission will be notified and consulted on the way forward if any cultural site or artefact is found.
Convention on International trade in Endangered Species of the wild fauna and flora (CITES), 1993.	There could be Endangered Species of wild fauna and flora in the project area.	It shall be ensured that no international trade of Endangered Species is practiced during project implementation.
The United Nations Framework Convention on Climate Change (UNFCCC), 1992.	Some activities during the project cycle may cause emissions into the atmosphere.	Potential sources of Greenhouse Gases (GHG) emitting substances during the construction and operation of the solar power plant will be avoided.

2.7 International Standards and Good Practice

This EIS makes due reference to internationally recognised standards in order to establish a transparent, efficient and effective safeguards framework for the Project, which is in line with both National requirements and the expectations of local and international stakeholders. The key referenced international standards for the Project ESIA are the International Finance Corporation (IFC) Policy and Performance Standards (PS) on Environmental and Social Sustainability (2012), the World Bank's Environmental and Social Standards (ESS) and the African Development Bank Integrated Safeguard System (ISS). Table 2 gives a summary of IFC standards aimed at preventing /mitigating potential adverse impacts.

Table 4: Application of relevant standards

Standards	Objectives	Relevance
IFC PS 1: Assessment and Management of Environmental and Social Risks and Impacts WB ESS 1: Assessment and Management of Environmental and Social Risks and Impacts AfDB OS 1: Assessment and Management of Environmental and Social Risks and Impacts	• To identify, assess, and manage environmental and social risks and impacts of projects through a systematic and risk-based approach, improving environmental and social performance. • To systematically identify, evaluate, and manage environmental and social risks and impacts throughout the project life cycle. • To provide opportunity for stakeholder engagement and consultation in assessing and managing the environmental and social risks and impacts.	This Environmental and Social Impact Assessment (ESIA) has been prepared in line with this requirement. Comprehensive baseline studies have been conducted to identify potential risks and impacts associated with the Project. An Environmental and Social Management Plan (ESMP) has been developed to address these risks, including mitigation measures, monitoring protocols, and a grievance redress mechanism. Public consultation was also an integral part of the ESIA process, ensuring that stakeholder concerns were incorporated into the Project design.
IFC PS 2: Labor and Working Conditions WB ESS 2: Labor and Working Conditions AfDB OS 2: Labor and Working Conditions	• To promote the fair treatment, non-discrimination, and equal opportunity of workers. • To establish, maintain, and improve the worker management relationship. • To promote compliance with national employment and labour laws.	ZESCO Limited, as a key stakeholder and shareholder in the project, has established operational health and safety guidelines under its Safety, Health, Environment, and Quality (SHEQ) procedures, which govern its operations. Additionally, ZESCO is ISO 45001 certified, demonstrating its commitment to international standards for occupational health and safety management systems. JIGSCO Energy Corporation

	• To protect workers, including vulnerable categories of workers such as children, persons with disabilities, workers engaged by third parties, and workers in the client's supply chain. • To promote safe and healthy working conditions, and the health of workers. • To provide workers with accessible mans to raise workplace concerns • To prevent the use of forced labour and child labour	Limited will adopt and adhere to ZESCO's SHEQ guidelines and ISO 45001 standards during the development of the Project.
IFC PS 3: Resource Efficiency and Pollution Prevention WB ESS 3: Resource Efficiency and Pollution Prevention and Management AfDB OS 3: Resources Efficiency and Pollution Prevention and Management	• To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote the sustainable use of resources, including energy and water, and raw materials. • To reduce project related emissions of short- and long-lived climate pollutants and GHG emissions. • To avoid or minimize generation of hazardous and nonhazardous waste • To minimize and manage the risks and impacts associated with pesticide use	As described in this EIS, an approach for pollution prevention and resource efficiency has been proposed and will be implemented as detailed in the ESMP.

IFC PS 4: Community Health, Safety, and Security WB ESS 4: Community Health and Safety AfDB OS 4: Community Health, Safety, and Security	• To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. • To promote quality and safety, and considerations relating to climate change in the design and construction of infrastructure • To avoid and minimize community exposure to project-related traffic and road safety risks, diseases, and hazardous materials • To help prevent against sexual exploitation, abuse and sexual harassment of members of the community by project workers.	As described in this EIS, an approach for managing community health and safety has been proposed and is included in the ESMP.
IFC PS 5: Land Acquisition and Involuntary Resettlement WB ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement AfDB OS 5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	• To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. • To avoid forced eviction. • To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at	The proposed Project was designed to minimize land acquisition; however, it will still result in some loss of property. As described in this EIS, an approach for managing involuntary resettlement has been developed and will be implemented as detailed in the Resettlement Action Plan (RCAP). Further, a grievance redress mechanism to address any concerns raised by affected communities will be implemented.

	replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • To improve, or restore, the livelihoods and standards of living of displaced persons. • To conceive and execute resettlement activities as sustainable development programs, providing sufficient investment resources to enable displaced persons to benefit directly from the project, as the nature of the project may warrant. • To ensure that resettlement activities are planned and implemented with appropriate disclosure of information, meaningful consultation, and the informed participation o those affected.	
IFC PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources WB ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources AfDB OS 6: Habitat and Biodiversity Conservation, and Sustainable	• To protect and conserve biodiversity and habitats • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities	A biological environment assessment has been conducted to evaluate the ecological characteristics of the project area. Additionally, the Forestry Department has been engaged to carry out a biomass assessment, while the Department of National Parks and Wildlife (DNPW) is conducting an ecological assessment to identify potential impacts on biodiversity.

Management of Living Natural Resources	• To apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity • To support livelihoods of local communities and inclusive economic development through the adoption of practices that integrate conservation needs and development priorities	Mitigation measures to address biodiversity impacts are outlined in the ESMP to ensure sustainable project implementation.
OS 7: Vulnerable Groups	• To affirm, respect, and protect the rights and interests of vulnerable individuals and groups throughout the life cycle of the project or investment • To adopt a gender-responsive approach to the management of environmental and social impacts, which takes into account the rights and interests of women and girls, men, and boys, including paying specific attention to the differentiated burden of impacts that women and girls might face	The EIS outlines an approach to safeguarding the welfare of vulnerable groups by ensuring that marginalized communities are actively included, protected from harm, and benefit equitably from project outcomes.
IFC PS 8: Cultural Heritage WB ESS 8: Cultural Heritage AfDB OS 8: Cultural Heritage	• To protect cultural heritage from the adverse impacts of project activities and support its preservation. • To promote the equitable sharing of benefits from the use of cultural heritage. • To promote meaningful consultation with stakeholders regarding cultural heritage.	Stakeholder engagement revealed that there are no known heritage sites in the Project area. However, a chance find procedure will be adopted to ensure that any cultural heritage discovered during construction is protected. This procedure will include immediate cessation of work in the affected area, notification of relevant authorities, and implementation of measures to preserve the heritage.

ESS 10: Stakeholder Engagement and Information Disclosure AfDB OS 10: Stakeholder Engagement and Information Disclosure	• To establish a systematic approach to stakeholder engagement, ensuring constructive relationships with project affected and interested parties. • To disclose project information in accessible formats, ensuring transparency and inclusivity. Special attention will be given to vulnerable groups, such as children and women, through tailored engagement methods. • To provide accessible grievance mechanisms for project-affected parties.	ZESCO Limited has established community engagement by maintaining open communication with all affected stakeholders. The ESMP and Grievance Redress Mechanisms have been established to maintain transparent communication channels address and resolve complaints or grievances from stakeholders affected by the project

3 PROJECT DESCRIPTION

3.1 Location

The proposed project is in the Southern Province of Zambia in Siavonga District in chief Simamba's Chiefdom. The Solar PV site is about 18km north of Siavonga Town and approximately 16km from Siavonga 330/132/33kV Substation. The project shall utilize two pieces of land, having a total area of 260.13 hectares. The two pieces of land are separated by a 3*330kV ZESCO wayleave.

The project area can be accessed by M15 road which branches off from T2, Great North Road, to Siavonga Town. The M15 is located on the eastern side of the site and is a tarred road in good condition. The altitude of the site area falls between ~456m and 502m. Figure shows the location of the project area. Additionally, the coordinates of the project site and the 132kV transmission line are listed in table 3 and 4 below.

Table 5: Coordinates of solar site

ID	Lat	Long
KS1a	16°21'26.70"S	28°42'25.83"E
KS1b	16°21'24.69"S	28°43'5.40"E
KS1c	16°22'29.15"S	28°43'10.93"E
KS1d	16°22'31.51"S	28°42'34.48"E
KS2a	16°21'23.73"S	28°43'10.47"E
KS2b	16°21'22.59"S	28°43'24.72"E
KS2c	16°21'47.01"S	28°43'27.34"E
KS2d	16°21'48.46"S	28°43'12.83"E

Table 6: Coordinates of 132kV transmission line

Name	Eastings	Northing
P1	16°21'45.30"S	28°43'6.56"E
P2	16°29'17.72"S	28°43'48.52"E
P3	16°30'14.27"S	28°44'36.28"E
P4	16°30'2.06"S	28°44'57.09"E
P5	16°30'23.46"S	28°45'19.48"E
P6	16°30'46.09"S	28°45'20.42"E

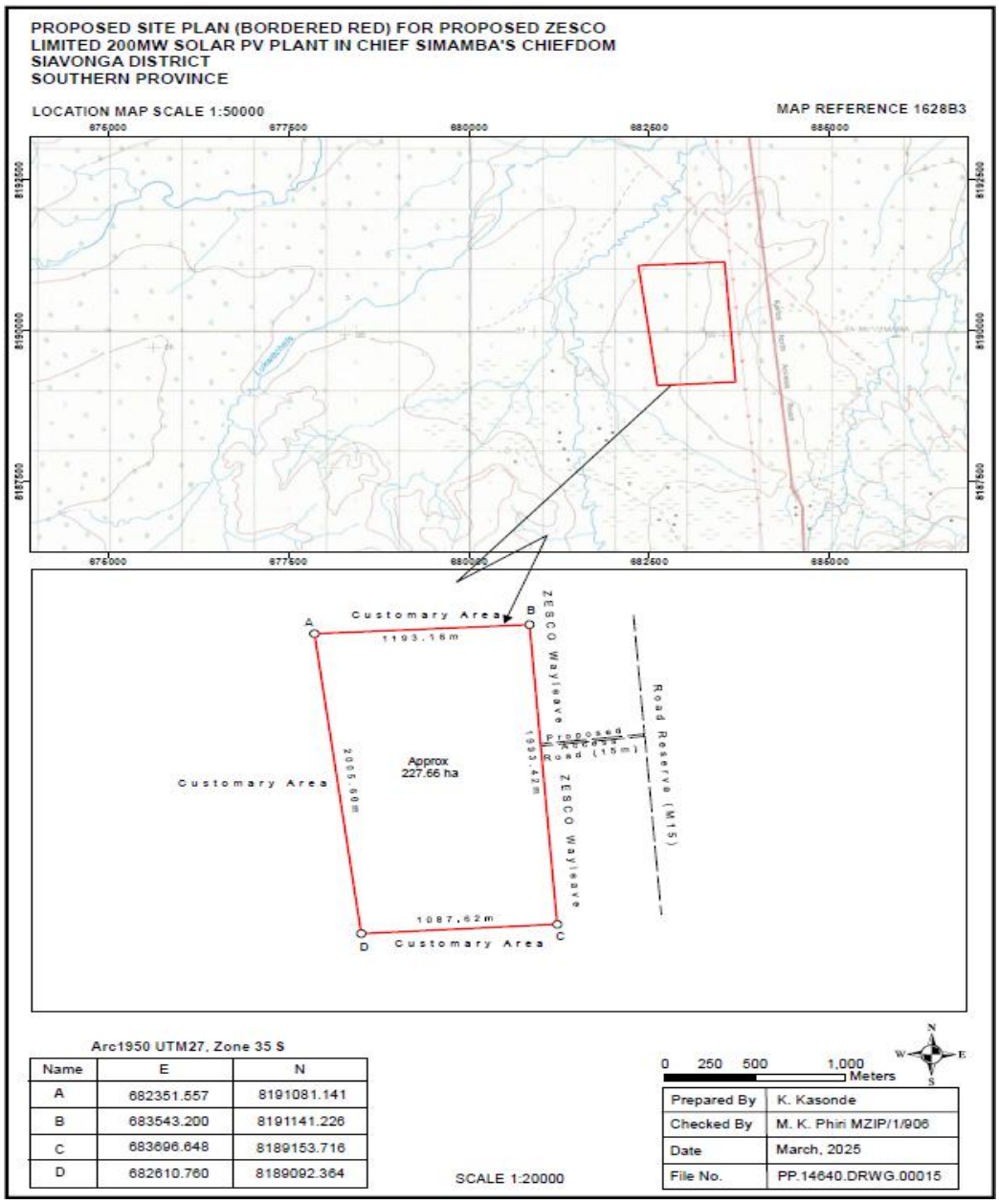


Figure 1: Proposed site plan for the solar PV plant

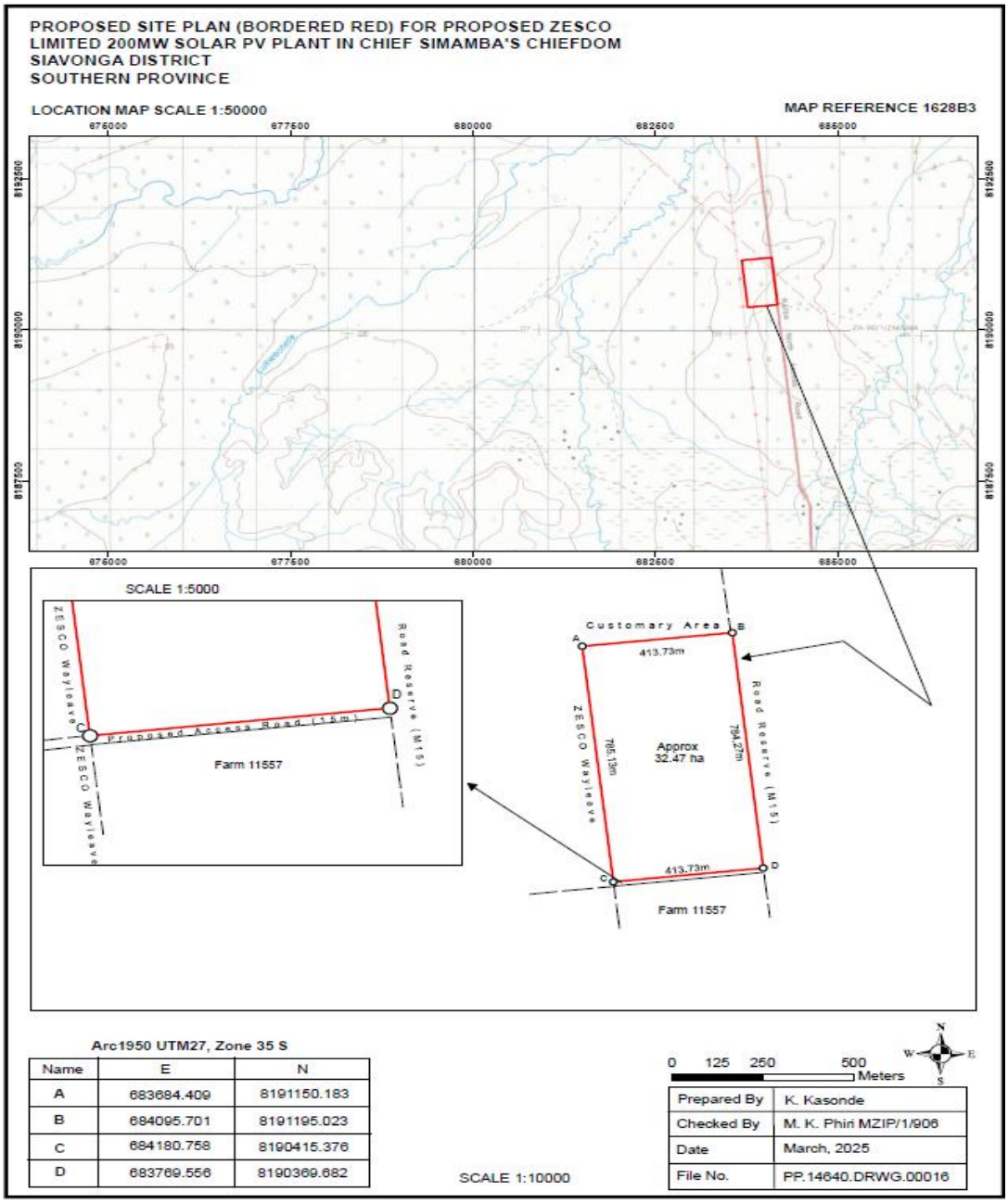


Figure 2: Proposed site plan two

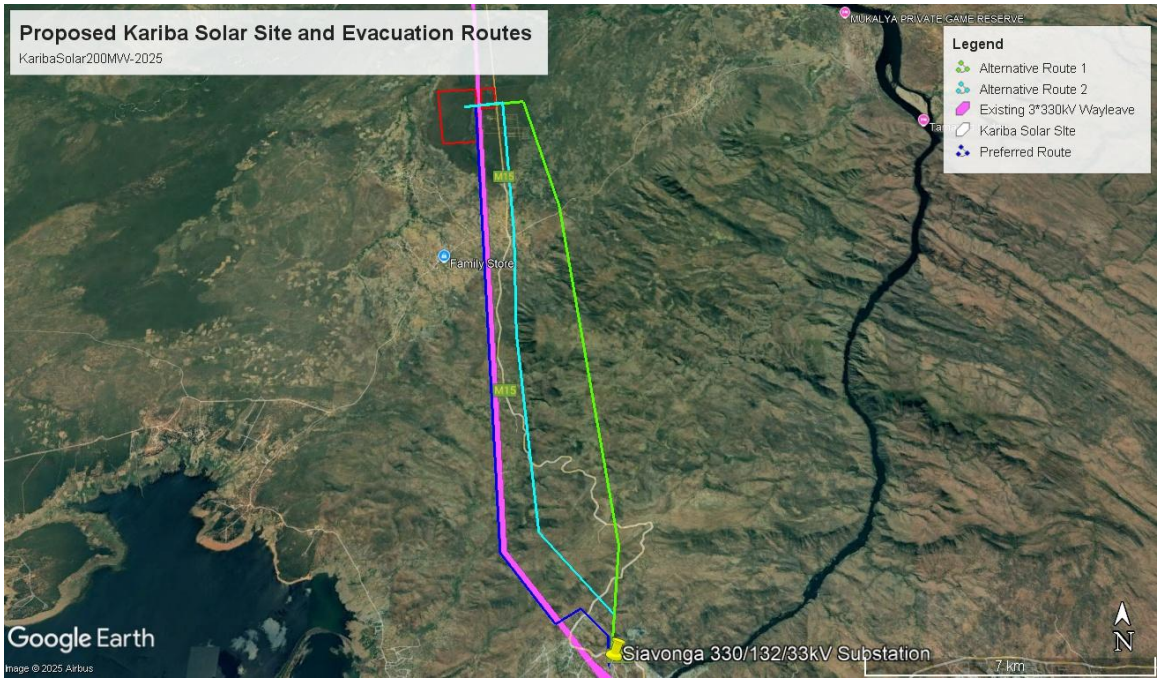


Figure 3: Google image of solar site and evacuation routes

3.2 Nature of the Project

3.2.1 Raw materials (including hazardous materials and their storage on site)

The main raw materials for the project include, but not limited to, the following:

Table 7: Project Raw Materials

Raw Material	Source	Mode of Delivery
Solar Plant • Photovoltaic modules, • The single-axis tracker, • String inverters, which convert DC from the solar field to AC; • Power Transformers, which raise the voltage level from low to medium; and • Power Stations, which hold the necessary equipment to convert the DC power to AC.	Imported, ensuring compliance with Zambian standards and regulations	Delivery Truck
Transmission Line • BISON double-bundle conductor system with 450mm intra bundle spacing • Ground wires o One 48-core Optical Ground Wire (OPGW) for communication.	Imported, ensuring compliance with Zambian standards and regulations	Delivery Truck

o One Aluminum-Clad Steel (ACS) stranded wire for additional grounding. • Insulation o Porcelain insulators for tension insulator strings. o Composite insulators for suspension insulator strings • Towers o Lattice steel structures from Q420 galvanized steel for main members o Q235 steel for diagonal and auxiliary members • Square ground rings using 7x3.25mm galvanized steel wires. • Lightening arresters • Stockbridge dampers		
• Sand, aggregates, laterite and cement for the concrete structure's installation.	Local suppliers/ borrow areas within project area	Delivery Truck
General building materials (e.g., timber for shuttering, polythene sheeting, brick force and mesh reinforcement, timber purlins, Cement Blocks Clay bricks etc.)	Local / International suppliers	Delivery truck
Diesel for operation of plant and machinery and diesel genset during construction (on site storage)	Local ERB approved supplier	Fuel Bowser
Water for construction, dust suppression and worker's domestic use; total demand estimated at 1.55m³/day	1. Borehole on site' 2. Nearby river/stream i.e Kafue River	3. Pumping and reticulation 4. Water bowser
Electricity during construction	5. Kariba HPP	6. Temporal 33kV Line

3.2.2 Products and by-products

The main product of the Project is electric power that will be generated by the Solar Plant and evacuated to the National grid via a 330kV transmission line. Associated substations will be constructed and upgraded, respectively.

By definition a by-product is a secondary product derived from a manufacturing process or chemical reaction. It is not the primary product or service being produced. A by-product can be useful and marketable or it can be considered waste. In this case the following waste materials are expected to be generated;

a) Waste generated during Site Preparation and Construction

Waste materials expected during the site preparation and construction phase of project development encompass excavation debris, packaging materials such as

polystyrene and cable drums, concrete waste, and effluent from on-site welfare facilities.

Excavation spoil will be utilized to fill designated areas, while non-recyclable solid waste, including packaging from worker food, will be appropriately disposed of at licensed waste disposal sites. Mobile sanitary facilities will be employed, and the waste from these facilities will be managed through either Engineered Septic Tanks or a Sewage Treatment Plant.

b) Waste generated during Operation

Potential waste materials during the operational phase may include maintenance related waste, faulty PV units, office waste, and effluent from site control rooms.

The system neither involves chemical usage nor generates chemicals as by products. Non-recyclable solid waste, like certain packaging materials and office waste, will be appropriately disposed of at designated, licensed waste disposal sites. Management of any hazardous waste from the Solar PV Plant will adhere to relevant legislation and international best practice. To promote responsible waste management, JIGSCO aims to collaborate with reputable PV module manufacturers offering voluntary take-back and recycling programs. These manufacturers will assume responsibility for the modules throughout the project's lifespan, ensuring proper collection and transportation for recycling or certified industrial recycling.

Anticipated maintenance activities on the site are not expected to yield substantial waste. It is proposed that all liquid and solid waste from the operational site will be directed to a centralized waste collection and treatment system within the site, adhering to National standards. Hazardous waste, such as used oils and solar modules, will be managed in accordance with National requirements and international best practice. Given the project's nature and operations, minimal waste generation is anticipated on-site.

c) Waste Generated at Decommissioning and Closure

At the end of life of the project estimated to extend to at least 25-30 years, used solar modules, associated electrical components and cabling will be the main waste types. These will require removal from the site for safe disposal or recycling. Site buildings will need to be demolished if there will be no agreed alternative use for them and the site will need to be restored to near pre-project conditions.

A comprehensive decommissioning plan for the Project will be developed and continuously updated. This Plan will be put into action to ensure the secure removal

and appropriate disposal of all Project components that have reached the end of their useful life or are no longer necessary for the ongoing operation of the Project.

d) Hazardous Waste from the Project

The Project is expected to use some materials that will generate some hazardous waste during the whole project cycle. Examples of some of the hazardous waste that will be generated from the Project include but not limited to the following (including the storage mechanisms):

- Waste from Fluorescent bulbs and tubes – will be stored in dedicated areas for safe disposal at an approved dump site;
- Spent Batteries (car batteries) – will be stored in dedicated areas pending transportation for recycling.
- Oils and greases – (where necessary) will be stored in dedicated areas pending transportation for recycling

3.2.3 Production capacity

The solar power plant will generate 200MWac of electrical power which shall be evacuated at 132kV to the Siavonga Step-down substation then injected into the national grid.

3.2.4 Schedule and life time of the project

The Project is scheduled to be implemented over a period of 15 months, following approval of this EIS and other applicable legislative requirements. The Solar Power Plant is expected to be in existence for approximately 30 years.

3.3 Main activities

3.3.1 Preparation phase

The pre-construction phase will include the following activities:

- Site rankings and selection;
- Reconnaissance and route alignment survey. A reconnaissance survey is essential for the purpose of establishing control points and collection of first-hand information of various important field data required;
- Feasibility Studies;
- Obtaining relevant approvals from regulatory authorities and other stakeholders;

- Carrying out of wayleave acquisition for the proposed line corridor and obtaining of relevant consent, including land acquisition for the substation and related infrastructure;
- Resettlement and/or compensation of affected persons and assets;
- Detailed survey works;
- Geotechnical Surveys;
- ESIA studies;
- Tendering process and awarding of contract(s); and
- Training of personnel. Environmental, Health and Safety, (EHS) training will be given to appropriate contracted personnel prior to the commencement of the works. The level of training will be commensurate with the type of duties of the personnel. The training program shall cover plans and procedures specific to the project and shall also include environmental policy, wayleave clearing, waste management guidelines and general environmental awareness campaigns and programmes.

3.3.2 Implementation Phase

The implementation phase will include the following activities:

- Detailed survey;
- Bush clearing, site preparation including all civil ground works and construction of access roads to Project site;
- Installation of earthing equipment and earthing resistance measurements;
- Erection of Mounting structures;
- Installation of primary equipment (PV Modules and Inverters);
- Construction of Control Building and offices;
- Construction of High Voltage substation and transmission line;
- Erection of Transformers;
- Laying of cables and associated equipment;
- Installation of metering, control panels, SCADA systems, telecommunication systems and protection equipment;
- Construction of water reticulation system;
- Equipment pre- commissioning tests and verification;
- Preparation and submission of a grid connection application;
- Submission of Building Drawings and manuals for all plant equipment;
- Commissioning tests and functional guarantees;
- Training of plant operators and maintenance personnel (Local training); and
- Equipment handover and signing of completion certificates.

The construction of the powerline will also involve several activities which include:

- bush clearing (14km x 50m width);
- Digging of foundations;
- Tower erection;
- Stringing conductor;
- Installation of counterpoise; and
- Clean-up and re-vegetation.

The construction of the access road to the Solar Power Plant will involve survey, bush clearing, grading and clean-up.

3.3.3 Operation and Maintenance Phase

The proposed Solar Power Plant and powerline will be operated and maintained in accordance with standard procedures designed to ensure the integrity of the power system.

Routine inspections will be conducted on the Solar Power Plant and powerline to ensure security of supply and occupational/public safety. During operation, routine maintenance of the proposed Power Plant and powerline will be carried out every year during maintenance by ground patrol.

The vegetation within the Power Plant and powerline wayleave will be controlled to ensure solar modules and conductor ground clearances are not exceeded.

In terms of technical activities, the following will be undertaken during the Operation and Maintenance (O&M) phase:

Preventive Maintenance:

- Routine maintenance in line with plant and equipment O&M Manual;
- Measurement of output comparing current and nominal values;
- Remote monitoring and daily review of data;
- Bi- annual site inspections and cleaning of solar modules;
- Periodic measurement of the array I-V curves and hot spot analysis;
- Periodic measurement of transformers and invertors; and
- Module cleanings to ensure performance guarantee obligations are met.

Corrective Maintenance:

- Onsite SCADA system with near real-time readings;

- Response targets – incidents to be reported and resolved accordingly;
- Minimum Spare Parts Inventory;
- Spare parts inventory management; any spare parts used to be replenished.
- Monthly and Bi- annual reporting;
- Monthly communication of production data, evacuation data, availability, spare parts status;
- Monthly and Bi-annual reporting;
- Monthly communication of production data, evacuation data, availability, spare parts status; and
- Monthly and Bi-annual reporting on production and performance data, corrective and preventative maintenance.

3.3.4 Decommissioning and Abandonment Activities

The Solar Plant is designed and will be operated and maintained to provide safe and efficient service throughout its entire lifespan. If some facilities need to be decommissioned or abandoned, appropriate methodology will be used to ensure that regulatory requirements are met. Decommissioning and abandonment of facilities will be carried out in a safe, efficient and environmentally sound manner. Decommissioning and abandonment plans will be developed after consulting with the Zambia Environmental Management Agency (ZEMA) and relevant Government Agencies.

It is expected that the proposed Solar Power Plant will have an estimated useful lifetime of approximately 30 years or more with equipment replacement/recycling and repowering.

The decommissioning and closure phase activities will include:

- Dismantling and removal of solar power plant components from site;
- Demolition of buildings and ripping concrete bases;
- Appropriate management of waste generated; and
- Re-profiling of all disturbed areas to allow for vegetation regeneration and restoring of natural drainage systems for the area.

4 Project alternatives

4.1 Site Location Alternatives

The site selection process relied on comprehensive constraint mapping of the study areas to identify possible sites and evacuation routes for the Solar Power Plant. Three (3) sites—Itezhi-Tezhi, Kariba, and Kafue Gorge Lower Hydropower Plant (HPP)—were assessed for their suitability for hydro-solar hybrid projects. The evaluation was based on criteria such as topography and geomorphology, engineering geology, grid connection, site access, flood control, and construction power and water supply. All three sites met the technical feasibility criteria and are recommended for implementation. However, Kafue Gorge Lower and Kariba Solar Plants were prioritized for execution, after have conducted Grid Impact Studies.

The proposed site is strategically located near the Kariba North Bank Hydropower Plant. This proximity is a key advantage, as one of the primary objectives of the Project is to strengthen Zambia's energy resilience by addressing climate-related risks to hydropower generation and diversifying the energy mix. By integrating the Solar PV Plant with the hydropower infrastructure, the Project will enhance operational flexibility, reduce dependency on water resources during dry seasons, and ensure a more stable and reliable energy supply. This hybrid approach leverages the complementary nature of solar and hydropower, where solar energy can offset reduced hydropower generation during periods of low rainfall, thereby mitigating the impacts of climate change on Zambia's energy sector.

4.2 Technology Alternatives

4.2.1 Power Generation

Whereas there is still a lot of hydropower generation development potential in the Country, the effects of climate change have exposed the vulnerability of this energy source. Detailed assessments have shown that there are other forms of energy that the Country can exploit easily, such as solar, wind and geothermal energy, to diversify the energy mix, while pursuing a low-carbon, climate-resilient developmental pathway.

The proposed Siavonga 200MWac Solar Photovoltaic Power Generation Project is a strategic response to the changing energy landscape in Zambia. While the Country has historically relied heavily on hydropower due to its abundant water resources, the effects of climate change and increasing electricity demand driven by socio-economic growth have highlighted the need for diversification in the energy mix. The Project aims to harness Zambia's significant solar energy potential, which is one of the most viable and readily exploitable renewable energy sources in the Country.

4.2.2 Power Transmission

a) Overhead Transmission Lines

Overhead lines were the preferred option owing to the following advantages:

- High power transmission;
- Low installation and material cost;
- Favourable for long distance transmissions;
- The fault or damage in overhead lines can easily be located and rectified;
- Maintenance of the line is easier; and
- Extension or joining on overhead lines can be performed easily and also it facilitates easy replacing.

b) Underground Transmission Cables

Underground cables (UGCs)are also used in transmitting power. However, despite having less environmental impacts, it is not economically viable to install a transmission UGC of this high voltage (132kV), as the cost is estimated to be ten (10) times more than for the conventional overhead transmission line.

In addition to the cost aspect, from the environmental point of view, it must be noted that some underground transmission cables are oil-cooled, requiring sealed conductors significantly larger in diameter than overhead conductors which are air-cooled. Of significance with this wayleave is that the line would need to be buried to a depth between 1.5m and 2m, thereby generating significant spoil that will need to be disposed of. There is also a danger of water and soil contamination from leaks in the underground cables.

With due consideration of the cost implication, technical complexities and environmental concerns associated with underground transmission cables, this option will not be considered further in the EIS.

4.3 Transmission Line Route Alternatives

4.3.1 Description of Alternatives

The route selection process relied on comprehensive constraint mapping of the study areas to identify possible routes for the proposed evacuation power line. Physical features and the social setup of the area were among the main considerations in the

route selection process. Regarding the evacuation routing, three route alternatives for the 330kV line were considered for implementation, taking into account environmental factors, access roads to the area, and socio-economic considerations. The alternative routes are described below.

Alternative 1 (Preferred Route)

Alternative 1, defined by centreline corner coordinates P1-P6, is approximately 18.5km. The line, from the proposed solar site, runs south, parallel to the 3*330kV wayleave from points P1 to P2,it then continues to run parallel to the 3*330kV wayleave in a south-west direction between points P2 and P3 before crossing the existing 3*330kV wayleave between P3 and P4 running north-east, it then turns to run in south-east direction crossing the M15 road (Siavonga -Lusaka Road) between P4 and P5, the line then turns in a south-west direction to the Siavonga 330/132/33kV Substation crossing the M15 road (Siavonga – Lusaka Road) again between points P5 and P6. This shall be a 132kV power line and is thus expected to have a wayleave width of 32m (16m on either side of the power line).

Alternative 2

Alternative 2, defined by centreline corner coordinates A11-A15 (the green line on the Map below), is approximately 17.7km long. This route option traverses some mountainous regions and crosses the M15 road (Siavonga – Lusaka Road) at 3 different points.

Alternative 3

Alternative 3, defined by centreline corner coordinates A21-A27, (the cyan line on the Map below), is approximately 17.9km long. This route option traverses some densely populated villages; hence it has the highest number of PAPs amongst the options.

As presented in Table 5 above, **Alternative 1** was found to be suitable because of the minimal adverse environmental and social effects that it would cause.

Option 2 was ranked low because of the mountainous terrain it traverses which would make access harder and increase the cost of construction.

Option 3 was ranked lowest due high number of PAPs which would entail high numbers of relocation cases.

Table 8: Coordinates of transmission line and remarks

Name	Latitude	Longitude	Remark
P1	16°21'45.30"S	28°43'6.56"E	
P2	16°29'17.72"S	28°43'48.52"E	
P3	16°30'14.27"S	28°44'36.28"E	
P4	16°30'2.06"S	28°44'57.09"E	
P5	16°30'23.46"S	28°45'19.48"E	Preferred
P6	16°30'46.09"S	28°45'20.42"E	Route
A11	16°21'46.31"S	28°42'54.23"E	
A12	16°21'39.36"S	28°43'56.26"E	
A13	16°23'43.65"S	28°44'35.45"E	
A14	16°29'11.66"S	28°45'29.62"E	
A15	16°30'45.26"S	28°45'20.59"E	Alternative 1
A21	16°21'46.31"S	28°42'54.23"E	
A22	16°21'40.90"S	28°43'34.55"E	
A23	16°24'13.96"S	28°43'51.25"E	
A24	16°25'58.90"S	28°43'56.54"E	
A25	16°29'0.55"S	28°44'21.16"E	
A26	16°30'6.40"S	28°45'24.56"E	
A27	16°30'45.26"S	28°45'20.59"E	Alternative 2

Existing Developments in the Project Area

The closest development to the proposed solar site is Southern Chickens, a chicken processing farm, on Farm 11557, located 15 meters south of the first piece of land and approximately 140 meters east of the second piece of land.

4.3.2 Environmental and Social Alternative Analysis of Alternatives

In the analysis of each proposed route for the 132kV line, various environmental and social factors were considered. Table 7 below summarizes the environmental and social parameters evaluated for each alternative.

Evacuation route surveys were conducted in order to acquire right of way for the Power Evacuation Structures from Siavonga Solar Substation to the Siavonga Substation. At this stage, three options were considered as outlined in table 7 below. Both technical and environmental considerations were used to assess the options.

Table 9: Power evacuation alternative evaluation

Lines	Line Length (km)	Number of Affected Persons	Number of corner points	Comments	Rank
Alternative 1	18.5	11	4	Preferred route because it is relatively easier to access, has least number of PAPs and will require the least amount of bush clearing hence minimising adverse environmental impact.	1
Alternative 2	17.7	13	5	It is the furthest from the main road therefore, its relatively hard to access, traverses mountainous terrain increasing cost of construction	2
Alternative 3	17.9	20	5	Has the most PAPs and traverses mountainous terrain	3

4.4 Selected Route and Justification

Alternative 1 was selected as the most suitable route due to its minimal adverse environmental and social impacts. Additionally, it is the shortest route and traverses entirely customary land, making it the most practical and cost-effective option

4.5 Do Nothing' Option

The 'do-nothing' alternative refers to the option of not establishing the proposed 200MWac Solar Photovoltaic (PV) Generation Plant. Under this scenario, no additional solar energy capacity would be added to Zambia's energy mix.

Without the implementation of this Project, several critical challenges would remain unaddressed:

- Limited Energy Diversification: Zambia's energy mix would continue to rely heavily on hydropower, which is increasingly vulnerable to climate change impacts such as prolonged droughts and reduced water levels. This over-reliance on a single energy source would exacerbate the risk of energy shortages and load shedding, particularly during dry seasons.

- Missed Renewable Energy Opportunities: The absence of this Project would compromise Zambia's ability to harness its abundant solar energy resources, which are among the best in the world. This would delay the transition to a more sustainable and environmentally sound energy system, undermining efforts to reduce greenhouse gas emissions and combat climate change.

- Unmet Energy Demand: The Project is designed to increase Zambia's generation capacity to meet current and future electricity demand. Without the Solar PV Plant, the Country would struggle to address the growing energy needs driven by socio-economic development, urbanization, and industrialization. This could lead to continued unstable power supply, hindering economic growth and development.

- Economic and Social Impacts: The do-nothing alternative would result in missed opportunities for job creation, skills development, and local economic benefits during the construction and operation of the Solar Plant. Additionally, the lack of reliable electricity would negatively impact businesses, households, and public services, further constraining socio-economic progress.

- Energy Security Risks: Failure to diversify the energy mix would leave Zambia's power system vulnerable to climate-induced disruptions, threatening energy security and resilience. This could deter investment and limit the Country's ability

to achieve its long-term development goals, as outlined in Vision 2030 and the Eighth National Development Plan (8NDP).

In summary, the do-nothing alternative would perpetuate Zambia's reliance on hydropower, leaving the energy sector exposed to climate risks and unable to meet growing demand.

5 ENVIRONMENTAL BASELINE STUDY

A combination of literature reviews, observations, interviews, discussion, and meetings were used to obtain the required information on the baseline environment of the project.

This sub-section will describe the physical environment associated with the construction of the proposed. The physical environment includes: the geology, topography, soils, climate, air quality and hydrology of the project area.

5.1 Climate

The climate of Siavonga is one of the hottest and driest in the Country. The mean annual temperatures are about 25°C while the maximum temperature is about 40°C. The minimum temperature is above 10°C.

The rainy season starts from December and ends in the middle of March. This results in a long dry season from April to November. The rainfall is erratic and insufficient. Further, dry spells of up to three weeks during the rainy season are also common in the district and this adversely affects good harvest of the rain-dependant crops. The District is in agro-ecological zone I (AEZ I) which receives annual rainfall of less than 800 mm. Figure two (2) below shows the agroecological zones in Zambia.

Figure 4: Zambia's Agro ecological zones

5.2 Air quality

Siavonga is located in a pristine environment with good air quality due to the surrounding river system and undisturbed vegetation cover. The District is generally quiet except for vehicular traffic attributed to tourism and transboundary water vessels between Zimbabwe and Zambia. Air quality assessment was undertaken at the Solar Plant site. The key parameters measured included Carbon dioxide (CO_2), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), hydrogen sulfide (H_2S) and particulate matter (PM) at different size fractions. The results are tabulated in Table 10 and 11 below.

Table 10: Air quality Results-Gases

Position	Coordinates	CO2 (ppm)	WHO Standard (ppm)	NO2 (ppm)	OSHA Standard (ppm)	SO2 (ppm)	OSHA Standard (ppm	H2S (ppm)	OSHA Standard (ppm
1	16° 21' 22.65" S, 28° 43' 25.23" E	549	800	0.33	5	0.00	5	0.06	20
2	16° 21' 48.13" S, 28° 43' 27.41" E	372	800	0.21	5	0.00	5	0.00	20
3	16° 21' 54.50" S, 28° 43' 8.37" E	366	800	0.23	5	0.00	5	0.00	20
4	16° 21' 27.65" S, 28° 42' 19.39" E	353	800	0.19	5	0.05	5	0.00	20
5	16° 22' 27.92" S, 28° 42' 9.33" E	370	800	0.17	5	0.14	5	0.00	20
6	16° 22' 25.78" S, 28° 43' 32.99" E	428	800	0.16	5	0.07	5	0.00	20

Table 11: Air quality results-Dust

Position	Coordinates	PM 2.5 (µg/m3)	WHO Standard (µg/m³)	PM 10 (µg/m3)	WHO Standard (µg/m³)
1	16° 21' 22.65" S, 28° 43' 25.23" E	8	15	8	100
2	16° 21' 48.13" S, 28° 43' 27.41" E	4	15	4	100
3	16° 21' 54.50" S, 28° 43' 8.37" E	21	15	44	100
4	16° 21' 27.65" S, 28° 42' 19.39" E	3	15	4	100
5	16° 22' 27.92" S, 28° 42' 9.33" E	3	15	3	100
6	16° 22' 25.78" S, 28° 43' 32.99" E	7	15	9	100

5.3 Geology

The Siavonga escarpment and its surrounding areas consist of underlying rocks of gneiss, magnatites and schist formations which are covered by shallow to moderately deep soils. Low lying valley areas are dominated by loamy-sand to clay - loam soils. These soils are shallow and poor in quality. The lake flood waters usually recede rapidly with the onset of the dry season. The average water table during the wet season is about 5metres and 40 metres during the dry season. Water recharge is rapid in the valley and near the lake shore. It is in this location where hydrological flood levels are attained.

Figure 5: Geology in the project area

5.4 Hydrology

The Siavonga escarpment and its surrounding areas consist of underlying rocks of gneiss, magnatites and schist formations which are covered by shallow to moderately deep soils. Low lying valley areas are dominated by loamy-sand to clay-loamy soils. These soils are shallow and poor in quality. The lake flood waters usually recede rapidly with the onset of the dry season. The average water table during the wet season is about 5metres and 40 metres during the dry season. Water recharge is rapid in the valley and near the lake shore. It is in this location where hydrological flood levels are attained.

5.5 Topography

Siavonga District is characterized by an escarpment zone which drops sharply from the plateau in the north to the valley which is now partly covered by Lake Kariba. Ecologically the District is divided into three zones: The escarpment area lying at about 1000 to 1200 meters above sea level runs from the Southwest to the Northeast of the district and is characterized by hilly terrain. The valley has an altitude of 500 to 600 meters but further decreases in the northern part of Lake Kariba from 400 to 500 meters. The Kariba Lakeshore lies at about 400 to 600 meters above sea level and is characterized by undulating landscape which experiences periodic inundation.

5.6 Soils

Generally, the soils in Siavonga District have disadvantages of having a low water holding capacity, being highly susceptible to erosion and shallow top soil depth. With regards to land use, Siavonga has a total land area of 3,413km2 of which only 540km2 is arable.

This represents approximately 15% of the total District land. Further, 10% of this arable land is degraded.

5.7 Land use and land tenure

Siavonga District has a total land area of 3,413km2 (341,300 Hectares) of which only 540km2 (54,000 Hectares) is arable. This represents approximately 15.8% of the total District land. The land tenure is classified into two (2) categories, namely Customary Land, that is held and managed by the traditional leadership and State Land, that is managed by the local authority. State land is used for activities such as, but not limited to, subsistence agriculture, livestock rearing, fisheries and informal and retail trading.

It is worth noting that the land in the Project area is traditional land under the jurisdiction of Chief Simamba. The Project area mainly consists of mainly rearing of livestock and gardening.

5.8 Built Environment

The quality of life of people in any given location depends, largely, on their accessibility to basic social facilities and the type and quality of infrastructure in the area. Remoteness, apart from distance from the main population centers, is also a matter of the extent to which a community is accessible and connected to the rest of the Country. Roads and telecommunication facilities are particularly important. Infrastructure development also helps communities to access vital facilities with important implication for wellbeing such as electricity, water, schools, health centers and food markets, investments that help to raise people's human capital. The people who live in the project area access secondary schools, hospital, post office, tarred road, markets, shops and recreation facilities in Siavonga town which is roughly 14km away. The people living in the immediate project area have no access to electricity, however, shops can be accessed at Kariba Store shopping center.

5.9 Noise and vibration

Siavonga District is generally quiet except for noise vehicular traffic attributed to tourism and transboundary water vessels between Zimbabwe and Zambia. The other main activities that could cause noise in the Project area is traffic (domestic and heavy equipment/vehicles). The immediate Project area is generally quiet. The noise levels were

measured during the baseline assessments at six positions of the Solar Plant site. The results of the noise levels are given in Table 12 below.

Table 12: Noise quality results

Position	Coordinates	Noise (dB)	Standard Limit (dB(A)) (OSHA/WHO)
1	16° 21' 22.65" S, 28° 43' 25.23" E	75	85
2	16° 21' 48.13" S, 28° 43' 27.41" E	75	85
3	16° 21' 54.50" S, 28° 43' 8.37" E	60	85
4	16° 21' 27.65" S, 28° 42' 19.39" E	60	85
5	16° 22' 27.92" S, 28° 42' 9.33" E	59	85
6	16° 22' 25.78" S, 28° 43' 32.99" E	75	85

5.10 Fauna

5.10.1 Mammals

Common mammals reported to be in the study area include; Chacma Baboons (Papio ursinus), Elephants (Loxodonta africana), and Vevert Monkeys (Chlorocebus pygerythrus) and African wild cat (Felis lybica). However, there is not much big game on the Zambian side of the lake shore. This is so because the animals have disappeared due to anthropogenic activities. Other wildlife species which exist in the project area are rodents and rabbits.

Endangered species include, Elephants, (Loxodonta africana), Buffalo (Syncerus caffer) Hippopotamus H. hamphibius and the C. niloticus. However, no species of terrestrial fauna and avifauna that are rare or endangered were found in the Project area. Similarly, no species of scientific value were found. As such, the impact on the population, habitat or biodiversity will be minimal. Further, the site is not in any land or property used as an animal sanctuary or wildlife reserve.

5.10.2 Reptiles

Reptiles that occur in the Project area include common lizards like: Rainbow Skink (Mabuya qumquetaeniata margaritifer), Striped Skink (Mabuya striata wahlbergii), Bibrons Gecko (Pachydactylus bibronii), House Gecko (Hemidactylus mabonia), Monitor Lizard (Vavanus niloticus niloticus and Vavanus exanthematicus albigularis) and the Chameleon (Chamaeleo dilepis).

5.11 Avifauna

Field survey of bird species revealed an exceptionally rich birdlife associated with the Lake Kariba. The most common species are White-faced Whistling-Duck (Dendrocygna viduata), White-backed Duck (Thalassornis leuconotus), Knob-billed Duck (Sarkidiornis

melanotos), Egyptian Goose (Alopochen aegyptiaca), Spur-winged Goose (Treron calvus), African Green-Pigeon (Treron calvus), Double-banded Sandgrouse (Pterocles bicinctus) and African Swift (Apus barbatus).

Critically endangered bird species in the Siavonga region are the White-backed Vulture (Gyps africanus), Martial Eagle (Polemaetus bellicosus), Hooded Vulture (Necrosyrtes monachus) and the African Darter (Anhinga rufa). On the other hand, rare bird species are the Common Myna (Acridotheres tristis).

Figure 6: bird nesting in the project area

5.11.1 Fish

Siavonga district hosts Lake Kariba and the Lower Zambezi River. The fish species found in the Lake include, Nile Tilapia (Oreochromis niloticus), Red Breasted Tilapia (Coptodon rendalli), the Zambezi Tiger fish (Hydrocynus vittatus), Enoumous Vudu (Heterobranchus longifilis) and Barbel (Barbus barbus). Hippopotamus (Hippopotamus hamphibius) and the Nile Crocodile (Crocodylus niloticus) are also often found.
Fish farming is practised in the area. The most common types of fish are Bream (Abramis brama), Tilapia (Oreochromis niloticus), Bottlenose (Mormyrus longirostris) and Barbel (Barbus barbus). Fishing activities in the project area take place in the Lower Zambezi River.

5.12 Flora

Zambia is divided into five ecological zones based on the distribution of flora and fauna, correlated to environmental aspects such as altitude, climatic conditions, topography, soil characteristics and land use. Siavonga district has a combination of the Zambezian

Mopane Woodlands and the Southern Miombo Woodlands. The ecological zone in the project area is predominantly Southern Miombo Woodlands with Savanna grasslands. The Southern Miombo Woodlands covers about 15% of the country in the south. Trees in this ecoregion are more scattered and generally smaller, and the relative proportion of woody shrubs is greater. (Figure 7) Agroecological zones of Zambia).

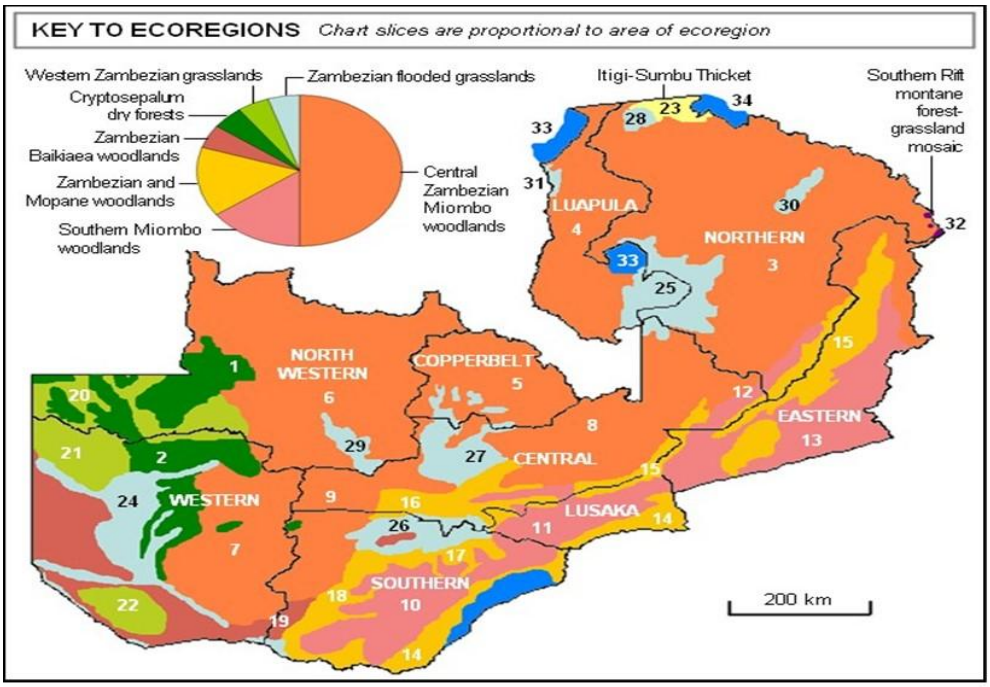


Figure 7: ecoregions of Zambia (www.en.Wikipedia.org/wiki/File:Map of Eco regions of Zambia)

The common tree species found in the district are Miombo *(Brachystegia)* .Trees found in the immediate project area include: Mopane (*Coleophospema mopane*), Miombo (*Brachystegia)*, Musangu *(Faldebia albida),* Munga (*Acacia polycantha*), Mutondo *(Julbernardia paniculate),* Baobab (*Adasonia digitata*) and *Isoberlinia Angosensis*. The acacia and mopane tree dominates other tree species. and symbolise fertility of the soil through nitrogen fixation` thus, making the majority of the land suitable for horticultural or agronomical activities.

The Munga woodland community is characterised by diagnostic woody plant species such as *Antidesma venosum, Erythrophleum africanum, Terminalia mollis* and *Ziziphus abyssinica, Albizia harveyi, Diplorhynchus condylocarpon* and *Parinari curatellifolia*. The grass component of this community is characterised by an abundance of *Andropogon gayanus, Brachiaria brizantha, Digitaria milanjiana, Hyparrhenia filipendula, Setaria sphacelata* and *Tristachya superba*. This woodland community has an open park-like appearance with many trees and thorn-bearing shrubs up to a mean height of 11m. It forms an intermediate zone between the seasonally wet dambos and other woodlands in

the project area. The woody vegetation consists of fire tolerant species, although many trees show scars from previous fire damage. The abundant grass within this community provides grazing that is well-utilised by game throughout the year.

The endangered tree species in the area is the Mopane (*Colosphosphermum Mopane*) The tree is endemic and is only found in the valleys in Zambia.

Figure 8: vegetation in the project area

5.12.1 Protected Areas

Siavonga District has two local forests reserves which are government owned namely Mutolanganga P 183 and Lukwechele P 184. The two local forests have been heavily encroached and disturbed. The two local forests structure and composition have been tempered with due to human activities such as clearing of land for cultivation and wood harvesting for timber and charcoal. The local forest closest to the project area is Lukwechele P 184. There is one (1) private GMA in the project area. However, it is important to note that some parts of the site serve as a corridor for Elephants crossing from Zimbambwe into Zambia and vice versa.

5.13 Archaeological and cultural environment

Recreation is an essential element of human biology and psychology. The Project area is generally rural, and communities enjoy a range of social, cultural and physical recreation activities such as localized celebrations, games (especially football), beer drinking, and traditional ceremonies. Of particular significance is the Bagande Lwiindi ceremony which is an annual thanksgiving celebration that takes place in December.

5.14 Social-economic set up

5.14.1 Population

According to the 2022 Census of Population and Housing Report Zambia had a total population of 19,610,769 of which 10,007,713 are females and 9,603,056 are males with a growth rate of about 3.4 percent (CSO, 2022). Siavonga district had a total population of 66,030 during the 2022 Census of population and housing. The district spans approximately 2,541 square kilometers, resulting in a population density of about 26 people square kilometers.

5.14.2 Growth rate, population density and distribution

The District has a population growth rate of 3.7%. The high growth rates have been influenced by economic development, urban expansion, cross-border activities, and a high birth rate. These factors are expected to continue shaping the district's demographic trends in the coming years. Most people live along Lake Kariba, the Zambezi River, and the Lusitu River, where fishing, agriculture, and trade thrive.

It is anticipated that during construction phase, the project area will experience a population influx from outsiders resulting in higher population. Once construction is completed, the workers will be laid off and they will go back to their respective home areas. The Project area is basically rural and most of the population is moderate and mostly concentrated in the Siavonga town. urban areas.

5.14.3 Administration

There are several Acts governing the administration of land. For the allocation and alienation of land, the Land Acquisition Act of 1995 provides for the compulsory acquisition of land and the Local Government Act (No. 2 of 2019) provides for control of land by Local Authorities. Under the Land Act, land has been demarcated into categories, namely: state and traditional land. The traditional authorities (Chiefs) have rights over the traditional land, with a mandate to recommend to Government lease to those who want to acquire land. The project area affects customary land in Simamba chiefdom.

The District is further divided into wards, each represented by a councillor elected by the residents. These councillors work alongside traditional leaders, such as chiefs and village headmen, who play an essential role in managing customary land, local governance, and community affairs.

Most of the people in Siavonga district are Tonga by tribe. The Tonga people have a strong connection to the land and the Lake Kariba area, which has been their ancestral home for centuries, they make up 70 to 80% of the total population. Other ethnic groups that include Nyanja, Bemba and Lozi make up 15 to 25% while 5% comprises expatriates and tourist.

5.14.4 Social services and amenities

5.14.4.1 Market availability on various commodities

The Project area covers Simamba ward however, the population in the project area normally access most of their daily necessities from Siavonga town. Siavonga District's economy is primarily driven by fishing, tourism, and mining. The Project area is in close proximity to the lower Zambezi River and enables locals to carry out fish farming which in turn supports the local economy. Tourism thrives due to the Lake Kariba's scenic beauty, attracting visitors for boating, fishing tours, and related recreational activities. Additionally, mining activities, particularly Uranium and Fluoride extraction, contribute to the Districts' economic growth. Recent developments, such as the establishment of a fertilizer plant and mining prospects are expected to further stimulate the local economy by creating employment opportunities and enhancing agricultural and industrial productivity, respectively. However, there are retail shops found near the project area. various types of shops cater to the daily needs of the local community. These shops are mostly small-scale businesses, reflecting the rural economy and lifestyle.

5.14.5 Literacy levels, health and gender equity

The Education sector has a total of 43 Schools comprising of 7 Community Schools, 26 primary schools, 4 secondary schools and 6 private schools. The primary and secondary schools currently host a population of 16,574 pupils segregated as 8,115 boys and 8,459 as girls, representing 63% of the total number of children enrolled. This number of children enrolled is low compared to the required population of 26,414 children. There are only 365 teachers on Government payroll (222 male and 143 female). Pupil enrolment has been increasing steadily in the past years. Increased enrolment has over taken infrastructure development leading to over enrolment, multiple sessions and condensed pupil contact time. The schools in the immediate project area include Simaundu primary school which is 3km away while the of the rest of the schools are far away the project area.

Siavonga District is served with one (1) District Hospital, nine (9) Rural Health Centres, eighteen (18) Health posts, one (1) private clinic (ZESCO) and one (1) border health post. All these facilities provide primary and curative health services to the general population.

The District has limited specialized treatment services and most of the specialized services are referred to other Health Facilities such as the University Teaching Hospital (UTH) in Lusaka. The health services offered include immunization, Male Circumcision, under five services, Maternity, Family Planning, HIV and AIDS treatment. Mutua RHC, Kabbila HP, Siamatika HP, Namoomba RHC, Chalokwa HP are identified to be close to the Project area, with Kabbila HP, Namoomba RHC and Chalokwa HP using solar energy.

Table 13: Predominant diseases in the district from 2022 to 2024

No.	2022		2023		2024	
	Disease	**Incidence/1000**	**Disease**	**Incidence/1000**	**Disease**	**Incidence/1000**
1	Respiratory Infection: non-pneumonia	471	Respiratory Infection: non-pneumonia	627.3	Respiratory infection non-pneumonia	545.2
2	Diarrhoea (non-bloody)	157	Diarrhoea (non-bloody)	182.4	Diarrhoea (non-bloody) incidence	196.1
3	Muscular skeletal and connective tissue	76	Muscular skeletal and connective tissue	91.9	Muscular skeletal and connective tissue (not trauma)	97.2
4	Malaria	64	Digestive system: (not infectious)	73.8	Lower back pain incidence	86.4
5	Digestive system: (not infectious)	58	Skin Diseases (not infectious)	60.4	Skin diseases (not infectious) incidence	78.7

6	Trauma: Other Injuries, wounds	43	Trauma: Other Injuries, wounds	44.9	Dermatitis incidence	73.9
7	Dental Carries	42	Dental Carries	42.1	Gastritis incidence	63.3
8	Skin Diseases (not infectious)	30	Throat Diseases	26.8	Nervous system disorders incidence	57.6
9	Throat Diseases	16	Skin Diseases (Infectious)	17.1	Headache tension type incidence	57
10	Asthma	10	Malaria	15.1	Birth asphyxia incidence	56.9

5.14.6 Traditional and religious practices and rites

The Project area is generally rural, and communities enjoy a range of social, cultural and physical recreation activities such as localized celebrations, games (especially football), beer drinking, and traditional ceremonies.

6.0 IMPACT ASSESSMENT

This Chapter provides information on the assessment of the associated and potential environmental and socio-economic impacts from the proposed Project. An impact is essentially any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The assessment has been undertaken following a systematic process that predicts and evaluates the impacts the Project or Project activities could have on aspects of the physical, biological, social and economic environments, and identifies measures that the Project will take to avoid, reduce, mitigate, or offset for adverse impacts and to enhance positive impacts.

6.1 Sources of Impact

The sources of impact can be defined as all the activities linked to the Project, including associated facilities that are likely to have an impact on the environment. The sources of impact are grouped by Project phase: preconstruction, construction, operation (including maintenance), and decommissioning, as depicted in Table 12.

Table 14: Sources of impacts

Project Phase	Activity/Source of Impact
Preconstruction Phase	Site survey
	Land acquisition
	Resettlement/Displacement – physical displacement and land based livelihood and economic displacement.
Construction Phase	Site clearance and preparation including establishment of labour camp, storage yard, access roads.
	Transportation of workers, machinery, construction material, solar modules, tower components, conductors, etc.
	Construction activities including; excavation, foundation works, erection of towers, stringing, transformer installation and other infrastructure at substations.
	Waste management (hazardous and non-hazardous), handling operations and storage of hazardous waste, including oil and domestic waste.
	Dismantling of temporal buildings i.e., workers camp, storage yard.
Operation Phase	Waste management (hazardous and non-hazardous), handling operations and storage of hazardous waste used during operations, including oil used in transformers at substations.
	Operation and maintenance of solar modules and transmission line, including; inspection, maintenance, and repairs of solar modules,

	conductors, towers, and as well as wayleave maintenance and vegetation control.
	Operation and maintenance of Substations.
Decommissioning Phase	Site clearance and preparation including establishment of labour camp, storage yard and access roads.
	Transportation of workers, machinery and dismantled components.
	Dismantling activities including; Excavation, dismantling towers conductors, revegetation.
	Waste management (hazardous and non-hazardous), handling operations and storage of hazardous waste, including oil and domestic waste.

6.2 Impact Identification and Assessment Methodology

In general, the assessment of impacts passed through a comprehensive process involving the following four key elements:

- Prediction of potential impacts and their magnitude (i.e., the consequences of the proposals on the natural and social environment);
- Evaluation of the importance (or significance) of impacts taking the sensitivity of the environmental resources or human receptors into account;
- Development of mitigation measures to avoid, reduce or manage the impacts or enhancement measures to increase positive impacts; and
- Assessment of residual significant impacts after the application of mitigation and enhancement measures.

Where significant residual impacts remained, further options for mitigation were considered and impacts re-assessed until they were as low as reasonably practicable for the Project. This is an iterative process that commenced during the scoping stage of the ESIA and continued throughout the impact assessment process. The process informs and runs in parallel with the design of the Project and links in with consultation and stakeholder input regarding the significance of impacts and the suitability of proposed mitigation measures.

6.2.1 Types of Impacts

Table 15: Types of impacts

Type of Impact	Definition
Positive	An impact that is considered to be an improvement on the baseline conditions or introduces a positive change.
Negative	An impact that is considered to be an adverse change from the baseline or introduces a new undesirable factor.
Direct	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g., the loss of vegetation and habitat as a result of site clearing).
Indirect	Impacts that follow on from the primary interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., increased forest loss due to improved access resulting from the construction of a road or loss of part of a habitat affecting the viability of a species population over a wider area). Indirect impacts can also be referred to as induced or secondary impacts.
Cumulative Impacts	The combined effects of the Project and other existing or planned future developments or natural processes on the same resources and/or receptors which are additive or interactive in nature.

6.2.2 Prediction of Magnitude

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. Magnitude ratings are: negligible, low, moderate, high.

The magnitude of each potential impact of the Project has been identified according to the criteria tabulated below in Table 14.

Table 16: Criteria for determining impact magnitude

Parameter	Description	Criteria
Frequency	A measure of the constancy or periodicity of the impact.	*Rare* – As far as possibly recurring impacts are concerned, such as accident or unplanned events (e.g., traffic accident, fire).
		Once-off – Impact occurs just once.
		Intermittent – Impact occurs periodically (repeatedly or sporadically).
		Continuous – Impact occurs continuously throughout project phase/ lifecycle.

Duration	The time period over which a resource or receptor is affected.	*Short-term* – predicted to last only for a limited period (i.e., during construction) but will cease on completion of the activity, or as a result of mitigation measures and natural recovery (e.g., non-local construction workforce-local community interactions).
		Medium-term – the impact is felt for some time after the completion.
		Long-term – will continue for the life of the project but cease when the project stops operating (i.e., 30 years).
		Permanent – will continue even after project life i.e., after decommissioning.
Spatial Extent	The reach of the modified natural and human environments	*On-site* – limited to the Project site.
		Local – affect locally important environmental resources or are restricted to a single (local) administrative area e.g., Chirundu District or a single community (Mwiinga Village).
		Regional – Impacts that affect regionally important environmental resources or are experienced at a regional scale e.g., North-western Province.
		National – Impacts extending outside regional/provincial boundaries or impacts that affect nationally important environmental resources; affect an area that is nationally important/protected; or have macro-economic consequences.
		International – transboundary impacts or impacts that affect internationally important resources such as areas protected by International Conventions.
Likelihood	Probability/certainty associated with a potential impact	*High* – the impact will certainly manifest itself. It will occur at normal operating conditions (i.e., it is essentially inevitable).
		Moderate - the impact might occur, without any certainty. It is likely to occur at some time during normal operating conditions.
		Low – the impact is unlikely/ rare and could occur only in the event of an accident.

The determination of overall impact magnitude rating was on the basis of professional judgement and Good International Industry Practice (GIIP), considering all four parameters collectively, where relevant. This is further detailed in Table 15.

Table 17: Impact Magnitude definitions

Magnitude	Definition
High	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature, and requiring significant intervention to return to baseline; exceeds accepted standards and limits.

Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change; within accepted standards and limits.
Low	Detectable but minor change to the specific condition assessed; well within accepted standards and limits.
Negligible	No perceptible change to the specific condition assessed.

6.2.3 Criteria for Determining Sensitivity

Receiving parameter sensitivity refers to the importance, significance or value or vulnerability of the social or environmental component under examination. Receptor sensitivity is the degree to which a particular receptor is more or less susceptible to a given impact. Receptor sensitivity takes into consideration receptor resilience and value.

Receptor value takes into consideration its quality and its importance as represented, for example, by its conservation status, its cultural importance and/or its economic value. It recognizes that, for a given magnitude impact, different receptors (either directly or indirectly) may be deemed to be of greater importance and as such the significance of the impact is greater than the impact magnitude alone.

Where the receptor is physical, the assessment considers the quality, sensitivity to change and importance of the receptor. For a human receptor, the sensitivity of the household, community or wider societal group is considered along with their ability to adapt to and manage the effects of the impact.
Similar to the approach adopted for impact magnitude, a structured description of receptor sensitivity employed a qualitative category scale of negligible, low, moderate, and high, as detailed in Table 16.

Table 18: Receptor sensitivity definitions

Sensitivity	Definition
High	Individual receptor has very limited or no capacity to accommodate, adapt or recover from the anticipated impact. The impact is likely to leave it in an altered state from which recovery would be difficult or impossible.
Moderate	Individual receptor has limited capacity to accommodate, adapt or recover from the anticipated impact, there may be some residual modification as a result.
Low	Individual receptor has some tolerance to accommodate, adapt or recover from the anticipated impact, and/or has some opportunities for mitigation.

Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact, and/or has excellent opportunities for mitigation.

6.2.4 Evaluation of Significance

Following the assessment of impact magnitude and determining the sensitivity of the receiving environment or potential receptor, the significance of each potential impact was established using the impact significance matrix shown in Table 17.

Table 19: Definition of impact significance

		Receptor Sensitivity (Vulnerability and Value)			
		Negligible	*Low*	*Moderate*	*High*
Impact Magnitude	*Negligible*	Not significant	Not significant	Not significant	Not significant – Low
	Low	Not significant	Low	Low – Moderate	Moderate
	Moderate	Not significant	Low – Moderate	Moderate	Moderate – High
	High	Low	Moderate	High	High
High	*Significant.* Impacts with a "High" significance are likely to disrupt the function and value of the resource/receptor, and may have broader systemic consequences (e.g. ecosystem or social well-being). These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.				
Moderate	S*ignificant*. Impacts with a "Moderate" significance are likely to be noticeable and result in lasting changes to baseline conditions, which may cause hardship to or degradation of the resource/receptor, although the overall function and value of the resource/receptor is not disrupted. These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.				
Low	*Detectable but not significant.* Impacts with a "Low" significance are expected to be noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause hardship, degradation, or impair the function and value of the resource/receptor. However, these impacts warrant the attention of decision-makers, and should be avoided or mitigated where practicable.				
Negligible	*Not Significant.* Any impacts that are expected to be indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not a concern of the decision-making process.				

6.3 IMPACTS

Table 20 presents the evaluation of significance of impacts

Table 20: Evaluation of significance of impacts

Area of environmental concern	Potential impact	Positive/ negative	Duration	Frequency	Sensitivity	Spatial extent	Significance
PHYSICAL ENVIRONMENT							
Soils	Excavations, levelling and movement of heavy-duty machines during construction may induce soil erosion. Gullies may develop over time in areas with sensitive soils;	Negative	Short term	Low	Low	Project Area	Low
Hydrology	Clearing vegetation at river crossings during the construction of the power line may induce bank erosion and subsequently cause siltation in the rivers. Incidental oil spillages chemicals during construction may adversely affect water quality.	Negative	Short term	Low	Low		Low

Area of environmental concern	Potential impact	Positive/ negative	Duration	Frequency	Sensitivity	Spatial extent	Significance
	Potential exists for pollution of surface water due to runoff from the work sites						
Air Quality	Dust pollution from activities such as blasting, earth moving, heavy trucks and construction machinery movements will cause deterioration in air quality	Negative	Short term	Low	Low	Project area	Low
Noise	Noise from construction works	Negative	Short term	High	Medium	Project area	Medium
Visual Impacts	The steel towers and wayleave will cause visual protrusion in some areas.	Negative	Long-term	High	Medium	Project Area	Medium
Waste Generation	Generation of construction waste and domestic waste	Negative	Short term	Medium	Low	Project area	Medium
BIOLOGICAL ENVIRONMENT							

Area of environmental concern	Potential impact	Positive/ negative	Duration	Frequency	Sensitivity	Spatial extent	Significance
Mammals	Disturbance to animals from construction activities	Negative	Short term	low	low	Project area	low
Reptiles	Disturbance and loss of habitats to reptiles due to construction activities	Negative	Short term	Low	Low	Project area	Low
Birds	Disturbance of bird habitats from construction works	Negative	Short term	Low	Medium	Project area	Medium
Fish	Indiscriminate fishing by workers during the construction and operational phase may lead to depletion of certain fish species.	Negative	Short term	Low	Low		low
Vegetation	Destruction to vegetation and permanent loss of some vegetation species during the construction phase and wayleave maintenance.	Negative	Long-term	Medium	Medium	Project Area	Medium
Protected Areas-	Bush clearing	Negative	Long term	Low	Low	Project area	Low
SOCIAL-ECONOMIC ENVIRONMENT							
Population	Stress on social amenities from increase in population	Negative	Short term	Low	Low	Project area	Low
Settlement Patterns	Displacement of people	Negative	Short term	Low	medium	Project area	Medium
Local Economy	Diversification of economic activity and increase in disposable income	Positive	Long-term	high	High	National	High
Land Use and Agriculture	The use of land will be restricted to low growing plants under the power line and within the wayleave	Negative	Long-term	Medium	medium	Project area	Medium

Area of environmental concern	Potential impact	Positive/ negative	Duration	Frequency	Sensitivity	Spatial extent	Significance
Planned Development Activities	Introduction of new amenities such as schools, roads, increased tourism	Positive	Long-term	High	High	National	High
Employment	Increase in national employment levels and raising of the standard	Positive	Long term	High	High	National	High
Goods and Services	There will be more goods and services available because of increased reliable supply coupled with the fact that locals will have more disposable income to spend.	Positive	Long-term	High	High	National	High
Health	Increase in population may create stress on public health services and increase in communicable diseases.	Negative	Short/long term	low	High	Project area	Medium
	Rehabilitation and creation of health centers due to power	Positive	Gradual	Low	Low	Project area	Medium
Occupational Health and Safety/Public safety	Workers and members of the public may be exposed to hazards such as road traffic accidents, flying objects and noise pollution at project site and public roads during construction and operation.	Negative	Short term	Medium	High	Project area	Medium
	Workers and members of the public may be exposed to hazards such as road traffic accidents, flying objects and noise pollution at project site and public roads during construction and operation.	Negative	Short term	Medium	Medium High	Project area	Medium

	Risk of electrocution to public by direct contact with high voltage line Collapse of transmission tower during storms Theft and vandalism of electricity infrastructure	Negative Negative Negative	Long term Long term Long term	Low Medium Medium	High High	Project area Project area Project area	High High High
Education	Developmental activities in the area due to increased power supply will include the construction of schools which will in turn increase the numbers school going pupils	Positive	Long term	Low	High	National	High
Transportation	Rehabilitation of the existing road network and construction of new roads	Positive	Long term	Low	Medium	Project area	Medium
Communication	The trickle-down effect of the envisaged boom in economic activities will spill over to the communication industry in terms of International Communication Technologies (ICTs) service, and road transport.	Positive	Long term	Low	High	National	High

Key for Rating Impact Significance

Table 21:Key for rating impact significance

IMPACT RATING	DESCRIPTION
Low	An insignificant amount of negative impact but requiring some mitigation; or positive impact requiring some attention to enhance it.
Medium	A level of negative or positive impact with moderate significance that will either require mitigation or enhancement respectively
High	A high level of adverse impact that could prompt authorities to reject implementation of the project; or A high level of positive impact that must prompt the project to be undertaken with enhancement measures.

6.3.1 Bio-Physical Environmental Impacts

6.3.1.1 Visual Intrusion and Change in Landscape

6.3.1.2 Impact Description

Construction

Infrastructure that is not harmonious with the landscape or negatively impacts its existing features can affect the aesthetics of an area. The Project will occupy approximately 250 hectares of land and 18km of wayleave, most of which will be cleared, potentially altering the existing forest and agricultural landscape. Facilities such as temporary workspaces, access roads, solar PV modules arrays, substations, and a 18km transmission line will be introduced. During construction, heavy machinery, including excavators, bulldozers, and transport vehicles, will be present, further altering the visual character of the area.

The visual character of the area will change due to short-term activities such as land clearing, trench digging, and the presence of construction vehicles and machinery. However, the installation of solar PV modules, substations, and the 14km transmission line, along with associated waste generation, will cause permanent aesthetic impacts.

Operation

The operational phase will introduce solar PV arrays and transmission line structures, which may create aesthetic impacts. The overall aesthetic effect is likely to be perceived negatively by most, though some may not find the structures objectionable.

6.3.1.3 Receptor(s)

Visual impacts may affect communities living and or farming near the project area.

6.3.1.4 Rating of impacts related to visual intrusion and change in landscape – (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	On-site	Restricted to the Project site.
Duration	Long Term	Impacts will occur for the duration of the construction period and throughout the operation period
Frequency	Continuous	The Project infrastructure will exist for the duration of the Project.

Likelihood	High	Impact will certainly occur because clearing, excavations and Solar module installation and tower erection are unavoidable activities associated with the Project.
Magnitude: High		
The project involves large-scale land use changes, introduces industrial infrastructure, and alters the visual character of the area from its current natural or rural setting.		
Sensitivity of Receptor: Moderate		
The proposed line will largely traverse areas that have already been disturbed by human activities. Farmers using the land may have moderate sensitivity to visual changes, as their primary concern is productivity rather than aesthetics.		
High Significance Rating Pre-Mitigation		

6.3.1.5 Mitigation Measures

Minimization and mitigation measures will include:

- Use of existing access roads as much as possible;
- Crossing rivers and streams using the shortest distance possible (i.e., perpendicular to the waterbody);
- Using construction methods that minimize damage to vegetation near the transmission line;
- Utilisation of solar modules with non-reflective coating to minimize glare, which can be visually disruptive;
- Installation and/or maintenance of visual barriers (trees and shrubs), where possible, to reduce the visibility so that there is still greenery present; and
- Appropriate management of construction waste at the site.

6.3.1.6 Residual Impact (Post-mitigation)

The residual impact is considered "**Moderate"**. While the Project would still alter the landscape, the residual impact would be significantly reduced, making it more acceptable to most stakeholders.

6.3.2 Air Pollution

6.3.2.1 Impact Description

Construction

Activities likely to impact air quality include transportation and construction activities such as clearance of vegetation, excavation, foundation works. Potential impacts on air quality will include increased particulate matter from; fugitive dust emissions caused by increased traffic and exposure of bare soil from wayleave clearance.

The amount of dust or gaseous emissions generated each day during the construction phase will depend on the magnitude and nature of construction activities and the atmospheric and weather conditions prevailing on that particular day.

Operation

The impacts during operation of the solar plant are expected to be negligible, as solar energy generation is a clean process that does not involve combustion or the release of pollutants.

Similarly, the operation of the transmission line will not contribute to any atmospheric emissions directly since the transmission lines will be fitted with SCADA system for communication, monitoring and controls as well as other operational activities, which minimizes travelling.

In summary, the net impact of the Project on air quality will be short term as it will be limited to the construction period.

6.3.2.2 Receptor (s)

Air pollution may affect communities living in the Project area i.e community members, construction workers and animals.

6.3.2.3 Rating of impacts related to air quality deterioration – (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	Particulate matter is likely to be generated along the local road network, access roads, wayleave and plant site.
Duration	Short Term	Air quality deterioration will mainly be restricted to the construction phase.
Frequency	Intermittent	It will be expected only during certain activities.
Likelihood	High	Impact will certainly occur because emissions of particulate matter are commonly associated to construction activities.
Magnitude: Low		
The overall magnitude of air quality impact is low to moderate during construction and negligible during operation and maintenance. The impact is short-term and localized, with no long-term or significant effects on air quality.		
Sensitivity of Receptor: Moderate		
Human activities in the project area are primarily agricultural. There are no settlements, schools or health centres in the area of direct impact.		
Moderate Significance Rating Pre-Mitigation		

6.3.2.4 Mitigation Measures

The following mitigation measures are recommended:

- A robust maintenance and operation regime for of all vehicles and equipment engines will be developed, in accordance with manufacturers recommendations;
- Prohibition of idling of vehicles on-site; shut down generators and machinery when not in use;
- Covering of loose materials and keeping top layers moist;
- Observing set speed limits on unhardened roads and surfaces;
- Use water for dust suppression on stockpiles, exposed soils, roads and prior to excavation works;
- Use of covered trucks for the transportation of materials that release dust emissions; and
- Use of appropriate PPE by workers on site e.g., dust masks.

6.3.2.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual significance of impacts on air quality can be expected to be "**Low".**

6.3.3 Noise and Vibration

6.3.3.1 Impact Description

Construction

Noise is generally defined as unwanted sound. Psychological effects of noise include annoyance and disruption of concentration. Physical effects include loss of hearing, pain, nausea, and interference with communication when the exposure is severe.

The occurrence of noise at this stage is inevitable, but it is good that the construction phase lasts briefly and equipment used is usually not intensely noisy. The noise generated by construction activities tends to decrease with distance due to factors such as sound absorption, atmospheric conditions, and obstacles in the environment. Noise impacts are expected to be more predominant within 200-500m of the activity areas.

Activities likely to be a source of noise and vibration include; site clearing, transportation activities and construction activities such as grading, blasting, drilling, tower erection, conductor stringing and human interactions. They will involve different movements of trucks, cranes and other construction machinery and equipment and handling of building materials.

Operation

During the operation phase, maintenance activities conducted near solar plants, substation, transmission line, or wayleave could lead to an increase in noise levels which may disturb nearby communities and local fauna. This impact is expected to be negligible as only few workers are expected on site with minimal or no heavy equipment/machinery.

After construction, noise levels compared to the current situation will be negligible. The net impact of the Project will be short term as it will be limited to the construction period.

6.3.3.2 Receptors(s)

The primary noise receptors are communities living in the Project area i.e community members, construction workers and animals.

6.3.3.3 Rating of impacts related to noise and vibration – (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	On-site	Noise will be predominant within 200- 500m of the project site.
Duration	Short Term	Noise is expected throughout the construction but negligible during the operation phase, though levels may vary
Frequency	Intermittent	Noise will not be continuous, it will be expected only during certain activities.
Likelihood	High	Impact will certainly occur because noise is commonly associated to construction activities such as blasting, concrete mixing, and vehicular movement for transportation of materials.
Magnitude: Moderate		
The impact is short-term, localized, and unlikely to cause significant or long-term disturbance.		
Sensitivity of Receptor: Moderate		
Human activities in the project area are primarily agricultural. There are no settlements, schools or health centres in the area of direct impact.		
Moderate Significance Rating Pre-Mitigation		

6.3.3.4 Mitigation Measures

The following recommendations for mitigation measures are outlined below:

- Use of temporary noise barriers for equipment (e.g., sound proofing walls around stationary power generating sources);
- Avoid dropping materials from height, where practicable;
- Maintain and operate all vehicles and equipment in accordance with manufacturers recommendations;

- Noisy activities (activities that can be heard in nearby communities) restricted to daytime working hours;
- Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration;
- Establishment of a grievance redress mechanism to provide means for residents to make noise complaints;
- Provision of hearing protective devices for workers, such as ear plugs and ear muffs;
- Development of a blasting schedule to be communicated to the public and appropriate warning shall be given; and
- Control of ground vibrations, for example through the use of non-electric shock tubes and emulsion explosives.

6.3.3.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance of noise and vibration can be expected to be **"Low"**.

6.3.4 Soil Erosion and Contamination

6.3.4.1 Impact Description

Construction

Site clearance and preparation will require the removal of vegetation, leading to the exposure of bare soil. Soil erosion may result from the loosening of soil material through the operation and movement of heavy-duty vehicles and machinery as well as from pitting, trenching and excavation of the soil for the placement of support structures such as towers and solar mounting systems/racks. This effect will be more pronounced on steep slopes.

Although existing roads and tracks will be used to access the solar plant site and wayleave as far as possible, some access roads in harder to access areas may be created. Vehicular movement around the project area can lead to soil compaction in those areas especially highly saturated areas such as those close to water bodies.

The excavation of soil for the construction of support structures will disrupt the soil cohesion and also may result in surplus soil due to the use of concrete for the foundation. If not properly restored or managed, this soil may erode and wash into nearby surface water bodies.

Soil contamination is likely to occur as a result of the mismanagement of chemicals, waste and accidental spills.

Operation

No significant soil erosion is expected. Soil contamination may result from unplanned events such as oil leaks resulting from equipment breakdown and/or accidental spills from machinery used for maintenance purposes at the solar plant, along the transmission line and at the substations.

6.3.4.2 Receptor(s)

Potential receptors include; soils, local farmers and fauna.

6.3.4.3 Rating of impacts related to soil erosion and contamination during construction – (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	On-site	The impact on soil quality and soil structure will be limited to the plant site, wayleave (more so at tower locations), access roads, camp site and service and storage areas.
Duration	Short Term	Soil erosion, compaction, organic layer losses, and contamination are largely restricted to the construction phase.
Frequency	Intermittent (erosion) Rare (contamination)	Soil disturbance will not be continuous, it will be expected only during certain activities. Soil contamination is expected largely due to accidental spills and leakages
Likelihood	High (erosion) Low (contamination)	Impact will certainly occur because soil disturbance is commonly associated to construction activities such as blasting, vehicular movement for transportation of materials. Soil contamination is expected largely due to accidental spills and leakages.
Magnitude: Moderate		
Risk of contamination from mismanagement of chemicals, waste, or accidental spills is present but can be minimized with proper handling and spill response plans		
Sensitivity of Receptor: Moderate		
The soils are a moderately sensitive receptor given its agricultural use		
Moderate Significance Rating Pre-Mitigation		

6.3.4.4 Mitigation Measures

The following mitigation measures to reduce impacts on soil structure from compaction and erosion are recommended:

- Construction of foundations to be undertaken mostly in the dry season;
- Protect excavated soil materials from erosion;
- Reduction of the construction of new access roads, where possible. Promoting the use of existing access roads for machinery and vehicle movement, increasing their width as necessary;
- Ensure that the land is physically restored (include revegetation where possible) and before the next rainy season; and
- Rehabilitation of any areas which will be exposed for any reason as soon as possible to prevent possible soil erosion. Rehabilitation will be by replanting disturbed areas, or returning the top soil so that grass is able to naturally grow.

The following mitigation measures to reduce potential for soil contamination are recommended:

- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques;
- Regular checking and maintenance of all vehicles and equipment to minimize the risk of fuel or lubricant leakages;
- Store hazardous materials in a manner that includes secondary containment and prevents interaction with other materials, the environment, and accidental tampering in addition to bunding of areas where hazardous substances are stored (e.g., fuel, waste areas);
- Provision of well labelled receptacles or bins that allow for segregation of waste materials according to waste streams;
- Use of mobile toilets at construction sites, and soak-a-way pits at camp sites;
- Development and implementation of a Waste Management Plan (Construction ESMP) to ensure that waste is disposed of correctly. Use of appropriate waste disposal methods including:

    - Composting of biodegradables;
    - Selling metal, wood, and plastic scraps;
    - Reuse of materials e.g., packages, concrete, etc.; and
    - Dumping of remaining wastes at approved sites.

6.3.4.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be **"Low"**.

6.3.4.6 Rating of impacts related to soil erosion and contamination during operation – (Pre-mitigation)

Type of Impact: Direct

Parameter	Designation	Summary of Reasoning
Extent	On-site	The impact will be limited to wayleave, substations, refueling areas.
Duration	Short Term	In the event of an accidental spill, it will be contained and cleaned-up immediately.
Frequency	Rare	Only expected during an unplanned event or accident.
Likelihood	Low	Only expected during an unplanned event or accident.
Magnitude: Low		
Sensitivity of Receptor: Moderate		
Due to the subtropical location of the Project, there is high probability that cleared areas will revegetate naturally thereby limiting the potential for erosion. Additionally, there will not be contamination unless an unplanned event or accident occurs.		
Low Significance Rating Pre-Mitigation		

Mitigation measures as recommended during the construction phase will apply during operation.

6.3.4.7 Residual Impact (Post-mitigation)

The residual impact can be expected to be "**Negligible".**

6.3.5 Change in Quality of Water Resources

6.3.5.1 Impact Description

Construction

Activities likely to affect surface water quality include; construction activities such as site clearance, excavation, foundation works and waste management. Project activities will interact with water resources in the following ways:

- There will be direct interaction during clearing and construction activities close to or in surface water bodies;
- There will be indirect interaction in the case of erosion of soils into water bodies;
- There will be direct interaction from the abstraction of water from surface water bodies for foundation works and dust control; and
- There will be direct interaction from the discharge of domestic and construction wastewater to surface water bodies.

Clearing of vegetation for the wayleave may increase suspended solids in the water due to increased surface run-off. Similarly, groundwater could be contaminated during digging of foundation pits for the towers or mounting systems for solar

modules. Proper management of excavation work will allow avoiding these potential impacts.

Leakage of fuel and oil from equipment and vehicles and other waste that is generated in these activities has the potential to contaminate surface water and affect aquatic ecology. Ground water impacts from the Project are negligible.

While the water demand for the Project is minimal, it could be satisfied in one of two ways namely:

- Use of water bowsers and storage of water in tanks; and
- Sinking new boreholes in accordance with the WARMA requirements.

Water requirements will likely be limited to domestic usage as well as for casting of foundations therefore its impact is likely to be insignificant.

Operation

In the same way, during the operation phase, oil spills could result from equipment breaking down at the site, leading to ground and surface water contamination in proportion to the magnitude of these accidental events.

Additionally, water will be required for cleaning of the solar modules periodically. Water for cleaning will be sourced at the boreholes onsite. The total maximum daily water consumption for living, greening and road watering will be approximately 1.55m³/day. The total annual water consumption for the Project is estimated at 566.24m³/yr.

Generally, the impact on the surface water and hydrogeology of the area during operation and maintenance shall be negligible and will not be assessed further.

6.3.5.2 Receptor(s)

The primary receptors of the impact on water pollution and quantity reduction are surface water bodies around the Project site as listed in Section 5.1.5 *(Hydrology and Drainage)*, local ground water wells and boreholes.

6.3.5.3 Rating of Impacts Related to Change in Quality of Water Resources – (Pre-mitigation)

Type of Impact: Negative		
Parameter	**Designation**	**Summary of Reasoning**

Extent	Local	Due to the nature of water, contaminants are likely to flow beyond the project site into downstream water bodies. However, the impact is expected to be at a local level only. Chemicals and fuels will not be stored in sufficient quantities to result in a spill of regional importance.
Duration	Short Term	Largely occurs during construction. The impact is short-term as construction works are expected to continue for a period of approximately 10 months.
Frequency	Intermittent	Water quality impacts will not occur continuously but rather, during specific construction activities, after rainfall events (potential sediment runoff) and during accidental spills (if they occur).
Likelihood	Moderate	Impact may occur due to the nature of construction activities such as vehicular movement and wayleave clearance.
Magnitude: Low		
Impacts will be limited in scal Siltation and contamination events will be sporadic and temporary. Also, Project water use (566 m^3/year) is negligible.		
Receptor Sensitivity: Moderate		
Impacts on waterbodies will indirectly affect communities around the project area, the majority of whom do not have access to piped water.		
Moderate Significance Rating Pre-Mitigation		

6.3.5.4 Mitigation Measures

The following management measures are recommended to manage the impacts on water resources:

- Conducting of activities as far as possible from water bodies i.e., > 100m away, except where crossings are required;
- As much as possible, conserve all the vegetation (trees, shrubs, herbaceous plants, and crops) present at the edge of watercourses and in erosion prone areas, that do not represent a risk for infrastructure;
- Working in rainy season especially close to waterbodies to be avoided in order to reduce disturbances to local drainage patterns caused by working on water saturated soils and sediment transport into rivers and streams in proximity to work areas and affect water and habitat quality;
- Sensitization on proper water usage and management. Encourage water reuse/recycling where possible;
- Regularly monitor ground water quality;
- Adopt less water consuming solar module cleaning methods;
- Storage of hazardous materials in a manner that includes secondary containment and prevents interaction with other materials, the environment, and accidental tampering. In addition to, bunding of areas where hazardous substances are stored (e.g., fuel, waste areas);

- All machinery and equipment to be kept in good working condition to prevent accidental oil spillages from machinery and any other chemicals;
- Provision of well labelled receptacles or bins that allow for segregation of waste materials according to waste streams;
- Use of mobile toilets at construction sites, and soak-a-way pits at camp sites;
- Avoiding the disposing of waste in sensitive areas such as water courses;
- Development and implementation of a Waste Management Plan (site ESMP) to ensure that waste is disposed of correctly and the use of appropriate waste disposal methods including:
  - Composting of biodegradables;
  - Selling metal, wood, and plastic scraps;
  - Reuse of materials e.g., packages, concrete, etc.; and
  - Dumping of harzardous wastes at approved sites.

6.3.5.6 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be **"Minor"**.

6.3.6 Loss of Vegetation

6.3.6.1 Impact Description

Construction

Activities likely to result in loss of vegetation include; wayleave and site clearance, creation of access roads, transportation and movement of vehicles and machinery.
The construction of the power line will involve minimum clearance of vegetation to create a wayleave of 50m (25m on either side) width leading to loss and destruction of flora species, some of which have medicinal and/or scientific value. Nevertheless, the Project has an embedded mitigation measure. In accordance with the Forestry Act No. 4 of 2015, Part VI Section 53 (1)(h), Regulation of Forest Produce, the Forestry Department has been engaged to conduct a Forest Resource Assessment (FRA), in order to grant a permit for the trees to be felled and pave way for project implementation.

Operation

During the operational phase, the primary environmental impact will be limited to vegetation control through periodic bush clearing to maintain the wayleave and area on installation of the solar modules.

6.3.6.2 Receptor(s)

Potential receptors include; flora along the line route and Solar site, fauna that depend on the cleared vegetation for habitat, shelter, and food sources. Especially protected, endangered, or migratory species.

6.3.6.3 Rating of Impacts Related to Loss of Vegetation – (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	The proposed line route will not traverse any nationally protected Forest areas. Only trees within the project site will be cut down.
Duration	Long Term	The vegetation will need to be cut and maintained at a given height for the entire project life.
Frequency	Once-off Intermittent	Vegetation including all scrubs and trees will only be removed once during construction. Clearance will be maintained during annual bush clearing.
Likelihood	High	Vegetation will have to be removed in order to implement and operate the Project.
Magnitude: Moderate		
While vegetation removal is necessary, it is localized, managed, and does not affect protected or highly sensitive areas.		
Sensitivity of Receptor: Moderate		
High Significance Rating Pre-Mitigation		

6.3.6.4 Mitigation Measures

The following mitigation measures are recommended to manage the loss of vegetation:

- Restriction of clearance to the wayleave. The boundaries shall be clearly identified and marked to avoid accidental clearing;
- Cleared woody vegetation from the wayleave and access road to be made available to local communities, to reduce the incremental disturbance to surrounding natural resources;
- Revegetation of temporal work areas and access roads with appropriate native species;
- Restriction of the creation of access roads by using existing roads and paths as far as possible; and
- Use of manual vegetation removal instead of chemical removal i.e., herbicides.

6.3.6.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be **"Moderate"**.

6.3.7 Habitat Fragmentation and Edge Effects

6.3.7.1 Impact Description

Habitat fragmentation refers to plant communities that have become divided or isolated. This could affect large and small mammals, birds, reptiles, amphibians, insects and other invertebrates.

Solar plants can act as physical barriers, preventing species from accessing resources, breeding sites, or migration routes. Similarly, linear clearings (wayleaves) that cut through habitats, can disrupt natural wildlife corridors, which are essential for species migration and dispersal.

The vulnerability of a particular species to habitat change is directly related to its ability to adapt. Relatively few animals find the wayleave to be a barrier. Some may simply move away to other areas, but some could be damaged or killed during the clearing process.

It is envisaged that no specific unique wildlife habitats will be affected by the Project.

6.3.7.2 Receptor(s)

Potential receptors include; flora and fauna within and around the Project area.

6.3.7.3 Rating of impacts related to habitat fragmentation and edge effects– (Pre-mitigation)

Type of Impact: Indirect		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	The Project site does not affect any nationally or internationally protected areas, therefore impact will be largely restricted to the project site.
Duration	Long Term	The vegetation will need to be cut and maintained at a given height for the entire project life.
Frequency	Once-off	Vegetation including all shrubs and trees will be removed during construction but this removal will be maintained throughout the project life.
Likelihood	High	Vegetation will have to be removed in order to implement and operate the Project.
Magnitude: Moderate		

Some species may adapt or relocate, but others could be negatively affected, particularly those with limited mobility or specific habitat needs (e.g., small mammals, reptiles, or ground-nesting birds).
Sensitivity of Receptor: Moderate
The area supports local biodiversity, but it is not highly unique or ecologically sensitive.
Moderate Significance Rating Pre-Mitigation

6.3.7.4 Mitigation Measure

Mitigation measures such as wildlife corridors, replanting native vegetation, and minimizing cleared areas are recommended. These steps can help maintain ecological connectivity and reduce the long-term effects of habitat fragmentation and edge effects. Further management of the impacts on local habitat is prescribed in *6.3.6 (Loss of Vegetation).*

6.3.7.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be "**Low".**

6.3.8 Introduction of Alien Invasive Species

6.3.8.1 Impact Description

Construction

The means of introduction of invasive species in an area is not easy to determine. However, the continual movement of heavy vehicles into the project area will pose a continual risk of introduction of seeds of invasive alien plants through mud in tire grooves. Parts of plants, seeds, and root stocks can contaminate construction equipment and essentially "seed" invasive species wherever the vehicle travels. The diseases, predators, and parasites that kept their populations in check in their native range may not be present in the Project area. Over time, non-native, invasive species can overwhelm and eliminate native species, reducing biodiversity and negatively affecting both ecological communities and wildlife habitats.

Operation

Infestation of invasive species can also occur during annual wayleave maintenance activities.

6.3.8.2 Receptor(s)

Flora and fauna within and around the Project area.

6.3.8.3 Rating of impacts related to invasion of alien invasive species – (Pre-mitigation)

Type of Impact: Indirect		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	In an event that invasive species are introduced to the site, it is most likely that they will not spread beyond the Project area.
Duration	Long Term	Invasive species may integrate themselves with the native species and may be extremely difficult to get rid of.
Frequency	Intermittent	Movement of heavy vehicles into the Project Area during construction may pose a risk of introduction of invasive alien species. Infestation of invasive species may also occur during annual wayleave maintenance activities.
Likelihood	Medium	Clearance of vegetation at the plant site and in the wayleave may create a conducive environment for invasive species.
Magnitude: Moderate		
In an event that invasive species are introduced to the site, it is most likely that they will not spread beyond the project area.		
Sensitivity of Receptor: Moderate		
Invasive species are likely to thrive in cleared wayleave due to their shrubby nature.		
Moderate Significance Rating Pre-Mitigation		

6.3.8.4 Mitigation Measures

The following mitigation measures are recommended to manage the proliferation of invasive alien species:

- Vehicles and machinery should be inspected and cleaned to remove any plant residue of invasive alien flora species, before equipment is used in a new work area. This will avoid the spread of invasive species from one area to another and prevent potential introduction into the wayleave and adjacent habitats; and

- Because preventive measures during construction may not be completely effective in controlling the introduction and spread of invasive species, post-construction measures are required. Sensitive areas such as riverbanks/riparian zones should be surveyed to identify invasive species following construction and site re-vegetation. If new infestations are discovered, measures shall be taken to control the infestation. The Forestry Department shall be consulted to determine the best methods for control of encountered invasive species.

6.3.8.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be **"Low"**.

6.3.9 Mortality of Avifaunal Species

6.3.9.1 Impact Description

Construction

Clearing of vegetation for the line will disturb the habitat for some birds and some of them may lose their nests which may cause mortality of avifauna. Also, disturbance and displacement may occur due to noise, light and/or vibration as a result of construction activities such as excavation, drilling, blasting, operation of camps, equipment and vehicle movement. Further, there may be an increased likelihood for poaching due to the presence of workers.

Operation

Birds may collide with solar modules, especially if the modules are highly reflective (acting like mirrors) and birds mistake them for open sky or water. This is particularly a risk for species during migration.

Additionally, power transmission and the presence of transmission structures poses a risk to avifauna. Some birds are likely to interact with transmission line and related infrastructure due to their behavioural or physical characteristics. The line can pose potentially fatal risks to birds and bats through collisions and electrocutions.

Birds may be at risk of electrocution if they come into contact with energized components of the transmission line infrastructure, such as conductors, insulators, or supporting structures. Birds of large wing span are most likely to be affected by the electrocution while small ones could easily perch on a live wire without much problem.

Collisions occur when birds or large mammals make contact with line hardware inadvertently. In general, birds usually collide with the shield wire rather than with the conductors, which are thicker or bundled and therefore easier to see.

6.3.9.2 Receptor(s)

Avifauna within and around the Project area.

6.3.9.3 Rating of impacts related to mortality of avifaunal species during construction – (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	Vegetation clearing may impact bird habitats within the wayleave while the risk of collisions, electrocution and poaching may occur in the wider area.
Duration	Long Term	Habitats will be permanently modified due to clearance of the wayleave.
Frequency	Once-off	For nesting sites, vegetation including all shrubs and trees will only be removed once during construction.
Likelihood	High	Vegetation will have to be removed in order to implement and operate the Project.
Magnitude: Moderate		
Generally, the area is largely characterised by degraded forest and agricultural fields. This entails that potential for habitat loss will be limited. Further, while avifaunal mortality is likely to occur long term (both construction and operation phases), much higher risk is posed by construction activities.		
Sensitivity of Receptor: Moderate		
No species of conservation concern have been identified in the Project area. Migratory birds may be considered to be more sensitive as losses may impact broad geographies.		
Moderate Significance Rating Pre-Mitigation		

6.3.9.4 Mitigation Measures

The following mitigation measures are recommended to manage the mortality of avifaunal species:

- Enforcement of speed limits and installation of bird diverters/markers to limit avifaunal collisions;
- Sensitization of workers against bird hunting, with strict penalties including dismissal of those found wanting (this measure shall be a part of the workers code of conduct); and
- Restriction of construction activities to day light hours. Lights to be used only where necessary and to be directed towards the subject area and away from habitat areas where possible.

6.3.9.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be "**Low"**.

6.3.9.6 Rating of Impacts Related to Mortality of Avifaunal Species during Operation – (Pre-mitigation)

Type of Impact: Direct

Parameter	Designation	Summary of Reasoning
Extent	On-site	Risk of collisions with solar modules and transmission line as well as electrocutions due to transmission line interactions.
Duration	Long Term	Risk of bird fatalities will occur as long as the line and solar plant are in operation.
Frequency	Intermittent	Collisions during construction as well as electrocutions/collisions during line operation may occur sporadically.
Likelihood	Low	However, there is no formal record of large scale bird electrocutions in the Country.
Magnitude: Low		
Bird mortality from collisions or electrocution is biologically significant when it results in a measurable change, for example in population decline (Manitoba Hydro, 2010). There has been no documented evidence of large bird kills from the existing lines in the Country. Also, impacts on species of conservation concern are uncertain. Further, while avifaunal mortality is likely to occur long term (both construction and operation phases), much higher risk is posed by construction activities.		
Sensitivity of Receptor: Moderate		
No species of conservation concern have been identified in the Project area. Migratory birds may be considered to be more sensitive as losses may impact broad geographies.		
Low Significance Rating Pre-Mitigation		

6.3.9.7 Mitigation Measures

The following mitigation measures are recommended to manage the mortality of avifaunal species during line operation:

- Use non-reflective or low-reflectivity solar modules to reduce the risk of collisions.
- Implementation of site specific and tailored management strategies once biologically significant bird interactions have been reported, including:
    - Reinstall modules at angles and heights that minimize collision risks;
    - Bird detractors e.g. scarecrow to prevent birds from venturing close to the solar modules;
    - Use of markers and bird diverters to make the lines more visible;
    - Illuminating conductors and earth wires to improve their visibility to night-flying birds;
    - Supplemental perches to lure birds from parts of the tower where phase to phase electrocutions are likely; and
    - Changing or reviewing the placement and routing of affected sections of the line (if warranted).

6.3.9.8 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be "**Negligible"**.

6.3.10 Mortality of Terrestrial Fauna

6.3.10.1 Impact Description

Construction

The presence of workers during construction may result in increased levels of noise as well as poaching. Also, small mammals are at risk of colliding with moving project vehicles especially at night.

Clearing of vegetation will disturb the habitat for some reptiles and small mammals. Normally the herptiles crawl and they are prone to road kills by vehicles. Species normally affected are snakes, lizards and geckos. During bush clearing and when digging foundations for towers, some animals such as rodents, lizards and snakes may be killed indiscriminately. Snakes may also be a danger to the construction workers as they risk being bitten.

Operation

Annual line maintenance activities will be infrequent and are only likely to temporarily disturb or displace wildlife, if at all. Disturbances can be related to noise from equipment or from maintenance worker's activities. When it does occur, unfamiliar noise may keep animals temporarily (e.g birds and snakes) away from the immediate area.

6.3.10.2 Receptor(s)

Terrestrial Fauna within and around the Project area. Species in critical life stages, such as breeding, nesting, or migration, may be highly sensitive. Disturbances during these periods can lead to reduced reproductive success, affecting population viability.

6.3.10.3 Rating of Impacts Related to Mortality of Terrestrial Fauna during Construction & Operation (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	The risk of collisions and poaching may occur in the wider project area.
Duration	Long Term	Likely to occur throughout construction as well as annual bush clearing.

Frequency	Intermittent	Collisions, poaching and conflict may occur during construction and line operation sporadically.
Likelihood	Moderate	Interactions between construction workers and Fauna is likely to occur more during construction and less during operation.
Magnitude: Moderate		
The proposed line route will follow existing lines and a considerable portion of the affected area is used for agriculture and settlements. This entails that potential for habitat loss will be limited. Further, while faunal mortality is likely to occur long term (both construction and operation phases), much higher risk is posed by construction activities.		
Sensitivity of Receptor: High		
Most interactions between humans and terrestrial fauna often result in fatalities for the animals. This is particularly concerning for species classified as endangered or threatened, as they are inherently more vulnerable to disturbances and habitat changes. In the project area, there have been reported sightings of elephants, which are listed as vulnerable on the IUCN Red List.		
Moderate – High Significance Rating Pre-Mitigation		

6.3.10.4 Mitigation Measures

The following mitigation measures are recommended to manage the mortality of terrestrial species:

- Sensitization of workers against hunting/ poaching, with strict penalties including dismissal of those found wanting (this measure should be a part of the workers code of conduct);
- All construction materials, particularly those used to reinforce structures e.g., steel wires, should be safeguarded and cleared from worksites, to avoid their use as wire snares. Wire snares are widely used in illegal harvesting of large animals;
- Enforcement of speed limits to limit terrestrial fauna collisions; and
- Restriction of construction activities to day light hours. Lights to be used only where necessary and to be directed toward the subject area and away from habitat areas where possible.

6.3.10.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be "**Low".**

6.3.11 Disturbance to Aquatic Habitats and Mortality of Aquatic Species

6.3.11.1 Impact Description

Construction

Construction activities can influence water quality or modify flooding patterns and surface water flow over a certain period of time. This can cause an increase in suspended solids in wetlands and aquatic environments, which could result in siltation of feeding sites and breeding grounds of some species, particularly for fish species. Furthermore, an increase of organic matter in aquatic environments could lead to an increase in biochemical oxygen demand (BOD) and a decrease in dissolved oxygen that could be locally harmful for aquatic fauna species.

Additionally, the presence of the construction workers in the Project area may induce illegal fishing and put a strain on the already depleting resource.

Further, waste such as oil and fuel from vehicles may find its way into water bodies, causing negative impacts on aquatic species.

No significant impacts are expected during operation of the Project.

6.3.11.2 Receptor(s)

Aquatic Species within the water bodies traversed by, or near the project area.

6.3.11.3 Rating of Impacts Related to Aquatic Ecosystems during Construction (Pre-mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	Due to the nature of water, contaminants are likely to flow beyond the project site into wider areas of the water body i.e from Nantumba and Namwazi stream into the Kafue River
Duration	Short Term	Will be limited to activities occurring in the construction phase.
Frequency	Intermittent	Disturbance will only occur when construction activities are being conducted on sections that are crossing or nearby water courses.
Likelihood	High	Crossing of perennial wetlands and watercourses cannot be avoided.
Magnitude: Moderate		
Illegal fishing activities and siltation and contamination of waterbodies are most likely to occur during construction and less so during operation.		
Sensitivity of Receptor: Moderate		
Aquatic organisms in the seasonal streams in the project area are highly dependent on the limited and temporary availability of water.		
Moderate Significance Rating Pre-Mitigation		

6.3.11.4 Mitigation Measures

In addition to the measures in *6.3.1.5 (Change in Quality of Water Resources)*, the following recommendations are made:

- Work, storage and movement of equipment and vehicles, should be avoided as much as possible within the riverine, floodplain, and wetland areas, such as dambos. If unavoidable, the access to these sites should be reduced to a minimum;
- When stream crossings are unavoidable, construction of suitable culverts to ensure sufficient water supply and minimize impact on fish habitat should be done; and
- Sensitization of workers against illegal fishing, with strict penalties including dismissal of those found wanting (this measure should be a part of the workers code of conduct).

6.3.11.5 Residual Impact (Post-mitigation)

With the implementation of the above measures the residual impact significance can be expected to be "**Negligible"**.

6.4 socio-economic and Cultural Impacts

6.4.1 National and Local Economic Benefits

6.4.1.1 Impact Description

Operation

The Project is designed to strengthen Zambia's energy resilience by addressing climate-related risks to hydropower generation and diversifying the energy mix. National economic benefits will accrue predominantly during the operational phase of the Project. Infrastructure development costs will be incurred during the construction phase of the Project. Trickle down economic benefits likely to be provided by the Project include:

- Generating profits as a result of electricity trade;
- Enabling business development and household benefits that result directly from the provision of reliable power; and
- Increased employment opportunities as a result of spin-off economic benefits.

Additionally, to benefit the local community, JIGSCO and the Sikoongo Royal Establishment will enter into a Corporate Social Responsibility (CSR) Memorandum of

Understanding (MoU). Once established, JIGSCO will fund a CSR programme, allocating a portion of its annual profits to interventions focused on the following proposed thematic areas, to ensure meaningful benefits for the community:

- Education;
- Health;
- Electrification;
- Social welfare;
- Environmental management;
- Climate change;
- Water and sanitation;
- Agriculture;
- Skills development and entrepreneurship;
- Cultural heritage;
- Sports development; and
- Women's enterprise development.

6.4.1.2 Receptor(s)

Local communities in the project area. All Zambian citizens will benefit from a stable and reliable power grid.

6.4.1.3 Rating of Impacts Related to National and Local Economic Benefits (Pre-enhancement)

Type of Impact: Direct Positive Impact		
Parameter	**Designation**	**Summary of Reasoning**
Extent	National Local	Zambian citizens will benefit from a stable and reliable power grid. Locals will directly benefit from the CSR programme.
Duration	Long Term	This impact will occur for the life span of the Project
Frequency	Continuous	Benefits will be experienced throughout the operation of the Project on an ongoing basis.
Likelihood	High	These benefits will be experienced should the Project proceed.
Magnitude of the Impact: High		
The Project will provide national-level benefits that are long-term and continuous, ensuring sustained economic and social improvements.		
Sensitivity of the Resource/Receptor: High		
Given the current shortage of electricity supply due to loadshedding, Zambian citizens are likely to be highly sensitive to improvements to the current status. Similarly, local communities are highly sensitive to improvements in economic opportunities and other socioeconomic indicators such as education, health, and skills development, which are essential for improving livelihoods.		

6.4.1.4 Enhancement/ Management Measures

No further enhancement measures for this impact are currently envisaged.

6.4.2 Local Employment Opportunities

6.4.2.1 Impact Description

Construction

There will be a number of direct employment opportunities created by the Project through contractors during the construction phase. Indirect employment opportunities will be created through the procurement of goods and services to support construction and will therefore include jobs created in the Project supply chain and their suppliers or sub-contractors/service providers.

Similarly, short term employment opportunities will be created through contractors during annual bush clearing and maintenance activities.

Induced employment (i.e., jobs created through spending in the local economy by direct and indirect employees on the Project) may also occur.

The percentage breakdown of the distribution of employment opportunities in terms of skilled, semi-skilled and unskilled positions is not currently known nor, where the workforce will be recruited from. However, it will be advised that the workforce will be a mix of locals as well as outsiders with preference given to locals for unskilled positions. Expatriates will be recruited where the national population do not possess the specialised skills and experience required.

Employment opportunities will result in improved income generation in the local community and in some cases security of this in the long term. This will help to improve living conditions, as more disposable income will be available for food, education and health care. Those that secure employment are likely to benefit from enhanced work experience and skills enhancement received through on-the-job and more formal training courses. Such skills enhancement will improve the potential of these people to secure future employment once their contract with the Project ends.

6.4.2.2 Receptor(s)

Local communities within and around the wider Project area. This may also include in-migrants in search for job opportunities.

6.4.2.3 Rating of impacts related to local employment opportunities (Pre-enhancement)

Type of Impact: Direct, Indirect and Induced Positive Impact		
Parameter	**Designation**	**Summary of Reasoning**
Extent	National	The Project will attract skilled workers from outside the Project area i.e from the wider District and Country at large.
Duration	Long Term	The impact will be experienced throughout the life of the Project as annual bush clearing activities will also present employment opportunities.
Frequency	Intermittent	This impact will occur in line with recruitment needs.
Likelihood	High	Employment opportunities will definitely be created by the Project.
Magnitude: Moderate		
Only a relatively limited number of jobs will be created as a result of the Project however, for those that are able to secure jobs, quality of life will be vastly improved if this allows for access to a secure income.		
Sensitivity of the Receptor: Moderate		
The development of employment opportunities will be very welcome by local communities. Local expectations are high that they will benefit from job opportunities.		
High Significance Pre-enhancement		
The likelihood that the local population will be able to take up the unskilled employment opportunities provided is relatively high. However, due to an absence of skills and experience in the area it is unlikely that they will be able to capitalise on many of the semi-skilled or skilled positions. The training received as part of the proposed Project will improve chances to seek employment opportunities in other developments.		

6.4.2.4 Enhancement Measures

In order to ensure that the positive impact is harnessed optimally, the following enhancement measures are proposed:

- Setting of targets to maximise the number of local, female, disabled, unskilled, and skilled employees from the project area;
- Publicly advertise employment opportunities in appropriate newspapers, public libraries, the District Offices and in all relevant languages; and
- No requirement for applicants to make payments for applying, or securing, employment on the proposed Project.

6.4.2.5 Residual Impact (Post-mitigation)

The designations will not change and the impact significance will remain a '**High Positive'**.

6.4.3 Local Procurement of Goods and Services

6.4.3.1 Impact Description

Construction

Goods and services will be procured during the construction and operation phases of the project from a diverse range of suppliers. The extent of this procurement and source thereof will largely be at the discretion of the contractor. It is anticipated that at a minimum, basic goods and services such as cement and aggregate will be sourced from the Project area. More specialised equipment will need to be sourced internationally.

The following equipment and materials may be required but not limited to; front end loaders, bulldozers, concrete plant, trucks, excavators, crusher, cranes, small vehicles, fire equipment, concrete, piping, aggregate, steel, pavement, fencing, fuel, wiring and electrical, switchyard, pumps, storage tanks, transmission pylons. In the study communities, at the time of reporting it is believed that there are only a limited number of businesses that would be able to provide the scale of goods and services required, as well as meet the stringent health and safety standards needed by the proposed Project.

There is a strong dependence on the informal sector; many local businesses are not formally registered as companies and they lack experience in providing goods and services for large scale clients. It is likely however that such businesses exist in the Capital city, Lusaka which is only 115km away.

Local procurement of goods and services by the Project could assist in building a more stable and diverse economy at the local level. This could lead to other effects such as creation of jobs by companies who secure contracts, thus enhancing living conditions for those who secure employment. This impact could be further be enhanced through in-migration to the area and increased spending power.

6.4.3.2 Receptor(s)

Local companies may be advantaged by the availability of contracts or procurement of goods and services for the Project.

6.4.3.3 Rating of impacts related to local procurement of goods and services (Pre-enhancement)

Type of Impact: Direct, Indirect and Induced Positive Impact		
Parameter	**Designation**	**Summary of Reasoning**

Extent	National	While this impact looks specifically at the possibility for local businesses to benefit from procurement opportunities, suppliers from outside the affected areas are also expected to benefit.
Duration	Long Term	The impact will be experienced throughout the life of the Project.
Frequency	Intermittent	This impact will occur in line with procurement needs.
Likelihood	High	Procurement of goods and services are necessary for the Project to go ahead.
Magnitude: Moderate		
The impact will be constrained at the local level by the current lack of capacity.		
Sensitivity of the Receptor: High		
The development of procurement opportunities will be very welcome by stakeholders. Local expectations are high that they will benefit from contracts to supply the Project goods and/or services.		
High Significance Pre-enhancement		

6.4.3.4 Enhancement Measures

In order to ensure that the positive impact is harnessed optimally, the following enhancement measures are proposed:

- To maximise local purchasing where possible in line with National legislation and tendering requirements, by directly working with local enterprises and by incentivising the Project's contractors to contract locally.

6.4.3.5 Residual Impact (Post-enhancement)

The designations will not change and the impact significance will remain a '**High'.**

6.4.4 Physical Displacement

6.4.4.1 Impact Description

Construction

Physical displacement (loss of land for residential or business purposes) shall occur as a result of the Project and will be strictly along the preferred line route as well as areas for construction/placement of the Solar Plant associated facilities.

Land will be acquired prior to the commencement of construction activities on site and therefore this impact will be felt during this phase of the Project rather than the operational phase.

Based on the studies conducted only agricultural fields are expected to be affected.

Operation

During operation, no further physical displacement is anticipated.

6.4.4.2 Receptor(s)

Households farming within the Project area.

6.4.4.3 Rating of impacts related to physical displacement (Pre-Mitigation)

Type of Impact: Direct		
Parameter	**Designation**	**Summary of Reasoning**
Extent	On site	Only those in the immediate project area (solar site and transmission line wayleave) will be affected.
Duration	Permanent	Physical displacement will be permanent particularly at the solar plant site. Those along the transmission line will be able to continue their agricultural activities.
Frequency	Once-off	The act of displacement will only occur once.
Likelihood	High	Some displacement will occur as a result of the Project.
Magnitude: High		
Displacement will lead to a fundamental change in the way of life of people affected and will affect both those who will be physically required to move, as well as the host communities**.**		
Sensitivity of Receptor: High		
The area is populated with low-income households who have limited/no savings and/or access to credit facilities. Vulnerability is heightened by dependency on agricultural and other land-based activities and limited education to take advantage of other economic opportunities.		
High Significance Pre-mitigation		

6.4.4.4 Mitigation/Management Measures

The specific mitigation measures required are:

Pre-construction and Planning

- Positioning of infrastructure to avoid and/or minimise resettlement. The positioning of Project infrastructure will be designed to avoid and/or minimise resettlement requirements as far as practicable, taking into account the feasibility of the location, as well as safety and legislative restrictions.
- Preparation of a Resettlement and Compensation Action Plan (RCAP). The preparation of this RCAP shall follow the requirements of National legislation and international good practice.

- Implementation of the grievance redress mechanism. Stakeholders will be made aware of the key guiding principles of the mechanism, as well as how and where they can submit any grievances, and means of resolution.

Construction Phase

- Compensation for loss of land and other assets. This will take place prior to construction and compensation may include the provision of replacement assets and land;
- Continuous engagement with broader stakeholder groups. A proactive Stakeholder Engagement Programme will be undertaken for the resettlement process that builds on the ESIA stakeholder engagement programme. Regular communication, information and updates to communities about the Project, including the resettlement process and management of project impacts will be conducted; and
- Post-resettlement monitoring and evaluation. This will be undertaken to determine the positive or negative effects of the displacement and the effectiveness of mitigation measures used.

A carefully implemented consultation process with all affected people, the development and implementation of a RCAP which accords households improved and more secure livelihoods, assistance to vulnerable people and the introduction of livelihood restoration projects will greatly reduce the severity of the impact.

6.4.4.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact will be a **"Low"** post mitigation.

6.4.5 Economic Displacement of Land Based Livelihoods

6.4.5.1 Impact Description

Construction

Similar to physical displacement, land acquisition for the construction of solar plant, transmission line towers, or other facilities, can lead to the displacement of individuals from their homes and agricultural lands, affecting their primary source of livelihood. Economic displacement is defined as the loss of income, or access to livelihood activities resulting from the acquisition of land associated with a project. The loss of access to land will take place during the construction phase of the Project and will continue to remain in effect or restricted during the operational phase.

Economic displacement with reference to land-based livelihood activities can result in the following:

- Loss of initial investment (time and resources) for establishing crops;
- Stress and ill-health as a result of disruption to livelihoods;
- Increased food insecurity and potential for nutritional diseases;
- Reduced income and economic activities within the communities; and
- Tensions between stakeholders and Project developers.

6.4.5.2 Receptor(s)

Households farming in the project area.

6.4.5.3 Rating of Impacts Related to Economic Displacement of Land Based Livelihoods (Pre-Mitigation)

Type of Impact: Indirect		
Parameter	**Designation**	**Summary of Reasoning**
Extent	On-site	This impact will be experienced primarily by households affected by land-take for project infrastructure.
Duration	Short term	Economic displacement will be permanent particularly at the solar plant site. Those along the transmission line will be able to continue their agricultural activities.
Frequency	Once-off	The act of displacement will only occur once.
Likelihood	High	Displacement is inevitable.
Magnitude: High		
Households facing economic displacement will experience disruption to their livelihoods and without support are unlikely to be able to re-establish their current livelihoods.		
Sensitivity of the Receptor: High		
The area is populated with low-income households who have limited/no savings and/or access to credit facilities. Vulnerability is heightened by dependency on agricultural and other land-based activities and limited education to take advantage of other economic opportunities.		
High Significance Pre-mitigation		

6.4.5.4 Mitigation/Management Measures

The mitigation measures detailed above under 6.4.4 Physical Displacement (Pre-Mitigation) will be applied, as well as the following:

- Re-establish and promote access to natural resource areas where viable, post-construction; and
- Ensure communities participate in pre-construction harvesting of resources as part of clearing activities. Identify optimal methods of storing harvested materials.

6.4.5.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the economic displacement of subsistence agricultural activities will be reduced to "**Low"**. Residual impacts will require determination and continual assessment through a post-resettlement evaluation.

6.4.6 Project Induced In-migration

6.4.6.1 Impact Description

Construction

The Project will require employment of non-local labour in terms of skilled labourers who might not be available in the Project area. There may Project Induced In-Migration (PIIM) into the area as a result of people seeking employment. Expectations regarding resettlement and compensation may also influence people to migrate to the area.

PIIM has the potential to create a range of positive and negative risks and impacts. Likely in-migrant groups include job seekers and their families, entrepreneurs/traders, opportunistic settlers looking to qualify for resettlement entitlements and commercial sex workers. Attempts to control or limit PIIM may unintentionally mitigate against efforts to promote local development, by inhibiting the establishment of a critical mass of local producers and consumers. Additionally, attempts to control or limit in-migration and other forms of human mobility engage fundamental questions related to international human rights related to freedom of movement and the pursuit of livelihoods. It is in the interest of the Project to ensure that any efforts to control migration or human mobility remain in accordance with established legal and social norms.

PIIM may result in impacts on ecosystem services, social services and social integrity in the project area.

- *Impact on Social Services*

The influx of Project-related workers and opportunists will increase demand for social infrastructure, including healthcare, sanitation, education, and housing. While construction camps will provide essential facilities to minimize the strain on local resources, those who do not secure employment will need alternative housing. Increased pressure on healthcare and education services may reduce service quality and accessibility for local communities, while housing shortages could lead to new construction, informal rentals, or homelessness. Informal settlements may exacerbate health risks, crime, and environmental issues, further straining local infrastructure and service delivery.

- *Impact on Ecosystem services*

Similarly, in-migration of people into communities may result in an impact on ecosystem services through a reduction in availability of natural resources. Reduced access to such services may create competition and potential conflict amongst local residents and newcomers to the area.

- *Impact on Social Integrity*

The influx of in-migrants may create social tensions due to differences in cultural values and a lack of allegiance to traditional leadership structures, potentially challenging the authority of local leaders. Increased cash flow from PIIM and staff recruitment could lead to higher rates of substance abuse, commercial sex work, teenage pregnancies, and single-parent households, particularly in areas with limited recreational opportunities. Income disparities between employed and unemployed individuals may fuel crime and violence, while competition for land and resources could drive illegal poaching. Corruption risks include undue recruitment, illicit land acquisitions, and unauthorized access to project benefits. To mitigate these challenges, contractors must be contractually obligated to manage the negative impacts of labour influx, with clear accountability measures for non-compliance.

6.4.6.2 Receptor(s)

Local communities in general will be very vulnerable in the context of PIIM impact to social services as access to such services is already limited. The poorest community members are likely to be disproportionately affected.

Traditional authorities could be particularly vulnerable as it may attack their position of influence.

6.4.6.3 Rating of impacts related to in-migration – (Pre-mitigation)

Type of Impact: Induced Negative Impact		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Local	Project induced in-migration is likely to occur in the project area and possibly the District.
Duration	Long Term	Impacts of in-migration will be felt as long as the migrant population is present.
Frequency	Intermittent	An influx of people to the area is not expected to happen suddenly, but rather continuously over the construction and operation period.
Likelihood	High	The project will definitely attract both skilled and non-skilled labour to the area.
Magnitude: High		
Insufficient ecosystem and social services to provide for increasing population numbers has the potential to affect a large number of households. The degree of change to livelihoods has the potential to be significant as quality of life and food security will be threatened. Impacts on Social Integrity may also be significant given the rural nature of the project area.		
Sensitivity of Receptor: High		
High sensitivity due to the reliance of the majority of households on natural resources for their livelihoods and social services that are already strained.		
High Significance Pre-mitigation		

6.4.6.4 Mitigation/Management Measures

It is important to note that in-migration is difficult to manage in any circumstance, regardless of location or driver. This is especially the case since some of the measures that need to be taken rely on the capacity and collaboration of third parties including the Government, Chiefdom authorities and other institutions in the area. The specific mitigation measures required are:

- Undertake communication related to PIIM. This will include:
  - Engagement with Government authorities on issues, risks, threats, and opportunities regarding in-migration;
  - Engagement with local communities to understand their concerns, raise awareness of risks and opportunities, and identify solutions to issues relating to in-migration;
  - Communication of the Project's policy of recruiting through the Local Labour Office.

- Development and Implementation of an induction programme including a Workforce Code of Conduct that will be adhered to by all Contractors. This will

increase worker-sensitivity to local norms and customs. The Workforce Code of Conduct will include:

- Zero tolerance of illegal activities by all personnel;
- Forbidding any gender-based violence activities;
- Forbidding prostitution;
- Forbidding the illegal sale or purchase of alcohol;
- Forbidding the sale, purchase or consumption of drugs; and
- Forbidding gambling and fighting.

6.4.6.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact will be **"Moderate"** post mitigation.

6.4.7 Health and Safety Risks

6.4.7.1 Impact Description

Construction

As a result of Project development, in particular during the construction phase when the workforce is likely to be greatest and when in-migration may peak, the rate of transmission of communicable diseases may increase. This will be largely due to:

- Interactions between the Project workforce and local communities;
- Potential for overcrowding as a result of increased pressure on existing housing infrastructure, water and sanitation services;
- In-migrants coming to the area bringing new communicable diseases of varying disease profiles compared to the existing community;
- Greater disposable incomes increasing a risk of engaging in high-risk sexual activities with commercial sex workers both in local communities and on transit routes to/from site, acting as a vector for possible diseases; and
- The presence of commercial sex workers with higher rates of STIs and HIV, may increase near construction sites.

If not treated in time, communicable diseases can affect the long-term health of those who contract them, leading to death in the worst-case scenario. Although stigma surrounding HIV/AIDs has decreased in recent years due to educational and awareness raising campaigns, there is the potential that any residual prejudice against those infected with STIs may discourage people from seeking testing, treatment and care, all of which will affect health outcomes. The increased incidence of

communicable diseases may impact on the availability of the Project workforce, by increasing absenteeism and staff turnover, leading to subsequent impacts on productivity and costs.

6.4.7.2 Rating of impacts related to health and safety – (Pre-mitigation)

Type of Impact: Direct and Indirect		
Parameter	**Designation**	**Summary of Reasoning**
Extent	Regional	The transmission of diseases has the potential to extend beyond the Project area given the presence of migrant workers.
Duration	Long Term	Impacts will occur for the duration of the construction period. However, some diseases such as HIV/AIDS have a lifetime impact.
Frequency	Continuous	The possibility of transmission may exist for the duration of the Project
Likelihood	High	Project induced in-migration as well as the presence of the Project workforce combined with the baseline conditions mean that the impact is likely.
Magnitude: High		
Sensitivity of Receptor: High		
High sensitivity due to poor access to healthcare facilities and reportedly poor service of healthcare establishments (e.g., long waiting times, inadequate drug supply, etc.).		
High Significance Pre-mitigation		

6.4.7.3 Receptor(s)

Local communities, healthcare facilities and healthcare providers will be susceptible to this impact. Changes in the local healthcare landscape can influence their ability to provide services or affect their working conditions. Vulnerable populations, such as the elderly, children, pregnant women, or individuals with pre-existing health conditions, may be more sensitive to changes in health services. Limited access to healthcare resources can disproportionately impact these groups.

6.4.7.4 Mitigation/Management Measures

Mitigation measures will be implemented by the Project in collaboration with other agencies (i.e. NGOs or health authorities). The Project shall proactively seek and manage these partnerships to ensure that impacts are being mitigated in a timely manner and to measure and monitor outcomes based on KPIs. The interventions

- Health awareness training will be provided to all employees. This will include knowledge and awareness around how communicable diseases are transmitted, diseases to be aware of, their symptoms and the benefits of early treatment. Health awareness training shall be provided as part of workers induction with refresher courses provided regularly;
- The emergence of major pandemics will be monitored through World Health Organisation (WHO) alerts such as Covid-1. If the WHO Pandemic Alert Scale reaches level 4 the Project will develop and implement the relevant Emergency Response Plans;
- Efforts will be made to ensure that health services are available to meet the day to day needs of Project personnel without impacting access to health care for communities. Agreements can be developed with health clinics or hospitals that the Project intends to use. These agreements should include support to increase capacity (health personnel, equipment, drugs etc.);
- Operate accommodation camps in accordance with National and international good practice. This will include prevention of overcrowding, access to clean water and sanitation and enforcing high levels of food hygiene standards within the camps to minimise disease transmission;
- Development of a policy to reduce the transmission of STIs, including HIV/AIDS, that is:
    - Provide support to workers to access treatment for HIV/AIDS through existing health facilities or NGO campaigns or programmes;
    - Ensure there is access to free condoms (including female condoms) at all worker sites and accommodation (including transit routes) to promote safe sexual practices; and
    - In partnership with local health officials and relevant NGOs ensure that all Project personnel are given specific HIV and STI prevention training. This should be given on induction and refresher training provided regularly.

6.4.7.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact will be reduced to "**Low**" post mitigation. Table 13 below provides a summary of impact significance and mitigation measures.

Table 9: Summary of Impact Significance and Mitigation Measures

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
CONSTRUCTION PHASE			
SOCIO-ECONOMIC ENVIRONMENT			
Physical Displacement	High	• Positioning infrastructure to avoid and/or minimise resettlement. • Preparation and implementation of a Resettlement and Compensation Action Plan (RCAP). • Preparation and implementation of a Grievance Redress Mechanism (GRM). • Compensation for loss of land and other assets. • Proactive, continuous stakeholder engagement programme. • Post resettlement monitoring and evaluation.	Low
Economic Displacement	High	• Re-establish and promote access to natural resource source areas. • Ensure communities participate in pre-construction harvesting of resources as part of clearing activities. • Work with Project affected communities and local authorities to assist in protecting land-based resources.	Low
In-migration	High	• Development and implementation of an induction programme including a Workforce Code of Conduct that will be adhered to by all Contractors. • Engagement of Government authorities and communities to understand their concerns, raise awareness of risks and opportunities, and identify solutions to issues relating to in-migration.	Moderate
Health and Safety Risks	High	• Health awareness training will be provided to all employees. • Development and implementation of Pre-Employment screening measures for workers, which will cover appropriate diseases.	Low

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
		• Development of Emergency Prevention, Preparedness and Response Plans • Monitoring the emergence of major pandemics through WHO alerts such as the Covid-19. • Ensure sufficient health services are available to meet the day to day needs of Project personnel without impacting on access to health care for communities. • Operation of accommodation camps in accordance with National and international good practice. • Provision for awareness, counselling and testing for all Project personnel, including voluntary testing for STIs and HIV/AIDS as part of any health screening program.	
BIOPHYSICAL ENVIRONMENT			
Visual Intrusion and Change in Landscape	High	• Use of existing access roads as much as possible • Crossing rivers and streams using the shortest distance possible (i.e., perpendicular to the waterbody). • Using construction methods that minimize damage to vegetation near the Solar Plant site and transmission line • Utilisation of solar modules with non-reflective coating to minimize glare, which can be visually disruptive; • Installation and/or maintenance of visual barriers (trees and shrubs), where possible, to reduce the visibility so that there is still greenery present; and • Appropriate management of construction waste at the site.	Moderate
Air Quality Deterioration	Moderate	• Maintenance and operation of all vehicles and equipment engines in accordance with manufacturers recommendations • Prohibition of idling of vehicles on-site; shut down generators and machinery when not in use.	Low

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
		• Covering of loose materials and keep top layers moist. • Observing set speed limits on unhardened roads and surfaces. • Use water for dust suppression on stockpiles, exposed soils, roads and prior to excavation works. • Use of covered trucks for the transportation of materials that release dust emissions. • Use of appropriate PPE by workers on site i.e., dust masks.	
Noise and Vibration	Moderate	• Use of temporary noise barriers for equipment (e.g., sound proofing walls around stationary power generating sources); • Avoid dropping materials from height, where practicable; • Maintain and operate all vehicles and equipment in accordance with manufacturers recommendations; • Noisy activities (activities that can be heard in nearby communities) restricted to daytime working hours. • Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration. • Establishment of a grievance redress mechanism to provide means for residents to make noise complaints. • Provision of hearing protective devices such as ear plugs and earmuffs.	Low
Soil Erosion	Moderate	• Construction of foundations to be undertaken preferably in the dry season; • Backfilling of foundation pits by the excavated soils which will resemble the order of the original soil layers; • Protect excavated soil materials from erosion; • Reduction of the construction of new access roads, where possible. Promoting the use of existing access roads for machinery and	Low

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
		vehicle movement, increasing their width as necessary. • Ensure that the land is physically restored (include revegetation where possible) before leaving to next tower location and before the next rainy season; • Rehabilitation of any areas which will be exposed for any reason as soon as possible to prevent possible soil erosion. Rehabilitation will be by replanting disturbed areas, or returning the top soil so that grass is able to naturally grow.	
Soil Contamination		• Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. • Regular checking and maintenance of all vehicles and equipment to minimize the risk of fuel or lubricant leakages. • Store hazardous materials in a manner that includes secondary containment and prevents interaction with other materials, the environment, and accidental tampering. In addition to, bunding of areas where hazardous substances are stored (e.g., fuel, waste areas). • Development and implementation of a Waste Management Plan (as part of the site- ESMP) to ensure that waste is disposed of correctly.	
Change in Quality of Water Resources	Moderate	• Activities shall be conducted as far as possible from water bodies' i.e > 100 m away, except where crossings are required. • Selective cutting of the vegetation in dambos and riparian habitats to keep low shrubby and herbaceous species that do not represent a risk for the powerline. As much as possible, conserve all the vegetation (trees, shrubs, herbaceous plants, and crops)	Minor

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
		present at the edge of watercourses and in erosion-prone areas. • Working in rainy season especially close to waterbodies to be avoided in order to reduce disturbances to local drainage patterns caused by working on water saturated soils and sediment transport into rivers and streams in proximity to work areas and affect water and habitat quality. • Sensitization on proper water usage and management. Encourage water reuse/recycling where possible. • Storage of hazardous materials in a manner that includes secondary containment and prevents interaction with other materials, the environment, and accidental tampering. In addition to, bunding of areas where hazardous substances are stored (e.g., fuel, waste areas). • All machinery and equipment to be kept in good working condition to prevent accidental oil spillages from machinery and any other chemicals. • Avoiding the disposing of waste in sensitive areas such as water courses. Development and implementation of a Waste Management Plan (site- ESMP) to ensure that waste is disposed of correctly.	
Loss of Vegetation	High	• Cleared woody vegetation from the wayleave and access road to be made available to local communities, to reduce the incremental disturbance to surrounding natural resources. • Revegetation of temporal work areas and access roads with appropriate native species. • Restriction of clearance to the wayleave. The boundaries shall be clearly identified and marked to avoid accidental clearing	Moderate

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
		• Restriction of the creation of access roads by using existing roads and paths as far as possible. • Use of mechanical vegetation removal instead of chemical removal i.e herbicides.	
Habitat Fragmentation and Edge Effects	Moderate	• Cleared woody vegetation from the wayleave and access road to be made available to local communities, to reduce the incremental disturbance to surrounding natural resources. • Revegetation of temporal work areas and access roads with appropriate native species. • Restriction of clearance to the wayleave. The boundaries shall be clearly identified and marked to avoid accidental clearing • Restriction of the creation of access roads by using existing roads and paths as far as possible. • Use of mechanical vegetation removal instead of chemical removal i.e., herbicides.	Low
Introduction of Invasive Species	Moderate	• Inspection and cleaning of vehicles and equipment/machinery before they come onto site. • Post construction survey for invasive species in sensitive areas such as wetlands and high quality forests.	Low
Mortality of Avifaunal Species	Low	• Enforcement of speed limits, installation of bird diverters/markers on transmission towers to limit avifaunal collisions. • Sensitization of workers against bird hunting, with strict penalties including dismissal of those found wanting (this measure should be a part of worker codes of conduct). • Restriction of construction activities to daylight hours. Lights to be used only where necessary and to be directed toward the subject area	Negligible

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
		and away from habitat areas where possible.	
Mortality of Terrestrial Fauna	Moderate	• Sensitization of workers against hunting/ poaching, with strict penalties including dismissal of those found wanting (this measure should be a part of worker codes of conduct). • All construction materials, particularly those use to reinforce structures i.e., steel wires, should be safeguarded and cleared from worksites, to avoid their use as wire snares. Wire snares are widely used in illegal harvesting of large animals. • Enforcement of speed limits to limit avifaunal collisions • Restriction of construction activities to day light hours. Lights to be used only where necessary and to be directed toward the subject area and away from habitat areas where possible.	Low
Disturbance to Aquatic Habitats and Species Mortality	Low	• Measures as recommended for "Change in Quality of Water Resources" above. • Work, storage and movement of equipment and vehicles, should be avoided as much as possible within river, floodplain, and wetland areas, such as dambos. If unavoidable, the access to these sites should be reduced to a minimum. • When stream crossings are unavoidable, construction of suitable culverts to ensure sufficient water supply and minimize impact on fish habitat. • Sensitization of workers against illegal fishing, with strict penalties including dismissal of those found wanting (this measure should be a part of worker codes of conduct).	Negligible
OPERATION PHASE			

IMPACT	PRE-MITIGATION IMPACT SIGNIFICANCE	SUMMARY OF MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE
Soil Erosion and Contamination	Low	• As recommended during construction	Negligible
Mortality of Avifaunal Species	Moderate	▪ Use non-reflective or low-reflectivity solar modules to reduce the risk of collisions. ▪ Implementation of site specific and tailored management strategies once biologically significant bird interactions have been reported, including: • Reinstall modules at angles and heights that minimize collision risks; • Use of markers and bird diverters to make the lines more visible; • Illuminating conductors and earth wires to improve their visibility to night-flying birds; • Supplemental perches to lure birds from parts of the tower where phase to phase electrocutions are likely; and • Changing or reviewing the placement and routing of affected sections of the line (if warranted).	Negligible

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) will facilitate the operationalization of the mitigation measures. The ESMP shall details its purpose and management and monitoring programmes shall also be outlined.

7.1 Objectives of the ESMP

The objectives of this ESMP are to:

i) Provide a system that develops a means for incorporating the findings and outcomes of the ESIA into the Project construction and operations processes;
ii) Establish systems and processes, to ensure compliance with applicable guidelines and legislation;
iii) Detail construction monitoring, reporting and auditing requirements;
iv) Identify environmentally sensitive assets and assist the construction crews and operations staff in avoiding and/or minimising potential impacts;
v) Incorporate the environmental mitigation measures identified by the assessment process into a comprehensive framework which facilitates appropriate interpretation and implementation of mitigation measures throughout the Project;
vi) Provide a tool to assist in tracking compliance with environmental obligations; and
vii) Clarify areas of responsibility during Project activities.

Monitoring is necessary to avoid negative effects during construction and operation of the proposed Project and to achieve sustained environmental compliance. Details of the proposed Environmental Social Monitoring Plan (ESMP) which provides mitigation/enhancement measures, and timing for the relevant actions are presented for construction and operational phases, respectively.

7.2 Management Arrangements

7.2.1 Roles and Responsibilities

- **JIGSCO Energy Corporation Limited**

This section describes the organizational structure and responsibilities for implementation of the ESMP. The general responsibilities of JIGSCO will include, but not limited, to the following:

- Supervising its contractors with the implementation of the ESMP during construction;
- Monitoring and evaluating the implementation of the ESMP during the operational phase;
- Monitoring key indicators of the Project's environmental impacts and performance;
- Reviewing plans, designs and strategies in relation to environmental, social and health considerations;
- Maintaining appropriate management systems and documentation;
- Preparing and submitting environmental and social documentation to Government agencies and financiers as required;
- Following-up non-conformance situations to ensure they have been successfully addressed; and
- Adapting management policies and strategies through lessons learnt.

Environmental and social safeguards team will be responsible for:

- Management, implementation, monitoring of compliance to the ESMP and any approval conditions, including construction supervision and performance of all Project staff, contractors and subcontractors;
- Review of ESMP performance and implementation of corrective actions, or stop work procedures, in the event of breaches of ESMP conditions, that may lead to serious impacts on local communities, or affect the reputation of the Project;
- Ensure effective communication and dissemination of the content and requirements of the ESMP to contractors and subcontractors;
- Assisting the contractor with implementation of ESMP sub-plans;
- Monitoring of ESMP and EIS performance;
- Ensuring compliance to all Project social commitments, including implementation of the social management and Resettlement and Compensation Action Plans;
- Report environmental performance of the project directly to JIGSCO Management;
- Report on environmental performance to ZEMA and other Government regulators as required;
- Prepare environmental reports summarizing Project activities, as required;
- Representing the Project at community meetings; and

- Ensuring effective community liaison and fulfilling commitments to facilitate public consultation throughout the Project cycle.

- **The Contractor**

The Contractor is required to appoint an officer(s) who will be responsible for the management of environmental and social issues on site, that is, the Safeguards Officer (SO). As a contractual requirement, the contractors will be required to demonstrate compliance of their activities against their approved Contractors ESMP (C-ESMP). This includes providing resources to ensure compliance of next tier contractors and a process for emergency stop-work orders in response to monitoring triggers. The SO will liaise regularly with the construction crews to ensure all environmental and social commitments are incorporated into the construction activities and work processes. Contractors will be responsible for performing all work:

- In compliance with relevant National legislation and international standards and regulations, ZESCO policies and with other requirements to which the Project subscribes;
- In conformance with the Project ESMP, and related management plans for specific aspects; and
- In accordance with contractual technical and quality specifications.

The Project's ESMP and related documentation will be the main contractual documentation to which the contractor(s) will be bound. However, contractors will be required to develop their own site management plans (C-ESMP) including worker camp management plan, which show how they will comply with these environmental and social requirements. In this way, the ESMP will be implemented and controlled using both ZESCO and contractor management systems.

Contractors will be required to self-monitor against their plan and compliance with the plan will be routinely monitored by JIGSCO directly or by third parties as required. Contractors will be required to submit regular reports of monitoring activities and the Project will review these on a regular basis.

Hierarchy for the implementation of the ESMP is as depicted in Figure 14.

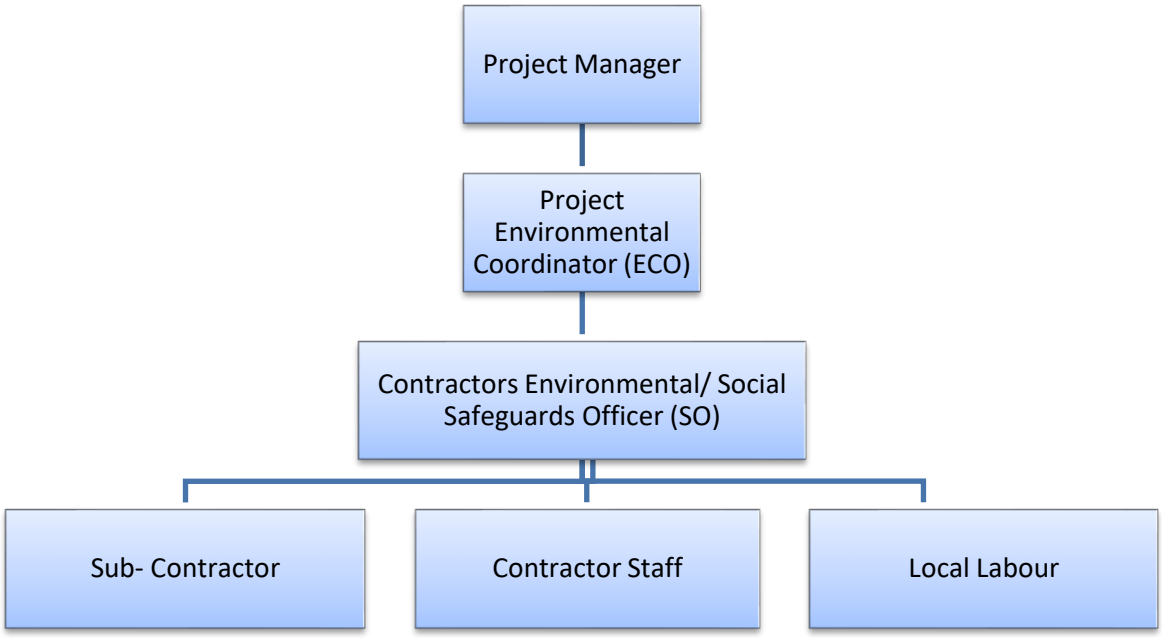


Figure 10: Organisational Structure for ESMP Implementation

7.2.3 External Institutions/Organisations

JIGSCO carries the ultimate responsibility for ensuring that the Project and all supporting infrastructure are designed, constructed and operated in conformance to Zambian legislative requirements and industry best practice. A monitoring programme will be implemented in collaboration with appropriate stakeholders and Government Departments operating in the Project area.

Listed below are some of the institutions and Government agencies that may be contacted whenever necessary to ensure successful implementation of the ESMP:

a. Ministry of Green Economy and Environment

- Zambia Environmental Management Agency (ZEMA)
- Provincial Forestry Department
- Chirundu District Forestry Department

b. Ministry of Water Development and Sanitation

- Department of Water Affairs
- WARMA

c. Ministry of Tourism

- Department of National Parks and Wildlife
- National Heritage Conservation Commission

d. Ministry of Lands and Natural Resources

- Lands Department

e. Ministry of Agriculture

- Chirundu District Agriculture Coordinators Office

f. Ministry of Health

- Provincial Health Office i.e Southern Province
- Chirundu District Health Office
- Local Rural Health Centres

g. Ministry of Local Government and Rural Development

- Siavonga Town Council
- Siavonga District Commissioner
- Area Members of Parliament; and
- Area Councillors

h. Ministry of Labour and Social Security

- Department of Occupational Health and Safety
- Department of Labour

7.3 Environmental Awareness and Training

The objective of the environmental awareness and training is to provide all personnel working on the Project with:

- An understanding of what their responsibilities are as outlined in the ESMP;
- A means of developing a culture of compliance with the Project environmental requirements; and
- A means to improve the environmental awareness of the workforce through the education of Project field personnel.

7.3.1 Project Environmental Awareness Induction

An environmental awareness induction (training) will be developed by the Contractors SO. An environmental training register will be kept, maintained and used to verify that all personnel working onsite have completed the environmental induction. The content of the induction is to include, but not be limited to:

i) An overview of the Project environmental policy;
ii) Relevant details of the ESMP including potential significant impacts;
iii) Identification of relevant Project stakeholders;
iv) Conditions of any environmental licenses, permits and approvals;

v) Roles and responsibilities of all personnel in achieving environmental conformance;
vi) Identification of any environmentally sensitive areas;
vii) Definition and management of environmental incidents and operation of pollution / spill control equipment;
viii) Definition and management of waste and an explanation of the waste minimisation and recycling strategy;
ix) Processes for refuelling and the management and use of hazardous substances; and
x) Appropriate responses to environmental incidents.

7.3.2 Environmental Toolbox Talks

A toolbox talk involves the dissemination of information to Project personnel at the field level. Generally, toolbox talks focus on safety aspects with reference to certain project jobs or tasks. They can also be used to disseminate environmental management information. Environmental toolbox talks should cover aspects such as:

i) Explanation of new project requirements;
ii) Explanation of the key environmental risks associated with an activity or specific procedures which could potentially have environmental impacts;
iii) Explanation of mitigation strategies with reference to an activity or specific procedures which could have potential environmental impacts;
iv) Reminder of the importance of specific or generic environmental commitments;
v) Traffic safety, safe driving and operation of movable equipment in the project area
vi) To obtain feedback related to environmental issues; and
vii) Any other purpose related to the implementation of the ESMP.

7.4 Monitoring, Auditing and Reporting

7.4.1 Monitoring

The environmental monitoring requirements for the Project are detailed for each environmental issue/impact addressed by the ESMP. All environmental monitoring equipment, such as noise meters, water quality meters etc. should be maintained and calibrated according to manufacturer's specifications. All monitoring equipment details, status, calibration dates and maintenance should be documented and recorded.

7.4.2 Auditing

Internal environmental audits will be undertaken throughout the construction process to ensure that the environmental requirements of the ESMP are implemented appropriately. The auditing process should be designed to identify any non-conformances and provide an opportunity to apply corrective and/or preventative action where appropriate.

7.4.3 Reporting

The SO will prepare periodic i.e monthly reports summarising monitoring, auditing and inspection outcomes as well as details of any environmental non-compliances. Other details to be reported on include:

i) Actions resulting from any environmental inspections or audits, including those completed by external regulatory bodies or Government agencies;
ii) Action and reporting of all incidents; and
iii) Other impacting non-conformance events, pertinent to the Project.

Regulatory and funding agencies may also require the preparation of reporting as part of approval conditions.

7.4.4 Inspections

The SO should undertake and document regular site inspections for the purpose of verifying compliance with the ESMP, licenses, permits and approvals, and the other environmental requirements. Inspection records shall be kept on file. Where inspections determine that environmental management measures are not effective, corrective and preventative measures will be implemented.

7.4.5 Project Records

A record keeping system will be developed and implemented, identifying how records will be managed and maintained during the Project. Records systems to be established which are directly relevant to environmental management include:

i) Induction register;
ii) Environmental incidents, non-conformances and complaints;
iii) Inspection reports, checklists, diary entries;

iv) Environmental monitoring results;
v) Meeting minutes;
vi) Formal letters and correspondence;
vii) Waste measurement and tracking records;
viii) Calibration records; and
ix) Activity specific environmental risk assessments.

7.5 Preventative & Corrective Action

7.5.1 Preventative Action

The Contractor's SO will be responsible for directing and monitoring of the following aspects of the Project to determine trends and recommend actions to be taken to avoid recurrences of environmental incidents:

i) Project, activity, or area-specific environmental risks;
ii) Any exceedance of environmental standards;
iii) Legislative changes; and
iv) Auditing outcomes.

7.5.2 Corrective Action

Deficiencies identified at worksites, if possible, be rectified immediately by the person identifying the deficiency, and reported to the foreman/ site engineer and the SO. A corrective action request should be completed and supplied within one working day of any of the following:

i) A major departure from agreed or approved procedure, approval conditions or Project environmental management objectives;
ii) A major non-compliance with the ESMP performance criteria; and/or
iii) Any perceived breaches of the legislative requirements.

The corrective action request should include details of the environmental effect, action taken to correct the problem and proposed measures to prevent the occurrence of a similar incident. The identification, reporting and rectification of environmental deficiencies should be encouraged at Project inductions and in toolbox discussions.

7.5.3 Maintenance Observations

Weekly site inspections should be undertaken by the SO to identify those day-to-day tasks such as the maintenance of environmental controls, the adjustment of existing

environmental controls or minor modifications to practices that need to occur. A list of observations will be made during these site inspections and actions recommended to rectify issues.

Where recommended actions are suggested, priorities should be set against these actions for site implementation. The list of actions should be distributed to the responsible personnel, typically the Project Manager, Foremen or responsible Engineer for action. A close out system should be included to ensure risks are managed.

7.6 Review and Update of the ESMP

JIGSCO Limited shall review the ESMP to assess its effectiveness and relevance as follows:

- A full review shall be undertaken as conditions prevail;
- Following a reportable incident, or a significant non-compliance; and
- Following an addition, up-date or change order to the ESMP, or a sub-plan.

The review of the ESMP should consider the following:

- Adequacy of data collection, analysis and review;
- Reporting;
- Non-compliance; and
- Corrective actions implemented.

The ESMP shall also be reviewed periodically to evaluate environmental controls and procedures to ensure that they are still applicable to the works being carried out. Reviews shall be undertaken by the Environmental team as follows:

- The full ESMP shall be reviewed periodically;
- Relevant parts of the ESMP shall be reviewed following a reportable incident;
- Relevant parts of the ESMP shall be reviewed following the receipt of an updated sub-plan; and
- At the request of stakeholders, including the Contractor, Supervising Engineer, ZEMA and other regulatory authorities, financiers and the communities.

7.7 Environmental and Social Monitoring Plan

The responsibility of implementation of the regular environmental and social monitoring (Implementation-Level) during construction primarily lies with the Contractor and is embedded in the contract. During construction JIGSCO Limited Project Implementation Unit (PIU) will be responsible for periodic monitoring & audit (Oversight-Level) as detailed in Table 18.

Environmental and Social Monitoring Plan

Table 22: ESMP

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
Clearing of vegetation in the wayleave, solar plant site access roads.	• Loss of vegetation • Change in the micro-climate of the project area due to loss of carbon sinks. • Loss of habitat for wildlife resulting from bush clearing	▪ Preservation of green space around the project site as a natural barrier. ▪ Conservation of vegetation in the surrounding areas. ▪ Stumping of trees in the wayleave shall be applied ▪ Implementation of Re-vegatation Management Plan	Quarterly	During the Construction and operation phase (if trees are cleared).	▪ Tree felling restricted to wayleave ▪ Proportion of non-built surfaces visibly retaining natural vegetation ▪ Trees stumped in the wayleave	Contractors Safeguards Officer (SO)	Embedded in project cost
	Change in landscape	▪ Use of existing access roads as much as possible ▪ Crossing rivers and streams using the shortest distance possible (i.e., perpendicular to the waterbody). ▪ Using construction methods that minimize damage to vegetation near the transmission line ▪ Placing structures to take advantage of existing natural screening to reduce the view of the line from nearby roadways.		Construction phase	▪ Minimal new access roads constructed ▪ Vegetation clearing restricted to construction site	Contractors Safeguards Officer (SO)	Embedded in project cost

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
		▪ Appropriate management of construction waste at the site.					
	• Loss of habitat and disturbance to breeding sites. • Mortality of avifauna species • Mortality of terrestrial fauna	▪ Ensure that only work areas are cleared of vegetation. ▪ In the wayleaves stumping as opposed to uprooting of the vegetation cover ▪ Mapping of sensitive breeding sites and periods ▪ All disturbed habitat areas must be rehabilitated as soon as possible to ensure that floral ecology is re-instated.	Monthly	Cconstruction phase	▪ Records of affected sites ▪ Clearance of prescribed work areas. ▪ Vegetation clearance done as per guideline. Uprooting only when absolutely necessary. ▪ Records of affected sites.	Contractors Safeguards Officer (SO)	Embedded in project cost
Increased traffic from motor vehicles and movement of construction equipment.	Air pollution by volatile organic compounds, dust and emissions from machinery on site.	▪ Ensure machinery is regularly serviced and watertight on any leakage of fuels. ▪ Dust suppression methods such as water spraying to be used to reduce dust. ▪ Covering of loose materials and keeping top layers moist. ▪ Use of covered trucks for the transportation of materials	Weekly	During construction phase and part of the operation phase	No visible leakage or spillage of fuel on site. No strong pungent smell of fuel as a result of leakage. Service record of vehicles and machinery.	Contractors Safeguards Officer (SO)	Embedded in project cost

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
		that release dust; and ▪ Use of appropriate PPE by workers on site e.g., dust masks.			Workers in appropriate PPE		
	Risk of road accidents	• Awareness and inductions on traffic management. • Implement traffic safety procedures to coordinate safe transport of workers to and from the workers' camp. • Construct and maintain roads, particularly emphasizing major slopes, to ensure slope stability and the safety of heavy vehicle operation.	Weekly	Throughout the Project cycle	Zero accidents on site throughout the project. Where accidents occur, they should be minor and nor more than three incidences in a year.	Contractors Safeguards Officer (SO)	Embedded in project cost
Blasting, drilling and machinery operations on site.	Noise pollution and vibration effect on local communities, wildlife and avifauna.	▪ Machinery is regularly serviced. ▪ Appropriate noise abatement technologies shall be employed. ▪ Controlled and timed blasting to ensure minimal disturbances to the surrounding will be employed.	Weekly	Construction phase	Noise levels maintained below 85 db. Vibration amplitude and frequency of vibration to a level of below 15Hz per second.	Contractors Safeguards Officer (SO)	Embedded in project cost

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
					No record of complaints from community members regarding noise		
Excavations and ground levelling	Soil erosion	▪ Construction of foundations to be undertaken in the dry season; ▪ Backfilling of foundation pits by the excavated soils which will resemble the order of the original soil layers; ▪ Protect excavated soil materials from erosion; ▪ Reduction of the construction of new access roads, where possible. Promoting the use of existing access roads for machinery and vehicle movement, increasing their width as necessary; ▪ Ensure that the land is physically restored (include revegetation where possible) before	Monthly	Construction phase	• All burrow pits are buried and revegetated • Grass planted or facilitated to grow naturally • Minimal signs of soil erosion	Contractors Safeguards Officer (SO)	Embedded in project cost

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
		leaving to next tower location and before the next rainy season; and ▪ Rehabilitation of any areas which will be exposed for any reason as soon as possible to prevent possible soil erosion. Rehabilitation will be by replanting disturbed areas, or returning the top soil so that grass is able to naturally grow.					
	Emission of dust which will result in air deterioration and visual impacts	▪ Use water for dust suppression on stockpiles, exposed soils, roads and prior to excavation works ▪ On the areas that are cleared, dust prevention measures need to be implemented during construction to reduce visual impacts associated with dust	Weekly	Construction phase	• Dust suppression methods applied • No record of complaints from community members regarding dust	Contractors Safeguards Officer (SO)	Part of the project cost
Waste generation	Contamination of surface and ground water with sewage and other generated	▪ Complex building will be built with water borne toilet facilities. The company will also develop their own	Quarterly during construction	Throughout the project cycle	▪ The faecal coliforms are maintained at less than 5000/100ml	Contractors Safeguards Officer (SO) during	Embedded in project cost during

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
	wastes.	sewerage treatment plant with capacity of 2.5 factor higher than the estimated population on site. ▪ All sewage will be treated and ensure compliance with the recommended concentration before disposal.	Annually for the first three years and then biennial (every two years) unless conditions require adjustments		of water sample. ▪ The Total Coliforms are maintained at 25000/100ml of waste water.	construction JIGSCO ECO during operation	constructi on 1,000.00 per sampling during operation
	Deterioration of water quality; surface and ground water. This may result in disturbance to aquatic ecosystems	▪ Ensure that machinery is serviced regularly throughout the project implementation. ▪ Ensure that soil sampling and analysis for hydrocarbons is done at regular intervals and where contamination is found, bioremediation done. ▪ All fuel/oil storage facilities are bunded for containment.	Quarterly during construction Annually for the first three years and then biennial (every two years) unless conditions require adjustments	Throughout the Project Cycle	Zero or insignificant contamination that is kept at Total Petroleum Hydrocarbon (TPH) of less than 10 mg/L of the water	Contractors Safeguards Officer (SO) during construction JIGSCO ECO during operation	Embedded in project cost during constructi on 1,000.00 per sampling during operation
	Contamination of soils with hydrocarbons.		Quarterly during construction	Throughout the Project Cycle	Zero or insignificant contamination that is kept at Total Petroleum	Contractors Safeguards Officer (SO) during	Embedded in project cost during

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
			Annually for the first three years and then biennial (every two years) unless conditions require adjustments		Hydrocarbon (TPH) of less than 2000mg/kg of the soils.	construction JIGSCO ECO during operation	constructi on 2,000.00 per sampling during operation
	Public health challenges and ecological impacts from indiscriminate disposal of solid and liquid waste (oils, lubricants, faecal matter).	▪ Ensure that waste is segregated at source and disposed of at designated sites. ▪ All project activities shall be handled according to the ZESCO Waste Procedure. The procedure prescribes reduction, re-use and recycling to promote sustainable waste management and prevent pollution to the environment ▪ Waste containing hazardous substances are to be collected and disposed using approved means.	Daily during construction Annually during operation	Construction phase Throughout the project cycle.	All wastes sorted, labelled and isolated on site prior to disposal ▪ All solid waste disposed of in designated areas away from human settlements. ▪ No record of sickness as a result of exposure to disease causing vectors. ▪ Well banded hazardous waste containers.	Contractors Safeguards Officer (SO) during construction JIGSCO ECO during Operation	Embedded in project cost during constructio n 1000.00 per year during operation

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
Creation of wayleave and solar plant	• Change of land tenure • Change in land use • Involuntary resettlement	The project affected people (PAP) shall be fairly and fully compensated. Compensated shall be done prior to commencement of the project. Resettlement and compensation shall be carried as per the RCAP.	Monthly	Throughout construction phase	▪ Compensation being paid to all PAPs. ▪ No grievances from PAPs concerning compensation.	JIGSCO ECO, Contractors Safeguards Officer (SO)	30,000.00
	Restricted agricultural activities	▪ Animal grazing in the wayleave will be allowed ▪ Farming of low laying crops will be allowed in the wayleave	Annually	Operation phase	Animal grazing and farming of low laying crops allowed in the wayleave	JIGSCO ECO	N/A
Erection of towers and stringing of conductors.	▪ Bird collision with and electrocution ▪ Visual intrusion	▪ Bird diverters to be installed in bird migration corridors.	Annually	Post construction	Bird diverters installed on conductors.	JIGSCO ECO	5,000.00
Installation of solar modules	▪ Visual impacts; glint and glare	▪ Appropriate facing of solar modules to minimize glint and glare impacts on resident and sensitive habitats. ▪ Preservation of green space around the project site as a natural barrier.	Annually	Construction Phase	• No grievances from community members • Natural barriers installed or maintained • No ecological impacts of significant scale e.g. mortality of birds from	Contractors Safeguards Officer (SO)	Embedded in project cost

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
					collisions with modules		
General construction works of the project	▪ Influx of people from outside the project area. ▪ Increased crime ▪ Increased incidence of communicable diseases • strain on local resources/amenities	▪ Prioritisation of locals for unskilled labour ▪ Health education on the dangers and prevention of communicable diseases shall be given to the construction workers and the local community. ▪ Distribution of condoms Partner with the District Medical Office for appropriate interventions	Weekly	Construction phase	▪ Attendance lists and minutes for health awareness ▪ Local employment ratio ▪ Cases of communicable diseases recorded ▪ Reports of criminal activities	Contractors Safeguards Officer (SO)	Embedded in project cost
	Improved energy access	Ensure that the project is implemented.	Annually	Operation phase	Power plant operating	JIGSCO Management	NA
	Water and sanitation risks	Water and toilets for workers will be provided at site	Monthly	Construction phase	Toilets and water available at site	Contractors Safeguards Officer (SO)/ HSE Officer	Embedded in project cost
	Human animal conflict	• Poaching will be prohibited • Conservation awareness campaigns will be conducted to construction workers	Quarterly	Construction phase	Records of conservation awareness held	Contractors Safeguards Officer (SO)	Embedded in project cost
	Improved local economy	• Local people shall be priotised for employment • Some building materials	Monthly	Construction phase	▪ Local employment ratio	Contractors Safeguards Officer (SO)	NA

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
		such as sand and crushed stones shall be bought locally.					
		• Implementation of the CSR MoU	Annually	Operation Phase	▪ Proportion of agreed funds disbursed	JIGSCO Management	50,000 annually
	Risks of occupational health and safety of workers.	▪ Site Safety and health procedures/guidelines shall be developed and enforced. ▪ PPE shall be provided to workers. ▪ Safety and health inductions and awareness campaigns shall be conducted periodically. ▪ Appropriate signage shall be placed on the construction site and the communities within the project area. ▪ Availability of emergency equipment e.g fire extinguishers, first aid kits	Weekly	Throughout the Project cycle	▪ Zero Accidents on site throughout the project. Where accidents occur, they should be minor and nor more than three incidences in a year. ▪ Availability and proper placement of signage ▪ Availability and proper placement of emergency equipment ▪ Emergency Preparedness and Response Procedure prepared	Contractors Safeguards Officer (SO)/ HSE Officer	Embedded in project cost

Aspect	Potential Impact	Proposed Mitigation/ enhancement Measures	Frequency Monitoring	Time Frame	Performance Indicator	Responsible Personnel	Cost (USD)
	Fire risks	▪ Fire safety training to be provided for the employees. ▪ Ensure that fire extinguishers are in place. ▪ Appropriate symbols and procedures of fire safety to be established on sites.	Monthly	Throughout the project cycle	▪ Zero record of fire throughout the project. Where a record is made, then only once in three years ▪ Emergency Preparedness and Response Procedure prepared ▪ Record of safety drills conducted	Contractors Safeguards Officer (SO)/ HSE Officer during construction JIGSCO SHEQ Officer during Operation	Embedded in project cost 5,000.00 annually

7.7 Environmental and Social Management and Monitoring Costs

Table 19 outlines the estimated costs associated with environmental and social management and monitoring activities, throughout the various phases of the Siavonga SPP. The monitoring framework ensures compliance with regulatory requirements, mitigates potential environmental and social impacts, and promotes sustainable project implementation.

The JIGSCO PIU will perform critical supervisory functions including validation of contractor monitoring data and targeted environmental and social sampling to verify mitigation effectiveness. These oversight activities will be funded separately from construction contracts.

Table 23: Environmental monitoring activities and costs

Project Phase/Activity	Activities	Person Responsible	Schedule/Frequency	Cost Element	Estimated Cost (USD)
Preparatory Phase	Environmental Impact Statement	PIU	Once - off	Review fees	45,000.00
	Obtaining Tree felling permit from Forestry Department	PIU- ECO	Once - off	Forestry resource assessment Compensation cost	20,000.00 50,000.00
Pre-Mobilization/Construction	• Compensation payments	• PIU – Social Specialist	• Compensation- Before project implementation	Valuation services Compensation cost Transport Staff allowances	10,000.00 300,000.00 15,000.00 20,000.00
Mobilization	• Local labour recruitment • Awareness meetings for workers: health, safety, security and environmental conservation	• PIU, Contractor & community leadership • ECO with Local Health Team • ECO with safety officers • ECO with security officer • ECO with officers from DNPW	• Recruitment – once prior to project execution • Health – twice during project implementation • Safety – twice during project implementation • Security – before project commencement • Environmental conservation – before project commencement	Transport & other logistics Staff allowances	10,000.00 4,500. 00

Project Phase/Activity	Activities	Person Responsible	Schedule/Frequency	Cost Element	Estimated Cost (USD)
	Locals people in project area Health, safety, security and environmental conservation awareness	ECO with Local Health Team ECO with safety officer ECO with security team ECO with local conservation team	• Health – soon after mobilization • Safety – soon after mobilization • Security – soon after mobilization • Conservation – soon after mobilization	• Staff allowances • Venue and other logistics	116,300.00 5,000.00
Construction	• Health awareness and monitoring for both Local people and construction workers • Safety & security awareness and monitoring for both Local people and construction workers	ECO with Health Team ECO, Safety & Security Officers & Contractor	Health – once off Safety & security – periodic during project implementation	Staff allowances Transport and other logistics Staff allowances Transport and other logistics	4,500. 00 10,000.00 4,500. 00 10,000.00
	Noise & dust mitigation	ECO, Safety and Health officer, Site Engineer	Periodic throughout project execution	Air quality measurements • Transport and other logistics	25,000.00 5,000.00
	Water pollution	ECO, Safety, Security, Civil Engineering & contractor	Periodic in selected locations	Transport and other logistics Water sampling & analysis	5,000=00 25,00.00

Project Phase/Activity	Activities	Person Responsible	Schedule/Frequency	Cost Element	Estimated Cost (USD)
	Conservation monitoring	ECO with Forestry Department and DNPW	Conservation - once	• Allowances for officers Transport	20,000.00 5,000.00
	General Monitoring of compliance to outlined environmental mitigation measures	• PIU (Site Engineer & ECO) • ZEMA	• Throughout project execution • Once or twice during project execution	• Staff allowances Transport & Other Logistics Allowances for officers Transport and other logistics	40,000.00 15,000.00 20,000.00 10,000.00
Pre-commissioning	Environmental Auditing	ECO with the ESD Auditing Team	Prior to project commissioning	Staff allowances Transport (operation) Audit report production	30,000.00 15,000.00 5,500.00
Operational	Environmental Auditing	ECO with the ESD Auditing Team	One year after project commissioning	• Staff allowances • Transport (operation) Audit report production	30,000.00 15,000.00 5,500.00
• **TOTAL**					**885,000.00**

8.0 DECOMMISSION AND REHABILITATION

Decommissioning is defined as the close down of operations, the removal of process equipment, buildings and structures and carryout site cleanup and remediation if required. The expected lifetime of the project ranges between 25 to 30 years that will be renewable as long as the appropriate predictive maintenance measures are taken, and all the necessary revamps and upgrades are done.

The proposed Project will have a life expectancy after which the performance of the project scales down to diminishing returns or the Project is no longer viable. At this point, the Project will be decommissioned in consultation with ZEMA and other stakeholders and in line with prevailing national legislative standards and good international practice at that time.

Decommissioning typically includes the removal of infrastructure. Removed parts will be re-used, recycled or disposed of. After removal of the line, the wayleave is restored to as close as possible to its natural setting.

8.1 Decommissioning Activities

The following are major activities during decommissioning:

8.1.1 Pre-Decommissioning Activities

- Stakeholders Consultation for Decommissioning

As the Project approaches the end of its economic viability, the developer will consult various stakeholders including host communities, nearby facility owners, ZEMA and experts. This will allow for a carefully planned redeployment and, where necessary, disengagement of personnel as appropriate. Activities associated with decommissioning are captured in Table 20.

- Preparation of Decommissioning Plan

Prior to engaging in decommissioning works, a decommissioning plan will be developed in accordance with regulatory requirements at the time of decommissioning. This will include a detailed Environmental and Social Management Plan (ESMP), which as a minimum will capture aspects as outlined in Table 21.

8.1.2 Decommissioning Activities

Table 24: Decommissioning activities

ACTIVITY	DESCRIPTION
Pre-Decommissioning Phase	
Site Preparation	• Site preparation activities similar to those undertaken in the construction phase will be required during decommissioning phase. This will include confirming the integrity of the site, access to the site in order to accommodate the required equipment (e.g lay down areas and decommissioning camp) and the mobilization of decommissioning equipment.
Decommissioning	
Disassemble and remove existing components for the solar plant	• The components including modules, tracking systems, inverters, and associated infrastructure would be disassembled, and reused and recycled (where possible), or disposed of in accordance with regulatory requirements.
Disassemble and remove existing components for the transmission line	• Complete discharging of oil from the transformers; • Removal of all electrical systems and accessories; • Demolition of substation walls and slab foundation; • Excavation and demolition of tower foundations; • Filling of tower spots with gravel, clean fill and top soil; and • Site restoration including revegetation and reseeding using of plants endemic to the site.
Disposal and handling	• Ensure proper handling and disposal of hazardous materials, if any, in accordance with environmental regulations • Salvage and resell components with resale value, such as solar modules, to secondary market
Site Restoration	
Land Reclamation	• Restore the land to its original condition, including the removal of any remaining infrastructure, restoration of vegetation, and land reclamation • Implement erosion control measures and ensure compliance with local land use regulations
Post-Decommissioning	
Monitoring and Maintenance	• Monitor the site post-decommissioning to ensure compliance with environmental and safety standards. • Establish a long-term maintenance plan for any remaining infrastructure or ongoing land reclamation efforts

Table 25: Environmental and Social Management during Decommissioning

Aspect	Impact	Pre-Mitigation Significance	Mitigation Measures	Residual Impact Significance
Site clearance Creation of access roads Excavation and backfilling of foundation towers Transportation of equipment and materials Accidental spills and leakages Waste management	Soil Erosion and Contamination	Moderate	Mitigation Measures as described for construction	Low
Excavation and backfilling of foundation towers Creation of access roads Transportation of equipment and materials especially over wet areas Accidental spills and leakages Waste management	Change in Quality of Water Resources	Low		Negligible
Excavation and backfilling of foundation towers Transportation of equipment and materials Emissions from operation of	Air Quality Deterioration	Moderate		Low

equipment and vehicles				
Labour influx Decommissioning activities e.g., demolishing of concrete	Noise and Vibration	Moderate		Low
Transportation and traffic Decommissioning activities Site restoration (risk from use of non-native species to revegetate)	Introduction of Invasive Species	Low		Negligible
Site clearance Decommissioning activities Transportation of equipment and materials (potentially leading to collisions) Labour influx (potentially leading to illegal hunting)	Mortality of Avifaunal Species	Low		Negligible
Site clearance Decommissioning activities Transportation of equipment and materials (potentially leading to collisions) Labour influx (potentially leading to illegal hunting)	Mortality of Terrestrial Fauna	Low		Negligible
Excavation and backfilling of foundation towers	Disturbance to Aquatic Ecosystems and Mortality of Aquatic Species	Low		Negligible

Creation of access roads Transportation of equipment and materials especially over wet areas Accidental spills and leakages Waste management Labour influx (potentially leading to illegal fishing)				

9.0 DECLARATION OF AUTHENTICITY

The environmental and social impact assessment team comprises of highly qualified and specialized individual experts in socio-economic assessment, environmental assessment and engineering development, and to the best knowledge of the experts involved, the information contained in this document is original and correct. Where secondary sources have been used, it is clearly indicated and acknowledged appropriately. All facts have been presented to the best knowledge of the developer. No part of this document shall be reproduced for any reason other than what it is intended for supporting decision making process for the competent authorities.

For correct discernment and interpretation of this document however, non-professionals or lay readers should seek clarification where necessary from either the Project developer (JIGSCO) or ZEMA for correct interpretation of the information contained herein.

AUTHORISED SIGNATUTRE OF PROJECT PROPONENT

Name: Bonje M. Muyunda

Designation: Head – Environment, ZESCO Limited

Sign: _____

Date: _____

10.0 REFERENCES

- The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) (2023), Revitalising Zambias Livestock Industry. https://www.ccardesa.org/revitalizing-zambias-livestock-industry
- Dumenu, W.K., Takam Tiamgne, X. (2020), Social vulnerability of smallholder farmers to climate change in Zambia: the applicability of social vulnerability index. *SN Appl. Sci.* **2**, 436 . https://doi.org/10.1007/s42452-020-2227-0
- Manitoba Hydro (2010). Fur, Feathers, Fins and Transmission Lines: How transmission lines and rights-of-way affect wildlife, Canada
- Ministry of Local Government and Rural Development (2025), Siavonga Town Council Integrated Development Plan, Siavonga Town Council, Siavonga. GRZ
- Ministry of National Development Planning (2022- 2026): Government of the Republic of Zambia (GRZ) Eighth National Development Plan. Lusaka, ZAMBIA.
- Zambia Statistics Agency (Zamstats) (2023). 2022 Census of Population and Housing: Preliminary Report
- ZESCO Limited. (2022). Environmental and Social Impact Assessment for the Proposed 200 MW Chisamba Solar-PV Project. Chisamba District, Central Province
- ZESCO Limited (2018) Kariba Northbank Extension (KNBE) hydropower project EIA, Lusaka
- ZESCO Limited (2022) Strategic Plan, 10 Year Rolling, 2022-2031.

11.0 APPENDICES

Appendix 1: Chance Finds Procedure
Appendix 2: Air Quality and Noise Baseline Assessment Report
Appendix 3: ZESCO Waste Management Procedure
Appendix 4: Abbreviated Resettlement Action Plan
Appendix 5: Letter of Approval for TOR and Scoping Report
Appendix 6: Approved Scoping Report
Appendix 7: Approved Terms of Reference (TORs)

Appendix 1: Chance Finds Procedure

In the event of a chance find, the following procedures shall be followed;

i) Stop the construction activities in the area of the chance find;

ii) Delineate the discovered site or area;

iii) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the NHCC take over;

iv) Notify the supervisory Engineer who in turn will notify the responsible local authorities and the NHCC;

v) The NHCC would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archaeologists of the NHCC. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;

vi) Decisions on how to handle the finding shall be taken by the NHCC. This could include changes in the layout (such as when finding an irremovable remain of cultural or archaeological importance) conservation, preservation, restoration and salvage;

vii) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the NHCC; and

viii) Construction work could resume only after permission is given from the responsible local authorities and the NHCC concerning safeguard of the heritage;

ix) These procedures must be referred to as standard provisions in construction contracts, when applicable. During project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed; and

x) Construction work will resume only after authorization is given by the responsible local authorities and the National Museum concerning the safeguard of the heritage.