40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

ENVIRONMENTAL IMPACT ASSESSMENT STUDY

ENVIRONMENTAL IMPACT ASSESSMENT REPORT - DRAFT

VOLTA RIVER AUTHORITY

AUGUST 2020

CORPORATE ENVIRONMENTAL POLICY STATEMENT

The Volta River Authority (herein referred to as "the Authority") is a public power utility and supplies electricity to industries and mining companies as well as distribution companies in Ghana. The Authority commits to ensuring continuous improvement of environmental performance that minimizes potential impacts of all its operations on the environment in accordance with the principles of sustainable development and complying with national and international environmental protection regulations.

In respect of the above, VRA will:

a. Make environmental considerations a priority in all business planning and decision-making and comply with relevant national and international environmental protection regulations.
b. Take reasonable steps to mitigate the impact of its actions with regard to the development, operation and management of its assets.

VRA will thus pursue the following specific objectives:

a. Develop and implement Environmental Management Systems for all its business units to:
    i. Assess environmental impact of processes, operations and products.
    ii. Focus on pollution prevention and waste reduction.
    iii. Ensure compliance with national/international environmental protection regulations.
    iv. Set annual environmental targets to ensure continuous improvements.
    v. Monitor and report on environmental performance as required to the appropriate stakeholders.
b. Ensure minimum environmental impact of VRA's projects and take adequate steps to mitigate any such anticipated adverse impacts as far as is practicable.
c. Promote environmental awareness and individual sense of responsibility among its employees through print material for distribution, safety meetings, and the corporate website which will continue to be updated and provide adequate empowerment and training for personnel to perform environmental jobs satisfactorily.
d. Support research efforts on materials, products, processes and pollution reduction techniques that are directly related to its operations.
e. Contribute to the development of public policy and programmes that enhance environmental awareness and protection.
f. Promote open communication on environmental issues.
g. Undertake projects and programmes in collaboration with relevant agencies to preserve the Volta Lake resource, and reasonably restore/mitigate ecological imbalance caused by the creation of the lake.
h. Undertake projects and programmes to mitigate the impact on the livelihood of individuals and communities displaced or affected by VRA's developmental projects.

VRA shall design evaluation procedures for all processes that fall under this policy to ensure that these processes comply. Deficiencies, in the policy or in the evaluation procedure, shall be addressed as required. Each employee of VRA is charged to exercise his or her responsibility on behalf of VRA to assure that the intentions of this Policy Statement are diligently carried out.

SIGNED: CHIEF EXECUTIVE

VOLTA RIVER AUTHORITY

SIGNATURE PAGE

Project Name	40MW Bongo Solar Power Project at Bongo in the Upper East Region, Ghana		
Proponent	Volta River Authority		
Report Name	Environmental Impact Assessment Report		
Name	Position	Signature	Date
Leader of Team of Consultants			
Ben A. Sackey	Manager, Environment & Social Impact		
Acceptance & Declaration of Proponent			
Emmanuel Antwi-Darkwa	Chief Executive		

REPORT DETAILS

Title:	Proposed 40MW Bongo Solar Power Project at Bongo in the Upper East Region, Ghana - Environmental Impact Assessment Report
Project Description:	This EIA Report forms part of a series of reports and information sources that are being provided under the Environmental Impact Assessment (EIA) process for the proposed 40MW Bongo Solar Power Project. The EIA is a process designed to ensure that new developments, and extensions to existing developments, are located and designed in such a way as to minimise environmental impact. and that all concerns are addressed as a project gains momentum through to implementation. Specifically, the EIA Report describes the affected environment, including the planning context, at a sufficient level of detail to facilitate informed decision making and provides recommendations to avoid or mitigate negative impacts and to enhance the positive benefits of the project.
Prepared by and for:	Environment & Sustainable Development Department, Volta River Authority Electro Volta House, 28Th February Road P. O. Box MB 77, Accra Digital Address: GA-145-7445 Tel No: +233-302-664941-9 WhatsApp: +233-501-620439 Email: desd@vra.com Web: www.vra.com
EIA Authors:	Environment & Sustainable Development Department, VRA
Lead Author	Ben A. Sackey
Specialist Authors:	Godfred Ofosu-Asare, Ebenezer Antwi, Lloyd Kofi Sutherland, Baffo Blankson, Frederic Kyei-Dompreh, Kofi Orstin, Linus Abenney-Mickson, Khalilu-lahi Abdulai and Lawrence Addipa
Date:	August 2020

DOCUMENT CONTROL SHEET

REPORT TITLE:	EIA Report for the Proposed 40MW Bongo Solar Power Project at Bongo in the Upper East Region		
DATE:	August 2020		
REPORT STATUS:	Draft Copy		
PROPONENT:	Volta River Authority		
INTERNAL DOCUMENT DISTRIBUTION			
Type	**Recipient Name**	**Location**	**Institution**
Electronic / Hard Copy	Director, Environment & Sustainable Development	Akosombo	Volta River Authority
	Director, Engineering Services	Akuse	
	Manager, Projects	Akuse	
	Manager, Env. & Social Impact	Akosombo	
	VRA Head Office Library	Accra	
Hard Copy	Executive Director	Accra	Environmental Protection Agency
	Upper East Regional Director	Bolgatanga	
Hard Copy	District Chief Executive	Bongo	Bongo District
Hard Copy	Regional Minister	Bolgatanga	Upper East Region

NOTE:

Hard Copies are held and distributed by the Environment & Sustainable Development Department of VRA. Electronic copies of this report are issued in portable document format and posted on the Corporate website of the Volta River Authority at www.vra.com.

ACRONYMS AND ABBREVIATIONS

Abbreviation		Meaning
AC	-	Alternating Current
ACP	-	Affiliate Country Program
AFOLU	-	Agriculture, Forestry and Other Land Uses
AIDS		Acquired Immunodeficiency Syndrome
ANSI	-	American National Standards Institute
AU	-	African Union
CDP	-	Community Development Programme
CHPS	-	Community Health Posts
CHRAJ	-	Commission on Human Rights and Administrative Justice Act
CLS	-	Customary Land Secretariat
COP	-	Conference of Parties
CPV	-	Concentrating Photovoltaic
CSP	-	Concentrated Solar Photovoltaic
CSR	-	Corporate Social Responsibility
CWSA	-	Community Water and Sanitation Agency
dBA	-	A-weighted decibels
DC	-	Direct Current
DCE	-	District Chief Executive
DCP	-	Decommissioning and Site Closure Plan
DISCos	-	Power distribution companies
ECG	-	Electricity Corporation of Ghana
EIA	-	Environmental Impact Assessment
EIS	-	Environmental Impact Statement
EMMP	-	Environmental Management & Monitoring Plan
EPA	-	Environmental Protection Agency
EPC	-	Engineering, Procurement & Construction
EPRD	-	Environmental Performance Rating & Public Disclosure
ESS	-	Environmental and Social Standards
FC	-	Forestry Commission
FSD	-	Forest Services Division
GENCos	-	Power generation companies
GHG	-	Greenhouse Gas
GMMB	-	Ghana Museums & Monuments Board
GNFS	-	Ghana National Fire Service
GNGC	-	Ghana National Gas Company
GoG	-	Government of Ghana

Abbreviation		Meaning
GRIDCo	-	Ghana Grid Company Limited
GRM	-	Grievance Redress Mechanism
GSA	-	Ghana Standards Authority
GSB	-	Ghana Standards Board
Ha	-	Hectare
HGVs	-	Heavy Goods Vehicles
HIV	-	Human Immunodeficiency Virus,
HSE	-	Health, Safety & Environment
I&APs	-	Interested and Affected Parties
ICOUR	-	Irrigation Company of Upper Region
IEC	-	International Electrotechnical Commission
IFC	-	International Finance Corporation
ILO	-	International Labour Organization
IPF	-	Investment Project Financing
IPPs	-	Independent Power Producers
JHS	-	Junior High School
LARF	-	Land Acquisition & Resettlement Policy Framework
LI	-	Legislative Instrument
LMP	-	Labour management Plan
MoEn	-	Ministry of Energy
MoU	-	Memorandum of Understanding
MV	-	Medium Voltage
MW	-	Megawatts
MWp	-	Megawatts Peak
NCCAS	-	National Climate Change Adaptation Strategy
NCCE	-	National Commission for Civic Education
NCCP	-	National Climate Change Policy
NED	-	Northern Electricity Department
NEDCo	-	Northern Electricity Distribution Company
NES	-	National Electrification Scheme
NHIS	-	National Health Insurance Scheme
NIHL	-	Noise Induced Hearing Loss
NITS	-	National Interconnected Transmission System
NLCD	-	National Liberation Council Decree
NRCD	-	National Redemption Council Decree
NTS	-	Non-Technical Summary
O&M	-	Operational & Maintenance
OPD	-	Outpatients Department
OSHEM	-	Occupational Safety, Health & Environmental Management

Abbreviation		Meaning
PAPs	-	Project Affected Persons
PHC	-	Population Housing & Census
PM	-	Particulate Matter Concentrations
PNDC	-	Provisional National Defence Council
PS	-	Performance Standard
PURC	-	Public Utilities Regulatory Commission
PV	-	Photovoltaic
RCC	-	Regional Coordinating Council
RE	-	Renewable Energy
REDP	-	Renewable Energy Development Programme
REMP	-	Renewable Energy Master Plan
REMP	-	Renewable Energy Master Plan
RoW	-	Right of Way
RPF	-	Resettlement Policy Framework
SDGs	-	Sustainable Development Goals
SEP	-	Stakeholder Engagement Plan
SHS	-	Senior High School
SIA	-	Social Impact Assessment
TBAs	-	Traditional Birth Attendants
TWA	-	Time Weighted Average
UNFCCC	-	United Nations Framework Convention on Climate Change
VRA	-	Volta River Authority
WBG	-	World Bank Group
WHO	-	World Health Organization
WRC	-	Water Resources Commission

NON-TECHNICAL SUMMARY

SCOPE, PURPOSE AND OBJECTIVES OF THE PROJECT

1. The Volta River Authority (VRA) proposes to construct and operate the "**40MW Bongo Solar Power Project**" (hereinafter referred as the "Project"). The Project is to be located at Asibiga in the Bongo District of Upper East Region of Ghana, and 15 kilometres south of the Ghana - Burkina Faso border. The project would involve the installation of a 40MW fixed ground mounted single axis PV panels solar power plant on a 0.5013 km^2 of land, which will tie into the national electricity grid. Basically, electricity from the solar power plant would be evacuated at 34.5kV voltage level and a sub-transmission line, of approximately 29 km with a wayleave of 15m, would be constructed from the solar power plant and would terminate on the 34.5kV bus at the Bolgatanga Substation, in the Bolgatanga Municipality also in the Upper East Region.

2. The objectives for embarking on such a project are as follows:
   - To utilize solar as an additional source of generation to supply the increasing domestic and export demand.
   - To align VRA's generation capacity development with Ghana's Renewable Energy Master Plan (2019) that seeks 10% of all electricity generation to come from renewable sources.

3. The most significant accruable benefit in the development of the project is the expected improvement in power supply reliability in Northern Ghana, as it will minimize the cost of transmission and transmission loses as well. This will attract businesses and services that otherwise would have been difficult to bring to these communities.

4. The potential off-takers of electricity from this project include Northern Electricity Distribution Company (NEDCo), a stand-alone, wholly owned, subsidiary of VRA with the responsibility of electricity distribution in Northern Ghana as well as Newmont Ghana and other mining companies that have indicated the need for additional energy for the expansion of their operations

BRIEF PROJECT DESCRIPTION

5. Key components of the project is shown in the table below.

Component	Description
Project Capacity	40 MW
Project Area	50.13 Ha
Technology Type	Photovoltaic (PV) Polycrystalline technology
Orientation	12° South
Module Power (Wp)	310

Component	Description
Modules in String	19
Total Modules	64525
No. of Inverters	1000
Infrastructure	• PV solar panels/modules (arranged in arrays) • Fixed PV module mountings • DC-AC electricity inverters and transformers • A 'loop-in loop-out' substation facilitating connection to the national grid • A substation located within the PV footprint • Underground cabling and Overhead power lines • On-Site buildings (including an operational control centre, office, inverter room and transformer units' warehouse, and a guard house) • Access roads and internal road network • Ancillary infrastructure, incusing security fencing

6. Financial closure for the project is targeted by close of 2021 and this will inform the procurement of an EPC Contractor. Depending on finances, the project could be developed in two (2) phases of 20MW each. VRA will engage a Consultant Engineer for the project who will be responsible for site verifications, design, specification and all technical aspects of the tender and contracting. The services will furthermore expand to the supervision of the whole construction process and commissioning, including working as specialist environmental advisors. During operations and maintenance, the responsibility is going to be taken over by a dedicated VRA Team.

LEGAL BASIS OF THE PROJECT

7. Within the context of the requirements of Ghana's Renewable Energy Act 2011 (Act 832) and the Renewable Energy Master Plan (February 2019), VRA has adopted a Renewable Energy Development Programme (REDP) which sets a 5-10 years' Renewable generation capacity target, taking cognisance of the local and export demand and the system constraints and is being rolled out in two (2) phases. The implementation of the project falls into the REDP Phase 2.

8. Under the provisions of the Ghana Environmental Assessment Regulations, 1999 (LI 1652), it is a legal requirement in Ghana that development projects such as the proposed solar power facility is subject to an Environmental Impact Assessment (EIA) process, and environmental authorisation through the issuance of an Environmental Permit by the Environmental Protection Agency (EPA).

9. Based on the screening, the EPA in response to the registration confirmed that the project falls into a category of undertakings for which an EIA is mandated (Regulation 3). The EPA subsequently directed VRA to prepare an Environmental Scoping Report which was to focus on key and relevant issues for decision making. A Scoping Report dated March 2018 was submitted to the EPA for review. The report was publicly disclosed on the VRA website, www.vra.com as well as in the Daily Graphic and Ghanaian Times, the two most widely circulating newspapers in Ghana. The EPA has subsequently approved of the Scoping Report and has requested VRA to proceed with the preparation of this EIA Report. This EIA Report has therefore been prepared in adherence to LI 1652, and is to address any predicted environmental and social issue associated with the construction and operation of the project.

10. The relevant institutional agencies that will be directly responsible for overseeing and administration of such an electric power development project at all stages, including the VRA, and the legal instruments that mandate them to play their said roles has been discussed. In addition, key national legal framework applicable to the envisaged project have been categorised as listed below and discussed:
    - Assessment and Management of Environmental and Social Risks and Impacts
    - Community Health, Safety and Security
    - Labour & Working Conditions
    - Land Acquisition & Involuntary Resettlement
    - Cultural Heritage
    - Resource Use Efficiency & Pollution Protection
    - Biodiversity Conservation and Sustainable Management of Living Natural Resources
    - Climate Change
    - Gender & Vulnerability.

11. The categorisation of the national legal framework has been done in order to align with that of international safeguards, and includes cross cutting issues such as climate change and gender. This is because, VRA as a public institution will access funding from international funding agencies through an on-lending agreement with the Ministry of Finance and its representative agency, Bank of Ghana. Thus, for the purpose of this solar power project, how the project also complies with these safeguards is key to its successful financial closure and those listed below have also been assessed:
    - Ghana Sustainable Banking Principles and the Sector Guidance Notes of the Bank of Ghana (November 2019)
    - World Bank Environmental and Social Standards (August 2016)
    - International Finance Company Performance Standards on Environmental & Social Sustainability (January 2012)
    - European Bank for Reconstruction and Development Performance Requirements (May 2014)

12. All relevant national and international environmental, social, health, safety and labour laws, policies, regulations, guidelines and standards that may apply to the development of the project will be applied as required.

DATA COLLECTION METHODOLOGY

13. The environmental assessment has been undertaken by a team of in-house experts from VRA, made up of Environmental Safeguard Specialist, Ecologists, Resettlement Specialist, Land Economist, Land Valuation Experts, Engineers and Geodetic Surveyors. The study commenced in 2014 with site identification and land acquisition and this was followed by the collection of both primary and secondary data for the identified sites. For primary data, a site reconnaissance visit was done in November 2017 and November 2019 to collect baseline data (dry season) in the context of physical and ecological environment as well as socio-economic and land use. Wet season data was gathered by the Team in July 2018. Baseline data on noise as well as traffic at the project site were obtained during these visits.

14. VRA in October 2018 engaged the services of the Forest Commission, Bolgatanga to undertake a quantification and listing of identified flora and fauna within the PV project site and a report on this was submitted in January 2019. The flora and fauna survey teams were led by two seasoned Forest Range Manager and a Wildlife Officer respectively.

15. The baseline data for the flora and fauna, compensation report indicating types of economic trees paid for as well as the site reconnaissance visit provided relevant data for the bio-physical environment. The compilation of the social data, including cultural heritage sites, in the communities was mainly coordinated in consultation with the locals. The secondary data to supplement the primary social was collected through a wide literature review on the project as well as the project area, and this included the current 2018-2021 Medium Term Development Plan for the Bongo District Assembly as well as the 2010 Population & Housing Census, District Analytical Report, Bongo District Assembly, October 2014.

BRIEF ON THE BASELINE DATA

16. A detailed report covering all aspects of the existing physical environment, biological environment, ecological sensitive areas as well as socio-economic conditions has been outlined in the EIA Report. With respect to location, the PV project site is bounded on the north by the Akorisi village, on west and south-west by Bongo and Bogorogo communities respectively and on the east and south by an untarred road, which provides accessibility to the site via Bongo and Bolgatanga. The 23 km stretch of the proposed route line commences from the solar site at Asibiga through the townships of Bogorogo, Zarre. Yorogo, Zorbisi all in the Bongo District, whilst six (6) km of the line runs within and terminates finally in Bolgatanga. The nearest PV plant is the 2.5MW Navrongo Solar Power Station, located at Pungu Telania, near Navrongo, west of Bongo and about 50Km away.

17. The PV site is about 9km from the Bongo township, the district capital, and about 14km off the Bongo Main Road joining the N10 Highway. The major route from Southern Ghana to the site is the Tamale- Bolgatanga Section of the N10 Highway.

18. Information provided on physical environment include national GHG Gases Emissions, Atmospheric & Climatic Conditions, Ambient Noise, Air Quality, Topography and Drainage as well as Geology & Soils.

19. There is no housing infrastructure on the site as the land selection process sought to avoid such facilities. The neighbouring / sensitive features around the immediate project site (within 2km) of the solar / sub-transmission project sites and their coordinates as well as distances from the project sites are listed below.

Name of Neighboring Sensitive Facility	Latitude	Longitude	Distance from PV Site at Asibiga (km)	Distance from Proposed Transmission Line Route (km)
Adaboya Clinic	10.8995	-0.7339	2.4	1.3
Akanaba CHP Compound	10.9077	-0.7656	4.4	0.75
Akigba RC/Kg	10.9104	-0.7639	4.15	1
Akigba Sacred Grove	10.9082	-0.7621	4	0.72
Apaatanga Catholic Church	10.915	-0.7489	2.43	0.95
Apaatanga RC, JHS	10.9129	-0.7504	2.65	0.8
Apostolic Church	10.9009	-0.7778	6.16	0.24
Bogorogo JHS	10.9201	-0.7860	6.42	2.6
Bogorogo Primary	10.9002	-0.7799	5.93	0.37
Bolgatanga Substation	10.7952	-0.8707	20.9	-
Bongo Dam	10.9059	-0.7920	7.1	1.81
Ghana-Daa RC, Kg/Primary	10.915	-0.7489	2.43	0.95
Vea Dam	10.8736	-0.8453	13.9	0.43
Zopelga Prayer Ground	10.9157	-0.7285	0.53	0.12

20. The site has a relatively flat topography and the soil is loamy with very few rocks and stones. The vegetation is mainly savanna grassland, interspersed with trees, the major ones being Sheanuts, Neem and Fig trees. The solar power site is designated for agricultural use, with current agricultural practises including mixed farming and grazing for livestock (cattle, goats and sheep. The remnant woodland vegetation apart from protracted farming and overgrazing, practically by cattle, suffers annual wildfires contributing to un-sustained regrowth to cover up open gabs. Limited cultivation such as millet, groundnut and Bambara beans depending on the season is, however, undertaken within the Project Site.

21. A total of 345 trees were identified at the PV site comprising of 20 different species. For the total of the trees enumerated, the Shea tree (*Vittellaria paradoxa*) dominated the list with 160 trees (46.47%), the reason being that the local people have interest in this species and deliberately make efforts in protecting them. Regarding the transmission system, the main economic trees identified along the line route were Teak, Mango, Berry, Baobab, Sheabutter and Dawadawa. The Global International Union for Conservation of Nature (IUCN) conservation designation of almost all the tree species shows that they have been evaluated as not being a focus of species conservation and therefore of "Least Concern". The benefits of the flora to the economic ecology of the rural community in a scale of preference ranges from medicine, commercial, firewood, shade/fodder and lastly fencing. As high as 24.6%, of the trees (flora) enumerated are used for medicinal purposes. Commercial trees particularly *Vitellaria paraboxa* (Shea), constitute 23% with the least of 4.4% being fencing.

22. A faunal survey carried out during the scoping stage showed insects such as grasshopper and butterflies as common to the area. Birds such as Vulture, Cattle Egret, Harrier Hawk were common. Reptiles identified included the agama lizard and snakes, and according to the locals, and these are mostly rattle snakes, python, cobras, Gabon Viper and the green mamba. From discussions with the locals, elephants from nearby Burkina Faso, can be found in the project area. In addition, rabbits, squirrels, bush guinea fowls, monkeys are animals that are commonly hunted by the locals. A detailed study recorded a total of 112 animals comprising 13 species.

23. Investigation did not suggest or provide any information describing or prescribing the site as a low range or habitat or ecological sensitive area for any wildlife. The nearest environmentally sensitive site is the Red Volta Forest Reserve located about 7 km north of the project site. The Red Volta runs through this reserve and provides support for wildlife namely baboons, monkeys, rats, mice, grass cutters, rabbits, buffalos, antelopes and guinea fowls. This forest has been depleted due to the activities of fuel wood dealers and some farmers. This Forest Reserve will not be directly affected by project development. As a result, clearing of the site vegetation to give way for the construction of the Solar Project have no significant impart for wildlife habitat.

24. With respect to socio-cultural baseline information, it is anticipated that the most significant impacts will occur within the Bongo District and its environs. For this reason, the discussion of baseline socio-economic conditions was looked at within the context of the Bongo District and key information provided included:
    - The land area taken up by the development, which is 0.8463 Km^2 and comprise of 50.13 Ha (0.5013 km^2) for the PV Site and 0.345 km^2 area for the associated sub-transmission line.
    - Using the 2.2% estimated annual growth in population, the projected population of the District as of September 2019 was 103,060. The District has an average sex ratio of 90 males per 100 females. The district is a multi-ethnic, with the Bossis and Gurunsis as major ethnic groups, with Frafra being the dominant language. Three major religious groups in the district are traditionalists (44.0%), Muslims (7.2%) and Christians (45.1%).

- Based on desktop research as well as a field investigation undertaken by the EIA Team, no archaeological material was found and recorded. However, an old isolated ancestral grave with the Yabatua Shrine (a Baobab tree) as well as the Kinkanga Shrine (a Ficus tree) are situated on the proposed PV site. Also, just within the project site on the eastern side is an area called the Dwarf island, where it is alleged that dwarfs exist. This is currently a prayer ground for Christians who come there to pray in the name of sacking the dwarfs. Also, along the transmission line is the Tindana sacred grove at Asibiga community and various churches, mostly Christian.
- The local economy consists of three major sectors namely agriculture, service and industry. Agriculture is the most dominant sectors employing 72.2 per cent of the population in food crop farming, animal rearing and as fishing.
- MTN, Tigo, Vodafone and Airtel are the mobile phone operators are found in the district. There is only one postal Agency located at Bongo, the district capital. The district is on the national grid and since 2014 to 2017 the number of communities with electricity has increased to 72 remaining 24 communities to be covered. The three main sources of lighting in dwelling units in the district are kerosene lamp (64.8%), flashlight/torch (20.3%) and electricity (11.5%). In all, the District has a potable water coverage of about 82%.
- Most of the people live in compound houses (50.3%) built of mud and roofed with straw or zinc. The main features of the predominantly traditional architecture are round huts with flat roofs and small windows that provide poor ventilation.
- Bongo District currently has 3 Public Senior High Schools, 3 Community SHS and 2 Technical and Vocational School. The District also has 56 public Junior High Schools and 6 private Junior High Schools, 74 public Primary Schools and 13 private Primary Schools, and 75 public KGs and 13 private Kindergartens. Health infrastructure in the district comprise of 1 hospital, 5 health centres, 1 clinic, 36 functional CHPS Zones and 59 outreach points, 10 feeding centres and 1 rehabilitation center. The Adaboya Clinic and the Akanaba CHP were identified as being within the immediate impact area of the solar and sub-transmission site.

IMPACTS IDENTIFIED

25. As required under the Ghana EA Regulations, the EIA process is expected to identify the potential impacts, both positive and negative, of the proposed development that occurs during the pre-construction, construction, operational and decommissioning phases of the development.

26. To identify key issues, a stakeholder mapping was done to identify those critical to be consulted during the process. Based on the issues raised at the project briefings, status quo conditions of the study area and the nature of the proposed development, the key issues of concern raised by the stakeholders that must be considered during project implementation are summarized as below:
    - Land Acquisition & Compensation for Loss Property
    - Effective Community Entry by Project Contractors
    - Employment for Community Members
    - Implementation of a Corporate Social Responsibility Programme

- Availability of Grievance Redress Mechanism
- Relocation of Cultural Properties
- Environmental Degradation
- Changes in Land Use
- Risk to Public Safety, Community Health & Security Issues
- Gender & HIV & AIDS
- Acquisition of Permits
- Continued Engagement During Construction & Operational Phase
- Effective Project Monitoring & Evaluation Process

27. Based on the key issues of concern and an assessments of the project description and environmental baseline, the following categories/attributes: nature, duration, spatial extent reversibility, direct and indirect impacts, short term and long term, positive or negative, cumulative, have been utilized in identifying project impacts.

28. The major positive impacts of the project identified are listed as follows:
    - Minimisation of Greenhouse Gas Emissions
    - Increased employment opportunities,
    - Stabilization of electricity,
    - Promotion of economic growth in the country.

29. Identified negative impacts of the project are listed as follows:
    - Increase in GHG Emissions
    - Increase in Noise & Vibrations
    - Degradation of Air Quality
    - Impact on Water Resources
    - Changes in Topography & Drainage
    - Impacts on Geology & Soils
    - Impact on Waste Generation
    - Landscape & Visual Intrusion
    - Impact on Ecological Environment
    - Destruction / loss of Historical & Cultural Heritage Resources
    - Occupational Health & Safety
    - Socio-economic impact such as Loss of Properties, loss of land for personal and commercial use, labour and working conditions, Injury to public, Increase in traffic and road accidents
    - Gender & Vulnerability

30. Within the project area and its surrounding there are no existing and/or planned developments which would result in cumulative impacts on any of the environmental or social receptors investigated as part of the EIA. The assessment of cumulative impacts in that sense is not relevant. However, impact on water resource especially, ground water, is critical as water is

required for cleaning of the PV modules on a regular basis. Estimated volume of water demand for wet cleaning of solar panels ranges from 242 m^3/year for a duration of 20 years. There is the need to ensure that enough water is available and that there is no negative impact on the drinking water supply situation of the nearby communities which may create substantial social conflicts.

ENHANCEMENT & MITIGATION MEASURES

31. Information on the enhancement or mitigative measures to be put in place based on the identified impacts has been accessed through the consideration of the following:
    - Enhancement measures, which outlined measures to be implemented to enhance already positive benefits of the project.
    - Embedded or In-built Controls, which outlines mitigation measures which is built into the project during the design process as well legal requirements that must be adhered to in order for easy transfer into all contractual documents with the EPC Contractor, if required
    - Mitigation of significant effects or key mitigation (pertinent measures that will be written into and enforced through the EMP for implementation to ensure that the significance of the associated impact is acceptable).
    - Mitigation of non-significant effects or additional mitigation (management actions to be considered by proponent and authority).

32. The impact assessment methodology employed as well as the potential environmental, social, economic, health and public safety related impacts likely to be associated with all phases of the project as required has been discussed. The issues and impacts presented have been identified via the environmental status quo of the receiving environment, a review of environmental impacts from other similar projects and inputs from specialists that form part of the project team. Both associated positive and negative impacts have been identified and discussed. Scores from the detailed calculations based on the defined approach to enable the EA to reach the various conclusions is summarised below:

Project Phase	Impact Rating			
	Positive		Negative	
Pre-Construction		Not Applicable	7.00	Medium Negative
Construction	10.00	Medium Positive	4.36	Low Negative
Operational & Maintenance	9.00	Medium Positive	1.58	Very Negative
Average Rating	9.50	Medium Positive	4.31	Low Negative
Decommissioning		Not Applicable	4.00	Low Negative

33. Based on the assessment of the various impacts associated with the pre-constructional,

constructional and operational phases, the positive impact had an average rating score of 9.5 defined as **MEDIUM POSITIVE** whilst the negative impact had an average rating score of 4.31, defined as **LOW NEGATIVE.** This means the project impacts may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures as outlined under this Chapter and should not have an influence on decision-making.

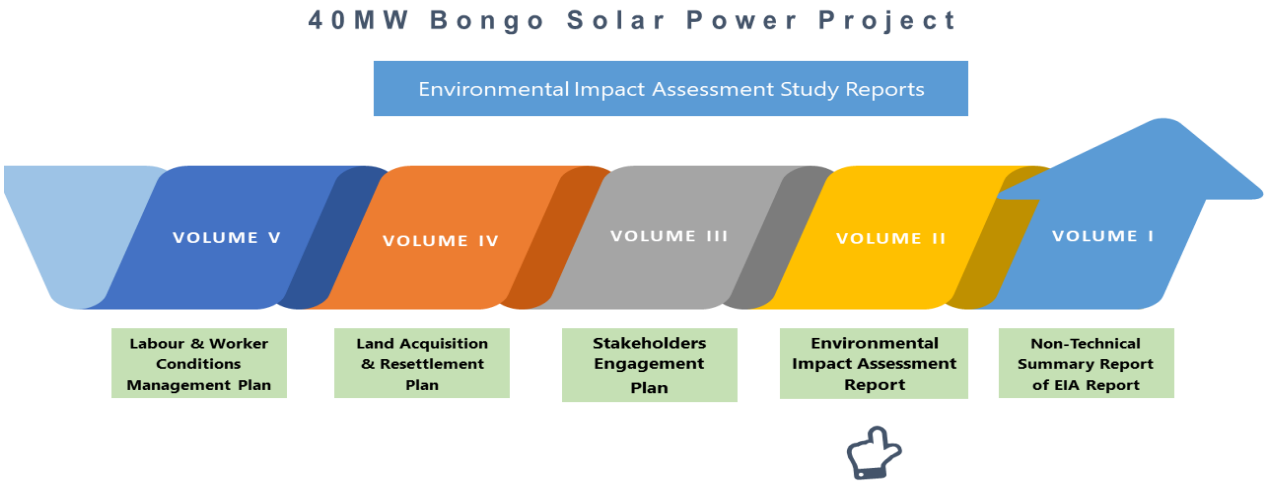
MONITORING

34. A provisional Environmental Management Plan (EMP) for the Project has been developed, the purpose of which is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the EMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment. The EMP therefore includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

35. For purposes of achieving a very high level of compliance with regard to implementation of all environmental commitments, the VRA/EPC Contractor shall make budgetary allocations towards all environmental programmes. Financial commitments shall be made from these allocations on program-by-program basis. Environmental monitoring at the operational stage shall largely form part of the O&M costs.

ANY OTHER CRITICAL MATTERS

36. Even though this EIA Report is a standalone document, it is part of the suite of documents that have been prepared as part of the environmental assessment process of the project to ensure adherence to international safeguards and represents Volume II of five (5) reports as shown below:



37. Other documents produced in support of the environmental assessment process are the Scoping Report (March 2018) which includes the terms of reference for the EIA. In addition, it must be noted that the VRA "***Safety, Health and Environment Standards for Contractors***", January 2013, applies and is to be adhered to under this project. It is therefore important that the implementation of this EIA Report is linked to the requirements of these documentations. As part of the public disclosure process, VRA will post these documentations on its website at www.vra.com for the information of all interested stakeholders.

38. VRA believes that the EIA Report has sufficiently dealt with the significant issues on the ground. It is hoped that the report will meet the expectations of the EPA and warrant the issuance of Permit to enable VRA to commence the project. VRA commits to collaborate with EPA to jointly manage the environmental and social concerns related to the solar power plant project and shall submit progress environmental reports to the EPA as required. The study therefore recommends that the EIA Report should be approved with the provision that the suggested mitigations measures will be adopted, and the EMP will be followed in the letter and spirit

TABLE OF CONTENTS

PLATES

FIGURES

TABLES

APPENDIX

40MW SOLAR POWER PROJECT AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 1: INTRODUCTION

1 INTRODUCTION

1.1. The Project

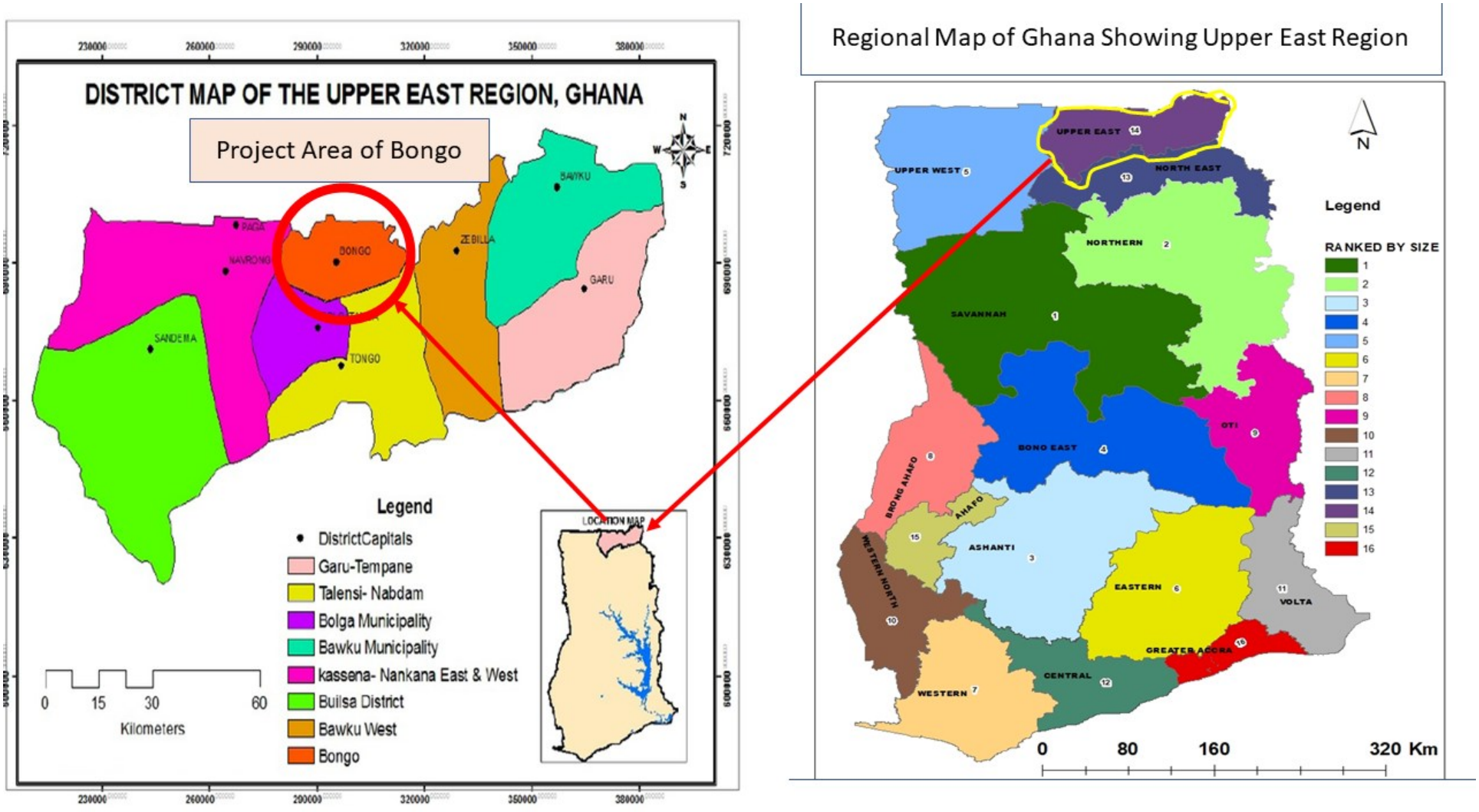
The Volta River Authority (VRA) proposes to construct and operate a solar power plant with a maximum capacity of 40 Megawatts peak (MWp) and associated electrical infrastructure on a 50.13 Hectare (Ha) of land at Asibiga, in the Bongo District in the Upper East Region of Ghana. The project would involve the installation of ground mounted single axis Photovoltaic Voltaic (PV) panels which will tie into the national electricity grid. Basically, electricity from the solar power plant would be evacuated at 34.5kV voltage level and a sub-transmission line, of approximately 29 km with a wayleave of 15m, would be constructed from the solar power plant and would terminate on the 34.5kV bus at the Bolgatanga Substation, in the Bolgatanga Municipality also in the Upper East Region. The project is titled the "***40MW Bongo Solar Power Project***" (hereinafter referred as the "Project") and depending on finances, could be developed in two (2) phases of 20MW each. The Bongo District is one of the eight districts of the Upper East Region and Figure 1-1 shows the location of Bongo District within the context of the Upper East Region of Ghana.

1.2. Project Applicant

The VRA was established on April 26, 1961 under the Volta River Development Act, 1961 (Act 46) of the Republic of Ghana with the mandate to generate, transmit and distribute electricity. Under the Volta River Development (Amendment) Law, 1987, PNDC 171, responsibility for distribution of power in the Northern part of Ghana was transferred from the then Electricity Corporation (ECG) of Ghana, later becoming Electricity Company of Ghana to the VRA and this was performed by its Northern Electricity Department (NED). NED has now been transformed into the Northern Electricity Distribution Company (NEDCo), a stand-alone, wholly owned, subsidiary of VRA with the responsibility of electricity distribution in Northern Ghana and became operational in May 2012.

The Volta River Development Act, 1961 (Act 46) was amended by the Volta River Development Amendment Act 2005 (Act 692) in the context of the Ghana Government Power Sector Reforms, and the power transmission function of the VRA was transferred to a separate transmission utility, known as the Ghana Grid Company (GRIDCo), which became operational in August 2008. The amendment was aimed at creating the requisite environment to attract Independent Power Producers (IPPs) into the Ghana energy market. Based on the various amendments to Act 46, VRA's current mandate has now been largely restricted to generation of electricity and distribution of electricity in the northern parts of the country. NEDCo is currently the sole distributor of electricity in the Upper West, Upper East, North East, Northern, Savannah, Bono, Bono East, Ahafo and parts of Ashanti and Oti Regions of Ghana.

Figure 1-1: Bongo District Within the Context of the Upper East Region of Ghana



VRA as of January 2020 had an installed electricity generation capacity of 2,519.5MW, with a dependable capacity of 2260.0MW and this is from two hydroelectric plants, one solar power plant and six thermal power plants. VRA reaches its customers in Ghana and neighbouring countries through GRIDCo. VRA's regulated customers are the Electricity Company of Ghana (ECG) for the southern part of Ghana and to its subsidiary company, NEDCo for the northern part and Enclave Power located within the Tema Export Processing Zone Bulk sales are also made to de-regulated customers (mining/industrial companies) as well as import/export of power with Communauté Electrique du Benin – CEB – Togo and Benin, Compagne Ivoirienne d'électricité - CIE – La Cote d'Ivoire and SONABEL (Burkina Faso). Details of the VRA can be accessed on its website www.vra.com.

1.3. Project Rationale

The Government of Ghana (GoG) passed the Renewable Energy Act (Act 832) in November 2011 to provide the necessary legal and regulatory framework for promoting the provision of energy from renewable sources. The objective of Act 832 is to promote the sustainable development and utilization of renewable energy resources for electricity and heat generation; consequently, increasing the proportion of renewable energy in the total national energy mix. The support for the law is also guided by the need to address climate change, as well as the rationale that Ghana has a range of renewable resources and that renewable applications are in fact the least-cost energy service in many cases, and more so when social and environmental costs are considered.

To address the attendant effects of short-term planning of the overall development of the renewable energy sector, the Renewable Energy Master Plan (February 2019) has been developed with the goal to provide investment-focussed framework for the promotion and development of the country's rich renewable energy resources for sustainable economic growth, contribute to improved social life and reduce adverse climate change effects. The REMP is to be implemented in three (3) cycles with the first cycle (or transition phase) running from 2019 to 2020. Subsequent cycles will run from 2021 to 2025 and 2026 to 2030 respectively. The successful implementation of the plan would lead to an installed electricity capacity of 1363.63 MW (with grid connected systems totalling 1094.63 MW), the creation of 220,000 jobs, and carbon savings of about 11 Million Tonnes of CO_2 by 2030.

Public utility companies such as VRA, Bui Power Authority and the Renewable Energy Authority (yet to be established) are to be encouraged to grow and expand the renewable energy electricity space through public sector led investments and or through public private partnerships. In view of this, the Energy Commission has exempted VRA from the current moratorium placed on the issuance of Provisional Licences, Siting and Permits for utility-scale power projects with public utilities as potential off-takers (http://www.energycom.gov.gh/public-notices).

In line with national actions in the renewable energy sector, VRA in February 2010 adopted a Renewable Energy Policy in order to develop and operate RE plants in an efficient, cost effective and environmentally sustainable manner. To achieve the purpose set out in the VRA RE Generation Policy, the Renewable Energy Development Programme (REDP) was formulated. The

VRA REDP sets a 5-10 years' Renewable generation capacity target, taking cognisance of the local and export demand and the system constraints and is being rolled out in two (2) phases.

The implementation of the 40MW Bongo Solar Power Project falls into the REDP Phase 2. Indeed, the development of such utility scale solar project is within the context of the requirements of the Renewable Energy Act and in line with the Renewable Energy Master Plan (2019). The potential off-takers of electricity from this project include NEDCo, Newmont Ghana and other mining companies that have indicated the need for additional energy for the expansion of their operations.

1.4. Objectives of Project

This "***40MW Bongo Solar Power Project***" is being developed with the following specific objectives:

- To utilize solar as an additional source of generation to supply the increasing domestic and export demand.
- To align VRA's generation capacity development with Ghana's Renewable Energy Master Plan (2019) that seeks 10% of all electricity generation to come from renewable sources.

1.5. Project Benefits

The most significant accruable benefit in the development of the "***40MW Bongo Solar Power Project***" is the expected improvement in power supply reliability in Northern Ghana, as it will minimize the cost of transmission and transmission loses as well. This will attract businesses and services that otherwise would have been difficult to bring to these communities. Other benefits are summarized in Chapter 10.

1.6. Purpose of Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process designed to ensure that new developments, and extensions to existing developments, are located and designed in such a way as to minimise environmental impact. and that all concerns are addressed as a project gains momentum through to implementation. Basically, EIA is an information gathering exercise from which a clearer picture emerges of the potential environmental effects of a project. The purpose of an EIA is not to reach a decision but to present the consequences of different choices of actions and to make recommendations to a decision maker.

The objectives of an EIA are therefore to:

- Identify environmental constraints and opportunities within the study area, taking account of the characteristics of the development and the local environment.
- Identify potential impacts and interpret the nature of these impacts.
- Describe the mitigation measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment, including the appropriateness of avoidance and prevention measures; and
- Determine the significance of any residual environmental effects following mitigation measures.

To achieve the above objectives, a baseline survey should be undertaken to establish the existing ecological and socio-economic environment in the project area to determine the anticipated impacts of the project on the environment or vice versa. This is complimented with stakeholder engagements and desk top studies. Identified impacts are then analysed to enable the potential mitigation measures to be put in place. Mitigation measures are proposed through the consideration of alternatives, physical design, project management or operation to avoid, reduce or remedy any significant adverse effects on people and the environment resulting from the proposed development. The process culminates in the preparation of an EIA Report for review and environmental authorisation by the Environmental Protection Agency (EPA), the nationally designated environmental authorisation agency. Associated charges for the EIA process is guided by the Environmental Assessment Fees and Charges (Amendment) Instrument, 2015 LI 2228.

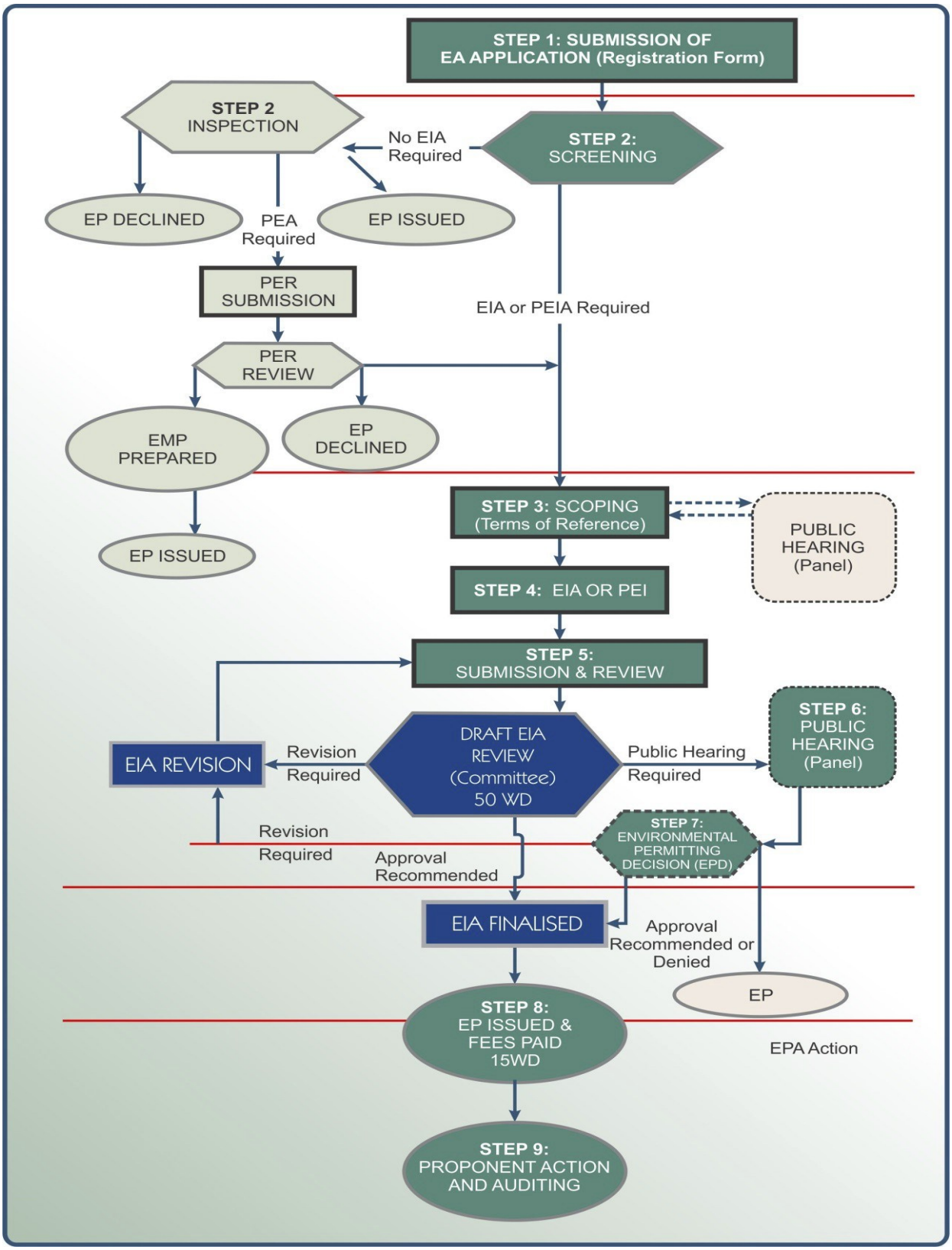
1.7. Our Approach & Methodology for the EIA Study

In Ghana, environmental assessments are regulated by the Environmental Assessment Regulations, 1999 (LI 1652), and the Regulations provide two schedules; Schedule 1 and Schedule 2, which enumerate the projects for which EIA is compulsory and the projects for which a Provisional Environmental Assessment (PEA) is required. Under the provisions of LI 1652, power generation and transmission projects are categorized under environmentally critical projects for which an EIA is required for environmental authorisation. The EIA Guidelines for the Energy Sector, Volume 1, dated September 2011, also indicates that ground mounted PV power plant/system, either stand-alone, hybrid or grid-tied with total surface area of array exceeding twenty (20) hectares requires the preparation of an EIA Report. It is therefore a legal requirement in Ghana that development projects such as the 40MW solar power facility at Bongo with a land size of 50.13 Ha is subject to an EIA process, and environmental authorisation through the issuance of an Environmental Permit by the Environmental Protection Agency (EPA). This EIA Report for the project has therefore been prepared in adherence to the requirement of the LI 1652.

The environmental assessment has been undertaken by a team of in-house experts from VRA, made up of Environmental Safeguard Specialist, Ecologists, Resettlement Specialist, Land Economist, Land Valuation Experts, Engineers and Geodetic Surveyors[1]. The EIA Study Team is led by Ben. A. Sackey, an Environmental Safeguard Specialist with over twenty-two (22) years of experience. This VRA team were responsible for the successful preparation of the EIA Report for the 35MW Solar Power Project in the Upper West Region of Ghana and a similar strategy has been adopted for this Report. The general methods used in the EIA Study follows the requirement of the Ghana EIA Procedures as shown in Figure 1-2, and are discussed below:

[1] ***List of members of the study team and their roles are provided in Appendix 1.***

Figure 1-2: Flowchart for Ghana EIA Procedures



1.7.1 Project Registration

VRA registered the project with the EPA in October 2017 as one that falls into a category of undertakings for which an EIA is mandated and this was done through the completion of an "**EPA Form EA2**", and endorsed by the Chief Executive.

1.7.2 Screening

Screening is conducted by the Ghana EPA through either a desktop study or site visit to gain a high-level understanding of the characteristics of a project and its environment in order to determine applicable level of the impact assessment requirements. Based on the screening of the Completed Form EA2, the EPA in response to the registration in October 2017, confirmed that the project falls into a category of undertakings for which an EIA is mandated. The EPA subsequently directed VRA to prepare a Scoping Report which should focus on key and relevant issues for decision making. The main objective of the scoping is to ascertain the environmental issues associated with the project on which the EIA study will be focused by reviewing the project information and ascertaining likely environmental issues associated with the project activities. This process helps in ensuring that all the relevant issues are identified and addressed in an appropriate manner in the EIA study.

1.7.3 Scoping Exercise

A Scoping Report dated March 2018 was submitted to the EPA for review. A copy of the report was also submitted to the Energy Commission, the Bongo District Assembly, the Bolgatanga Municipal Assembly and the Bongo Naaba and was disclosed on the VRA website, www.vra.com as well as in the national dailies. So far, review comments have been received from the Energy Commission and the EPA in May and August 2018 respectively and these have been considered in the preparation of this EIA Report. It must be noted that till date, VRA has not received any comments from the public.

See Appendix 2 for general correspondences on the EIA Study.

1.7.4 Structure of EIA Report

The results of the EIA study has formed the basis of the preparation of this EIA Report, which has captured all relevant information in the required format. The EIA Report has been structured under ten (10) Chapters with a Non-Technical Summary as shown in Table 1-1. The EIS format as presented is in line with the structure and content as released by the Ghana EPA in 2016 and revised further in November 2018. The 2018 revision was to ensure the incorporation of climate change issues into the EIA process.

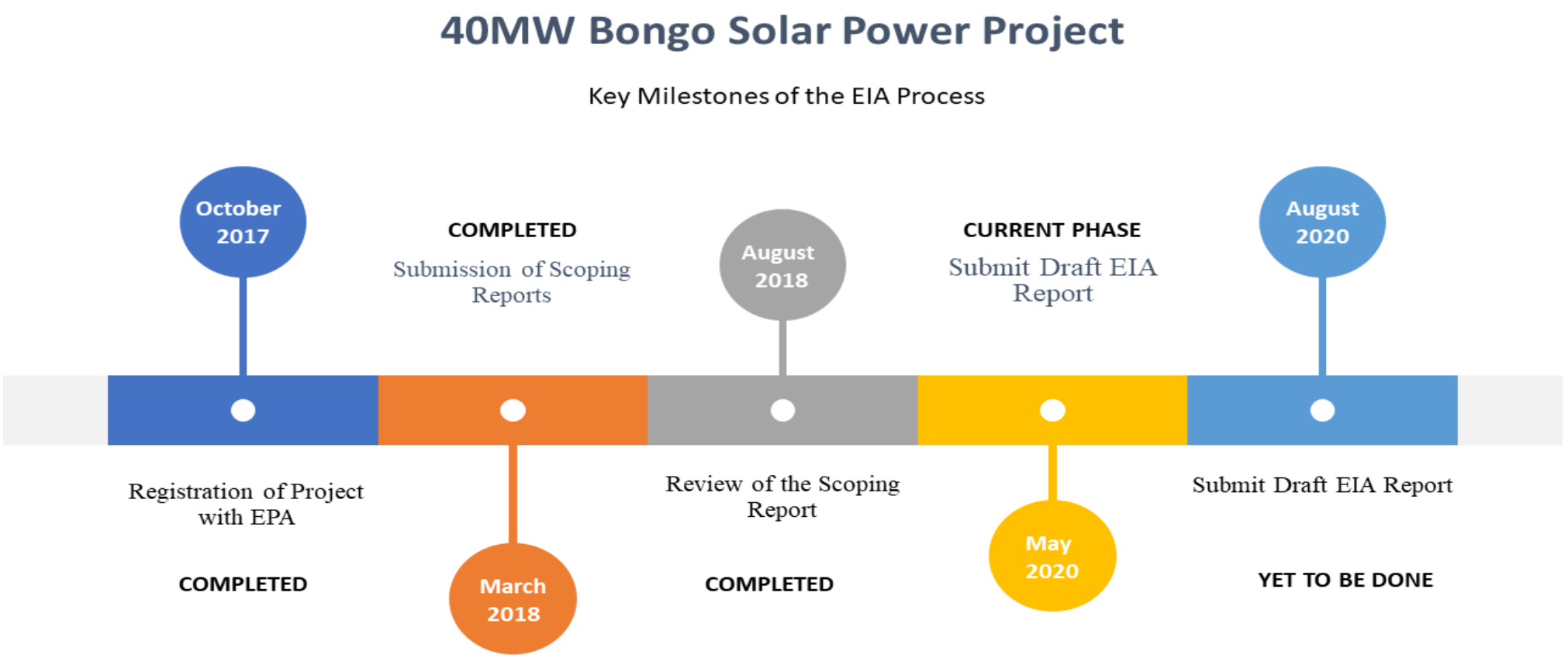
Table 1-1: Structure & Content of the EIA Report

Title	Content to be Provided
Non-Technical Summary	A Summary of the EIA exercise and conclusions
Chapter 1: Introduction	Introduction to the Project and EIA scope and methodology adopted
Chapter 2: Policy, Legislative and Administrative Requirements	Discusses the applicable environmental and social regulatory framework and its relevance for the Project
Chapter 3: Project Description & Alternatives	Technical description of the Project & related infrastructure and activities.
Chapter 4: Description of Existing Environment	Outlines Environmental, Ecology and Social Baseline status in the study area of the project
Chapter 5: Stakeholder Engagements	Provides an overview of the stakeholder engagement activities undertaken during the EIA
Chapter 6: Impact Identification & Significance	Discusses the project screening with respect to environmental and social risks and presents details of identified environmental impacts and associated risks due to project activities, assessment of significance of impacts
Chapter 7: Enhancement & Mitigation Measures	This section presents mitigation measures for minimizing and / or offsetting adverse impacts identified
Chapter 8: Provisional Environmental Management Plan	Outline of the EMP taking into account identified impacts and planned mitigation measures and monitoring requirements.
Chapter 9: Conceptual Decommissioning & Site Closure	Process for decommissioning of project facilities hen required
Chapter 10: Conclusion & Recommendations	Summary of impacts identified for the project and conclusion of the study.

1.8. Schedule For EIA

It is expected that the EIA Study will be completed latest by August 2020 for the issuance of an environmental authorisation. It is expected that the EIA Study will be completed latest by August 2020 for the issuance of an environmental authorisation. The key milestones for the process are summarised in Figure *1-3*. This schedule could be revised during the EIA Process, depending on factors such as the time required for decisions from authorities.

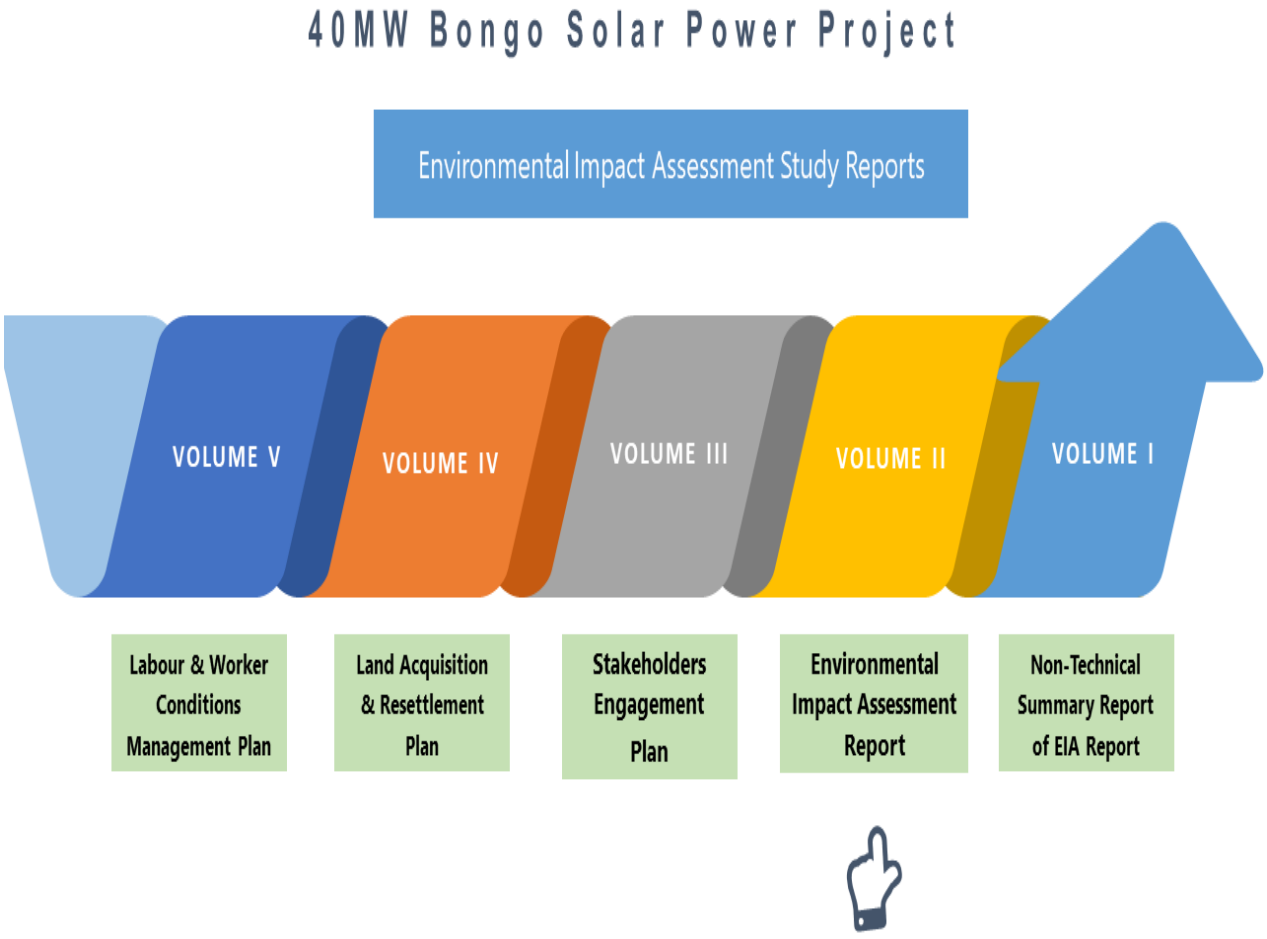
Figure 1-3: Key Milestones of the EIA Process



1.9. Organisation of Environmental Assessment Reports

Even though this EIA Report is a standalone document, it is part of the suite of documents that have been prepared as part of the environmental assessment process of the project to ensure adherence to international safeguards and represents Volume II of five (5) reports as shown in Figure 1-4. As part of the public disclosure process, VRA will post these documentations on its website at www.vra.com for the information of all interested stakeholders. Other documents produced in support of the environmental assessment process are the Scoping Report (March 2018) which includes the terms of reference for the EIA. In addition, it must be noted that the VRA "***Safety, Health and Environment Standards for Contractors***", January 2013, applies and is to be adhered to under this project. It is therefore important that the implementation of the outcome of the Environmental Assessment is linked to the requirements of all these documentations.

Figure 1-4: Suite of Documents for EIA Study for 40MW Bongo Solar Power Project



40MW SOLAR POWER PROJECT AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 2: POLICY, LEGISLATIVE & ADMINISTRATIVE REQUIREMENTS

2 DESCRIPTION OF EXISTING POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Overview

It is a requirement to provide an overview of all national legislation and international conventions/guidelines that may inform the EIA Process in Ghana to ensure that the proposed power project meets the highest possible standards of EIA and the subsequent management policies. Subsequently, the institutional and administrative framework of the power sector in Ghana as well as the relevant national policies and legislative requirements that must be considered for the successful implementation of this project have been gathered and how they apply discussed as part of this environmental assessment report. In addition to national laws, the proposed project has also committed to align as far as possible with the requirements of international environmental and social safeguards.

2.2 Institutional & Administrative Framework of the Power Sector in Ghana

The power sector in Ghana is under the sectoral/ministerial supervision of the Ministry of Energy (MoEn). A key goal of the MoEn is to support the development of a reliable, high-quality energy service at the minimum cost to all sectors of the economy through the formulation, implementation, monitoring, and evaluation of energy sector policies. The policies and programmes cover downstream and upstream petroleum subsectors and the power subsector (including renewable energy for power generation). MoEn is also responsible for the implementation of the National Electrification Scheme (NES), which seeks to ensure the provision of universal access to electricity for all communities in Ghana by 2020.

The electricity subsector in Ghana currently has an unbundled structure with separate entities having functional mandates over power generation, transmission, and distribution. The objective of this unbundled structure is to provide open and non-discriminatory access to transmission services to encourage private sector participation and market competition in the generation and distribution business functions. Power generation companies (GENCos) include the state-owned utilities, the VRA, the proponent of this project, and Bui Power Authority and a number of private Independent Power Producers (IPPs). These IPPs have been licensed by the Energy Commission (EC) to build, own, and operate power plants, and sell their power to bulk customers or to distribution companies.

Fuel for power generation is on the whole procured by the GENCos themselves. Supplies of natural gas come from N-Gas of Nigeria, through the West African Gas Pipeline, and from the Ghana National Petroleum Corporation and the Ghana National Gas Company (GNGC). GNGC is currently the owner and operator of the gas processing plant in Atuabo and is the licensed natural gas transmission utility. GNPC is the national gas aggregator, and holds equity positions in the investments for natural gas development for the Government of Ghana. Fuel oil, light crude oil, and diesel come from a variety of suppliers contracted by the power plants.

Power distribution companies (DISCos) include the two state-owned utilities and Enclave Power Company, which is a private company that distributes power in the free zones enclave in Tema. The state-owned ECG distribute electricity in the southern parts of the country (which accounts for

about 71% of the total electricity consumed annually), and the Northern Electricity Distribution Company (NEDCo), a subsidiary of VRA, distributes electricity in the northern parts of Ghana (9%) and Enclave Power Company (1%). Other bulk customers (some industrial customers, mining companies, hotels, etc.) consume 19% of the total energy transmitted. The transmission function is performed by the Ghana Grid Company (GRIDCo), a state owned entity.

The operations and activities of all entities within the power sector are governed by contracts and electricity regulations. The provision of electricity services by the distribution utilities to both public and private consumers are subject to an independent regulator. There are two main electricity regulators in the sector:

a. The Public Utility Regulatory Commission (PURC), an independent body, was set up as a multi-sectoral regulator under the Public Utilities Regulatory Act, 1997 (Act 538) to regulate the provision of utility services in the electricity and water sectors, and by virtue of the Energy Commission Act, 1997 (Act 541), PURC also has regulatory responsibility over charges for natural gas supply (aggregated gas prices are processed by the aggregator, GNPC), transportation, and distribution (gas transportation pipeline tariff) of natural gas services.

b. The EC, which was set up in 1997 under the Energy Commission Act, 1997 (Act 541) to regulate and manage the development and utilisation of energy resources in Ghana as well as to provide the legal, regulatory, and supervisory framework for all providers of energy in the country. The EC under Section 2.2(c) of Act 541 is mandated to "prepare, review and update periodically indicative national plans to ensure that all reasonable demands for energy are met". The Act also mandates the EC to grant licences for the construction and operation of all transmission, wholesale electricity supply and distribution assets within the sector, and to enforce performance standards (technical and operational rules of practice) of the utilities. The EC also grants licences for natural gas and related matters.

2.3 Key Legislations In the Ghana Electricity Sector

The various legislations that guide the operation of the Ghana power sector are outlined in Table 2-1. The objectives of each legislation are also stated.

Table 2-1: Relevant Legislations in the Ghana Electricity Sector

Regulation / Legislative Instrument	Summary of Objectives
Electricity Transmission (Technical, Operational, and Standards of Performance) Rules, 2008 (LI 1934)	These rules define NITS and establish the requirements, procedures, practices, and standards that govern the development, operation, maintenance, and use of the high-voltage National Interconnected Transmission System (NITS). These rules shall apply to the Electricity Transmission Utility and persons connected to the transmission system including: (a) Wholesale electricity suppliers licensed by the Commission, (b) Electricity distribution utilities licensed by the Commission, and (c) Bulk customers of electricity duly authorised by the Commission.

Regulation / Legislative Instrument	Summary of Objectives
Electricity Supply and Distribution (Standards of Performance) (LI 1935)	The regulations apply to electricity supply and distribution utilities licensed by the Commission. These regulations define the "electricity supply and distribution utility" as a person licensed under the Act to distribute and sell electricity without discrimination to consumers in an area or zone designated by the Commission. The regulations also provide performance benchmarks for electricity supply and distribution in conformity with the provisions of Electricity Supply and Distribution (Technical and Operational) Rules, 2005 (LI 1816).
Electricity Regulations (LI 1937)	These regulations provide guidance to the planning, expansion, safety criteria, reliability and cost-effectiveness of the NITS, regulate the Wholesale electricity market, the technical operations of the Electricity Transmission Unit; define the minimum standards and procedures for the construction and maintenance of facilities and installations; the protection of electrical installations and services; life, property and the general safety of the public in respect of electricity services; define the minimum reserve margins to satisfy demand and the development and implementation of programmes for the conservation of electricity.
Electricity Supply and Distribution (Technical and Operational) Rules, 2005 (LI 1816)	These rules provide technical and operational guidance for services in the standard voltage range of 230 V – 34.5 kV. The guidance is provided under five main technical and operational areas of: ✓ Supply and Metering of Electricity (Rules 1 – 7) ✓ Quality of Supply of Electricity (Rules 8 – 14) ✓ Electricity Interruption (Rules 15 – 19) ✓ Electricity Billing (Rules 20 – 22) ✓ Bill Payment (Rules 23 – 44)
National Electricity Grid Code of Ghana, 2009	The purpose and scope of the National Electricity Grid Code is to ensure the coordinated operation of the high-voltage NITS within Ghana, for the provision of fair, transparent, non-discriminatory, safe, reliable, secure, and cost-efficient delivery of electrical energy. It establishes the requirements, procedures, practices, and standards that govern the development, operation, maintenance, and use of the high-voltage transmission system in Ghana. The Grid Code describes the responsibilities and obligations associated with all the functions involved in the supply, transmission, and delivery of bulk electric power and energy over the NITS, including the functions of the ETU, a NITS asset owner, a wholesale supplier, a distribution company, and a bulk customer.
Renewable Energy Act, 2011 (Act 832)	The purpose for this regulation is to provide for the development, management and utilisation of renewable energy sources for the production of heat and power in an efficient and environmentally sustainable manner and to attract investment in renewable energy sources.
Public Utilities Regulatory Commission 1997 (Act 538)	This Act provides for the establishment of a PURC to regulate and oversee the provision of utility services by public utilities to consumers and to provide for related matters.
Energy Commission Act, 1997 (Act 541)	This Act establishes an Energy Commission and defines its functions relating to the regulation, management, development and utilisation of energy resources in Ghana. The primary objective of the Energy Commission is to regulate and manage the utilisation of energy resources in Ghana and coordinate policies in relation to them.
Volta River Development Act, 1961 (Act 46)	The Act established the VRA and as amended by the Volta River Development Amendment Act 2005 (Act 692), largely restricts VRA to

Regulation / Legislative Instrument	Summary of Objectives
	generation of electricity and distribution of electricity in the northern parts of the country, by its subsidiary NEDCo
Volta River Development Amendment Act 2005 (Act 692)	Allowed for the setting up of the GRIDCo, a separate transmission utility responsible for the National Intersection Transmission System

2.4 Relevant Legal Framework to the Proposed Project

Key legal framework applicable to the envisaged project have been categorised as listed below:

- Assessment and Management of Environmental and Social Risks and Impacts
- Community Health, Safety and Security
- Labour & Working Conditions
- Land Acquisition & Involuntary Resettlement
- Cultural Heritage
- Resource Use Efficiency & Pollution Protection
- Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Financial Intermediaries
- Climate Change
- Gender & Vulnerability.

The categorisation has been done in order to align with that of environmental and social safeguards standards of international financial institutions, and includes cross cutting issues such as climate change and gender. This is because VRA is expected to access international funding and as a public institution this is to be done through an on-lending agreement with the Ministry of Finance and its representative agency, Bank of Ghana. In view of this, project compliance to the underlisted safeguards is key to its successful financial closure and have been assessed:

- World Bank (WB) Environmental and Social Standards (ESS), August 2016.
- International Finance Company (IFC) Performance Standards (PS) on Environmental & Social Sustainability, January 2012.
- European Bank for Reconstruction and Development (EBRD) Performance Requirements (PR), May 2014.

The World Bank Group has also produced guidelines for Environmental, Health & Safety (EHS) as technical reference documents on cross-cutting environmental, health, and safety issues applicable to all industry sectors. Key guidelines of relevant to this project is the EHS Guidelines for Electric Power Transmission & Distribution (2007). When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. A comparison of the relevant Ghana Standards Authority (GSA) Standards and that of the EHS Guidelines for ambient air (PM_{10}) and Community Noise Levels (residential/institutions) are provided at the appropriate sections under Chapter 4 of this report. The applicable levels are the

same and therefore either can be adopted. The GSA standards have replaced the published EPA guidelines for industrial or facility effluents, air quality and noise levels, and therefore these guidelines are no longer applicable.

A relationship between the national legal framework and international safeguards and how the project complies are detailed in Table 2.2. All relevant national legal and international safeguards that may apply to the development of the project will be applied as required.

Table 2-2: Compliance to Legal Framework Relevant to Project

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
Assessment and Management of Environmental and Social Risks and Impacts	▪ Environmental Protection Agency Act, 1994 (Act 490) ▪ Environmental Assessment Regulations 1999, LI 1652 and related guidelines in the Energy and General Construction Sectors ▪ The Environmental Assessment Fees and Charges (Amendment) Instrument, 2015 LI 2228	▪ IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts ▪ EBRD PR 1: Environmental and Social Appraisal and Management ▪ **WB ESS1:** Assessment and Management of Environmental and Social Risks and Impacts	These sets out the responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with a project.	**Complies:** An environmental assessment has been undertaken for the project and this EIA Report is available for funding agencies to assess any associated environmental risk. An Environmental Management Plan has also been developed as part of this EIA Report. It must be noted that stakeholder engagements have been held under the EIA Study and the outcome discussed under Chapter 5, whilst as a stand-alone "**Stakeholder Engagement Plan**" has been prepared as part of the study reports, as required
Labour & Working Conditions,	▪ Labour Act No (2003) Act 651 ▪ Labour Regulations, 2007 (LI 1833) ▪ Children's Act No. 560 of 1998 ▪ Workmen's Compensation Act, 1987 (PNDC Law 187) ▪ Commission on Human Rights and Administrative Justice Act (Act No. 456 of 1993) ▪ Public Procurement Act, 2003 (Act 663) ▪ Criminal Code, 1960 (Act 29) ▪ National Employment Policy, 2014	▪ IFC PS2: Labour and Working Conditions ▪ EBRD PR 2: Labour & Working Conditions ▪ WB ESS2: Labour and Working Conditions	Recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. The need to promote sound worker-management relationships and enhance the development benefits by treating workers fairly and providing safe and healthy working conditions. Clients are required to develop and	***Complies:*** The implementation of the project will result in the creation of employment, both on the local and national level and this is discussed under Section 3.13. Subsequently, impacts and mitigation measures on labour have been provided under Section 6.9.3 and Section 7.7.3 respectively. As part of the EIA Study, a **Labour & Working Conditions Management Plan** has been developed to guide VRA in the project execution. The plan sets out the way in which project workers will

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
			implement written labor management procedures applicable to the project.	be managed, in accordance with the requirements of national law and ILO conventions, which Ghana is a member of. No underaged persons shall be engaged to undertake physical construction on the project. This shall serve as supporting document to that to be prepared by EPC Contractor to outline labor management procedures applicable to the project. VRA and its contractors do not and will not engage children for any of its activities under the project, and this is to be included in the Project Contract documentation.
Resource Use Efficiency & Pollution Protection	▪ Hazardous & Electronic Waste Control Management Act, 2016 (Act 917) ▪ Land Planning and Soil Conservation Act, 1957 ▪ Water Resources Commission Act, 1996, Act 552 ▪ The National Land Policy, 1999 ▪ Pesticides Control and Management Act (1996) Act 528 ▪ Ghana Standards Authority (GSA) Standards Decree, 1973 (NRCD 173) and applicable standards for ambient air quality, ambient noise control and effluent discharges	▪ IFC PS3: Resource Efficiency and Pollution Prevention ▪ EBRD PR3: Pollution Prevent & Abatement ▪ WB ESS3: Resource Efficiency and Pollution Prevention and Management	Recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. These sets out the requirements to address resource efficiency and pollution prevention and management.	***Complies:*** Resources required for the project have been outlined under Section 3.14. Management of such resources such as energy, water and raw materials have been addressed as part of this EIA Report, whilst pollution and prevention measures have been outlined.

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
Community Health, Safety and Security	▪ Factories, Offices and Shops Act (1970) Act 328 (As amended by the Factories, Offices and Shops (Amendment) Law, 1991 (PNDCL 275) ▪ Ghana National Fire Service Act of 1997 (Act 537) and related Fire Precaution (Premises) Regulations, 2003, LI 1724 ▪ National Road Safety Commission Act, 1999 (Act 567) ▪ Driver & Vehicle Licensing Authority Act, 1999 (Act 569) ▪ Ghana National Building Regulations, 1996, LI 1630 ▪ Health Care Waste Management Policy & Guidelines, 2006 ▪ Environmental Sanitation Policy, Revised 2010 ▪ Road Traffic Acts, 2004, Act 683 ▪ National Road Safety Policy, 2007	▪ IFC PS4: Community Health, Safety, and Security ▪ EBRD PR 4: Health, Safety, and Security ▪ WB ESS4: Community Health and Safety	Addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Clients to avoid or minimize such risks and impacts, with particular attention to people who, because of their particular circumstances, may be vulnerable.	Complies: Some occupational/community safety and health hazards are expected during the various phases of the project and these have been identified and mitigative measures outlined under Sections 6.8 and 6.9.4 . The VRA "**Safety, Health and Environment Standards for Contractors**" is to be adhered to be the Contractor. In addition, the contractor is mandated by the requirements of the tender document to develop a **Health & Safety Plan** for project construction purposes. An operational H&S Plan in line with corporate rules will be developed for the operational phase.
Land Acquisition & Involuntary Resettlement	▪ Immovable Property Rate Regulations (1975) LI 1049 ▪ Lands Statutory Wayleaves Act, (1963) Act 186 ▪ Lands (Statutory Way leaves) Regulations, 1964 (LI334) ▪ Survey Act 1962, Act 127 ▪ State Lands Regulations (1962) LI 230 / State Lands (Amendment) Act (2005) Act 586 ▪ Stools Lands Act, 1994 (Act 481) ▪ Arbitration Act 1961 (Act 38)	▪ IFC PS5: Land Acquisition and Involuntary Resettlement EBRD PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement ▪ WB ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Involuntary resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.	Complies: The project involved the acquisition of land for the PV site and Row for the transmission line component of the project. Both voluntary and involuntary sale of lands were applied under the project. Land take requirement is provided in Section 3.14.2 and the acquisition processes discussed under Section 3.10.4. Currently, landowners have been compensated at fair market or replacement value. There are no affected persons at the PV power plant

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
	▪ Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542) ▪ Volta River Authority (Transmission Line Protection) (Amendment) Regulation, 2004 (LI 1737), ▪ Resettlement Policy Framework (RPF), 2011 of the Ministry of Finance			site as the land is currently vacant. A "**Land Acquisition & Resettlement Plan**" has been prepared for the project as part of the EIA Study.
Biodiversity Conservation and Sustainable Management of Living Natural Resources	▪ Wildlife Reserves Regulations 1971 (LI 710) ▪ Wild Animals Preservation Act, 1962 (Act 43) ▪ Economic Plants Protection Act, 1979 ▪ Forest and Wildlife Policy, 2012 ▪ Economic Plants Protection Act, 1979 (AFRCD 47) ▪ Wildlife Conservations Regulations, LI 685, 1971 (and Amendments) ▪ National Wildlife Management Policy, 2006 ▪ Forest and Wildlife Policy, 2012	▪ IFC PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources ▪ EBRD PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources ▪ WB ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Recognizes that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development and it recognizes the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support.	Complies: A detailed ecological survey has been undertaken within the project area and their ecological significance determined to inform mitigative actions and this is provided under Section 4.7. This was done in collaboration with the Forestry Commission and mitigation measures proposed for ecological impacts. Impacts and mitigative measures on biological environment are discussed under Section 6.6 and Section 7.4 of this EIA Report. *Acacia dangarensis*, *Sclerocarya birrea* have been listed as endangered whilst *Vittellaria paraboxa* is listed as Vulnerable. Generally, it was discussed that VRA could provide materials and seedlings for replanting of to replace the trees to be felled.

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
Indigenous Peoples		▪ IFC PS7: Indigenous Peoples EBRD PR7: Indigenous Peoples ▪ WB ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Ensures that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples	Not Applicable
Cultural Heritage	▪ National Museums Act, Act 387 of 1969 (formerly National Museums Decree (1969) NLCD 387)	▪ IFC PS8: Cultural Heritage ▪ EBRD PR8: Cultural Heritage ▪ WB ESS8: Cultural Heritage	Recognizes that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. It sets out measures designed to protect cultural heritage throughout the project life cycle.	***Complies:*** Cultural resources within the project area have been identified and discussed under Section 4.8.6. Measures have been proposed under Section 6.7 to ensure that no damage occurs to these as a result of project implementation.
Financial Intermediaries	▪ Ghana Sustainable Banking Principles and the Sector Guidance Notes of the Bank of Ghana (November 2019)	▪ IFC Interpretation Note on Financial Intermediaries (Updated Nov. 2018) EBRD PR9: Financial Intermediaries WB ESS9: Financial Intermediaries	FIs recognizes that strong domestic capital and financial markets and access to finance are important for economic development, growth, and poverty reduction. FIs are required to monitor and manage the environmental and social risks and impacts of their portfolio and FI subprojects, and monitor portfolio risk, as	**Complies** Risks associated with Guidelines of the "Power & Energy" Sector covering Impacts on natural environment, Employee Health, Safety & & Security, Community Health & Safety and Labour Working Conditions have been captured in relevant sections of this Report. As required, the project has been registered with the EPA and an EIA Study is ongoing.

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
			appropriate to the nature of intermediated financing.	
Stakeholder Engagement	▪ Environmental Assessment Regulations 1999, LI 1652 and related guidelines in the Energy and General Construction Sectors	**IFC PS1:** Assessment and Management of Environmental and Social Risks and Impacts **EBRD PR 10:** Information Disclosure and Stakeholder Engagement **WB ESS10:** Stakeholder Engagement and Information Disclosure	Recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.	**Complies:** Stakeholder engagements have been held under the EIA Study and the outcome discussed under Chapter 5, whilst as a stand-alone "**Stakeholder Engagement Plan**" has been prepared as part of the study reports, as required
Climate Change	▪ National Climate Change Policy, 2013	Cross Cutting theme	Requires the inclusion of climate change related impacts during EIA preparation. The need for the quantification and reporting of GHG during project development is good practice and is emphasised.	**Complies:** Constructional activities will contribute to mobile combustion and vegetation removal, thus contributing to GHG emissions. Issues on GHG emissions and climate change have been included in the EIA Study. GHG inventory in Ghana is discussed in Section 4.4, impacts and mitigative measures are also provided in the EIA Report under Chapters 6 and 7.
Gender & Vulnerability	▪ Persons with Disability Act, 2006 Act 715	Cross Cutting theme	The Ghana EIA study requires the assessment of the	**Complies:**

Categorisation	National Requirement	International Safeguard Standard	General Requirement	Relevance & Applicability to Project
	▪ Domestic Violence Act (Act 732) of 2007 ▪ Ghana Gender Policy, 2015 ▪ Persons with Disability Act, 2006 Act 715 ▪ National HIV/AIDS STI Policy, 2004	IFC PS 2 - Paragraph 15 on Non-Discrimination and Equal Opportunity	vulnerable as part of the process and this is discussed under Section 4.8.10. Gender Based Violence, Sexual Exploitation and Workplace Sexual Harassment are the key gender and vulnerability impact related to the project constructional activities.	Key impacts of capital and large infrastructural projects on women, children and the vulnerable have been discussed under Section 6.10 and mitigative measures provided Section 7.8.

2.5 International Conventions

2.5.1 United Nations Framework Convention on Climate Change

Ghana became a party to the United Nations Framework Convention on Climate Change (UNFCCC), hereinafter referred to as the Convention) after ratification in September 1995. Upon ratification, Ghana had committed itself to pursue coordinated actions to reduce Greenhouse Gas (GHG) emissions and climate change impacts on the most vulnerable people, while continuing to advance national economic development. As a party to the Convention, Ghana has an obligation under Article 4, paragraph 1, and Article 12, paragraph 1 of the Convention to regularly prepare, publish and report its national communication to the Conference of Parties to the UNFCCC. Ghana intends to increase the contribution of RE source (including hydro, solar, biomass and wind) by 10% for grid, mini grid and off-grid applications; by 2030, thus the development of the solar power projects is one of the proposed carbon offsets projects in Ghana.

2.5.2 Kyoto Protocol

The 1997 Kyoto Protocol shares the Convention's objective, principles and institutions, but significantly strengthens the Convention by committing developed countries to individual, legally-binding targets to limit or reduce their overall greenhouse gas emissions (of carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, perfluorocarbons and sulphur hexafluoride). Developing countries are not required to reduce emissions of greenhouse gases to specific targets as yet on the basis that it is industrialised countries that produce most of the emissions and more urgently need to take corrective action. Developing countries were asked to contribute as far as possible, but were not bound to take action, under the principle of 'shared but differentiated responsibility'. The Kyoto Protocol sets out how developing countries must monitor and report on their greenhouse gas emissions. There are also agreements on how the international community must help developing countries adapt to the impacts of climate change.

2.5.3 Sustainable Development Goals

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. There are 17 Goals under the SDGs and these build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities. The goals are interconnected – often the key to success on one will involve tackling issues more commonly associated with another. Goal 13 requires governments to take urgent action to combat climate change and its impacts, and it is in this respect that the National Climate Change Policy 2013 and Renewable Energy Act, 2011 (Act 832) have been passed.

2.5.4 Africa Union Agenda 2063

Agenda 2063 – a shared strategic framework for inclusive growth and sustainable development – was developed through a people-driven process and was adopted, in January of 2015, in Addis Ababa, Ethiopia by the 24th African Union (AU) Assembly of Heads of State and Government, following 18 months of extensive consultations with all formations of African society. Agenda 2063 is anchored on the AU vision and is based on the seven aspirations. Aspiration 1 which is *"A Prosperous Africa based on inclusive Growth and Sustainable Development"* targets among others, using mainly adaptive measures to address Climate change risks. In line with this, Ghana has developed the

National Climate Change Adaptation Strategy (NCCAS), 2012, "*to enhance Ghana's current and future development to climate change impacts by strengthening its adaptive capacity and building resilience of the society and ecosystems*". Its main objectives are *to improve societal awareness and preparedness for climate change, enhance the mainstreaming of climate change into national development planning*. The NCCAS has 10 priority programmes for climate change adaptation and integration into national development, such as the proposed solar power facility infrastructure.

2.5.5 International Labour Organization Fundamental Conventions

With respect to Labour & Working Conditions, it must be noted that Ghana has been a member of the International Labour Organisation (ILO) since May 20, 1975, and has since ratified 51 Conventions, comprising of all the eight Fundamental Conventions, two out of the four Governance Conventions, as well as 41 out of the 178 Technical Conventions.[2] ILO has identified eight conventions as "fundamental (or core)", covering subjects that are considered as fundamental principles and rights at work. These eight fundamental conventions are presented in Table 2-3, all of which are ratified by Ghana and are also requirements under the "***Labour & Working Conditions***" safeguards which requires complying with four core labour standards of ILO comprising of child labour, forced labour, non-discrimination and freedom of association and collective bargaining. Subsequently, it is a legal obligation on VRA to comply with the requirements of the ILO conventions during project implementation and this has been discussed in detail in the "***Volume V: Labour & Working Conditions Management Plan***" of this EIA Study.

The "***WB ESS7 - Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities***" requires that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples. In Ghana, The ILO Recruiting of Indigenous Workers Convention, 1936 (No. 50) has been abrogated by ILO at its 107 Session (2018) and not in force in Ghana, and therefore no indigenous persons are to be affected by the project.

Table 2-3: ILO Fundamental Conventions Regarding Principles & Rights at Work

Convention Name	Key Provisions	Ratification Date
C29: Forced Labour	✓ Forced or compulsory labour not permitted ✓ Existing practices to be suppressed in the shortest possible time ✓ Regulated by governments that are signatories to the convention	1957
C87: Freedom of Association and Protection of the Right to Organize	✓ Workers and employers have the right to establish and join organizations of their choice, subject to the rules of the organization concerned ✓ Regulated by governments that are signatories to the convention	1965

[2] https://www.ilo.org/dyn/normlex/en/f?p=1000:11200:0::NO:11200:P11200_COUNTRY_ID:103231

Convention Name	Key Provisions	Ratification Date
C98: Right to Organize and Collective Bargaining	✓ Workers to be protected against anti-union discrimination in the workplace ✓ Worker's and employer's organizations to be protected from acts of interference ✓ Regulated by governments that are signatories to the convention	1959
C 100: Equal Remuneration	✓ Men and women to receive equal remuneration for work of equal value, consistent with the provisions of the applicable remuneration methods ✓ Regulated by governments that are signatories to the convention	1968
C 105: Abolition of Forced Labour	✓ Forced labour not to be used for political ends, for economic gain, as a form of discipline or punishment, or in the context of discrimination ✓ Regulated by governments that are signatories to the convention	1958
C111: Discrimination	✓ Equal opportunity in respect of employment and opportunity to be pursued in a manner appropriate to national practice ✓ Discrimination based on race, colour, sex, religion, political opinion, nationality not permitted ✓ Exclusion or preference in respect of the requirements of a specific job is not discrimination ✓ Regulated by governments that are signatories to the convention	1961
C138: Minimum Age	✓ Child labour to be progressively abolished where it is still practiced ✓ Signatories to determine a locally appropriate minimum age, not less than 15 years or 14 in specific circumstances ✓ Regulated by governments that are signatories to the convention	2011 *Minimum age specified: 15 years*
C182: Worst Forms of Child Labour	✓ Elimination of child exploitation through slavery, prostitution, safety pornography illicit services or work which is harmful to health, morals or ✓ Regulated by governments that are signatories to the convention	2000

40MW SOLAR POWER PROJECT AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 3: PROJECT DESCRIPTION & ALTERNATIVES

3 PROJECT DESCRIPTION AND ALTERNATIVES

3.1 Introduction

This Chapter provides a description of the project in terms of location, facilities and associated project infrastructure and activities during the project lifecycle and facilitates a comprehensive identification of the potential impacts on resources and receptors that could result from project activities during the pre-construction, construction, operation and decommissioning stages. Figures, maps and pictures have been provided as illustration for a better understanding of the project description.

3.2 Overview of Solar Energy Generation Process

The process of solar power generation is basically using a photovoltaic technology to produce solar power. Photovoltaic means electricity from light, i.e., photo meaning light and voltaic meaning electricity. Solar panels, also known as modules, contain photovoltaic cells made from silicon that transform incoming sunlight into electricity rather than heat. Solar PV plants generate electricity from solar radiation using a PV Module, which comprises of several solar cells. The solar photovoltaic cells consist of a positive and a negative film of silicon placed under a thin slice of glass. Solar cells produce Direct Current (DC), which is converted to Alternating Current (AC) in inverters before the plant is connected to the grid. During this process, the photovoltaic cells absorb the particles of light known as photons. As the photons of the sunlight beat down upon these cells, they knock the electrons off the silicon. The negatively charged free electrons are preferentially attracted to one side of the silicon cell, which creates an electric voltage that is collected and channelled. The energy produced will then be released during the process of absorption and will be transferred as the electrical current. A simplified setup of the proposed PV plant is as shown in Figure 3-1.

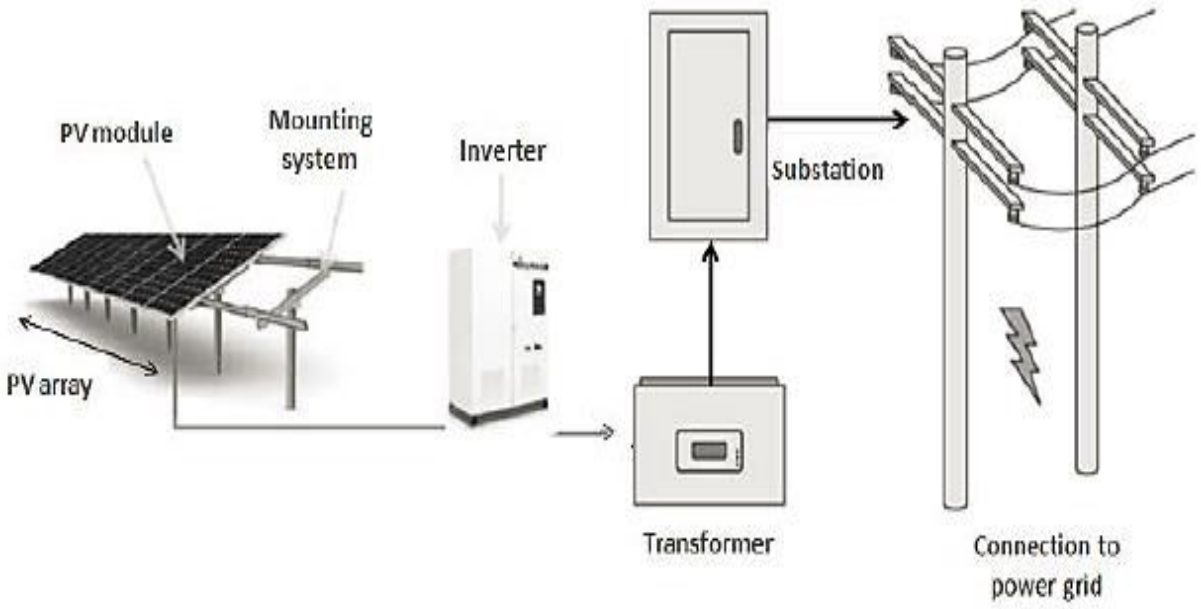


Figure 3-1: Setup of a Typical Solar PV Plant

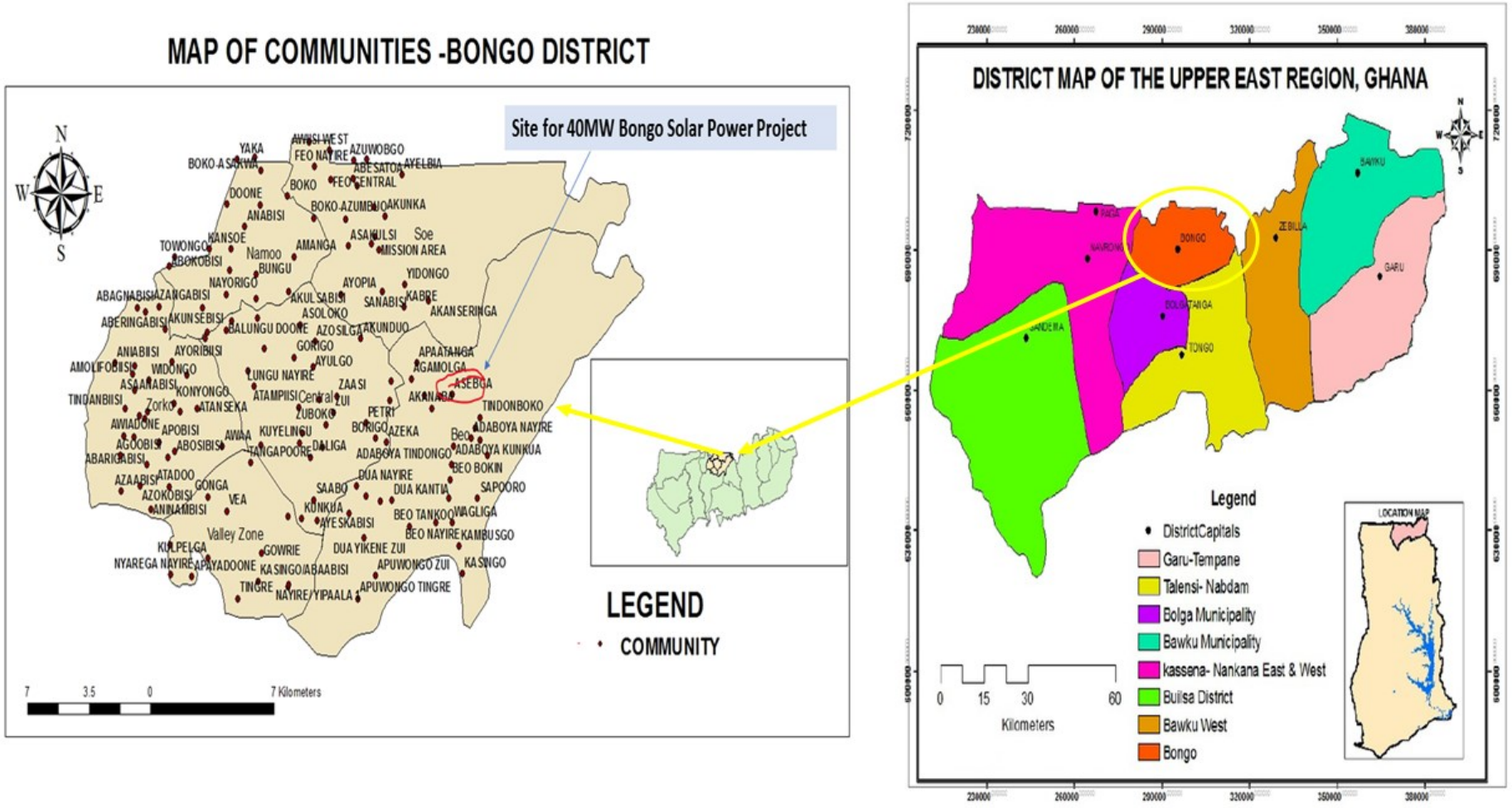
A single solar cell will not be able to produce a useful amount of electricity so there is a need to link many solar cells together. This current is gathered by wiring the individual solar panels together in series to form a solar photovoltaic array. These collections of solar cells will be mounted into a panel to create a module. When enough electricity is generated, a cable will direct it to an electrical inverter, which changes the direct current that was produced into an alternating current. This is because alternating current is the standard type of electricity being used in most power outlets, so all the inverter does is make the energy into a usable form. To maintain efficiency, PV Modules are washed on a regular basis.

3.3 Project Location & Site Setting

The proposed solar power facility is at Asibiga, which is about 1.3km from the nearest village, Akorisi, in the Bongo District of the Upper East Region of Ghana, and 15 kilometres south of the Ghana - Burkina Faso border. The respective location of Asibiga in the Bongo District vis-à-vis the Upper East Region is shown Figure 3-2. The breadth (East – West) of the site is about 0.75km and the length is 0.65km, and covers a geographical area of about 0.51 Km^2 and on a Latitude 10.92° and Longitude -0.73°, at an elevation of about 252.15m. The site is about 9km from the Bongo township, the district capital, and about 14km off the Bongo Main Road joining the N10 Highway. The nearest PV plant is the 2.5MW Navrongo Solar Power Station (NSPS), located at Pungu Telania, near Navrongo, west of Bongo and about 50Km away. Site plan for the PV Site is provided in Appendix 3 of this EIA Report. The solar power site is designated for agricultural use, with current agricultural practises including mixed farming and grazing for livestock (cattle, goats and sheep).

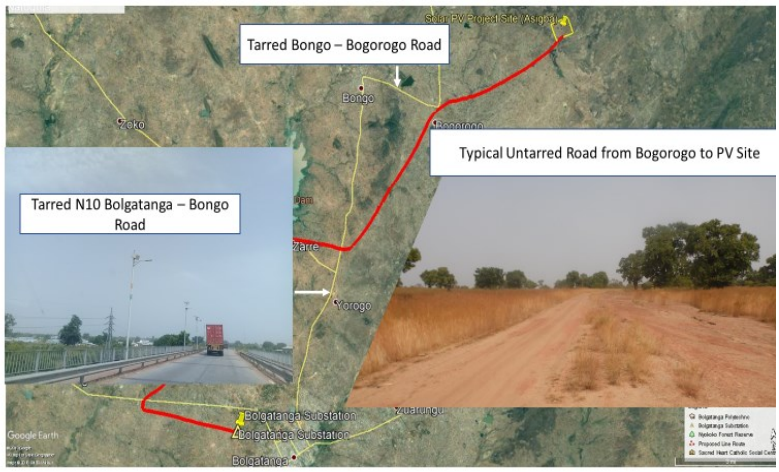
The 23 km stretch of the proposed route line commences from the solar site at Asibiga through the townships of Bogorogo, Zarre. Yorogo, Zorbisi all in the Bongo District, whilst six (6) km of the line runs within and terminates finally in Bolgatanga. Main land use along the sub-transmission line is subsistence farming as well as some economic trees such as Sheabutter, Dawadawa, Baobab, Berries, Teak and Mango. It must be noted that the final route for the sub-transmission line component of the project will be established and relevant maps to this effect will be produced to guide construction.

Figure 3-2: Geographical Location of Bongo District in the Upper East Region



3.4 Accessibility to Project Site

The major route from Southern Ghana to the site is the Tamale – Bolgatanga Section of the N10 Highway. The N10 Highway is part of the trunk roads between major urban centers and forms part of the backbone of the road system in Ghana. It runs from Kumasi, through Techiman to Fufulso and to Tamale and finally to Bolgatanga. To join Kumasi from Accra is the N6 Highway (See Figure 3-3). These highways are all asphalted and are classified as a first-class road. The equipment procured will be brought from Tema on the N1 Highway to Accra and transported overland to the project site more than 830 km away.

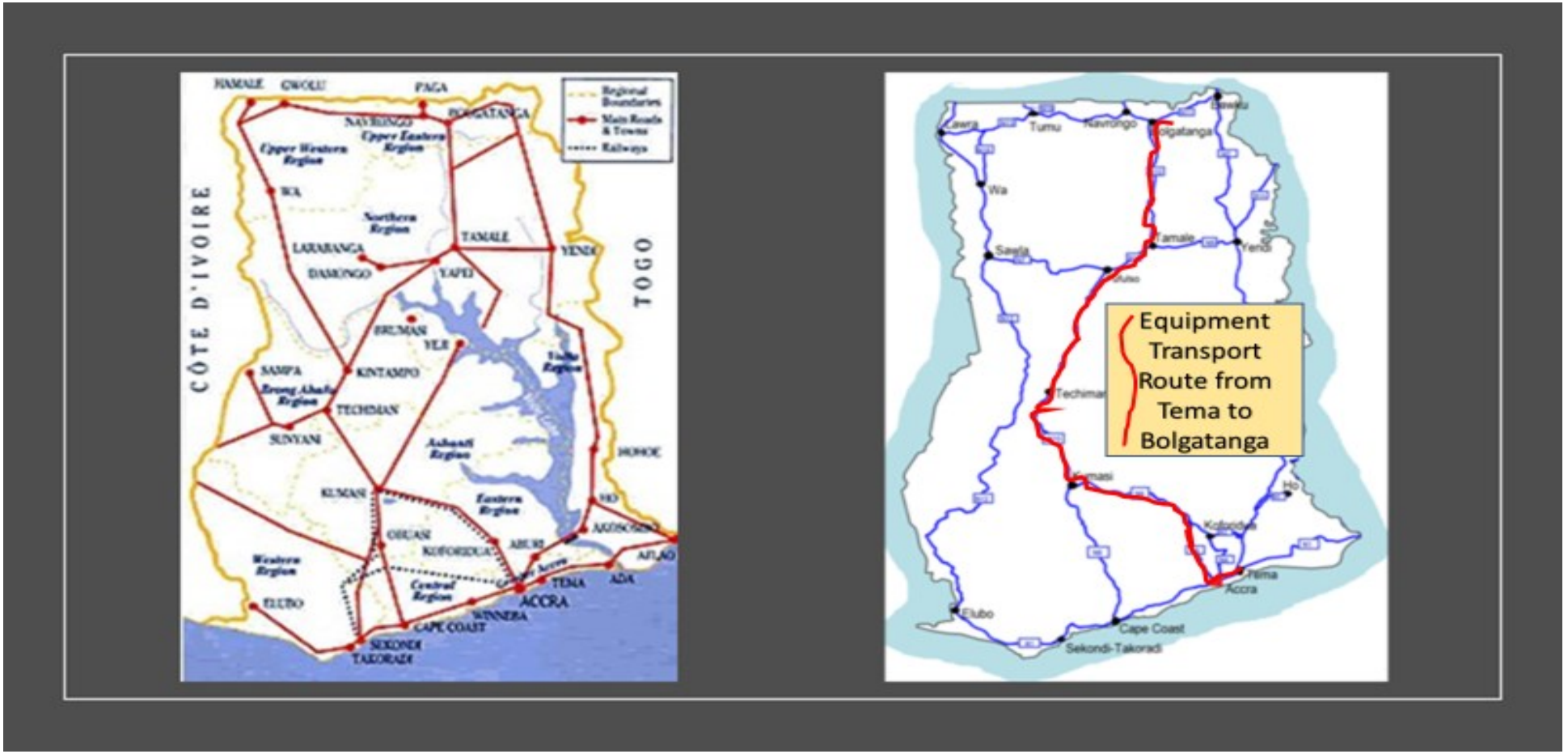


State of Access Route to Project Site

Access Route to PV Site at Asibiga cut off due to rainfall

The main route from Tema, Accra through Kumasi, Tamale, Bolgatanga, through Yorogo to Bongo is asphalted. However, the routes within Bongo District leading to the project site, i.e. from Bogorogo to Asibiga, are untarred and poor in nature. Indeed, during the raining season, the route to the PV site Asibiga can be cutoff due to waterlog as was experienced during the baseline survey and this must be factored in during project development.

Figure 3-3: Transport Route for Project Equipment



3.5 Project Facilities & Components

Project facilities and components associated with the PV Facility has been indicated in Table 3-1 whilst that of the sub transmission line is provided in Table 3-2. Most of the components for the power plant, both solar and sub-transmission line, will be manufactured and procured internationally, as they are not available for purchase in Ghana. As part of the EPC Contractor's quality policy, first worldwide level suppliers from China, Canada, Spain, Italy, USA etc, are to be utilised for the manufacture of the major equipment and accessories. Details of the equipment and materials and sources are to be clarified during the procurement process and at the negotiation stage with the EPC contractor.

The equipment should have the minimum but necessary configuration to achieve the objectives of the project. The procurement of the equipment will take into consideration, past importation records of such equipment, the operation and maintenance capability of the VRA and other relevant matters. Manufacturer's authorizations are to be provided showing that the EPC Contractor has been duly authorized by the main manufacturers for this project to supply and install that item in Ghana. The EPC Contractor is to provide all documents obtained from the supplier during tendering process. Catalogues, certificates, references list, ISO and OHSAS certificates, etc. are to be provided to VRA for concurrence. Any other documentation required by VRA during clarification period or project execution will be studied with the manufacturers and provided as detailed as possible.

VRA will engage with the EPC Contractor in the construction supply chain early in the project decision making process and will seek to use innovative techniques in the procurement and project delivery process. In addition, the necessary spare parts, testing instruments, maintenance tools and operation and maintenance manuals will be provided as part of the project, and stored as appropriate and brought to site as and when required. It is expected that these components will be stored at the NEDCo Office in Bolgatanga and supplied on as required basis to a protected site at the power plant site at Asibiga.

3.5.1 Solar Power Component

Key components of the solar power component of the project is shown in *Table 3-1*.

Table 3-1: Key components of the Solar PV Plant

Component	Description
Project Capacity	40 MW
Project Area	50.13 Ha
Technology Type	Photovoltaic (PV) Polycrystalline technology
Orientation	12° South
Module Power (Wp)	310
Modules in String	19
Total Modules	64525
No. of Inverters	1000

Component	Description
Infrastructure	• PV solar panels/modules (arranged in arrays) • Fixed PV module mountings • DC-AC electricity inverters and transformers • A 'loop-in loop-out' substation facilitating connection to the national grid • A substation located within the PV footprint • Underground cabling and Overhead power lines • On-Site buildings (including an operational control centre, office, inverter room and transformer units' warehouse, and a guard house) • Access roads and internal road network • Ancillary infrastructure, incusing security fencing

The project will involve fixed mounted Solar Photovoltaic Plants with polycrystalline panels that that will occupy an area of 50.13 Ha of land size at Asibiga. The total number of PV panels required for such an area for the project will be around 64,525. The PV panels will be 1956 mm in length, 992 mm in width and 40 mm in height with each producing an output of 310 Wp. The PV panels will be connected in arrays to form units with a total power of 1MW each. Each PV panel will weigh approximately 22.4kg. Within each PV panel there will be 65 polycrystalline cells (each 156-mm x 156 mm). These polycrystalline cells will be encapsulated in Ethylene Vinyl Acetate (EVA). The front substrate of the PV panel will be 3.2 mm of antireflection glass, while the back substrate will be Tedlar or APA composite sheeting. Each PV panel will be placed in a black or raw anodized aluminium frame 45 mm in width and equipped with drainage holes.

The PV panels will be mounted on aluminium fixed frame structures approximately 3.33m in height from the ground. The aluminium structures will be mounted on steel screw piles or concrete foundations 1500mm deep, depending on soil conditions. The distance or spacing between rows will be approximately 6.2m. The PV arrays will be tilted 12° south to capture maximum sunlight. Within the PV arrays, a minimum spacing of 6m is required between each row to avoid shadowing of the panels by adjacent rows. These spaces will be gravelled and not paved. PV power facility maintenance will consist mainly of PV panel replacement, PV panel cleaning and other minor mechanical and electrical infrastructure repairs. Access will be needed primarily for light service vehicles entering the site for maintenance, inspection and PV panel cleaning purposes. During the

Typical array of fixed PV Panels at the 2,5MW Navrongo PV Plant

operational phase, traffic impacts will be less, with vehicles only required to transport infrastructure during routine maintenance and upgrading phases.

The PV panel arrays will be connected via underground cables to array enclosures. Array enclosures combine the power generated by many PV panels and transmit that power via two underground DC cables to an inverter/transformer enclosure. The array enclosures will be mounted underneath the PV module mounting structures and each array enclosure will occupy an area of approximately $1m^2$. The inverter/transformer enclosures convert the direct current produced by the PV panels to alternating current. The inverter/transformer enclosures also contain transformers that transform Low Voltage AC from the inverter to Medium Voltage AC. The nominal DC input power of each inverter is 20kW. Two central inverters, along with a Low Voltage AC to Medium Voltage AC step-up transformer will be placed inside a prefabricated concrete container. The inverter / transformer enclosures will connect via underground cabling to a new 'loop-in loop-out' substation.

Internal roads, accesses and parking areas on the site would be designed and constructed of sufficient width and for maximum likely loads. The main internal roads would have a width of 5 m and they would be illuminated by solar streetlights. In addition, smaller internal roads will be constructed of 2.50 m width for Operational and Maintenance (O&M) purposes. The aggregates of base and subbase of the main road material will be of well graded pit run gravel or equivalent. Moreover, some indicative dimensions of small and big trucks have been included in the civil layout in order to show the accessibility through the site. A designated part of the internal road system shall be reserved for parking of maintenance vehicles. The sub-distribution cabinets and transformer kiosks shall be between the arrays and internal road, making their access for any maintenance and repair quite convenient. Their distance from the road is 2 m and lights shall be located along the internal roads as safety margins against potential crashes during manoeuvring.

Provision for Internal Roads under the 35MW PV Project in the Upper West Region

The fire-fighting area for the power plants shall include the power distribution rooms in the substation area and in PV power plant. A fire fighting and emergency concept shall be developed for the site. The firefighting concept shall be in line with current VRA Health, Safety & Environmental and local regulations as well as national standards, and contain the placement of adequate equipment on the sites and facilities therein such as smoke detectors and extinguishers. Additionally, the organisational issues that will be addressed will include an interface with the regional fire brigade, training of fire fighters and on-site staff to take correct actions in case of a fire.

The site for the solar power plant will be fully secure with barbed wire fencing and will have one principal entry/exit with a guardhouse. The construction of a wall fence of at least 2.50m height around the power plant is required for power plant's equipment protection, as also for avoiding any accident by external causes. Installing an open field PV Plant raises at the same time the request for security against theft. Hence, security systems have become state of the art in free-field PV Plants.

Constructed Fence at the 35MW PV Plant in the Upper West Region

The drainage, sanitary and sewerage systems will be constructed to accommodate the Solar Power Project requirements. The embankment, its slopes and drainage facilities shall all be within the boundaries of the project site depicted by the benchmarks provided on the site plan included in the enquiry drawings. Rainfall run-off and general drainage of the Power plant, substation yard, customer service area, car parking and landscaped areas shall be carried by appropriately sized reinforced concrete perimeter open channel drains to an appropriate outfall as shall be approved by VRA. A sewage treatment tank shall be located at the back of the main house, accessible to vehicles from outside for services. It will receive mainly the outflow of the latrine. All local and national environmental regulations shall be respected when disposing contaminated water containing residues such as oil or chemicals. Water collected the drainage channels from on-site precipitation is collected into larger gravel filled channels at the fences where it can trickle away.

Generally, security systems are recommended to be equipped with periodically maintained backup battery banks, which are regarded as market standard. In other cases, an automatic message is sent to the operator in case of disruption and / or interruption of the grid. A system based on Sensor Post with Barbed Wire System and CCTV is recommended. The final requirements are to be clarified with the insurance provider. A security guard shall be onsite 24/7. This person may perform as well small jobs on site and check error signals.

3.5.2 Sub Transmission Line Component

Key components of the sub transmission line component of the project is shown in Table 3-2.

Table 3-2: Key Components of Sub Transmission Line

Main Equipment
Suspension lattice steel towers
Small angle towers
End and large angle towers
Conductors (i.e. wires)
Earth wire
Insulator chains

The power will be connected to the national grid, through the existing 34.5kV bulk transmission lines located about 1.8 km away from the southern end of the project site at Asibiga. It is anticipated that the project will feed the total of 40 MW into the national grid via the GRIDCo substation in Bolgatanga. The electricity from the PV plant would be evacuated at 34.5kV voltage level and a 29Km sub-transmission line would be constructed from the plant to the GRIDCo substation in Bolgatanga. This sub-transmission line would terminate on the 34.5kV bus at the Bolgatanga substation. The supporting structures shall be self-supporting lattice steel towers of conventional type with tapered body or parallel legs and square base. Either one foundation only or four independent footing can be applied, at Tenderer's choice. In addition, special tower arrangements shall be provided for auto recloser support and for Tee-off of lateral lines. The design shall be in accordance with the ASCE manuals and reports on engineering practice No. 52 "*Guide for design of steel transmission towers, 2nd Edition, 1988*".

Typical Transformer in Grid Connection at the 2,5MW Navrongo PV Plant

Figure 3-4: Sub-transmission Line Route for the Bongo Solar Power Project

Source: VRA Engineering Services Department (February 2018)

3.6 Project Alternatives

The Environmental Assessment process as required under LI 1652 of 1999 mandates the provision of an outline of the main alternatives considered and the main reasons for the preferred choice. This analysis is aimed at comparing, based on a set of previously established criteria, the best feasible alternatives to identify the one causing the least impact and allowing to determine the optimal option. Subsequently, prior to the selection of the various project components, various alternatives were considered both in terms of both design and equipment. In this respect, a full description of the alternative processes followed, to select the proposed preferred activity, technology, site and location and the outcome, including the "No Development Alternative", are discussed under this Section.

3.6.1 No Development Alternative

The 'No Development' alternative is the option of not implementing the activity or executing the proposed development. If the solar power plant would not be developed at the proposed site, the site would remain in its current state. Therefore the agricultural potential (although limited for this site) would not be lost due to the establishment of the facility on agricultural land. Similarly, without the development, the project benefits summarised below will also be lost:

- No increase in electricity generation,
- No CO_2 savings associated with the power generations from the proposed development,
- No economic benefit to the landowners associated with the potential income generated through the operation of the facility,
- No employment generated, and
- No contribution to meeting Ghana's targets for renewable energy generation.

Although there will be no need for land acquisition and development under the "***No Development Alternative***", it does not guarantee that the existing environmental quality will continue to be maintained. At the same time, the large society of people in the local area, e.g. Upper East Region as well as Northern Ghana in general would not derive the associated environmental, economic, employment and political/social benefits benefit but rather they are going to lose in terms of development, good health and improved quality of life, increased pollution and deforestation in some areas. The "***No Development Alternative***" does therefore not represent an option that meets the best interests of the national development agenda and is proposed that the project proceeds.

3.6.2 Use of Solar Energy As Alternative Fuel for Power Generation

Based on the need to proceed with the project, the source of fuel to be utilised for the project has to be considered. According to the "*2020 Electricity Supply Plan for The Ghana Power System*", Ghana as at close of December 2019, had a total installed capacity 5043MW, comprising of 3416.5MW (67.7%) of fossil fuels (Light crude oil, diesel fuel oil, heavy fuel oil, natural gas), 1584MW (31.4%) of hydropower and 42.5MW (0.008%) of Solar power. From the data, VRA notes that the continual use of other forms of energy like fossil fuels (Light crude oil, diesel fuel oil, heavy fuel oil, natural gas) as an alternative power generation with high impact on climate

change will not assist the Ghanaian government in addressing climate change, in reaching the set targets for renewable energy, nor will it assist in supplying the increasing electricity demand within the country. It is therefore imperative to look for alternatives to fossil fuel-based power generation to achieve long term power solution of the country.

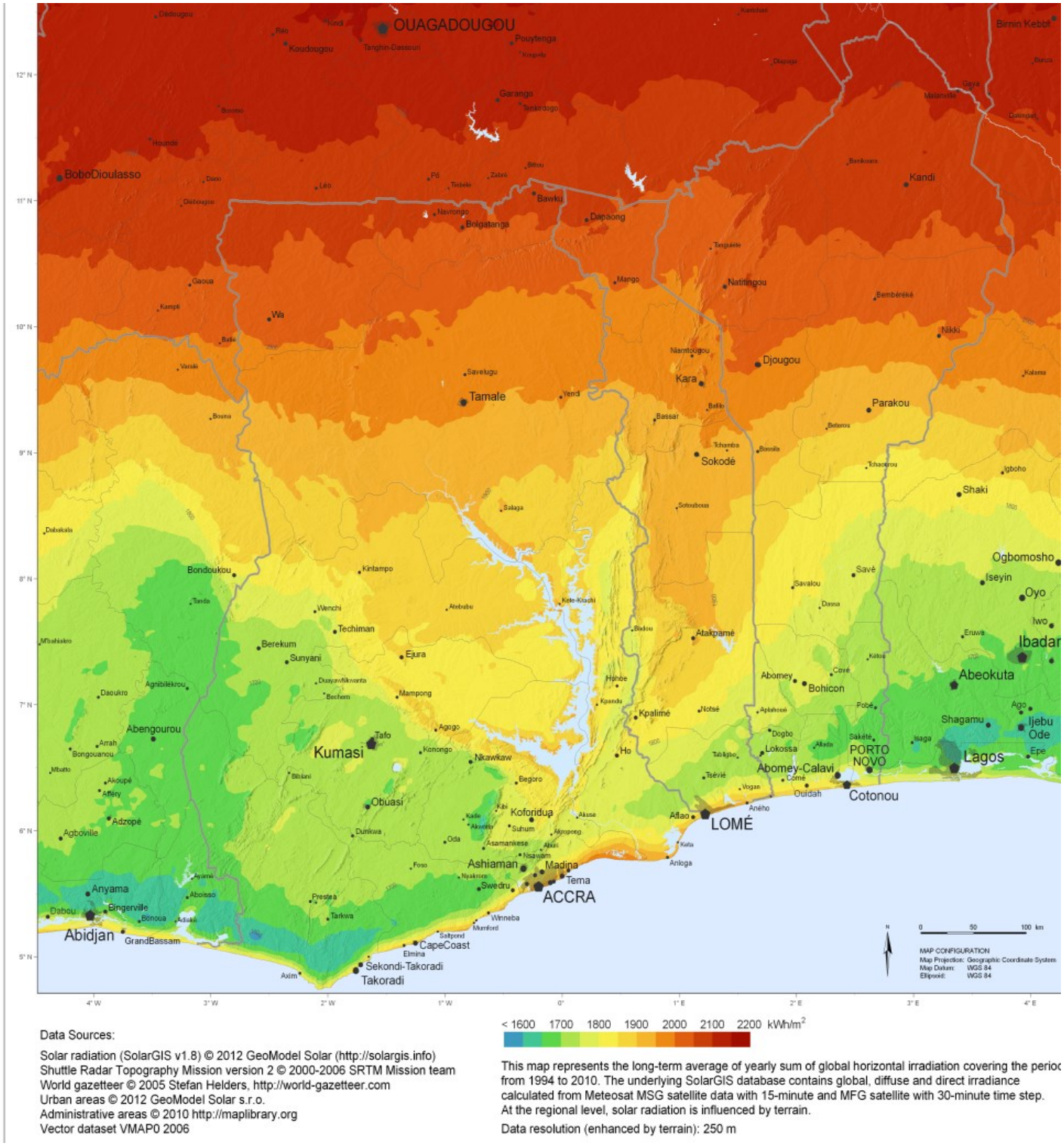
Development of power from nuclear and hydropower sources are highly limited and long term in nature. Therefore, the choice of solar power is envisaged to contribute significantly to addressing potential power demand and supply growth in-balance and deficit in the immediate future, as it will play a significant role in the stabilization of power situation in the country. In addition, the uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows Ghana to contribute towards mitigating climate change through the reduction of greenhouse gas (GHG) emissions, especially with the current target of 10% Renewable Energy into the electricity mix targeted by 2030 under the ***Ghana Renewable Energy Master Plan,*** which will require a total of 500MW of RE Thus, the use of solar energy if implemented, instead of fossil fuels based ones, will help achieve the national GHG target, and is recommended.

3.6.3 Physical Location

Following the need to utilise solar energy, the selection of a physical location is crucial for its successful operation. The selection of a physical location for a site for solar power generation is based on the total amount of annual solar energy radiation. The energy yield of a solar power plant is greatly influenced by the amount of solar irradiation available in the location of interest. In accordance with the total radiation data from National Aeronautics and Space Administration (NASA), the solar radiation amount reaching the inclined plane of the equator is calculated using what is known as the Klein method. Factors that are considered in this method include direct solar radiation, sky scattering radiation, and ground reflection radiation. A solar irradiation level of about 1600kWh/m^2/year or greater is usually preferred for Solar PV sites.

Data from the solar radiation map in Ghana is shown in Figure 3-5. The data shows that the solar resource in abundant in Northern Ghana, particularly in the Upper East and Upper West Regions, and this has formed the basis of the various sites selected for solar power projects by the VRA. With the ongoing development of a 35MW solar power project in the Upper West Region by the VRA, the Upper East Region has been selection under this solar power plant.

Figure 3-5: Solar Radiation Map of Ghana



Source: Bongo Solar Power Project - Feasibility Report, August 2017

3.6.4 Candidate Site for PV Plant

Following the selection of the Upper East Region, the next step was the selection of the candidate site, which is a crucial part of developing a viable solar PV project as it aims at maximising output and minimise cost. The criteria for selection of candidate sites for PV projects are usually based on factors such as:

- Availability of adequate land – area required for different module technologies, access requirements, potential for future expansion, pitch angle and minimising inter-row shading.
- Land use – this has an impact on land cost and environmental sensitivity as well as the impact of other land users on the site.
- Topography
- Accessibility – proximity to existing roads, extent of new roads required.
- Proximity to settlements (residential areas are avoided as much as possible)
- Grid connection – proximity to electrical grid, cost, timescale, capacity and availability.

As indicated, this project falls under VRA's REDP Phase 2 which targets the development of 200 MW of solar PV plant capacity. It is anticipated that this capacity would be deployed in plant sizes ranging from 20 MWp to 50 MWp and the land required for each plant would range from 36 ha to 60 ha depending on the size of the plant and configuration to be used. Using the Klein method, the solar radiation data of the Bongo District area in the Upper East Region has about 2000kWh/m^2. This value of irradiation is above the preferred minimum of 1600kWh/m^2/year and thus makes Bongo District a very suitable site, which informed VRA to embark on the selection sites within this District.

The selection of site of this magnitude begun with the utilisation of Google Earth, OpenStreetMap, SweraGST as desk top tools to identify nature and land use of the sites. From the desktop studies, various potential areas were identified in the Bongo District. This was followed by a site visit, where through interactions with Chiefs and Community elders, the team were taken to six different sites in the environs of Asibiga, Adaboya and Soe communities in the Bongo District. Power evacuation from the six (6) identified sites at Bongo would most likely be done by a 34.5 kV line from the site through Bongo and onwards to Bolgatanga.

Based on the assessment of the available land, competing uses of land and power evacuation, a comparative analysis of the six sites at Bongo was made and ranked as shown in Table 3-3. Site 5 at Asibiga of about 50Ha was chosen as the preferred site for the construction of the 40 MW Solar Plant. Sites 1 & 2 were rejected due to their smaller potential land sizes, proximity to settlements and potential for land in this area to have a high agricultural value. Sites 3 and 4 which the required land sizes were also rejected due to the presence of settlements. Site 6 has also not been considered due to distance from the main road.

Table 3-3: Comparative Analysis of Candidate sites at Bongo

Factor	Candidate Sites					
	Bongo Site 1	**Bongo Site 2**	**Bongo Site 3**	**Bongo Site 4**	**Bongo Site 5**	**Bongo Site 6**
Geo Position	Lat: 10°54'22.86"N Lon: 0°46'37.85" W	Lat: 10º 55'26.81"N Lon: 0º 46'34.16"W	Lat: 10°54'51.72"N Lon: 0°44'24.27" W	Lat: 10º 55' 3.53", Lon: 0º 43' 29.52"	Lat: 10°53'29.91"N Lon: 0°43'14.31"W	Lat: 10°56'52.46"N Lon: 0°44'39.96"W.
Land Availability	< 30Ha	Parcels of 12 – 15 Ha	60 Ha (in parcels of 15Ha each)	60Ha	50Ha	60Ha
Accessibility	5 km from Bongo on the Bongo-Soe road	6.7km from Bongo on the Bongo - Soe road	11.5 km from Bongo on the Bongo - Asibiga road	9 km laterite road by line of sight from Bongo.	9km dirt tracks off the Bongo-Kongo road	14.Km on Bongo-Soe road
Land use	Generally flat, and the vegetation consists of grass and scattered shrubs.	Fairly flat the vegetation is mainly savannah, at the time of the visit there were no signs of farming apart from the grazing cattle.	Generally flat, and the vegetation consists of grass and scattered shrubs.	Generally flat, and the vegetation consists of grass and scattered shrubs	Land slopes with low grass dotted with well-spaced trees and a few shrubs.	Generally flat and there was no visible farming
Proximity to Settlements	Few settlements and earmarked for school	Few settlements	Few settlements	Few settlements	No Settlements	No Settlements
Ranking	**5th**	**4th**	**2nd**	**2nd**	**1st**	**3rd**

3.6.5 PV Technology

PV technology alternatives considered under this project were the Concentrated Solar Photovoltaic (CSP) Plants and the Solar Photovoltaic Plants. Two factors considered in the selection of the CSP and PV were market size and technological simplicity. The remaining types of PV technologies were also evaluated, i.e. the Fixed PV plants; and Tracking PV plants and the preferred configuration was selected based primarily on the operating environment. From the analysis, Solar Photovoltaic Plants are the most environmentally sensitive technology for the preferred site, as large volumes of water are not needed for power generation purposes compared to the CSP option. CSP requires large volumes of water for cooling purposes. PV is also preferred when compared to CSP technology because of the lower visual profile. In addition, the Bongo Solar PV facility will install fixed mounted PV system instead of a Tracking PV system.

There are further advantages which are gained from fixed mounted systems, the reasons are indicated below:

- The maintenance and installation costs of a fixed mounted PV system are lower than that of a 'tracking' system which is mechanically more complex given that these PV mountings include moving parts.
- Fixed mounted PV systems are an established technology with a proven track record in terms of reliable functioning. In addition, replacement parts are able to be sourced more economically and with greater ease than with alternative systems.
- Fixed mounted systems are robustly designed and able to withstand greater exposure to winds than tracking systems.

3.6.6 PV Module Technology

The design of a PV plant involves a series of compromises aimed at achieving the lowest possible cost of electricity. Choosing the correct technology (especially modules and inverters) is of central importance. Selecting a module requires assessment of a complex range of variables. At the very least, this assessment would include cost, power output, benefits / drawbacks of technology type, quality, spectral response, performance in low light, nominal power tolerance levels, degradation rate and warranty terms. Summarized in Table 3-4 are some of the advantages and disadvantages of the three main types of solar PV module technologies. The suitability of different types of PV solar panels was assessed including thin film and polycrystalline panels. Based on performance in high temperature environments like those typical of Bongo, polycrystalline panels has been selected as the preferred option.

Table 3-4: A comparison of PV Module Technologies

PV Module Technology	Advantages	Disadvantages
Mono crystalline	▪ High efficiency ▪ High availability on the market	▪ High cost per kWp installed ▪ Poor temperature coefficient
Poly crystalline	▪ Cheaper than mono crystalline modules ▪ High availability on the market	▪ Medium efficiency as compared to the mono crystalline modules ▪ Poor temperature coefficient
Thin film	▪ Good temperature coefficient ▪ Takes advantage of diffuse irradiation ▪ Less expensive as compared to the crystalline modules	▪ Low efficiency as compared to the crystalline modules ▪ Must be used with an inverter with a transformer ▪ Less availability on the market as compared to the crystalline modules

3.6.7 Transmission Line Type

Underground and overhead transmission lines exist and the selection of any of this type depends on various factors. When deciding whether to put transmission lines overhead or underground, installation costs become a primary concern. The advantage in initial capital costs goes to overhead lines. Installation cost becomes a primary concern when determining how to construct transmission lines. According to Florida Power & Light Company, it costs five to 15 times more to install transmission lines underground, making it prohibitive and rarely used except in densely populated urban areas where overhead is not feasible[3]. Currently, the use of overhead transmission lines is the main medium for power evacuation in the country. VRA, NEDCo and GRIDCo has immense experience in the operation and maintenance of overhead transmission lines, using self-supporting lattice steel towers of conventional type with tapered body or parallel legs and square base. Considering all these factors, the use of overhead transmission lines with such facilities is recommended for this project and has been opted for.

3.6.8 Selection of Optimal Transmission Line Route

The selection of the most appropriate routing for the construction of a new transmission line is normally an iterative process that tries to secure the most environmentally acceptable route that is both technically and economically feasible. In addition to constraints and criteria linked to the choice of corridors, the selection should seek to avoid as far as possible, sensitive environmental elements located inside the zone of study. Further, for technical considerations, as well as to reduce the visual impact of any proposed lines, heavily developed and residential areas should be avoided as much as possible. The placing of transmission lines within an existing route corridor provides significant advantages both in terms of reducing visual impact but more

[3] The Advantages of Using Overhead Line Transmission | eHow.com http://www.ehow.com/list_7600893_advantages-using-overhead-line-transmission.html#ixzz1yhTkkPwE

importantly in reducing the environmental impact of the project. Therefore, the next stage of the iterative process involves looking at existing lines and way leaves to see if these can be included for some or all of the proposed new line. Finally, the process concludes with a detailed analysis of a variety of options to ensure that the best compromise of all the above actors can be adopted.

The considerations for selecting the optimal line route is shown in Figure 3-6. The shortest route line survey for the Bongo Solar Power Project (straight course) commences from the Solar site (Asibiga) to the Bolgatanga Sub-station (magenta line 20.9km). However, due the presence of communities, farmlands, and streams within the course of the route line which will add additional cost during the construction of the route line, utilisation of this route is not considered feasible. The proposed route line (Red line 29km) commences from the solar site at Bongo (Asibiga) to Bogorogo junction (A1) and turns left and runs parallel with the high-tension lines along the main Bogorogo road. It continues to run parallel to the road using the right of way corridor until it crosses the main Bolgatanga- Bongo road (A2). The line was expected to turn left and run parallel by using the right of way corridor along the Main Bolgatanga-Bongo highway (blue line 9.8km) through Yorogo until it reaches the Bolgatanga sub- station.

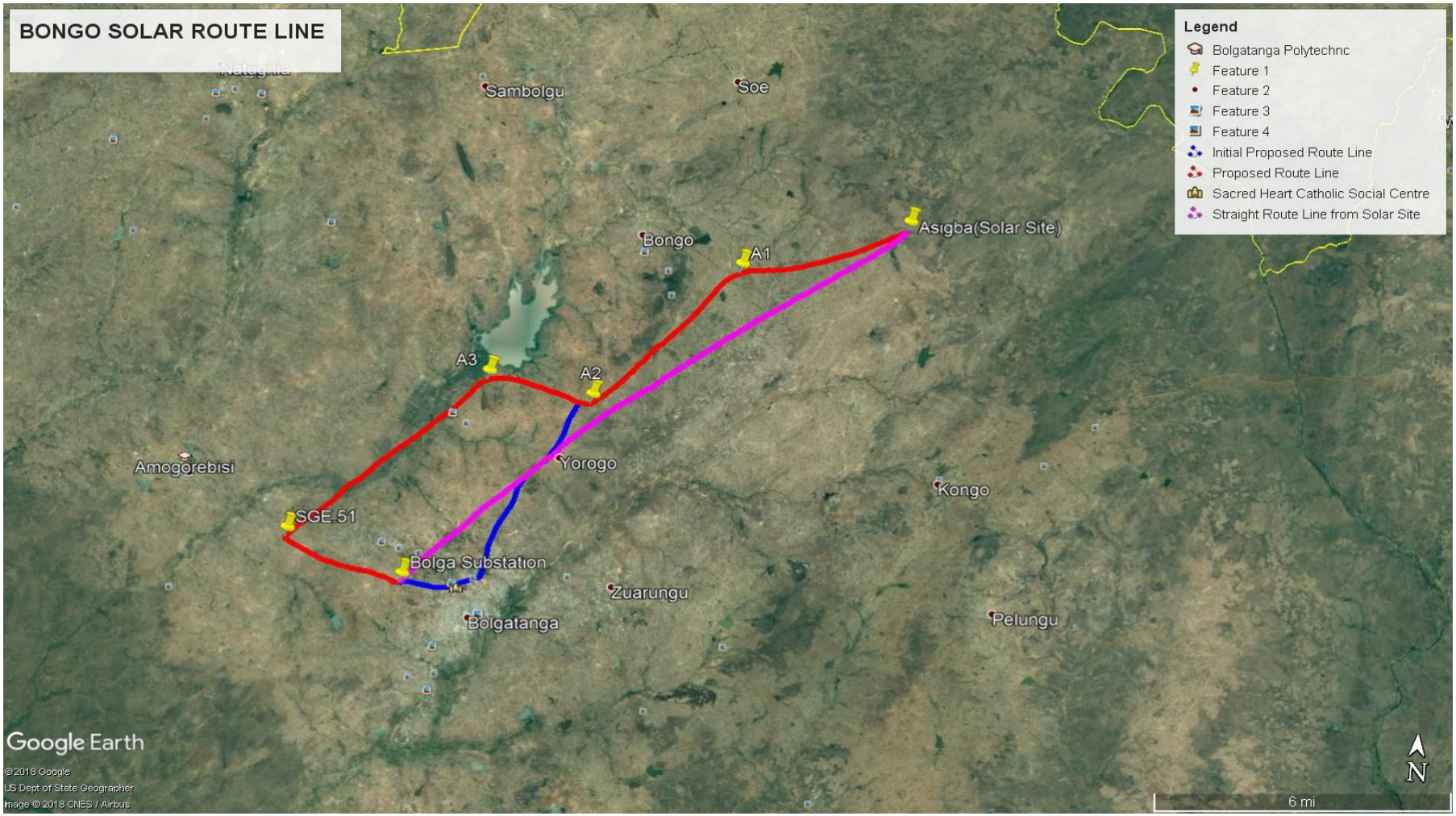
However, due to the already utilized right of way by the presence of existing 34.5kv lines and encroachment of houses along the main Bolgatanga-Bongo highway, the route line was diverted to cross the main Bolgatanga-Bongo highway road and runs behind the Zarre Township (A2-A3), the Yorogo outskirts and then terminates at the Bolgatanga-Navrongo highway (SGE 51). The route line then crosses the highway to meet the Bolgatanga-Ouagadougou 161kv Tower lines at Zorbisi and then turns to the left and runs parallel with the 161kv line using its right of way until it reaches the substation. This route line has been selected because, the existing route line from Bolgatanga through Yorogo to Bongo has already been exhausted using 34.5kv lines by the NEDCo and the encroachment of houses along the road corridors making it impossible for any further route lines to be established.

3.7 Project Financing Details

The VRA is expected to provide funding for the project, and as a public institution will access funding from international funding agencies through GoG. Currently, discussions have commenced with Ministry of Energy and some international financial institutions with respect to project funding. A cost estimate of about $35.0M has been provided for the Solar PV Component in the project feasibility report. That of the sub transmission line is yet to be estimated. Financial closure for the project is targeted by close of 2020 and this will inform the procurement of an EPC Contractor.

The project funding arrangement will be under the supervision of the Ministry of Finance and its representative agency, Bank of Ghana, which by definition by the **"WB ESS9:** Financial Intermediaries" is a Financial intermediary to the project. This EA exercise is to ensure adherence and to mitigate the associated risk as required by the Bank of Ghana through the "Ghana Sustainable Banking Principles".

Figure 3-6: 40MW Bongo Solar Power Project Line Route Selection Considerations



Source: VRA Engineering Services Department (February 2018)

3.8 Acquisition of Project Permits & Licenses

Various statutory permits and licenses are to be acquired for the various phases of the project as shown in Table 3-5. VRA has commenced activities to acquire these from the relevant state agencies to ensure adherence.

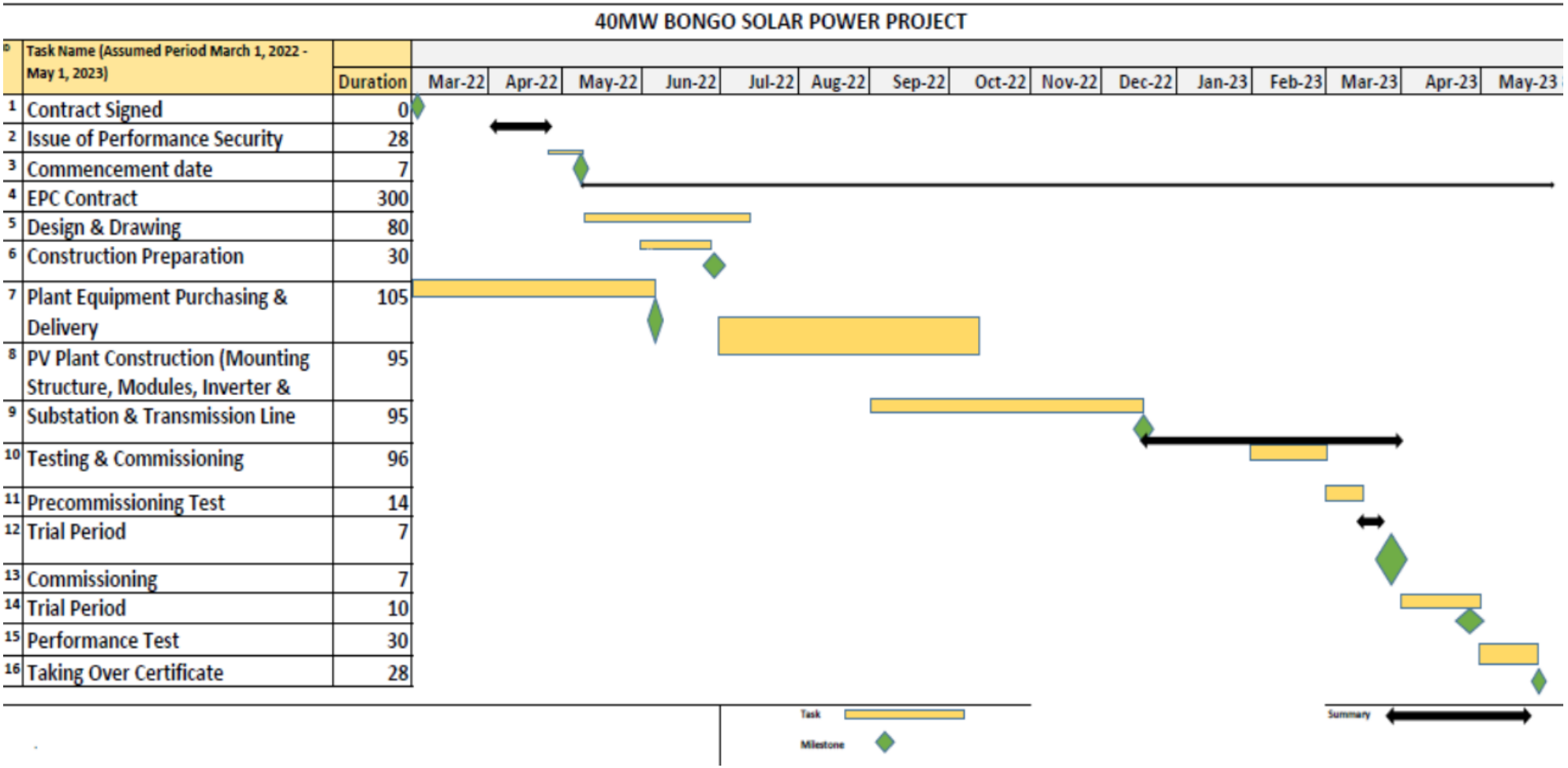
Table 3-5: Required Project's Permits & Licenses

#	Project Phase	Type of Permit/License	Issuing Authority
1	Pre-Construction	Environmental Permit	Environmental Protection Agency
2		Siting Permit	Energy Commission
3		Fire Permit	Ghana National Fire Service
4		Development Permit	Bongo District Assembly
5	Construction	Water Use Permit	Water Resources Commission
6		Construction Permit	Energy Commission
7	Operational & Maintenance	Generation & Electricity Wholesale Supply Licence	Energy Commission
8		Environmental Permit	Environmental Protection Agency
9		Water Use Permit	Water Resources Commission
10		Fire Permit	Ghana National Fire Service

3.9 Project Schedule

VRA is the responsible organization of the project's implementation. Currently, preparations of project concept design, project specification and final design documentations are on-going. This includes, but not limited to the acquisition of the Environmental Permit. Procurement of EPC Contractor is to be done when all permitting requirements have been collected. Bidding process using the Public Procurement Agency guidelines for the EPC Contractor / Consultant is expected to be completed by close of 2021. Subject to obtaining the necessary consents and engagement of the EPC Contractor by close of 2021, the project construction shall commence in 2022 (Year 1) and is targeted to take approximately 12 months to complete as shown in the project schedule illustrated in Table 3-6.

Table 3-6: Project Schedule



3.10 Project Activities During Pre-Construction Phase

3.10.1. Identification of Land Area & Site

The process entails a systematic, on-the-ground site inspection as an essential first step in acquiring the land and the strategies adopted in selecting the candidate site has been discussed on Section 3.6.8 on Page 3-18. Following site inspections, a land verification exercise was done at the Lands Commission to ensure that the rightful owners are identified for compensation payment. Discussions were held with the Regional Lands Valuer and Regional Lands Officer, where the process leading to acquisition of lease as well as current rates/values of lands in the project area were confirmed. This exercise was necessary to enable the VRA formally acquire the sites to enable the commencement of the project implementation

3.10.2. Project Feasibility Studies

The preparation of project design documents for the PV plants, both civil and electrical, are ongoing by the VRA Team. The Pre-Feasibility Study Report (August 2015) has been prepared by in-house Team from the Engineering Services Department of VRA. The report provided information on characterisation of the intervention area, study of the site lay out, study of the electrical design, evaluation of the irradiation data, grid connection, environmental assessment requirements, etc. A detailed feasibility study report is expected to be developed to outline the final civil and electrical design for the PV plants. Existing approaches employed in developed PV markets will be considered and adapted to Ghanaian conditions and the project framework. It is expected that these documents will be subjected to review by external consultants as well the funding agency prior to finalisation.

3.10.3. Site Survey & Drawings

Currently, marked survey pillars, eight in number, have been placed at vantage areas for the identification of the PV project site. A site map has been prepared and approved for the PV Site. In addition, a preliminary line route survey has been done to identify the sub-transmission component of the project Site maps for the PV Power and Sub transmission Line component is shown Appendix 3. The final route for the sub-transmission line component of the project will be established and relevant maps to this effect will be produced to guide construction.

Survey Pillars at Project Site

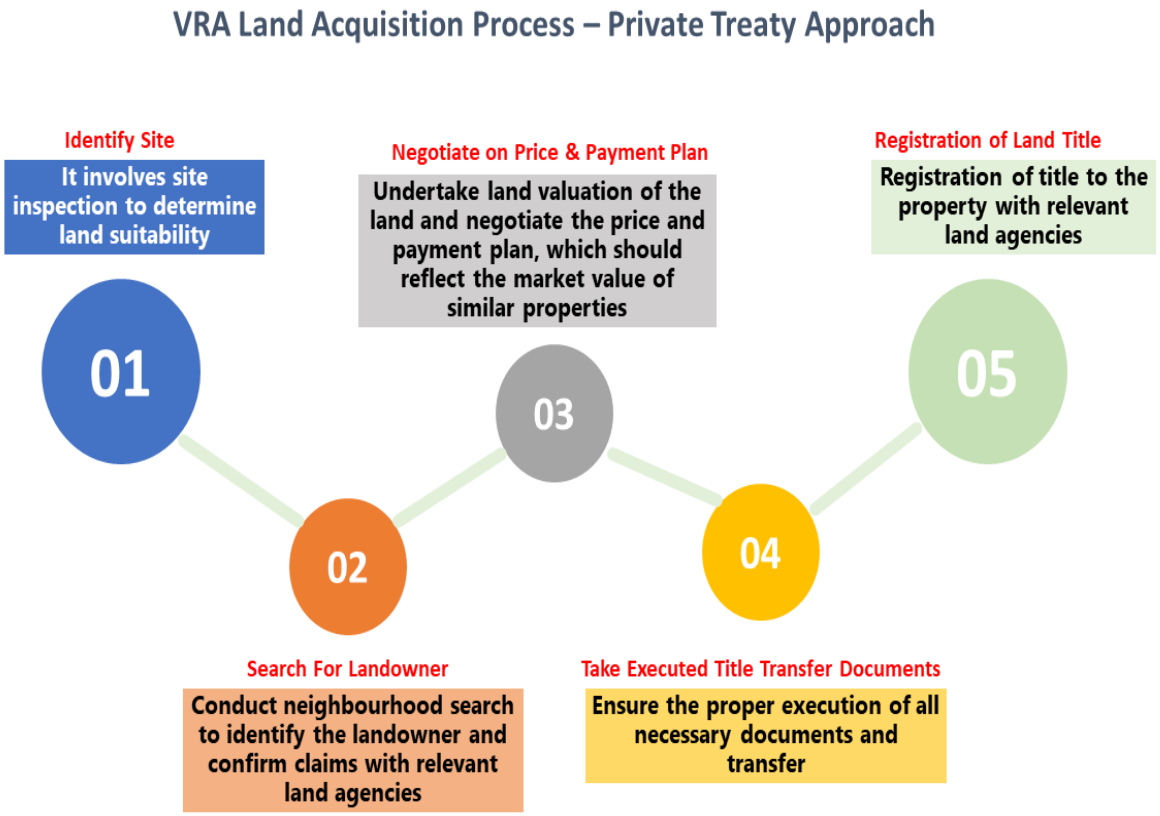
3.10.4. Land Acquisition & Compensation

There are no residence and structures at the site for both the solar power project at Asibiga or the 29 km 34.5kV sub-transmission line to the Bolgatanga Substation because the selection of the land site as discussed took into consideration the need to avoid such structures. The land acquisition process was facilitated by the VRA Property Valuation professionals, led by Frederick Kyei-Dompreh, a licensed member of the Ghana Institute of Surveyors. The process was supported by the traditional and the local political authority. The process of the land acquisition and compensation have been detailed out in Volume IV of the EIA Study Report**,** the ***"Land Acquisition & Resettlement Plan",*** that has been prepared for the project as part of the suite of documents for the EIA Study to inform and guide in the land procurement process. The total cost implication for the implementation of the land acquisition processes is GH¢736,920.46 and VRA shall solely be responsible for make funds available for these activities. The processes for the acquisition of land for the PV and sub transmission line is discussed below.

PV Solar Site

The land for the PV project site is a private land and was procured by VRA through private treaty transactions on mutually agreed price using Private Treaty Approach. Processes involved in this approach is shown in Figure 3-7.

Figure 3-7: Private Treat Approach to Land Acquisition



Compensation was assessed based on an arm's length discussions on current market values within the neighbourhood. Comparable land sales in the neighbourhood was hard to come by, however, field investigations collaborated by information from the Customary Land Secretariat revealed that plots of land averaging 0.23 of an acre leased for considerations ranging between GH¢2,000.00 - GH¢3,000.00. This works up to a rate of between GH¢8,000.00 - GH¢12,000.00 per acre. Commercial plots are sold at relatively higher prices. Having regards to the location, size of land and the intended use, a rate of GH¢4,000.00 per acre was deemed reasonable and fair and this was adopted and utilised for the payment of the land. Payment was made through the banking system using Stanbic Bank in Bolgatanga.

Land acquisition for the solar power facility has been completed and compensation has been paid in full for the site as well as economic trees on the site. Land was finally released by the traditional authority on behalf of the landowners (Property Affected Persons) to the VRA for use in December 2014. A declaration leasing out the land was made in December 2014 by Anafo Akor, the Chief of Asibiga. Subsequently, a 50-year lease agreement, commencing on January 1, 2015 has been executed between the Bongo Skin and VRA for the solar power site, a copy of which is attached as Appendix 4.

Sub-Transmission Line Component

Based on the selection of the optimal line route as discussed under Section 3.6.8, the 34.5 kV sub-transmission and associated distribution lines will, in principle, be constructed in the wayleave zones of the existing roads, transmission and distribution routes. Thus, for the sub-transmission line route, there would not be the need for any RoW acquisition with the associated resettlement and compensation. However, due to safety of the lines because of threats from falling economic trees, VRA in 2016 proceeded to undertake valuation of trees that are economic in nature and within 7.5m on each side of the line route. The most recent rates issued by the Lands Commission (i.e. 2014 rates) at the time were adopted and applied in the assessment of crops / economic trees affected by the proposed project.

These rates are captured in stands (per tree) or in acreage and are used in computing the compensation payable for each person. These rates are issued periodically by Lands Commission and are arrived at by considering factors such as:

- The farm gate price of the produce at the time period.
- The yield of the crop/ tree
- The stage and health of the produce, and
- Cost of establishing the farm produce at the various stages.

Payment of compensation has been completed and trees paid for included Shea butter, Dawadawa, Baobab, Teak, Berry and Mango. The assessed values were fair as the prevailing rates were used and all the affected properties included in the valuation. As construction has not commenced, the

owners are still allowed to pick up dawadawa fruits, sheabutter and berries from the land even though they have been paid for, and legally now belongs to the VRA.

3.10.5. Procurement of Project Contractor & Consultant

The development will proceed on a turnkey Engineering, Procurement and Construction (EPC) basis and a Project Contractor as well as Project Consultant (independent technical advisors) shall be engaged through competitive procurement bidding. The engagement process will be in line with the Public Procurement Act, 2003 (Act 663) as amended by the Procurement Amendment Act, 2016 (Act 914), of the Republic of Ghana. The risks of anti-competitive conduct such as bid rigging in procurement shall be mitigated by designing tenders in a way that minimises the likelihood of collusion, as required by the Public Procurement Authority (PPA).

VRA includes environmental, health and safety management requirements in the bid documents as part of the contractual clauses for the project, subsequently, the EPC Contractor would be required to provide a Health & Safety Plan, Environmental Protection Plan, Labour Management Plan and Quality Assurance Plan. This is to be used in conjunction with the VRA "**Safety, Health and Environment Standards for Contractors**". In addition, this EIA Report and its permitting requirements shall form part of the Contract documents for the Contractor. Subsequently, the contractor will be required to implement the measures proposed in this EIA and this will be agreed as part of the contract prior to actual construction.

3.11 Activities During Constructional Phase

3.11.1. Overview

The EPC Contractor will be responsible for the engineering, procurement of the power plant and associated components, transportation, erection on site (including civil works), installation, testing, commissioning. Design specifications to be followed during construction are to be in line with both the Ghana National Building Regulations, 1996, LI 1630 as well as the Ghana Standards Authority GS IEC 61836 - Solar Photovoltaic Energy Systems. All contractors for the project shall assume full professional liabilities regarding fulfilment of any statutory requirements and shall be expected to carry out all civil based works in line with VRA approved specifications and drawings as well as national/international standards and codes.

3.11.2. Geotechnical Investigations

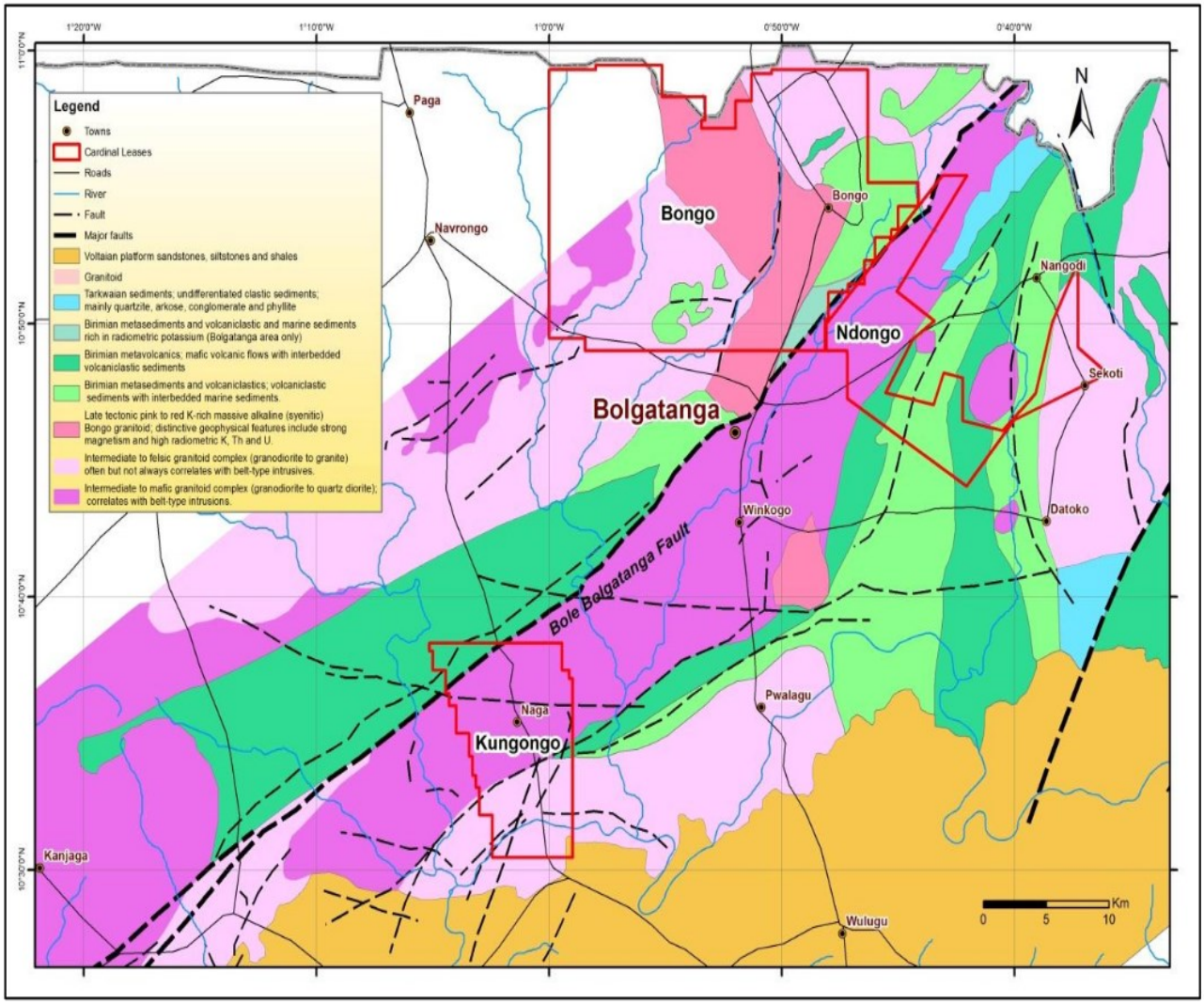
Geotechnical studies shall be conducted to determine the soil type, which will form the basis for the foundation type to be exploited. The results from the geo-technical study will also determine the topography's effect on the proposed design. Preliminary investigations indicated that there are no major fault lines at Bongo. Figure 3-8 shows the fault lines in the Upper East Region of Ghana[4].

[4] Report on Independent Geologist's Report Bolgatanga Gold Project, Ghana Subranum Gold Project, Ghana Kilo - Moto Gold Project, Democratic Republic of Congo by SRK Consulting (Australia

However, it is recommended that Geotechnical Investigations be done to confirm the assumptions made. In addition, the Geotechnical Investigations would provide information on the soil profile at the site which would inform the choice of mounting structure that would be used and provide information on the availability of ground water which could be used for the cleaning of the panels and use by the plant personnel during the operational phase of the solar PV plant.

It must be noted that this activity is to be done by the EPC Contractor and therefore will be dependent on the award of contract and findings cannot be included in this EIA Report. Findings of this study will be made available to the EPA when completed, as part of project environmental reporting.

Figure 3-8: Fault Lines at Bongo



Source: ***Draft Feasibility Study Report for the Bongo Solar Power Project, August 2017***

3.11.3. Transportation of Equipment

Materials and equipment procured locally or internationally will be transported directly to the storage site at the NEDCo Office in Bolgatanga. PV modules are fragile equipment; however, the current off-site traffic conditions to the storage site can satisfy the equipment transport requirements. It must be noted that the materials will not be bulky and unwieldy. They will therefore not require any specialised vehicles. A detailed description of the nature of the roads from Southern part to the project sites in the Upper East Region in the Northern part of Ghana has been discussed.

3.11.4. Civil & Related Works

Civil and related activities during the construction shall include the following:

- Site Preparation including fencing, clearing of bushes, pit filling, levelling and grading;
- Construction of site office and internal roads;
- Construction of temporary storage facilities;
- Foundation laying for ground mounted structures;
- Storage of PV modules delivery and their installation;

PV Mounting under the 35MW PV Project in the Upper West Region

- Laying of internal electrical connections;
- Construction of sub-station and office buildings;
- Installation of inverter and transformers;

3.11.5. Site Security

Site security during construction is the responsibility of the contractor, and will comprise security fencing, gates, and a gatehouse. The contractor's recommendations for site security during construction must meet the approval of VRA.

3.11.6. Testing & Commissioning

All systems will undergo a full functional and safety test to ensure that they are fit for purpose. The contractor will be responsible for functional testing, commissioning, performance testing and reliability testing of the complete plant. Testing and commissioning will require 24-hour operations.

3.11.7. Post Construction Demobilization

Upon completion of the construction phase, the EPC Contractor shall be responsible for all demobilisation activities in accordance with the requirements of the contract agreement documents.

3.12 Project Activities During Operations & Maintenance Phase

3.12.1. Solar Power Plant Component

Solar power plants do not require sophisticated operational and maintenance activities. Operation and maintenance of the system would involve replacement of modules, cleaning of PV modules, repair of inverters and other supporting equipment, which would be expected to occur on a limited basis at certain points during the system's estimated life cycle. Faulty components will be replaced as soon as problems are identified. An overview of a suggested preventive maintenance schedule is provided in Table 3-7.

Table 3-7: Overview on Suggested Preventive Maintenance Procedures

Item	Interval	Required Time	Workforce	Equipment
Cleaning of Modules	6 months	2 days	2 unskilled workers	Filtered water, cleaning brush, rubber lip, Transportation carriage
Maintenance of Inverter (depends on manufacturer instructions)	1 year	1 day	2 engineers	Electrician tools
Maintenance of Mounting Structure (visual inspection)	6 months	2 days	2 unskilled workers	Camera
Checking of Surge Arresters, Cables and PV Junction Boxes (visual inspection, test of cable fit, cleanliness of equipment, check on no intruded water)	6 months	2 days	1 technician	Electrician tools
Monitoring	weekly	4 days at implementation 0.5 days during operation	1 engineer	Service car, Camera
Metrological Sensor	weekly	1 hour	1 technician	Filtered water, Cleaning brush
Landscape and auxiliaries (fence, roads, vegetation, cleaning of all housings)	6 months	1 day	2 unskilled workers (for vegetation: 1 shepherd, if necessary)	For vegetation: lawn mower, For housings: broom, vacuum cleaner

3.12.2. Sub Transmission Line Component

After commissioning, ownership of the sub-transmission system will pass to VRA, and subsequently to its subsidiary company, NEDCo. Regular inspection of transmission lines, substations, and support systems is critical for safe, efficient, and economical operation of the Project. NEDCo staff will operate and maintain the substation and sub-transmission line once it has been commissioned. NEDCo operation and maintenance of the sub-transmission line will be based on their existing procedures and corporate policies. Operations and maintenance activities will include transmission line patrols, climbing inspections, tower and wire maintenance, insulator washing in selected areas as needed, vegetation management, land uses, and access roads repairs.

3.13 Decommissioning Activities

A Decommissioning & Site Closure Plan (DCP) is required to guard against the remote possibility that the project ceases to operate and the facilities are abandoned by VRA, and this has been discussed in Chapter 9.

3.14 Resource Requirements

3.14.1. Manpower Requirements

In line with the VRA Local Content Policy and the Energy Commission Local Content & Local Participation, Regulations, 2017, LI 2354, the Contractor is required to have a local component. It is expected that a peak construction work force of approximately 70 locals will be contracted, including community members, during the construction period. This work force will be employed on short term basis during the project. The EPC Contractor and Consultant direct workers staff will comprise of about 10 expatriates and 15 Ghanaians. During the operational phase, a dedicated team of about 10 VRA engineers and technicians will be responsible for the upkeeping of the plant. Security and cleaning tasks will be outsourced and supervised by the O&M team. Estimated labour requirements for the project during the various phases is illustrated in Table 3-8.

Table 3-8: Project Related labour Requirements

Type of labour	No. of Personnel			
	Pre-Constructional Phase	Constructional Phase		O&M Phase
	VRA	VRA	Contractor	VRA
Project Director	1	1	1	1
Other Directors	2	2	0	2
Project Manager	1	1	1	1
Supporting Managers	3	3	5	2
Site Engineers	0	1	2	0
Office Engineers	3	3	5	1
HSE Officers	3	2	1	2
Valuation Officers	2	2	0	0
Geodetic Engineers	2	2	2	0

Type of labour	No. of Personnel			
	Pre-Constructional Phase	Constructional Phase		O&M Phase
	VRA	VRA	Contractor	VRA
Auxiliary Officers	2	2	2	2
Tech. Engineers	2	5	3	10
Local Contract Workers	0	0	70	3
Total	21	24	92	24

3.14.2. Land Take Requirements

As indicated, a land area of 50.13 ha (0.5013 km^2) has been acquired at Asibiga, in the Bongo District. It is within this site that the associated substation will be developed. In addition, an associated 23 km sub-transmission line with a 15m Right of Way, is to be developed, and this will occupy a total of 0.345 km^2 area. Thus, a total area of 0.8463 Km^2 would be required for the solar power plant and the associated sub transmission line project in the Bongo District. The additional 6km stretch of sub-transmission line within the Bolgatanga Municipality will be within existing Bolgatanga-Ouagadougou 161kv Tower lines and therefore will not require additional land. Details of the land acquisition process for the PV and sub-transmission line has been discussed under Section 3.10.4.

3.14.3. Water Requirements

Estimated water requirements for the project has been summarised in Table 3-9. Estimation for civil works and PV panel cleaning is based on past projects. For example, at the Navrongo Solar Power Station, located about 50km away, the average annual water consumption for 2017 and 2018 was 32,350 litres. This implies that an amount of 3.752 litres of water is used per module (given that there are 8,622 modules at the station. Using this background information, the total water requirement for the project with a total of 64,525 modules has been estimated around 242 m^3/year. The estimated volume for worker requirements was calculated using the Water Science Activity Center water requirements,[5] and was based on a maximum construction workforce of 70 person and 10 operational staff.

Table 3-9: Project Water Requirements

Project Phase	Activity	Estimated Water Requirements	Source of Water
Construction	Civil Works	20 m^3litres/Day	Water tankers from local suppliers
	Worker Personal Use	4.025 m^3 litres / day	
	Drinking	0.175 m^3 litres / day	Sachet/Bottle Water
Operational	Panel Cleaning	242 m^3/year.	Groundwater from Boreholes
	Worker Personal Use	0.575 m^3 litres / day	
	Drinking	0.025 m^3 litres / day	Sachet/Bottle Water

[5] https://water.usgs.gov/edu/activity-percapita.html

3.14.4. Power Requirements

The project will consume about 30Kwh mainly for site works, lighting purposes and constructional work, during the constructional period. Power for construction and project activities will be obtained from the existing 34.5 kV power system lines of NEDCo which will be connected by NEDCo on behalf of VRA as well as a 135kV Stand-by generator. For the operational phase, the proposed project will not consume energy, but will instead provide a new source of clean, renewable electricity not only into national grid but for operational activities of the solar facility itself.

3.14.5. Raw Materials Requirements

Raw materials required such as aggregates, cement, reinforcing bars, fencing materials and other materials for the construction of the project can be locally procured in Ghana and local materials will be used as much as possible for the project. These are to be sourced from the Bongo District and the Bolgatanga Municipality, as appropriate, and will be done in consultation with the local government authorities to ensure the acquisition of any permits if required. Winning of sand and aggregates will require state permitting, subsequently, the EPC Contractor will most likely outsource the acquisition of these materials to local contractors who already have such permits. Other local procurement will include foodstuffs and miscellaneous supplies and services.

3.14.6. Cultural Heritage Resources

The cultural properties that have been identified so far within the project impact area is discussed under Section 4.8.6. VRA in principle negotiates on the cost of items required for any relocation and agrees on the monetary value which is later presented to the appropriate person(s) for the necessary rites to be performed. Dates for performing such rites are agreed and is usually witnessed by the VRA team for records purposes.

Pacification Rites for Site Acquisition

Based on request from the Landowners, VRA provided for the performance of the necessary pacification rites for the site to pave way for the VRA surveyors to undertake surveying, pillaring and demarcation of the land for the project to take off. The rites were performed by the Tindanas (landlords of Bongo) in March 2014. Outstanding is the pacification for the relocation of the identified shrines at the PV Site. No additional pacification rites are expected under the project.

3.15 Risk Assessment & Management

Risk assessment and management shall be an integral part of the proposed project's execution. Risks related to project execution and operations shall be identified by a structured approach. Risk assessments shall be planned and conducted in advance of appropriate activities to allow resolution of risk without schedule interruption. Competent personnel shall be included in risk assessments to ensure that risks are correctly identified and assessed. The responsibility of risk management in the proposed project lies with the EPC contractor, and would involve developing a detailed site risk assessment and control to cover all aspects of the work. Monitoring by the VRA Project Management Team will ensure that contractor processes are being implemented fully and effectively.

3.16 Future Upgrades

While no specific upgrades to the solar arrays or project footprint are planned at this time, it would be reasonable to expect that future technological improvements may warrant changing some or all PV panels in order to achieve improved efficiency. It is also conceivable that future upgrades, employing similar updated technologies, could be proposed to expand the arrays beyond their current proposed footprint. Any future upgrades would be reviewed through established EPA procedure.

40MW SOLAR POWER PROJECT AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 4: DESCRIPTION OF THE EXISTING ENVIRONMENT

4 DESCRIPTION OF EXISTING ENVIRONMENT

4.1. Introduction

This Chapter provides a detailed report covering all aspects of the existing physical environment, biological environment, ecological sensitive areas as well as socio-economic conditions. It must be noted that even though the project is specific to the Asibiga community as well as communities along the transmission line route, namely Bongo, Soe, Yorogo, Zare, which can be described as the immediate impact area (assessed within 2km from the specific project sites), its environmental and social influence may affect a large area of the other parts of the affected districts in question. Thus, aside providing specific data on the project site, it also includes information such as climate, social-economic development that transcends the specific communities and is general to the Bongo district, defined as the broader impact area.

4.2. Data Collection Methodology

A study on the existing biophysical and social environment commenced in 2014 and this was achieved through the collection of both primary and secondary data. For primary data, a site reconnaissance visit was done by the Environmental Safeguard Specialists in November 2017 and November 2019 to collect baseline data (dry season) in the context of physical and ecological environment as well as socio-economic and land use. Wet season data was gathered by the Team in July 2018. Baseline data on noise as well as traffic at the project site were obtained during these visits. VRA in October 2018 engaged the services of the Forest Services Division, Bolgatanga to undertake a quantification and listing of identified flora and fauna within the PV project site and a report on this was submitted in January 2019. The flora and fauna survey teams were led by two seasoned Forest Range Manager and a Wildlife Officer respectively.

The baseline data for the flora and fauna, compensation report indicating types of economic trees paid for as well as the site reconnaissance visit provided relevant data for the bio-physical environment. The compilation of the social data, including cultural heritage sites, in the communities was mainly coordinated in consultation with the locals. The secondary data to supplement the primary social was collected through a wide literature review on the project as well as the project area, and this included the following:

- 2010-13 Medium Term Development Plan for the Bongo District Assembly.
- 2014-17 Medium Term Development Plan for the Bongo District Assembly.
- 2018-2021 Medium Term Development Plan for the Bongo District Assembly.
- 2010 Population & Housing Census, District Analytical Report, Bongo District Assembly, October 2014.
- 2019-2022 Programme Based Budget Estimates for 2019 Bongo District Assembly
- Bongo District Water & Sanitation Plan, August 2008.
- Bongo Solar Power Project - Draft Feasibility Study, August 2017
- School Report Card, Ghana Education Service, Bongo District, 2016
- Report on Acquisition of Site, Bongo Power Project, June 2014
- Bongo Solar Power Project, Valuation Report on Economic Trees, May 2016

- Bongo Solar Power Project, Baseline Flora & Fauna Survey Report, January 2019

4.3. Ghana in Brief

The Republic of Ghana is located along the Gulf of Guinea and Atlantic Ocean, in the sub region of West Africa. Spanning a land mass of 238,535 km^2, Ghana is bordered by the Ivory Coast in the West, Burkina Faso in the North, Togo in the East and the Gulf of Guinea and Atlantic Ocean in the South. Ghana's population of approximately 29 million and there are diverse geography and ecology ranges from coastal savannahs to tropical rain forests. Ghana is a unitary constitutional democracy led by a president who is both head of state and head of the government. Ghana's growing economic prosperity and democratic political system have made it a regional power in West Africa. It is a member of the Non-Aligned Movement, the African Union, the Economic Community of West African States, Group of 24 (G24) and the Commonwealth of Nations.

Ghana is classified as a middle-income country. GDP estimates for 2017 showed a growth rate of 8.5% compared to 3.7% in 2016. The Industry sector recorded the highest growth rate of 16.7%, followed by Agriculture (8.4%) and the Services (4.3%) sectors. Ghana is an average natural resource enriched country possessing industrial minerals, hydrocarbons and precious metals. The top exports of Ghana in 2017 were pearls, precious stones and metals (41%); mineral fuels, oils, distillation products (25%); cocoa and cocoa preparations (17%). For the remaining 17%, Ghana has exported mainly fruit, plastic, vegetables, wood, fish and aluminium. Its main exports partners are Netherlands, Burkina Faso, South Africa and United Kingdom[6].

Electricity generation is one of the key factors in order to achieve the development of the Ghanaian national economy, with aggressive and rapid industrialisation. The generation capacity in Ghana by VRA and Independent Power Producers (IPP) as at December 2019 is shown in Table 4-1 with thermal and large scale hydropower generation constituting 99.2% of the total installed capacity in Ghana.

[6] Source: https://tradingeconomics.com/ghana/exports

Table 4-1: Installed Generation Capacities in Ghana as At December 2019

Plants	Installed Capacity (MW)	Dependable Capacity (MW)	Fuel Type
Akosombo GS	1020	900	Hydro
Kpong GS	160	105	Hydro
TAPCO (T1)	330	300	LCO/Gas
TICO (T2)	340	320	LCO/Gas
TT1PP	110	100	LCO/Gas
TT2PP	80	70	Gas
KTPP	220	200	Gas/ Diesel
VRA Solar Plant	2.5	0	Solar
TOTAL VRA	2,263	1,995	
Bui GS	404	360	Hydro
CENIT	110	100	LCO/Gas
AMERI	250	230	Gas
SAPP 161	200	180	Gas
SAPP 330	360	340	LCO/Gas
KAR Power	470	450	HFO
AKSA	370	350	HFO
BXC Solar	20	0	Solar
Meinergy Solar	20	0	Solar
Genser	60	60	Gas
CEN Power	360	340	LCO/Gas
Amandi	190	190	LCO/Gas
TOTAL IPP	2,780	2,558	
TOTAL (VRA, Bui & IPPs)	5,043	4,553	

Source: 2020 Electricity Supply Plan for The Ghana Power System

4.4. National Greenhouse Gas Emissions

According to the Second Biennial Update Report submitted to the UNFCC in September 2018, Greenhouse gas (GHG) and Short-lived Climate Pollutant inventory was conducted for the period 1990-2016 using the latest 2006 IPCC guidelines. The total national greenhouse gas emissions are estimated at 31.5 million tonnes carbon dioxide equivalent (MtCO2e) in 2016 representing 65% increase compared to 2000 emissions. The increasing trends in the overall emissions is attributed to the rising population and the economic diversification measures. The Energy sector contributes 50.2% of the total 2016 GHG emissions.

Within the Energy sector, road transport and electricity generation are the two dominant sources of GHG emissions. GHG emissions from Agriculture, Forestry and Other Land Uses (AFOLU) is the

second dominant source (36.4%) of the total GHG emissions in the same year. Emissions from the Waste and Industrial Process and Product Use (IPPU) sectors contributed respectively to 10.1% and 3.3% of the total emissions. Some of the selected top levels and trends key categories of the emissions and removals are: (a) forest land remaining forest land, (b) lands converted to cropland, (c) lands converted to grassland, (d) road transportation, (e) energy industries etc.

In terms of gas species, Carbon Dioxide (CO_2) is the most dominant greenhouse gas totalling 16.22 Mt in 2016, of which road transportation and electricity generation account for 42.7% and 31.1% respectively. Methane (CH_4) emissions levels of 0.32 Mt is the second dominant greenhouse gas and the highest short-lived climate pollutant. Majority of the CH_4 emissions come from livestock (48.3%), wastewater treatment and discharge (19%) and solid waste disposal (16.9%). Emissions levels of the rest of the greenhouse gases are as follows: Nitrous oxides (N_2O), (0.025 Mt), Perfluorocarbon (PFCs) (0.613 $MtCO_2e$) and Hydrofluorocarbon (HFCs) (0.033 $MtCO_2e$).

4.5. General Site Information

4.5.1 Geographical Location

The PV project and about 23km of the associated sub transmission is located within the Bongo District whilst about 6 km of the sub-transmission line also located within the Bolgatanga Municipality, all in the Upper East Region of Ghana. The Upper East Region is in the north-eastern corner of Ghana between Longitude 0° and 1° West and Latitudes 10° 30' to 11° North. It has two international boundaries, namely Burkina Faso to the north and the Republic of Togo to the East. The Bongo District lies between longitudes 0.45°W and latitude 10.50°N to 11.09°N and has a total area of 459.5 square kilometres. The District shares boundaries with Burkina Faso to the North, Kassena-Nankana East to the West, Bolgatanga Municipal to the South West and Nabdam District to South East (see Figure 3-2). The Bongo District is made up of thirty-six (36) communities and has seven (7) Area Councils.

4.5.2 Land Use

The PV site and its surroundings is mainly savanna grassland, interspersed with trees, the major economic ones being Sheanuts, neem and fig trees. The area is predominantly dominated by Shea tree just so because of its commercial potential and importance to the livelihood of the rural folks in particular and the rural economic ecology of the community in general. Community members pick sheanuts from the site. The site location is fairly flat, undulating plains with sparse woody vegetation amidst mosaic of extensive farming characterized by sandy soil. The soils of the district exert great influence on the pattern of land-use. The landscape is largely put into annual/seasonal agricultural land use system and livestock grazing, predominantly cattle grazing with trees in a patchy non-contiguous arrangement, scattered over the site. Land is basically allocated for farming, grazing, forest reserves, settlements, road network, dams and dug-outs. The pattern of farming is of compound subsistence farming. In cultivating the soil located in the stony areas, the stones are shifted into control heaps against which terraces are formed.

The above description is typical of the project site. Land use at the site was identified as being mainly for farming purposes and animal husbandry. Indeed, during the field survey, groundnuts was being harvested and mounds of yam were observed. The harvesting was being done mainly by women. Livestock like cattle, goats and sheep were abundant in the area. The remnant woodland vegetation apart from protracted farming and overgrazing, practically by cattle, also suffers annual wildfires contributing to un-sustained regrowth to cover up open gabs. Limited cultivation such as millet, groundnut and Bambara beans depending on the season is, however, undertaken within the Project Site. See Plate 4-1 for pictures of land use at the PV Site.

Plate 4-1: Typical land use Activities at the PV Site at Asibiga

There are no visible sources of surface water on the PV site. The solar site harbours two family tree shrines (one Baobab and one ficus tree) and an ancestral grave and VRA has commenced the necessary discussions with the landowners and community leaders for pacification rites as required before the projects commence. Again, there are no residential buildings within the site and also no habitants on the land and therefore no relocation of individuals will also be required. The immediate neighbourhood of the project site at Asibiga is not covered by any layout, however information from the Customary Lands Secretariat indicate that the surroundings areas have been planned. Lands lying between the Bongo Township and the project area, in which the sub-transmission component also will be physically located, have been reserved for future development. Most of the developments around the project area are traditional mud houses designed for occupation by households. They are roofed with either thatch or zinc sheets (See Plate 4-2).

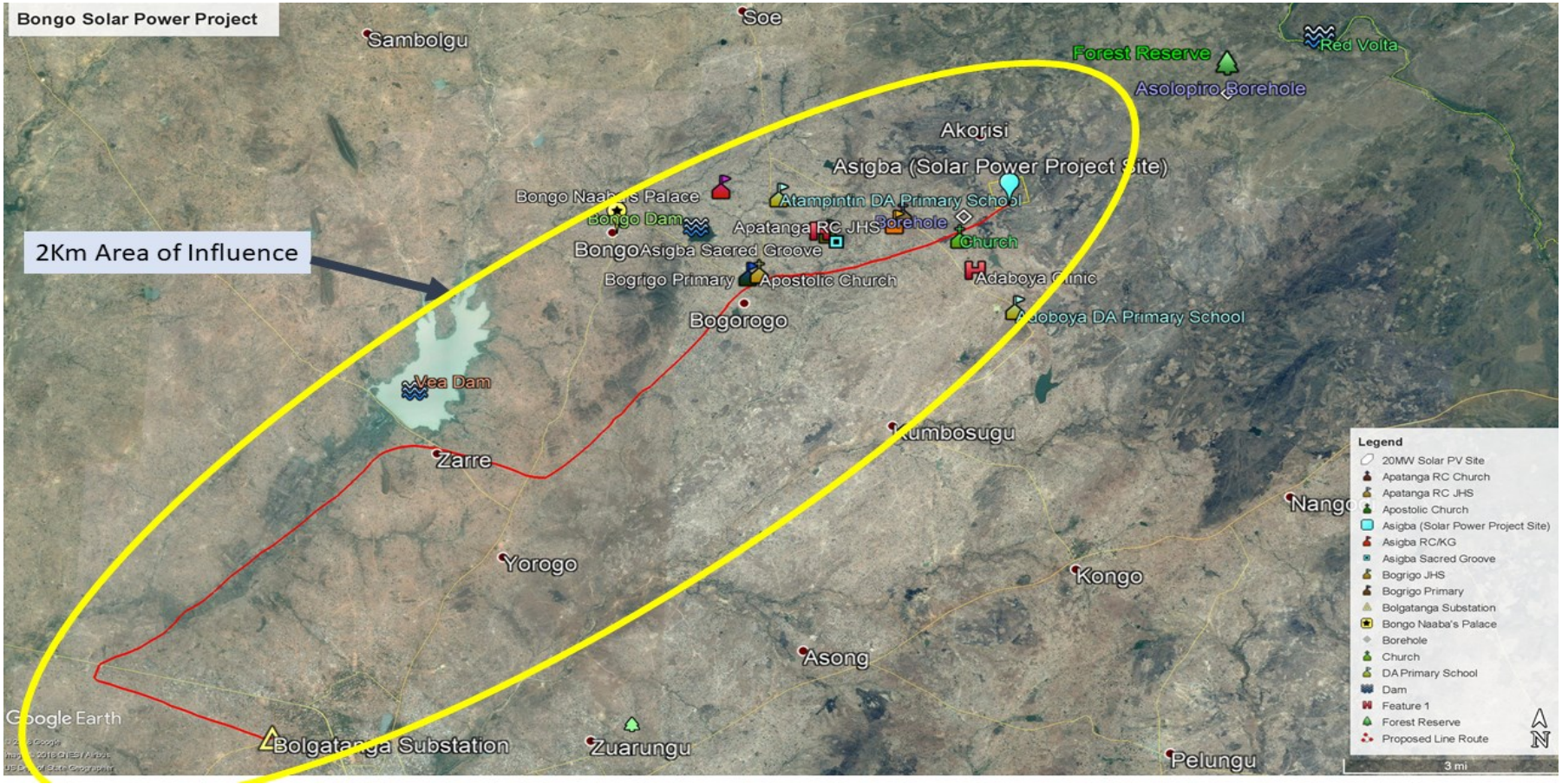
Plate 4-2: Typical Round Huts within the Project Enclave

The neighbouring / sensitive features around the immediate project site (within 2km) of the solar / sub-transmission project sites and their coordinates as well as distances from the project sites are shown in Table 4-2 and a satellite view shown in Figure 4-1.

Table 4-2: Neighbouring Infrastructure Within the Project Area

Name of Neighboring Sensitive Facility	Latitude	Longitude	Distance from PV Site at Asibiga (km)	Distance from Proposed Transmission Line Route (km)
Adaboya Clinic	10.8995	-0.7339	2.4	1.3
Akanaba CHP Compound	10.9077	-0.7656	4.4	0.75
Akigba RC/Kg	10.9104	-0.7639	4.15	1
Akigba Sacred Grove	10.9082	-0.7621	4	0.72
Apaatanga Catholic Church	10.915	-0.7489	2.43	0.95
Apaatanga RC, JHS	10.9129	-0.7504	2.65	0.8
Apostolic Church	10.9009	-0.7778	6.16	0.24
Bogorogo JHS	10.9201	-0.7860	6.42	2.6
Bogorogo Primary	10.9002	-0.7799	5.93	0.37
Bolgatanga Substation	10.7952	-0.8707	20.9	-
Bongo Dam	10.9059	-0.7920	7.1	1.81
Ghana-Daa RC, Kg/Primary	10.915	-0.7489	2.43	0.95
Vea Dam	10.8736	-0.8453	13.9	0.43
Zopelga Prayer Ground	10.9157	-0.7285	0.53	0.12

Figure 4-1: Project Site Showing Key Social Features



Source: VRA Engineering Services Department (February 2018)

4.5.3 Transport & Traffic

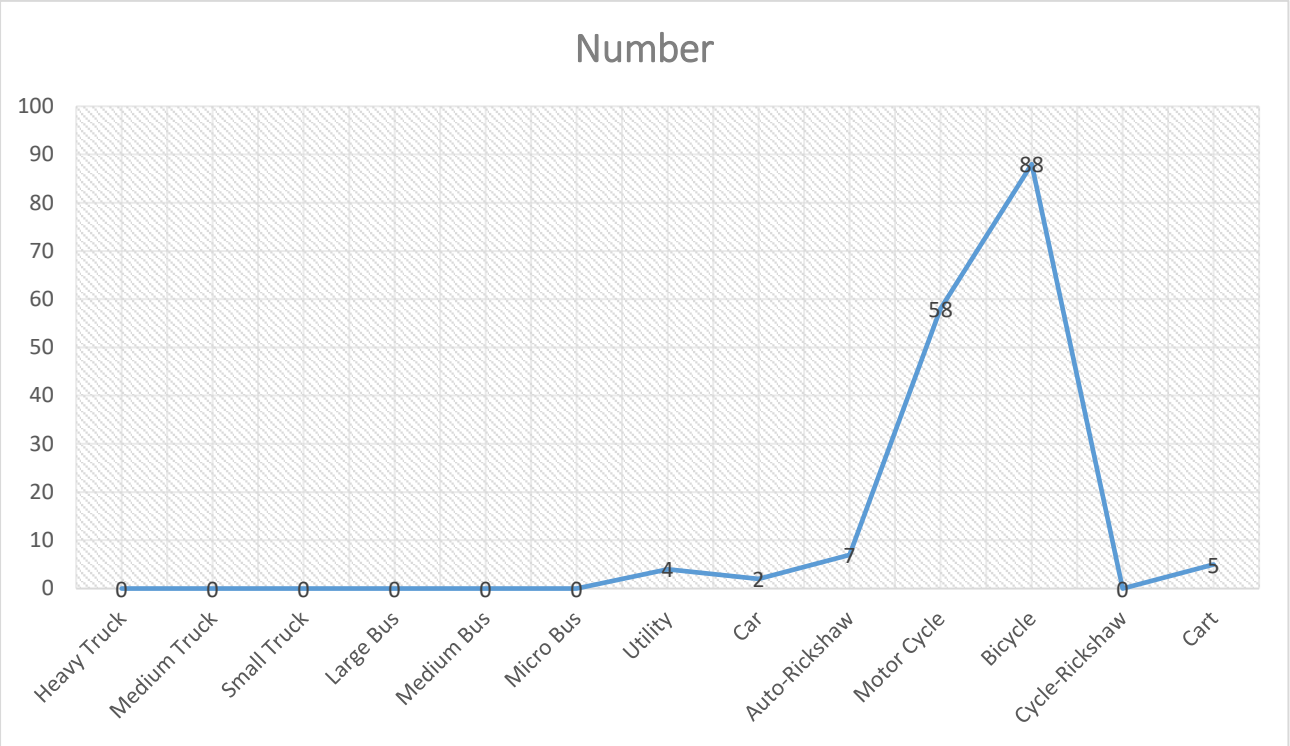
The proposed solar site and majority of the sub-transmission line within the Bongo District is rural and serene and experiences virtually no public transportation. There is an untarred road on the southern border of the acquired land which links Bongo to Bolgatanga and the site is accessible via this road. Generally, the use of donkey carts, motorcycles, bicycles and auto rickshaws are common sights in the District. Thus, traffic load from vehicles on the road network within the Bongo District is very low. However, areas within the Bolgatanga Municipality is however well served by public transport, the local bus service known as the Metro Mass, as well as short-hub transport, popularly known as "Tro-tro", as well as taxis runs several times on the route

A 3-Day traffic survey was undertaken from July 23-25, 2018 to assess the volume of traffic in the PV Site area. This was done close to the project site on the Asibiga and the results are shown Table *4-3* and Figure 4-2. During the baseline survey, the mode of transportation for most of the public at the project site was by donkey cart and auto rick show. Individuals mostly use bicycles and motorcycles. This can be attributed to the largely bad roads within the area, which make its unmotorable by saloon cars as well as the low level of income of the community members. Vehicles able to use such roads will be mainly four-wheel drives.

Table 4-3: Results of 3-Day Traffic Survey at PV Project Site

Transport Type	July 23, 2018	July 24, 2018	July 25, 2018	Total
Heavy Truck	0	0	0	0
Medium Truck	0	0	0	0
Small Truck	0	0	0	0
Large Bus	0	0	0	0
Medium Bus	0	0	0	0
Micro Bus	0	0	0	0
Utility	0	4	0	4
Car	0	2	0	2
Auto-Rickshaw	3	2	2	7
Motorcycle	20	38	0	58
Bicycle	52	34	2	88
Cycle-Rickshaw	0	0	0	0
Cart	4	1	0	5
Total	**79**	**81**	**4**	**164**

Figure 4-2: Graphical Representation of Results of Traffic Survey



4.6. Physical Environment

4.6.1. Atmospheric & Climatic Conditions

The climate in the project affected districts of Bongo District and Bolgatanga Municipal, all in the Upper East Region are similar and is classified by Gmet Classification as having a Tropical Savannah Climate (Aw). There are two seasons, the dry and the wet seasons. The wet season commences from early April and ends in October. The Bongo District has an average of some 70-rain days in a year with rainfall ranging between 600mm and 1400mm (2010 PHC District Analytical Report). The rains fall heavily within short periods of time, flooding the fields and eroding soils into rivers. However, the fields dry up soon after the rainy season.

Mean monthly temperature is about 21°C. Very high temperatures of up to 40°C occur just before the onset of the single rainy season in June. Low temperature of 12°C are experienced in December when desiccating winds from the Sahara dry up the vegetation. During the dry season, ideal conditions are created for bush fires, which have become an annual phenomenon of the environment. Wind speeds are relatively higher during the dry seasons in December and January. Relative humidity figures are usually high in the rainy season, which spans from July to September (92%) and low in the dry harmattan period from December to March (15%). Duration of wind speeds and rainfall is a critical factor and must guide modalities for constructional activities.

Climatic data covering years 2009-2017 was obtained from the nearest national synoptic weather station at Navrongo, Weather station: 654010 (DGLN) located at Latitude: 10.9 | Longitude: -1.1 | Altitude: 201 and this is presented in Table *4-4* to Table 4-7. This weather station is very representative of the area within which the proposed project will be located.

Table 4-4: Data on Average Temperature (°C) in Project Area

Average Temp °C	2009	2010	2011	2012	2013	2014	2015	2016	2017
January	28.6	28.9	33.5	28.0	29.2	28.4	29.3	28.8	29.4
February	32.4	31.8	35.1	30.7	32.1	31.5	32	31.4	31.5
March	33.6	34.5	40	33.0	34.5	32.8	33.5	34.7	34.3
April	32.8	34.1	38.4	32.5	32.8	32.7	34.3	35.0	34.5
May	31.5	31.4	35.5	30.6	30.7	31.5	33.8	31.9	31.2
June	29.1	28.5	33.3	28.0	30.4	30.2	30.3	29.6	29.1
July	27.4	27.1	31.8	27.1	27.6	28.6	28.4	29.6	27.0
August	27.0	26.9	30.1	26.6	26.7	27.6	27.1	27.9	27.6
September	27.7	27.1	31.6	26.8	27.4	27.3	27.6	27.4	28.4
October	28.3	28.4	34.2	28.1	28.9	29.4	ND	29.6	29.9
November	29.0	29.7	36.9	30.4	31.6	30.1	30.6	31.4	30.7
December	29.3	27.9	34.6	30.1	30.7	29.9	27.7	29.0	36.6

Table 4-5: Average Data on Mean Visibility (km) in Project Area

Mean Visibility (Km)	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan.	5.1	7.6	4.6	5.4	6.9	9.1	7.1	4.5	7.4
Feb.	7.5	7.6	9.1	5.5	7.7	7.5	9	4	5.3
Mar.	9.9	5.3	12.9	4.7	8.9	9.7	6.2	4.6	8.6
April	13.9	10.8	11.6	10.8	11.4	14.1	9.2	11.9	8.3
May	16.7	12	13.6	15.3	13.7	14.3	12.5	12.6	8.9
June	17.3	11.9	14.2	15.3	16.1	13.9	13.5	13.3	9.5
July	16.4	11.9	14.4	13	11.8	13.9	12.6	12.2	10.1
Aug.	16.4	12	13.1	12.8	13.6	14.3	12.7	12.2	10.7
Sept.	17.1	11.9	13.4	12.6	14	14.4	12.6	12.7	11.3
Oct.	17.5	12.8	11.3	15	9	14.2	ND	11.8	11.9
Nov.	12.7	10	6.6	8.2	9	8.9	8.6	7.3	12.5
Dec.	7.2	7.3	5.6	5.6	5.4	7.6	3.9	5.8	13.1

Table 4-6: Average Data on Humidity (mm) in Project Area

Humidity (mm)	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan.	0	0	0	0	0	0	0	0	0
Feb.	14.99	0	0	1.02	0	0	3.05	0	0
Mar.	1.02	0	0	0	7.11	0	0	0	36.07
April	23.88	16	45.47	59.95	76.2	8.89	26.67	20.83	0.76
May	39.88	40.89	98.04	66.81	95	44.96	20.07	33.53	18.795
June	65.53	213.1	62.99	67.31	23.11	15.7	58.93	61.22	22.63
July	61.99	162.05	29.71	128.27	81.54	85.85	92.2	62.49	26.465
Aug.	191	233.18	311.16	85.6	66.03	60.72	186.71	106.94	30.3
Sept.	82.56	146.3	59.71	204.21	29.46	84.32	73.91	112.28	34.135
Oct.	84.83	67.06	2.55	39.12	13.97	14.99	ND	6.1	37.97
Nov.	1.02	0	0	0	0	0	0	0	41.805
Dec.	0	0	0	0	0	0	0	0	45.64

Table 4-7: Average Data on Mean Wind Speed (km/hour) in Project Area

Mean Wind Speed (Km/hour)	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan.	4.4	5.0	9.9	10.9	7.2	6.3	6.9	6.0	7.0
Feb.	3.8	6.2	9.5	9.5	6.9	5.9	5.3	4.5	6.0
Mar.	4.9	8.3	6.9	7.1	6.4	4.5	4.8	4.6	5.2
April	6.4	8.3	6.6	5.7	5.9	6.6	5.7	4.6	5.2
May	5.3	6.6	6.3	4.3	5.1	4.6	7.3	5.7	5.3
June	5.5	4.9	6.5	4.7	6.1	4.8	5.3	6.8	4.9
July	4	5.3	7.0	5.1	5.7	4.4	5.6	5.4	4.7
Aug.	2.5	5.5	6.8	5.0	4.5	4.8	4.4	5.2	4.1
Sept.	2.7	4.8	6.3	4.6	5	4.1	4.9	5.1	4.6
Oct.	3.5	7.9	7.4	4.3	3.6	4.2	ND	4.5	4.4
Nov.	3.9	6.0	6.2	5.2	3.8	5.6	5.1	5.1	4.4
Dec.	4.9	7.0	10.1	6.9	7.6	7.1	7.3	7.0	6.0

4.6.2. Ambient Noise

The Ghana Standard for Health Protection – Requirements for Ambient Noise Control (GS 1222:2018) specifies the requirements for acceptable ambient noise control emission levels within categorized locations. It does not apply to sounds generated by nature without human intervention. GS 1222:2018 mandates the use of the "ASTM E1014 Standard" for the measurement of outdoor A-weighted sound levels. The standards offer guidance that is intended to prevent or reduce noise pollution at the local level, by suggesting suitable daytime and night-time noise levels at the external facade of a building, or alternatively, inside the structure. The standards also provide advice on how to minimise the adverse impacts of noise at the planning stage of a development and are an

integral component in development plan policies. The control of noise in Ghana is largely accomplished through such guidance and legislation and is normally implemented by the EPA.

Classification of areas of noise descriptions by zones by the GS1222:2018 is shown in Table 4-8. The permissible noise requirements per each zone is also provided in Table 4-9. From the definitions and the existing conditions at Asibiga in the Bongo District and the associated transmission line to the Bolgatanga Municipality, the project sites can be described as belonging to Zone B Category for now but will move to Zone C Category during project operations.

Table 4-8: Classification of Area of Noise Description into Zones

Zone	Description of Area
A	Residential areas
B	Educational (school) and health (hospital, clinic) facilities, office and courts
C	Mixed used (Residential areas with some commercial or light industrial activities)
D	Areas with some light industry, places of entertainment or public assembly, and places of worship
E	Commercial areas
F	Light industrial areas
G	Heavy industrial areas

Source: Ghana Standard - GS 1222:2018

Table 4-9: Ambient Noise Control Level Requirement

Zone	Permissible Noise Level In dB(A)	
	DAY (6:00am - 10:00pm)	NIGHT (10:00pm - 6:00am)
A	55	48
B	55	50
C	60	55
D	65	60
E	75	65
F	70	60
G	70	70

Source: Ghana Standard - GS 1222:2018

A 2-day survey of baseline noise levels were carried out in July 2018 within the environ of the project site at Asibiga where noise was likely to be an impact during the constructional and operational phases of the project cycle. The integrating meter used conforms to the latest edition of American National Standards Institute (ANSI) S1.43. The entire instrumentation system was calibrated in accordance with the manufacturer's recommended procedure before and after each test series. Sound level measurements were made in A-weighted decibels (dBA) with the microphone about 1.2m to 1.5m above the ground before 9 a.m. when construction will not have started and between 11 a.m. – 5 p.m. when construction will be underway. The meter was set for slow response and the data recorded represented the time average of the meter readings at that location.

The results of this baseline data on noise levels, compared to the permissible levels as set by *Ghana Standard - GS 1222:2018* as well as that of the EHS Guidelines, is shown in *Table 4-10*. Noise levels before 9 am were all largely within the permissible values, whilst some of the values before 5 pm exceeded these levels. The exceedance was basically due to movements of motor bikes during such period.

Table 4-10: Results of Noise Monitoring Levels in dB(A)

Measuring positions	**Measured values (average),**		**Peak values**		**GSA Permissible Noise level**	**EHS Guidelines Community Noise Level**
	< 9 a.m.	11 a.m. – 5 p.m.	< 9 a.m.	11 a.m. – 5 p.m.	6am – 10pm	6am – 10pm
N - 10°54'47.0" W - 000°44'53.4" Elev.- 244m	Day 1 - July 24, 2018					
	32.5	48.36	35.6	53.8	55	55
	Day 2 - July 25, 2018					
	33.0	55.0	34.0	57.0	55	55

4.6.3. Ambient Air Quality

The Ghana Standard for Environment and Health Protection- Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236: 2019) specifies the requirements and methods of analysis for ambient air. The Standards mandates the use of "ASTM D4096-17, Standard Test Method" or the determination of Total Suspended Particulate Matter in the Atmosphere (High—Volume Sampler Method). Per the standard, the maximum permissible levels for ambient air pollutant is shown in Table 4-11.

Table 4-11: Ambient Air Pollutants – Maximum Limits

#	Substance	Maximum Limits	Averaging Time	Test Method
1	Sulphur Dioxide (SO2), µg/m3	520	1 hour	AS 3580.4.1
		50	24 hours	
2	Nitrogen Oxides (measured as NO2), µg/m3	250	1 hour	ISO 7996
		150	24 hours	
3	Total Suspended Particulate Patter, µg/m3	150	24 hours	ASTM D4096 - 17
		80	1 year	
4	PM_{10}, µg/m3	70	24 hours	ASTM D4096 - 17
		70	1 year	
5	$PM_{2.5}$, µg/m3	35	24 hours	ASTM D4096 - 17
6	Black Carbon, µg/m3	25	24 hours	ASTM D6602 -13
7	Benzene, µg/m3	**5**	**1** year	ASTM D5466 — 15
8	Lead, µg/m3	0.5	1 year	ISO 9855
		1	24 hours	

Source: Ghana Standard - GS 1236: 2019

For this EIA, measurement of suspended particulate matter concentrations on the project site were establish for monitoring purposes. The Casella AMS 950 Air Monitoring System was used for the monitoring of Particulate Matter Concentrations (PM_{10}). Static sampling methods were employed for this exercise since the standards/guideline limits are founded upon static sampling. All measurements were taken downwind of the suspected sources of generation of the dusts. The values recorded have been averaged for the site and presented in Table 4-12. Levels of Particulate matter were largely within acceptable levels due to the serene nature of the project area.

Table 4-12: Results of Air Quality Analysis

Measuring positions	Time weighted Average µg/m³		Measured values (Maximum), Particulate Matter (µg/m³)		GSA Permissible level µg/m³	EHS Guidelines µg/m³
	< 0900 Hrs	11–17Hrs	< 0900 Hrs	11–17Hrs		
	Day 1 - July 24, 2018					
N - 10°54'47.0" W - 000°44'53.4" Elev.- 244m	90	115	125	159	150	150
	July 25, 2018					
	98	100	110	135	150	150

Times of Survey: Time: 8.00 a.m. - 5.00 p.m. Instrument used: Casella AMS 950 Air Monitoring System

4.6.4. Water Resources

The nearest water bodies to the project site are the Vea Irrigation Facility, Bongo dam and the Red Volta River (See Figure 4-3). The Red Volta is about 8 km away from the PV Solar Power / Sub transmission Project Site, whilst the Vea Dam as shown in the Plate *4-3*, is about 0.43 km from the sub-transmission line and also 14km away from the PV Site. The Bongo dam is about 7.1km from the PV site and 1.81 km from the sub transmission site. Thus, the Vea Irrigation Facility and the Bongo dam are within the immediate project site area. The Vea Irrigation Facility was constructed in 1965 has provided water supply for agriculture purposes to various communities including Vea, Nyariga, Bongo, Bolgatanga, Zaare, Dindubisi, Yikine, Gowrie, Yorogo, Yorogo-Gabisi and Sumbrungu. The facility is being managed by the Irrigation Company of Upper Region (ICOUR) – Vea Irrigation Project and they have accordingly been briefed on the project and the outcome of this engagement provided under Chapter 5. VRA is to collaborate with ICOUR throughout the project phases to ensure smooth implementation.

Most households rely on groundwater collected from drilled boreholes with hand-pumps or hand-dug open wells for their domestic water. Groundwater is generally considered a safe and economical source of drinking water, but there are pockets in the Upper East Region where the groundwater contains concentrations of naturally occurring fluoride well above the World Health Organization (WHO) recommended limit of 1.5 Mg/Litre (WHO, 2011). The source of groundwater fluoride is Bongo granite and data from research by Laura Craig et al, 2018[7] indicate that the higher elevation recharge areas with outcrops of Bongo granite have elevated concentrations of fluoride in

[7] Laura Craig∗, et. Al (2018) Determining the optimum locations for pumping low-fluoride groundwater to distribute to communities in a fluoride area in the Upper East Region, Ghana

the groundwater up to 4.6 Mg/Litre posing the highest risk of fluorosis in the nearby communities. Due to the health risks of drinking high fluoride water, many drilled boreholes in the region remain closed because the fluoride in these wells exceeds 1.5 Mg/Litre.

The lower elevation areas, which are the farthest from the Bongo granitic, have the lowest groundwater fluoride (< 0.5 Mg/Litre) and the lowest risk of fluorosis. The Bongo PV Site is at an elevation of 243m and within the lower elevation areas. Groundwater flow models suggest that the steady decrease in fluoride is driven by dispersion, with the fluoride concentrations dropping to the World Health Organization's recommended drinking water limit of 1.5 Mg/Litre at about 400–500 Metres from the source.

Plate 4-3: Vea Dam in Relation The Proposed Line Route

Figure 4-3: Water Resources Within Project Site

Source: VRA Engineering Services Department (Feb. 2018)

4.6.5. Topography & Drainage

From literature, it is noted that the topography of the area is generally flat and low lying with outcrops of granite and Birimian rocks, which are mainly phyllites quartz-serrate schist and grey wacke. Granite rocks lie under the entire Bongo District. These granite rocks are coloured pink, coarse grained and potassium rich. Areas occupied by granites are generally of low, gently rolling relief 90–300 meters above sea level. Exceptions to these are inselbergs near Bongo (1,086ft), which abruptly rise to heights of 92–122m above the surrounding lands. The granite has a rectangular joining and weathers into large upstanding masses and blocky-perched boulders. Hornblende and a little biotite are some of the constituent primary minerals in the district.

From the field survey, the topography of the proposed project site itself is largely flat with sheet and gully erosion observed at the southern end of the site as shown in Plate 4-4[8]. These deep gullies are caused by running storm water from the many hills in the area and must be a subject of consideration in the development of the site. The Bongo hill rises several hundreds of meters above the surrounding land with steep and craggy sides. Because of inadequate vegetation cover, flooding and erosion are severe resulting in the occurrence of sheet and gully erosions.

The District is drained by the Red Volta and its tributaries including *Ayedama* and *Kulumasa*. There are other small dams and dugouts located in Bongo, Zorko, Balungu, Adaboya, Akulmasa, Namoo and Soe-Yidongo. These rivers out flow their banks in the main rainy season (April–October) and dry up soon after the season leaving disconnected pools of water in their beds, separated by dry stretches of sand and rock. During the rainy season, the streams and rivers are liable to sudden fluctuations in water level, suggesting that there is considerable surface run-off within their catchments during heavy rainfall.

Plate 4-4: Deep gully erosion observed close to project site

[8] Source: Field Survey Nov. 2017

4.6.6. Geology and Soil Characteristics

Granite rocks lie under the entire Bongo District. They have well-developed fractures and the granite rocks obtrude all over the landscape. These granite rocks are coloured pink, coarse grained and potassium rich. Hornblende and a little biotite are some of the constituent primary minerals in the district. The parent materials of the soils have been known to be very productive due to the high potash and phosphate content. Human population densities are high in the district and owing to long periods of intensive farming accompanied by mismanagement of the land, soil exhaustion and erosion are prevalent.

Generally, the Bongo soils consist of about 3 inches of very slightly humus stained, crumbly coarse sandy loan overlying reddish brown, fine blocky, very coarse sandy loan containing occasional incompletely weathered feldspar particles. The soils are those derived from granites, sandstones and greenstones. It grades below into red, mottled pink and yellow coarse sandy clay loamy of partially decomposed granite. The soils are well drained, friable and porous and possess good filth. Consequently, they have good water capacity.

4.7. Biological Environment

There is currently a Memorandum of Understanding (MoU) between VRA and the Forestry Commission that provide guidelines on how the two parties can collaborate for the effective management of power related activities in national forest reserves, off forest reserves and the Volta Lake Basin. This MoU allows for VRA to engage FC to quantify the flora and fauna in the project area. In line with the MOU and as part of the environmental assessment processes, the FC was tasked to conduct a baseline survey of flora and fauna prior to commencement of the project. The objectives of this baseline survey were:

- To provide clear listing and quantification of fauna and flora identified. In particular, flora which is source of livelihood should be quantified as well as current productive use of the sites, even if it is marginal.
- Identified fauna and flora species to be listed in a table with indication on frequency, environmental relevance and level of endangerment.
- Clear identification and quantification of impact of the transmission line through the forest reserve

The scope of work was to provide information indicating the frequencies of the taxa, environmental relevance (conservation values), level of extinction as well as the current land use practices on the site. The survey was carried-out on the entire total ear-marked area of 50.13Ha, thus 100% assessment survey was undertaken. The findings of the study report, dated January 2019, has helped provide the relevant data on the biological environment.

According to the report, limitations that may affect survey results could have been the timing of the survey, since it was done just around the dry season. Implying that not all fauna and flora could be captured but an average of the two different seasons (thus rainy and dry season) might have presented a more accurate picture. There was no presence of small, creeping, shrub and herb plants to be captured during the survey because most of the lower plants might have been withered or

eaten up through grazing. Direct counts of the fauna have the potential of either being under or over-estimating population. Conditions of the place consisted of high temperatures and hash weather at the time of the survey and may constitute to anthropogenic errors.

4.7.1. Flora

Generally, vegetation in the district is mainly of Sahel Savannah type consisting of short drought and fire-resistant deciduous trees interspersed with open savannah grassland. Grass is very sparse, and, in most areas, the land is bare and severely eroded. The vegetation of the area exhibit changes during the different seasons of the year. In the wet season, the vegetation is green, and trees and grasses shoot up and blossom. Soon after the rains the leaves change colour from green to yellow and brown as trees shed their leaves. The area begins to look parched and very dry. Very little of the vegetation exists in its original form owing to population pressure, annual and periodic bush fires, and loss of soil fertility. Typical species are the locust (*Parkia biglobosa),* the shea (*Vitellaria paradoxa)*, the mahogany (*Khaya senegalnesis),* the silk-cotton (*Ceiba pentandra) and the* Baobabs (*Adansonia digitata*). Of introduced trees, the neem, *Azadirachta indica*, and the mango, *Mangifera indica*, are common in villages and increasingly common as escapes in uncultivated areas.

The composition of grassland in the Bongo District varies according to soil type, location, and conditions of burning and grazing. Large areas of exposed land carry only a thin cover of *Heteropogen contortus. Imperata Cylindrical* and *Pernisetum Polystchyon* occur on arable soils. The latter is valued highly as a fodder grass and transportation of this by donkey carts was a common site near the project enclave. On the vast of the degraded land, the common grasses include *Dactyloctinium aegytium, chloris spp* and *Aristida kerstins* and this is evident within the project site.

From the FC assessment, a total of **343** trees were identified at the PV site comprising of 20 different species. For the total of 343 trees enumerated, the Shea tree (*Vittellaria paradoxa*) dominated the list with 160 trees (46.6%), the reason being that the local people have interest in this species and deliberately make efforts in protecting them. The species type, number identified and conservation value of the vegetation at the PV site is summarized below in *Table 4-13*. Pictures of some of the major species identified are captured in Table *4-14*. Regarding the transmission system, the main economic trees identified along the line route were Teak, Mango, Berry, Baobab, Sheabutter and Dawadawa.

The Global International Union for Conservation of Nature (IUCN) conservation designation of almost all the tree species shows that they have been evaluated as not being a focus of species conservation and therefore of "Least Concern". *Acacia dangarensis*, *Sclerocarya birrea* have been listed as endangered whilst *Vittellaria paraboxa* is listed as Vulnerable. Generally, it was discussed that VRA could provide materials and seedlings for replanting to replace the trees to be felled and this has been included as part of the mitigative factors.

Figure 4-4 illustrates the benefits of the flora to the economic ecology of the rural community in a scale of preference from medicine, commercial, firewood, shade/fodder and lastly fencing. As high as 24.6%, of the trees (flora) enumerated are used for medicinal purposes. Commercial trees particularly *Vitellaria paraboxa* (Shea), constitute 23% with the least of 4.4% being fencing.

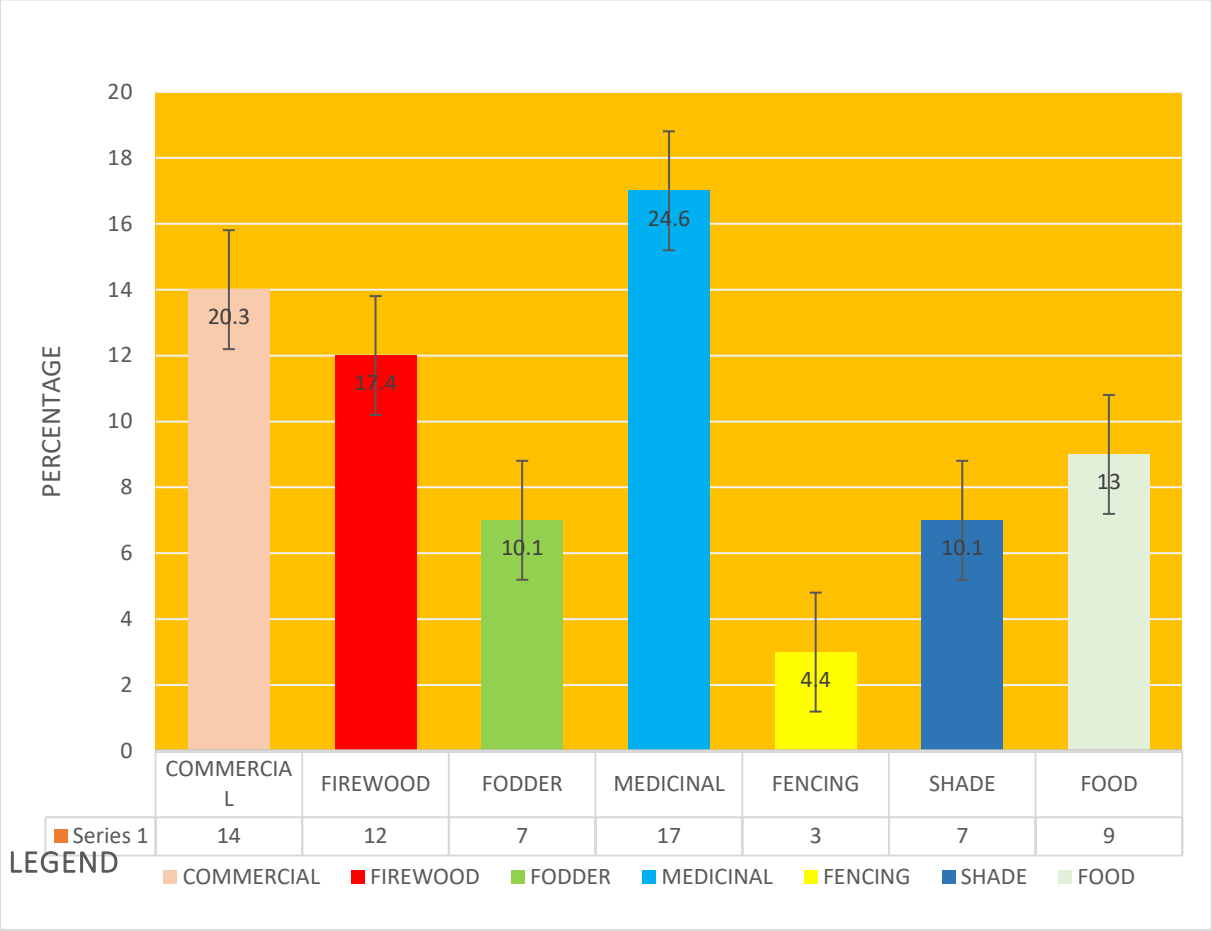


Figure 4-4: Various Uses of the Flora Species

Table 4-13: Total Number of Different Trees (Flora) Species Surveyed

No	Name			Total	Global IUCN Conservation Status	Uses
	Local	Botanical	Family			
1	Bagi-ne	Piliostigma thonningii	Cesalpinioideae	4	Not Listed	Medicinal and food
2	Dosunka	Gardenia aqualla	Rubiaceae	2	Not Listed	Not available
3	Dua	Parkia biglobosa	Fabaceae	3	Least Concerned (LC)	Medicinal and food
4	Gian	Diospyros messpiliformis	Ebenaceae	13	Not Listed	Medicinal and food
5	Gonmoliga	Acacia dangarensis	Mimosoideae	6	Endangered[9]	Not available
6	Gon-npeliga	Vachellia sieberiana	Fabaceae	6	Not Listed	Medicinal, Fuelwood and Timber.
7	Kinkaliga	Afzilia africana	Leguminoseae	2	Least Concerned (LC)	Timber
8	Kinkanga	Ficus gnaphalocarpa	Moraceae	42	Least Concerned (LC)	Shed and fodder
9	Kinkansinya	Ficus lepire	Moraceae	3	Least Concerned (LC)	Folder and shed
10	Kunkundaa	Crossopteryx febrifuga	Rubiaceae	1	Least Concerned (LC)	Medicinal and shed
11	Nanobiga	Sclerocarya birrea	Anacardiaceae	4	Endangered (EN)	Food and tradition alcohol.
12	Neem	Azadirachta indica	Meliaceae	23	Least Concerned (LC)	Timber, Medicinal, Fuel Wood, Crop Fertilizer Insecticides
13	Petire	Terminalia avicennoide	Combretaceae	7	Least Concerned (LC)	Timber, fuelwood Medicinal
14	Punpunga	Sterculia sepigera	Malvaceae	1	Not Listed	Food, Medicinal and Fiber
15	Shia	Anogeissus leiocarpus	Combretaceae	10	Least Concerned (LC)	Fuel wood and building material
16	Sinsabdaa	Lannea macrocarpa	Anacardiaceae	5	Least Concerned (LC)	Food, Medicinal and Fiber
17	Sinsabiga	Lannea acida	Anacardiaceae	28	Least Concerned (LC)	Medicinal and food
18	Ta-anga	Vittellaria paraboxa	Sapetaceae	160	Vulnerable (VU)	Shea butter, Timber, Firewood and charcoal.
19	Tua	Adansonia digitata	Malvaceae	21	Least Concerned (LC)	Food and medicinal
20	Zenzeriga	Acacia nilotica	Mimosaceae	2	Least Concerned (LC)	Timber, Fodder, Tannin, Gum, Fence, Shade Fuel Wood
Total				**343**		

[9] The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the small tree Acacia dangarensis Tindale & Kodela as an ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act.

Table 4-14: Pictures of some major flora species on PV Site at Asibiga

 *Anogeissus leiocarpus* (LC)	 *Sclerocarya birrea* (EN)	 *Parkia biglobosa* (LC)
 *Terminalia avicennoides* (LC)	 *Gardenia aqualla* (Not Listed)	 *Acacia dangarensis* (EN)

		
Lannea macrocarpa (LC)	*Ficus lepire* (LC)	*Vittellaria paraboxa* (VU)

4.7.2. Fauna

The fauna of the project area has been extensively affected by alteration and fragmentation of habitat resulting from especially fire, human settlements, and agricultural activities. A faunal survey carried out during the scoping stage showed insects such as grasshopper and butterflies as common to the area. Birds such as Vulture, Cattle Egret, Harrier Hawk wee common. Reptiles identified included the agama lizard and snakes, and according to the locals, and these are mostly rattle snakes, python, cobras, Gabon Viper and the green mamba. From discussions with the locals, elephants from nearby Burkina Faso, can be found in the project area. In addition, rabbits, squirrels, bush guinea fowls, monkeys are animals that are commonly hunted by the locals.

FSD in their assessment utilised the use of transect lines both during day and night in tracking the presence and detection of the animal species, and their names recorded. The techniques used to determine their counts included footprints, ground tracks, droppings, sound and presence (actual viewing). In all, a total of 112 animals (fauna) were recorded comprising 13 species. Details are as shown in Table *4-15*, including their uses, whilst Figure 4-5 shows the frequency occurrence of the animals. Faunal species play very important and sometimes critical roles in food chains and by implication in the ecosystems in which they live. The presence or absence of some species may act as key ecological indicators. They may also be sources of food for the local human populations. Because of their roles in food chains, any anthropological activities that may impact negatively on them directly or their habitats may pose problems for the survival of other species in other trophic levels. It is expected therefore that the project developmental activities within their habitats would be carried out with due consideration for environmental concerns.

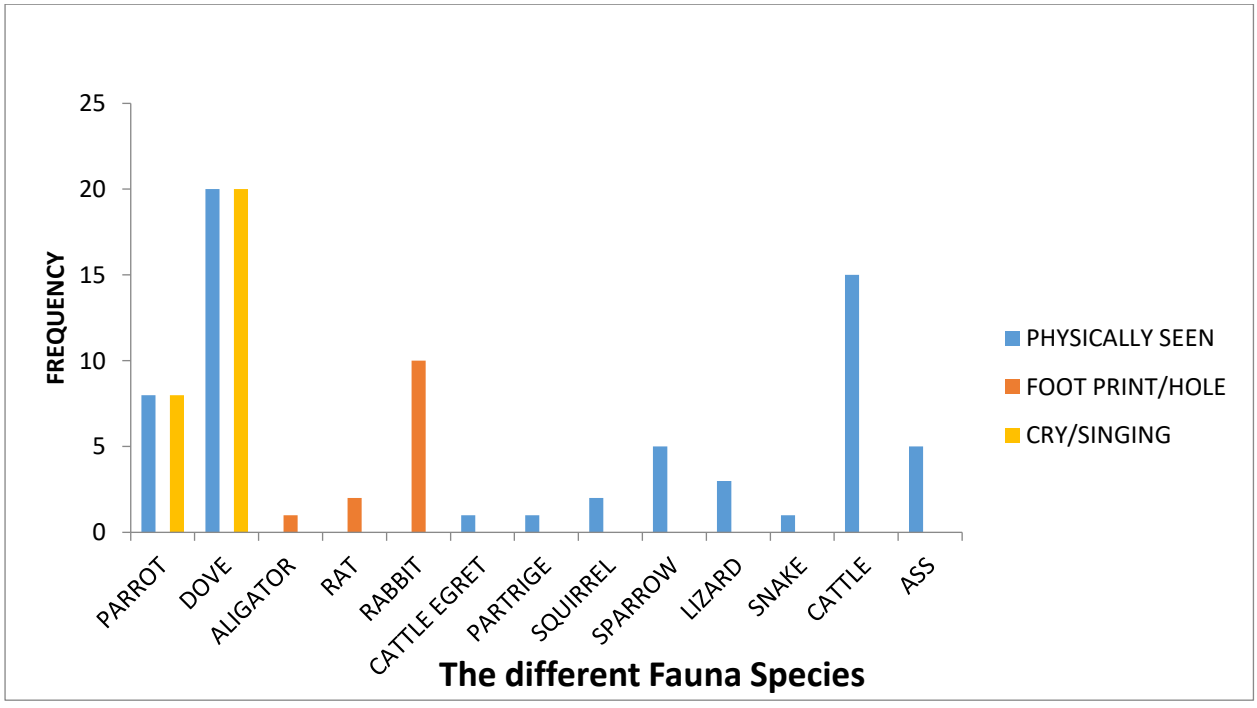


Figure 4-5: Frequency of the faunal species at the Project Site

Table 4-15: Total Number of Animals (Fauna) Surveyed at The PV Site

Common Name	Scientific Name	Physically Seen	Foot Print	Feaces	Sound/ Singing	Total	**Conservation Values**	**Economic Values**	**Ecological/ Environmental Values**	**Cultural Values**
Parrot	Psittaci formes	8	-	-	8	**16**	Least Concern (LC)	Game, Export	Seed dispersal	Symbol of some clans
Dove	Zeneida asiatica	20	-	-	20	**40**	Least Concern (LC)	Game	Seed dispersal	Rituals, Pets
Alligator	Aligator mississippiensis	-	1	-	-	**1**	Least Concern (LC)	Game, leather sale, intrinsic values (monetary)	Improve soil through their holes	-
Rat	Rattus norvegicus	-	2	-	-	**2**	Least Concern (LC)	Game	Improve soil by their boring factor	
Rabbit	Oryctolagus cuniculus	-	10	10	-	**20**	Least Concern (LC)	Game, Export	Drops improve soil	Pets
Egret	Ardea alba	1	-	-	-	**1**	Least Concern (LC)	Game, tourist attraction	Symbioses (cattle)	-
Partridge	Perdix perdix	1	-	-	-	**1**	Least Concern (LC)	Game, money	Seed dispersal	-
Squirrel	Sciurus carolinensis	2	-	-	-	**2**	Least Concern (LC)	Game, money	Improve soil fertility by hole	-
Sparrow	Passer domesticus	5	-	-	-	**5**	Least Concern (LC)	Game,	Seed dispersal	Pets
Lizard	Agama agama	3	-	-	-	**3**	Least Concern (LC)	Game	-	-
Snake	Serpentes	1	-	-	-	**1**		Game, tourist attraction	-	Rituals
Cattle	Bos taurus	15	-	-	-	**15**		Game, money	Dung as fertilizer, seed dispersal	Pets
Ass (Donkey)	Equus africanus	5	-	-	-	**5**		Game, money, tourist attraction	-	Pets
Total		**61**	**13**	**10**	**28**	**112**				

4.7.3. Environmentally Sensitive Areas

Investigation did not suggest or provide any information describing or prescribing the site as a low range or habitat or ecological sensitive area for any wildlife. As a result, clearing of the site vegetation to give way for the construction of the Solar Project would not have any significant impact for wildlife habitat. The nearest environmentally sensitive site is the Red Volta Forest Reserve located about 7 km north of the project site. The Red Volta (See Plate *4-5*) is about 3km north of this reserve and provides support for wildlife namely baboons, monkeys, rats, mice, grass cutters, rabbits, buffalos, antelopes and guinea fowls. This forest has been depleted due to the activities of fuel wood dealers and some farmers. This Forest Reserve will not be directly affected by project development.

Plate 4-5: Red Volta

4.8. Socio-Economic & Cultural Environment

4.8.1. Overview

The revised structure for Ghana EIA Reports requires the discussion of the following issues as part of the socio-cultural baseline information and these have been examined in this Report:

- The land area taken up by the development, its location clearly shown on a map and geographical coordinates provided.
- Human beings: (population composition and distribution, socio-economic conditions, cultural and ethnic diversity, population growth rate);
- Land use: (agriculture, forests, industrial, commercial, residential), transportation routes such as roads, rail, water and air, utility corridors)
- Social services: (electricity, telecommunication, water supply, hospitals, etc);
- Cultural heritage: (unique features of the area or its people; cemetery, fetish grove, festivals etc).

This section presents a description of the social and economic characteristics of the project area (See Figure 4-1). Description of Land take has been outlined under Section 3.14.2. It is anticipated that the most significant socio-economic impacts will occur within the Bongo District and its environs within the Upper East Region of Ghana. For this reason, the discussion of baseline socio-economic conditions was looked at within the context of the Bongo District.

4.8.2. Governance Structure

Political Authority

The Bongo District Assembly was created by a Legislative Instrument (LI 1446) in 1988 with the mission to improve upon the quality of lives of its people through the creation of an enabling environment, harnessing of its resources, proper co-ordination and integration of its activities within the framework of national policies. To promote and ensure efficient and effective performance of its functions, in line with its mission, the Assembly is headed by a District Chief Executive (DCE), in the person of Honourable Peter A. Ayinbisa at the time of the study. The Assembly has a total membership of fifty-four (54) Assembly Members. The Member of Parliament is an ex-officio member of the Assembly.

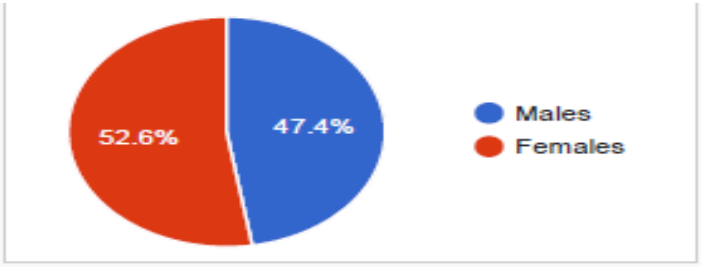
Traditional Authority

The traditional authority of the District resides in the paramount chief known as the Bonaba or Bongo Naaba in the person of Baba Salifu Alemyarum. The Bongo Skin is reputed to be the allodial owner of all lands in the area and is in control of lands for and on behalf of the people of Bongo and all formal acquisitions are made by him. There are eleven divisional chiefs and thirty-one sub-chiefs who support the Bonaba in the administration of the traditional area. There are also the Tindanas' who are literally the landowners and are responsible for pacifying the gods in times of adversities. There are no known chieftaincy disputes currently in the District and the commendation goes to the traditional authorities and the people for the roles they play in ensuring peace in the District.

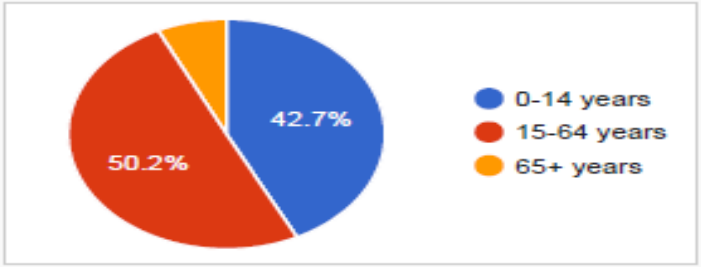
4.8.3. Demographic Profile

According to the 2010 Population and Housing Census, the Bongo District has a population of 84,545, representing an increase of 8.6 percent of its population in the 2000 PHC (77,885). Using the 2.2% estimated annual growth in population, the projected population of the District as of September 2019 was 103,060. With a sex ratio ranging from between 61 and 96 males per 100 females, the female dominance in the district population is observed among the adult population aged between 20 to 79 years. More males than females are observed among the aged population 80 years and older in the district. Figure 4-6 shows that the population structure of the District.

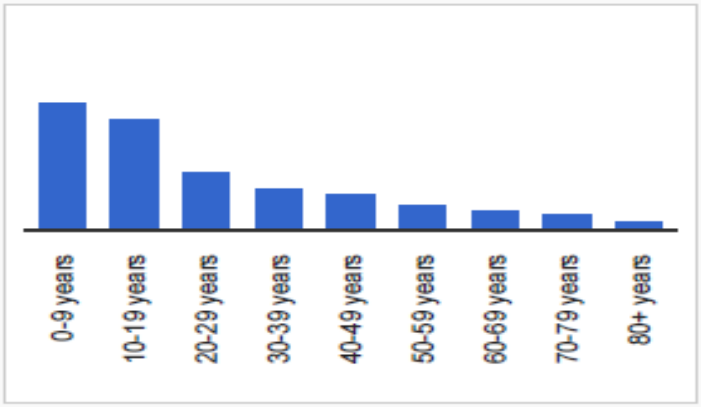
Figure 4-6: Population Structure of the Bongo District



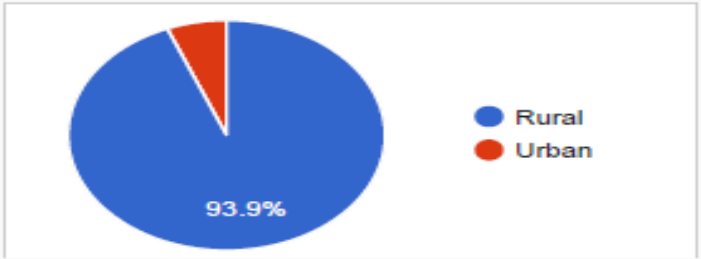
Gender (C 2010)	
Males	40,084
Females	44,461



Age Groups (C 2010)	
0-14 years	36,075
15-64 years	42,449
65+ years	6,021



Age Distribution (C 2010)	
0-9 years	24,348
10-19 years	21,298
20-29 years	11,124
30-39 years	7,974
40-49 years	6,694
50-59 years	4,890
60-69 years	3,568
70-79 years	3,158
80+ years	1,491



Urbanization (C 2010)	
Rural	79,376
Urban	5,169

Source: https://www.citypopulation.de/en/ghana/admin/upper_east/0906__bongo/

4.8.4. Ethnic & Religious Composition

The district is a multi-ethnic, with the Bossis and Gurunsis as major ethnic groups. There are also Tindaanas who hail from Zorko, Namoo and other settlements. Two major languages are spoken in the District; these are Bonni which is spoken by the Bossis and Guruni which is spoken by the Gurunsis. The Bossis and the Gurunsis constitute about 95.1 percent of the district's population. Besides these two major ethnic groups are other settler ethnic groups like the Kusasi, Nankani, Builsa, Kasena, and Dargaba. The two major ethnic groups co-exist peacefully ostensibly because they have a common ancestry.

Frafra or Farefare, also known as Gurenɛ, is the language of the Frafra people of northern Ghana, particularly the Upper East Region, including Bongo and southern Burkina Faso. It is a national language of Ghana, and is closely related to Dagbani and other languages of Northern Ghana, and also related to Mossi, also known as Mooré, the national language of Burkina Faso. Frafra consists of three principal dialects, Gurenɛ (also written Gurunɛ, Gudenne, Gurenne, Gudeni, Zuadeni), Nankani (Naani, Nankanse, Ninkare), and Booni. Nabit and Talni have been mistakenly reported to be Frafra dialects.[10]

There are three major religious groups in the district. These are traditionalists (44.0%), Muslims (7.2%) and Christians (45.1%). Among the Christians, the Catholics are the majority (32.3%), followed by the Pentecostal/Charismatic (6.6%), Protestants (4.6%) and other Christians (1.6 %). Whereas the Christian population in the district experienced an increase over the 2000 figure of 34.2%, that of the traditionalists declined from 53.6% in 2000[11]. There is peaceful co-existence among the various religious grouping and efforts must be made to consolidate the peace.

4.8.5. Land Management/Land Tenure System

Though land in the District is communally owned some portions remain under the custody of the Tindanas, the original custodians of the land. Land ownership is vested in the lineage and no one can dispossess a landholder or his family. In general, land is regarded as sacred. Land use rights are patrilineal. The Bongo Skin is reputed to be the allodial owner of all lands in the area. The lands were said to have been acquired by conquest and settlement thereof since the 16th century and has since been in the occupation of the people of Bongo. The Bonaba or Bongo Naaba (Paramount Chief of Bongo) is in control of these lands for and behalf of the people of Bongo. All formal acquisitions are therefore made by the Bongo Naaba. In some cases, land allocation may be shared between the Tindana, the religious head, and the community.

Women get access to land only through allocations made to them by their husbands. However, this is done after considerations that there would be no shortage of farmland during the farming season when the woman is cropping her own farm. Widows with sons are usually permitted to keep land their husbands possessed and farm it until their sons are old enough to farm. In such case the land passes automatically to the children. Individuals and families own about 95% of farmlands. Most families depend solely on the land for their livelihood and find it difficult to part with their land. The land holding is very small due to scarcity. Farmers on the average farm a little over 1.9 hectares with plots scattered. Farmlands are found around dwellings of compounds houses with some farms about 500metres to 1km from the houses. This coupled with inappropriate land management practices have led to low crop yields and other environmental consequences.

[10] https://en.wikipedia.org/wiki/Frafra_language
[11] Ghana Statistical Services: 2010 Population and Housing Census, District Analytical Report

4.8.6. Archaeological, Heritage & Cultural Structure

With respect to cultural resources, the EIA study discovered an old isolated ancestral grave with the Yabatua Shrine (a Baobab tree) as well as the Kinkanga Shrine (a Ficus tree) to be situated on the proposed PV site as shown in Figure 4-7. The Kinkanga Shrine and the Yabatua Shrine are family shrines. The ancestral grave according to the locals, were the burial ground of their ancestors prior to the relocation to their new site. According to traditional history, the first person from Bongo was buried there some generations ago and the Yabatua Shrine (Baobab Tree) represents the great grandmother of the people of Bongo because it grew at her burial place. The baobab tree, serves as the reference area for the graves. The Kinkanga Shrine (Ficus tree) is alleged to bring good fortunes to the Bongo people. According to the Chief of Asibiga, the siting of the proposed project in the community is the doing of the Yabatua Shrine which seeks to bring developments into the community. The two trees are, therefore, very sacred and significant to them and before the project can kick-start, there are certain traditional rites that must be done to relocate the ancestral grave and purify the trees.

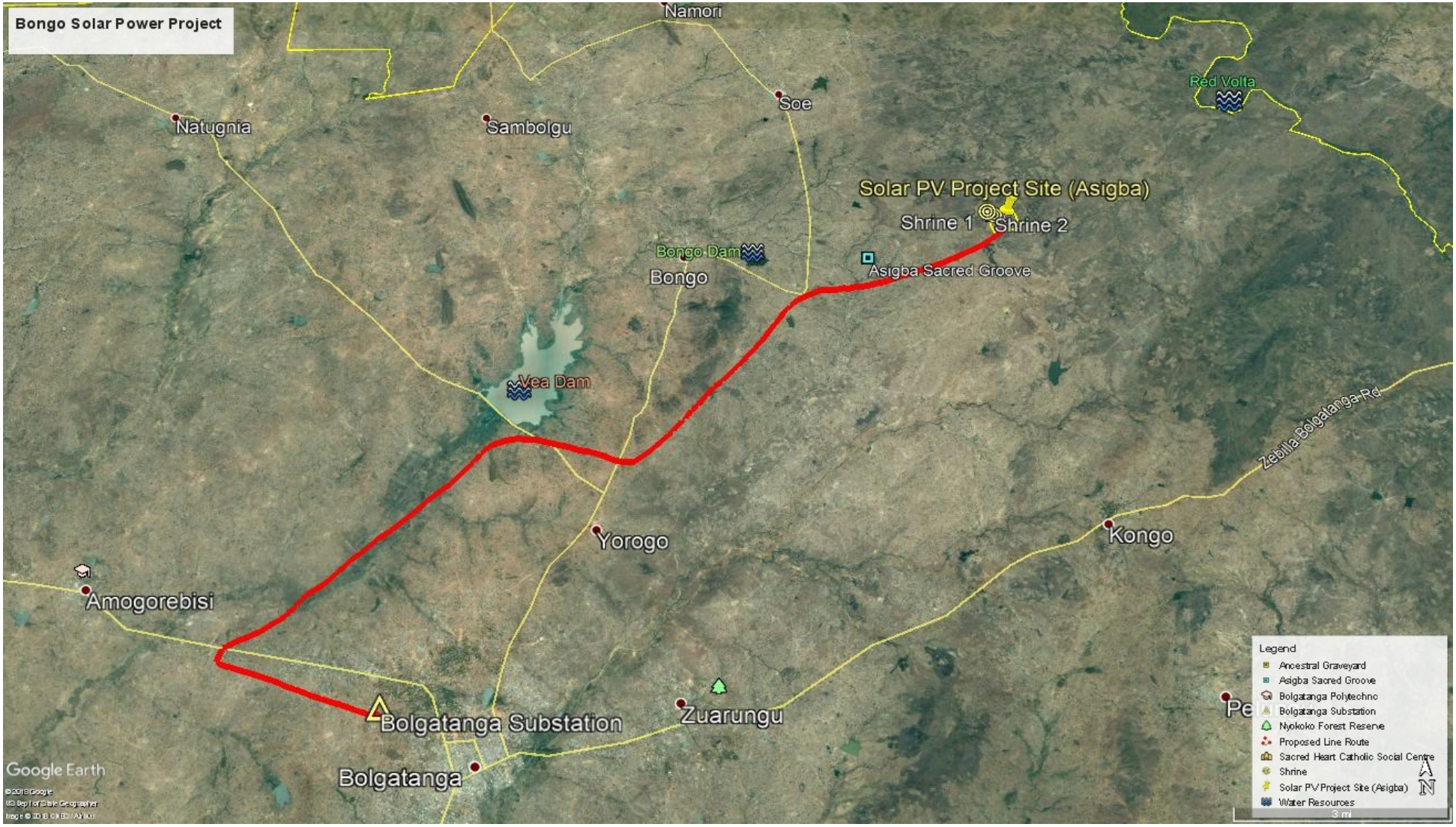
Also, just within the project site on the eastern side is an area called the Dwarf island, where it is alleged that dwarfs exist. This is currently a prayer ground for Christians who come there to pray in the name of sacking the dwarfs. These however will not be impacted directly by the project development. Also, along the transmission line is the Tindana sacred grove (Se Figure 4-8)., which serves as a form of forest reserve for the Asibiga community as well as various churches, mostly Christian. Pictures of the identified cultural resources are shown in See Plate 4-6. The locals indicated that no day has been slated as a taboo day, meaning project development can proceed on any day without any pacification rites to the community.

Plate 4-6: Cultural Resources Within the Project Site

Figure 4-7: Shrines and ancestral grave on Proposed Site

Source: VRA Engineering Services Department (February 2018)

Figure 4-8: Cultural Sites Along Project Corridor



Source: VRA Engineering Services Department (February 2018)

4.8.7. Economic Characteristics

Economic Activity Status

Most people in the District are employed in the Agriculture Sector. Among them are those in crop and livestock production as well as fishery. Crafts and related trades also constitute a larger percentage whilst service industry forms the least percentage in the local economy. The proportion of the population economically active (75.0%) is three times higher than proportion of the population not economically active (25.0%). Of the total economically active population, 73.0 percent is employed, and 2.1 percent is unemployed.

Structure of the Local Economy

The local economy consists of three major sectors namely agriculture, service and industry. Agriculture is the most dominant sectors employing 72.2 per cent of the population in food crop farming, animal rearing and as fishing. Land use specific to agriculture in the Bongo District is shown in Table 4-16. The source of income for many households is sale of foodstuff, small ruminants and poultry. The industrial sector employs 15.5 percent whilst the service sector engages 12.3 percent of the district's population of 15 years and older. Whereas a few women sell provisions, the majority are engaged in shea butter processing, groundnut oil extraction, dawadawa processing, malt making, pito brewing as well as handicraft production. Men on the other hand, are usually engaged in the sale of cattle, small ruminants, and poultry.

Sheabutter processing is one area that has engaged the services of most women in the district. It employs close to 75% of women in the district and this includes the pickers and the processors. It is one area that has served as a major source of income for most women and their families. It also has the potential of breaking through the international market and local markets. Guinea fowl rearing is one activity that cuts across the entire district and being done by men and women but dominated by the men. The guinea fowl is reared by almost all small holder farmers with an average house holding of 5-200 birds.

Table 4-16: Land Use Specific to Agriculture in the Bongo District

Land Use	Ha	%
Total Land Area	459.5	100%
Agricultural Land Area	183.8	40%
Area under cultivation (2017)	155.08	33%
Total area under irrigation (2017)	64.33	14%
Area under inlands	36.76	8%
Other forest reserves, savannah woodlands, etc.	22.975	5%

Source: Bongo District Agriculture Department, 2017

Tourism Potential

Tourism is undeveloped in the district though a lot of tourist sites abound. These include the following:

1) The Vea Irrigation dam
2) Beautifully formed rocks such as Aposerga and Azudoo rocks located in Bongo town
3) Apasepanga footprint, footprint of an ancient warrior located in Bongo town
4) Avea masera crocodile pond
5) Beautiful handicraft products such as baskets, hats, and mats which is district-wide
6) Leather works and smocks weaving at Sambolgo, Namoo, Feo and other communities in the district.
7) Azambene which literally means 'Fire Festival'

Among these tourist sites, the Vea Irrigation Dam site is fast becoming a holiday resort for holiday makers especially during festivities like Easter, Christmas and other public holidays.

Industry & Occupation

There are three major industrial activities at the District level: agriculture, including forestry and fishing (72.2%), manufacturing (14.2%) and wholesale and retail; repair of motor vehicles and motorcycles (4.6%). The three combined contribute as much as 91.0 percent of industrial activities in the district. Agriculture is the primary activity in the district for both males and females. But females (18.4%) are into more manufacturing activities than males (8.9%). Manufacturing activities in the District include brewing, shea butter extraction, groundnut processing, weaving, smock making, etc.

Major of people in the District are employed in the agriculture sector, including forestry and fishing works (72.6%). Craft and related trades workers constitute 15.5 percent while services and sales workers constitute 5.3 percent and professionals make up 2.2 percent. The first three together make up 93.4 percent of all occupations in the District. The substantial lack of formal sector office-based bureaucratic activities in the District is reflected in the fact that the proportion of managerial and clerical support workers in the District make up only 1.0 percent of the employed population. This further highlights the rural nature of the District.

Agriculture

Out of a total household of 16,499 households in the District, 15,771 (95.7) are engaged in agricultural activities. This suggests that nearly every household in the District is engaged in agricultural activities. Majority of households are engaged in crop farming accounting for 98.8 percent of household in agriculture and 88.1 percent of the households are engaged in livestock rearing. Tree planting and fish farming have smaller proportions of households that are engaged in them, 0.4 percent and 0.1 percent respectively.

Farming is the major economic activity in the district. It employs a little over 90% of the population and both men and women participate in this activity. Majority of the farmers are subsistence farmers while a few are into medium scale commercial farming. Major crops cultivated in the district are

millet, sorghum, groundnuts, rice, soya beans while a few of them grow maize. Farmers who are close to the Vea Irrigation dam and other small dams also grow tomatoes and leafy vegetables. They also do all-year farming at the irrigation site.

The use of cows and donkeys for farming is common in the district and this account for the significant raising of these animals in the district. Majority of farmers still use the hoe and cutlass for farming and practice the slash and burn method. Very few farmers use tractor and other mechanized methods of farming and mostly they complain that it is very expensive to employ the services of tractors and other mechanized modes of farming.

Apart from the monetary gains from fish farming, the fish also provides yet another source of protein to the people and the growing of trees can help to deal with the menace of desertification which seriously threatening the regions in the north. This can turn to affect the crop production as well as livestock rearing which almost all the households in agricultural are engaged in.

According to the 2014-2017 MDTP, crop production in the District has recorded varying trends over since 2010, depending on the type of crop. But, overall, production has not been encouraging. Millet production has been fluctuating from 3,780 Mt in 2010 to 2,434 Mt in 2011 and 3,300 Mt in 2012. Sorghum, groundnuts, rice and cowpea have also recorded similar trends in production. Maize production on the other hand recorded consistent increases from 598 Mt in 2010 to 810 Mt in 1,377 Mt in 2012. Generally, crop production levels in the District have become a real concern to stakeholders. The trend is attributed to the continuous depletion of soil fertility, out-migration of the youth and the changing occupational pattern resulting from an increasing educated class in the District. Unlike crop production, livestock and poultry production in the District has been increasing consistently since 2010. The populations of all the major animals have increased considerably.

Mining

Mining is not done in a large scale in the district. However, it is done on a very small scale in the north eastern corner of the district on riverbeds and on the banks around Apaatanga, Adaboya and surrounding areas, and these are areas close to the project site. It is done mostly by indigenes, but some strangers come along just for very short period. This activity though on a very small-scale basis can cause problems such as pollution of water bodies and degrading farmlands.

Inter /Intra Trade

Trade in the Bongo district is done among citizens of the district within the district and among citizens of neighbouring districts such as Bolgatanga Municipality, Kassena Nankana East and West Districts and Bawku West District. There is also trade among citizens of the district and citizens of neighbouring countries such as Burkina Faso and Togo. There is also inter-regional trade where some traders go to the Ashanti, Brong-Ahafo and Greater Accra regions.

A few people export handicraft products and sheabutter. Most traders in the district trade in foodstuffs, livestock, poultry and vegetables such as tomatoes and leafy vegetables. Some traders

deal in provisions and fashion wares. There is currently brisk business between the district and Burkina Faso at a market located in Yelwongo in Burkina Faso.

4.8.8. Social Services

Post and telecommunications

Regarding postal services, the district is highly deprived. There is only one postal Agency located at Bongo, the district capital. The services at the Postal Agency are also not effective since most people prefer to go to Bolgatanga, the regional capital to post and receive letters. However, few organizations and individuals patronize the services of the agency. With the introduction of the Digital Addressing System in Ghana, which covers every inch of the country and ensures that all locations in the country are addressed, it is expected to make it easier for locations to be found to boost postal and service delivery

There are no fixed telephone lines in the district. However, four mobile phone operators are found in the district: MTN, Tigo, Vodafone and Airtel. These operators provide mobile telephony services in district. Notwithstanding the presence of these operators in the district, the services they provide are still beyond the reach of most of the people. According to the 2010 Population and Housing Census, only 16.6 per cent of the population of the district 12 years and older have mobile phones. The data reveals that only one out of every six (16.6%) persons 12 years and older in the Bongo District own mobile phones compared to a regional average of 24.2 percent. Whiles one out of every five (21.2%) of the male population 12 years and older own mobile phones, about one in every eight (12.7%) of their female counterparts own mobile phones.

According to the 2010 PHC, there is also a low usage of internet facility in the district, about 1% of the population, and this can be attributed to inadequacy of internet facilities, especially internet cafes in the district. In 2010 there was only one internet cafe at the district assembly ICT Centre with less than 15 computers connected to internet which was operational and opened to the public. It must be noted that currently mobile operators are also providing internet facility on mobile phone and therefore most mobile phone users now have internet access.

Access to Electricity and Energy

Electricity/energy plays an important role in the socio-economic development of every country or district. This is because it stimulates economic activities leading to improvement in the standards of living of the people. Since 2014 to 2017, the number of communities with electricity has increased to 72 remaining 24 communities to be covered. Bongo, Bongo-Soe, Zorkor, Balungu, Namoo, Feo, Beo, Vea, Gowrie, Dua, Kansoe townships are the communities in the District with streetlights. Table 4-17 shows the number of communities with access to electricity from 2014 to 2017.

Table 4-17: Electricity Coverage in the Bongo District

Year	2014	2015	2016	2017
Number of Communities with Electricity	43	55	63	72
Number of Communities with no Electricity	53	41	33	24

Source: 2019-2022 Programme Based Budget Estimates For 2019 Bongo District Assembly

Communities without electricity are to be connected under the on-going Self-Help Electrification Programme (SHEP). The key issue is that whenever they are connected payment of bills can be a stumbling block to most people acquiring electricity. This buttresses the point that alternative and less expensive sources of energy such as solar and wind are better alternatives for this part of the country since patronage can be higher and the benefits that shall result much more spread over the communities.

Fuel wood for cooking is rare. Crop residue such as dry stems of sorghum and millet are mostly used for cooking. Although the use of liquefied petroleum gas is being encouraged, constant shortages of the product remains a major obstacle to a significant shift from the stem of sorghum and millet to liquefied gas. The three main sources of lighting in dwelling units in the district are kerosene lamp (64.8%), flashlight/torch (20.3%) and electricity (11.5%).

Housing Facilities

The District's population of 91,723 lives in a total of 11,231 housing units. This implies that on the average there are 1.5 households per house in the district, which translate into 8.1 persons in a house. This figure is lower than the regional figure of 9.1 persons in a house. Most of the people live in compound houses (50.3%) built of mud and roofed with straw or zinc (See Plate 4-2). The main features of the predominantly traditional architecture are round huts with flat roofs and small windows that provide poor ventilation.

Water & Sanitation

The District has a good spread of water infrastructure. Whereas the rural communities are served by mainly boreholes (See Plate 4-7) and hand-dug wells the District capital and some small towns are served by Small Town Water Systems. In all, the District has a potable water coverage of about 82%. Distribution of Water Facilities by Town/Area Council is shown in Table 4-18. The major challenge in providing water facilities in the Bongo District is the high fluoride content which led to the capping of so many boreholes. Some existing boreholes even are in use are suspected of containing high fluoride content. There is therefore the need for Ghana Water Company to reconnect most communities especially those close to it in the District to the treated water from the Vea Dam.

Table 4-18: Distribution of Water Facilities by Town/Area Council

No.	Area council	Number of Small Hand pumps	Small Town Water System	Limited Mechanized System
1	Balungu	40	-	1
2	Beo	61	-	1
3	Bongo	95	1	1
4	Bongo-Soe	42	1	-
5	Namoo	118	-	6
6	Valley Zone	63	-	1
7	Zorko	78	1	1
	Total	496	3	11

Source: Bongo DSWT Quarterly Report, 2016

Plate 4-7: Borehole Near Project Site

The use of public refuse containers is very low as only 1.4 percent of household in the district use public container dumps compared to 25.1 percent for open public dump sites. The use of the sewerage system, drainage into a gutter, and drainage into a pit (soak away) which may be considered more appropriate, account for only 6.9 percent. Across the District there are only 6 septic tank latrines, 6 KVIP latrines, 1 environloo, 9 urinals, 110 house-hold water closets, 874 pit latrines and 87 institutional latrines. About 80% of the populace practice open defecation due to the limited number of households, public and institutional latrines. Public toilet (WC, KVIP, Pit, Pan) is used by 3.1 percent of households and 2.8 percent of households used KVIP. More than fifty percent of households (52.9%) have own bathrooms for exclusive use. Households which use open space around house account for 15.5 percent and private open cubicle, 14.7 percent.

Ghana National Fire Service

There is a fire station in Bongo which was opened in 1993. The office was initially located in a makeshift building; however, they have now been provided with an office accommodation as well as basic firefighting equipment like fire tender and communication gadgets. The services of the fire service are very much needed in the district to help curb the incidence of bush fires which could pose a danger to the district. Since the district is also connected to the national electricity grid, the possibility of domestic fires is tenable, and the fire service would have to be present to deal with all these issues.

Road Network

The District has about 91.2 km of roads comprising gravel roads (44.9) and earth road (46.3km). Although the District has an entry point from Burkina Faso at Namoo, which is highly patronized, the road linking Namoo to Bongo is deplorable. The Bongo-Namoo-Burkina Faso road is the shortest and most preferable road by heavy trucks to and from Burkina Faso which could generate a lot of revenue to the Assembly and the nation at large if attention is given to it.

The poor road network in the district has adversely affected economic activities especially at the Namoo entry point. Farmers in the District also find it difficult carting foodstuff from the farm gates to the market. Also transporting patients especially pregnant women when in labour from the communities to health facilities or to the District Hospital especially in the raining season is always a challenge which is contributing a lot to the District not achieving zero (0) maternal mortality rate for all year round. Thus, the development of Feeder roads in the District is very crucial since this has the potential of boosting socio-economic activities in the District, apart from that when such roads are developed it will serve to open up the communities to potential investors.

The road network from the main road in the Bongo township to the solar power site at Asibiga, about 14 km, is untarred and dusty. Tarring of the Bongo town roads is currently ongoing. These roads include the Bongo-Namoo road, Namoo-Zorkor, Yorigor-Gowrie-Vea, Balungu-Vea, Yorigor-Bogrigor, Adaboya-Apatanga and Kongo-Beo feeder roads. It is expected that the full rehabilitation of these roads would improve travel time and also open up the road network for easy and quick transportation of farm produce to marketing centres in and outside the district. There are also several streams which are not bridged in the district and hence accessibility to many communities is a problem, as a result many communities are either inaccessible or cut off especially during the raining the season.

4.8.9. Persons with Disability

Disability, especially blindness, is a major concern in the District. Of the district disabled population of 4,408, 38.5 percent have sight disability. The proportion with physical disability accounted for 23.3 percent of total disability and comes second after sight disability (%). Hearing disability and emotional disability accounts for 21.8 percent and 12.9 percent respectively. The high proportion of sight disability is probably due to the fact that until somewhere in 1984 when the now onchocerciasis freed zone was rid of the vector that causes blindness, the Beo and Soe zones were at the mercy of the vector that made a lot of people in these communities (to go) blind.

4.8.10. Gender & Vulnerability

The Ghana EIA study requires the assessment of the vulnerable as part of the process and this is discussed under this Section. Results of a vulnerability analysis of the Bongo district is illustrated in Table 4-19.

Table 4-19: Analysis of vulnerability in the Bongo District

No.	Nature of Shock	Period of Occurrence	Vulnerable Group
1.	Natural/Environmental shocks: ▪ Scarcity of fertile land (extremely rocky terrain, high population pressures, soil erosion, erratic and inadequate rainfall) ▪ Floods	During raining season (once a year)	▪ Subsistence farmers
2.	Financial/Economic barriers: Constrained employment opportunities (both unemployment & underemployment)	All year round	▪ Women ▪ Youth ▪ PWDs
3.	Human assets barriers:	All year round	▪ Women

No.	Nature of Shock	Period of Occurrence	Vulnerable Group
	Education/Skills ▪ Low literacy levels ▪ Occupational skills defects, ▪ low retention levels		▪ Girls ▪ Boys ▪ PWDs
4.	Barriers associated with physical infrastructure: ▪ Poor physical accessibility (seasonal streams) ▪ Constraints in road motorability ▪ Limited land for physical development	All year round	▪ Entire district population
5.	Gender/life cycle barriers: ▪ Inimical gender biased traditions e.g. widowhood rites, inequitable assets ownership, curtailment of girls' rights ▪ Involvement of women in decision making	All year round	▪ Women ▪ Children (Girls) ▪ PWDs

Source: 2010-2013 Bongo District Medium Term Development Plan

An internet based search revealed the Bongo district records more cases on Sexual and Gender Based Violence (SGBV) in the Upper East Region and this even necessitated the selection of the district for the campaign on ending Sexual and Gender Based Violence in 2015. According to the Bongo District 2010-2013 Medium Term Development Plan, 33% of children in the Upper East Region are engaged in Child Labour while in the Bongo District, 30% of children are engaged in child labour. Engagement in child labour is much higher for children from poorer families, about 34% than for children from richer families who constitute about 25%. Data also shows that that 85% of child labourers in the Bongo District are also attending school, and thus could have an impact on their future potential as well as impact on their health. Even though data utilised was in 2010, stakeholder discussions and issues raised shows that little has changed till date.

Gender equality and women's empowerment are key dimensions in overcoming vulnerability and ensuring sustainable development. According to the 2018-2021 District MDTP, the females in the Bongo District constitutes majority of the district population (about than 52%) and yet they have little say in decision making in the District. They are continually discriminated in all aspects of life, be it at the family, community, or district level, as they are having no potentials to contribute to the socio-economic development of the District. At the highest level of decision making at the District females are woefully underrepresented in leadership positions. Out of 38 elected members of the Assembly in 2019, there is only one female. With the appointed members, females make up 2 of the 15 members. Holistically, females make up only 5% of all the Assembly Members.

Men and women in rural communities of the District have highly differentiated roles. They are assigned specific tasks to their sexes. Traditionally, men are expected to grow and provide grain for the family main meals as well as shelter and family security, while women provide soup ingredients to go with the meals as well as other household needs such as kerosene, soap, etc. Women responsibility towards household upkeep such as cooking and child care is on the increase. Their roles and responsibilities have gone beyond providing soup ingredients and basic household

items to providing the farm labour, marketing of farm produce grains. They also incur additional expenses of the family in areas of child education and medical bills. The relatively low participation of women in public level decision making process affects their ability to participate in discussions with development agencies in matters affecting their well-being since their numbers are limited in development committees. Low female enrolment and high drop-out rate of the girl-child is a common phenomenon. This means that high illiteracy rate among women is not likely to change considering the fact that illiteracy is one of the major problems of under-development, and therefore high illiteracy of women in the Bongo District is a severe limitation to development. The cumulative effects of these problems on the women are poverty, ignorance, and low standard of living.

The district is also abound with some negative cultural practices that impede development in the district especially women and children particularly the girl-child. There are bad practices such as dehumanizing widowhood rites that infringe on the rights and freedoms of women. Child betrothal is still practiced in the district as well as early marriages. This has affected children and those who are already in school. The practice also accounts for high drop-out rate especially among the girl-child. Another practice that affect the development of the girl-child and children in general is the practice of "tanzaba" which literally means "Sister-in-bed," This is a practice where a young man can flirt with a relative who is a sister and give birth but cannot marry her.

This practice has affected a lot of young girls and women in the district. It is noted as the principal cause of teenage pregnancies in the district. The practice is also responsible for some form of streetism in the district since children born out of this relationship are usually left to the care of the unfortunate young girls and women. Another cultural belief which a potential threat to peace in the district is also is alleged witchcraft. People have taken the law into their hands and mete out instant justice to alleged witches by lynching them. This issue also has a gender dimension where most of the alleged victims are women.

4.8.11. Health Services

The District Health Management Team (DHMT) is responsible for the overall management of health services in the district. The DHMT is supported by six sub-district Health Management Teams, namely the Bongo Central, Bongo Beo, Bongo Soe, Namoo, Zorko and Valley Zone. Health infrastructure in the district as shown in Table 4-20. The Adaboya Clinic and the Akanaba CHP were identified as being within the immediate impact area of the solar and sub-transmission site.

Table 4-20: List of Health Facilities in the Bongo District

Facility Type	2014	2015	2016	2017
Hospitals	1	1	1	1
Sub-Districts	6	6	6	6
Health Centres	5	5	5	5
Clinics	1	1	1	1
Functional CHPS Zones	35	36	36	36
CHPS with Compounds	21	21	22	24

Source: GHS - Bongo District, 2017

Like other rural districts and the nation at large, malaria is the dominant disease in the District with 52% of all OPD cases. This is largely attributed to improper sanitation and hygiene practices. Malaria continues to be a major public health concern and is one of the leading causes of morbidity and mortality, especially among children under five and pregnant women. Others are Acute Respiratory Infection, Diarrhoea diseases, Skin diseases & ulcers, Acute eye infection, Anaemia, Rheumatism & joint pains, Pregnancy & related complications, Typhoid fever and Home accidents & injuries. The district lies within the Onchocerciasis Freed Zone.

The vibrant market at the Burkina side of the border known as Yelwongo where citizens in the district brisk business with their neighbours also serves as an important source of revenue for the District. Adversely, however, it poses some health risk on the people of the district and beyond regarding the spread of HIV/AIDS. Because of the brisk trade and interaction in the area, it predisposes the people to some health risk such as HIV/AIDS and other communicable diseases. In 2017 alone, the District has of November 2017 recorded fifty-nine cases of HIV infection during the year. HIV Prevalence in the district is estimated at 0.64%[12]. Literature indicates that there was ample evidence that knowledge of the HIV disease is high but ways of preventing it is very low.

Over half of the District's population is enrolled on the NHIS (57%) while new registrations are also in an increasing trend. Access to health facilities in the district is still a big challenge especially regarding physical accessibility. Limited access to health care in the District has compelled people to resort to unorthodox health service delivery with its attendant consequences. There are a lot of traditional knowledge, attitudes and practices in the district and a lot of ailments are still being treated with traditional medicine and resorting to soothsayers for diagnosis of certain diseases, like HIV& AIDS and occurrences of calamities.

4.8.12. Education

Schools in the district are listed in
Table 4-21. Forty Seven percent (47.7%) percent of population aged 11 years and older are literate while 52.3 percent are not literate (illiterates). 60.2% are literate in English only, 36.2% literate in English and a Ghanaian language, while only 3.3 percent are literate in a Ghanaian language only. Ten schools were identified as being close to the solar and sub-transmission site and these are listed in Table 4-22 and their locations indicated in Figure 4-9.

Table 4-21: Number of Schools in the Bongo District

Level	Public	Private	Total
KG	75	13	88
PRIMARY	74	13	87
JHS	56	6	62
SHS	3	3 COM.SHS	6
TVET	1	1 Com. Technical	2

Source: GES – Bongo District, 2017

[12] National and Sub-National HIV and AIDS Estimates and Projections, 2017 Report

Table 4-22: Number of Schools Located in Project Area

School	Boys	Girls	Total
Atampintin D/A KG/Primary	157	160	317
Atampintin JHS	52	73	125
Adaboya DA/KG/Primary	146	159	305
Adaboya JHS	46	65	111
Kabre DA/KG/Primary	74	69	143
Akulyoo KG/Primary	52	51	103
Ghana Daa RC KG Primary School	216	217	433
Light Academy	15	23	38
Apatanga RC JHS	41	57	98
Tindonbonko JHS	44	43	87

Source: GES –Bongo District, 2017

Figure 4-9: Nearby Educational & Health Facilities to PV Project Site

Source: VRA Engineering Services Department (February 2018)

40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 5: STAKEHOLDER ENGAGEMENTS

5 STAKEHOLDER ENGAGEMENTS

5.1. Introduction

Public consultation is an integral part of the EIA and once consultation has been initiated, it is considered best practice to continue consultation throughout the project life. This section presents an overview of consultation undertaken to date for the project and summarises the proposed consultation activities for the remainder of the project. It must be noted that a stand-alone "***EIA Study Report Volume III - "Stakeholder Engagement Plan***", has been prepared as part of the suite of documents for the EIA Study to inform and guide in the stakeholder process, and must be referred to for further details on the stakeholder engagement process.

5.2. Stakeholder Mapping

A stakeholder mapping was done to identify those critical to be consulted within the setting of this project. It therefore largely involved identifying stakeholders located within the project's proximity as they are the most likely persons to be impacted upon, like those whose properties will be affected by the project, or those who reside in the communities. With respect to stakeholder mapping, four (4) categories of stakeholders can be identified with respect to the levels of interest and influence of impact they have on project outcomes. Stakeholders based on the categorisation that will have to be consulted are presented in Table 5-1. The wide range of stakeholders engaged is because from our perspective, diversity of opinion rather than consensus building is likely to enrich ultimate decision-making, which is critical for project success.

Table 5-1: Stakeholders Consulted

Category	Stakeholder Type	Stakeholders Consulted
1	<u>High Interest/High Influence</u> • Traditional Authorities • Bongo District Assembly	▪ Upper East Regional Coordinating Council ▪ Bongo District Assembly ▪ Bolgatanga Municipal Assembly ▪ Paramount Chief of Bongo ▪ Chief of Asibiga ▪ Chief of Soe ▪ Landlords of Bongo (Tindabas)
2	<u>High Interest/Low Influence</u> • Land/Crops Owners • Caretakers of Cultural Assets • Community Representative on Local Government • Community members	▪ Landowners of the Bongo Solar Project Site ▪ Crop owners associated with the proposed 40MW solar power generation plant site at Asibiga ▪ Crop owners associated with the 23 km Sub-transmission line route in Bongo ▪ Caretakers of cultural sites, comprising of the old isolated ancestral grave and two shrines. ▪ Bongo Assemblyman ▪ Members of Asibiga, Bongo and neighbouring communities
3	<u>High Influence /Low Interest</u>	▪ Environmental Protection Agency ▪ Energy Commission ▪ Water Resources Commission

Category	Stakeholder Type	Stakeholders Consulted
	• Permitting Issuing State Agencies • Key state actors within the Upper East Region, Bolgatanga Municipality as well as Bongo District • Policy and law makers	▪ Ghana National Fire Service, Bongo District ▪ District Education Service, Bongo District ▪ District Health Services, Bongo District ▪ Land Use & Spatial Planning Department ▪ Department of Feeder Roads ▪ National Disaster & Management Organisation ▪ Lands Commission, Upper East Region ▪ Northern Electricity Distribution Company ▪ Bongo Customary Land Secretariat ▪ Forestry Services Division, Bongo District
4	Low Influence /Low Interest Non state actors with facilities within immediate impact area and has indirect role in the project development process	Proprietors of facilities/activities identified closed to the project site, including churches and schools, and these were ▪ Irrigation Company of Upper East Region (ICOUR) – Vea Irrigation Project. ▪ Atampintin DA Primary ▪ Atampintin JHS ▪ Adaboya DA Primary ▪ Adaboya JHS ▪ Kabre Primary ▪ Akulyoo DA Primary ▪ Christ the King RC KG/Primary ▪ Light Academy ▪ Atapanga RC JHS ▪ Tindomboko JHS ▪ Ghanada RC Primary School ▪ Other PAPs including road users (impacts associated with traffic congestion)

5.3. Methodology for Stakeholders' Engagements

The process of engagements of identified stakeholder begun in January 2014 following the selection of the project site in April 2013 and has continued till date. The VRA team working on the EIA Study were formally introduced to the stakeholders through a "***Letter of Introduction***". The letter advised that as part of the process for the acquisition of the Project's Environmental Permit, VRA is preparing an EIA Report and is gathering the relevant baseline data covering all aspects of the existing biological and physical environment as well as the socio-economic conditions in the affected communities and district for input into the Report. The letter requested all concerned stakeholders to give the VRA Team all the necessary assistance they may require either in the form of documentation or in responding to questionnaires, that they may need.

An important element of the EIA Process is to evaluate the issues raised through the interactions with authorities, the public, the specialists on the EIA team and the project proponent. In accordance with the philosophy of Integrated Environmental Management, it is important to focus the EIA on the key issues, such as those issues that are considered critical for decision-making. To assist in the

identification of key issues, a decision-making process is applied to the issues raised, based on whether or not the issue falls within the scope and responsibility of the proposed project of whether or not enough information is available to respond to the issue raised without further specialist investigation.

Depending on the stakeholder, the type of engagements made were either formal/informal meetings, one-on-one meetings, telephone or community gatherings. Arrangements for such meetings were done in collaboration with the Bongo Assemblyman who was mostly present to help translate the discussions in the local language, i.e., Frafa, if required. Generally, depending on the stakeholder, project information provided during the consultations centred on the following:

1. Project Rationale, Objectives and Benefits
2. Status of VRA REDP Programme and how the project fits into it.
3. Project development activities, including skills development
4. Project Impacts, both positive and negative
5. Rational for EIA Study and data collection strategy
6. It is a legal requirement in Ghana that development projects such as the 40MW solar power
7. As part of the EIA process, VRA has embarked on stakeholder engagements with the primary aim of:
    - Disseminating general project and programme information to affected persons and interested parties.
    - Providing local knowledge and input in identifying potential environmental (biophysical and social) impacts associated with the proposed development.
    - Providing VRA with an opportunity to record comments/opinions of affected persons/interested parties, and where possible to address these issues within the EIA.
    - Providing information and answer questions regarding the location of the power generation plant and the transmission line and substation works.
    - Discussing and addressing areas of concern/confusion.
    - Promoting transparency and an understanding of the project and its consequences.
    - Complying with national / international standards, for environmental impact statement.

Through these consultations with I&APs and Stakeholders, issues for inclusion within the EIA has been identified and recorded.

5.4. Records of Stakeholders' Engagements To date

From the various engagements, the communities and other stakeholders, including the state agencies, generally welcomed the plans to establish the proposed solar power project in the area. Since the project would not directly affect them, the community members generally did not have any apprehension or reservation about the project. They nevertheless viewed the project as one that would create employment opportunities and small business/trade opportunities for the local population.

As to be expected, these stakeholders raised a series of questions, comments and concerns and a summary of the main inquiries, proposals and concerns raised by the stakeholders during these various community engagements events and the responses provided are outlined in Appendix 5. Pictures from these engagements are also provided as part of Appendix 6. List of key participants during the engagements are provided in Appendix 7, including signed list of participants at some of the engagements.

5.5. Public Disclosure

The rationale for public disclosure in an EIA exercise is to ensure accountability and transparency in line with international best practice. With respect to public disclosure under the EIA Study, VRA published a Scoping Notice on the project in Daily Graphic and Ghanaian Times in June 2018 to enable the public make inputs or provide review comments. The Daily Graphic and the Ghanaian Times are the two (2) most widely circulating newspapers in the country. A copy of the report was also posted on the corporate website. The Scoping Report was also distributed to the Energy Commission, the Bongo Naaba and the Bongo District Assembly.

In addition, it is expected that an Advertisers' Announcement will also be made in a widely circulating national dailies for the public to access and make inputs into this EIA Report and following related documents:

- Non-Technical Summary of the EIA Report
- Stakeholders Engagement Plan
- Land Acquisition & Compensation Action Plan.
- Labour & Working Conditions Management Plan

Copies of these reports will be made available at the following locations:

- VRA Corporate website at www.vra.com
- VRA Head Office Library in Accra
- VRA Environment & Sustainable Development Department Library in Akosombo
- EPA Head office in Accra
- EPA Regional Office in Bolgatanga
- Bongo District Assembly
- Upper East Regional Coordinating Council,
- Bolgatanga Municipal Assembly
- Bongo Traditional Authority

Comments are to be provided to the EIA team at the address, tel. numbers or e-mail address provided below. All comments received following the release of the EIA/NTS Report, through meetings and written correspondence will be reviewed and addressed as necessary. Going forward

and as part of the disclosure processes, VRA will also give approval for any potential funding agency to publicly disclose these reports on their online portal.

The Chief Executive
Volta River Authority
Electro Volta House, 28Th February Road
P. O. Box MB 77, Accra
Digital Address: GA-145-7445
Tel No: +233-302-664941-9
WhatsApp: +233-501-620439
Email: corpcomm@vra.com

5.6. Grievance Redress Mechanism

As required, VRA will establish a grievance redress mechanism for the project basically as a formal procedure through which communities and individuals affected by project activities can formally communicate their specific concerns and grievances and facilitate resolutions that are mutually acceptable by the parties and within a reasonable timeframe. The grievance procedure is to be used by anyone without any concern or fear of retribution. For project affected persons and communities who may not have direct access to the internet or have difficulty understanding the English Language, VRA communicate the contents of the GRM in locally accepted languages agreed with the affected parties.

5.6.1. Establishment of Grievance Committee

Stakeholders in the form of landowners, local youth and government officials are being engaged in a need-based manner, whenever grievance arises. This is because VRA is yet to establish a Grievance Committee for the project. As is the practice, VRA utilise the services of District Chief Executives, the Assemblypersons, VRA Project Site Engineer as well as the Contractor's Representative as contact persons for grievances. These persons form the Grievance Committee and are required to assist in project implementation in the following ways:

- Serves as a liaison between the community members and VRA
- Address misleading issues/problems if any.
- Bear witness to any damages and compensations to be paid.
- Identify and testify rightful owners of properties.

The VRA Project Site Engineer and the Contractors Representative (most likely the HSE Officer) serve as Community Liaison Officers to address issues raised by the community during the construction phase of the project. These persons are to be introduced to the traditional authorities and community members prior to project construction.

5.6.2. Grievance Redress Process

Currently, a Grievance Redress Mechanism – Operational Manual (June 2016) has been released by the Ghana EPA. The Manual seeks to ensure an efficient and transparent execution of the GRM process and was developed to provide a standardized mode of addressing grievances across board. It is therefore planned that the strategies recommended in the Operational manual is to be adopted by the VRA in project implementation. Recommended steps for grievance redress mechanism outlined in the manual are as follows:

- Receive and register grievance
- Acknowledge receipt of grievance
- Access and assign grievance for investigation
- Investigate grievance
- Select a resolution option
- Formulate and communicate response
- Institute resources or appeal mechanism
- Follow up and close out
- Monitor, report and evaluate the GRM.

Sample formats to record and register complaints as provided in the GRM-Operational Manual is to be adopted for the project and are provided as Table 5-2 and Table 5-3. All formal grievances will receive a formal written reply within seven (7) working days. In all cases VRA will state the date of the resolution. The final response will provide additional information or, if appropriate, further instructions on proposed measures to resolve the issues. VRA will make concerted efforts to resolve grievances amicably within thirty (30) days; yet, if a grievance cannot by resolved, VRA will seek to involve other individuals or agencies, as necessary. A database will be developed of all recorded grievances. In receiving the grievances of vulnerable affected persons (e.g. women, those over 60, the illiterate, or the physically challenged), VRA will pay careful attention to any special needs, difficulties or concerns that they may have. The grievance procedure is to be used by anyone without any concern or fear of retribution.

Table 5-2: Sample Format of Grievance Register

Ref. No.	Date Receipt	Particulars of Client				Particulars of Grievance				
		Name	Address	Phone No	Whether acknowledgement given at the time receipt (Yes/No)	Subject of t grievance	Office	Brief Description	Date of Acknowledgment / Date of redress	Immediate action taken

Table 5-3: Sample Form for Assessing Grievance

Ref. No	Date & description of Grievance	Grievance Prone Area Identified	Root Cause Identified	Action Required to Improve System	Planned date and Authority Responsible for Taking Action	Action Taken Date

5.6.3. Arbitration:

Arbitration shall be an option for grievance redress where the parties involved agree to resolve their dispute through arbitration. The Arbitration Act 1961 (Act 38) makes provisions for aggrieved parties to agree to settle disputes out of court through arbitration. In order to use arbitration in the settlement of disputes, the parties ought to make a written agreement to submit a present dispute, or future disputes to arbitration. The parties are at liberty whether or not to name an arbitrator in the agreement. Where an arbitrator is not named in the agreement, the agreement should designate a person who would appoint an arbitrator.

5.6.4. Courts of Law

It should be noted that arbitration only works where the parties to a dispute agree to resolve a difference through arbitration. Where there is no consent, then a court of jurisdiction may be used to resolve a dispute.

5.7. Next Steps in the Stakeholder Engagement Process

Based on the issues raised at the project briefings, status quo conditions of the study area and the nature of the proposed development, the key issues of concern that must be considered during project implementation are summarized as below and how they are to be addressed discussed at appropriate sections of this EIA Report and or the related documentations:

- Land Acquisition & Compensation for Loss Property
- Effective Community Entry by Project Contractors
- Employment for Community Members
- Implementation of a Corporate Social Responsibility Programme
- Availability of Grievance Redress Mechanism
- Relocation of Cultural Properties
- Environmental Degradation
- Changes in Land Use
- Risk to Public Safety, Community Health & Security Issues
- Gender & HIV &AIDs
- Acquisition of Permits
- Continued Engagement During Construction & Operational Phase
- Effective Project Monitoring & Evaluation Process

Further consultation is planned to refresh the project information and to disclose the mitigation and other management plans upon commencement of constructional activities. The following activities are to be undertaken as part of the next steps engagements:

- Public Disclosure of the EIA Report and elated documentations on the VRA Corporate website, www.vra.com.
- Make available copies of the Non-Technical Summary Report / EIA Reports to the Upper East Regional Minister, the Bongo District Chief Executive and the Bongo Naaba.
- In collaboration with their caretakers, engage and perform all relevant pacification rites to relocate cultural properties form the project site.

- Engagement with state agencies for the acquisition of all relevant permits and licenses.
- Formal notification of the Upper East Regional Minister and the Bongo District Chief Executive on the period for project commencement. The letter should be copied to the traditional authorities.
- Self-introduction of EPC Contractor to the Bongo District Chief Executive on arrival of onsite prior to project implementation.
- Self-introduction of EPC Contractor to the traditional authorities and community leaders on arrival of onsite prior to project implementation. The traditional authorities are Bongo Naaba, Chief of Asibiga and Chief of Soe
- Provide platforms for the community leaders to provide information on concerns that needs to be considered during the project implementation and to agree on grievance redress mechanism in place, including the introduction of the Grievance Community members who shall directly address issues raised by the community during the construction phase of the project.. It is recommended that the engagement with traditional authorities should be used as one of such platforms.
- Engagement with representatives of the identified neighbouring facilities to notify them on project commencement and expected roles to safeguard the public.
- Engagement with the Ghana Highway Authority with respect any development of road infrastructure within the project area and work within the RoW of existing roads with respect to the sub transmission line within the Bolgatanga Municipality.
- VRA / EPC Contractor must observe all necessary traditional requirements prior to project commencement.
- Continuation of stakeholder consultation and communications through project construction and implementation phases.
- Provide information releases to the community if new issues arise or if the community has specific concerns. Company representative contact information will be available to the public to address concerns and questions during construction as well as operations and maintenance.
- Personal consultations as requested or if warranted.
- Meetings with district and other local government authorities.
- Ongoing consultation and meetings with local communities and organizations.

In addition, VRA shall also monitor and report on the on-going stakeholder engagement efforts to ensure that the desired outcomes are being achieved, and to maintain a comprehensive record of engagement activities and issues raised. The stakeholder engagement activities should be periodically evaluated using the following indicators:

- Level of understanding of the project by stakeholders as determined through random surveys conducted in the affected communities on a bi-annual basis using a short questionnaire.
- Monthly review of grievances received and how they have been addressed, including analysis of the time taken to resolve the grievances; number of grievances resolved to the satisfaction of the original party; categorisation in themes of complaints identifying areas for improvements. This will include grievances submitted directly to VRA and those submitted to contractors; and

- Level of involvement of affected people in committees and joint activities and in the project, itself.

To measure these indicators, the following data are to be used:

- Issues and management responses linked to minutes of meetings.
- Feedback from primary stakeholder groups (through interviews with sample of affected people); and
- Grievance registers from VRA and contractors.
- These evaluation reports will be presented to the Project Team, including that the EPC Contractor, on a quarterly basis.

A summary of the results shall be provided in the Project Annual Environmental Report that will be submitted to the Ghana EPA and the Energy Commission as part of project implementation reporting.

40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 6: IMPACTS IDENTIFICATION & SIGNIFICANCE

6 IMPACT IDENTIFICATION AND SIGNIFICANCE

6.1. Overview

As required under the Ghana EA Regulations, the EIA process is expected to identify the potential impacts, both positive and negative, of the proposed development that occurs during the pre-construction, construction, operational and decommissioning phases of the development. The following categories/attributes: nature, duration, spatial extent reversibility, direct and indirect impacts, short term and long term, positive or negative, cumulative, etc. are to be utilized in identifying project impacts in accordance with the Environmental Assessment Regulations LI 1652 (1999). To identify the potential impacts, it is important that the nature of the proposed projects is well understood so that the impacts associated with the projects can be assessed.

The process of identification and assessment of impacts is to be done based on the following:

- Determining the current environmental conditions in enough detail so that there is a baseline against which impacts can be identified and measured.
- Determining future changes to the environment that will occur if the activity does not proceed.
- Developing an understanding of the activity in enough detail to understand its consequences; and
- Identification of significant impacts which are likely to occur if the activity is undertaken.

6.2. Approach to Impact Assessment

A simple, clearly defined method has been used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment. Nonetheless, it must be remembered that an impact assessment will always contain a degree of subjectivity, as it is based on the value judgment of various specialists and Environmental Assessment Practitioners. The evaluation of significance is thus contingent upon values, professional judgement, and dependent upon the environmental and community context. Ultimately, impact significance involves a process of determining the acceptability of a predicted impact to society.

The following methodology has been applied to the predication and assessment of impacts:

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
- **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. The cumulative impacts will be assessed by identifying other applicable projects, such as construction and upgrade of electricity generation, and transmission or distribution

facilities in the local area that have been approved (i.e. positive EP has been issued) or is currently underway.

- **Nature of impact** - this review the type of effect that a proposed activity will have on the environment and should include "what will be affected and how?"

- **Potential Intensity**

Potential Intensity Description (negative)	Rating	Score
Potential to severely impact Human Health (morbidity/mortality) or to lead to Loss of species (fauna and/or flora)	Very High/Fatal Flaw	16
Potential to reduce faunal/flora population or to lead to severe reduction/alteration of natural process, loss of livelihoods or seve impact on quality of life, individual economic loss	High	8
Potential to reduce environmental quality – air, soil, water. Potential Loss of habitat, loss of heritage, reduced amenity	Medium	4
Nuisance	Medium-Low	2
Negative change – with no other consequence	Low	1
Potential Intensity Description (positive)	**Rating**	**Score**
Potential Net improvement in human welfare	High	8
Potential to improve environmental quality – air, soil, water. Improved individual livelihoods	Medium	4
Potential to lead to Economic Development	Medium-Low	2
Potential positive change – with no other consequence	Low	1

Note that the concept of "**irreplaceable loss of a resource**" is to be taken into account in the Potential Intensity score of an impact

- **Irreplaceability of resource** loss caused by impacts –
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment. For example, if the project will destroy unique wetland systems, these may be irreplaceable);
  - Moderate irreplaceability of resources.
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

- **Spatial extent** – The size of the area that will be affected by the risk/impact:

Spatial Extent Description	Score
Site specific	1
Local (<10 km from site)	2
Regional (within 100 km of site)	3
National	4
International/Global (e.g. Greenhouse Gas emissions or migrant birds).	5

- **Duration** – The timeframe during which the risk/impact will be experienced:

The concept of "reversibility" is reflected in the duration scoring, i.e. the longer the impact endures the less likely it will be reversible.

Duration Description	Score
Temporary (less than 2 year) or duration of the construction period. This impact is fully reversible.	1
Short term (2 to 5 years). This impact is reversible.	2
Medium term (5 to 15 years). The impact is reversible with the implementatio of appropriate mitigation and management actions.	3
Long term (> 15 years but where the impact will cease after the operational lif of the activity). The impact is reversible with the implementation of appropria mitigation and management actions.	4
Permanent (mitigation will not occur in such a way or in such a time span tha the impact can be considered transient). This impact is irreversible	5

- **Reversibility of impacts** -
  - High reversibility of impacts (impact is highly reversible at end of project life, i.e. this is the most favourable assessment for the environment. For example, the nuisance factor caused by noise impacts associated with the operational phase of an exporting terminal can be considered to be highly reversible at the end of the project life).
  - Moderate reversibility of impacts.
  - Low reversibility of impacts; or
  - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment. The impact is permanent. For example, the loss of a palaeontological resource on the site caused by building foundations could be non-reversible).

Using the criteria above, the impacts will further be assessed in terms of the following:

- **Probability** – The probability of the impact/risk occurring:

Probability Description	Score
Unlikely (little or no chance of occurring <10%)	0.1
Low Probability (10 - 25% chance of occurring)	0.25
Medium Probable (25 - 50% chance of occurring)	0.5
Highly probable (50 – 90% chance of occurring)	0.75
Definite (>90% chance of occurring).	1

- **Magnitude**–The anticipated severity of the impact (Intensity + Extent + Duration):
  - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);
  - Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or
  - Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).

- **Significance** – Will the impact cause a notable alteration of the environment? To determine the significance of an identified impact/risk, the consequence is multiplied by the probability (as shown below).

*Significance Rating = Impact Magnitude * Probability*

"Impact Magnitude" = Potential Intensity + duration + extent

Table 6-1: Guide to Assessing Risk/Impact Significance

Scoring	Significance rating	Description
18-26	**Fatally Flawed**	The project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating.
10 - < 18	**High**	The impacts will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making.
5 - <10	**Medium**	The impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures and

Scoring	Significance rating	Description
		will only have an influence on the decision-making if not mitigated.
2 - <5	**Low**	The impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures and will not have an influence on decision-making.
<2	**Very Low**	The impact may result in very minor alterations of the environment and can be avoided through the implementation of mitigation measures.

- **Status** - Whether the impact on the overall environment (social, biophysical and economic) will be:
  - Positive - environment overall will benefit from the impact.
  - Negative - environment overall will be adversely affected by the impact; or
  - Neutral - environment overall will not be affected.

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
  - Low.
  - Medium; or
  - High.

Where appropriate, national standards will be used as a measure of the level of impact.

6.2.1. Dealing with Uncertainty

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty, but in projects such as the proposed power project, where the design process is currently in progress, uncertainty stemming from on-going development of the Project design is inevitable, and the environment is typically variable from season to season and year to year. Where such uncertainties are material to the EIA findings, they are clearly stated and are approached conservatively ('the precautionary approach') in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

Potential impacts may be assessed using tools ranging from quantitative techniques such as modelling to qualitative techniques based on expert judgment and historical information. The accuracy of these assessment tools depends on the quality of the input data and available information. Where assumptions have been made, the nature of any uncertainties associated with the assumption is discussed. For qualitative predictions/assessments, some uncertainty is removed through consultation. These uncertainties are reflected in the Confidence level scoring.

6.2.2. Mitigation and Assessing Residual Impacts

As specified in Section 12 of Part II of the EIA Regulations, appropriate mitigation measures will be identified to eliminate, minimise or manage identified potential significant environmental effects. Impacts will be described both before and after the implementation of the proposed mitigation and management measures. It is expected that for the identified significant impacts, the project team will work with the client in identifying suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the Project design in order to avoid or reduce the negative impacts or enhance the positive impacts will be developed. A description of these mitigation measures will also be included within the Environmental Management Plan (EMP).

Residual impacts are those impacts which remain once the mitigation measures have been designed and applied. Following the identification of mitigation measures to address significant adverse effects, an assessment of the significance of any residual effects (i.e. those remaining after mitigation) will be completed. The result is a significance rating for the residual impact. The proposed enhancement /mitigation measures associated with the identified impacts are provided under Chapter 7 of this EIA Report.

6.2.3. Proposed Management & Monitoring

After the completion of the assessment, proposals for monitoring requirements are to be put forward where relevant. Proposals for monitoring are to be designed to evaluate the accuracy of the impact prediction and the success of any implemented mitigation measures. Thus, the final stage in the IA Process has been the definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards/ guidelines; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted. This is covered in Chapter 8 under Environmental Management Plan (EMP).

6.3. Summary of Project Impacts

The potential interactions matrix for project activities and likely impacted resources/ receptors is summarised in Table 6-2 and discussed in detail in the subsequent sections. These have been explained using colour codes and numbers. The projected impacts basically encompass both positive and negative changes and the extent of impact has been illustrated using colour codes and numerical expression, explained by its key for easy appreciation, and are discussed in detail in the subsequent sections. By the key, if the row associated with an activity is 0 or without any colour shade, the impacts from that activity are negligible, or of lower significance and screened out of further consideration. A green shade or +1 is a potential significant beneficial impact and this is an impact that provides direct socio-economic benefit. The associated impacts with the other colour codes are as explained in Table 6-1. Owing to site conditions there are certain possible interactions that will not take place, and thus are scoped out and not discussed. It is imperative therefore that project developers consider these impacts in execution of the development of the solar PV infrastructure facility.

Table 6-2: Activity Impact Interaction Matrix for Project Phases

Key Broad Activities	Ecology		Climate Change	Physical Environment							Health & Safety		Socio-cultural Environment								
	Flora	Fauna	GHG Emissions	Noise	Air Quality	Water Resources	Topography & Drainage	Geology & Soils	Waste	Visual intrusion	Public Safety	Occupational Safety	Cultural Heritage	Land tenure, Ownership	Traffic & Transportation	Labour	Gender & Vulnerability	Land use	Employment	Economic Growth	Electricity Stabilisation
Pre-constructional Phase																					
Project Feasibility Study	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Survey Exercise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquisition of Land	0	0	0	0	0	0	0	0	0	0	0	0	-2	-3	0	0	0	-1	0	0	0
Constructional Phase																					
Contractor mobilization, including engagement of labour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	+1	0	0
Acquisition of Land	-3	-3	0	0	0	0	0	0	0	0	0	0	0	-1	0	-1	-1	-3	0	0	0
Site Clearing & Land Preparation	-3	-3	-2	-3	-2	-3	-3	-1	-1	-1	-1	-3	-1	0	-3	-1	-1	-3	+1	0	0
Transportation of equipment	-3	-3	-3	-3	-2	0	-3	0	-1	-1	-1	-3	-1	0	-3	-1	-1	0	+1	0	0
Civil works to prepare site	-3	-3	-2	0	-2	0	-3	0	-1	-1	-1	-3	-1	0	-3	-1	-1	0	+1	0	0
Installation of facilities	-3	-3	-2	0	0	0	0	0	-1	-1	-1	-3	-1	0	-3	-1	-1	0	+1	0	0
Demobilisation	0	0	-2	0	0	0	0	0	-1	-1	-1	-3	0	0	-3	-1	-1	0	+1	0	0
Testing & Commissioning	0	0	0	0	0	0	0	0	-1		-1	-3	0	0	0	-1	-1	0	+1	0	0
Operational & Maintenance Phase																					

Key Broad Activities	Ecology		Climate Change	Physical Environment						Health & Safety		Socio-cultural Environment							
	Flora	Fauna	GHG Emissions	Noise	Air Quality	Water Resources	Topography & Drainage	Geology & Soils	Waste	Visual intrusion	Public Safety	Occupational Safety	Cultural Heritage	Land tenure, Ownership	Traffic & Transportation	Labour	Gender & Vulnerability	Land use	Employment	Economic Growth	Electricity Stabilisation
Plant O&M	-1	-1	+1	-1	0	0	0	0	0	-1	-1	-1	0	0	-2	-1		-3	+1	+1	+1
PV Site Landscaping	0	0	0	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	-3	+1	0	0
PV Cleaning	0	0	0	-1	-1	-1	-1	-1	0	0	0	-1	0	0	0	0	0	-3	+1	0	0
RoW Maintenance	-1	-1	0	-1	-1	-1	-1	-1	0	0	-1	-1	0	-2	0	0	0	-3	+1	0	0
Line Route O&M	0	0	0	-1	-1	-1	-1	-1	0	0	-1	-1	0	0	0	0	0	-3	+1	+1	0

Key

Significance Rating	
Positive	+1
Fatally Flawed Negative	-5
High Negative	-4
Medium Negative	**-3**
Low Negative	**-2**
Very Low Negative	-1
	0

6.4. Positive Project Impacts

In the past decade, Ghana has experienced severe electricity supply challenges costing the nation an average of US $2.1 million in loss of production daily. The electricity supply challenges can be attributed to a few factors, including a high level of losses in the distribution system, which is mainly due to the obsolete nature of distribution equipment, as well as non-payment of revenue by consumers. Other factors are overdependence on thermal and hydro sources for electricity generation and a poor tariff structure, which makes it difficult for the utility companies to recover the cost of electricity production.[13]

Thus, solving Ghana's electricity challenges would require measures including, but not limited to, diversifying the electricity generation mix through, amongst others, the development of other hydro power and renewable energy sources for which the country has huge potential. The development of the solar power facility will result in significant and positive environmental and economic impacts on the strategic and national level. Such positive impacts are important to highlight and considered before investigating the potential negative environmental impacts anticipated from the Project. The major positive impacts of the project that shall occur at various phases of the project is detailed below:

6.4.1. Increased Employment Opportunities

Various activities have been undertaken at the pre-constructional phases that has required some form of employment opportunities with related payments. This included the project designs, land surveying, land acquisition as well as stakeholder consultations. This was however largely undertaken by VRA staff who are already in gainful employment. Therefore, it is at the constructional phase that will lead to a positive impact on the employment of the area and region. The proposed project has the potential to create jobs in the local area both directly and indirectly. Details of the work force have been outlined in Section 3.13.

Constructional Phase

During the constructional phase, this project will create job opportunities in the project area and beyond, including the international community and therefore the spatial extent will be international. Direct job opportunities will be available for high calibre professionals including engineers, mechanics and consultants. It is, however, unlikely that the local community will benefit from this calibre of specialised job market. Of greater relevance to the local community will be job opportunities involving unskilled and semi-skilled labour. Unskilled jobs will be offered mainly to the local people. In addition to direct benefits from the employment of residents, the proposed project may also offer potential economic benefits through the procurement of goods and services, both at the regional and national level. Other employment opportunities in the project area will spring from spin-off activities including trade, accommodation, and supply of goods and services to both the skilled and unskilled.

[13] *https://www.cgdev.org/ publication/electricity-situation-ghana-challenges-and-opportunities*

Aside the spatial extent being international, the impact of employment opportunities created during construction will be definite, and at a high confidence level, the impact can be described as **MEDIUM POSITIVE.**

Operational Phase

During the operational phase, beneficiaries for employment will mainly be engineers and technicians with experience in the power sector who can provide a swift response to labour requirements with minimum training. Based on the interactions during engagements, it was realised that very few of these types of candidates will be available from within the local area. As a result, employment benefit for skilled labour during operational phase is expected to be experienced mainly by university graduates usually residing in urban centres such as Bolgatanga. Increased income generating opportunities will be experienced at the local level to varying scales, causing different degrees of economic growth.

Looking at the numbers involved, the potential intensity on employment is low, regional in spatial extent and of long-term duration and definite and at a high confidence level, the impact can be described as **MEDIUM POSITIVE** in nature.

6.4.2. Minimisation of GHG Emissions

Pre-Constructional & Constructional Phase

The potential for offsetting greenhouse gas emissions can only be realised when project development is complete and operational.

Operational Phase

The solar power infrastructure facility represents an investment in clean, renewable energy infrastructure, which given the challenges created by climate change, represents a positive social benefit for society, as it would indirectly reduce/eliminate considerable percentage of air pollutants emissions due to consistent use of thermal power generation to support the exiting hydropower plants. The "Tool for GHG Accounting for Energy Projects", developed by KfW Development Bank, allows for calculating carbon emissions as well as emissions savings. For renewable energy projects (solar / wind / hydro / geothermal / bioenergy), this is achieved by calculating the amount of electricity generated annually, on average, by the renewable energy project will be multiplied by and thus compared to the combined grid margin Operating Margin (OM) 75% / Build Margin (BM) 25% for Solar and Wind, the rest assumes OM ⅓ and BM⅔. It is assumed that this amount of renewable electricity displaces electricity that would be generated per the country-specific fuel mix.

For this project, the PV power plant utilises polycrystalline technology, with an expected default operational life time of 20 years. Specific Capacity Factor, Default Capacity Factor and Default Emission Factor of the facility has been determined to be 16%, 15.5% and 0.509 tCo2/MWh. Using this tool, at an installed capacity of 40W, the total estimated emission savings from the solar power project during the

operational phase will be 28,264 Tonnes CO2e annually, for the entire occupancy phase or 571,279 Tonnes CO2e per lifetime.

The potential intensity of the project in minimising GHG emissions can be described as medium positive as it leads to improving environmental quality, spatial extent is global in nature, duration defined as long-term as it will continue as long as the project is in operation. At a high confidence level, the significance of the impact can be described as **HIGH POSITIVE** as it will lead to improvement of environment due to low carbon emissions and individual livelihoods for the entire country during the estimated 20 – 25 years of its operations.

6.4.3. Stabilization of Electricity

Developing the solar power facility to feed the national grid with approximately 40MW of power will contribute to creating a stable and reliable power supply base and helping to solve the serious domestic power supply volatility experienced in Ghana over recent years. The current primary energy generation sources in Ghana have experienced serious limitations due to low water levels and oil and gas supply constraints. Consequently, solar power facility coming on stream by 2021 will provide broader electricity supply market space as well as optimize the power generation portfolio and improving generation mix and power supply stability and reliability in Ghana.

Pre-Constructional & Constructional Phase

There are no positive impacts during the pre-constructional and constructional phases as stabilisation of electricity can only be realised when project development is completed and operational.

Operational Phase

Operations of the solar power facility is envisaged to contribute significantly to addressing potential power demand and supply growth in-balance and deficit in the near future, as it will play a significant role in the stabilization of power situation in Northern Ghana in specific and the country in general during the operational phase. The potential intensity can be described as medium low, spatial extend on the regional level and spatial extent to be long term. Stabilisation of electricity can be described to be definite and at a high confidence level, can be described as a **MEDIUM POSITIVE** impact on the country as it will lead to improvement of environment and individual livelihoods for the entire country during operations.

6.4.4. Promotion of Economic Growth in the Country

Growth in the Ghanaian population is driving up electricity demand. The current access rate of electricity in Ghana is estimated at 83 percent, with 91 percent in urban and only 50 percent in rural areas. An estimated 1.2 million of households are presently without power supply. Solar energy is used in some remote off-grid locations and at a single on-grid facility (a small pilot project in the country's north)[14]. Thus, this 40MW solar project which will be fed into the national grid will play

[14] https://www.export.gov/article?id=Ghana-Energy

a significant role in stimulating economic growth, especially in the Upper East Region and neighbouring Upper West, North East, Northern and Savannah Regions. The power input will contribute significantly to the ongoing national electrification programme, which has potential to promote spin-off effects on rural economy. The project also has power export potential to companies in the neighbouring countries, particularly Burkina Faso.

Pre-Constructional & Constructional Phase

There are no positive impacts during the pre-constructional and constructional phases as the promotion of economic growth can only be realised when project development is completed and operational.

Operational Phase

The project has the potential of reducing the cost of the power because the power generated from the project will in the long-term cost less than any other existing sources as its production cost will not increase thereafter. In effect, this implies that the project has the potential to usher the country into a low-power tariff regime. This has not only a positive effect on the cost of the energy production but will also lead to economic gains through improved competitiveness. The Project in specific will contribute to increasing energy security through reliance on an indigenous, inexhaustible and mostly import-independent energy resource.

At a high confidence level, the impact of the project in the promotion of economic growth during the 25 years of its operations can be said to be **MEDIUM POSITIVE** as it is national and of long term in nature and definite.

6.5. Project Negative Impacts on Physical Environment

The construction sector is considered as one of the main sources of environmental pollution as it has massive direct and indirect effects on the environment. It is therefore important to enhance the knowledge and awareness of construction participants regarding environmental impacts of construction in the early stage of the projects to curb down the adverse impacts of construction. This can help decision makers to identify major construction impacts on environment and make environmentally friendly construction plans in the early stages of construction. The potential for negatively impacting on the identified and environmental and social receptors, especially within the 2Km of anticipated immediate project impact area, during the various phases of the project are discussed below.

6.5.1. Increase in GHG Emissions

The development of the Solar Power Plant Project would involve the use of construction equipment and operation of motor vehicles which would produce GHGs. In addition, project emissions may occur either as a result of clearance of existing live vegetation during site preparation (including by slash-and-burn practices) within the project boundary, and/or from decay of un-cleared existing live vegetation that dies. The cutting down of economic trees as well as the removal of ground vegetation during project construction will contribute to GHG emissions and its impact on climate change, and

tree replacement as an offset will need to be considered. Trees capture greenhouse gases (GHGs) like carbon dioxide, preventing them from accumulating in the atmosphere and warming our planet. Thus, tree cover forms a source of carbon sinks and therefore contribute immensely to reducing the impact of GHG emissions. GHG emissions are also created by cutting down trees, because when trees are felled, they release into the atmosphere all the carbon they have been storing.

Constructional Phase

As indicated, a land area of 50.13 ha (0.5013 km^2) has been acquired at Asibiga, in the Bongo District. It is within this site that the associated substation will be developed. In addition, an associated 23 km sub-transmission line with a 15m Right of Way, is to be developed, and this will occupy a total of 0.345 km^2 area. Thus, a total area of 0.8463 km^2 would be required for the solar power plant and the associated sub transmission line project in the Bongo District. The vegetation clearing of not more than 84.63Ha (0.8463 Km^2) will also reduce carbon sinks and contribute to greenhouse gas emissions.

This EIA study has not estimated GHG emissions due to vehicular/equipment use during the constructional phase, as it occurs only during the 12 months period and anticipates it to be minimal GHG emissions from removal of herbaceous vegetation may also be considered as insignificant and hence can be neglected. Using the IPCC Guidelines for National GHG Inventories, which estimates carbon stock using the tree species, diameter, height and basal area, it is noted that when all the 343 trees enumerated on the 50.13 ha of land is removed prior to construction, an estimated 2617.49 Tonnes of CO_2e per year is expected to be lost from the atmosphere. This calculation does not consider the after use of the wood, either for fuel wood or would be left to decay.

With 2617.49 Tonnes of CO_2e sequestration lost annually, the potential intensity of the project in contributing to GHG emissions can be described low, spatial extent is global in nature, duration defined as temporal as it will last for the duration of the construction and definite to occur. At a high confidence level, the significance of the impact can be described as **MEDIUM NEGATIVE.**

Operational Phase

For the operational phase, direct emissions from various transportation used by staff and air conditions (office/vehicle) as well as the indirect sources from contractors, visitors' electrical line and transmission / conversion losses from project facilities is expected. It is expected that VRA official vehicles to be assigned to the project may be two (2) pickups, either Toyota or Nissan. Each vehicle is expected to be provided with at most, 40litres of diesel fuel a week as allocation. Thus, for the 52 weeks annually, the maximum volume of fuel that could be consumed by the vehicles will be 4,160 litres of car diesel fuel.

Under the Corporate Carbon Footprint Management Programme, VRA has adopted the "Mobile Combustion GHG Emissions Calculation Tool Version 2.6" which calculates the CO_2, CH_4 and N_2O emissions from vehicles to calculate mobile emissions. The use of fuel based approach methodology is in use with the 1995 IPCC Second Assessment Report for the Global Warming Potential. Using this tool, an estimate of 11.134 Tonnes of CO_2 e is estimated to be generated annually from vehicular emissions.

Thus, the potential intensity of the project in contributing to GHG emissions during the operational phase can be described as low, spatial extent is global in nature, duration defined as long term as it will last for the duration of the operation, with low probability of occurring. At a high confidence level, the significance of the impact can be described as **LOW NEGATIVE.**

6.5.2. Increase in Noise & Vibration Levels

The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. GSA: 1212:2018 requires that an entity responsible for a construction site shall erect an acoustic barrier around the construction site and ensure that the maximum noise level near the construction site does not exceed 66 dB (A) Leq (5 min.) in other areas. It is generally accepted that predicted noise levels from the development need to be compared with existing background levels at particularly sensitive residential locations close to the site. Neighbouring infrastructure within the project sites at Bongo that can be affected with noise and vibrational effects. A preliminary noise survey has been undertaken to identify impacts of noise from the proposed project. Noise levels were all largely within the permissible EPA values. The noise levels were influenced largely by moving vehicles in the project area.

Constructional Phase

During the construction period, the use of the equipment and machinery generate noise in the project area. The operations on site are also not intrinsically noisy, i.e. excavation of foundation, mixing of concrete, bolting of steel work, vehicle movement for delivery of men and materials. Table 6-3 outlines the possible diesel mobile equipment that might be used in the construction of roads, platforms and erection of solar panels, and typical sound power levels (LWA's) for such equipment at 10 m, 100 m and 500 m from each activity or piece of equipment. LWA's were sourced from the British Standard BS 5228-1:2009 code of practice for noise and vibration on construction and open sites (BSI, 2008). From the table, the impact of most activities reduces to below the GSA noise standard and IFC guideline for residential areas within 500 m from the activity or piece of operational equipment. Looking at the distance of about 1.3km from the Akorisi village, nearest community, from the project site, noise and vibrational noise will have very little effect on the community members.

Table 6-3: Noise Data for Construction & Demolition Equipment

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
Sound level data on site preparation					
Clearing site	Dozer (142 kW)	103	75[(a)]	55	41
	Tracked excavator (102 kW)	106	78	58	44
	Wheeled backhoe loader (62 kW)	96	68	48	34
Distributing of material	Articulated dump truck (tipping fill) (187 kW)	102	74	54	40
	Articulated dump truck (187 kW)	109	81	61	47

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
Earthworks	Dozer (142 kW)	109	81	61	47
	Tracked excavator (226 kW)	107	79	59	45
Loading lorries	Tracked excavator (75 kW)	107	79	59	45
	Wheeled loader (193 kW)	108	80	60	46
Rolling and compacting	Dozer (towing roller) (142 kW)	109	81	61	47
	Hydraulic vibratory compactor (tracked excavator)	106	78	58	44
	Vibratory roller (29 kW)	102	74	54	40
Sound level data on piling and ancillary operations					
Rotary bored piling - cast in situ	Compressor for mini piling (45 kW)	103	75	55	41
	Large rotary bored piling rig	111	83	63	49
	Mini piling rig (29 kW)	104	76	56	42
	Mini tracked excavator (17 kW)	96	68	48	34
	Tracked drilling rig (104 kW)	110	82	62	48
Welding / cutting steel piles	Gas cutter (cutting top of pile)	96	68	48	34
	Generator for welding	101	73	53	39
	Hand-held gas cutter	93	65	45	31
	Hand-held welder (welding piles)	101	73	53	39
Sound level data on general site activities					
Distribution of materials	Articulated dump truck (194 kW)	109	81	61	47
	Fuel tanker lorry	104	76	56	42
	Fuel tanker pumping	100	72	52	38
	Tracked excavator (41 kW)	99	71	51	37
	Wheeled backhoe loader (62 kW)	95	67	47	33
	Wheeled excavator (90 kW)	94	66	46	32
Lifting	Caged material hoist (electric)	96	68	48	34
	Lifting platform (35 kW)	95	67	47	33
	Mobile telescopic crane (260 kW)	110	82	62	48
	Tower crane (51 kW)	105	77	57	43
	Tracked mobile crane (240 kW)	103	75	55	41
	Wheeled mobile crane (275 kW)	98	70	50	36
Miscellaneous	Angle grinder (grinding steel) (2.3 kW)	108	80	60	46
Mixing concrete	Cement mixer truck (discharging)	103	75	55	41
	Concrete mixer truck (216 kW)	108	80	60	46
Power for lighting	Diesel generator (15 kW)	93	65	45	31
	Pumping water (7.5 kW)	93	65	45	31
Power for site cabins	Diesel generator	94	66	46	32
Pumping concrete	Concrete mixer truck (discharging) & concrete pump (pumping)	103	75	55	41
Pumping water	Water pump (diesel) (10 kW)	96	68	48	34
	Water tanker extracting water	107	79	59	45
Dust suppression	Dust suppression unit trailer	106	78	58	44
Sound level data on road construction works					
Earthworks	Articulated dump truck (194 kW)	109	81	61	47
	Bulldozer (250 kW)	114	86	66	52
	Tracked excavator (172 kW)	108	80	60	46
Paving	Asphalt paver (and tipper truck) (94 kW)	112	84	64	50
Road planning	Road planer (185 kW)	110	82	62	48
Rolling and compaction	Road roller (95 kW)	108	80	60	46

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
Trenching	Tracked excavator (27 kW)	102	74	54	40
	Wheeled excavator (51 kW)	98	70	50	36
Sound level data on demolition					
Breaking up concrete	Breaker mounted on backhoe (59 kW)	120	92	72	58
	Hand-held pneumatic breaker	111	83	63	49
	Pulverizer mounted on excavator (147 kW)	104	76	56	42
Breaking up/cutting	Gas cutter	107	79	59	45
	Tracked excavator (74 kW)	111	83	63	49
Crushing concrete	Tracked crusher (172 kW)	110	82	62	48
Dumping rubble	Articulated dump truck (dumping) (250 kW)	108	80	60	46
	Tracked excavator (loading truck) (228 kW)	113	85	65	51

Source: EIA for the proposed development of a Wind Energy Facility in Anloga Extension (Dec. 2017)

For traffic noise, movements from the Tema Port to the project site through about 830km will not have any impact on traffic noise as existing highways with heavy vehicular movements are to be utilised. The key issue with traffic noise will be the daily traffic movements from Bogorogo to the project sites, a serene area with roads which is untarred and poor in nature. The potential therefore exists for impacts to be felt by inhabitants along this access routes due to this change. However, this is likely to represent a slight increase over the current traffic volumes due to the very low current number of movements. The overall total traffic volumes predicted to be low as the delivery requirements for workforce and materials at the site is low and will be restricted to daytime only.

Thus, the main potential noise and vibrational impact during project construction will be from vehicle and construction noise affecting workers. The potential intensity of noise increases over the current baseline along the access routes will be a nuisance and is medium low, spatial extent being local to regional in nature, short term in nature as it will persist over the constructional period, and definite to occur. At a medium confidence level, the significance rating of the impact is said to be **MEDIUM NEGATIVE**.

Operational Phase

During operation, the main sources of noise are likely to be the vehicular noise and vocal noise from staff. The highest noise level to sensitive receptors will be from daily vehicular traffic movements. The solar power as a facility is not considered to exhibit any significant noisy operations, although the facility's inverters and transformers may produce noise, but this is not considered a serious issue, since they will not generate any significant noise. Plant operations might increase ambient noise level in few areas, mainly due to operation of the electrical components but the noise generated will not be audible at sensitive receivers. Low levels of noise will be generated during routine maintenance activities. It can be considered that the only people who could potentially be impacted by the noise are the employees working within the project site; these increased noise levels are considered occupational noises that require occupational health and safety measures.

In addition to this, some reptiles and mammals, within the project area can potentially be driven away from the site due to the sound levels. However, these noise impacts are not considered to significantly harm animals nor cause impacts on a population level. Since the activities will occur under normal operating conditions and are expected to have only localized and temporary effects within the project area, the impact significance is low.

Protective instruments will be provided to the operators and workers working near the high noise generating machinery. As per Occupational Safety and Health Administration (OSHA) Standards, the maximum allowable noise level for the workers is 90 dB (A) for 8 hours exposure a day. Therefore, adequate protective measures in the form of ear mufflers/ear plugs to the workers working in high noise areas will be provided. In addition, reduction in noise levels in the high noise machinery areas will be achieved by adoption of suitable preventive measures such as adding sound barriers, use of enclosures with suitable absorption material, etc.

These noise levels as a result of operation of the plant are minimal and therefore will not be a health concern to the workers while external noise at the boundaries of the power plants and will also not be a disturbance to the local community. At a high confidence level, the significance rating of the impact is said to be **VERY LOW NEGATIVE.** This is because the potential intensity of noise will be very low, spatial extent being site specific, long term in nature as it will persist over the entire operational period and has a low probability to occur.

6.5.3. Degradation of Air Quality

Air quality is the highest priority of site management with respect to worker health and safety and impacts on neighbours and the general public. For this environmental assessment, measurement of suspended particulate matter concentrations within the project area was established over a two (2) day period in July 2018 at various times of the day for monitoring purposes. The values recorded have been averaged for each of the site and presented in

Table 4-12. PM levels were observed basically to be withing within GSA permissible values due to the pristine nature of the project area.

Constructional Phase

The key construction activities likely to result in increased dust levels are site cleaning, excavation work, cutting and levelling work, movement of trucks transporting solar infrastructure to the site, movement of construction vehicles along dusty roads, clearance of vegetation, trenching, burial of cables and screwing/ piling support poles of structures into the ground. Dust emissions are exacerbated by dry weather and high wind speeds. The impact of dust also depends on the wind direction and the relative locations of dust sources and receptors.

Apart from the dust particles that will be generated, vehicular emissions that will emanate from the haulage trucks during construction is also a potential source of air pollution. Vegetation clearing, excavation and haulage of heavy machinery and construction materials to and from one

location to the other has the propensity to impact negatively on-air quality. It is however expected that such impacts will be localised especially during the rainy season but has the potential to be widespread during the dry harmattan season occurring from December – February.

Particulate matter on the neighbouring communities could increase considerably during the construction phase. This could be caused by the removal of topsoil and vegetation, the movement of vehicles and equipment and the construction activities in general. However, impacts related to increased generation of dust during the construction phase are expected to be short term impacts and should not be significant. The increase in particulate matter on the neighbourhood would decrease gradually over the construction period and may be very minimal if construction is targeted during the wet season.

The significance rating of the air quality impact during the constructional phase is said to be **LOW NEGATIVE**. This is because the potential intensity of impact on air quality will be Medium, spatial extent being site specific to local, temporal in nature and has a medium probability to occur.

Operational Phase

Plant operation would not significantly affect the air quality, as solar project is green field project and there are no gaseous emissions during operation phase from the proposed project. Therefore, there would be no significant air pollutants during plant operation as there is no emission. Taking account, the rural and serene nature of the project site settings, and the proposed works, it is considered that there are no significant air quality issues during the operational phase. At a high confidence level, the significance rating of the impact is said to be **VERY LOW NEGATIVE.**

6.5.4. Impact on Water Resources

The nearest water bodies to the project site are the Vea Irrigation Facility, Bongo dam and the Red Volta River. The Red Volta is about 8 km away from the PV Solar Power / Sub transmission Project Site, whilst the Vea Dam is about 0.43 km from the sub-transmission line and also 14km away from the PV Site. The Bongo dam is about 7.1km from the PV site and 1.81 km from the sub transmission site. Thus, the Vea Irrigation Facility and the Bongo dam are within the immediate project site area

The impacts of project on the water resources are assessed due to consumption of water during project activities and contamination of water (both surface and ground water) from accidental spillage of fuel, lubricant and hazardous waste. Water requirements and sources for the project has been discussed under Section 3.14.3. It must be noted that the surface water bodies found within the immediate the project area, the Vea Irrigation Facility and the Bongo dam, will not serve as source of water at any stage of project development..

Constructional Phase

It is expected that the project throughout the construction phase will require water for potable usage (drinking, showering, etc) and non-potable usage (mainly used for minimizing fugitive dust emissions, and to some extent for cleaning of machinery and vehicles). Construction of the project

will require water from local sources to carry out its activities. The Water requirements throughout the construction phase will be temporary (for construction period only) and are considered minimal and not significant.

Construction of the PV plant and civil works involves both deep and shallow excavation to support the electrical equipment to be installed. Such constructional activities could have an impact on water quality as a result of alteration of the existing drainage characteristics of the site. Erosion, resulting from vegetation clearing and excavations can lead to downstream siltation resulting from run-offs with high sediment load. This could ultimately lead to contamination of water resources. Water pollution may also result from spillages, leaking fuel and grease from construction machines. Contamination of water resources could also result from the spillage of lubricants, oils and machine fuel during construction activities and from the disturbance of soils and dust which is washed off into local water courses.

The main potential impacts on groundwater arise if deep excavations are required during construction that need dewatering or if fuels and oils leak or are spilt during construction and operation causing potential groundwater contaminations. The fuels, lubricant and hazardous waste generated during all phases will be stored at a designated area which is paved with provision of secondary containment. Thus, the contamination of groundwater can happen only due to accidental spillage of fuel, lubricants and chemicals from storage areas or and during the transfer of fuels and chemicals. The Bongo soils are well drained, friable and porous and possess good filth. Consequently, they have good water capacity. Consequently, any spillage could easily contaminate ground water. However, due to the low volumes of such materials, any spillage of chemicals and fuel may not cause measurable changes in the ground water quality.

The significance rating of the impact on water environment during the constructional phase is said to be **LOW NEGATIVE**. This is because the potential intensity of impact will be Medium, spatial extent being site specific to local, short term in nature and has a medium probability to occur.

Operational Phase

Ground water is to be utilised from the use of the boreholes and the volumes required during the operational phase discussed earlier. Even though, water from the borehole will be filtered to make it fit for consumption, it is expected that water for drinking purposes will sourced mainly from local merchants during operations. PV panels do not use water for the generation of electricity. However, water is required for their maintenance, for the systems to maintain their maximum performance. Specifically, water is necessary for the cleaning of the panels, the amount of which greatly varies depending on the location of the system. Estimated volume of water demand for wet cleaning of solar panels is 242 m^3/year for a duration of 25 years. This may result in competing demands with the community members. It is therefore important to ensure that adequate water resources are available which would be able to meet the Project requirements without entailing any constraint on the existing users - such as the local community.

Operation of the power plant will also have the potential to cause impacts to water quality as a result of uncontaminated drainage such as storm water and uncontaminated runoff as well as foul water drainage such as the generation and disposal of sanitary waste from the workforce. A network of storm drains shall be constructed at the PV Plant to collect and direct storm water away from the power site. This network shall be isolated from the oil and fuel storage areas to ensure that storm water is not contaminated with oil products prior to discharge. Due to the nature of the proposed PV plant power and transmission line development, groundwater issues are not of potential significance and do not require any significant mitigation measures.

The significance rating of the impact on water environment during the operational phase is said to be **VERY LOW NEGATIVE**. This is because the potential intensity of impact will be low spatial extent being site specific, temporal in nature and unlikely to occur.

6.5.5. Changes in Topography & Drainage

The topography of the proposed project site itself is largely flat with sheet and gully erosion observed at the southern end of the site. These deep gullies are caused by running storm water from the many hills in the area and must be a subject of consideration in the development of the site. The Bongo hill rises several hundreds of meters above the surrounding land with steep and craggy sides. Because of inadequate vegetation cover, flooding and erosion are severe with the occurrence of sheet and gully erosions.

Project activities (e.g., site development, construction of access roads) may lead to alteration of the topography and drainage of this area. The implementation of the project has the potential to change the topography of the land on which the facilities are constructed and may also disrupt the natural drainage of the area and surrounding areas to the site. This is because the construction of the facilities includes cut and fill earthworks. The cut and fill works will normally change the natural topography of the land which will result in a disruption of the natural drainage of the land and the surrounding vicinity.

Constructional Phase

The site location is fairly flat, undulating plains and various micro drainage channels were identified within this project site. For the construction of the PV collector field, constructional activities involving terrain preparations which includes activities such as site Excavation, Filling, Levelling & Grading, Ground Finishing as well as construction of Internal Roads, Foundations for Buildings & Shared facilities and Fencing. Tall trees as well as smaller vegetation on the project sites will have to be removed. This activity shall however take place within the first six (6) months of commencement of construction. It is expected that such development will result in an imperceptible change in topographical characteristics and this change will be short term.

The significance rating of impact on topography and drainage during the constructional phase is said to be **MEDIUM NEGATIVE**. This is because the potential intensity of impact will be

Medium, spatial extent being site specific, short term in nature and has a definite probability to occur.

Impacts on Topography & Drainage

A network of storm drains shall be constructed at the PV Plant to collect and direct storm water away from the power site. During operations, drainage channels from on-site precipitation shall be in place to collect surface run off water into larger gravel filled channels at the fences where it can trickle away into the municipal drainage. It is expected that the topography and drainage during this phase will not be altered in any form.

The significance rating of impact on topography and drainage during the operational phase is said to be **VERY LOW NEGATIVE**. This is because the potential intensity of impact will be low, spatial extent being site specific, short term in nature and there is an unlikely probability to occur.

6.5.6. Impact on Geology & Soils

The physical effects of developments can lead to changes in local topography and soil damage and erosion. The EPC contractor is expected to carryout detailed investigation of the soil conditions for each of the sites to cover all the requirements for design of all relevant works as well as the borrow pits (for verification of the suitability and adequacy) where materials for embankment formation will be obtained and submit a report to the VRA for approval. The soil investigation shall be carried out in accordance with BS 5930:1999 or any other approved standard. A copy of the soil investigation report shall be submitted to the EPA for informational purposes, if so required.

Constructional Phase

Construction activities will have negative impacts on soil resources due to the removal of topsoil and other layers of the soil causing loss of vegetation cover and soil erosion. This can arise from changes in ground conditions, land-lake clearance, compaction by heavy machinery during construction and soil movement, deep digging for foundation and piling, removal of vegetation, trees and hedges, etc. Such physical disturbances may lead to changes in the density of soil, its moisture retaining ability, natural drainage, and in organic matter content and also soil biota. Thus, the effects of physical disturbance of soil can have impacts upon soil microorganisms, natural flora and fauna, crops and livestock, groundwater and surface hydrology and quality, landscape and visual amenity as well as upon engineering works and buildings. Erosion of soil from the surface and removal or change at depth, may further lead to surface subsidence. Additionally, sedimentation of the eroded soil can occur if the eroded soil is carried into nearby water bodies.

Site preparation for the establishment of the solar PV power plant, internal access road(s), temporary laydown area and associated buildings during the construction phase will require vegetation clearance, some site levelling and grading and soil compaction. During the site preparation, topsoil will be stripped out and levelling the land. The proposed project site is low lying. Topsoil removal, excavations, vehicular traffic impact on the un-tarred access routes, etc. has the potential to engender the sheet erosion by exposing the soil to soil erosion agents. As the

topsoil removal activity will be restricted within the project boundary it will not have off-site impacts.

The project will also involve the use of paints for solar PV power plant and switchyard structures during construction which if not handled and used properly, may lead to contamination of soil. Improper disposal of hydraulic fluids, diesel, lubricating oils and other used oils can also result in contamination of soil. Improper storage of construction material can also result in the unwanted dispersal of contaminants into adjoining areas. Spills could have a long-term impact on soil quality but are expected to be localized in nature. Spill control measures such as the storage and handling of chemicals and fuel in concreted areas will be implemented to minimize impacts in the event of a spill.

The significance rating of the impact of the project on soils during the constructional phase can be described as **VERY LOW NEGATIVE.** Substances that will have the potential for ground contamination will be small quantities, the intensity of any such contamination may be direct, negative and low and reversible. The spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact on soil is low.

Operational Phase

Most impacts of Solar PV project on soil are restricted to the construction phase, which will get stabilized during operation phase. The soil conditions of the project site would be allowed to stabilize during this period after the impacts of the construction phase. The topsoil in non-built up areas would be restored and such portions of the site would be replanted with appropriate plant species to stabilize soil. There is also unlikely to be an impact on soils, and organisms living within these soils, as a result of electricity and magneticity arising from the operation of the PV Plant and the sub-transmission line system.

Substances that will have the potential for impacting on soils during the operational phase will be small quantities, the intensity of any such contamination may be direct, negative and low and reversible. Indeed, no significant impact is also expected on the soils on and around the site, due to the following management measures to be put in place:

- All solid wastes and hazardous wastes from the plant complex are collected properly collected, stored and disposed.
- Appropriate storage of oil and lubricants on site
- The entire plant site area is well drained and thus there is no leaching of any substances in case of spills, which are well confined and decontaminated.

The spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact on land quality is low. The significance rating of the impact of the project on land quality during the operational phase is therefore anticipated to be **VERY LOW NEGATIVE.**

6.5.7. Impact on Waste Generation

A list of waste streams comprising of non-hazardous and hazardous wastes associated with the constructional and the operational and maintenance phases of the project is outlined in Table 6-4.

Table 6-4: Example of Non-Hazardous & Hazardous Waste

		Project Phase	
Category	**Example Types**	**Constructional**	**O&M**
Non-Hazardous Waste			
Concrete and rubble	Blocks from construction	√	
Food	Organic waste, food, etc.	√	√
Glass	Bottles and jars, etc.	√	√
Metal cans and tins	Drink and food cans	√	√
Metal drums (cleaned)	Uncontaminated drums	√	√
Metal, ferrous	Steel, gratings, sheet steel, iron beams, tubulars and casings, transmission cables etc.,	√	√
Metal, non-ferrous	Aluminium	√	√
Paper and card	Printer paper, newspapers, magazines	√	√
Plastic bottles	Drinks, bottles	√	√
Plastic drums (cleaned)	Empty plastic drums	√	√
Greywater	Mixed waste from staff, residual domestic waste	√	√
Clean water	Flood waters, waters from PV Cleaning	√	√
Textiles	Unwanted clothes, uncontaminated	√	
Fixed Assets	Furniture, Vehicles	√	√
Wood	Pallet, crate, beam, general packaging	√	√
Hazardous waste			
Acids / Alkali	Cleaning or workover acids	√	
Adhesive and pipe coatings	glues	√	√
Aerosols	Spray cans	√	√
Batteries	Camera batteries, vehicle batteries	√	√
Chemical mixture	Anti-scalents	√	
Clinical/Medical waste	Needles, bandages, medicines	√	√
Fluorescent tubes/ bulbs	Bulbs,	√	√
E-wastes	Cartridges, Fridges and Electronics such as Computers, Lab Tops, Printers, TVs, Videos etc.	√	√
Oil filters and liquids	motor oil, lubricants, hydraulic fluid	√	√
Oily solid waste	Rags, gloves	√	√
Paints	paints, thinners, stains, wood preservatives	√	√
Solvents, halogenated	Refrigerants, fire extinguishers	√	√

		Project Phase	
Category	**Example Types**	**Constructional**	**O&M**
Solvents, non-halogenated		√	√
Spill absorbents	Oil and fuel absorbents, general purpose absorbents, floor sweeps	√	√
PV Panels	Broken & Obsolete PV Panels		√
Black water	Waters contaminated with human waste, e.g. sewage	√	√

Constructional Phase

In general, the following wastes are likely to be generated as a result of constructional activities:

- Clearance and excavation wastes: clearance of site vegetation and removal of soils, inert construction materials and residues, spoil, etc.
- General construction wastes: reject and excess material, drainage from wastewater and site run-off, containers etc.
- Other hazardous wastes may result from spillages from construction equipment.
- Other wastes: from offices, food preparation wastes, sanitation etc.

The Design Specification will require that that water/liquid retaining structures should be in accordance with BS 8007 "***Design of Concrete Structures for Retaining Aqueous Liquids***" as appropriate or equivalent international or Ghana standard. Due to the nature of the site and the works to be undertaken, general construction wastes and hazardous wastes are predicted to be low. Septic tanks will be installed on the site for the construction period. During the civil works, the period when the largest workforce numbers will be on site, it is possible that these tanks could supply a workforce of up to 100 people, although this total number is unlikely to occur at any one time during this period. Sewage wastes will be removed from the site and disposed of in an appropriate manner by an approved contractor.

Proposed mitigation plan suggests maximum reuse/recycle of construction waste on site or removal of waste at the site and proper disposal, which would reduce the impact significantly. The impact significance for waste generation during construction has been assessed as ***LOW NEGATIVE***. The the intensity of any such impact can be defined as a merely a nuisance and medium Low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact on waste generation is medium low.

Operational Phase

The operation of the plant will not generate solid waste from its direct processes. Operation of the PV plant will result in the generation of general plant wastes and commercial wastes. Solid waste is expected to emanate mainly from the administration as office wastes. Again, it is expected that a limited amount of waste will be generated during this phase from vegetative matter, cans,

packaging materials, insulators etc. These wastes, if not treated properly, may result in the contamination of the site, pose a health risk to workers, and/or be dumped illegally. Solid wastes generally could be an eyesore and cause environmental problems together with their associated health hazards if proper and adequate measures are not put in place to segregate, evacuate and dispose or recycle it.

Liquid waste will also be generated from the possible washing of various items that may be used. Liquid wastes arising from the plant processes include waste lubricating oils and sewage. It is, however, not anticipated that liquid wastes from the various washings will be generated in significant quantities. It must be noted that accidental spillage of oil, fuel or paints as well as broken and obsolete PV modules are all hazardous waste and will need to be managed effectively, as required.

The impact significance for waste generation has been assessed as **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as a merely a nuisance and low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be long term and reversible. The probability of the impact on waste generation is low probable.

6.5.8. Landscape & Visual Intrusion

Landscape impact assessment is based on two principal aspects. First is the alteration of the landscape character of an area including impacts on recognised features of landscape importance either nationally or locally. The second aspect is impact on public views of the site either from residential properties or areas of public access, e.g. footpaths, and from public roads. Landscape encompasses a range of issues, including the physical features of landform and surface area, the way in which these features are perceived, and the values attached to scenery. Landscape impacts relate only to the construction and operational phase of the project. No potential impacts arise during pre-construction activity. The extent of the impact on the character of the landscape and visual impact will depend on the nature of existing land uses and whether there are any sensitive views that will be altered by the removal of vegetation (especially taller vegetation) and the PV plant, substation and fence wall.

Information on the project site, landscape, topography as well as access roads have been described under Chapter 4. The site is bounded on the north by the Akorisi village, on west and south-west by Bongo and Bogorogo communities respectively and on the east and south by an untarred road, which provides accessibility to the site. The routes within Bongo District leading to the project site, i.e. from Bogorogo to Asibiga, are untarred and poor in nature and will have to be improved as part of project development. The 23 km stretch of the proposed route line commences from the solar site at Asibiga through the townships of Bogorogo, Zarre. Yorogo, Zorbisi all in the Bongo District, whilst six (6) km of the line runs within and terminates finally in Bolgatanga.

The site location is fairly flat, undulating plains with sparse woody vegetation amidst mosaic of extensive farming characterized by sandy soil. The landscape is largely put into annual/seasonal agricultural land use system and livestock grazing, predominantly cattle grazing with trees in a

patchy non-contiguous arrangement, scattered over the site. There are no settlements on this site, and the land is largely fallow with Sheanut being the most dominant tree.

As the project site for the PV installations and associated sub-transmission lines are identified as a greenfield, careful consideration will need to be taken regarding preserving the appearance and open character of the area as well as the potential impacts on landscape character and existing views. However, based on their closeness to communities it is anticipated that the general landscape character will not be altered significantly.

Constructional Phase

The constructional phase may have an adverse visual impact as a result of tall construction equipment, affecting views to the site from properties and amenity sites, due to the presence of nearby communities. This may create a a temporary effect on the visual quality of the site and its surroundings. The visual environment during the construction phase would include the presence of elements typical of a construction site such as equipment and machinery to include excavators, trucks, front end loaders, compactors and other. The main construction equipment that will potentially be visible during construction will be the equipment to move the power plant facilities into place. The development of the power plant will involve major earth and civil works that may impact the local topography and therefore alter the physical landscape features of the area.

By removing plants and trees the land is being left exposed, which can cause soil erosion. This in turn affects the health of nearby streams, creeks and rivers, and ultimately affects the drinking water of animal and human populations. However, there are no key sensitive visual receptors within the surrounding vicinity - such as recreational activities, environmental reserves, remarkable historical or cultural sites, or other natural structures normally seen as valuable by the human perception. The nearest water body being the Vea Irrigation Facility and Bongo dam will not be impacted as a result of the project development.

The impact significance for landscape and visual intrusion during construction has been assessed as **LOW NEGATIVE**. The intensity of any such impact can be defined as a merely a nuisance and Medium Low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact is definite.

Operational Phase

The Project is expected to be visible within the immediate vicinity and up to some kilometres around the Project site only and thus is likely to create visual impacts. The maximum height of the PV mounting structures is expected to be in the range of 2-3.5 m. Only the PV substation will comprise higher installations being typical for HV substations and sub-transmission lines - including towers of the transmission line, which will be in line with the already existing towers within the localities. The installation of a mesh fence of at least 2.50 m height around the various power plants is required for power plant's equipment protection, as also for avoiding any accident by external causes. Further, a fire buffer zone comprising of undeveloped bare land will be within

the fence wall. This means the PV Panels and other infrastructure outside will be visible to external sources outside the plant.

Potentially sensitive receptors include the residents living in close by dwellings at Asibiga and Akorisi and along the access road as well as those in passing vehicles. However, such views would be temporary and limited to the time of passage within the area. However, being visible is not necessarily the same as being intrusive. Aesthetic issues are by their nature highly subjective. For some viewers, a PV Plant could be regarded as manmade structures with visual burdens while to others it represents a positive impact in the sense that they introduce a break in the otherwise dull and monotonous view. More importantly, as discussed earlier, there are no key sensitive visual receptors within the surrounding vicinity of the Project site - such as recreational activities, environmental reserves, remarkable historical or cultural sites, water courses or other natural structures normally seen as valuable by the human perception.

The main impact during operation is the visual impact of the photovoltaic panels during the day. The panels are geometric and reflective and will clearly stand out from the surrounding natural landscape. Besides the presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated far from any airport. The intensity of any such impact can be defined as Low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be long term as it will persists if the project is operational. There is low probability that the impact will occur due to the already built up nature of the nearby communities. The impact significance for landscape and visual intrusion during operations has been assessed as **VERY LOW NEGATIVE**.

6.6. Impact on Ecological Environment

A total of **345** trees were identified at the PV site comprising of 20 different species. For the total of 345 trees enumerated, the Shea tree (*Vittellaria paradoxa*) dominated the list with 160 trees (46.47%), the reason being that the local people have interest in this species and deliberately make efforts in protecting them. Regarding the transmission system, the main economic trees identified along the line route were Teak, Mango, Berry, Baobab, Sheabutter and Dawadawa. As high as 24.6%, of the trees (flora) enumerated are used for medicinal purposes. Commercial trees particularly *Vitellaria paraboxa* (Shea), constitute 23% with the least of 4.4% being fencing. In all, a total of 112 animals (fauna) were recorded comprising 13 species and these mostly serve as game.

Due to closeness of the sites to human settlement coupled with continuous farming activities and annual bushfire, few wildlife resources are identified at the project sites. Impact on habitats and species may result from vegetation clearance, construction of site and access roads. Impact to avifauna may also occur due to electrocution with the transmission lines.

Constructional Phase

Construction activities will lead to removal of vegetation at the project site and this reduces options for nesting habitat, shelter from predators, foraging resources, shade, perching habitat and breeding sites of herpetofauna and ground dwelling birds. The is expected to occur at small enough scale to

have an impact on habitat for species (birds, mammals and some reptiles) as vegetation is scattered and there is no continuous vegetation patch within the site. These potential impacts will be limited to the direct loss of habitat as a result of the footprint of the plant and the construction laydown area as well as disturbance and/or damage to habitats and species as a result of construction activities e.g. through smothering of plants by dust, movement of vehicles and construction workers to and from the site.

The loss of vegetation can also have a negative effect on soil quality and hamper survival of neighbouring floral species, burrowing faunal species and foraging resources for herbivores in the area. Flammable and lubricating materials may contaminate the vegetation and change the diversity of flora and fauna species. Building materials used by the construction of the solar power plant, including equipment and transportation vehicles driving along the road may contaminate the ground soil and vegetation. The impact of the construction activities would be primarily confined to the project site. Thus, the site development works would not lead to any significant loss of important species or ecosystems. It must also be noted that in addition to payment of land, VRA is also to make payment for all economic trees that have been enumerated to the landowning families.

The impacts described above will not cause a significant change in the population of these floral species as the floral species are common to the area and have widespread distribution. Moreover, similar kind of habitats are widespread in the areas adjoining to the project site, hence loss of habitat for faunal species within the project site will not cause any substantial change in population of the faunal species as they could easily relocate to surrounding areas.

The area of habitat within the project site will be permanently lost, and the overall significance of the impact on the ecology during construction is **MEDIUM NEGATIVE**. The intensity of any such impact can be defined as medium low due to the low conservation value of the habitat within the site area., the spatial extent of the impact will be specific only to the project site. The duration of the impact will be long term as the loss will be long term, and will continue through the project life cycle, and the loss of habitat is definite to occur.

Operational & Maintenance Phase

Operation of the plant could potentially have an impact on flora and fauna as a result of damage due to the movement of workers and vehicles on and around the site. There shall be no emissions associated with the PV plant and long-term impacts as a result of air emissions do not pertain to the project. There are no sensitive habitats or species on the site, therefore the significance of any impact would be low. The plant site shall be fenced and therefore all operations will take place within this boundary. There will be enough turning space within the plant site for vehicles. No movements outside of the site boundary are therefore anticipated.

During operation there is a particular risk to birds mainly from operation of the high voltage overhead lines from the substation onsite to the High Voltage National Grid. Birds utilize transmission towers for nesting by placing the nests across wires or using holes in the tower itself.

Birds that roost on or near solar modules can also be affected by the wiring that is connecting the module to the main grid. Birds are attracted to these modules because of the reflection of the solar panel mimicking the reflection of water bodies. The routine maintenance activities will ensure that there are no such roosting places for birds on the PV panels. In addition, sub-transmission lines already exist within the project site and new ones to be developed will be mainly within the right of way of existing ones.

Trees that can impact on the sub-transmission line would have to be cut both during the constructional as well as during the operational phases in order to protect the lines. All dangerous and potentially dangerous trees will have to be enumerated and documented by VRA prior to felling. This is important in order to avoid field/technical personnel of FSD taking undue advantage of the situation.

Nevertheless, putting things into perspective there is some risk of avi-fauna mortality and which could occur with most human development (ranging from buildings to large scale industrial projects). However, with regards to the project in specific, it is highly unlikely that avian mortality levels would be of any concern due to the following:

- The Project site in general is considered barren and of low ecological significance due to its natural setting and does not support endangered or rare species or sensitive avi-fauna habitats, while all recorded avi-fauna species are generally common to such habitats. In addition, such an area is considered, to some extent, disturbed by human activity and which would affect bird activity in the area.
- Other impacts on the biodiversity of the site are mainly from improper management of the site which could include improper conduct and housekeeping practices by workers (i.e. hunting of animals, discharge of hazardous waste to land, etc).

The overall significance of the impact on the ecology during operations is **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be short term and there is unlikely probability to occur.

6.7. Impact on Cultural Heritage Resources

Cultural resources and heritage comprise tangible historical/archaeological sites, documents and artefacts together with religious/spiritual sites (sacred sites) and activities important to local communities, customary law, traditional beliefs, values and practices. The sensitivity of a cultural feature to direct impacts reflects the level of importance assigned to it. This is the product of several factors, including for features of present-day cultural value: its current role; its cultural or sacred associations, its aesthetic value; association with significant historical events or traditions and its role as a sacred site or local landmark; and in addition, for those of heritage value, its potential as a resource of archaeological data. It should be noted that the assessment of impacts and development of mitigation actions for some cultural features cannot be wholly segregated from other social impact assessments and there will be overlap in some mitigation actions.

Within the PV project site is an old isolated ancestral grave with the Yabatua Shrine (a Baobab tree) as well as the Kinkanga Shrine (a Ficus tree). Also, just within the project site on the eastern side is an area called the Dwarf island, where it is alleged that dwarfs exist. This is currently a prayer ground for Christians who come there to pray in the name of sacking the dwarfs. Also, along the transmission line is the Tindana sacred grove at Asibiga community and various churches, mostly Christian. As indicated earlier, pacification rites have been performed for the right to entry of the PV Site. Outstanding is the pacification for the relocation of the various cultural facilities. During the various stakeholder engagements, VRA has been advised that as part of their customs, certain rites ought to be performed before the projects commence. VRA shall therefore initiate relevant pacification rites prior to project construction in order to ensure smooth project implementation. The Tindana sacred grove will however not be directly impacted by the project.

Constructional Phase

Throughout the construction phase and as the case with any project development that entails such construction activities there is a chance that potential archaeological remains in the ground are discovered. Thus, as with any project site, there is a potential for previously unrecorded cultural sites to lie within. As all unknown cultural heritage will be sub-surface it is only direct impacts arising from disturbance that could occur. An appropriate watching brief will be implemented to ensure that in the case of unearthing important archaeological finds during excavation, such findings will be removed and preserved accordingly, with the agreement of the authorities.

It is expected that such measures for such chance find procedures are implemented in line with standard requirements by the National Museums Act, Act 387 of 1969. Those mainly require that construction activities be halted, and the area fenced, while immediately notifying the Ghana Museums & Monuments Board (GMMB). No additional work will be allowed before GMMB assesses the found potential archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.

The overall significance of the impact on the Cultural resources and heritage during construction is **LOW NEGATIVE**. The intensity of any such impact can be defined as Medium low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be short term and there is high probability to occur.

Operational & Maintenance Phase

Disturbance within the project area following operation could potentially occur during the excavation works of building facilities, infrastructure, pipelines and the installation of fencing for other works. Since all the activities related to project during operational stage shall be confined to the designated site, and the nature and magnitude of the activities is too small, hence no impact on any of the archaeological properties are anticipated. In case of discovery of historical and cultural heritage or memorabilia during operations of the Solar PV power plant, necessary preservation

and protection measures shall be taken in cooperation with the local authorities, including professional organizations.

It is expected that the relocation of the cultural sites at the PV Sites will be completed during the constructional phase and there will be no issues on it during the operational phase. However, from experience even though one-off payments for such relocation are done, clients may be required to make irregular payments, as and when the demand is made regarding activities of the shrine.

The overall significance of the impact on the Cultural resources and heritage during operations is **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be short term and there is unlikely probability to occur.

6.8. Impact on Occupational Health & Safety

The development of the proposed Solar PV facility will involve a range of activities that could potentially be unsafe to workers without mitigation measures. Such activities require the use and operation of heavy-duty earth moving equipment, machinery and vehicles Examples of such activities include excavation for Solar PV foundations, use of drills for cutting, working at heights, trenching, etc. Thus, occupational health and safety hazards can include construction machinery, handling of electricals, delivery of equipment to site, noise pollution and dust pollution. In the case of spills/leaks there is a potential for fire hazards and some hazardous substances.

Constructional Phase

The construction workforce on the project, both regular and contractual working, during construction will be exposed to occupational health and safety impacts arising from construction activities of solar PV plant. The transportation of heavy plant and equipment through the townships and settlements and the presence of unprotected excavations could pose potential safety problems for the local populace. Materials and equipment used for the construction work could be harmful, when not handled with care. These activities could pose danger to both workers and visitors to the site. The possibility of workers or visitors to the site falling into the pits cannot be overruled. Loose scaffolds and debris falling from heights could also be harmful to workers. Other potential hazards include injury from sharpened tools and instruments and dust effect on workers.

There are unlikely to be any significant community health and safety issues at the site, the main impact on the community is associated with the movement of heavy goods vehicles to and from the site. Without mitigation measures, all construction sites present a risk to occupational health and safety. The contractor is required to prepare a Health & Safety Plan to be reviewed and approved by VRA prior to the start of construction on site. Construction equipment will be stored at a site to be secured and guarded by the contractor.

The intensity of this impact can be said to be medium with international influence, as this impact also can affect the EPC Contractor. The duration is temporal and reversible with a probability to

occur. The significance rating of the impact of the project on community health, safety and security can be described as **MEDIUM NEGATIVE**.

Operational & Maintenance Phase

Public safety, Occupational safety and health hazards associated with the project are extremely significant and must be the first priority of site management as they pose potential threat to the safety and health of the workers. These hazards could be from falling and/or swinging objects, potential collapse of towers due to rainstorms or vandalism, falling from heights and snakebites.

Due to the nature of technology involved, the operation and maintenance activities will be minimal. Nevertheless, there are potential occupational hazards regarding work force engagement in both daytime and/or night-time activities albeit on a small scale. The nature of occupational hazards will include:

- Machine/equipment injury risk.
- Occupational noise and vibration.
- Fire risk.
- Risk of exposure to electro-magnetic radiation.
- The risk of electrical shock; and
- Miscellaneous hazards.

Considering the number of workers involved at this stage, the intensity of this impact is anticipated to be low the spatial extent of the impact will be local, and the duration of the impact will be temporal and reversible. There is a low probability of the impact occurring. The significance rating of the impact of the project on community health, safety and security can be described **AS LOW NEGATIVE.**

6.9. Impact on Socio-economic Environment

6.9.1. Land Acquisition

A land area of 50.13 ha (0.5013 km^2) has currently been acquired at Asibiga in the Bongo District. It is within this site that the associated substation will be developed. In addition, an associated 23 km sub-transmission line with a 15m Right of Way, is to be developed, and this will occupy a total of 0.345 Km^2 area. Thus, a total area of 0.8463 Km^2 would be required for the solar power plant and the associated sub transmission line project in the Bongo District. The additional 6km stretch of sub-transmission line within the Bolgatanga Municipality will be within existing Bolgatanga-Ouagadougou 161kv Tower lines and therefore will not require additional land.

Issues on gender and vulnerability regarding land acquisition, compensation and economic displacement is also key. This is because compensation, and rehabilitation and resettlement benefits accrue to men due to family headship, deny women access to and control over economic benefits. This increases women's economic dependence on men, disempowering them and deteriorates the existing inequalities Displacement caused due to loss of land leads to loss of livelihoods.

Establishing new sources of income and shifting from traditional to a cash based economy can lead to the loss of traditional values and way of life. This may also increase work burden on women.

Pre-Constructional Phase

The acquisition of this land requires payment of compensation to the various property affected persons within the communities. The land acquisition has far-reaching socio-economic impact on the lives of persons whose parcels of land are acquired. The effects of land acquisition include changes in income levels, land utilisation, land-ownership structure, farming practices, familial composition and cultural and social values, norms and bonds.

Land acquisition and economic displacement will require compensation, and this is definite. The intensity of this impact can be said to be high, negative and direct. The spatial extent of the impact will be specific to the people within the project site. The duration of the impact will be long term and irreversible and will last during the lifetime of the project. There is a definite probability of the impact on occurring. The significance rating of the impact of the project on land acquisition during the pre-constructional phase can be described as **HIGH NEGATIVE**.

Constructional Phase

Land acquisition and economic displacement will require compensation and under this project, it is planned that all land acquisition processes will be completed prior to commencement of project operations. Indeed, this has been completed and all PAPs have been compensated. Land leases covering fifty (50) year period have been executed. However, from experience, land ownership and compensation issues could persist during all phases of the project. If required, any outstanding payments will be made during this phase and therefore there is a probability of compensation payments during this stage, even if it is not definite.

This impact can be said to be of low intensity, negative, direct and irreversible. The spatial extent of the impact will be specific to the people within the project site. The significance rating of the impact of the project on land acquisition during the constructional phase can be described as **VERY LOW NEGATIVE.**

Operational Phase

It is expected that all land acquisition and economic displacement that require compensation will be completed prior to the constructional phase and will not be an issue during the operational phase. However, from experience, land ownership and compensation issues could persist during all phases of the project. If required, any outstanding payments will be made during this phase and therefore there is a probability of compensation payments during this stage, even though it is highly unlikely. As the PV site has been leased, VRA is expected to pay annual rent to the landowners. The significance rating of the impact of the project on land acquisition during the operational phase can be described as **LOW NEGATIVE.**

6.9.2. Land Use

Pre-Constructional & Constructional Phase

The establishment of the solar plant will convert cultivable land to industrial use for long term (25 years). Thus, the constructional activities could lead to loss of economic trees, or economic displacement from key activities such as farming, as a result of the development and associated infrastructure and this can plunge households into poverty. Changes in land use are also envisaged for material store yard and temporary site office. It must be noted that the project will not require new access road, and therefore there will not be any permanent changes in land use. There will be the need to provide alternative routes for the community members to ensure that community lifestyle is not affected. However, such community routes are not planned and are generated based on convenience and therefore it is expected that as the project constructional activities are ongoing, the community members themselves will identify alternate routes to utilise.

The significance rating of the impact on land use is said to be **MEDIUM NEGATIVE**. The potential intensity of this impact is medium and negative as families and farmers will lose their lands and livelihood. The spatial extent of the impact will be specific only to the project site; however, the duration of the impact will be long term and irreversible as the land will be acquired and its uses will be restricted from then on.

Operational & Maintenance Phase

As indicated, the land to be affected by the implementation of the proposed project has the following categories of land-uses: agricultural lands, potential agricultural lands or fallow agricultural lands as well as grazing of animals. Due to land acquisition, farming activities or hunting will cease during the operational phase, as the acquired land will be fenced off to prevent encroachment and now be used for power operations. The project will be operational 24 hours a day, seven days a week with the proposed operational period of the Project being 25 years. The loss to access of lands for subsistence farming will also affect income generation ability by residents.

The significance rating of the impact on land use is said to be **MEDIUM NEGATIVE**. The potential intensity of this impact is low. The spatial extent of the impact will be specific only to the project site. This impact to land use and access is definite and of long-term duration as the land will not be available for subsistence farming or for hunting. The impact of loss of income or lowered income generation is definite and will occur in the long-term.

6.9.3. Labour & Working Conditions

Labour use on the project shall comprise of full-time, part-time, temporary, seasonal, or migrant workers. International safeguards basically categorize workers into direct workers, contracted workers, community workers and primary supply workers, and how it applies to the project has been outlined in the LWCMP. Estimated labour requirements for the project during the various phases is discussed under Section 3.13. Employees from VRA and EPC Contractor/Consultants delegated to the project will generally be required full time and around the year for the project

duration. Civil works contract workers will be required as per the need. There is no constructional season in Ghana, however, it is critical that this takes into consideration, the two seasons, the dry and the wet seasons, as it occurs in the project area. So, it will be up to the contractor to mobilize labour force to coincide with the type of work and the season.

The timing and duration of the employment of contracted workers will be known at later stages, however they will only be engaged for the duration of respective sub-components which will unlikely extend more than 12 months. Working hours will not exceed 8 hours a day, with the provision of at least 1 hour for the rest. Contractors will be required to pay overtime if this is exceeded or 40Hours a week. In addition, the EPC Contractor is to avoid construction and transportation activities as far as possible during night (6:00 pm to 6:00 am).

Labour and working conditions risk assessment is one of the key tools for improving occupational safety and health conditions at work as well as enhancing productivity. Productivity has been known to deteriorate on construction sites due to labour unrest, leading to a negative impact on the cost and quality of construction as well as the livelihood and morale of workers. Wages, bonus and other compensation disputes remains the main reason for work stoppages and accounting for working days lost. Another impact that may occur is the need for new or additional material, constraints, and equipment, which affect the sequence, duration, and schedule of work packages. This could result in an increase in idle time of workers waiting on material and causing drop in productivity. There is the need to protect workforce by ensuring that forced labour and Child labour are not be utilised on the project.

A summary of key labour related risks associated with the project are as follows:

- Working Conditions and Management of Worker Relationships
- Protection for the Work Force
- Occupational Health and Safety (OHS) Practices
- Gender & Vulnerability
- Grievance Mechanism
- Non-Employee Workers and Supply Chain

It must be noted that there will be no worker accommodation or camp to be developed under with the project. Employees of VRA and EPC Contractor will be housed, most likely in hotels and or hired accommodation within Bolgatanga for the duration of the project. Other workers will find accommodation at Bongo.

Constructional Phase

Given the important role of labour productivity and industrial action to workers and to the economy, there is the need for VRA to play an increasingly active role in mitigating the damages resulting from industrial action. The EPC contractor and subcontractors usually have contracts with a defined work scope, duration, start date, and other parameters to base their estimate. A change in a project scope of any kind usually means there will be associated productivity impacts that can be attributed to inefficiencies as well. Often, the design is incomplete, or changes are made

that will impact the original estimate. A key example will be requests from VRA to keep the same completion date, despite the added scope of work. This may require overtime, second shift work, rework, additional crafts, and many other impacts to the original plan and estimate. This increase in person-hours, constraints, and other resources would affect the cost and schedule. Employment of locals was a key issue by all stakeholders, especially traditional authorities. With this, there is the conscious need to employ locals during the constructional phase of the project to avoid any disaffection and subsequent disruption of project activities.

In any working environment, it is essential for both employers and employees to be fully conversant with all aspects of disciplinary processes, the grievance handling procedures and the legal requirements and rights involved. In implementing an effective dispute management system consideration must be given to the disputes resulting from the following:

- Disciplinary action
- Individual grievances
- Collective grievances and negotiation of collective grievances
- Gender-based violence, sexual exploitation, and workplace sexual harassment

One of the mandates of the NLC is to facilitate the settlement of industrial disputes and to investigate labour related complaints, unfair labour practices and take such steps as it considers necessary to prevent labour disputes in the Country. The Commission is also required to maintain a database of qualified persons to serve as Labour Mediators and Arbitrators who will assist the Commission and the disputing parties to Mediate or Arbitrate their disputes. Employees shall be encouraged to use this medium for all labour related complaints.

Migration will occur to the surrounding areas as there is an opportunity for employment. Coinciding with the influx of migrant workers is typically a raise in demand for goods and services during the construction period which can result in a rapid expansion in supply chain businesses operating in the area. This will result in increases in formal employment and informal labour. This expansion may result in migration into the area. The impacts that may arise from the presence of migrant and/or expatriate employees that has been a subject of discussions during the various stakeholder engagements largely comprise the following:

- Inappropriate behaviour and lack of respect for local leadership and cultural norms on the part of expatriate workers.
- Conflict resulting in part from resentment by skilled nationals and residents if they perceive that expatriates have been hired into jobs for which they are suitably qualified.
- Disruption of local communities with an increase in crime and anti-social behaviour.
- Spread of transmissible diseases including HIV/AIDS both within the workforce and between the workforce and the local community.
- Resentment of non-local nationals by residents if they are perceived to have taken jobs that could be successfully filled by local people, or due to non-integration with the local community; and

- Increased local demand for consumer goods and housing with resulting encouragement for improved supply resulting in financial hardship and benefits for local people; and,
- Increased pressure on infrastructure, services (such as healthcare) and roads, particularly with the establishment of informal settlements.

Primary suppliers are suppliers who, on an ongoing basis, provide goods or materials directly to the Project. The project will require procurement of a substantial amount of aggregates, cement, reinforcing bars and other materials procured locally for the construction of the project, and VRA has in place various practices to deal with risk associated with primary suppliers as discussed in the LWCMP. The project will not engage community workers due to the specialized labour needs required and therefore there are no measures in place to deal with this. Under no circumstances will Contractors, suppliers or sub-contractors engage forced labour.

The potential intensity of this impact occurs is described as medium low, international in nature as the EPC Contractor will be affected, but temporal in nature and with a low probability to occur, if relevant measures are not put in place. The significance of the impact on labour and working conditions during constructional phase is **LOW NEGATIVE**.

Operational & Maintenance Phase

A dedicated team of about 10 VRA engineers and technicians will be responsible for up keeping of the solar plant during operation as well as coordinate and execute maintenance activities. In addition to this number, about 3 persons from the locality will be engaged for unskilled labour required on site such as security guards, cleaners, gardeners, etc. Receptors in the Social Area of Influence (AoI) that may be able to make the most of these opportunities are those who have received experience of formal employment, gained basic education or learned English language skills. Typically, this may be youthful persons who have received some education, have experience working for the government or other international companies.

The socio-economic environment of the social study area is characterised by a low degree of livelihood productivity with some degree of diversity. The study showed low levels of educational achievement and capacity within the project area. From the literature reviewed, it is determined that majority of household respondents have only reached 2nd cycle and primary school. Based on the baseline conditions it is assumed that very few of these types of candidates will be available from within the local area. As a result, this benefit is expected to be experienced mainly by beneficiaries in urban centres such as Bolgatanga.
It should be noted that at the local level the overall lack of education, skills and capacity means that vulnerability is high, meaning a large majority would be ill equipped to maximise benefits. Experience has shown that such situations usually cause the community members to be peeved that others have been successful, with its subsequent negative attitudes to the project and the workers that have been engaged. Vandalism sometimes results from such ill feelings.

VRA provides employees with the right to join and form an organization for purpose of labour representation. VRA has two workers organisations with respect to collective bargaining, and these

are the Public In ensuring full compliance with the law in this regard, staff shall benefit from the Collective Bargaining Agreement between VRA with its workforce.

VRA has in place a Workplace HIV Policy but does not currently have a policy in place related to gender-based issues or harassment in the workplace. As an equal opportunity employer, VRA shall commit to fight for safe and decent workplaces for women; to ensure that a policy on bullying and sexual harassment is agreed upon at every workplace; and seeks to address women's safety and health at work.

The potential intensity if this impact occurs is described as low negative, regional and temporal in nature with a low probability to occur, if relevant measures are not put in place. The significance of the impact on labour and working conditions during operational phase is **VERY LOW NEGATIVE.**

6.9.4. Community Health, Safety & Security

Constructional Phase

Possible sources of impacts to community health and safety during the construction phase include changes in environmental quality due to construction activities, increased prevalence of disease arising from the influx of construction workers as well as heavy traffic movement. Changes in baseline environmental conditions can be experienced by the local community in terms of increased nuisance levels from emissions to air, contamination of surface water or ground water and high noise levels during the construction phases, as discussed in the previous sections. An increase in dust and noise during the construction period has the potential to lead to health impacts associated with eye irritation and general disturbance to daily activities.

Again, the discharge of domestic waste effluent from sanitary facilities for construction workers may have the potential to cause contamination of surface water and groundwater in this area, if not properly supervised. However, due to adequate safeguard facility, the potential for long term impacts to community health are minor. Pollution control and mitigation measures will be implemented to reduce the likelihood of contamination of surface and groundwater from sanitary effluent (construction camps) generated during construction. The land where the solar power facilities are to be located are mostly agricultural lands, the surrounding area of which would still be used for cultivation in future. The solar power plant may restrict access or make accessibility difficult especially during the construction phase and there is need for effective engagement with community members to avert such situations which can lead to conflicts.

There shall be no labour camps established within the communities as workers shall be integrated into the communities. Influx of workers to the community may cause impacts to public health,

especially an increase in prevalence of diseases as well as pressures on existing health infrastructure. There is also the possibility of increase in sexually transmitted diseases such as HIV/AIDS as a result of the expected influx of workers to the area. In addition, vector-borne diseases will be sensitivity for settlements closer to campsites for the construction phase labour, particularly due to lack of hygienic conditions. The EPC Contractor is expected to be put in place appropriate measures for the workforce to be aware of impacts of Sexually Transmitted Diseases and HIV/AIDS as well as any common communicable diseases associated with the area.

One key issue could be rise of domestic violence due to disagreements between family and friends in relation to the project development. Such issues could relate to increase in comes, refusal to provide for the family, illicit relations, etc. VRA and the EPC Contractor may not be equipped to handle complaints or provide relevant services to survivors, but will reference any person to relevant service providers, including health facilities, law enforcement's gender unit or others, as relevant using the information on available services. Should grievances related to gender-based violence be reported through the project/contractor, the nature of the complaint will be recorded along with the age of the complainant and relation to the project will be recorded but the issue will be referenced to relevant institutions.

Considering the possible changes in environmental quality, health related impacts and influx of migrant workers at the constructional phase, the intensity of this impact can be said to be medium, the duration will be over the constructional phase and therefore temporal in nature and high irreversible with a medium probability to occur. The significance rating of the impact of the project on community health, safety and security at the constructional phase can be described as **LOW NEGATIVE**.

Operational & Maintenance Phase

The only foreseen impacts in relation to community health, safety, and security are mainly limited to trespassing of unauthorized personnel into the Project site and which could result in potential risks from several hazards of the various Project components (e.g. electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc).

Considering the works and population involved, the intensity of this impact can be said to be low, it will occur over the project operational phase and therefore duration is long term and moderately irreversible with a low probability to occur. The significance rating of the impact of the project on community health, safety and security at the operational phase can be described as **VERY LOW NEGATIVE.**

6.9.5. Traffic & Transportation

Constructional Phase

The nature, size and location of the development proposal, together with the characteristics of its surroundings suggest that a detailed assessment of traffic impacts will not be required. Constructional impacts due to traffic and transport generally can occur in the form of:

- Disruption of transport links, including delays and congestion brought about by an increase in overall traffic numbers due to construction traffic movements.
- Conflict with other road users, including pedestrians and public transport (buses, taxis, etc.) as a result of delivery of equipment and plant to the site.
- Specific annoyance due to additional heavy goods vehicle movements.
- Localised disruption as a result of the constructional activities.
- Risk of accidents along delivery roads and on the site.

In terms of total traffic generated by the construction phase, daily movements will be low. Estimated average construction vehicle movements are 5 trucks and 10 pickups per day. The requirement will only be for the delivery of workers at the start and end of each day and the construction materials during the working day, both to the depots and to the construction sites. This will present an increased safety risk but with the application of proper mitigation measures particularly the speed controls through villages, this increased risk should be minor. Any traffic obstructions caused by construction activities would be temporary and moderate and conditions would return to normal once the proposed project action is completed. Administrative measures would have to be put in place to stagger the delivery of construction equipment and materials to the construction sites, and the delivery of materials and equipment would be carried out during off-peak hours.

Taking account of the low overall total traffic movement that will occur, the intensity of this impact is anticipated to be high the spatial extent of the impact will be regional, and the duration of the impact will be temporal and reversible. There is a high probability of the impact occurring. The significance rating of the impact of the project on traffic and transports can be described as **MEDIUM NEGATIVE.**

Operational & Maintenance Phase

The nature, size and location of the development proposal, together with the characteristics of its surroundings suggest that a detailed assessment of traffic impacts will not be required. Constructional impacts due to traffic and transport generally can occur in the form of:

- Disruption of transport links, including delays and congestion brought about by an increase in overall traffic numbers due to construction traffic movements.
- Conflict with other road users, including pedestrians and public transport (buses, taxis, etc.) as a result of delivery of equipment and plant to the site.
- Specific annoyance due to additional heavy goods vehicle movements.
- Localised disruption as a result of the constructional activities.
- Risk of accidents along delivery roads and on the site.

In terms of total traffic generated by the construction phase, daily movements will be low. Estimated average construction vehicle movements are 5 trucks and 10 pickups per day. The requirement will only be for the delivery of workers at the start and end of each day and the construction materials during the working day, both to the depots and to the construction sites.

This will present an increased safety risk but with the application of proper mitigation measures particularly the speed controls through villages, this increased risk should be minor. Any traffic obstructions caused by construction activities would be temporary and moderate and conditions would return to normal once the proposed project action is completed. Administrative measures would have to be put in place to stagger the delivery of construction equipment and materials to the construction sites, and the delivery of materials and equipment would be carried out during off-peak hours.

Taking account of the low overall total traffic movement that will occur, the intensity of this impact is anticipated to be high the spatial extent of the impact will be regional, and the duration of the impact will be temporal and reversible. There is a high probability of the impact occurring. The significance rating of the impact of the project on traffic and transports can be described as **MEDIUM NEGATIVE.**

6.10. Gender & Vulnerability

Women often experience negative impacts of development projects more than men, and rarely receive the same benefits. Generally, some of the key impacts of capital and large infrastructural projects on women, children and the vulnerable are as follows:

Environmental Impact

- Environmental damage and degradation can affect women's capacity to provide food and clean water to their families, which women and girls are often primarily responsible. This leads to an increase in their workload such as having to walk greater distances to access water, fuel or wood, forest products and land to plant food crops.
- Pollution of water sources and water scarcity threatens their health and agricultural productivity. This would have a direct impact on livelihood opportunities.

Social & Health Impact

- Due to sudden influx of a transient workforce during a project's construction and operation, social and health problems, including those associated with law and order, are common. These problems can include increased alcohol consumption, domestic and sexual violence, sexually transmitted infections such as HIV and AIDS, and prostitution.
- Unsuitable resettlement sites can lead to security threats with respect to social, economic, and health security, such as lack of employment opportunities, natural resources, familiarity with the area etc.
- Dust, pollution, noise and bad odour released from the activity site have adverse impact on the health of women, men and children.
- When women work at project sites, children often accompany them instead of going to school, if there is no support system for women to enable them to send their children schools.

Economic Impact

- Compensation, and rehabilitation and resettlement benefits accrue to men due to family headship, deny women access to and control over economic benefits. This increases women's economic dependence on men, disempowering them and deteriorates the existing inequalities
- Displacement caused due to loss of land leads to loss of livelihoods. Establishing new sources of income and shifting from traditional to a cash based economy can lead to the loss of traditional values and way of life. This may also increase work burden on women.
- Women face food insecurity when there is a movement of men out of the villages for construction activities.
- Women can experience discrimination in the workplace. Employment and training opportunities are provided to men, and women are only left to work in the most menial, low-paid positions.
- Women returning from childbirth or childcare may struggle to regain employment.
- Women can be marginalized due to lack of adequate training regarding new technologies, which may come from and reinforce gender stereotyping.
- Lack of availability of a proper crèche or childcare facilities deters new mothers from taking up jobs, increasing their dependence on men.

Constructional Phase

The constructional phase will lead to employment of both the community members as well as those from neighboring areas. Such gainful employment will lead to higher incomes and acquisition of properties. Foreign and nationals from elsewhere will also benefit from project employment and would be most likely be accommodated in the locality. Tensions and fights over money, property and arising out of increased income from the project could be a leading determinant of all forms of associated domestic violence in the project communities. Domestic violence causes immediate devastating consequences to those affected: physical injuries, mental health problems and poor well-being, to name but a few. But it also has long-term, far-reaching effects, including persistent inequalities between men and women, which limit women and girls' abilities to fulfil their potential

Gender Based Violence, Sexual Exploitation and Workplace Sexual Harassment are the key gender and vulnerability impact related to the project constructional activities. The term "violence against women" means any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private life.

Migration from short term or long term, increases opportunities to have sexual relationship with multiple partners, thus becoming a critical factor in the propagation of HIV/AIDS. With any influx of temporary workers there is a significant risk of spreading HIV/AIDS; specific measures will need to be undertaken by the contractor to minimise this risk. Although awareness of the disease is said to be very high amongst the Ghanaian population, behavioural change lags far behind this awareness. With this in mind, it is important that sexual exploitation and harassment both at the

workplace and at the domestic level should not be side lined as 'just a women's issue' and that it is a central part of safety and health for workers, as well as a gender equality issue.

Taking account of the short-term nature of the construction, the intensity of this impact is anticipated to be low, the spatial extent of the impact will be regional, and the duration of the impact will be of medium term. There is also a low probability of the impact occurring. The significance rating of the impact of the project on gender and vulnerability can be described as **LOW NEGATIVE.**

Operational Phase

Operational phase will lead to electricity stabilization and economic growth and this will help positive impacts on the project as has already been discussed, as well as on gender and vulnerability issues. Negative impacts could be on land use and this has been discussed. Workforce during the operational phase will be minimal, around 10 persons and these persons will be accommodated within the communities and therefore will become an integral part of the communities. This notwithstanding, Gender Based Violence and Sexual Exploitation could be become issues at this phase, albeit less likely.

Taking account of the short-term nature of the construction, the intensity of this impact is anticipated to be low, the spatial extent of the impact will be regional, and the duration of the impact will be of long term. There is also the unlikelihood of the impact occurring. The significance rating of the impact of the project on gender and vulnerability can be described as **LOW NEGATIVE.**

6.11. Potential Cumulative Impacts

For each of the impacts assessed, the EIA is to investigate the cumulative impacts which could result from incremental impacts from other known existing and/or planned developments in the area and based on currently available information on such existing/planned developments. Within the project area and its surrounding there are no existing and/or planned developments which would result in cumulative impacts on any of the environmental or social receptors investigated as part of the EIA. The nearest PV plant is at Pungu Telania, near Navrongo, west of Bongo and about 50Km away (See Plate 6-1). The nature of the potential impacts which have been addressed above are site-specific and relevant mitigation measures will be adopted. The assessment of cumulative impacts in that sense is not relevant.

However, impact on water resource especially, ground water, is critical as water is required for cleaning of the PV modules on a regular basis. Estimated volume of water demand for wet cleaning of solar panels is 242 m^3/year for a duration of 25 years. There is the need to ensure that enough water is available and that there is no negative impact on the drinking water supply situation of the nearby communities which may create substantial social conflicts.

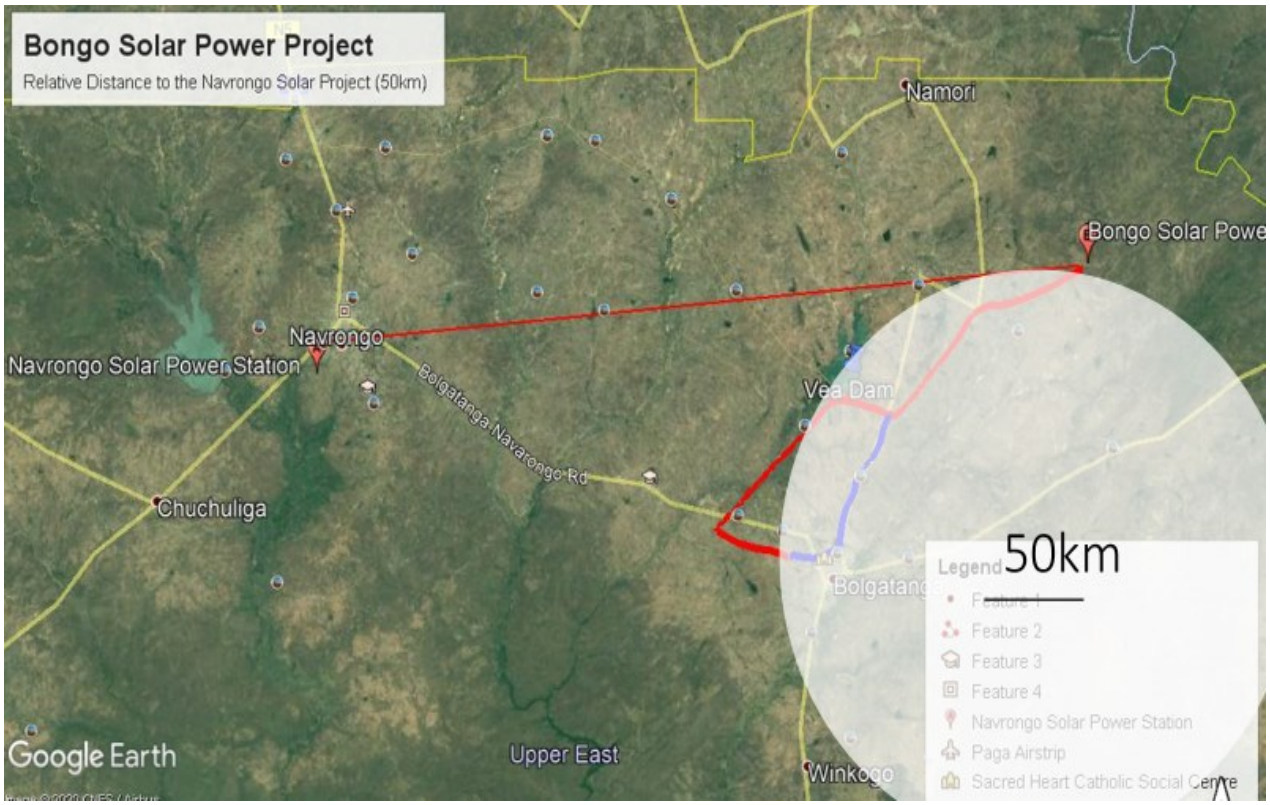


Plate 6-1: Distance Between Solar Power Project Sites at Bongo and Navrongo

6.11. Impacts During Decommissioning Phase

The decommissioning and dismantling operations of the PV site which would have been part of the local social fabric for many years will certainly create vacuum in the lives of the people directly and indirectly connected with it. Decommissioning will have impact on environment due to noise and dust arising out of it. It will also have other negative impact such as Waste Generation, Occupational Health & Safety as well as Traffic & Transport. The project is expected to have similar impacts as the construction phase during decommissioning phase and will not be discussed further.

Specific strategies shall be adopted to handle each type of item to keep the impact during the actual activity low. These strategies have been discussed in brief under Chapter 9 of this Report within a contextual "**Decommissioning & Site Colure Plan**". The impact due to decommissioning on power, social and environmental scenario will be guided by applicable laws and guidelines and these will be addressed as appropriate.

6.12. Summary of Results of Impacts

The impact assessment methodology employed as well as the potential environmental, social, economic, health and public safety related impacts likely to be associated with all phases of the project as required has been discussed. The issues and impacts presented have been identified via the environmental status quo of the receiving environment, a review of environmental impacts from other similar projects and inputs from specialists that form part of the project team. Both associated positive and negative impacts have been identified and discussed. Scores from the

detailed calculations based on the defined approach outlined under the Section 6.2 to enable the EA to reach the various conclusions is provided as Appendix 8 and summarised in Table 6-5.

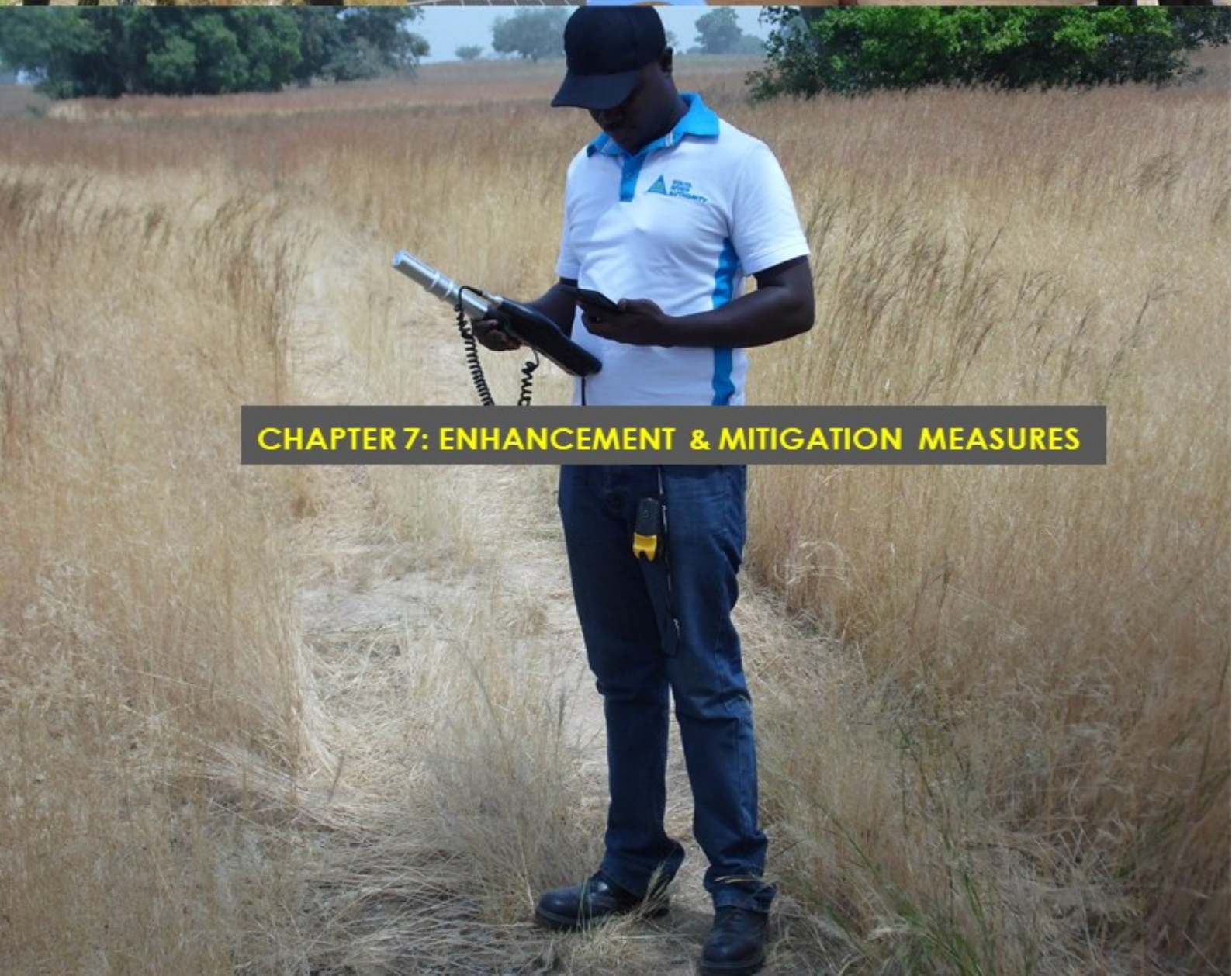
Table 6-5: Summary of Impact Rating Scores

Project Phase	Impact Rating			
	Positive		Negative	
Pre-Construction	-	Not Applicable	7.00	Medium Negative
Construction	10.00	Medium Positive	4.36	Low Negative
Operational & Maintenance	9.00	Medium Positive	1.58	Very Negative
Average Rating	9.50	Medium Positive	4.31	Low Negative
Decommissioning		Not Applicable	4.00	Low Negative

Based on the assessment of the various impacts associated with the pre-constructional, constructional and operational phases, the positive impact had an average rating score of 9.5 defined as **MEDIUM POSITIVE** whilst the negative impact had an average rating score of 4.31 defined as **LOW NEGATIVE.** This means the project impacts may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures and should not have an influence on decision-making. Chapter 7 outlines the enhancement/mitigation measures proposed for the identified positive and negative impacts associated with the project.

40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report



CHAPTER 7: ENHANCEMENT & MITIGATION MEASURES

7 ENHANCEMENT & MITIGATION MEASURES

7.1. Overview

This Section provides information on the enhancement or mitigative measures to be put in place based on the identified impacts outlined under Chapter 6 through the consideration of the following:

- Enhancement measures, which outlined measures to be implemented to enhance already positive benefits of the project.
- Embedded or In-built Controls, which outlines mitigation measures which is built into the project during the design process as well legal requirements that must be adhered to in order for easy transfer into all contractual documents with the EPC Contractor, if required
- Mitigation of significant effects or key mitigation (pertinent measures that will be written into and enforced through the EMP for implementation to ensure that the significance of the associated impact is acceptable).
- Mitigation of non-significant effects or additional mitigation (management actions to be considered by proponent and authority).

The identified measures are to be implemented mostly by the EPC Contractor in collaboration or under the supervision of VRA at the constructional stage whilst the VRA is solely responsible for the operational stage. Based on expert experience. an evaluation of the residual, i.e. remaining, impacts after implementation of the mitigation measures, has also been undertaken and indicated. The rating of an impact's significance has been determined and categorised as negligible, low, medium or high, and the rationale for arriving at this is discussed in the subsequent Sections.

7.2. Recommended Enhancement Measures for Positive Benefits

7.2.1 Increased Employment Opportunities

Embedded/In-built Control	*Enhancement Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to Labour Act 2003 (Act 651) of 2003 and the Labour Regulations, 2007 (LI 1833). ▪ Adherence in line with VRA Local Content Policy ▪ Adherence to the provision of the Children's' Act, 1998 (Act 560) with regards to child labour.	EPC Contractor shall: ▪ Prepare and implement a Labour Management Plan for the constructional phase. ▪ Use local employment and sourcing policies to give priorities to people within the project communities specifically and the Bongo District in general. ▪ Adopt strategies under the previous solar power projects in the recruitment of locals under this project. ▪ No child shall be employed on the project ▪ Announce job opportunities via both the electronic and print media. ▪ Procure food stuff and fish from the local communities, thus providing a source of income for such communities. Regarding this, food vendors from the local communities must be encouraged to sell their food to workers at designated

Embedded/In-built Control	*Enhancement Measures*
	places within the project site.
*The significance of the impact during the constructional phase has been evaluated as **MEDIUM POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the rating for both phases will have a **HIGH POSITIVE** significance.*	
OPERATIONAL PHASE	
▪ Application of relevant national policies, labour laws and codes concerning employment conduct. ▪ Design and adherence to employment and workforce policies.	▪ VRA shall ensure continuous electricity availability to help manufacturing sectors which are often constrained by a lack of reliable power to produce more, consume more inputs from other sectors, and hence create additional employment.
*The significance of the impact during the operational phase has been evaluated as **MEDIUM POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the rating for both phases will have a **HIGH POSITIVE** significance.*	

7.2.2 Minimisation of Greenhouse Gas Emissions

Embedded/In-built Control	*Enhancement Measures*
CONSTRUCTIONAL PHASE	
▪ Not Applicable	▪ Not Applicable
OPERATIONAL PHASE	
Embedded/In-built Control	*Enhancement Measures*
▪ Implementation of VRA REDP to enhance the contribution of the solar power project to reduction of greenhouse gases and its contribution to climate change impacts. ▪ Provision of reports on project operations to the EPA in line with the requirements of the National Climate Change Policy and the Kyoto Protocol.	▪ VRA shall undertake regular and routine maintenance of solar power facilities for continuous operations of the plant to ensure it displaces energy sources from fossil fuels.
*The significance of the impact during the operational phase has been evaluated as **HIGH POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the significance of the rating will continue to be **HIGH POSITIVE.***	

7.2.3 Stabilisation of Electricity

Embedded/In-built Control	*Enhancement Measures*
CONSTRUCTIONAL PHASE	
▪ Not Applicable	▪ Not Applicable
OPERATIONAL PHASE	
Embedded/In-built Control	*Enhancement Measures*
▪ Development and implementation of an O&M concept for all relevant aspects of work in line with the Energy Commission Act (1997), Act 541 and the Factories, Shops and Offices Act of 1970 (Act 328) ▪ Acquisition of valid permits in line with national requirements to prevent shut down of the solar power facility.	▪ VRA shall undertake regular and routine maintenance of solar power facilities for continuous operations of the plant to ensure it displaces energy sources from fossil fuels.
*The significance of the impact during the operational phase has been evaluated as **HIGH POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the significance of the rating will continue to be **HIGH POSITIVE.***	

7.2.4 Promotion of Economic Growth

Embedded/In-built Control	*Enhancement Measures*
CONSTRUCTIONAL PHASE	
▪ Not Applicable	▪ Not Applicable
OPERATIONAL PHASE	
Embedded/In-built Control	*Enhancement Measures*
▪ Implementation of CDP/CSR to enhance local economy.	VRA shall: ▪ Ensure stably priced electricity for consumers to promote local businesses. ▪ Ensure continuous electricity availability to help in manufacturing at the local level. ▪ Provide job opportunities for locals and nationals to enhance their economic development. ▪ Appoint a Community Relations Officer to serve as liaison between the communities and VRA. ▪ Engage with traditional authorities and heads of state agencies in the various districts on the modalities to apply and benefit from the CDP/CSR. ▪ Improve local skills through training under the CDP/CSR to maximize local employment and facilitate economic development initiatives that benefit the project communities.

Embedded/In-built Control	*Enhancement Measures*
	▪ Extend its Employee Volunteerism Program to the educational institutions in the Bongo District
*The significance of the impact during the operational phase has been evaluated as **MEDIUM POSITIVE**. With the implementation of the enhancement measures proposed below, it is expected that the impact will maintain its **MEDIUM POSITIVE** significance.*	

7.3. Mitigation Measures for Negative Impacts on Physical Environment

7.3.1 Increase in GHG Emissions

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adhere to requirements of GS IEC 61836 - Solar Photovoltaic Energy Systems ▪ Use of low carbon intensive constructional materials, e.g. Cement.	▪ Implement 4Rs in waste management (reduce, Reuse, Recycle, Reduce) ▪ Use of well-maintained machinery ▪ Regular servicing of equipment and vehicles ▪ Minimisation of tree felling activities ▪ Ensure implementation of MOU between VRA and FSD and assess affected flora and economic trees ▪ Provision of tree seedlings to FSD to offset affected trees
*The significance rating of the noise impact at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adhere to requirements of GS IEC 61836 - Photovoltaic Energy Systems	▪ Implement 4Rs in waste management (reduce, Reuse, Recycle, Reduce) ▪ Use of well-maintained machinery ▪ Regular servicing of equipment and vehicles ▪ Adhere strictly to plant maintenance schedule ▪ Monitor and provide data on plant operations in VRA GHG Accounting Reporting
*The significance rating of the noise impact at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to **VERY LOW NEGATIVE***	

7.3.2 Noise & Vibrational Impacts

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328). ▪ Adherence to Ghana Standard for	The EPC Contractor shall: ▪ Define normal working hours (preferable 0700 Hours to 1800 hours) and that if work needs to be undertaken outside these hours, it should be limited to activities which

Embedded/In-built Control	*Mitigative Measures*
Health Protection – Requirements for Ambient Noise Control (GS 1222:2018). ▪ Compliance with Occupational Safety and Health requirements of the Factories & Inspectorate Division to ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment.	do not generate noise. ▪ Operate only well-maintained equipment on-site. ▪ Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc. ▪ Stop construction activities until adequate control measures are implemented, if noise levels were found to be excessive. ▪ Shut down or throttled down machinery and construction equipment that may be in intermittent use during non-work periods. ▪ Encourage minimal use of vehicle horns and heavy engine breaking in the project area.
*The significance rating of the noise impact at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to Ghana Standard for Health Protection – Requirements for Ambient Noise Control (GS 1222:2018). ▪ Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328) as well as the Corporate Health & Safety Policy.	VRA shall: ▪ Ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment (e.g. Earmuffs). ▪ Ensure only well-maintained equipment are operated on-site.
*The significance rating of the noise impact at the operational phase stage has been identified as **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	

7.3.3 Air Quality Impacts

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to requirements of Driver & Vehicle Licensing Authority Act, 1999 (ACT 569) by having valid Vehicle Examination Certificate from the Driver & Vehicle Licensing Authority to minimise vehicular emissions. ▪ Adherence to Ghana Standard for	EPC Contractor shall: ▪ Apply basic dust control and suppression measures which could include: a) Regular watering of all active construction areas. b) Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period. c) Proper management of stockpiles and excavated material

Embedded/In-built Control	*Mitigative Measures*
Environment and Health Protection- Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236: 2019). ▪ Compliance with the Factories & Inspectorate Requirements to ensure that for activities associated with high dust levels, workers are equipped with proper Personal Protective Equipment (e.g. masks, eye goggles, breathing equipment, etc);	(e.g. watering, containment, covering, bunding). d) Proper covering of trucks transporting aggregates and fine materials (e.g. using tarpaulin). e) Adhering to a speed limit of 15km/h for trucks on the construction site. ▪ If dust or pollutant emissions were found to be excessive, stop construction activities until the source of such emissions have been identified and adequate control measures are implemented. ▪ Ensure diesel generator use is restricted to emergencies and power back-up only to minimize air emissions. ▪ Limit speed of vehicles on site to 10-15 km/hr. ▪ Prevent idling of vehicles and equipment. ▪ Develop a regular inspection and scheduled maintenance program for vehicles, machinery, and equipment to be used throughout the construction phase for early detection of issue to avoid unnecessary pollutant emissions.
*The significance rating of the air quality impact at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to Ghana Standard for Environment and Health Protection- Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236: 2019). ▪ Ensure adherence to requirements of Driver & Vehicle Licensing Authority Act, 1999 (ACT 569) by having valid Vehicle Examination Certificate from the Driver & Vehicle Licensing Authority to minimise vehicular emissions.	VRA shall: ▪ Limit speed of vehicles on site to 10-15 km/hr. ▪ Prevent idling of vehicles and equipment.
*The significance rating of the air quality impact at the operational phase stage has been identified as **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	

7.3.4 Topography & Drainage

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Implementation of a surface water drainage system design that will effectively drain the site in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006. ▪ Adoption of a holistic approach for managing	EPC Contractor shall: ▪ Avoid any unnecessary changes in the topography. ▪ Minimise to the extent possible, disruption/alteration of any micro-watershed drainage pattern.

Embedded/In-built Control	*Mitigative Measures*
and mitigating flood risks, given the generic nature of such risks on all developments. ▪ Connection of a properly designed sewerage system within the site/office to the public sewer system. ▪	▪ If required, to provide appropriate number of cross drainage channels during access road construction to maintain flow in existing natural channels. ▪ Carry out restoration of the worked areas immediately by backfilling, professional landscaping/levelling and planting of low grass in open areas, flowers and suitable tree species, once earthworks have been done.
*The significance rating of the topography and drainage impact at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to minor.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Ensure adherence to surface water drainage system designs in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.	▪ VRA shall regularly maintain surface water drainage and culverts to prevent storm water (run-off) from accumulating within the site spreading to the neighbourhood. These must effectively drain the storm water from the premise into the existing public drainage system to be developed along the access road.
*The significance rating of the topography and drainage impact at the operational phase stage has been identified as **VERY LOW NEGATIVE**. By implementing the above recommended measure, it is expected that the impact will remain **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	

7.3.5 Geology & Soils

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to the requirements of the Land Planning and Soil Conservation Act, 1957 within the designated project areas.	EPC Contractor shall: ▪ Not undertake site clearance, piling, excavation and access road construction during the raining season to minimize erosion and run-off. ▪ Ensure that construction activities are restricted to designated work areas to avoid damage and disturbance outside of the power plant site. ▪ Strip and store topsoil separately from subsoil. ▪ Locate temporary storage tanks on impervious bases and will use drip trays during re-fuelling of equipment. ▪ In case of accidental/unintended spillage, immediately collect contaminated soil and stored as hazardous waste. ▪ Make available on site, all equipment and materials required to execute a clean-up. ▪ Utilize existing roads to access the site. ▪ Widen existing roads to have the width and turning radius to accommodate the necessary vehicles for the project.

Embedded/In-built Control	*Mitigative Measures*
The significance rating of the impacts on geology and soils at the constructional stage is said to b ***VERY LOW NEGATIVE****. By implementing the above recommended measures, it is expected tha the impact will remain at a* ***VERY LOW NEGATIVE*** *significance and the residual impac significance will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to the requirements of the Land Planning and Soil Conservation Act, 1957 within the power facilities.	▪ Take responsibility for ensuring that operational activities are restricted to designated work areas, to avoid damage and disturbance outside of the power plant site, especially the sub-transmission line component. ▪ In case of accidental/unintended spillage, immediately collect contaminated soil and stored as hazardous waste.
The significance rating of the impacts on geology and soils at the operational stage is said to be ***VERY LOW NEGATIVE****. By implementing the above recommended measure, it is expected that the impact will remain at a* ***VERY LOW NEGATIVE*** *significance and the residual impact significance will be negligible.*	

7.3.6 Water Resources

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to requirements of Drilling License & Groundwater Development Regulations, 2006, LI 1827 for the construction of a well for the abstraction of groundwater.	EPC Contractor shall: ▪ Adhere to agreed arrangements for the disposal of aqueous effluents during construction and commissioning phases with VRA. ▪ Provide impervious storage area, especially for fuel & lubricant, hazardous waste, etc. ▪ Not store hazardous materials near natural drainage channels. ▪ Ensure that any temporary refuelling tanks are bunded. ▪ Have available on site, all equipment and materials necessary to execute clean up.
The significance rating of the impacts on water resources at the constructional stage is said to b ***LOW NEGATIVE****. By implementing the above recommended measures, it is expected that th impact will remain at a* ***VERY LOW NEGATIVE*** *significance and the residual impact significanc will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Acquisition of valid Water Use Permit for abstraction of ground water as required under the provision of the Water Use Regulations, 2001 (L.I. 1692). ▪ Installation of automatic water level sensors inside wells.	VRA shall: ▪ Engage with Community members continuously on issues of water security to avoid potential conflicts. ▪ Regularly monitor the ground water abstraction and report on it on regular basis to the EPA. ▪ Maintain logbook for water consumption, ▪ Progressively adopt less water consuming module cleaning methods.
The significance rating of the water resources impact at the operational phase stage has been identified as ***VERY LOW NEGATIVE****. By implementing the above recommended measures, it*	

Embedded/In-built Control	*Mitigative Measures*
*is expected that the impact will remain **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	

7.3.7 Waste Generation

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to legal requirements such as the National Environmental Sanitation Policy 2010, Hazardous & Electronic Waste Control Management Act, 2016 (Act 917) and Hazardous, Electronic and other wastes (Classification) and Management Regulations 2016, L1 2250. ▪ All waste arising from the works shall be deposited, treated, kept, disposed of and carried in accordance with the provisions of relevant national and local environmental protection acts and also in accordance with any additional instructions outlined by VRA. ▪	The EPC Contractor shall, Solid Waste ▪ Implement 4Rs in waste management (reduce, Reuse, Recycle, Reduce) ▪ Store construction and demolition waste separately and be periodically collected by an authorized treatment and storage facility. ▪ Distribute enough properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. ▪ Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". ▪ Store all waste in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels. ▪ Coordinate with relevant District assembly or hire a competent private contractor for the collection of solid waste from the site to the approved landfill. ▪ Provide designated areas for solid municipal waste and daily collection and period disposal should be ensured. ▪ Ensure that only a licensed waste collector will transport all waste arising from the works. ▪ Where possible, must seek ways to reduce construction waste by reusing materials. ▪ Not permit burning of waste. ▪ Implement proper housekeeping practices always on the construction site. Wastewater ▪ Ensure all clean waste waters like flood waters, water from PV cleaning activities are directed into the municipal drain provided within the project site to prevent waterlog. ▪ Provide annual quantities of wastewater used in PV cleaning activities as has been determined ▪ Coordinate with respective District Assemblies to hire a private contractor for the collection of black waters from the site. ▪ Ensure that black waters, e.g. sewage from septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing. ▪ Ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil. ▪ Prohibit illegal disposal of wastewater to the land.

Embedded/In-built Control	*Mitigative Measures*
	Hazardous waste ▪ Maintain a logbook for quantity and type of hazardous waste generated. ▪ Prohibit illegal disposal of hazardous waste to the land. ▪ Ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at the site. ▪ Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing. ▪ In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste. Hazardous Material ▪ Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another. ▪ Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must always be present. Spilled material should be tracked and accounted for. ▪ Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc). ▪ Undertake regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage (such as refuelling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material. ▪ Ensure that a minimum of 200 litres of general-purpose spill absorbent is available at hazardous material storage facility. ▪ Ensure that if spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste. ▪ Store and package all broken and obsolete PV Panels, when large quantities are achieved, and ship to manufacturers for recycling. The EPC Contractor shall be responsible under the contract for disposal of broken and obsolete PV Panels that will occur during constructional period.
*The significance rating of the impacts on waste generation at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to the National Environmental Sanitation Policy 2010 and the Hazardous & Electronic	The VRA shall: ▪ Implement 4Rs in waste management (reduce, Reuse, Recycle, Reduce) ▪ Coordinate with relevant District assembly or hire a competent

Embedded/In-built Control	*Mitigative Measures*
Waste Control Management Act, 2016 (Act 917). ▪ All waste arising from the works shall be deposited, treated, kept, disposed of and carried in accordance with the provisions of relevant national and local environmental protection acts. ▪ Procedures for the disposal of waste will be contained in the operational site Environmental Management Plan and will be incorporated into any contract between VRA and the licensed operator. ▪	private contractor for the collection of solid waste from the site to the approved landfill. ▪ Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste" ▪ Provide waste oil tanks to hold the waste lubricating oils to be produced. ▪ Engage EPA licensed operators to remove waste oil from the site for re-use. ▪ Ensure foul water always go to a septic tank. ▪ Prohibit illegal disposal of wastewater to the land. ▪ Ensure disposal of waste from the septic tank in an environmentally acceptable manner by a licensed operator approved by EPA. ▪ Ensure that constructed septic tanks during operation are well contained and impermeable to prevent leakage of wastewater into soil. ▪ Store and package all broken and obsolete PV Panels, when large quantities are achieved, and ship to manufacturers for recycling.
The significance rating of the impacts on waste generation at the operational stage is said to b ***LOW NEGATIVE****. By implementing the above recommended measures, it is expected that th impact will remain at a* ***VERY LOW NEGATIVE*** *significance and the residual impact significanc will be negligible.*	

7.3.8 Landscape & Visual Intrusion

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Use of appropriate colour, materials and proportioning as well as appropriate architectural detailing to assist in the respectful integration of the facades of the power facility with surrounding environment and existing buildings.	The EPC Contractor shall: ▪ Ensure the construction site is left in an orderly state at the end of each workday. ▪ Remove in a timely manner to the greatest extent possible, construction machinery, equipment, and vehicles that are not in use and these shall be kept in locations to reduce visual impacts to the area. ▪ Ensure proper storage, collection, and disposal of waste streams generated ▪ Upon completion of construction activities, install informative signs on the Highway for commuters regarding potential for glare within the area.
The significance rating of the impacts on landscape and visual intrusion at the constructional stage is said to be ***LOW NEGATIVE****. By implementing the above recommended measures, it is expected that the impact will remain at a* ***VERY LOW NEGATIVE*** *significance and the residual impact significance will be negligible.*	

OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Effective repairs and maintenance of the solar power facilities in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.	VRA Shall: ▪ Plant trees native to the area at the frontage of the power plant facilities to act as windbreaks, noise buffer and to reduce the visual effect of having a power plant located at the site.
*The significance rating of the impacts on landscape and visual intrusion at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.4. Ecological Environment

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ As part of project design, appropriate routing of lines, use of bird deflectors, and pole design which minimizes electrocution risks shall be developed to reduce impacts from power lines and associated infrastructure. ▪ Adherence to requirements of existing conditions of MoU Between VRA and FSD regarding work in off forest areas. ▪ Anti-poaching, trapping and hunting policy among employees should be strictly enforced. ▪ Detailed assessment to identify of key faunal species of importance (reptiles and mammals) to allow for their relocation. It must be noted that this has been completed through a detailed survey in Jan. 2019 and species of IUNC conservation status of "Least Concern" were identified.	The VRA shall: ▪ Develop tree offset as part of mitigating GHG impact by replacing the trees removed through planting of a similar number within its ongoing tree planting programme. The EPC Contractor shall: ▪ Ensure that the fencing constructed for the Project site allows for the natural movement of small faunal species within the area. ▪ Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following: a. Prohibit hunting at any time and under any condition by construction workers onsite b. Restrict activities to allocated construction areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances. ▪ Restrict vegetation disturbance and clearance to the project activity area location of laydown area, construction activities and storage areas; ▪ Prohibit unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement and destruction of floral resources. ▪ Conduct construction activity in a phased manner, in other words, construction activity should not be widespread affecting all habitats at the same time. ▪ Strictly enforce anti-poaching, trapping and hunting policy among contractor's workforce. ▪ Enhance general awareness regarding fauna through trainings, posters, etc. among the staff and labourers.
*The significance rating of the impacts on ecology at the constructional stage is said to be **HIGH NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	

Embedded/In-built Control	*Mitigative Measures*
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ The use of bird deflectors, and pole design which minimizes electrocution risks shall be maintained during project operations to reduce impacts from power lines and associated infrastructure. ▪ Adherence to requirements of existing conditions of MoU Between VRA and FSD ▪ Enforcement of anti-poaching, trapping and hunting policy among employees.	VRA shall: ▪ Ensure upright insulators on transmission poles are covered with plastic insulating caps or insulating tubing to prevent electrocution risk. ▪ Erect bird detractors such as moving cloth or scarecrow to prevent birds from venturing close to solar modules. ▪ Regularly check the vacuums or holes in the towers to avoid nesting by any of the birds. ▪ Enhance general awareness regarding fauna through trainings, posters, etc. among the staff.
*The significance rating of the impacts on ecology at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.5. Historical or Cultural Heritage Resources

Embedded/In-built Control	*Mitigative Measures*
PRE-CONSTRUCTIONAL & CONSTRUCTIONAL PHASE	
▪ Adherence to requirements of the National Museums Act, Act 387 of 1969. ▪ Pacification rites requirements, prior to construction, as requested by the landowners and community leaders during the various stakeholder engagements.	The EPC Contractor shall: ▪ Establish an engagement platform with local community and owners/caretakers to provide the support to ensure that any identified resource. ▪ Ensure that the Code of Conduct, awareness raising, and training developed for construction workers to emphasizes the presence of the locations of the cultural resource that may be identified later in the area - this could include providing information on their locations, prohibit any improper conduct which could disturb/ damage those locations, etc. ▪ Properly plan construction activities to consider the identified resources locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, prohibit movement of vehicles near those areas during the various construction activities, etc. ▪ Undertake all works take place within the authorised footprint to avoid impacts to any nearby tangible and intangible heritage resources. ▪ Dialogue with community members on compensation and moving any identified shrine.

Embedded/In-built Control	*Mitigative Measures*
	▪ Ensure strict observation of the cultural taboos. ▪ Implement appropriate chance find procedures in collaboration with the Ghana Museums & Monuments Board (GMMB). ▪ Ensure proper documentation and reporting of chance finds and submission to Ghana Museum in Accra.
*The significance rating of the impacts on historical and cultural heritage resources at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to requirements of the National Museums Act, Act 387 of 1969.	VRA shall: ▪ Properly plan operation activities to consider the identified archaeological locations to ensure they are protected from any potential damage. ▪ Ensure that the Code of Conduct, awareness raising, and training developed for staff to emphasizes the presence of archaeological locations in the area ▪ Undertake all works take place within the authorised footprint to avoid impacts to any nearby tangible and intangible heritage resources. ▪ Ensure strict observation of the cultural taboos. ▪ Ensure proper documentation and reporting of chance finds and submission to GMMB in Accra. ▪
*The significance rating of the impacts on historical and cultural heritage resources at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.6. Occupational Health & Safety

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to requirements of Factories, Shops and Offices Act of 1970 (Act 328). ▪ Adherence to requirements of VRA's "Safety, Health and Environment Standards for Contractors". ▪ Acquisition of a Development Permit from the relevant District Assembly, prior to construction.	EPC Contractor shall: ▪ Develop and implement a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan during construction. ▪ Provide all workers (regular and contracted) with training on Health and Safety Plan. ▪ Develop and disseminate international best practices regarding working conditions, health and safety and overall management practices to the workforce. ▪ Undertake construction activities during daytime hours and vigilance should be maintained for any potential accidents. ▪ Provide PPEs such as safety shoes, helmet, goggles, earmuffs and face masks to workers always. ▪ Ensure that cranes and other lifting equipment are operated by trained

Embedded/In-built Control	*Mitigative Measures*
▪ Acquisition of a Fire permit prior to project implementation to ensure fire safety.	and authorised persons. ▪ Train personnel of the Ghana National Fire Service on how to deal with fire resulting from solar projects as part of the requirements for the Engineering, Procurement and Construction (EPC) Contract. ▪ Provide training for the workers on climbing techniques, and rescue of fall-arrested workers. ▪ Provide an up to date first aid box at all construction sites and a trained person should be appointed to manage it. ▪ Ensure that electrical and maintenance work are not carried out during poor weather and during lightning strikes. ▪ Provide training on vehicular safety to the transport workers. ▪ Undertake health education about communicable diseases as part of the induction training for workforce members. ▪ Undertake regular health check-ups of the workforce and reporting any major illnesses at the earlier to the local medical officer. ▪ Implement a permitting system to ensure that cranes and lifting equipment is operated by trained and authorized persons only. ▪ Ensure that appropriate safety harnesses and lowering/raising tools are used for working at heights. ▪ Ensure all equipment are turned off and checked when not in use. ▪ Avoid construction and transportation activities as far as possible during night (6:00 pm to 6:00 am). ▪ Avoid obstructing water source/flow as a result of constructional activities. ▪ Install temporary barriers on excavated areas. ▪ Follow good housekeeping for construction activities, and properly dispose of all waste packaging material. ▪ Provide proper sanitation facilities at site offices. ▪ Put in place suitable measures to maintain a healthy environment for the labour force.
*The significance rating of the impacts on occupational health and safety at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" ▪ Implementation of VRA Health & Safety Policy ▪ Acquisition of valid permits for operating the solar power facility.	VRA Shall: ▪ Provide all workers (regular and contracted) with training on Health and Safety management system on its EHS policies and procedures. ▪ Place appropriate warning signs at the site where there is a risk to health and safety. ▪ Install a comprehensive fire detection and protection system to cover all equipment on site that could constitute a fire risk. ▪ Monitor health and safety performance and have an operating audit system for the facilities. ▪ Have in place safety or emergency management plan to account for natural disasters, accidents and any emergency situations. ▪ Develop and implement Standard Operation Procedures on Health &

Embedded/In-built Control	*Mitigative Measures*
	Safety measures.
*The significance rating of the impacts on occupational health and safety at the operational phase is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible*	

7.7. Socio-Economic Effects

7.7.1 Land Acquisition

Embedded/In-built Control	*Mitigative Measures*
PRE-CONSTRUCTIONAL PHASE	
▪ Adherence to requirements of the project "Land Acquisition & Compensation Action Plan" and pay prompt, adequate and fair compensation to all project-affected persons before the start of constructional activities. Indeed, this has been completed to enable project construction to commence. ▪ Adherence to the requirements of the project's Stakeholder Engagement Plan.	VRA shall: ▪ Assign a Community Liaison Officer to liaise with the EPC Contactor, Traditional Authorities and the District Chief Executive upon commencement of the project. ▪ Institute appropriate grievance mechanisms to address concerns of the public ▪ Undertake detailed survey of project-affected persons for the purposes of compensation payment. ▪ Utilise existing right of way for roads and sub-transmission lines to minimise land acquisition. ▪ Assist vulnerable person whose livelihood activities have been affected with alternative livelihood.
*The significance rating of the impacts on land acquisition at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	
CONSTRUCTIONAL PHASE	
▪ Adherence to requirements of its "Land Acquisition & Compensation Action Plan"	VRA shall: ▪ Assign a Community Liaison Officer to liaise with the EPC Contactor, Traditional Authorities and the District Chief Executive upon commencement of the project. ▪ Institute appropriate grievance mechanisms to address concerns of the public ▪ Undertake detailed survey of project-affected persons for the purposes of compensation payment. ▪ Utilise existing right of way for roads and sub-transmission lines to minimise land acquisition. ▪ Assist vulnerable person whose livelihood activities have been affected with alternative livelihood.
*The significance rating of the impacts on land acquisition at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that*	

Embedded/In-built Control	*Mitigative Measures*
*the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Monitor and evaluate requirements of the project "Land Acquisition & Compensation Action Plan"	▪ Institution of an appropriate grievance mechanisms to address concerns of the public ▪ VRA shall appoint a Community Liaison Officer as a designated point of contact for the community.
*The significance rating of the impacts on land acquisition at the operational stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.7.2 Impact on Land Use

Embedded/In-built Control	*Mitigative Measures*
PRE-CONSTRUCTIONAL & CONSTRUCTIONAL PHASE	
▪ Acquisition of Development Permit from the relevant District Assemblies, prior to construction. ▪ Effective zoning of project area by the Land Use & Spatial Planning Dept. (formerly Town and Country Planning Department).	EPC Contractor shall: ▪ Restrict construction activities to within the allotted land and immediate surroundings only. After construction work, any land taken for a temporary basis for storage of material shall be restored to their original form. ▪ Utilise existing roads for access to the project site. ▪ On completion of construction activities, land used for temporary facilities, if any, should be restored to the extent possible. ▪ Undertake activities that will disturb land use in and around permanent project facilities. ▪ Utilise existing right of way to minimise land acquisition. VRA shall: ▪ In consultation with local community, provide the required resource and support to ensure that accessibility to solar fields is not a problem. ▪ Undertake appropriate consultations with all stakeholders to raise awareness about the project. Of special importance is awareness regarding project benefits ▪ Institute appropriate grievance mechanisms to address concerns of the public. ▪ Compensation to landowners for all economic trees. ▪ Appoint a Community Liaison Officer as a designated point of contact for the community. ▪ Assist vulnerable person whose livelihood activities have been affected with alternative livelihood.
*The significance rating of the impacts on land Use at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	

Embedded/In-built Control	*Mitigative Measures*
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Renewals of Development Permit from the District Assembly, during operational phase ▪ Ensure adherence to the zoning of project area by the Land Use & Spatial Planning Dept.	VRA shall: ▪ Implement CDP/CSR activities to improve the standards of living and long-term wellbeing of the affected communities. ▪ Take proactive action in case required to avoid any undue confrontation with affected community. ▪ CSR activities under the CDP should include assistance to Forest Services Division to educate community members on impact and effects of bush fires.
*The significance rating of the impacts on land Use at the operational stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.7.3 Labour and Working Conditions

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Application of relevant national policies, labour laws and codes concerning employment conduct including adherence to Labour Act No (2003), Act 651, Labour Regulations, 2007 (LI 1833) and the Workmen's Compensation Act, 1987 (PNDC Law 187), Children's Act, Act 560 of 1998, ▪ Prepare Labour Management Plan as part of HSE Plan for the construction phase. ▪ The contractor will be required to prepare a statement of intent detailing how local employment opportunities will be addressed and the procedure for application for jobs. ▪ Measures are to be designed and adhered to regarding employment and workforce policies to mitigate environmental, health and social impacts that are associated with the influx of formal and informal workers by the Contractor. ▪ Design and adhere to employment and workforce policies.	The EPC Contractor shall: ▪ Local people are preferred by the project for the requirement of manpower under un-skilled category to the best possible extent. ▪ In case of non-availability of suitable workers, migrant workers will be hired to meet the manpower requirement. ▪ Maximise work opportunities for local citizens and recruit in accordance with the geographic priorities determined by the production organisation ▪ Enhance local employees' skills base through training and development programs ▪ Working hours will not exceed 8 hours a day, and if it does, overtime will be paid. ▪ Avoid construction and transportation activities as far as possible during night (6:00 pm to 6:00 am). ▪ Provide written contract for all categories of workers employed on the project, documenting their conditions of service and conditions concerning the termination of the contract. ▪ Provide adequate shelter, drinking water, toilet facilities for the workers. ▪ Institute appropriate grievance mechanisms to address concerns of both workers and the public.

Embedded/In-built Control	*Mitigative Measures*
	▪ Ensure that no child labour is used, in accordance with international and local labour laws. ▪ Put in place a worker grievance mechanism including monitoring and resolving of such concerns. ▪ Put in place suitable measures to maintain a healthy environment for the labour force. VRA shall: ▪ Appoint a Community Liaison Officer as a designated point of contact for the community.
*The significance rating of the impacts on Labour and Working Conditions at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Measures are to be designed and adhered to regarding VRA employment and workforce policies to mitigate environmental, health and social impacts ▪ Application of relevant national policies, labour laws and codes concerning employment conduct.	VRA shall: ▪ Ensure that local people are employed where skills permit. ▪ Provide adequate shelter, drinking water, toilet facilities for the workers. ▪ Institute appropriate grievance mechanisms to address concerns of both workers and the public. ▪ Ensure that no child labour is used, in accordance with international and local labour laws. ▪ Put in place a worker grievance mechanism including monitoring and resolving of such concerns. ▪ Put in place suitable measures to maintain a healthy environment for the labour force. ▪ Appoint a Community Liaison Officer as a designated point of contact for the community.
*The significance rating of the impacts on Labour and Working Conditions at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the said recommended measures, it is expected that the impact will remain at **VERY LOW NEGATIVE** significance and the residual impact will be insignificant.*	

7.7.4 Community, Health, Safety and Security

Embedded/In-built Control	*Mitigative Measures*
PRE-CONSTRUCTIONAL & CONSTRUCTIONAL PHASE	
▪ Observation of all necessary traditional requirements during project implementation. ▪ Presence of Community	VRA shall: ▪ Give a formal notification of the Bongo District Chief Executive on the date of project commencement. The letter should be copied to the traditional authorities.

Embedded/In-built Control	*Mitigative Measures*
Liaison Officer as a designated point of contact for the community. ▪ EPC Contractor shall provide training on vehicular safety to the transport workers.	▪ Ensure self-introduction of EPC Contractor to the DCE on arrival of onsite prior to project implementation. ▪ Ensure self-introduction of EPC Contractor to traditional authorities on arrival of onsite prior to project implementation. ▪ Create a platform for the various parties to provide information on concerns that needs to be considered during the project implementation and to agree on grievance redress mechanism in place. ▪ Form Complaint redress committee to receive and facilitate resolution of concerns and grievances about concerns raised by individuals or groups from the project affected communities, including domestic and gender-based violence. The main functions of the committee will be as follows: a. To provide a mechanism for aggrieved persons to report on problems arising because of project activities. b. To facilitate and prioritize the grievances of project affected persons that needs to be resolved. c. To ensure reporting to the aggrieved parties about the developments regarding their grievances and the decision of the project authorities ▪ Seek the assistance of the respective District Health Service in execution of any health education program for the workers. EPC Contractor shall: ▪ Undertake constructional activities only during the day i.e. between 0700 hours to 1800 hours to minimize disturbance to the public within the proximity of the site/project especially the residential estates. ▪ Provide adequate security during the construction period and especially during the night when there are no constructional activities. It is important that warning/informative signs (billboards) be erected at the site. These should indicate the operation hours and when works are likely to be started and completed. ▪ Ensure onsite guards are adequately trained to deal with trespassing incidents. In addition, guards must refrain from using excessive force, unless situation extremely requires so. ▪ Institute appropriate grievance mechanisms to address concerns of both workers and the public. ▪ Ensure its workforce desist from irresponsible sexual behavior during project implementation. ▪ Undertake sexual health education programs for its workers. through. ▪ Engage with communities on gender related risks, grievance and response measures available. ▪ Put in place mechanisms to deter the work force from engaging in cutting of trees for fuel wood, charcoal burning, and building material and for any other purposes, which has the potential of causing conflict with the communities. ▪ Ensure that excavated areas should be temporarily fenced to avoid

Embedded/In-built Control	*Mitigative Measures*
	access to outsiders and wildlife. ▪ Put in place mechanisms for the collection of all wastes generated (solid wastes, organic wastes, food remains, garbage etc.), segregate the various wastes and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill.
*The significance rating of the impacts on Community, Health, Safety & Security at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" to provide for the control, management, disposal of hazardous waste, electrical and electronic waste and for related purposes. ▪ Implementation of VRA its Health & Safety Policy in line with IFC Occupational Health and Safety (OHS) Guidelines for the solar power project.	VRA shall: ▪ Provide effective security measures for the PV Plants and the project sites through fencing, enough security staff and other measures such as floodlights with motion control. ▪ Ensure onsite guard is adequately trained to deal with trespassing incidents. In addition, guard must refrain from using excessive force, unless situation extremely requires so ▪ Cultivate harmonious co-existence between itself and the local communities in the project area.
*The significance rating of the impacts on Community, Health, Safety & Security at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.7.5 Traffic and Transport Impacts

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Development of a Traffic Method Statement (TMS) for the construction phase with the aim of minimizing disturbance to the nearby residents, industrial workers and general road users. The TMS will govern vehicle movements in and out of the site. The TMS will include, amongst other things details of signage requirements, transportation times etc. In addition, a health and safety management plan for all operating vehicles and machines. ▪ Coordination with the Ghana	EPC Contractor shall: ▪ Involve local authorities in defining optimum project traffic routes and times for transit. ▪ Engage local authorities and security agencies in the removal of speed ramps, if necessary. ▪ Control traffic on the access road to the site, especially when heavy trucks are turning in and out of the site. This will ensure that no accidents are caused by the site's activities. ▪ Enforce speed limits for heavy good vehicles and workforce transportation vehicles. ▪ Provide training in defensive driving training to drivers. ▪ Provide site vehicle maintenance services in order to ensure technical failures do not occur. ▪ Avoid densest areas of traffic, if possible, through planning and channelling of traffic.

Embedded/In-built Control	*Mitigative Measures*
Highway Authority and Department of Urban Roads to minimise interference between installation and operation following guidelines of the "Road Reservation Management: Manual for Coordination" (June 2001).	▪ Install traffic safety signage at vantage points along access routes with the project sites. ▪ Install traffic calming measures (speed bumps and rumble strips) to slow traffic down where heavy vehicles cross or enter busy roads. ▪ Engage communities on road risk and educate them through constant communications, road signals as well as with communications with the local authorities and community leaders. ▪ Improve and enhance community sensitization on road traffic accidents within the project area. ▪ Install speed control limits for the project and ensure all vehicles comply with the site driving regulations. ▪ Develop and implement a "No Drinking" "No Alcohol" policy on site during both construction and operation. Monitor all vehicles and ensure they have a "No Alcohol" sticker. The same must be done for all construction equipment and machines. ▪ Monitor all vehicles and ensure they have a "No Alcohol" sticker. The same must be done for all construction equipment and machines. ▪ Conduct periodic and routine alcohol checks for all site drivers and site workers.
*The significance rating of the impacts on Traffic & Transport at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
	VRA shall: ▪ Limit speed of vehicles on site to 10-15 km/hr. ▪ Prevent idling of vehicles and equipment. ▪ Promote car sharing amongst staff
*The significance rating of the impacts on Traffic & Transport at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at **LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.8. Gender & Vulnerability

Embedded/In-built Control	*Mitigative Measures*
CONSTRUCTIONAL PHASE	
▪ Adherence to conditions of contract, targeting issues on gender and vulnerability ▪ Adopting a policy to cooperate	EPC Contractor shall: ▪ Ensure equity in land acquisition and compensation processes ▪ Endeavour to eliminate Gender Based Violence,

Embedded/In-built Control	*Mitigative Measures*
with law enforcement agencies in investigating complaints about gender-based violence.	Sexual Exploitation and Workplace Sexual Harassment at the workplace ▪ Contribute to social investment activities targeting girls, children and women to enhance gender equity. ▪ Site induction and continuous worker education will include workplace bullying, harassment, gender-based violence, need to accept cultural differences, etc. ▪ Develop and strictly implement policies in the areas of harassment and gender-based violence ▪ Develop Code of Conduct for employees regarding relations with the community ▪ Consult with women workers to find out what can be done to reduce the risks identified. ▪ Adhere strictly to national laws regarding employment age. ▪ Employment in manual based work shall be based on evidence of being above 18 years. ▪ Acceptable ID cards shall be that of the National Identification Authority or Driver's Licence.
*The significance rating of the impacts on Gender & Vulnerability at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	
OPERATIONAL PHASE	
Embedded/In-built Control	*Mitigative Measures*
▪ Adhere to VRA conditions of service, with respect to issues on gender and vulnerability.	VRA shall: ▪ Develop and strictly implement policies in the areas of harassment and gender-based violence. ▪ Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence ▪ Contribute to social investment activities targeting girls, children and women to enhance gender equity.
*The significance rating of the impacts on Gender & Vulnerability at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at **LOW NEGATIVE** significance and the residual impact significance will be negligible.*	

7.9. Mitigation of Cumulative Impacts

There are no other known large development projects in the project's area of influence, the cumulative impact has been assessed to be negligible and there are no proposed mitigative measures for this impact. As indicated, the water requirement for cleaning of modules is an important aspect to be kept in view. Water conservation measures is a must requirement for the project and should be practiced

at the site. It is recommended that VRA consider incorporating into the facility design, the harvesting and storage of rainwater for use on the project.

7.10. Mitigation of Impacts During Decommissioning Phase

Impacts identified during the decommission phases are listed below:

- Noise Impacts
- Air Quality Impacts
- Solid Waste
- Occupational Health & Safety Impacts
- Traffic & Transport Impacts

Mitigative measures proposed for the constructional phase for the identified impacts also pertains to the decommissioning phase and these have been listed in the earlier sections and will not be discussed further.

7.11. Summary of Significance of Mitigation Measures

Table 7-1 provides a summary of the evaluation of impacts (both positive and negative) at the constructional, operational and decommission phases as well as its significance rating with and without enhancement or mitigative measures.

Table 7-1: Summary of Significance of Mitigation Measures

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
POSITIVE IMPACTS – CONSTRUCTIONAL PHASE											
Job Creation	Increase in Employment Opportunities	Positive	International	Temporal	Medium	Definite	High	Replaceable	Medium	High	High
POSITIVE IMPACTS – OPERATIONAL PHASE											
Climate Change	Minimisation of GHG emissions	Positive	International	Long Term	Medium	Definite	Low	High	High	High	High
Job Creation	Increase in Employment Opportunities	Positive	International	Temporal	Low	Definite	High	Replaceable	Medium	High	High
Electricity Availability	Stabilization of Electricity	Positive	Regional	Long Term	Medium-Low	Definite	Low	Moderate	Medium	Medium	High
Economic Growth	Promotion of Economic Growth	Positive	Local	Long Term	Medium-Low	High Probable	Low	Moderate	Medium	Medium	Low
NEGATIVE IMPACTS – PRE-CONSTRUCTIONAL PHASE											
Land Acquisition	Loss of Properties	Negative	Site Specific	Long Term	Medium Low	Definite	Non-reversible	High	Medium	Medium	Low
NEGATIVE IMPACTS – CONSTRUCTIONAL PHASE											
Climate Change	Increase in GHG emissions	Negative	International	Temporal	Medium	Low Probable	High	Low	Low	Low	Medium
Noise & Vibrations	Disturbance to general populace	Negative	Local	Temporal	Medium-Low	Definite	High	Low	Medium	Low	Medium
Air Quality	Increase levels of fugitive dust and vehicular emissions	Negative	Local	Temporal	Medium	Medium Probable	High	High	Low	Very Low	High
Topography & Drainage	Flood risks	Negative	Site Specific	Short Term	Medium	Definite	High	Moderate	Medium	Low	High
Geology & Soils	Soil Pollution	Negative	Site Specific	Temporal	Low	Low Probable	High	Low	Very Low	Very Low	Medium

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
Water Resources	Water Pollution	Negative	Local	Short Term	Medium	Medium Probable	High	High	Low	Very Low	High
Waste Generation	Increase risks to environment and health	Negative	Site Specific	Temporal	Medium-Low	Medium Probable	High	Moderate	Low	Very Low	High
Landscape & Visual Intrusion	Altered sense of place and visual intrusion from construction activities	Negative	Site Specific	Temporal	Medium-Low	Definite	Low	Low	Low	Very Low	Moderate
Ecology	Loss of habitat and listed/rare species	Negative	Site Specific	Long Term	Medium	Definite	Moderate	Moderate	Medium	Low	High
Historical & Cultural Heritage Resources	Destruction / loss of Historical & Cultural Heritage Resources	Negative	Local	Temporal	Medium-Low	High Probable	High	Low	Low	Very Low	Medium
Occupational Health & Safety	Injury to workers	Negative	International	Temporal	Medium	Medium Probable	High	Low	Medium	Very Low	Medium
Land Acquisition	Loss of Properties	Negative	Site Specific	Long Term	Low	Unlikely	Non-reversible	High	Very Low	Very Low	High
Land Use	Loss of land for personal and commercial use	Negative	Site Specific	Long Term	Medium	Definite	Low	Moderate	Medium	Low	Medium
Labour & Working Conditions	Reduction in productivity	Negative	International	Temporal	Medium-Low	Low Probable	High	Low	Low	Very Low	Medium
Community Health, Safety and Security	Injury to public	Negative	Local	Temporal	Medium Low	Medium Probable	Low	High	Low	Very Low	Medium
Traffic & Transport	Increase in traffic and road accidents	Negative	Regional	Temporal	High	High Probable	High	Low	Medium	Very Low	Medium

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
Gender & Vulnerability	Increase in Gender Based Violence, Sexual Exploitation and Workplace Sexual Harassment	Negative	Regional	Medium term	Low	Low Probable	Moderate	Low	Very Low	Very Low	Medium
NEGATIVE IMPACTS – OPERATIONAL PHASE											
Climate Change	Increase in GHG emissions	Negative	International	Long Term	Low	Low Probable	High	Low	Low	Very Low	Medium
Noise & Vibrations	Disturbance as a result of increased environmental noise levels caused by operational equipment	Negative	Site Specific	Long Term	Low	Low Probable	High	Low	Very Low	Very Low	High
Air Quality	Poor air quality	Negative	Site Specific	Long Term	Low	Unlikely	High	Low	Very Low	Very Low	High
Topography & Drainage	Flood risks	Negative	Site Specific	Long Term	Low	Unlikely	High	Low	Very Low	Very Low	Moderate
Geology & Soils	Soil Pollution	Negative	Site Specific	Temporal	Low	Low Probable	High	Low	Very Low	Very Low	Medium
Water Resources	Water Scarcity	Negative	Site Specific	Temporal	Low	Unlikely	Moderate	Moderate	Very Low	Very Low	High
Waste Generation	Increase in health hazard	Negative	Site Specific	Long Term	Low	Low Probable	High	Moderate	Very Low	Very Low	High
Landscape & Visual Intrusion	Altered sense of place and visual intrusion from the PV panels and plant facilities	Negative	Site Specific	Long Term	Low	Low Probable	Low	Low	Very Low	Very Low	High
Ecology	Loss of connectivity and habitat fragmentation may result if fauna	Negative	Site Specific	Temporal	Low	Low Probable	Moderate	Moderate	Very Low	Very Low	High

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
	avoid the area or cannot move through the area on account of the presence of the facility										
Historical & Cultural Heritage Resources	Destruction / loss of Historical & Cultural Heritage Resources	Negative	Local	Temporal	Low	Unlikely	High	Low	Very Low	Very Low	Medium
Occupational Health & Safety	Injury to workers	Negative	Site Specific	Long Term	Low	Low Probable	Low	Low	Very Low	Very Low	Medium
Land Acquisition	Loss of Properties	Negative	Site Specific	Long Term	Medium Low	Medium Probable	Non-reversible	High	Low Negative	Very Low	High
Land Use	Permanent loss of land for personal and commercial use	Negative	Site Specific	Long Term	Low	Definite	Low	High	Medium	Very Low	Medium
Labour & Working Conditions	Reduction in productivity	Negative	Regional	Temporal	Low	Low Probable	High	Low	Very Low	Very Low	Medium
Community, Health, Safety and Security	Injury to public	Negative	Local	Temporal	Low	Low Probable	Moderate	Low	Very Low	Very Low	Medium
Traffic & Transport	Increase in traffic and road accidents	Negative	Local	Long Term	Low	Low Probable	High	Low	Very Low	Very Low	High
Gender & Vulnerability	Increase in Gender Based Violence, Sexual Exploitation and Workplace Sexual Harassment	Negative	Local	Long term	Low	Unlikely	Moderate	Low	Very Low	Very Low	Medium

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
NEGATIVE IMPACTS - DECOMMISSIONING PHASE											
Noise & Vibrations	Disturbance to general populace	Negative	Site Specific	Temporal	Low	Medium Probable	High	Low	Very Low	Very Low	Medium
Air Quality	Increase levels of dust	Negative	Site Specific	Temporal	Medium-Low	Medium Probable	High	High	Low	Very Low	High
Solid Waste	Increase in health hazard	Negative	International	Temporal	Medium-Low	Definite	Hugh	Low	Medium	Very Low	Hugh
Occupational Health &Safety	Injury to workers	Negative	International	Temporal	Medium-Low	Medium Probable	High	Low	Low	Very Low	Medium
Traffic & Transport	Increase in traffic and road accidents	Negative	Regional	Temporal	Medium-Low	High Probable	High	Low	Low	Very Low	Medium

Key

Significance Rating	
Positive	+1
Fatally Flawed Negative	18-26
High Negative	10 - < 18
Medium Negative	5 - <10
Low Negative	2 - <5
Very Low Negative	< 2
	18-26

40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 8: PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

8 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

The Ghanaian EIA Regulations, LI1657, requires the project proponent to prepare an environmental management plan which addresses the identified potential impacts and risks. The importance of managing social and environmental performance throughout the life of a project is also highlighted by the IFC Performance Standard-1. This section presents a provisional Environmental Management Plan (EMP) for the Project. The purpose of this Provisional EMP is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the EMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural, and social environment.

VRA/EPC Contractor is committed to execute all construction and operation related activities for the proposed Solar PV Project as per the best established environmental, health and safety standards and it will be aligned with upcoming project to be implemented at asset level. Mitigation measures are proposed for impacts which are identified and quantified. Some residual impact will however persist after all mitigation measures are employed, the EMP intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during construction and operational phase. The EMP therefore includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

8.2 Mitigation Plan

A Mitigation Plan has been developed following the delineation of impacts and mitigation measures. These measures will be adopted by VRA and imposed as conditions of contract of the sub-contractor employed for respective phases of this solar power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule. The responsibility for implementation of mitigation plan will primarily lies with the VRA Project HSE Officer and the Manager, Environment & Social Impact will play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues. The Mitigation Plan as developed for the project to minimize adverse impacts during different phases of project lifecycles, are given in Table 8-1.

Table 8-1: Mitigation Plan

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢	Responsibility
PRE-CONSTRUCTION PHASE (prior to January 2021)						
▪ Loss of Properties	▪ Adhere to requirements of project's "Land Acquisition & Compensation Action Plan	▪ Implement requirements of SEP ▪ Assign Project Community Liaison Officer ▪ Institute appropriate grievance mechanisms ▪ Undertake detailed survey of project-affect ▪ Pay prompt and adequate compensation for lost [properties ▪ Utilise existing right of way for roads and sub-transmission lines to minimise land acquisition. ▪ Assist vulnerable person whose livelihood activities have been affected with alternative livelihood.	Effectively and transparently manage land acquisition process.	Zero grievances of non-payment from rightful landowners	▪ 0.7 Million	▪ VRA
▪ Loss of land for personal and commercial use	▪ Effective zoning of project area by the Land Use & Spatial Planning Dept.	▪ Implement requirements of SEP ▪ Acquire Development Permit ▪ Utilise existing right of way to minimise land acquisition. ▪ Utilisation of existing roads for access ▪ Assign Project Community Liaison Officer ▪ Land use in and around permanent project facilities should not be disturbed. ▪ Land used for temporary facilities, if any, shall be restored to the extent possible.	Minimise impacts on changes to land use	Zero grievances complaints from landowners regarding changes in current land use	▪ 0.03 Million	▪ VRA
CONSTRUCTIONAL PHASE (January 2021 – March 2022)						
▪ Increase in GHG	▪ Climate Change Mitigation Actions	▪ Implement 4Rs in waste management ▪ Use of well-maintained machinery ▪ Regular servicing of equipment and vehicles ▪ Minimisation of tree felling activities ▪ Provision of tree seedlings to FSD to offset affected trees ▪ Use of low carbon intensive constructional materials	To reduce GHG emissions	Reduction of potential GHG emissions	▪ Part of Project Cost	▪ EPC Contractor
▪ Increase in Noise Levels	▪ Use of adequate general noise suppressing measures.	▪ Restrict normal working hours from 7 am to 6pm. ▪ Restriction of the use of vehicle horns ▪ Erection of appropriate warning signages on noise making ▪ Monitoring of noise levels ▪ Apply adequate general noise suppressing measures ▪ Use of relevant PPEs for high noise levels ▪ Continued review of all site activities to establish and quantify	To reduce and monitor construction noise	No complaints from surrounding communities	▪ Part of Project Cost	▪ EPC Contractor

		noise activities. ▪ Operation of only well-maintained equipment on-site.				
▪ Increase in fugitive dust and vehicular emissions levels	▪ Application of basic dust control and suppression measures	▪ Regular watering of all active construction areas. ▪ Prevention of idling of vehicles and equipment ▪ Limitation of speed of vehicles on site to 10-15 km/hr. ▪ Regular inspection and scheduled maintenance program for all vehicles, machinery, and equipment ▪ Appropriate signages will be erected to checking of vehicular speed on construction site ▪ Workers will be provided with appropriate PPE's e.g. masks, eye goggles, breathing equipment, etc.	To minimise fugitive dust and vehicular emissions on ambient air quality to acceptable health and safety requirements	Establish and quantify the effectiveness of planned management practises to minimise fugitive emissions production and vehicular emissions.	▪ Part of Project Cost	▪ EPC Contractor
▪ Flood risks due to changes in topography and drainage	▪ Develop and construct an appropriate design for surface water drainage system.	▪ Construction of the facility in line with approved design ▪ Carry our restoration of the worked areas immediately by backfilling, professional landscaping/levelling and planting of low grass in open areas, flowers and suitable tree species. ▪ Provide appropriate number of cross drainage channels during access road construction to maintain flow in existing natural channels.	To avoid flood risks due to constructional activities	Minimise project associated floods	▪ Part of Project Cost	▪ EPC Contractor
▪ Soil Pollution	▪ Ensure adherence to the requirements of the Land Planning and Soil Conservation Act, 1957	▪ Ensure construction activities are restricted to designated work areas ▪ Constructional activities shall be restricted to the dry season. ▪ Topsoil shall be stripped and stored separately from subsoil. ▪ Drivers shall be restricted to the use of existing access roads. ▪ Existing roads will be widened to have the width and turning radius to accommodate the necessary vehicles for the project. ▪ Locate temporary storage tanks on impervious bases and use drip trays during re-fuelling of equipment. ▪ Install fuel and lubricants storage containers and prevent leakages. ▪ Clean up equipment shall be supplied ▪ Contaminated soil shall be treated as hazardous material and handled as such.	To prevent soil contamination due to constructional activities	Zero contamination of soil quality Minimal erosion inside the construction areas and surrounds.	▪ Part of Project Cost	▪ EPC Contractor
▪ Water Pollution	▪ Effective arrangements for disposal of aqueous effluents. ▪	▪ Construction of borehole should be in line with LI 1827. ▪ Provide impervious storage area for Fuel & lubricant, hazardous waste. ▪ Prevent storage of hazardous materials near natural drainage channels.	To prevent contamination of water resources	▪ Zero contamination of water quality	▪ Part of Project Cost	EPC Contractor

		▪ Provide equipment and materials for clean ups ▪ Temporary refuelling tanks should be bunded.				
▪ Increase risks to environment and health from waste generation	▪ Practice waste reduction techniques such as Reduce, Recycle, Reuse and Recover	▪ Construction debris will be utilised for levelling of the land ▪ Unused debris shall be disposed-off to nearest Municipal waste disposal site. ▪ Random stocking of raw material, storage of debris, piling of loose soil etc. to be strictly controlled ▪ Hazardous waste (like used oil, paint tins, defected panels, etc.) shall be stored at designated place and only be sold to authorized vendors. ▪ Dispose labour waste regularly in approved waste disposal sites ▪ Wastes like wood packaging material, metal, jute, etc. will be sold to scrap dealers/ buyers. ▪ Provision of proper sanitation and sewage facility	To ensure constructional waste generation does not pollute the environment	Zero contamination of soil and water from solid and liquid constructional waste	▪ Part of Project Cost	▪ EPC Contractor
▪ Altered sense of place and visual intrusion from construction activities	▪ Undertake appropriate design to assist in the respectful integration of the facades of the power facility with surrounding environment and existing buildings	▪ Appropriate colour and materials shall be used in architectural designs. ▪ Proper housekeeping shall be undertaken, and workforce instructed accordingly ▪ Waste shall be collected and evacuated in a timely manner and the project site will be left in an orderly state after each working day. ▪ Ensure all machines, vehicles and tools used during construction should be removed on the earliest time possible	Reduce visual intrusion of construction activities project wide.	Minimal visual intrusion of construction activities project wide.	▪ Part of Project Cost	▪ EPC Contractor
▪ Loss of habitat and listed/rare species	▪ Implement proper management measures to prevent damage to the biodiversity of the site.	▪ Conditions of MoU b/n VRA and FSD to be strictly adhered to ▪ Undertake detailed flora and faunal assessment to inform habitat management. ▪ Appropriate routing of lines, use of bird deflectors, and pole design shall be undertaken to reduce electrocution risks from power lines and associated infrastructure. ▪ Undertake trainings among the staff and labourers to enhance general awareness regarding anti-poaching, hunting ▪ Hunting at any time and under any condition by construction workers onsite shall be prohibited ▪ Conduct construction activity in a phased manner ▪ Vegetation disturbance and clearance should be restricted to the project activity area location of laydown area, construction activities and storage areas.	Ensure compliance with relevant legislation in respect of habitat and vegetation forms. Avoidance of unnecessary disturbance to the site and surrounds, and to establish buffers where required.	Minimal disturbance to fauna in the area Avoid loss of habitat within the designated sensitive areas.	▪ 0.06 Million	▪ EPC Contractor

▪ Destruction / loss of Historical & Cultural Heritage Resources	▪ Adhere to requirements of project's "Land Acquisition & Compensation Action Plan Ensure adherence to requirements of the National Museums Act, Act 387 of 1969	▪ Continuous dialogue with local community and owners/caretakers to provide the support to ensure that any identified resource does not pose a problem for project development, ▪ Appropriate chance find procedures shall be implemented in collaboration with GMMB ▪ Only professional archaeologist shall be engaged to examine, document and/or remove and identified archaeological material. ▪ All works shall be executed within the authorised footprint to avoid impacts to any nearby tangible and intangible heritage resources. ▪ Strict observation of the cultural taboos shall be observed.	To avoid disturbance, damage to and destruction of heritage resources To enhance gains to the science of archaeology by recording chance finds	No damage to any significant cultural heritage features on site	▪ 0.08 Million	▪ EPC Contractor ▪ VRA ▪ Traditional Authority
▪ Injury to workers	▪ Requirements of Factories, Shops and Offices Act of 1970 (Act 328)	▪ Adhere to Contractor's and VRA SHE Standards for Contractors ▪ Acquire Fire permit ▪ Acquire Development Permit ▪ Adopt and implement the provisions of the Occupational Health and Safety Plan throughout the Project construction phase ▪ Provide Personal Protective Equipment to workers ▪ Undertake health screening of workers ▪ Undertake health and safety awareness training amongst staff and workers	To prevent injury to workers	Zero injury	▪ Part of Project Cost	▪ EPC Contractor ▪ VRA
▪ Reduction in productivity	▪ Adhere to conditions of Labour & Working Conditions Management Plan	▪ Design and adhere to employment and workforce policies. ▪ Locals shall be engaged for unskilled manpower requirements ▪ Provision of adequate shelter, drinking water, toilet facilities for the workers. ▪ Put in place suitable measures to maintain a healthy environment for the labour force ▪ Institute and Implement Worker Grievance Mechanism ▪ Appoint Community Liaison Officer	To ensure working conditions of employees are in line with national and international standards	Minimal grievance related to working conditions at the project site	▪ Part of Project Cost	▪ EPC Contractor
▪ Injury to public	▪ Requirements of Factories, Shops and Offices Act of 1970 (Act 328)	▪ Institute public grievance mechanism including monitoring and resolving of such concerns. ▪ Constructional activities shall be undertaken only during the day i.e. between 0700 hours to 1800 hours. ▪ Segregation of the various wastes and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill.	Reduce impacts associated with the influx of people during the construction phase	Influx of people and impacts during the construction phase to be appropriately managed	▪ Part of Project Cost	▪ EPC Contractor

		▪ Fencing of all excavated areas to avoid access to outsiders and wildlife. ▪ Provision of security and warning signages around construction site ▪ Undertake public health awareness amongst staff, especially on Sexually Transmitted Diseases and HIV/AIDS.				
▪ Increase in traffic and road accidents	▪ Preparation and implementation of a Traffic Method Statement with the aim of minimizing disturbance to the nearby residents, industrial workers and general road users.	▪ Traffic shall be controlled on the access road to the site ▪ Drivers shall be trained in defensive driving ▪ Speed limits shall be enforced ▪ Densest areas of traffic, if possible, shall be avoided through planning and channelling of traffic. ▪ Involvement of local authorities in defining optimum project traffic routes and times for transit ▪ Institute traffic calming measures ▪ Installation of speed control limits ▪ Implement requirements of Alcohol & Drug Policy ▪ Provision of site vehicle maintenance services ▪ Install traffic safety signage at vantage points ▪ Improve and enhance community sensitization on road traffic accidents within the project area. ▪ Engage with the local authorities and community leaders on road risk issues	Reduce number of road accidents due to increased traffic during construction	▪ Zero accidents from road and traffic	▪ Part of Project Cost	▪ EPC Contractor
▪ Gender & Vulnerability	▪ Adherence to conditions of contract, targeting issues on gender and vulnerability ▪ Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence.	▪ Site induction and continuous worker education will include workplace bullying, harassment, gender-based violence, need to accept cultural differences, etc. ▪ Develop and strictly implement policies in the areas of harassment and gender-based violence ▪ Develop Code of Conduct for employees regarding relations with the community ▪ Consult with women workers to find out what can be done to reduce the risks identified. ▪ Adhere strictly to national laws regarding employment age. ▪ Employment in manual based work shall be based on evidence of being above 18 years. ▪ Acceptable ID cards shall be that of the National Identification Authority or Driver's Licence.	Minimise gender and vulnerability impact on employees	▪ Zero harassment ▪ No child labour employed	▪ Part of Project Cost	▪ EPC Contractor
OPERATIONAL PHASE ((After March 2022)						

Disturbance as a result of increased environmental noise levels caused by equipment	▪ Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328).	▪ Equip workers with proper Personal Protective Equipment (e.g. Earmuffs) ▪ Ensure only well-maintained equipment are operated on-site.	To reduce and monitor operational noise	▪ No complaints from surrounding communities	▪ 0.015M annually	▪ VRA
Poor air quality	▪ Adherence to requirements of Driver & Vehicle Licensing Authority Act, 1999 (ACT 569)	▪ Limit speed of vehicles on site to 10-15 km/hr. ▪ Prevent idling of vehicles and equipment. ▪ Ensure vehicles have valid Vehicle Examination Certificate to minimise vehicular emissions.	To minimise vehicular emissions on ambient air quality to acceptable health and safety requirements	▪ Establish and quantify the effectiveness of planned management practises to minimise vehicular emissions.	▪ 0.025M annually	▪ VRA
Flood risks	▪ Ensure maintenance of surface water drainage system designs in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.	▪ Regularly maintain surface water drainage and culverts to prevent storm water (run-off) from accumulating within the site spreading to the neighbourhood.	To avoid flood risks due to power operations	▪ Minimise project associated floods	▪ Part of O&M Cost	▪ VRA
Soil Pollution	▪ Adherence to the requirements of the Land Planning and Soil Conservation Act, 1957 within the power facilities.	▪ Restrict operational activities to designated work areas, to avoid damage and disturbance outside of the power plant site, especially the sub-transmission line component. ▪ Collect contaminated soil immediately and stored as hazardous waste.	To prevent soil contamination due to operational activities	▪ Zero contamination of soil quality ▪ Minimal erosion inside the operational areas and surrounds.	▪ Part of O&M Cost	▪ VRA
Water Scarcity	▪ Ensure valid Water Use Permit from Water	▪ Engage with Community members continuously on issues of water security to avoid potential conflicts.	To prevent contamination	▪ Zero contamination of water	▪ Part of O&M Cost	▪ VRA

	Resources Commission for abstraction of ground water as required under the provision of the Water Use Regulations, 2001 (L.I. 1692).	▪ Regularly monitor the ground water abstraction and report on it on regular basis to the EPA. ▪ Maintain logbook for water consumption. ▪ Progressively adopt less water consuming module cleaning methods. ▪ Installation of automatic water level sensors inside wells	of water resources	quality		
Increase in health hazard due to waste generation	▪ Adherence to requirements of National Environmental Sanitation Policy 2010 and the Hazardous & Electronic Waste Control Management Act, 2016 (Act 917).	▪ Manage waste in line with operational site Environmental Management Plan and will be incorporated into any contract between VRA and the licensed operator. ▪ Coordinate with Local Government Authority to hire a private contractor for the collection of wastewater from the site ▪ Ensure all waste arising from the works is managed in accordance with the provisions of relevant national and local environmental protection acts. ▪ Distribute appropriate number of properly contained litter bins ▪ Provide waste oil tanks to hold the waste lubricating oils ▪ Utilize EPA licensed operators for re-use of waste oil ▪ Foul water should always go to a septic tank. ▪ Waste from the septic tank should be disposed of in an environmentally acceptable manner by a licensed operator approved by EPA. ▪ Prohibit illegal disposal of wastewater to the land. ▪ Ensure that constructed septic tanks during operation are well contained and impermeable to prevent leakage of wastewater into soil;	To ensure waste generation does not pollute the environment	▪ Zero contamination of soil and water from solid and liquid waste	▪ Part of O&M Cost	VRA
Altered sense of place and visual intrusion from the PV panels and plant facilities	▪ Ensure effective repairs and maintenance of the solar power facilities in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National	▪ Informative signs shall be maintained on the N12 Highway for commuters regarding potential for glare within the area. ▪ Native trees shall be planted at the frontage of the power plant facilities to act as windbreaks, noise buffer and to reduce the visual effect of having a power plant located at the site.	Reduce visual intrusion of project facilities	▪ Minimal visual intrusion of construction activities project wide.	▪ Part of O&M Cost	VRA

	Building Code, 2006.					
Loss of connectivity and habitat fragmentation may result if fauna avoid the area or cannot move through the area on account of the presence of the facility	▪ General awareness regarding fauna should be enhanced through trainings, posters, etc. among the staff and labourers. ▪ Adhere to requirements of existing conditions of MoU Between VRA and FSD	▪ Maintain the use of bird deflectors, and pole design which minimizes electrocution risks during project operations to reduce impacts from power lines and associated infrastructure. ▪ Anti-poaching, trapping and hunting policy among employees should be strictly enforced. ▪ Cover upright insulators on transmission poles with plastic insulating caps or insulating tubing to prevent electrocution risk; ▪ Install bird detractors such as moving cloth or scarecrow to prevent birds from venturing close to solar modules. ▪ Regular checking of the vacuums or holes in the towers to avoid nesting by any of the birds;	Ensure compliance with relevant legislation in respect of habitat and vegetation forms.	▪ Minimal disturbance to fauna in the area ▪ Avoid loss of habitat within the designated sensitive areas.	▪ Part of O&M Cost	VRA
Destruction / loss of Historical & Cultural Heritage Resources	▪ Adhere to requirements of the National Museums Act, Act 387 of 1969.	▪ Activities shall be properly planned to consider the identified archaeological locations to ensure they are protected from any potential damage. ▪ All works shall be undertaken within the authorised footprint so as to avoid impacts to any nearby tangible and intangible heritage resources. ▪ Community members shall be engaged with regarding compensation and moving any identified shrine. ▪ Ensure strict observation of the cultural taboos. ▪ Documentation and reporting of chance find and submission to GMMB in Accra. ▪ Ensure that the Code of Conduct, awareness raising, and training developed for personnel involved in the operation phase of the Project to emphasizes the presence of archaeological locations in the area	▪ To avoid disturbance, damage to and destruction of heritage resources ▪ To enhance gains to the science of archaeology by recording chance finds	▪ Compensation of all community members for the removal of important heritage sites ▪ No damage to any significant cultural heritage features on site	▪ Part of O&M Cost	VRA
Injury to workers	▪ Adherence to requirements of the Factories, Offices and Shops (Amendment) Law, 1991 (PN	▪ Acquire valid permits from Ghana National Fire Service, Factories & Inspectorate Division, Environmental Protection Agency and the Energy Commission. ▪ All workers (regular and contracted) shall be provided with training on Health and Safety management system on EHS policies and procedures. ▪ Warning signs shall be placed at appropriate sites where there is a risk to health and safety.	To prevent injury to workers	▪ Zero injury	▪ Part of O&M Cost	VRA

	DCL 275) "As amended	▪ Comprehensive fire detection and protection system shall be provided to cover all equipment on site that could constitute a fire risk. ▪ Health and safety performance shall be continuously monitored. ▪ An operating audit system for the facilities shall be put in place. ▪ Cranes and lifting equipment shall be operated by trained and authorized persons only. ▪ Appropriate safety harnesses and lowering/raising tools shall be provided for use for working at heights.				
Loss of Properties	▪ Institution of an appropriate grievance mechanisms to address concerns of the public	▪ Community Liaison Officer shall be appointed as a designated point of contact for the community.	Effectively and transparently manage land acquisition process.	▪ Zero grievances of non-payment from rightful landowners	▪ Part of O&M Cost	VRA
Permanent loss of land for personal and commercial use	▪ Implementation of CSR activities to improve the standards of living and long-term wellbeing of the affected communities.	▪ Proactive action shall be taken in case required to avoid any undue confrontation with affected community. ▪ Ensure the availability of wood fuel and fodder should not be affected by the project and in case if there is shortage reported due to the project then it must be supplemented by VRA. ▪ After construction work, any land taken for a temporary basis for storage of material shall be restored to their original form.	Minimise impacts on changes to land use	▪ Zero grievances complaints from landowners regarding changes in current land use	▪ Part of O&M Cost	VRA
Reduction in productivity	▪ Prepare and adhere to a Labour Management Plan	▪ Design and adhere to employment and workforce policies. ▪ Locals shall be engaged for unskilled manpower requirements ▪ Provision of adequate shelter, drinking water, toilet facilities for the workers. ▪ Worker grievance mechanism to be instituted including monitoring and resolving of such concerns. ▪ Community Liaison Officer to be appointed as a designated point of contact for the community ▪ Provisions shall be made to accommodate migrant labour within the communities. ▪ Put in place suitable measures to maintain a healthy environment for the labour force	To ensure working conditions of employees are in line with national and international standards	Minimal grievance related to working conditions at the project site	▪ Part of O&M Cost	VRA

▪ Injury to public	▪ Adherence to requirements of the "Factories, Offices and Shops Act (1970) Act 328 As amended by the Factories, Offi ces and Shops (Amendment) Law, 1991 (PNDC L 275)	▪ Effective security measures shall be provided for the PV Plants and the project sites through fencing, enough security staff and other measures such as floodlights with motion control. ▪ Necessary precautions shall be taken to beef up the security of the solar park. ▪ Onsite guards shall be adequately trained to deal with trespassing incidents. In addition, guard must refrain from using excessive force, unless situation extremely requires so ▪ Cultivate harmonious co-existence between itself and the local communities in the project area.	Reduce impacts associated with the influx of people during the construction phase	▪ Influx of people and impacts during the construction phase to be appropriately managed	▪ Part of O&M Cost	VRA
Increase in traffic and road accidents	▪ Implementation of a Traffic Method Statement.	▪ Continue implementation of TMS ▪ Encourage car sharing amongst staff	Reduce number of road accidents due to increased traffic during construction	▪ Zero accidents from road and traffic	▪ Part of O&M Cost	▪ VRA
Gender & Vulnerability	▪ Adherence to conditions of contract, targeting issues on gender and vulnerability ▪ Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence.	▪ Develop and strictly implement policies in the areas of harassment and gender-based violence. ▪ Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence	Minimise gender and vulnerability impact on employees	▪ Zero harassment	▪ Part of O&M Cost	▪ VRA
DECOMMISSIONING (After 2047)						
Noise disturbance to general populace	▪ Use of adequate general noise suppressing measures.	▪ All the decommissioning activities will be done during daytime ▪ The contractor will be kept informed by the community of any noise or vibration complaints. ▪ Conduct demolition activities in line with the maximum permitted noise levels	To reduce and monitor construction noise	▪ No complaints from surrounding communities	▪ Part of D&D Cost	▪ Contractor

		▪ Inspection of activities during decommissioning by carrying out regular Noise level test. ▪ Emphasize on the use of noise reduction techniques such as silencers and ear mufflers to employees while onsite. ▪ Develop a regular inspection and scheduled maintenance program for vehicles and machineries in order to abate the noise produced				
Increase levels of dust	▪ Regular watering of all active construction areas.	▪ Train all workers on the management of air pollution from vehicles and machinery ▪ Strictly control the speed limit for all motor vehicles during the demolition exercise. ▪ Sprinkle water on dusty places onsite and on dust to reduce fugitive dust emissions ▪ Provide workers with dust masks	To minimise fugitive dust and vehicular emissions on ambient air quality to acceptable health and safety requirements	▪ Establish and quantify the effectiveness of planned management practises to minimise fugitive emissions production and vehicular emissions.	▪ Part of D&D Cost	▪ Contractor
Increase risks to environment and health from waste generation	▪ Practice waste reduction techniques such as Reduce, Recycle, Reuse and Recover	▪ Develop and implement a Solid Waste Management Plan (SWMP) before decommissioning commencement in line with the governing regulations ▪ The waste streams generated should be re-used, re-cycled and reduced to the extent possible ▪ Dispose all demolition waste that cannot be recycled or reused to a licensed waste disposal site using a licensed waste handler ▪ Rehabilitate the site as appropriate using indigenous vegetation species for landscaping to restore biodiversity	To ensure constructional waste generation does not pollute the environment	▪ Zero contamination of soil and water from solid and liquid constructional waste	▪ Part of D&D Cost	▪ Contractor
Injury to workers	▪ Adherence to requirements of the Factories, Offices and Shops Act (1970) Act 328 (As amended by the Factories, Offi ces and Shops (Amendme	▪ Develop and implement an Occupational Health and Safety Plan ▪ Train employees on the importance of occupational health and safety ▪ Provide workers with appropriate personal protective clothing such as helmets, safety boots, gloves, dust masks, ear mufflers and overalls. ▪ Strictly enforce the use of the Personal Protective Equipment to minimise the accidents during decommissioning ▪ Regular medical checks	To prevent injury to workers	▪ Zero injury	▪ Part of D&D Cost	▪ Contractor

	nt) Law, 1991 (PN DCL 275)	▪ Provide fully equipped First Aid Kit and sanitary facilities on site, including water for drinking and bathing ▪ Put clear signage to restricted areas ▪ Prohibit unauthorized persons at the site during decommissioning ▪ Promote HIV/AIDs Awareness				
Increase in traffic and road accidents	▪ Preparation and implementation of a Traffic Method Statement with the aim of minimizing disturbance to the nearby residents, industrial workers and general road users.	▪ Traffic shall be controlled on the access road to the site, especially when heavy trucks are turning in and out of the site. ▪ Drivers shall be trained in defensive driving ▪ Speed limits shall be enforced for heavy good vehicles and workforce transportation vehicles. ▪ Densest areas of traffic, if possible, shall be avoided through planning and channelling of traffic. ▪ Involvement of local authorities in defining optimum project traffic routes and times for transit ▪ Traffic calming measures (speed bumps and rumble strips) shall be installed to slow traffic down where heavy vehicles cross or enter busy roads. ▪ Installation of speed control limits for the project and ensuring all vehicles comply with the site driving regulations. ▪ Conduct periodic and routine alcohol checks for all site drivers and site workers ▪ Provision of site vehicle maintenance services in order to ensure technical failures do not occur. ▪ Install traffic safety signage at vantage points along access routes with the project sites. ▪ Develop and implement a “No Drinking” “No Alcohol” policy on site during both construction and operation. ▪ Improve and enhance community sensitization on road traffic accidents within the project area. ▪ Engage communities on road risk and educate them through constant communications, road signals as well as with communications with the local authorities and community leaders.	▪ Reduce number of road accidents due to increased traffic during construction	▪ Zero accidents from road and traffic	▪ Part of D&D Cost	▪ Contractor

8.3 Monitoring Plan

Monitoring will be a key activity during project implementation. The significance of monitoring stems from the fact that the inputs derived from the environmental and social assessment into the project design and planning, including mitigation measures are based largely on "predictions". It is essential that the basis for the choices, options and decisions made in formulating or designing the project and other environmental and social safeguard measures are verified for adequacy and appropriateness. Monitoring verifies the effectiveness of impact management, including the extent to which mitigation measures are successfully implemented.

Monitoring specifically helps to:

- Improve environmental and social management practices.
- Check the efficiency and quality of the EA processes; and
- Provide the opportunity to report the results on safeguards and impacts and proposed mitigation measures implementation to regulatory bodies such as the EPA and the Energy Commission.

A monitoring programme has been developed to determine impacts on the physical, biological and socio-economic/cultural environments within the project's area of influence and around the proposed power plant and associated facilities. The monitoring results are expected to indicate whether the predictions of potential environmental impacts are accurate and also whether the mitigation measures proposed for the management of the impacts are appropriate and adequate. The programme will also serve as an early warning system by revealing unforeseen impacts and allowing additional corrective measures to be implemented to arrest the situation and ensure that irreversible damage is not caused. The programme is also expected to provide useful guidance for the successful planning and implementation of future solar power projects that will be undertaken by the VRA.

A description of the environmental monitoring activities showing parameters, methodology, period for monitoring, location and responsibilities is presented in Table 8-2.

For purposes of achieving a very high level of compliance with regard to implementation of all environmental commitments, the VRA/EPC Contractor shall make budgetary allocations towards all environmental programmes. Financial commitments shall be made from these allocations on program-by-program basis. Environmental monitoring at the operational stage shall largely form part of the O&M costs. Detailed budget for achieving environmental compliance shall therefore form part of VRA Corporate budget. Budget required for monitoring activities is provided as part of the *Table 8-2.*

Table 8-2: Monitoring Plan

Monitoring Parameters		Monitoring Frequency	Methodology	Responsibility	Budget GH¢
Noise levels	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Limitation of constructional activities only during the day i.e. between 0700 hours to 1800 hours.	▪ Daily	▪ Use of work logbook	Contractor's EHS Officer	0.01 Million
	▪ Levels of noise within project designated site	▪ As required	▪ Noise meter		
	▪ Application of adequate general noise suppressing measures.	▪ As required	▪ Std. Ops. Procedure		
	▪ Use of relevant PPEs for high noise levels	▪ Daily	▪ Supply of PPEs		
	▪ Restriction of the use of vehicle horns and heavy engine breaking	▪ As required	▪ Std. Ops. Procedure		
	▪ Erection of appropriate warning signages on noise making	▪ Monthly	▪ No. of Signage		
	▪ Operation of only well-maintained equipment on-site.	▪ As required	▪ Maintenance Schedules		
	OPERATIONAL PHASE				
	▪ Use of appropriate PPEs for high noise levels	▪ Daily	▪ Supply of PPEs	Project EHS Officer	0.005 Million Annually
	▪ Operation of only well-maintained equipment on-site.	▪ As required	▪ Maintenance Schedules		
Air Quality	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Regular watering of all active construction areas.	▪ Daily	▪ Use of Water tankers	▪ Contractor's EHS Officer	▪ 0.01 Million
	▪ Regular inspection and scheduled maintenance program for all vehicles, machinery, and equipment	▪ As required	▪ Maintenance Schedules		
	▪ Erection of appropriate signages to checking of vehicular speed	▪ Monthly	▪ No. of Signages		
	▪ Provision of appropriate PPE's	▪ As required	▪ Supply of PPEs		
	▪ Visual monitoring of the dust emissions	▪ Daily	▪ Optics		
	▪ Regular health check-ups and treatment of employees	▪ As required	▪ Medical Check Ups		
	▪ Limitation of speed of vehicles on site to 10-15 km/hr.	▪ Daily	▪ Speed rumps/Signages		
	▪ Prevention of idling of vehicles and equipment	▪ As required	▪ Std. Ops. Procedure		
	▪ Restriction of diesel generator use to emergencies and power back-up only	▪ As required	▪ Std. Ops. Procedure		
	OPERATIONAL PHASE				
	▪ Limitation of speed of vehicles on site to 10-15 km/hr	▪ Daily	▪ Speed rumps/Signages	▪ Project EHS Officer	▪ 0.015 Million Annually
	▪ Prevention of idling of vehicles and equipment	▪ As required	▪ Std. Ops. Procedure		
	▪ Ensure vehicles have valid Vehicle Examination Certificate to minimise vehicular emissions.	▪ Annual	▪ VELD Certificate		

Flood Risks	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Construction of the facility in line with approved design	▪ As required	▪ Constructional Design	▪ Contractor's Engineer	▪ Part of Project Cost
	▪ Immediate restoration of worked areas	▪ As required	▪ Std. Ops. Procedure	▪ Project Engineer	
	▪ Provision of appropriate number of cross drainage channels	▪ As required	▪ Drainage Channels	▪ Project Engineer	
	OPERATIONAL PHASE				
	▪ Regular maintenance of surface water drainage and culverts to prevent storm water (run-off)	▪ As required	▪ Maintenance Schedules	Site Engineer	▪ Part of O&M Cost
Soil Pollution	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Restriction of construction activities to designated work areas	▪ As required	▪ Constructional Areas	▪ Contractor's Officer	▪ Part of Project Cost
	▪ Restriction of constructional activities to the dry season.		▪ Period of work	▪ Project Engineer	
	▪ Avoidance of construction during raining seasons to minimize erosion and run-off		▪ Period of work		
	▪ Storing of stripped topsoil separately from subsoil.		▪ Storage areas		
	▪ Restriction of drivers to the use of existing access roads.		▪ Access road		
	▪ Widening of existing roads to accommodate the necessary vehicles for the project.		▪ Existing roads		
	▪ Installation of fuel and lubricants storage containers to prevent leakages.		▪ Storage Containers		
	▪ Location of temporary storage tanks on impervious bases and use drip trays during re-fuelling of equipment.		▪ Impervious Bases/Drip Trays		
	▪ Supply of on-site clean up equipment		▪ Clean up equipment.		
	▪ Treatment of contaminated soil as hazardous material and handled as such.		▪ Std. Ops. Procedure		
	OPERATIONAL PHASE				
	▪ Restriction of operational activities to designated work areas	▪ As required	▪ Operational Areas	Site Engineer	▪ Part of O&M Cost

	▪ Treatment of contaminated soil as hazardous material and handled as such.		▪ Std. Ops. Procedure		
Water Resources	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Registration of borehole construction with WRC.	▪ As required	▪ Registration Forms	▪ EPC Contractor	▪ Part of Project Cost
	▪ Construction of borehole should be in line with LI 1827.		▪ Std. Ops. Procedure	Project Engineer	
	▪ Prevention of storage of hazardous materials near natural drainage channels.		▪ Std. Ops. Procedure		
	▪ Provision of clean ups equipment and materials on site		▪ Clean-up equipment		
	▪ Installation of temporary and permanent run-pass pipes during rainy flood and road barriers against rainwater storm where necessary.		▪ Std. Ops. Procedure		
	▪ Provision of impervious storage area for Fuel & lubricant, hazardous waste.		▪ Impervious Bases/Drip Trays		
	▪ Provision of bund for temporary refuelling tanks.		▪ Bunds		
	OPERATIONAL PHASE				
	▪ Engaging with Community members continuously on issues of water security to avoid potential conflicts.	▪ As required	▪ Meeting minutes	Site Engineer	Part of O&M Cost
	▪ Regular monitoring of the ground water abstraction	▪ Monthly	▪ Monitoring Report		
	▪ Regular reporting on volume of ground water abstraction to the EPA.	▪ Monthly	▪ EPA Monitoring report		
	▪ Maintenance of logbook for water consumption.	▪ Weekly	▪ Logbook for water consumption		
	▪ Adoption of less water consuming module cleaning methods.	▪ As required	▪ Facility design		
Waste Generation	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Utilisation of construction debris for levelling of the land	▪ As required	▪ Use of debris	▪ Contractor's EHS Officer	Part of Project Cost
	▪ Disposal of unused debris to nearest Municipal waste disposal site. ▪		▪ Volume of debris	▪ Project Engineer	
	▪ Regular disposal of labour waste at approved waste disposal sites		▪ Volume of waste		

	▪ Strict control of random stocking of raw material, storage of debris, piling of loose soil		▪ Std. Ops. Procedure		
	▪ Storage of hazardous waste at designated place		▪ Storage areas		
	▪ Sale of hazardous waste to authorized vendors.		▪ Waste Log sheet		
	▪ Sale of recyclable waste to scrap dealers/ buyers.		▪ Waste Log sheet		
	▪ Provision of proper sanitation and sewage facility		▪ Sewage facility		
	OPERATIONAL PHASE				
	▪ Use of a private contractor for wastewater collection	▪ Monthly	▪ Type of Waste Contractor	Site Engineer	▪ Part of O&M Cost
	▪ Presence of properly contained litter bins	▪ Weekly	▪ Labelled Bins		
	▪ Provision of waste oil tanks	▪ Monthly	▪ Waste oil tanks		
	▪ Utilization of EPA licensed operators for re-use of waste oil	▪ As required	▪ Type of waste contractor		
	▪ Disposal of waste from the septic tank by EPA licensed operator	▪ As required	▪ Std. Ops. Procedure ▪		
	▪ Illegal disposal of wastewater to the land.	▪ As required	▪ Std. Ops. Procedure		
	▪ Utilisation of well contained and impermeable septic tanks	▪ As required	▪ Septic Tank type		
Landscape & Visual Intrusion	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Usage of appropriate colour and materials in architectural designs.	▪ As required	▪ Architectural designs.	▪ Contractor's Engineer	▪ Part of Project Cost
	▪ Proper housekeeping practices by workforce	▪ As required	▪ Std. Ops. Procedure		
	▪ State of workplace after day's work	▪ Daily	▪ Std. Ops. Procedure	▪ Project Engineer	
	▪ Early removal of machines, vehicles and tools after use	▪ As required	▪ Std. Ops. Procedure		
	OPERATIONAL PHASE				
	▪ Informative signs regarding potential for glare within the area.	▪ As required	▪ Informative signages	e Engineer	▪ Part of O&M Cost

	▪ Utilisation of native trees as windbreaks	▪ As required	▪ Windbreaks		
Flora & Fauna	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Assessment of Flora and faunal to inform habitat management.	▪ As required	▪ Study report	▪ Project EHS Officer	▪ 0.02 Million
	▪ Appropriate routing of lines to reduce electrocution risks,		▪ Constructional Design		
	▪ Pole design to reduce electrocution risks		▪ Constructional Design		
Flora & Fauna	▪ Enforcement of anti-poaching, trapping and hunting policy among employees		▪ Std. Ops. Procedure		
	▪ Onsite hunting and poaching		▪ Worker attitude ▪		
	▪ Training of staff regarding anti-poaching, hunting	▪ Quarterly	▪ H&S Meetings ▪		
	▪ Restriction of vegetation disturbance to the project activity area	▪ As required	▪ Worker attitude		
	OPERATIONAL PHASE				
	▪ Maintenance of the use of bird deflectors, and pole design which minimizes electrocution risks during project operations to reduce impacts from power lines and associated infrastructure.	▪ Quarterly	▪ Bird deflectors	Site Engineer	▪ Part of O&M Cost
	▪ Use of bird deflectors to reduce electrocution risks	▪ Daily	▪ Policy implementation		
	▪ Cover upright insulators on transmission poles with plastic insulating caps or insulating tubing to prevent electrocution risk.	▪ Quarterly	▪ Insulating caps		
	▪ Regular checking of the vacuums or holes in the towers to avoid nesting by any of the birds;	▪ Quarterly	▪ Presence of holes		
	PLANNING & CONSTRUCTIONAL PHASE				
	▪ Institution of platform for dialogue with local community and owners/caretakers	▪ Quarterly	▪ Engagement Platform	▪ CLO	▪ 0.05 Million
	▪ Implementation of an appropriate chance find procedures in collaboration with GMMB	▪ As required	▪ Std. Ops. Procedure	▪ Project EHS Officer	
	▪ Engagement of professional archaeologist to examine, document and/or remove and identified archaeological material.		▪ Contract Document		
	▪ Execution of works within the authorised footprint		▪ Work Areas		
	▪ Strict observation of the cultural taboos.		▪ Mode of work		

Historical & Cultural Heritage					
	▪ Compensation for identified owners for the removal of any cultural heritage sites and shrines.		▪ Compensation paid		
	OPERATIONAL PHASE				
	▪ Protection of identified archaeological locations to prevent potential damage.	▪ As required	▪ State of archaeological locations	Site Engineer	▪ Part of O&M Cost
	▪ Execution of works within the authorised footprint		▪ Work Areas		
	▪ Institution of platform for dialogue with local community and owners/caretakers		▪ Engagement platforms		
	▪ Strict observation of the cultural taboos		▪ Std. Ops. Procedure		
	▪ Documentation and reporting of chance find and submission to GMMB in Accra.		▪ Chance finds procedures		
Occupational Health & Safety	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Implementation of a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan	▪ As required	▪ Std. Ops. Procedure	▪ Contractor EHS Officer	▪ Part of Constructional Cost
	▪ Provision of PPEs to workers always.	▪ Monthly	▪ PPEs		
	▪ Construction activities during daytime hours	▪ Daily	▪ Use of work logbook		
	▪ Vigilance for any potential accidents shall be maintained	▪ As required	▪ Routine Safety Checks		
	▪ Presence of valid Fire permit	▪ Annual	▪ Fire permit	▪ Project Engineer	
	▪ Presence of valid Development Permit	▪ Annual	▪ Development Permit		
	▪ Health screening of employees	▪ Annual	▪ Screening Report	▪ Project EHS Officer	
	▪ Training of disease prevention awareness	▪ Quarterly	▪ Training Report ▪		
	▪ Training on Health and safety awareness amongst staff and workers	▪ Quarterly	▪ H&S Report		
	OPERATIONAL PHASE				
	▪ Provision of PPEs to workers always	▪ Monthly	▪ PPEs	Site Engineer	▪ 0.03 Million annually
	▪ Presence of valid Fire permit	▪ Annual	▪ Fire Permit		
	▪ Presence of valid EPA Permit	▪ Annual	▪ EPA Permit		
	▪ Presence of valid Factories Inspectorate Certificate	▪ Annual	▪ FI Certificate		
	▪ Training on Health and safety awareness amongst staff and workers	▪ Quarterly	▪ Training Report		

	▪ Existing of safety warning signages	▪ As required	▪ Signages		
	▪ Provision of Comprehensive fire detection and protection system	▪ Monthly	▪ Fire detection System		
	▪ Monitoring of Health and safety performance	▪ Quarterly	▪ H&S Monthly reports		
	▪ Existing operating safety audit system	▪ Quarterly	▪ Audit Reports		
Loss of Properties	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Utilisation of existing right of way to minimise land acquisition.	▪ As required	▪ Line route survey ▪	▪ Project Engineer	▪ 0.5 Million
	▪ Survey of project-affected persons for the purposes of compensation payment.	▪ As required	▪ List of PAPs	▪ Project EHS Officer	
	▪ Compensation payment before the start of constructional activities	▪ Annual	▪ Amount of compensation paid		
	▪ Presence of Community Liaison Officer as a designated point of contact for the community.	▪ Monthly	▪ Presence of CLO		
	▪ Implementation of appropriate grievance mechanisms to address concerns of the public	▪ Quarterly	▪ Complaint Register		
	▪ . Support for alternative livelihoods for vulnerable persons	▪ s required	Type of assistance provided		
	OPERATIONAL PHASE				
	▪ Presence of Community Liaison Officer as a designated point of contact for the community.	▪ Annual	▪ Presence of CLO	Site Engineer	▪ 0.015 Million Annually
Land Use	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Level of awareness amongst stakeholders on the project	▪ Monthly	▪ Community engagement	▪ Community Liaison Officer	▪ Part of Project Cost
	▪ Institution of grievance mechanism to keep record of all complaints from the community	▪ Quarterly	▪ Complaint Register	▪ Contractor Engineer	
	▪ Presence of valid Development Permit	▪ Annual	▪ Development Permit		
	▪ Restoration of land acquired on temporary basis for storage of material to their original form.	▪ As required	▪ State of temporary lands		
	▪ Utilisation of existing right of way to minimise land acquisition.	▪ As required	▪ Use of Right of way		
	▪ Utilisation of existing roads for access to the project site ▪	▪ As required	▪ Use of existing roads		

	▪ Presence of Community Liaison Officer as a designated point of contact for the community.	▪ Quarterly	▪ Presence of CLO		
	▪ Non disturbance of land use in and around permanent project facilities	▪ Daily	▪ State of land around project facilities	▪ Project Engineer	
	▪ Use CDP to assist GNFS to educate populace on effects of bush fires	Annual	▪ CSR Report		
	OPERATIONAL PHASE				
	▪ Implementation of CSR activities to improve the standards of living and long-term wellbeing of the affected communities.	▪ Annual	▪ CSR Report	Site Engineer	▪ Part of O&M Cost
	▪ Undertake proactive action to avoid any undue confrontation with affected community.	As required	▪ Complaint Register		
	▪ Under the CDP, assist GNFS to educate populace on effects of bush fires	▪ As required	▪		
Labour & Working Conditions	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Adherence to employment and workforce policies.	▪ Daily	▪ Labour Policies	▪ Community Liaison Officer ▪ Project Engineer	▪ 0.01 Million
	▪ Engagement of Locals for unskilled manpower requirements	▪ Monthly	▪ Employment records		
	▪ Provision of adequate shelter, drinking water, toilet facilities for the workers.	▪ Monthly	▪ Accommodation for staff		
	▪ Provision of accommodation of migrant labour within the communities	▪ Monthly	▪ Accommodation for migrant staff		
	▪ Implementation of worker grievance mechanism	▪ As required	▪ Compliant Register		
	▪ Maintenance of a healthy environment for the labour force	▪ As required	▪ Complaint Register		
	OPERATIONAL PHASE				
	▪ Same at constructional phase	▪ See above	▪ See above	Site Engineer	▪ Part of O&M Cost
	PLANNING & CONSTRUCTIONAL PHASE				
	▪ Observation of all necessary traditional requirements prior to project commencement	▪ As required	▪ Pacification Rites	▪ Project Engineer	▪ 0.2Million

Public Safety	▪ Notification to local government/traditional authorities on the date of project commencement.	▪ As required	▪ Notification Letter	▪ CLO	
	▪ Institution of public grievance mechanism.	▪ As required	▪ Complaint Register	▪ Contractor Engineer	
	▪ Creation of awareness amongst staff about local cultural sensitivities.	▪ Quarterly	▪ Training Report	▪ Project EHS Officer	
	▪ Limitation of constructional activities only during the day i.e. between 0700 hours to 1800 hours.	▪ Daily	▪ Use of work logbook		
	▪ Segregation of the various wastes and arrange for subsequent	▪ As required	▪ Waste log book		
	▪ Disposal through either efficient incineration or disposal in a sanitary landfill.	▪ As required	▪ Std. Ops. Procedure		
	▪ Fencing of all excavated areas to avoid access to outsiders and wildlife.	▪ Daily	▪ Std. Ops. Procedure		
	▪ Provision of security and warning signages around construction site	▪ As required	▪ Warning signages		
	▪ Briefings to create awareness on Public health amongst staff, especially on Sexually Transmitted Diseases and HIV/AIDS.	▪ Monthly	▪ Briefing report		
	OPERATIONAL PHASE				
	▪ Provision of fencing for the PV Plants	▪ Quarterly	▪ Fence	Site Engineer	▪ Part of O&M Cost
	▪ Provision of security staff	▪ Monthly	▪ Security Staff		
	▪ Provision of floodlights within facility	▪ Monthly	▪ Floodlights		
	▪ Provision of motion controls within facility	▪ Monthly	▪ Motion Controls		
	▪ Training of onsite guards to deal with trespassing incidents.	▪ Annual	▪ Training Report		
	▪ Maintenance of harmonious co-existence between staff and the local communities in the project area.	▪ As required	▪ Std. Ops. Procedure		
	PLANNING & CONSTRUCTIONAL PHASE				
	▪ Implementation of TMS	▪ Daily	▪ Std. Ops. Procedure	▪ CLO	▪ 0.03 Million
	▪ Implementation of traffic control measures	▪ Daily	▪ Speed rumps, signages	▪ Contractor Engineer	

Traffic & Transport	▪ Training of drivers in defensive driving	▪ As required	▪ Training Report	▪ Project EHS Officer	
	▪ Enforcement of speed limits for heavy good vehicles and workforce transportation vehicles	▪ Daily	▪ Speed limits		
	▪ Avoidance of dense areas of traffic through planning and channelling of traffic.	▪ As required	▪ Level of traffic		
	▪ Involvement of local authorities in defining optimum project traffic routes and times for transit	▪ As required	▪ Traffic routes		
	▪ Implementation of a "No Drinking" "No Alcohol" policy on site	▪ As required	▪ Policy on No Drinking and No Alcohol		
	▪ Conduction of periodic and routine alcohol checks for all site drivers and site workers	▪ As required	▪ Report on routine checks		
	▪ Provision of site vehicle maintenance services in order to ensure technical failures do not occur	▪ As required	▪ Vehicle maintenance site		
	▪ Installation of traffic safety signage at vantage points along access routes with the project sites.	▪ As required	▪ Traffic safety signages		
	▪ Sensitisation programs for communities within the project area on road traffic and risks	▪ As required	▪ Sensitisation Report		
	▪ Removal of speed ramps to be done in collaboration with DAs and Security agencies	▪ As required	▪ # of Speed Rumps		
	OPERATIONAL PHASE				
	▪ Implementation of TMS	▪ As required	▪ Std. Ops. Procedure	▪ Project Engineer	▪ Part of O&M Cost
	▪ Use of car sharing amongst staff	▪ As required	▪ Car sharing strategy		

40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 9: CONCEPTUAL DECOMMISSIONING PLAN

9 CONCEPTUAL DECOMMISSIONING & SITE CLOSURE PLAN

9.1 Introduction

Solar power projects typically have a life expectancy of 20 to 25 years. The current trend in the solar energy industry has been to replace or "re-power" older solar energy projects by upgrading older equipment with more efficient PV plants and ancillary equipment. However, if not upgraded the PV plants will be decommissioned. The purpose of this conceptual Decommissioning & Site Closure Pan (DCP) is to describe the general objectives for the post project land use, and the planning processes leading to development of a Final DCP Plan.

The specific objectives in managing the decommissioning process will be:

- To ensure that rehabilitation and decommissioning are carried out in a planned sequential manner, consistent with best practice,
- To ensure that agreed post-project land-use outcomes are achieved, and
- To avoid on-going liability

The solar power facility decommissioning process shall be initiated upon the termination of the leases with the landowners. The primary reason for the leases to be terminated would be the completion of the project's useful life or the lack of a power purchase agreement with the relevant national authority at the time. VRA at the time agree shall meet with the landowner prior to the lease expiration date to ensure that the owners perform its obligations to remove its property and restore the premises. Removal of machinery, equipment, PV Modules/Inverters and all other materials related to the project is to be completed within one year of decommissioning. Thus, within twelve (12) months of initiating the decommissioning, the relevant project components will have been removed from the leased land.

9.2 Decommissioning During Construction (Abandonment of Proposed Project)

While not expected and considered to be extremely unlikely, if construction of the proposed project and associated work may not be completed, the project would be decommissioned in a manner as described in this report. Further, mitigation measures as described in the Environmental Management & Monitoring Plan (part of the Design and Construction Report) would be implemented. As with the construction, the Project EHS will be present on site for the duration of the work.

9.3 Decommissioning After Ceasing Operation

The decommissioning of the solar power facility will follow the VRA's Health & Safety Policy along with any applicable national, and the relevant District Assembly's Regulations and standards. During decommissioning activities, the Regional Physical Planning Department and the EPA office shall have access to the site, pursuant to reasonable notice, to inspect the results of complete decommissioning. All decommissioning and restoration activities will be in accordance with all applicable state and local permits and requirements and will include the following specific activities:

- **PV Plant removal:** Cranes and/or other machinery will be used for the disassembly and removal of the PV plants. Electronic components and controls such as protection devices, switches, junction and combiner boxes, transformers, auxiliary power supply and internal cables will be removed. The solar modules and the inverters will be lowered to the ground for disassembly and transporting. These will either be transported whole for reconditioning and reuse or dissembled into salvageable, recyclable, or disposable components.
- **PV foundation removal:** PV foundations will be removed down to a level 0.914m (or as per Ghana EPA guidelines or requirements). The remaining excavation will be filled with clean sub-grade material, compacted to a density similar to surrounding sub-grade material, and finished with topsoil.
- **Underground collection cables**. All cables buried less than 0.914m or as per Ghana EPA guidelines or requirements), will be removed. All cables buried deeper than 0.914m, will be kept in place if it is determined that their presence does not adversely impact land use and they do not pose a safety hazard.
- **Access roads and parking areas:** At the discretion of the new landowners, gravel will be removed from access roads and parking areas and transported to a pre-approved disposal location. Any drainage structures will be removed and backfilled with sub-grade material (if necessary). The ground will be de-compacted (in agricultural areas only) and allowed to re-vegetate naturally.
- **Monitoring:** A monitoring and remediation period of two years immediately following the completion of any decommissioning and restoration activities will be undertaken. If agriculture impacts are identified during this period, follow-up restoration efforts will be implemented.
- **Substation:** The Project substation is generally valuable to the local transmission owner. As per the interconnection rules of NEDCo or GRIDCo, the project sub-stations shall revert to the ownership of the transmission owner and thus VRA does not intend to decommission the substation.

9.4 Restoration of Land and Water Negatively Affected By Facility

Once all the facilities are removed, the remaining work to complete the decommissioning will consist of shaping and grading of the areas to as near as practicable to the original contour prior to construction of the power facilities. All areas will be restored as near as practical to their original condition with native soils and seeded. Other than the concrete, which will remain 0.9 meters below the soil at the depth of the native bed rock or, no other residual impact is foreseen. The decommissioning will affect the agricultural practices directly around the access roads, substation locations, but only during their removal. Also, no impacts to terrestrial vegetation and wildlife are expected since all the project infrastructures will be located exclusively outside agricultural land.

The most significant risk to the aquatic environment will be when the access roads near drains or municipal drain crossings are removed. Like the construction phase, the plant decommissioning will follow a storm water protection plan that will ensure proper steps are followed to mitigate

erosion and silt/sediment runoff. As with the project's construction, noise levels around the decommissioning work will be higher than average. Proper steps will be followed to minimize this disturbance, such as working only during daylight hours. Also, as with the project's construction, road traffic in the area will increase temporarily due to crews and heavy equipment movements.

9.5 Procedures for Managing Waste and Materials

VRA shall aim to engage a contractor for this assignment, who is part of PV CYCLE, a non-profit, member-based organization which offers collective and tailor-made waste management and legal compliance services for companies and waste holders around the world. Members of PV CYCLE organizes the take-back and recycling of PV modules at end-of-life. The recycling program of PV Cycle is a comprehensive recycling process which recovers most of the materials within the PV panel (including glass, semiconductor material, ferrous and non-ferrous metals, etc.) for reuse in new products. Such an option is to be highly considered for the PV panels at the end-of-life.

9.6 Decommissioning Notification

The process for notification of decommissioning activities will be the same as the process for notification of construction activities. EPA will be formally notified of the process to enable them to provide relevant guidance as required. A report describing the performance of the Final DCP Plan in working towards its objectives, based on monitoring results, and the extent to which it has been complied with, will be submitted to the EPA. The report will be provided to documented stakeholders and will otherwise be publicly available on request. Files and documents used to collate information regarding closure commitments, licences, approvals and other information concerning closure will be catalogued and maintained in accordance with standard VRA practices.

9.7 Conditions of Approval

VRA will ensure that the decommissioning stage of the proposed facility is carried out in accordance with EPA/Energy Commission as well as the District Assembly's requirements and the measures/practices as described in this report. VRA understand that the EPA could requests specific decommissioning activities as a condition of approval that could include, for example:

- Providing notification regarding the plans to continue or cease the operation of the proposed facility by the end of power purchase agreement.
- Providing notification regarding the need for an application for amendment to the EPA to keep the proposed facility in operation after the end of power purchase agreement.
- Providing timelines for the start and completion of the decommissioning activities.
- Keeping this report updated to ensure that when required a portion of the facility which is not operational due to technical failure can be properly decommissioned.
- Providing site restoration measures that would ensure that the nutrient content of the soil is restored.
- Providing restoration of the site as close to a pre-construction state as feasible.
- Providing a decommissioning cost estimate as well as the methods for ensuring that the funds will be available for decommissioning and site restoration.

The D&D Plan shall be binding upon VRA or any of its successors, insofar as it constitutes a mandatory permitting requirement under each Districts' law, and each permit shall run with the land and improvements comprising the Project. Best practice requires that planning of solar power plant closure be undertaken progressively throughout the lifetime of the operational phase. As such the conceptual plan will be reviewed and detail added as it becomes available. The DCP Plan will be finalised and submitted to the relevant authorities for approval at least six months prior to closure of the site.

9.8 Calculations for Decommissioning Costs

In order to provide such financial assurance before the end of the useful life of the equipment, VRA agrees to deliver to relevant agencies prior to the decommission and closure phase, a financial instrument with an aggregate initial face amount equal to the decommissioning cost estimate prepared and certified by a professional engineer in accordance with national and respective local laws. Subject to such estimate and certification, the anticipated formula for calculating the estimated decommissioning cost is provided in Table *9-1*.

Table 9-1: Calculation for Decommissioning Costs

Schedule	Activity	Costs (GH ¢)	Total Costs (GH ¢)
A	PV Plant Removal	(# of man hours) x (labor rate - GHS/hour) = GHS Equipment (# of days in use) x (daily rate) = GHS	Total A
B	Concrete Foundation Removal	(# of man hours) x (labor rate - GHS/hour) = GHS Equipment (# of days in use) x (daily rate) = GHS	Total B
C	Access Road and Buried Cable Removal	(# of man hours) x (labor rate - GHS/hour) = GHS Equipment (# of days in use) x (daily rate) = GHS	Total C
D	Seeding and Re-vegetation	(# of man hours) x (labor rate - GHS/hour) = GH S Equipment (# of days in use) x (daily rate) = GHS Materials (cost per unit) x (# of units) = GHS (seed, mulch and topsoil)	Total D
E	Total Estimated Removal Cost Per Each PV Plant Site = GHS		A+B+C+D
F	Estimated Salvage Cost	Value of each PV Module = Total D = GHS Value of each ancillary component = GHS	Total F
G	Total Value for Decommissioning Project = GHS		E - F

40MW SOLAR POWER PROJECT AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

CHAPTER 10: CONCLUSION & RECOMMENDATIONS

10 CONCLUSION & RECOMMENDATIONS

10.1. Project's Benefits

Some major positive benefits of the project have been discussed under Section 1.5 as well as Section 6.4 and further elaborated under this Section as follows:

Environmental Benefits

- Decrease environmental emissions associated with private power generators and other thermal fossil fuel based power plants, thereby encouraging renewable energy form as better option to sustainable power sector development.
- Allow VRA to increase power generation capacity whilst reducing the carbon footprint of the electricity generated.
- Align VRA's generation capacity development with GoG Policy on Renewable Energy that seeks that 10 % of all electricity generation to come from renewable sources.

Economic Benefits

- At the national level, construction of the power plant will result in an increase in grid based power generation capacity.
- The utilisation of solar as an additional source of generation to supply the increasing domestic and export demand. This will improve VRA's power supply security by diversifying it sources of power generation.
- Increased revenue/derivations to local and state governments as well as other mandated agencies/commissions.
- Generated power price from the solar facility that is independent from the price of crude, the up skilling of the Ghanaian labour force and the contracting of a local civil construction companies and labourers.
- Solar energy systems are virtually maintenance free and will last for decades. Once installed, there are no recurring costs. Solar energy supports local job and wealth creation, fuelling local economies.

Employment Benefits

- At the local level, the project directly contributes to development of Bongo District and the Upper East Region as a whole through the employment opportunities it will directly create and through multiplier effects that will flow from the increased availability of power within the region
- The selection of world-class expertise enlisted for the project will bring a wealth of skills and technology not only to the project but the wider solar energy sector within Ghana. This will help in the development of the requisite skills required in solar plant development, design and operation to position the VRA to provide leadership technical expertise for deployment of renewable based electricity generation in African.

Political and Social Benefits

- Meet future renewable energy purchase obligations to be placed on NEDCo with VRA's owned RE plants.
- The project will illustrate the country's commitment to renewable energy generation as well as being a flagship project for the country's commitment to renewable energy generation.

10.2. Conclusion

Based on the assessment of the various impacts associated with the pre-constructional, constructional and operational phases, the positive impact had an average rating score of 9.5 defined as **MEDIUM POSITIVE** whilst the negative impact had an average rating score of 4.29 defined as **LOW NEGATIVE.** This means the project impacts may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures and should not have an influence on decision-making.

Following this, the EIA has also outlined the potential measures to avoid, reduce or remedy any associated negative impact. Subsequently, an Environmental Management Plan (EMP) has been prepared which identifies all mitigation measures relevant to the project, including those required to ensure that all environmental regulations are met and those that have been agreed following extensive consultations with a wide range of interested parties. The EMP also identifies the periods during which mitigation measures must be implemented, who is responsible for implementation and the longer-term monitoring requirements of the project. It shall be ensured that contractors fulfil their obligations under their contracts.

To ensure compliance of the project with the EIA Report, through the framework of the EMP, an Environmental Monitoring Plan has been developed and VRA will designate a Project EHS Officer who will be responsible for ensuring that obligations are adhered to during construction and operational phase. In conclusion, it is affirmed that VRA is committed to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations. This is an undertaking VRA is firmly committed to and shall adhere to it.

10.3. Recommendation

The EIA Report has recorded the results and conclusions of the environmental assessment carried out to determine the potential impacts (both adverse and beneficial) of the proposed solar power project. Based on associated impacts of the project definition, ongoing consultations as well as the experience of the study team, various mitigation measures have been recommended under Chapter 7.0 in this EIA Report.

The solar power project in particular and the REDP in general seek to foster sustainable low carbon energy provision, provision of jobs in local communities and global partnerships that ensure that the projects should have some form of local content during development and operation. Based on this,

the EIA Study finds that the value addition characteristics of this solar power project would respond to the principles of sustainable development that aim at "socially equitable and economically viable development to improve the quality of life for all citizens of the earth, without altering the balance in the ecosystem". The benefits to be derived from the implementation of the project are immense, especially considering the challenges that electricity consumers have been exposed to high and the volatile electricity prices linked to oil prices over the last ten years. Therefore, there is assurance from all stakeholders to help ensure that this project is implemented to the benefit of the people of Ghana and with little or no damage to the environment.

VRA believes that the EIA Report has sufficiently dealt with the significant issues on the ground. It is hoped that the report will meet the expectations of the EPA and warrant the issuance of Permit to enable VRA to commence the project. VRA commits to collaborate with EPA to jointly manage the environmental and social concerns related to the solar power plant project and shall submit progress environmental reports to the EPA as required. The study therefore recommends that the EIA Report should be approved with the provision that the suggested mitigations measures will be adopted, and the EMP / Monitoring Plans will be followed in the letter and spirit.

11 REFERENCES

1. 2010 Population & Housing Census, District Analytical Report, Bongo District Assembly, October 2014.
2. 2010-13 Medium Term Development Plan for the Bongo District Assembly.
3. 2014-17 Medium Term Development Plan for the Bongo District Assembly.
4. 2019-2022 Programme Based Budget Estimates for 2019 Bongo District Assembly
5. 2020 Electricity Supply Plan for the Ghana Power System
6. 35MW Solar Power Project Phase 1 (SPP1): Environmental and Social Impact Assessment (EIA), September 2019
7. Bongo District Water & Sanitation Plan, August 2008.
8. Bongo Solar Power Project - Draft Feasibility Study, August 2017
9. Bongo Solar Power Project, Baseline Flora & Fauna Survey Report, January 2019
10. Bongo Solar Power Project, Valuation Report on Economic Trees, May 2016
11. Domestic Violence in Ghana – Incidence, Attitude, Determinants & Consequences, July 2019
12. Ebenezer Nyarko Kumi. 2017. "The Electricity Situation in Ghana: Challenges and Opportunities." CGD Policy Paper. Washington, DC: Center for Global Development.
13. Environmental & Social Impact Assessment (EIA), Anwar Al-Ardh 20 MW PV Power Plant Project REV - 1 3 September 2014
14. Environmental & Social Management Plan (ESMP) Summary: 55 Mw Solar Photovoltaic (PV) Plant, Sokoto Nigeria April 2018
15. Environmental and Social Impact Assessment (EIA) For 25MW Solar Power Plan in Village Baret District Mansa, Punjab, June 2016
16. Environmental and Social Impact Assessment (EIA) of Proposed 100 MW Solar PV Power Project: Veltoor, Telangana, INDIA, Draft Final Report, March 2017
17. Environmental Impact Assessment Guidelines for the Energy Sector, Volume 1, dated August 2010,
18. Environmental Impacts Assessment Report for Reinforcement and Upgrade of Dar es Salaam, Kilimanjaro and Arusha Transmission and Distribution System Project
19. Environmental Impacts Assessment Report for Songo Songo Gas Development and Power Project - 2005
20. Environmental Impacts Assessment Report, Cameroon Limbe Power Project 2 – 2003
21. Ghana Energy Sector Strategy & Development Plan, February 2010
22. Ghana Environmental Impact Assessment (EIA) Procedures into the EA Regulations (LI 1652, 1999)
23. Integrated Power System Master Plan for Ghana Volume #2, May 2019 (Final version)
24. Report on Acquisition of Site, Bongo Power Project, June 2014
25. School Report Card, Ghana Education Service, Bongo District, 2016

40MW SOLAR POWER PROJECT
AT BONGO IN THE UPPER EAST REGION, GHANA

Environmental Impact Assessment Report

APPENDIX

Appendix 1: EIA Study Team
Appendix 2: General Correspondences on EIA Study
Appendix 3: PV Site & Sub-Transmission Route Maps
Appendix 4: Land Acquisition Documents
Appendix 5: Record of Stakeholder Engagements
Appendix 6: Pictures from Stakeholder Engagements
Appendix 7: List of Interested & Affected Persons
Appendix 8: Impact Assessment Sheet

APPENDIX 1:
EIA Study Team

Contact Details	Qualification	Role/Study to Be Undertaken
Name: Ben A. Sackey Email: ben.sackey@vra.com Mobile: 0243344779	• BSc Biochemistry • MPhil Food Science • PG Cert. OSHEM • Cert. in PPM • Certified Env. Auditor • Certified ISO 14001 EMS Implementor • Member, IAIA	ESIA Team Leader • Undertake rapid socio-economic and environmental appraisal of project area • Lead expert responsible for data collection and literature review • Provide inputs in the determination of the Present Ecological State and Ecological Importance and Sensitivity of any ecological sensitive areas • Lead in Public Consultation Process • Due diligence for quality project reporting • Drafting Reports and Quality Assurance
Name: Godfred Ofosu-Asare Email: godfred.ofosu-asare@vra.com Mobile: 0243503588	• BSc Chemistry • MSc in Env. Science • Member, IAIA	ESIA Specialist • Environmental Management Expert / ESIA Specialist • Supervision and coordination for effective implementation of project activities. • Baseline ambient noise/air quality study • Conduct interviews and collect relevant oral accounts, including migration and settlement histories of descendant communities in the project areas • Due diligence for quality project reporting • Partake in public education/stakeholder consultations • Review and assure timely compilation and submission of all reports. • Coordinate preparation of project Environmental Scoping as well as Detailed ESIA reports
Name: Lloyd Kofi Sutherland Email: lloyd.sutherland@vra.com Mobile: 0241370926	• BSc in Biochemistry • MSc in Env. Science; • NEBOSH-IGC • Member, IAIA	ESIA Specialist • Environmental Management Expert / ESIA Specialist • Supervision and coordination for effective implementation of project activities • Baseline ambient noise/air quality study • Due diligence for quality project reporting

Contact Details	Qualification	Role/Study to Be Undertaken
		• Partake in public education/stakeholder consultations • Review and assure timely compilation and submission of all reports. • Coordinate preparation of project Environmental Scoping as well as Detailed ESIA reports
Name: Baffo Blankson Email: baffo.blankson@vra.com Mobile: 0200366511	• Forestry Certificate • BSc Environment & Natural Resource Management, • MSc in Env. Science (ongoing)	Natural Resource Management Specialist • Responsible for supervision of data collection and literature review of biological environment • Identify floral species around environmental influences of the project • Draw up a list of floral and faunal species in the study area and identifies environmental impacts. • Partake in public education/stakeholder consultations
Name: Frederick Kyei-Dompreh Email: fred.kdompreh@vra.com Mobile: 030-2660078	• BSc. (Hons) Land Economy; • MBA • Member-GhIS	Property Valuation Expert • Valuation Expert responsible for valuation of all properties • Measure, describe and record vital ethnographic objects and surface archaeological materials in project areas • Partake in public education/stakeholder consultations. • Lead in the preparation of the “Property Valuation Report”.
Name: Kofi Orstin Email: kofi.ortsin@vra.com Mobile: 0244234336	• BSc. (Hons) Land Economy; • Member-GhIS	Property Valuation Expert • Valuation Expert responsible for valuation of all properties • Conduct interviews and collect relevant oral accounts, including migration and settlement histories of descendant communities in the project areas • Measure, describe and record vital ethnographic objects and surface archaeological materials in project areas • Partake in public education/stakeholder consultations. • Assist in the preparation of the “Property Valuation Report”.
Name: Ebenezer Kojo Antwi	• BSc. Electrical Engineering	Electrical Engineer • Development of project technical feasibility report

Contact Details	Qualification	Role/Study to Be Undertaken
Email: ebenezer.antwi@vra.com Mobile: 0260438891	• Member-GhIE	• Project design and layouts • Partake in public education/stakeholder consultations Due diligence for quality project reporting • Provide quality assurance in the preparation of project Environmental Scoping as well as detailed ESIA Reports.
Name: Linus Abenney-Mickson Email: linus.mickson@vra.com Mobile: 0208889688	• BSc. Electrical Engineering • Member-GhIE	Electrical Engineer • Development of project technical feasibility report • Project design and layouts • Partake in public education/stakeholder consultations Due diligence for quality project reporting • Provide quality assurance in the preparation of project Environmental Scoping as well as detailed ESIA Reports.
Name: Khalilu-lahi Abdulai Email: abdulai.khalilu-lahi@vra.com Mobile: 0204544074	• BSc. Mechanical Engineering • Member-GhIE	Mechanical Engineer • Development of project technical feasibility report • Project design and layouts • Partake in public education/stakeholder consultations Due diligence for quality project reporting • Provide quality assurance in the preparation of project Environmental Scoping as well as detailed ESIA Reports.
Name: Lawrence Addipa Email: lawrence.addipa@vra.com Mobile: 0509180415	• MSc. In Geomatic Engineering • Diploma in Mine Surveying	Geodetic Surveyor • Coordinate surveying of project area • Production of Maps for project technical feasibility report.

APPENDIX 2:
General Correspondences of the EIA Study

Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
Email: info@epa.gov.gh

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra
Website: http://www.epa.gov.gh

Our Ref: CE: 6384/01/02

October 26, 2017

The Chief Executive Officer
Volta River Authority
Electro Volta House
P.O. Box MB 77
Accra

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
20MW BONGO SOLAR PHOTOVOLTAIC POWER PROJECT

We acknowledge receipt of your letter dated October 10, 2017, submitted to the Agency for the purpose of obtaining environmental approval for the above proposal in accordance with the Environmental Assessment Regulations 1999, (LI 1652)

The proposal falls in the category of undertakings (Regulation 3) for which Environmental Impact Assessment (EIA) is required to help understand the likely implications of the proposal, the relevant alternatives and mitigations to consider in order to ensure sound decision-making and sustainable development of the project.

However, in line with Regulation 11 of LI 1652, you are advised to carry out a scoping exercise to generate the relevant terms of reference (TOR) to guide satisfactory EIA study of the proposal.

Please note that scoping is meant to focus the EIA on the key issues, concerns and decision areas and solicit input and guidance of all relevant stakeholders on the TOR. Scoping notices must be served as appropriate to facilitate stakeholder involvement (see attached sample). Six (6) hard copies of the scoping report must be submitted to the Agency for study and agreement on the TOR, prior to the EIA studies.

It is important that the Scoping Report and Environmental Impact Statement contains information on the consultants who prepared the reports. This should include the names, address, email, telephone, experience and their specific contribution to the study. Failure to provide this information would render the submission incomplete.

Do not hesitate to contact the Agency (Head Office Room 305) and the EPA Upper East Regional Office, Bolgatanga for any further guidance you may require in this regard.

Yours faithfully,

KWABENA BADU-YEBOAH
AG. DIRECTOR/ EAA DIVISIO
FOR: EXECUTIVE DIRECTOR

CC: The Regional Director, EPA, Upper East, Bolgatanga

SCOPING NOTICE

The Volta River Authority (VRA) proposes to construct and operate a 40MW solar power plant and associated electrical infrastructure on a 0.5013 km² of land at Asebga, in the Bongo District in the Upper East Region of Ghana. The project would involve the installation of ground mounted single axis Photovoltaic Voltaic (PV) panels which will tie into the national electricity grid. Basically, electricity from the solar power plant would be evacuated at 34.5kV voltage level and a sub-transmission line, of approximately 29 km with a wayleave of 15m, would be constructed from the solar power plant and would terminate on the 34.5kV bus at the Bolgatanga Substation, in the Bolgatanga Municipality also in the Upper East Region. The project is titled the "***40MW Bongo Solar Power Project***".

Notice of the proposed "***40MW Bongo Solar Power Project***" is hereby served for public information, as required under the procedures for the conduct of EIA in accordance with Regulation 15(1) of LI. 1652. Hard copies of the Scoping Reports are available at the EPA Head office in Accra, the Bongo District and Bolgatanga Municipality in the Upper East Region, as well as the Palace of the Bongo Naaba. The electronic copy is available on the VRA's website at www.vra.com.

Any person(s) who have an interest, concern, or special knowledge relating to potential environmental effects of the proposed undertaking may contact or submit such concerns, etc., to:

The Chief Executive
Volta River Authority
P. O. Box MB 77, Accra
Tel No: +233-302-664941-9
Fax: +233-30-2662610
Email: corpcomm@vra.com

AND

The Executive Director
Environmental Protection Agency
P. O. Box M 326, Accra
Tel No: +233-302-664697/8
Fax No: +233-302-662690
Email: info@epa.gov.gh

VOLTA RIVER AUTHORITY

Not later than July 15, 2018

Daily Graphic, Monday June 11, 2018 pg. 67

Ghanaian Times: Monday, June 11, 2018. Pg. 25

SCOPING NOTICE

The Volta River Authority (VRA) proposes to construct and operate a 40MW solar power plant and associated electrical infrastructure on a 0.5013 km² of land at Asebga, in the Bongo District in the Upper East Region of Ghana. The project would involve the installation of ground mounted single axis Photovoltaic Voltaic (PV) panels which will tie into the national electricity grid. Basically, electricity from the solar power plant would be evacuated at 34.5kV voltage level and a sub-transmission line, of approximately 29 km with a wayleave of 15m, would be constructed from the solar power plant and would terminate on the 34.5kV bus at the Bolgatanga Substation, in the Bolgatanga Municipality also in the Upper East Region. The project is titled the "***40MW Bongo Solar Power Project***".

Notice of the proposed "***40MW Bongo Solar Power Project***" is hereby served for public information, as required under the procedures for the conduct of EIA in accordance with Regulation 15(1) of LI. 1652. Hard copies of the Scoping Reports are available at the EPA Head office in Accra, the Bongo District and Bolgatanga Municipality in the Upper East Region, as well as the Palace of the Bongo Naaba. The electronic copy is available on the VRA's website at www.vra.com.

Any person(s) who have an interest, concern, or special knowledge relating to potential environmental effects of the proposed undertaking may contact or submit such concerns, etc., to:

The Chief Executive
Volta River Authority
P. O. Box MB 77, Accra
Tel No: +233-302-664941-9
Fax: +233-30-2662610
Email: corpcomm@vra.com

AND

The Executive Director
Environmental Protection Agency
P. O. Box M 326, Accra
Tel No: +233-302-664697/8
Fax No: +233-302-662690
Email: info@epa.gov.gh

VOLTA RIVER AUTHORITY

Not later than July 15, 2018

Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
Email: info@epa.gov.gh

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra
Website: http://www.epa.gov.gh

Our Ref: CE: 6384/01/04

August 06, 2018

The Chief Executive
Volta River Authority
P. O. Box MB 77
Accra-Ghana

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT:
PROPOSED 40MW SOLAR PHOTOVOLTAIC POWER PROJECT LOCATED AT BONGO IN THE BONGO DISTRICT OF THE UPPER EAST REGION

We refer to the Scoping Report on the above proposal submitted to the Agency for the purpose of obtaining environmental approval in accordance with the Environmental Assessment Regulations 1999 (LI 1652).

The report has been reviewed and found to be generally satisfactory. You are therefore advised to proceed with the EIA study and submit **eight (8) hard copies** of the draft Environmental Impact Statement taking into account the attached comments in accordance with the Environmental Assessment Regulations 1999 (LI 1652).

You are reminded to pay the non-refundable processing fee issued on May 31, 2018 to enable the Agency continue the processing of your application

Do not hesitate to contact the EPA Head Office (Room 305) for any assistance or guidance you may require in this regard.

Yours faithfully,

ANDRIANA NELSON
CHIEF PROGRAMME OFFICER/EAA DIVISION
FOR: AG. EXECUTIVE DIRECTOR

Attached:

VOLTA RIVER AUTHORITY: PROPOSED 40MW BONGO SOLAR PHOTOVOLTAIC PROJECT-SCOPING REVIEW COMMENTS

Specific Comments

- The report limited itself predominantly to project site impacts and ignoring the transmission line component of the project. Example such as topography, flora and fauna, cultural and archaeological finds, etc should be conducted for both the project site and the transmission line component of the project.

- The Terms of Reference for the EIA study was not properly linked to some preliminary issues generated during the public consultation/engagement process. The issues were broadly repeated without giving much focus to issues raised during the consultation process. These issues should be discussed in the EIS

- Waste management during the operation and decommissioning phase should be considered in the EIA Study contrary to what was discussed under sections 6.8.3 and 6.16.1. One key waste generated during these phases are electronic and electrical waste coming from defective, damaged or broken electronic parts or components. This should be managed under the current provisions of Act 917 and LI 2250 on hazardous and electronic waste materials or substances.

ENERGY COMMISSION

Ghana Airways Avenue, Airport Residential Area (behind Alliance Française)

Private Mail Bag
Ministries Post Office
Accra - Ghana

Tel: 0302 813756/7
Fax: 0302 813764
IDD Code: (233-302)
E-mail: info@energycom.gov.gh
Website: http://www.energycom.gov.gh

Ref: EC/RE/VRA/18/01

VOLTA RIVER AUTHORITY RECEIVED 11 JUN 2018 ENV & SUST. DEV. DEPT

VOLTA RIVER AUTHORITY RECEIVED 08 JUN 2018 D.C.E. (E & O)

17th May, 2018

The Chief Executive
Volta River Authority
P.O. Box MB 77
Accra

Dear Sir,

RE: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) 40MW BONGO SOLAR PHOTOVOLTAIC POWER PROJECT

SUBMISSION OF SCOPING REPORT

We write to acknowledge receipt of a copy of your letter with reference **EXR/321/007/41C** submitting the Environmental Impact Assessment (EIA) for your proposed 40MW solar PV plant at Bongo to the Environmental Protection Agency.

We wish to inform you that you need to acquire a Wholesale Electricity Supply Licence from the Energy Commission in order to establish the proposed solar PV plant at Bongo.

The licensing requirements can be found in the Licence Manual for Service Providers in the Renewable Energy Industry which can be accessed through the Energy Commission's website (www.energycom.gov.gh/licensing/licensing-in-the-renewable-energy-sector).

Yours faithfully,

A. K. Ofosu Ahenkorah (Dr.)
Executive Secretary

ENERGY COMMISSION

Ghana Airways Avenue, Airport Residential Area (behind Alliance Française)

Private Mail Bag
Ministries Post Office
Accra - Ghana

Tel: 0302 813756/7
Fax: 0302 813764
IDD Code: (233-302)
E-mail: info@energycom.gov.gh
Website: http://www.energycom.gov.gh

EC/RE/VRA/GWSL/19/03

CHIEF EXECUTIVE'S OFFICE RECEIVED 17 DEC 2019 VOLTA RIVER AUTHORITY

VOLTA RIVER AUTHORITY
EXECUTIVE REGISTRY
RECEIVED
17 DEC 2019
HEAD OFFICE

13th December, 2019

The Chief Executive Officer
Volta River Authority
P.O. Box MP 77
Accra

ENG SERVICES DEPT P O Box 77, Akuse RECEIVED 20/12/2019 VOLTA RIVER AUTHORITY

Dear Sir,

CONSTRUCTION PERMITS FOR VOLTA RIVER AUTHORITY'S PROPOSED SOLAR POWER PROJECTS AT KALEO AND LAWRA

We refer to your application for Construction Permits for your proposed solar PV power projects with a combined capacity of 17MWp, at Kaleo and Lawra in the Upper West Region of Ghana.

Reference the moratorium placed on the issuance of Provisional Licences, Siting and Permits for utility-scale power projects with public utilities as potential off-takers, the Volta River Authority is one of only two entities which are exempt. We are therefore pleased to inform you that your application has successfully been assessed and the Energy Commission has granted you the Construction Permits.

Kindly find attached, the Construction Permits for the proposed solar PV plants at Kaleo and Lawra, of the the Upper West Region and the Schedules to the Permits.

Yours faithfully,

O. A. N

Ing. Oscar Amonoo-Neizer
Executive Secretary

(2) DGE CS For yr [illegible]

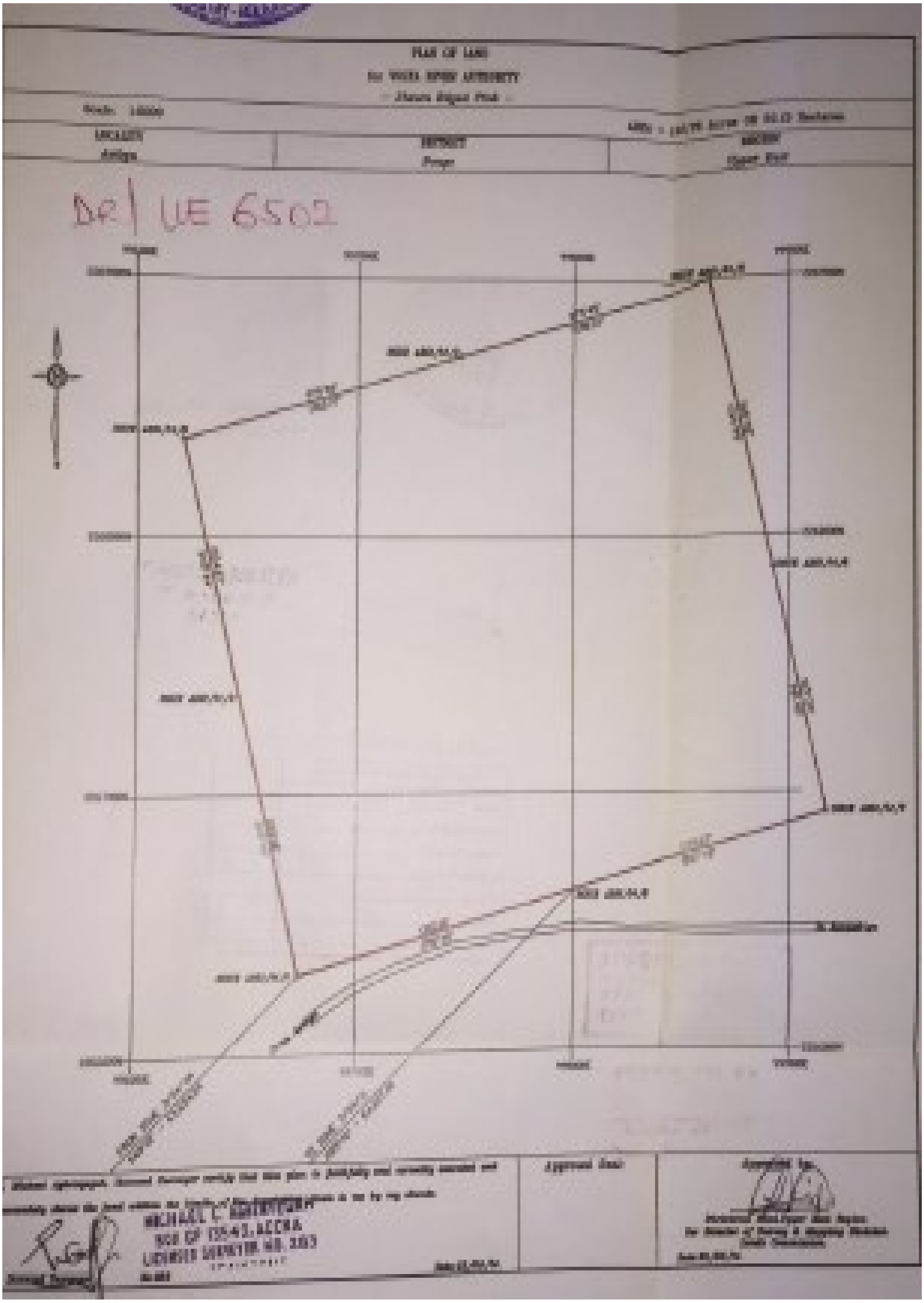
18/12/19

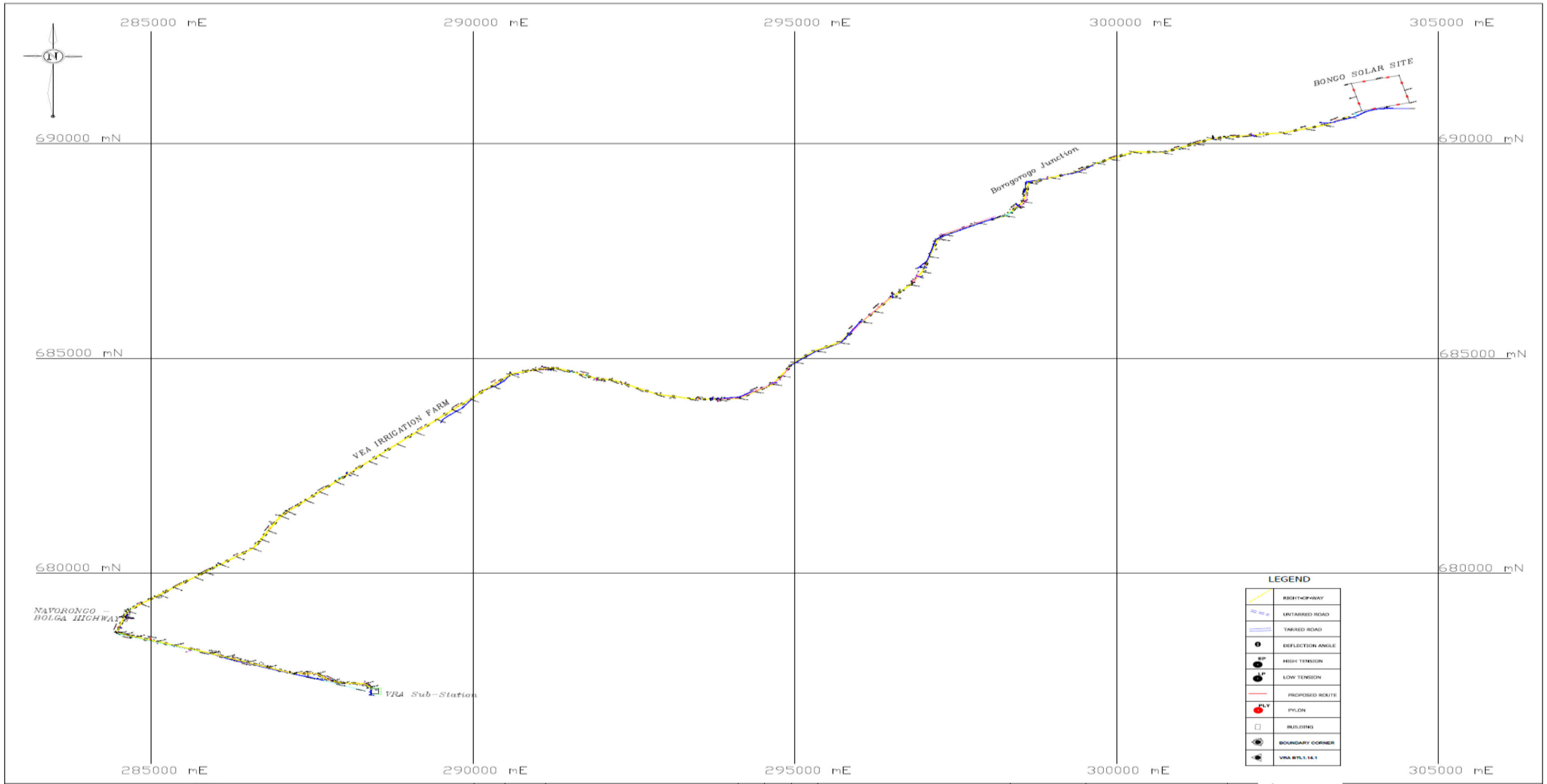
(3) DESD No note our "exemption" 20/12/2019

Fyi please. Let us scan also.

APPENDIX 3:

PV Site & Sub-Transmission Line Route Maps


PLAN OF LAND
for VOLTA RIVER AUTHORITY
DR/ UE 6502
Approval Date
ACCRA



NOTES:

No.	DATE	REVISION	BY	APP	APP	REFERENCE DRAWING	DATE

SURVEYED: LAWRENCE ADDIPA — DEC 14

DRAWN: LAWRENCE ADDIPA — DEC 14

CHECKED: MICHAEL AGBENYEGAH — DEC 14

APPROVED
DIRECTOR, ENGINEERING SERVICES DEPARTMENT. — DATE

THIS DRAWING IS THE PROPERTY OF VOLTA RIVER AUTHORITY AND IS NOT TO BE COPIED OR USED WITHOUT ITS WRITTEN PERMISSION

VOLTA RIVER AUTHORITY

PROPOSED ROUTE LINE SURVEY
FOR SOLAR POWER PROJECT (BONGO)
IN THE UPPER EAST REGION

SCALE = 1 : 2500 | DWG. No. | SHEET. 6 OF 24 | REV.

ARCHITECTURAL | CIVIL | ELECTRICAL | GEO. TECH | MECHANICAL | PLANNING | PROJECT | SURVEYING

APPENDIX 4:
Land Acquisition Documents

LEASE

BETWEEN

BONGO SKIN
ACTING ITS LEGAL REPRESENTATIVE
BABA SALIFU ALEMYARUM
PARAMOUNT CHIEF OF BONGO

A N D

VOLTA RIVER AUTHORITY
POST OFFICE BOX MB77
ACCRA

DR/UE 6502

SCHEDULE

ALL THAT PIECE OR PARCEL OF LAND containing an approximate area of 50.13 hectares or 123.78 acres situated at Asibiga in the town of Bongo of the Bongo District in the Upper East Region of the Republic of Ghana lying about 63654.84 feet from the north eastern edge of survey pillar SGUE 3/04/4A and 64,617.40 feet to survey pillar SGUE 3/04/11 at bearing of 049◦10' and 229◦ 41' respectfully and bound on the North-west by the lessor's land measuring on that side 1115.12 feet at pillar SGUE A351/14/2 to a distance of 1034.67 feet more or less at pillar SGUE A 351/14/3, on the North west and measuring 1312.77 feet to SGUE A351/14/4 measuring more or less 1198.37 feet on the north east by 1164.99 feet to pillar SGUE 351/14/6 measuring 981.40 feet on the south east by Asibiga – Azopeeliga road measuring on that side 1198.07 feet from pillar SGUE A 351/14/8 to 1312.16 feet at pillar SGUE A 351/14/1 which piece of land is more delineated on the site attached hereto and thereon shown edged pink TOGETHER with rights, easements, privileges and appurtenance to the said piece of land:----

IN WITNESS WHEREOF the parties hereto have here unto set their hands and names the day and year first above written:

SIGNED, by setting his mark hereto)
by the said **BABA SALIFU ALEMYARUM**)
PARAMOUNT CHIEF OF BONGO)
for and on behalf of the Lessor in the presence of)

.....
BABA SALIFU ALEMYARUM
PARAMOUNT CHIEF OF BONGO

BONAGA BABA SALIFU ATAMALE
LEMYAARUM
Paramount Chief Of Bongo
Traditional Area

WITNESSES

Chief of SOE:- NABA AVENGA NYABBA (LAND OWNER)

Address:- BONGO-SOE PALACE

Signature/Thumbprint:.....

Name of Elder:- AVENGA MAXWELL A.

Address:- BONGO SOE PALACE

Signature/Thumbprint:.....

Name of Elder:- ANAFO AKOR

Address:- ASIBIGA CHIEF'S PALACE ASIBIGA-BONGO

Signature/Thumbprint:-.....

MINISTRY OF LANDS
LAND REGISTRY - BOLGATANGA

APPENDIX 5:
Record of Stakeholder Engagements

Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response/action from VRA Team
Bongo Traditional Authority during the ff. dates: • April 2013 • January 2014 • March 2014 • Dec. 2014 • February 2015 • May 2016 • Nov. 2017 • July 2018 • Nov. 2018	1	Appreciative of the project as it will bring development to the area	VRA will ensure project brings the needed benefits to the communities through the implementation of a Local Content Policy
	2	They want the negotiation for the acquisition of their land done quickly and the payment done promptly	Payment will be based on valuation exercise to be done in collaboration with the Land Commission
	3	Need to perform customary rite for site / community entry	VRA will require list of customary rights for consideration by VRA management
	4	Need for community sensitization for valuation of land, crops and socio-economic survey	Items for customary rights presented to enable surveyors enter the site
	5	Community will fully cooperate to ensure survey works is done without hindrance. VRA should not deal directly with families but rather the chief and the Assembly man in the negotiation for compensation packages	VRA will come to undertake referencing of affected crops after the survey. As requested, VRA will deal directly with the Chief and assembly man in the negotiation of the compensation packages.
	6	Grateful for the involvement of the traditional authority for land negotiations	VRA will continue to liaise with the traditional authorities regarding land acquisition and compensation
	7	Traditional authorities will ensure that all affected person receive their compensation	VRA has issued cheque for compensation of affected crops using approved rates as determined by the Lands Valuation Division of the Lands Commission (2014)
	8	Need to finalise studies so that the project can commence. It is important that workers are recruited from the community	VRA will ensure that project development is facilitated and that community members will surely be considered for employment
	9	It is important that such signages are placed as part of project visibility	VRA shall put in all safety measures required for such a project. Such measures shall be discussed in the EIA Report.

Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response/action from VRA Team
	10	Need to sensitize all communities within the project area, especially school children, to avert any incidence or accident that may occur as a result of the movement of vehicles and equipment to and from the project site.	VRA will engage the schools to assist with the education of the school children
	11	Ned for locals to benefit from employment	VRA will ensure the EPC Contactor implement Local Content Policy regarding employment
	12	EIA reports should be made available to the Traditional Authority	Copy of EIA Report shall be made available to Bongo Naaba, and also published on the corporate website. Scoping Report was made available to Bongo Naaba in July 2018.
Affected Landowners on the ff. dates: • January 2014 • Dec. 2014 • May 2016 • Nov. 2017 • Nov. 2018	1	Negotiation for the acquisition of their land should be done quickly and the payment done promptly	This will be done after the project site has been properly demarcated and the total area clearly determined. Awareness created on the rationale for compensation.
	2	Need to pay compensation for ancestral grave and shrine at Asibiga Site	VRA will require list of customary rights for consideration by VRA management and this was provided
	3	Traditional authorities will ensure that all affected person receive their compensation	VRA has issued cheque for compensation of affected crops using approved rates as determined by the Lands Valuation Division of the Lands Commission (2014)
	4	Compensation has been made and Chief of Soe was satisfied with what he has received	VRA was grateful and will continue to liaise with the Chief in project execution.
Landlords of Bongo (Tindabas) on ff. dates: • March 2014 • June 2014 • Dec. 2014 • May 2016	1	Need for community sensitization for valuation of land, crops and socio-economic survey	To perform customary rights to enter surveyors enter the site
	2	Leadership of Bongo will continue to collaborate with VRA regarding project implementation if VRA continues to consult with the elders	Consultations with communities will be an ongoing process
	3	What compensation would be available and how titled, untitled and customary land would be addressed.	Property evaluation will be done, and payment effected in line with requirements of the Lands Commission.
	4	Concern that the works will provide employment	The Local content policy of VRA will be applicable to the project and the contractor will be required to consider locals for

Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response/action from VRA Team
		opportunities for workers from large towns outside of the study area.	recruitment. The contractor will also be advised to consider this proposal from the community. However, this will be dependent on the skill set available within the community and what is required to successfully execute the project.
Bongo Customary Land Secretariat in • Dec. 2014 • Feb. 2015	1	CLS to prepare Lease Agreement on behalf of the Lands Commission	Payment for documentation of lands have been made
	2	Draft lease Agreement made available to VRA	Draft lease Agreement to be reviewed by VRA legal team
Irrigation Company of Upper Region (ICOUR) – Vea Irrigation Project in • June 2014 • Dec. 2014	1	ICOUR will support VRA in the development of the project	VRA will collaborate with ICOUR throughout the project phases to ensure smooth implementation
	2	Crops to be affected are cereals and vegetables and there is the need for VRA to pay compensation for affected	VRA will pay compensation for any affected crop
Lands Commission in • June 2014 • Dec. 2014 • Feb. 2015	1	Lands Commission to investigate currents rates for lands and advise VRA	VRA to utilise rates received as basis for negotiations with landowners
	2	Lands Commission to develop a lease agreement for review by the VRA	VRA to review lease agreement when received
Bolgatanga Municipal Assembly in • June 2014 • Dec. 2014	1	Project will bring development to the area and the country.	VRA will ensure project brings the needed benefits to the communities.
	2	The Assemblyman will be contacted to help in the survey process to ensure a smooth implementation of the works	Survey will commence in 2015 and is grateful for the assistance from the Municipal Assembly
Upper East Regional Coordinating Council in • June 2014 • Dec. 2014	1	Need to utilise design that will help optimise space.	VRA will consider the optimal design for such project during the front-end engineering design stage
	2	Ministry will ensure support for the project but VRA should formally inform them on the project	VRA will continue to update the Minister on project development
	3	Ministry is happy about the project and would provide any assistance that would be required	VRA will continue to update the Minister on project development

Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response/action from VRA Team
Bongo District Assembly in: • Dec. 2014 • Nov. 2017 • July 2018 • Nov 2018	1	Happy about the development in the Bongo District and there is the need for VRA to formally inform the Assembly on it	Project briefing and VRA requested for cooperation from the District Assembly
	2	Chiefs are custodians of the land and should be engaged in the land acquisition process	Property evaluation will be done, and payment effected in line with requirements of the Lands Commission. Chiefs will be required to participate in all aspects
	3	Need to finalise studies so that the project can commence	VRA will ensure that project development is facilitated
	4	How will the communities' benefit from employment	VRA will ensure the EPC Contactor implement Local Content Policy regarding employment
District Health Service in: • Nov. 2017 • Nov. 2019	1	Deprived district with teenage pregnancy being an issue as well as TB due to migration from neighbouring Burkina Faso	The community will benefit from the VRA's Community Development programme which provides among others, support for health facilities in project impacted communities..
District Education Services in Nov. 2017	1	Need for the District to benefit from the VRA Community Development programmes that students are provided with scholarships and the provision of free text books	The community will benefit from the VRA's Community Development programme which provides among others, educational scholarships to needy students in project impacted communities.
Northern Electricity Distribution Company in Nov. 2017	1	As NEDCo will be the off taker, there is the need for greater collaboration in project implementation to ensure all concerns are addressed.	VRA will endeavour to collaborate with NEDCo throughout the project implementation phases.
Proprietors of neighbouring facilities in Nov. 2018	1	Would there be job opportunities for the youth in the area when the construction of the project commences?	The project contractor will definitely consider employing people within the locality of the proposed project.
	2	Can the solar panels cause any health issues such as skin cancer?	No.
	3	When will construction of the project commence?	It is scheduled to begin in the fourth quarter of 2020.

Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response/action from VRA Team
	4	Is the electricity generated from the Solar Plant for the Bongo Community?	Electric energy generated will be fed into the national grid via a substation to be located in Bolgatanga; for the benefit of all. However, the voltage fluctuations that is currently being experienced in the region will be greatly reduced as a result of the availability of power and reduced transmission loss from transporting electricity over long distances.
	5	When should the sensitization of the pupils and community regarding the movement of constructional materials to and from the project site begin?	The project sensitization should begin immediately. The pupils should be instructed not to run after big trucks or cars; they should not undertake any stone-throwing activities around the project site when the project commences.

APPENDIX 6:
Pictures from Stakeholder Engagement

Meeting with Bongo Traditional Authority

Presentation of Scoping Report to Bongo Naaba

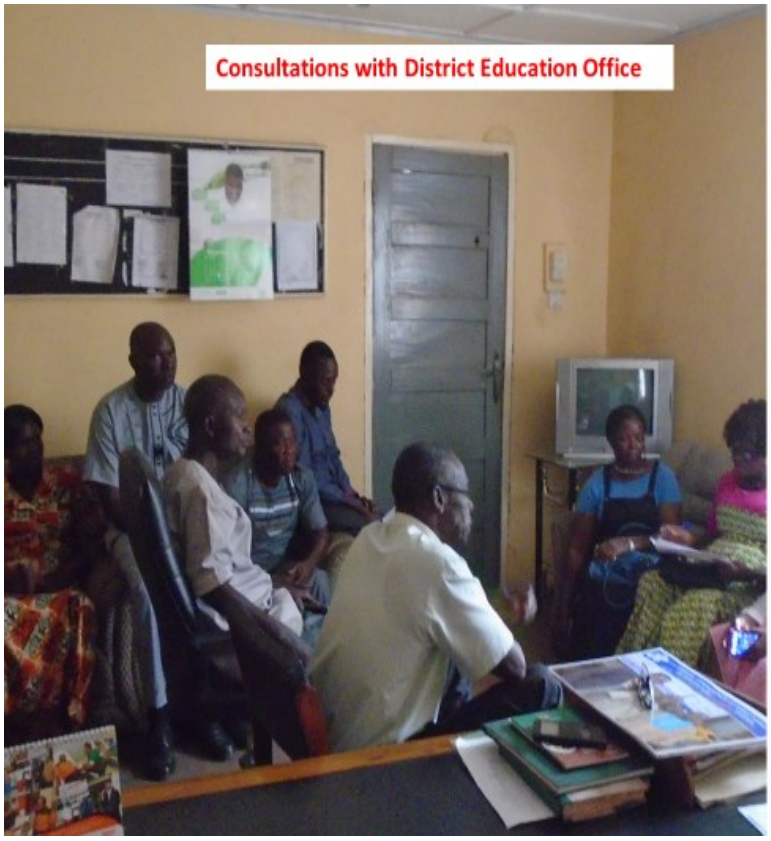

Meeting with Chief of Soe


Meeting with Chief & Opinion Leaders of Asibiga

Meeting with Official of NEDCo

Consultations with the Upper East Regional Coordinating Council

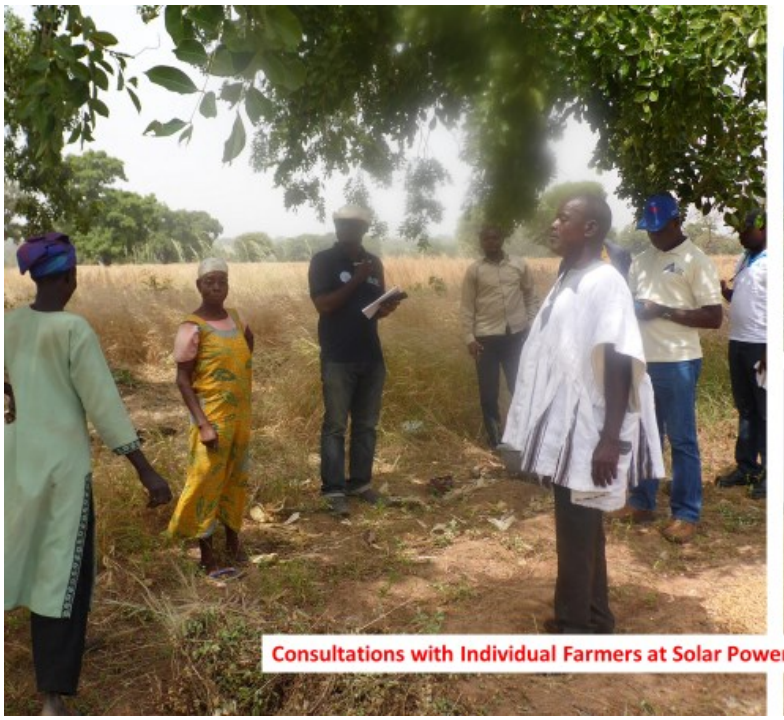
Consultations with the Bongo District Assembly



Consultations with District Education Office

Consultations with District Fire Service

Consultations with District Health Service



Consultations with Individual Farmers at Solar Power Plant Site at Asibiga

Consultations with Individual Farmers at Solar Power Plant Site at Asibiga

Consultations at Adaboya JHS

Consultations at Tindomboko JHS

Consultations at Tindomboko JHS

Consultations at Adaboya Primary


Consultations at Apatanga R/C JHS
Consultations at Apatanga R/C JHS


Consultations at Atampintin Primary
Consultations at Kabre DA Primary


Consultations at Akulyoo DA Primary
Consultations at Christ the King R/C Primary
Consultations at Light Academy

APPENDIX 7:
List of Interested & Affected Persons

Stakeholder	Name	Position	Contact Number
Bolgatanga Regional Coordinating Council	Ayambire Akaditi	Deputy Director	0244884712
	Godwin A. Nkuru	Public Relation Officer	0209378764/ 0547333272
	Hon. James Zoogah	Immediate Past Regional Minister	
	Hon. Daniel Aweyme Syme	Immediate Past Deputy Regional Minister	
Bolgatanga Municipal Assembly	Edward Ayagle	Municipal Chief Executive	038-20-22214 / 22534
Bongo District Assembly	Ebenezer Asomaning	Water & Sanitation Engineer	0249419063
	Issaka Mohammed	Internal Audit	0200330607
	Sibaway Ahmed	District Budget Office	0244458910
	Fawei Issifu Mohammed	District Coordinating Director	0243645512
	Abubakar W.A Bila	District Planning Officer	0243768724
	David Aruk	Head Of Works	0249364844
	Mohammed Mubarak	Senior Procurement Assistant	0244011002
	Ayinbisa A. Peter	District Chief Executive	0244940509
	Atayom Cosmos Mba	Assemblyman	0200211240
	Joseph Arizie	Area Engineer	0208156299
	Yakubu Bukari	Technician Engineer	0208777191
Bongo District Health Administration	Bantin Cabral	DNO	0200956334
	Aminu Mashoud	Deputy Chief Accountant	0507369910
	Yamusah Salifu	CHPS Coordinator	0203030001
	Faustina Anabile	Enroll Nurse, Adaboya Clinic	0245721944/0507361822
Bongo District Education Office	Ayamga Christiana	AD II/ CPC	0242388575
	Yadeh Evelyn	AD II/SHEP	0209021852
	Adindaa Rose	AD I/2ND Cycle Coordinator	0207928251
	James Asampana	AD II/BUDGET	0208784246
	Linus Akolgo Amigra	PS/ STATISTICS	0246924278
	Stephen Akuba	AD I / SENCO	0246776500

Stakeholder	Name	Position	Contact Number
	Abamah Rita	AD II/ DGEO	0203104846
	Awine David K.	A/D SUPERVISION	0200816055
	Nicholas N. Kolog	A/D HRMD	0243635330
	Ayariga Joseph A	C/S, SOUTH	0208379158
	Agambure Paul	C/S, NORTH	0203517670
Northern Electricity Distribution Company	Frank Akligo	Managing Director	0208162454
	Moses Tawiah	Director, Engineering Services	0244546588
	Mohammed Tayeb Tampuri	Electrical Engineer	0548588853
	Ms. Victoria Kotia Bugri	Area Manager	0205687785
	Joseph Arizie	Area Engineer	0208156299
	Justice Abban	Engineer	0200795502
	Moses Anaba	Senior Watchman	0209779731
Bongo Customary Land Secretariat	Musah Salifu	Coordinator	
Bongo Traditional Authorities	Bonaba Baba Saklifu Lemyaaron	Paramount Chief	0249805087
	Anafo Ako	Chief of Asibiga	
	Aviiga Nyaaba	Chief of Soe	
	Naazo Anaba	Chief Linguist	
	Atayom Cosmos	Assemblyman	0200211240
	Sam Abata	Elder	0244118640
	Azengoo Aduko	Elder	0246913800
	Apolle Mwee	Elder	
	Aduko Agana	Elder	
	Ishmeal Salifu	Elder	0243931129
	Yinne-Tun Abudu	Elder	
	Asampana Abugalaa	Elder	

Stakeholder	Name	Position	Contact Number
	Ayam Ga Adugbile	Elder	
	Azumah Anaba	Elder	
	Kobina Abugbile	Elder	0242383825
	Anamdita Ako	Opinion Leader	
	Ayamga Azubire	Opinion Leader	
	Anambila Anamdita	Opinion Leader	0206160201
	Elijah Aviiga	Opinion Leader	
	Paul Aviiga	Opinion Leader	
	Georgina Nyaaba	Opinion Leader	
	Musah Haruna	Opinion Leader	
	Martha Nyaaba	Opinion Leader	
Ghana National Fire Service	Aduko Nyaaba Joseph	Leading Fireman	0506373144
	Ayiredine Patritus	Station Officer II	0249443588
	Abaje Sixtus Kaba	Assistant Station Officer	0506110303
	Salifu Mariam	Leading Fire Woman	0245983346
	Adugbire John	Subordinate	0508165238
	Felix Akpaloo	District Fire Officer	0249721923
Irrigation Company of Upper Region (ICOUR) – Vea Irrigation Project	Alhaji Issah Bukari	Managing Director	0244577663
	Sebastian Bagira	Deputy Managing Director	0244599393
	Iddrisu Seidu	HR Manager	
Lands Commission (Upper East Region)	Charles Agama	Regional Valuer	0244535106
	Erxi Mwin	Regional Lands Officer	0202857941
Farmers	Abongo Asempana	Farmer	
	Aduko Asempana	Farmer	
	Anamdita Arku	Farmer	
	Asabsu Anaafo	Farmer	

Stakeholder	Name	Position	Contact Number
	Akologu Anaafo	Farmer	
	Awini Ngange	Farmer	
	Ayambila Muntala	Farmer	0202384178
	Akaliga Nyamba	Farmer	
	Mba Akiske	Farmer	
Yabatua Shrine / / King Kalaga Shrine / old isolated ancestral grave	Anamdita Ako	Caretaker	
Tindana Sacred Grove	Atayom Cosmos	Assemblyman	0200211240
Adaboya Primary	Anaamdingo A. John		0248069981
	Awuni Michael Adabre		0247434834
	Asauyuure Baifare A.		0547748773
	Opuriga Onayine John		0241115408
	Ayamga Awine Raymond		0201117516
	Aniah Joshua A.		0240874785
Adaboya JHS	Atibire Barnabas		0246188066
	Akurigo A Joseph		0547487410
	Akurugo John		0246068563
	Adongo A. Robert		0502971129
	Atanga Francis A.		0243928680
Tindomboko JHS	Nyaaba Thomas		0246557446
	Mbelimah Michael		0547053903
	Santos Adombila		0244699179
	Anyorka Janet		0548494370
	Timothy Vifah		0243733436
	Agekine Jonathan		0551486034
	Atanga Christopher		0248912436

Stakeholder	Name	Position	Contact Number
	Mba Christopher		0206386100
	Abdul Raheem Saheed		0249238351
Ghana Daa Primary	Awongya Philemon		0242363188
	Atuuya Joseph		0249743772
	Akoigo John Atiah		0249718219
	Yenaa Mba Gideon		0247155163
	Aduko Moses Azudaa		0248541242
Apatanga R/C JHS	Nsoh Sunday Akolbila		0246054733
	Awafo Clement A.		0241823202
	Akondoo John		0554065204
	Ayamga Mathew A.		0204511514
	Adia Raymond		0209517045
	Apuko A. Samuel		0249860553
	Azeko Ibrahim A.		0248404488
	Atia Samuel A.		0249214851
	Tampuri Vitalis A.		0205085451
Atampintin JHS	Abongo Isaac A.		0245831599
	Akurugo Clothilda N.		0554111042
	Ndemah Felix A.		0242088678
	Gerald Anamjongya		0244970190
	Achaglinkame Patricia A.		0547636076
	Asaah Francis Mbayaaba		0240859150
	Ania Adulo Simon		0248965522
	Ayesa Pius A.		0248674287
	Abelewine Gifty		0554637118
	Aduko Vida A.		0248549086

Stakeholder	Name	Position	Contact Number
	Amidu Wasila		0204225960
Atampintin Primary	Atanga Abel		0540687752
	Atanga Martin		0549299072
	Apokate Ebenezer		0203171410
	Awaafo Godwin		0200552621
	Mumuni Mahamada		0247157585
	Asaama Moses		0203782705
	Ayamga Jennifer		0249686612
Kabre D/A Primary	Akongyire Ezekiel		0548792138
	Atings Anaba Emmanuel		0548885449
	Awuni Emmanuel		0543382720
	Apii Lawrence		0246527304
Akulyoo Primary	Akafari Emmanuel		0246184833
	Alule Richard		0245985671
	Nboka Matthew		0245275450
	Nyaba Jennifer		0248227275
Christ The King R/C Primary	Ababire Tardon Adagwine		0240121562
	Grace A. Akasiya		0209287842
Light Academy	Ayambire Nicholas		0547180970
	John Faith		0559467681
	Akaabila Gladys		0547356780

COMMUNITY CONSULTATIONS

NAME OF PROJECT: 20 MW Bongo Solar Project

Name of Community: Bongo **District:** Bongo **Region:** Upper East

Date: 30/10/2017 **Time:** **Venue** Palace

	Name of Participant	Rank Title	Mobile No.	Sex		Age Group		
				M	F	<30	30-49	>50
1	Bonabe Baba Salifu Lemigaron	Paramount Chief	0249805087	✓				✓
2	Hon. Cosmos Atayom	Assbly member	0200211240	✓		✓		
3	Sam Abotr	Family member	0244116640	✓			✓	
4	Azangeo Adwko	✓ ✓	0246913800	✓			✓	
5	Nagzo Anabo	Chiefs Linguist	—	✓		✓		
6	Apolle Mwee	Family member	—				✓	
7	Adwko Agama	✓	—					✓
8	Ishmael Salifu	✓	0245931129	✓		✓		
9	Yisine-tiim Abodw	✓	—	✓			✓	
10	Asampana Abugdag	✓	—	✓			✓	
11	Ayemga Adugbile	✓	—	✓			✓	
12	Azumah Anabo	✓	—	✓		✓	✓	
13	Kobina Abugbile	✓	0242383825	✓				
14								
15								
	TOTAL							

40MW BONGO POWER PROJECT
STAKEHOLDER ENGAGEMENT ATTENDANCE SHEET

SECTION: Consultation with Schools

Date: November 27, 2019

No.	Name	Institution	Email	Telephone No.	Signature
1	Anaamdingo A. John	Adaboya prim.	atibilgjohn@gmail.comm	0248069981	[signature]
	Awuni Michael Atabre	Adaboya Prim	Michaelawuni64gmail.com	0242434834	[signature]
	Asanyuure Banifac A.	Adaboya Primary	asanyuure anaba@gmail.com	0547748723	[signature]
	Opuriga Anayine John	Adaboya Primary	anayinejohn@gmail.com	0241115408	[signature]
	Ayamga Asine Raymond	Adaboya Primary	ayamga asineraymond@mail.com	0201117516	[signature]
	Aniah Joshua A.	Adaboya Primary	aniatanga@gmail.com	0240874785	[signature]
	Atibire Barnabas	Adaboya JHS	barnabasati2014@gmail.com	0246188066	[signature]
	Akurigo A Joseph	Adaboya JHS	Akurigo Joseph @yahoo.com	0547487410	[signature]
	Akurugo John	Adaboya JHS	akurugojohn@gmail.com	0246088563	[signature]
	Adongo A. Robert	Adaboya JHS		0502971129	[signature]
	Atanga Francis A	✓ ✓	fatanga22@gmail.com	0243928680	[signature]
	Nyaaba Thomas	Tindomboko J.H.S	thomasnyaaba4@gmail.com	0246557446	[signature]
	Mbelimah Michael	✓ ✓	Michaelmbelima@gmail.com	0547053903	[signature]

	Santos Adombile	Tindomboko JHS	cedombile1474@gmail.com	0246991174	
	Anyorka Janet	Tindomboko JHS	anyorkajanet@gmail.com	0548424872	
	Timothy Vifah	Tindomboko JHS		0243733436	
	Agekine Jonathan	Tindomboko JHS	agekinejonathan@gmail.com	0551486054	
	Ayanga christopher	Tindomboko JHS	ayangachris2@gmail.com	0248912436	
	Mba christopher	Tindomboko JHS	Chr8tphr@gmail.com	0206886100	
	Abdul Raheem Sahead	Tindomboko J.H.S	agarasaeed1@gmail.com	0249238351	
	Alalongya Philemon	Ghana Da'a Primary	awongya.pa@gmail	0242363188	
	Atuuya Joseph	Ghana Da'a Primary	atuuyajoseph@gmail.com	0249743772	
	Akolgo John Atiah	Ghana Da'a Primary	Johnfiah024@gmail.com	0249718219	
	Tenaa Mba Gideon	Ghana Da'a Primary	yenaambagideon@gmail	0247155163	
	Aduko Moses Azudaa	Ghana Da'a primary	Adukomosesazudaa@gmail.com	0248591242	

40MW BONGO POWER PROJECT
STAKEHOLDER ENGAGEMENT ATTENDANCE SHEET

SECTION: Consultation with Schools

Date: 27 Nov. 2019

No.	Name	Institution	Email	Telephone No.	Signature
1	Nsoh Sunday Akolbila	Apatanga RIC JHS		0246054733	
2	AWATO CLEMENT A	Apatanga RIC JHS		0241823202	
3	Akondoo John	" "		0552406520	
4.	Ayamga Mathew A.	Apatanga RIC JHS		0204511514	
5.	Adia Raymond	Apatanga RIC JHS	ayamgararaymond233@yahoo.com	0209517045	
6	Apuko A. Samuel	Apatanga R/C J.H.S.		0249860553	
7	Azeko Ibrahim A	" "	azekoibrahim@gmail.com	0248404698	
8	ATIA SAMUEL A.	" "		0249294857	
9	Tampuri Vitalis A.	Apatanga RIC JHS.	Abagnavitalis@gmail.com	0250854	

40MW BONGO POWER PROJECT
STAKEHOLDER ENGAGEMENT ATTENDANCE SHEET

SECTION: Consultation with Schools

Date: Nov. 28, 2019

No.	Name	Institution	Email	Telephone No.	Signature
1.	Abongo Isaac A.	Atampintin JHS	abongoisaac12@gmail.com	0245831599	
2.	Akurugo Clothilda N.	Atampintin JHS	akurugoclothilda@gmail.com	0554111042	
3	Ndewale Felix A.	Atampintin JHS	Felix[illegible]zubila@gmail.com	0242058678	
4	Gerald Anamjongya	Atampintin JHS	agerald100@gmail.com	0244970190	
5	Achaglintame Patricia A.	Atampintin JHS	patriciaawoonnate@gmail.com	0547636076	
6	Asaah Francis Mbagaba	Atampintin JHS	asaahfrancismbagaaba@gmail.com	0240859150	
7	Anie Aduko Simon	Atampintin JHS	adukosimonsimon@gmail.com	0248865522	
8	Ayesa Pius A.	✓ ✓ ✓	ayesapius@gmail.com	0248674287	
9	Abelewine Gifty	— — —	giftyabelewine88@gmail.com	0554637118	
10	Aduko Vida A	✓	adukovida123@gmail.com	0248549082	
11	Amidu Wasila	✓	amiduwasila06@gmail.com	0204225985	
12	Atanga Abel	Atampintin Jhs	atangaabel80@gmail.com	0540687752	
13	Atanga Martin	✓	atangamartin1987@gmail.com	0542[illegible]	

14	APOKATE EBENEZER	ATAMPINTIN PRIM.	apokate ebenezer @gmail.com	0203171410	[signature]
15	Awaato Godwin	✓		020055264	[signature]
16	Mumuni Mahamadu	✓		0247157585	[signature]
17	ASaana Moses	✓		0203782705	[signature]
18	Ayamga Jennifer	✓		0249686[illegible]	[signature]
19	Akongyire Ezekiel	Kabre D/A Prim	Ezekiel adadaar .g mail.com	0548792138	[signature]
20	Atinga Anaba Emmanuel	Kabre D/A Primary		0548885449	[signature]
21	Awuni Emmanuel	Kabre D/A Primary		0543382720	[signature]
22	Apii Lawrence	Kabre D/A primary	lawrenceapii3@gmail.com	0246527304	[signature]
23	Akatari Emmanuel	Aksuyoro D/A Prim.		0246174853	[signature]
24	Alute Richard	✓	[illegible]richard1983@[illegible].com	0245983621	[signature]
25.	Nboka Matthew	✓	Atranboka matthew@gmail.com	0245273450	[signature]
26	Nyaaba Jennifer	✓	jennifernapotele@gmail.com	0248227218	[signature]
27	Ababire Tanson Adagwine	Christ the King R/c prim.	www.ababireTanson.Com	024021562	[signature]
28	Grace A-Akasiya	" " " "		0209287842	[signature]

40MW BONGO POWER PROJECT
STAKEHOLDER ENGAGEMENT ATTENDANCE SHEET

SECTION: Consultation with Schools

Date: Nov. 28, 2019

No.	Name	Institution	Email	Telephone No.	Signature
	Ayambire Nicholas	Light Academy		0547180970	
	John Faith	Light Academy		0559467681	
	Akaabila Gladys	Light Academy		0547256280	

COMMUNITY CONSULTATIONS

NAME OF PROJECT: Bongo Solar Project

Name of Community: Bongo. District: Bongo Region: Upper East

Date: 31/10/17 Time: 10:05am Venue DHI Health Office

	Name of Participant	Rank Title	Mobile No.	Sex		Age Group		
				M	F	<30	30-49	>50
1	Bonfin Gabriel	DHO	0200956334	✓			✓	
2	Amina Matthews	Deputy Chief Accountant	0507369910	✓			✓	
3	Yamusah Salifu	CHPS Coordinator	0208039001	✓			✓	
4								
5								
6								
7	FIRE SERVICE OFFICE							
8	LFM Aduko Nyaaba Joseph	Leading Fireman	0506373144	✓			✓	
9	Ayiredine Patrikus	Station Officer II	0249443588	✓			✓	
10	Asst O Abagi Silas Kaba	Assist Station Off.	0506110303	✓			✓	
11	Lfw Salifu Mariam	Leading Fireman	0245983346		✓	✓		
12	Sub O Adugbire John	Sub Officer	0508165238					
13	ADO II ~~FELIX~~ AKPALOO	DFO	0249724923					✓
14								
15								
	TOTAL							

COMMUNITY CONSULTATIONS

NAME OF PROJECT:

Name of Community: District: Bongo Region: Upper East

Date: 31/10/17 Time: Venue Bongo Dist Education office

	Name of Participant	Rank Title	Mobile No.	Sex		Age Group		
				M	F	<30	30-49	>50
1	AYAMGA CHRISTIANA	AD II / CPC	0242388573		F		✓	
2	YADEH EVELYN	AD II / SHEP	0209021852		F		✓	
3	ADINDAA ROSE	AD I / 2ND CYCL CO-ORD	0207928251		F		✓	
4	JAMES ASAMPANA	AD II / BUDGET	0208784496	✓	M		✓	
5	LINUS AKOLGO AMIGRA	PS / STATASTICS	0246924278	✓	M		✓	
6	STEPHEN ASUBA	AD I SENCO	0246776900	✓	M		✓	
7	Abamah Rita	AD II / DGED	0203104846		F		✓	
8	Awine David K.	AD Supervision	0200816055	✓	M			✓
9	NICHOLAS N. KOLOG	AD HRMD	0243635330	✓				✓
10	AYARIGA JOSEPH A	C/S, SOUTH	0208379158	✓				✓
11	AGAMBURE PAUL	C/S, NORTH	0203517070	✓			✓	
12								
13								
14								
15								
	TOTAL							

COMMUNITY CONSULTATIONS

NAME OF PROJECT: 20MW BONGO SOLAR POWER.

Name of Community: District Assembly District: BONGO Region: UPPER EAST

Date: 30/10/2017 Time: 2:40pm Venue DISTRICT ASSEMBLY

	Name of Participant	Rank Title	Mobile No.	Sex		Age Group		
				M	F	<30	30-49	>50
1	Ebenezer Asomaning	Water & Sanitation Eng	0249419063	✓			✓	
2	Issaka Mohammed	Internal Aud	020033060??	✓			✓	
3	Siyawey Ahmed	Dis. Budget off	02444589[illegible]	✓			✓	
4	Fawei Issifu Mohammed	Dist. Coord Dir	0243645512	m			✓	
5	Abubakar W.A. Bila	Dist. Planning Officer	0245768724	✓			✓	
6	David Ariuk	Head of Works	0249364844	✓				✓
7	Mohammed Alhasrack	Snr. Proc. Assistant	0244011082	✓			✓	
8	Ayintisa A Peter	Asst. Chief. Exe	0244940509	✓			✓	
9	Atayom Cosmos Mba	Assemblyman	0208211240	✓			✓	
10	Joseph A. Arizie	Area Engr. Bolga	0208156299 0208156299	✓				
11	Yakubu Bukari	Technician Engr.	0208777191 020877[illegible]	✓			✓	
12								
13								
14								
15								
	TOTAL							

COMMUNITY CONSULTATIONS

NAME OF PROJECT: 20 MW Bongo Solar Project

Name of Community: Bongo District: Bongo Region: Upper East

Date: 30/10/2017 Time: Venue Palace

	Name of Participant	Rank Title	Mobile No.	Sex		Age Group		
				M	F	<30	30-49	>50
1	Bonabe Baba Sahjo Lemgarm	Paramount Chief	0249805087	✓				✓
2	Hon. Cosmos Adongo	Assbly member	0200211240	✓		✓		
3	Sam Aboke	family member	0244116540	✓			✓	
4	Azamgeo Adelco	✓ ✓	0246913802	✓			✓	
5	Naazo Anabe	Chiefs Linguist	–	✓		✓		
6	Apolle Mwee	Family member	—				✓	
7	Adelko Agamo	✓	—					✓
8	Ishmael Sahjo	✓	0243931129	✓		✓		
9	Yinne-tim Abudu	✓	—	✓			✓	
10	Asampana Abugalas	✓	—	✓			✓	
11	Ayem ga Adugbile	✓	—	✓			✓	
12	Azumal Anabe	✓	—	✓		✓	✓	
13	Kobina Abugbile	✓	0242383825	✓				
14								
15								
	TOTAL							

APPENDIX 8:
Impact Assessment Sheet

Nature of Impact	Impact Criteria																				Score	Impact Significance Before Mitigation
	Potential Intensity					Spatial Extent					Duration					Probability						
	16	8	4	2	1	1	2	3	4	5	1	2	3	4	5	0.1	0.25	0.5	0.75	1		
	Very High	High	Medium	Medium Low	Low	Site Specific - PV & Sub Transmission Line	Local (<10 km from PV /Transmission Site)	Regional (Upper East Region)	National (Ghana)	International/Global	Temporal (Less than 2 Years)	Short Term (2-5 Years)	Medium Term (5-15 Years)	Long Term (> 15 Years)	Permanent	Unlikely (<10%)	Low Probable (10 - 25%)	Medium Probable (25 - 50%)	High Probable (50 - 90%)	Definite (>90%)		
POSITIVE IMPACTS - CONSTRUCTIONAL																						
Increase In Employment Opportunities			1					5					1					1			7	Medium Positive
POSITIVE IMPACTS - OPERATIONAL																						
Minimisation of GHG			4					5					4					1			13	High Positive
Increase In Employment Opportunities			2					2					4					1			8	Medium Positive
Stabilization of Electricity			2					3					4					1			9	Medium Positive
Promotion of Economic Growth			2					2					4					0.75			6	Medium Positive
Average of Summary Rating of Positive Impacts - Operational Phase																					9	Medium Positive
NEGATIVE IMPACTS - PRE-CONSTRUCTIONAL PHASE																						
Land Acquisition			2					1					4					1			7	Medium Negative

NEGATIVE IMPACTS - CONSTRUCTIONAL PHASE						
Increase in GHG	1	5	1	1	7	Medium Negative
Noise & Vibration	2	2	1	1	5	Medium Negative
Air Quality	4	2	1	0.5	3.5	**Low Negative**
Topography & Drainage	4	1	2	1	7	Medium Negative
Water Resources	4	2	2	0.5	4	**Low Negative**
Geology & Soils	1	1	1	0.25	0.75	Very Low Negative
Waste	2	1	1	0.5	2	**Low Negative**
Landscape & Visual Intrusion	2	1	1	1	4	**Low Negative**
Ecology	2	1	4	1	7	Medium Negative
Historical & Cultural Heritage Resources	2	2	1	0.75	3.75	Low Negative
Occupational Health & Safety	4	5	1	0.50	5	Medium Negative
Land Acquisition	1	1	4	0.1	0.6	Very Low Negative
Land Use	4	1	4	1	9	Medium Negative
Labour & Working Conditions	2	5	1	0.25	2	**Low Negative**
Community, Health, Safety and Security	2	2	1	0.50	2.5	**Low Negative**
Traffic & Transport	8	3	1	0.75	9	Medium Negative
Gender & Vulnerability	1	3	3	0.25	2	Very Low Negative
Average of Summary Rating of Negative Impacts - Constructional Phase					**4.36**	**Low Negative**
NEGATIVE IMPACTS - OPERATIONAL PHASE						
Increase in GHG	1	5	4	0.25	2.5	**Low Negative**
Noise & Vibration	1	1	4	0.25	1.5	Very Low Negative

Air Quality	1	1	4	0.1	0.6	Very Low Negative
Topography & Drainage	1	1	4	0.1	0.6	Very Low Negative
Water Resources	1	2	1	0.1	0.4	Very Low Negative
Geology & Soils	1	1	1	0.25	0.75	Very Low Negative
Waste Generation	1	1	4	0.25	1.5	Very Low Negative
Landscape & Visual Intrusion	1	1	4	0.25	1.5	Very Low Negative
Ecology	1	1	1	0.25	0.75	Very Low Negative
Historical & Cultural Heritage Resources	1	1	1	0.25	0.75	Very Low Negative
Occupational Health & Safety	1	1	4	0.25	1.5	Very Low Negative
Land Acquisition	1	1	4	0.5	3	**Low Negative**
Land Use	1	1	4	1	6	Medium Negative
Labour & Working Conditions	1	3	1	0.25	1.25	Very Low Negative
Community, Health, Safety and Security	1	2	4	0.25	1.75	Very Low Negative
Traffic & Transport	1	2	4	0.25	1.75	Very Low Negative
Gender & Vulnerability	1	2	4	0.10	0.7	Very Low Negative
Average of Summary Rating of Negative Impacts - Operational Phase					**1.52**	Very Low Negative
Average of Summary Rating of Negative Impacts					4.	**Low Negative**
NEGATIVE IMPACTS - DECOMMISSIONING					**4.0**	**Low Negative**
Noise & Vibration	1	1	1	0.5	1.5	Very Low Negative
Air Quality	2	1	1	0.5	2	**Low Negative**
Solid Waste	2	5	1	1	8	Medium Negative

Community, Health, Safety and Security	2	5	1	0.50	4	**Low Negative**
Traffic & Transport	2	3	1	0.75	4.5	**Low Negative**