Kpong Dam Rehabilitation Project in the Lower Manya Krobo Municipal of the Eastern Region, Ghana

ENVIRONMENTAL IMPACT STATEMENT
Draft Report

VOLTA RIVER AUTHORITY

SEPTEMBER 2024

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:

1. Make environmental considerations a priority in all business planning and decision-making and comply with relevant national and international environmental protection regulations.
2. 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.

Approved: Date: 18 – 6 – 2019

Emmanuel Antwi-Darkwa
CHIEF EXECUTIVE

VOLTA RIVER AUTHORITY

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Report Name	Environmental Impact Statement - Kpong Dam Rehabilitation Project
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Date	September 2024

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ABBREVIATIONS

AAR	-	Alkali-Aggregate Reaction
AGS	-	Akosombo Generating Station
AoI	-	Area of Influence
ASCE	-	American Society of Civil Engineers
AU	-	African Union
BID	-	Background Information Document
CAP	-	Criteria Air Pollutants
CCRA	-	Climate Change Resilience Assessment
CFMP	-	Corporate Carbon Footprint Management Programme
CIA	-	Cumulative Impact Assessment
CIRIA	-	Construction Industry Research and Information
CRO	-	Community Relations Officer Corruption
CSR	-	Corporate Social Responsibility
DSA	-	Dam Safety Assessment
EHSGs	-	Environmental, Health and Safety Guidelines
EIA	-	Environmental Impact Assessment
EIB	-	European Investment Bank
EIS	-	Environmental Impact Statement
EMC	-	Environmental Monitoring Coordinator
EMP	-	Environmental Management Plan
EPA	-	Environmental Protection Agency
EPP	-	Environmental Protection Plan
ESF	-	Environmental and Social Framework
ESHS	-	Environmental, Social, Health & Safety
ESIA	-	Environmental and Social Impact Assessment
ESS	-	Environmental and Social Standard
EU	-	European Union
FPIC	-	Free, Prior and Informed Consent
GES	-	Ghana Education Service
GHG	-	Green House Gas
GIA	-	Gender Impact Assessment

GM	-	Grievance Mechanism
HGV	-	Heavy Goods Vehicles
I&APs	-	Interested and Affected Persons
ILO	-	International Labour Organisation
KDRP	-	Kpong Dam Rehabilitation Project
KGS	-	Kpong Generating Station
LMKM	-	Lower Manya Krobo Municipality
MA	-	Municipal Assembly
MAP	-	Mitigation Action Plan
MCE	-	Municipal Chief Executive
MoEn	-	Ministry of Energy
MoF	-	Ministry of Finance
MSDS	-	Material Safety Data Sheet
MW	-	Mega Watts
NADMO	-	National Disaster Management Organization
NCCAS	-	National Climate Change Adaptation Strategy
NDT	-	Non-Destructive Testing
NEDCo	-	Northern Electricity Distribution Company
NGO	-	Non-Governmental Organization
NLD	-	National Level Datum
O&M	-	Operations and Management
PHC	-	Population Housing Census
PLC	-	Programmable Logic Controller
PPE	-	Personal Protective Equipment
PWD	-	Person with Disability
SCADA	-	Supervisory Control and Data Acquisition
SDGs	-	Sustainable Development Goals
STEM	-	Science, Technology, Education and Mathematics
UNFCCC	-	United Nations Framework Convention on Climate Change
VRA	-	Volta River Authority
WB	-	World Bank
WRC	-	Water Resource Commission
WRI	-	Water Research Institute

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NON-TECHNICAL SUMMARY

Scope, Purpose, and Objectives of The Project

1. The Kpong Generating Station (KGS) is a 160MW Hydroelectric Power Plant located in Akuse in the Lower Manya Krobo Municipality (LWKM) of the Eastern Region, Ghana. The KGS is operated by the Volta River Authority (VRA), and as part of its operation and maintenance actions, the VRA intends to undertake the following rehabilitation works at the power plant:
   a) Repair of the displaced rockfill dyke on the face of the upstream slope of the Kpong Dam to ensure the proper operation and function for the next 50 years. It will involve the revision and improvement of the existing slopes as well as the proper rock grading on the 2 dykes and River dam and an update of the instrumentation systems.
   b) Rehabilitation of all fifteen (15) spillway gates to ensure the proper operation and function of the gates for the next 25 years.
2. The project known as the "**Kpong Dam Rehabilitation Project**" (KDRP), is herein after referred to as the "Project".
3. The overall objective of the KDRP is to support the energy transition in Ghana towards more sustainability and resilience, the main objective being to enhance and maintain the structural integrity of the Kpong Dam to ensure continuous clean power generation. The Specific Objectives are to:
   a) Extend the safety of existing assets by at least 25 years so to maintain the availability of green electricity in Ghana.
   b) Contribute to the reduction of floods downstream in the areas of the dam and ensure the safety of the population.

Brief Project Description

4. The rehabilitation of a hydro power plant dyke involves dredging and surface works as well as Supply and placement of course and fine rockfill and fillers including ancillary works. The contractor shall be required to acquire and transport boulders from nearby quarries, and the most likely ones are those at the Shai Hills, located within 25km – 37km radius from the site. An estimated volume of rock is about 150,000 cubic meters will be required. Rock placement shall involve using rocks or riprap to stabilize and protect the dyke from erosion and other forms of degradation and this activity will be done using an excavator on a floating barge, where about 5 to 40kg and the 45/125mm light grading rock will be placed overboard, as required.

5. Rehabilitation of hydropower spillway gates requires specialized equipment to ensure the safety, efficiency, and longevity of the structures. For the purposes of reservoir management, the repair works on the gates would be planned to ensure that adequate number of gates are always available to allow for managing the reservoir if required. The Consultant shall be required to carefully dismantle and remove the existing gates and ensure safe handling and disposal of old materials.
6. Associated with the KDRP, will be the rehabilitation of a 10km stretch of road from the Okwenya Junction to the Akuse Town, which serves as part of the access road to the project site. The rehabilitation of the road will form part of the social benefit of the project.
7. The rehabilitation of the dyke would be scheduled to be completed within 18 months and the spillway gates repair works within four years. The project is expected to commence in Q4 of 2025 for a period of four (4) years.
8. KDRP is being co-funded by the VRA, European Investment Bank (EIB) and the European Union (EU). Currently, the financials for the different work components available are only high-level estimates and this is about €60.0 Million.
9. The VRA Operational & Maintenance Team is responsible for monitoring the dam and its related dykes/spill gates.

Legal Basis of The Project

10. Within the context of the Environmental Assessment Regulations, LI 1652 of 1999, existing projects prior to the promulgation of the law such as the Kpong GS are mandated to submit Environmental Management Plans (EMP) for the purposes of being issued with Environmental permit. VRA has subsequently complied with this and has been issued with an Environmental Permit for the Kpong Hydropower Station. The Permit mandates the VRA to notify the EPA of any changes in the existing operations, including, systems modifications and changes. Thus, the proposed project will have to be communicated to the EPA.
11. VRA in May 2024, with an accompanying project concept note, formally informed EPA on the project and how it intends to address the environmental requirements of the project. Following this, the EPA in June 2024, advised that the project falls into the category for which an EIA is required. VRA was subsequently requested to undertake the EIA and submit six hard copies of the EIS Report for review, and that there was no need for a Scoping Report as the Project Concept Note had identified the key issues to be addressed which should serve as the Terms of Reference for the study.
12. To ensure adherence to both the Ghana EPA and EIB environmental requirements, VRA has prepared this EIS Report, which is to guide the rehabilitation project and is specific to the project. Even though it is a standalone document, it is part of the suite of documents that

have been prepared as part of the environmental assessment process to ensure adherence to international safeguards and represents one of three (3) reports.

13. Other associated reports are the:
    a) Environmental & Social Management Plan
    b) Stakeholders Engagement Plan
    c) Labour & Worker Conditions Management Plan

Data Collection Methodology

14. The environmental assessment has been undertaken by a team of in-house experts from VRA. To achieve the objectives of the EIA requirements, a detailed baseline survey has been 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. For primary data, a site reconnaissance visit was done to collect baseline data in the context of physical and ecological environment as well as socio-economic and land use.

15. Baseline data on noise, air and water quality has been obtained from progress reports emanating for the routine monitoring activities of the VRA within the project area in line with the conditions of the existing EMP for the facility as well as onsite monitoring activities undertaken in August 2024, as part of this EIA study. The secondary data with maps and figures to supplement the primary social was collected through a literature review on the project as well as the project area and referenced as required. This was complemented with stakeholder engagements and desktop studies from similar work done in the project area.

Brief On the Baseline Data

16. KGS is located at Akuse, and the main access route to the project site will be via the Tema-Akosombo N2 Highway, some 90km from Accra and some 70km from Tema (travel time by car about 1½ hour from Accra and 1 hour from Tema). At Okwenya Junction, (about 55 km north of Tema harbour), access is via the minor arterial highway of the Akuse road. A total of 15,354 m^2 (1.534 Ha) land area is required for use as Office and Lay down areas for sandblasting, minor repairs, and material storage.

17. There are various communities and settlements in the vicinity of KGS. These include both planned residential areas and informal settlements, housing the workers of the power station and the local population engaged in various economic activities. Notable amongst them are the VRA Township, Akuse, Natriku, Fodzoku, Nuaso, Torgorme, Okwenya and Nyiflakpo. Within these communities are various sensitive receptors such as churches, mosques, prisons, and schools and these have been listed in the main report.

18. The communities also rely on the river and the reservoir for fishing, farming, and other livelihoods. The flat terrain is conducive to agriculture, and much of the land around the dam is predominantly used for agriculture. This includes farming of annual crops such as maize, cassava, and vegetables, as well as aquaculture due to the proximity to the Volta River and its reservoirs. Aside from this, perennial crops such as coconut, palm trees plantain and palm-nut are available and scattered in the area.

19. There are two fishing landing sites upstream and located close to the dam. One of them is the Natriku Landing site utilised by the Natriku community for fetching water, washing, and for berthing of canoes for the fishing activities. The other fishing landing site is close to the Akuse Watermanship Training Camp, which is under the Wajjr Barracks of the Engineering Training School of the Southern Command of the Ghana Armed Forces headed by the Commanding Officer.

20. Generally, the project area lies within the semi-equatorial climate belt with a mean annual rainfall ranging between 900mm to 1,150 mm. Relative humidity is high during the wet season, between 70% and 80%, and low in the dry season with about 55% to 60%. Other information provided on physical environment include both Corporate VRA as well as National GHG Gases Emissions, Ambient Noise Levels, Air Quality, Topography and Drainage as well as Geology & Soils, Seismic Activities, and natural hazards.

21. The project site is situated within the Southern Forest-Savanna Transition Zone between the moist, deciduous Southern Marginal Vegetation Zone and the Coastal / North Guinea Savanna Zone which support similar habitats. All but one of the recorded plant species are classified as ‘Least Concern’ (LC) according to the IUCN Red List of Threatened Species. This is the mahogany tree *Khaya senegalensis* which is a ‘Vulnerable’ (VU) species due to logging and local exploitation in parts of its global range (it is widespread in western and central Africa).

22. The Kpong Headpond currently also supports aquatic vegetation, including *Typha domingensis*, *Eichhornia crassipes*, *Nephrolepis biserrate* and *Nymphaea lotus*. The aquatic vegetation consists of 47 emergent, 12 free floating and four submerged species. Some invasive alien species (*Eichhornia crassipes*, *Cyperus papyrus* and *Salvinia molesta*) which were hitherto not present in the Volta River system have also invaded the waterbody.

23. Except for birds, the Kpong head pond and its environs is not home to any wildlife of conservation value. This is due to the intensive land use and human presence. All the species recorded are categorised as 'Least Concern' (LC) based on the IUCN Red List of

Threatened Species. The aquatic ecosystem of the Kpong reservoir is recognised for its rich diversity of fish species, contributing significantly to both local economies and ecosystem health.

24. There are no protected areas or key biodiversity areas in the immediate proximity to KGS. The closest conservation areas are the Shai Hills Forest Reserve, Kalakpa Resource Reserve, Keta Lagoon Ramsar site and the Songhor Ramsar Site. The Shai Hills Forest Reserve, which accommodates the monkey sanctuary, is along the Accra – Tema N2 Highway, which will be the route for the transportation of boulders to the project site.

25. With respect to socio-cultural baseline information, it is anticipated that the most significant impacts will occur within the Lower Manya Krobo Municipal Assembly and its environs. For this reason, the discussion of baseline socio-economic conditions was looked at within the context of the Lower Manya Krobo Municipal Assembly and key information provided covered the following:
    - 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; festivals etc).
    - Gender & Vulnerability

Impacts Identified

26. 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.

27. To identify key issues, a stakeholder mapping was done to identify those critical to be consulted during the process. A total of one hundred and fifteen (115) persons were directly engaged from August Sept. 2024, and this comprised of 96 males (83%) and 19 females (17%). Out of this number, 19 (17%) were below the age of 30 years, 53 (46%) were within the ages of 30-50 whilst 37 (32%) were above the age of 50 years.

28. 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 have been summarized.

29. The major positive and negative impacts identified are listed below:

Positive Impacts	Negative Impacts	
• Increased in Employment Opportunities. • Stabilization of Electricity • Reduction of Exposure to flooding • Production of low carbon electricity • Promotion of Economic Growth in the Country	• General apprehension by public • 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 • Impact on Ecological Environment • Occupational Health & Safety • Fire Hazards • Socio-economic impact such as labour and working conditions, Injury to public, Increase in traffic and road accidents. • Gender & Vulnerability

30. 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. Within this context, the cumulative impacts of the planned rehabilitation of the 10km Okwenya Junction - Akuse Road, which serves as transportation route for the project is assessed. The objective of the road repairs is to improve road safety and accessibility, particularly for transporting goods and materials to the dam during rehabilitation.

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 for easy transfer into all contractual documents with the 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 positive impact during the preconstruction/construction phases had an average rating score of 9.0 defined as **MEDIUM POSITIVE**, whilst the operational phase had a positive impact of 11.0 defined as **HIGH POSITIVE.**

33. The negative impact during construction had an average rating score of 3.6 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. These impacts primarily include temporary disturbances during construction, potential impacts on aquatic ecosystems, and concerns related to waste management, water quality, and occupational health and safety.

Monitoring

34. A provisional Environmental Management Plan (EMP) is provided as part of the EIS report. 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 also provides environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

35. VRA/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. It must be noted that KGS is an already existing facility, and the main objective of this project is to enhance and maintain the structural integrity of the dam to ensure continuous clean power generation. Activities under the operational and maintenance phases, relating to the two subprojects, specifically the dyke's rehabilitation and spillway gates repairs, are all part of already ongoing actions under this phase. Both direct and indirect impacts related to the existence and operation of the KGS have been captured in the underlisted documentations that guide the environmental management of the power plant.

    a) Environmental Management Plan for Akosombo & Kpong Hydroelectric Power Plants: September 2010 (First edition).
    a) Emergency Preparedness Plan for the Akosombo Dam and Kpong Dam, February 2011 (First edition)

37. These reports are updated every three years for the purpose of Environmental permitting, with the most recent being the 2022-2024 EMP report, and are relevant to the requirements of this EIS Report. These are therefore associated reports to this EIS Report and operational and maintenance phase impacts are not discussed.

Final Recommendation

38. The findings of the assessment indicate that while the project will yield significant positive outcomes, such as improved energy generation, flood control, and enhanced infrastructure longevity, there are potential adverse impacts on the environment and local communities.
39. 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 project and shall submit progress environmental reports to the EPA as required.
40. It is recommended that the Kpong Dam Rehabilitation Project proceed with the proposed mitigation measures and monitoring programs in place. This will ensure that the project achieves its intended objectives of enhancing energy security and water resource management while safeguarding environmental and social well-being.
41. The project shall also remain flexible to adapt to unforeseen environmental or social challenges, ensuring continuous improvement in environmental management and community relations throughout its life cycle.

TABLE OF CONTENT

List Of Appendices

LIST OF TABLES

FIGURES

LIST OF PLATES

1 INTRODUCTION

1.1 The Project

The Kpong Generating Station (KGS) is a 160MW Hydroelectric Power Plant located in Akuse in the Lower Manya Krobo Municipality of the Eastern Region, Ghana and is operated by the Volta River Authority (VRA). As part of its operation and maintenance actions, VRA intends to undertake the following rehabilitation works at KGS:

a) Repair of the displaced rockfill dyke on the face of the upstream slope of the Kpong Dam. It will involve the revision and improvement of the existing slopes as well as the proper rock grading on the 2 dykes and River dam and an update of the instrumentation systems to ensure the proper operation and function for the next 50 years.
b) Rehabilitation of all fifteen (15) spillway gates to ensure the proper operation and function of the gates for the next 25 years.

The works on the spillway gates and the dykes are necessary to ensure the sustainability of the dam and of the safety of the population surrounding and downstream of the dam in the Lower Volta Area. The development is known as the "**Kpong Dam Rehabilitation Project**" (KDRP), herein after referred to as the "Project". Associated with the project will be the rehabilitation of a 10km road network from Okwenya Junction to Akuse, all in the Lower Manya Krobo Municipal, to allow for the smooth haulage of materials and equipment during the project execution.

1.2 The Project Developer

The VRA is a public corporation established under the Volta River Development Act, 1961 (Act 46). Its function includes the generation of electric power for industrial and domestic uses in the country and the operation of a distribution system in the northern sector. VRA has diversified its power generation portfolio to take advantage of available and sustainable sources of energy, mainly hydro, natural gas, and renewables. VRA owns and operates a total installed electricity generation capacity of 2,547MW as of close of June 2024, comprising of hydro, thermal and solar power plants. Two main hydro plants, Akosombo and Kpong Generating Stations, both located on the Volta River, have installed capacity of 1,020MW and 160MW respectively (source: www.vra.com).

VRA's regulated customers are the Electricity Company of Ghana 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 (Togo and Benin), Compagne Ivoirienne d'électricité (La Cote d'Ivoire) and SONABEL (Burkina Faso).

1.3 Project Rationale

The VRA in 2023 undertook a preliminary assessment of the state of the facilities at the KGS. From the study, it was concluded that there was a need for some major repair works to ensure the proper operation and function of the spillway gates for the next 25 years. As part of this assessment, geotechnical and hydraulic analysis were also carried out for the upstream and downstream faces of the dyke structures. The downstream faces were found acceptable and required no remediation. However, the upstream face did not meet the requirements of current standards and therefore requires remediation due to the observed dicontinuous and distributed rockfill collapse. The dykes need to be completely revised and upgraded to handle significant loadings over a lifespan of 50 years with minimal damage.

It was recommended that these works with the revision of the operations of the dam will ensure a proper flow regulation, reduce the average number of people exposed to flooding below the dam and protect the power station. It is based on this that the VRA is implementing the KDRP. The Project is to be co-funded by the European Investment Bank (EIB) and the European Union (EU).

1.4 Objectives of Project

The overall objective of the KDRP is to support the energy transition in Ghana towards more sustainability and resilience, with the main objective being to enhance and maintain the structural integrity of the Kpong Dam to ensure continuous clean power generation.

The Specific Objectives are to

1. Extend the safety of existing assets by at least 25 years as to maintain the availability of green electricity in Ghana.
2. Contribute to the reduction of floods in the areas of the dam and a better safety of the population downstream

1.5 Project Benefits

1.5.1. Technical Benefits

Whereas a dams' purpose is to retain the water, the dykes protect the land behind it from flooding and Spillway gates are used to pass floodwater safely and in a controlled way. The 3 elements are necessary to ensure the proper functioning and the safety of the dam and its power plant. Thus, the rehabilitation works on the Spillway gates and dykes are necessary to ensure the sustainability of the dam and safety of the population surrounding the dam.

1.5.2. Environmental & Social Benefits

Over the last years, the number of people living downstream of the dam and impacted by flooded have increased. Due to climate change-exacerbated rainfalls, flow regulation by both Akosombo and Kpong dams will play a crucial role to reduce the average number of people exposed to flooding as well as protect the power station.

1.5.3. Economic Benefits

- This action aligns with Ghana's most urgent needs in the energy sector and complements programmes that targets technical and commercial losses to address the issues impairing the sustainability of the sector.
- The rehabilitation works will consolidate hydroelectric production by at least 25 years, at a lower cost at a time when Ghana needs to rebalance the financing of its electricity sector and consolidate its production of low-carbon electricity.
- By consolidating hydroelectric production, the action paves the way to the clean and just energy transition planned by Ghana and the European Union thus contributing to a greener economic recovery.

1.6 Purpose of the Environmental Impact Assessment

1.6.1. Environmental Clearance Requirements

Within the context of Ghana's Environmental Assessment Regulations, LI 1652 of 1999, and the Environmental Guidelines for the Energy Sector, 2011, existing projects prior to the promulgation of the law such as the Kpong GS are mandated to submit Environmental Management Plans (EMP) for the purposes of being issued with Environmental permit. VRA has subsequently complied with this and has been issued with an Environmental Permit for the Kpong Hydropower Station[1]. The Permit mandates the VRA to notify the EPA of any changes in the existing operations, including, systems modifications and changes. Thus, the proposed project will have to be communicated to the EPA.

VRA per letter dated May 29, 2024, with an accompanying project concept note, formally informed EPA on the KGRP and how it intends to address the environmental requirements of the project. Following this, a team from the EPA, led by the Director, Environmental Assessment & Audit Department undertook a field verification visit to KGS on June 11, 2024, to physically assess the dykes and understand the project requirements to inform their response. Subsequently, the EPA per letter dated June 20, 2024, formally advised that the project falls into the category for which an Environmental Impact Assessment (EIA) is required. VRA was subsequently requested to undertake the EIA and submit six (6) hard copies of the EIA Report for review, and that there was no need for a Scoping Report as the project concept note had identified the key

[1] See Appendix 1 for the Environmental Permit

issues to be addressed which should serve as the Terms of Reference for the study. The correspondences with the EPA are provided in Appendix 2.

As part of the requirements of the Loan Agreement for the project, VRA is mandated to adhere to the requirements of the Environmental & Social Standards (February 2022) of the EIB Group, which requires proponents to undertake an Environmental & Social Impact Assessment (ESIA) whenever the national requirements mandate so. To ensure adherence to both the Ghana EPA and EIB environmental requirements, an in-house team of experts from VRA have undertaken the EIA and prepared this EIA Report. Details of the Team and their roles in the process is provided in this report as required by the EPA.

1.6.2. Structure of EIS Report

This EIS Report has prepared to bring the project into compliance with applicable national legislation and regulations of Ghana as well as satisfy the requirements of the EIB. Based on discussions with the EIB on the content of such documentations, the EIS has been structured under eleven (11) Chapters with a Non-Technical Summary as listed below:

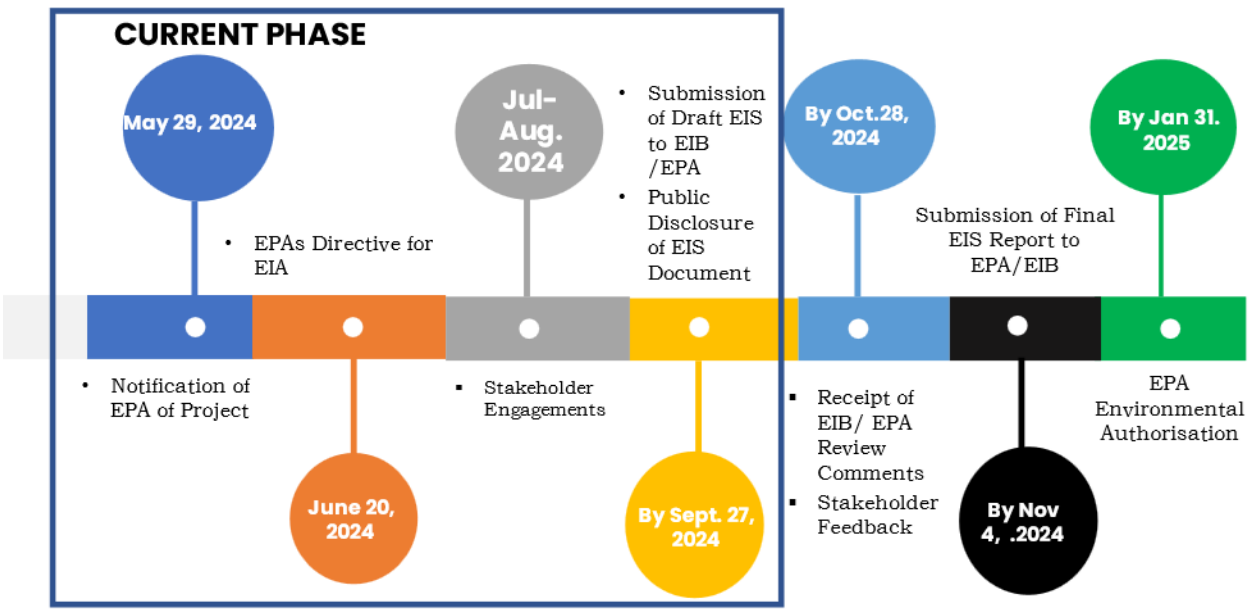
Non-Technical Summary
Chapter 1: Introduction
Chapter 2: Policy, Legal and Administrative Framework
Chapter 3: Project Description & Alternatives
Chapter 4: Description of the Existing Environment
Chapter 5: Public Participation & Stakeholder Engagements
Chapter 6: Analyss of Project Alternatives
Chapter 7: Impact Identification & Significance
Chapter 8: Enhancement & Mitigation Measures
Chapter 9: Provisional Environmental Management Plan
Chapter 10: Conclusion & Recommendations
Chapter 11: References
Appendices

There is no discussion on decommissioning exercise since the life expectancy of the infrastructure is estimated at 50years for the dykes and 25 years for the spill gates, and as required the facilities will again be upgraded with the state-of-the-art equipment and technology. depending on the state at the time, and decommissioning is not envisaged as part of such infrastructures.

1.6.3. Schedule For EIA Study

Key milestones of the EIA study are shown in **Figure 1-1**. This Draft EIS shall be submitted to the EPA and EIB in Sept. 2024 and review comments is expected latest by October 28, 2024. It is hoped the EIS shall be finalised latest by Nov. 4, 2024, to allow for public disclosure by the EIB. It is hoped that the Project Environmental Permit will be issued by the Ghana EPA y close of Jan. 31, 2025.

Figure 1-1: Key Milestone of EIA Exercise



1.6.4. Associated Environmental Reports

This EIS has been prepared to guide the KDRP and is specific to the project. Even though it is a standalone document, it is part of the suite of documents that have been prepared as part of the environmental assessment process to ensure adherence to international safeguards and represents one of four (4) reports, the other three being:

1. Environmental & Social Management Plan
2. Stakeholders Engagement Plan
3. Labour & Worker Conditions Management Plan

In addition to the above reports, the following existing documentation that support the ongoing environmental management of KGS are relevant to the requirements of this EIS Report:

1. EMP for Akosombo & Kpong Hydroelectric Power Plants (2010) – First Edition.
2. Emergency Preparedness Plan (EPP) for the Akosombo Dam and Kpong Dam (2011) - First Edition.

The EMP and EPP Reports are updated as required for the purpose of Environmental permitting, and the latest edition of the EMP covers activities from 2022-2024. The EIS report is also to form part of the tender documents for engaging the contractor(s) and is to be utilised by contractors and subcontractors on the project. The contractor shall be required to develop the underlisted plans, among others, to guide their work under the project:

- Health, Safety, Security & Environmental Management Plan
- Waste Management Plan
- Labour Management Plan
- Risk Assessment Report
- Quality Assurance & Management Plan

The provisions of this EIS and the Environmental Permit to be issued are binding on the contractor during the construction period and defects liability period of the contract. If any conflict occurs between the terms of the EIS and the project specifications, the terms of the EIS shall stand. It is also to form the basis of site-specific management plans that will be prepared by contractors as part of their construction methodology prior to the commencement of works. It is required that the selected contractor and subcontractors apply the mitigation measures in all the above referenced documents.

2 POLICY, LEGAL & 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 project meets the highest possible standards of EIA and the subsequent management policies. Reviewing the legal framework during an EIA study in Ghana is critical for ensuring such regulatory compliance, protecting the environment, engaging stakeholders, aligning with international standards, managing risks, enhancing project design, and supporting regulatory authorities. This comprehensive approach not only safeguards the environment but also contributes to the sustainable development of the country.

This Chapter provides an overview of the main stakeholders and corresponding institutional and/or organisational issues (mandates, potential roles, and capacities) to be covered by this action. In addition, environmental and social regulations, and its relevance to the project as well as information on the requirements of EIB Environmental and Social Standards (2022) is discussed, and gap between the national environmental legislation and the Standards identified to ensure such limitations are addressed.

2.2 Institutional & Administrative Framework

Volta River Authority: VRA is the main generator and supplier of electricity in Ghana. The main purpose of VRA is to generate and supply electricity for Ghana's needs. It is also the responsible for the maintenance of the Akosombo and Kpong Hydropower Plants. It is also responsible for managing the environmental impact of the creation of the Volta Lake on the towns and people bordering the lake. VRA owns and operates a total installed electricity generation capacity of 2,532MW. VRA will oversee the implementation of the project, will launch the call for tender, consult the final beneficiaries and supervise the works.

Ministry of Energy: The Power sector in Ghana is under the sectoral/ministerial supervision of the Ministry of Energy. A key goal of the Ministry of Energy (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. MoEn is also responsible for programmes and projects in the energy sector and supporting access to affordable and sustainable energy for all, including groups living in most vulnerable situations. It is also the institution in charge of the implementation of rural electrification. VRA is an agency which is under the responsibility of the Ministry of Energy.

Ministry of Finance (MoF): MoF role is to ensure effective economic policy management for the attainment of macroeconomic stability and sustainable economic growth through sound fiscal policy and efficient public financial management by deploying competent staff and robust systems for the development of Ghana. The MoF would be involved in securing the sovereign loan from the EIB.

National Disaster Management Organisation: NADMO is the Agency in charge of disasters management. NADMO co-ordinates the resources of government institutions and non-governmental agencies and develops the capacity of communities to respond effectively to disasters and improve their livelihood through social mobilization, employment generation and poverty reduction projects. NADMO is responsible for coordinating the disaster management components of the Emergency Preparedness Plan for the Kpong Dam.

Environmental Protection Agency (EPA) was formally established by Act 490 of 1994 and given the responsibility of regulating the environment and ensuring the implementation of Government policies on the environment. The EPA is the leading public body for protecting and improving the environment in Ghana and will be responsible for environmental regulation and authorisation of the project.

Lower Manya Krobo Municipal Assembly is responsible for the political administration and development of the project area, and local communities, including traditional authorities, within the Municipality. As part of the process, the Municipal Assembly will be regularly associated and consulted in the project action.

2.3 Relevant National Legal Framework to the Proposed Project

The relevant policies and legal frameworks that will be required to guide project implementation to ensure sustainable development and compliance with national and the EIB Environmental and Social Standards are briefly described below. These have been categorised as listed below to align with that of the EIB Group ESS:

EIB Environmental and Social Standards		
1	Standard 1:	Environmental and Social Impacts and Risks
2	Standard 2:	Stakeholder Engagements
3	Standard 3:	Resource Efficiency & Pollution Protection
4	Standard 4:	Biodiversity Diversity & Ecosystems
5	Standard 5:	Climate Change
6	Standard 6:	Involuntary Resettlement
7	Standard 7:	Vulnerable Groups, Indigenous People & Gender
8	Standard 8:	Labour Rights
9	Standard 9:	Health, Safety & Security
10	Standard 10:	Cultural Heritage

The relationship between the national legal framework and the EIB ESS, and its applicability and relevance as well as how the project complies are detailed in in Table 2-1.

Table 2-1: List of Applicable National & International Legal Requirements

National Legal Requirement	General Requirement	Relevance/Applicability
EIB ESS Standard 1: Environmental and Social Impact and Risks		
• 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) (Miscellaneous Provisions) Act, 2022 (Act 1080)	These sets out the responsibilities for assessing, managing, and monitoring environmental and social risks and impacts associated with a project, including charges.	***Complies:*** The KGS is operational with a valid Environmental permit. This EIS has been prepared to specifically guide the implementation of the KGRP during construction. The need to undertake an risk assessment and management has been highlighted in the project. In addition, The Contractor is required to submit Risk Assessment Report and Quality Assurance & Management Plan for the project.
EIB ESS Standard 2: Stakeholder Engagements		
• Environmental Assessment Regulations 1999, LI 1652 and related guidelines in the Energy and General Construction Sectors • Right to Information Act, 2019 (Act 989)	Recognizes the importance of open and transparent engagement between the proponent and project stakeholders as an essential element of the EIA process. Public disclosure is a key requirement to ensure broad consultations.	**Complies:** Stakeholder analysis and engagements have been completed and discussed in this report, including the need for public disclosure. A Stakeholder Engagement Plan has also been prepared as part of documentation for the EIA Study.
EIB ESS Standard 3: Resource Efficiency & Pollution Protection		
• Hazardous & Electronic Waste Control Management Act, 2016 (Act 917) • Hazardous, Electronic and Waste (classification) Control and Management Regulations, 2016 (LI 2250) • Land Planning and Soil Conservation Act, 1957 • Water Resources Commission Act, 1996, Act 522 • The National Land Policy, 1999	These sets out the requirements to address 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	***Complies:*** Resource requirements for the project has been defined. The project should ensure that resources such as Water, electricity, land, water and raw materials are efficiently utilised during project implementation. There are no

National Legal Requirement	General Requirement	Relevance/Applicability
• Pesticides Control and Management Act (1996) Act 528 - Part II of the EPA Act 490 of 1994 • Ghana Standard for Environmental Protection-Requirements for Effluent Discharge (GS 1212: 2019) • Ghana Standard for Environment and Health Protection-Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236: 2019 • Ghana Standard for Health Protection-Requirements for Ambient Noise Control (GS 1222: 2018)	environment at the local, regional, and global levels.	cultural resources to be impacted by the project.
EIB ESS Standard 4: Biodiversity and Ecosystems		
• 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 • National Biodiversity Strategy and Action Plan, 2016 • Wildlife Conservation (Amendment) Regulations, 1989 (LI 1452)	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:** Ecological baseline information has been captured and mitigation measures outlined to ensure protection of such resources. Ecological survey of the power plant site has indicated that there are no species or habitats of conservation value.
EIB ESS Standard 5: Climate Change		
• Renewable Energy Act, 2011 (Act 832) • Renewable Energy Amendment Act, 2020 (Act 1045) • National Climate Change Policy, 2013 • Nationally Determined Contribution (NDC) for 2020-2030 • National Energy Transition Framework (2022 – 2070) • Ghana Renewable Energy Master Plan (2019)	It provides for the development, management, utilisation, sustainability, and adequate supply of renewable energy for generation of heat and power and for related matters. 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	Complies: Issues on climate change related impacts have been identified and are to be investigated at all phases of project implementation, as relevant. VRA undertakes quantification of all its Scope 1 emissions and reports on it annually and this shall be extended to activities under the project at KGS.

National Legal Requirement	General Requirement	Relevance/Applicability
	emphasised.	
EIB ESS Standard 6: Involuntary Resettlement		
• 1992 Constitution of Ghana • Immovable Property Rate Regulations (1975) LI 1049 • Lands Statutory Wayleaves Act, (1963) Act 186 • Lands (Statutory Way leaves) Regulations, 1964 (LI334) • State Lands Regulations (1962) LI 230 • State Lands (Amendment) Act (2005) Act 586 • Land Use and Spatial Planning Act, 2016 (Act 925) • State Lands Act, 2020 (Act 1026) • Stools Lands Act, 1994 (Act 481) • Local Governance Act, 2016 (Act 936) • Arbitration Act 1961 (Act 38) • Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542) • Volta River Authority (Transmission Line Protection) (Amendment) Regulation, 2004 (LI 1737)	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.	***Non-Applicable:*** Project action is within an already acquired area. There shall be no associated land acquisition or resettlement issues.
EIB ESS Standard 7: Vulnerable Groups, Indigenous People and Gender		
• Persons with Disability Act, 2006 Act 715 • Domestic Violence Act (Act 732) of 2007 • Ghana Gender Policy, 2015 • Persons with Disability Act, 2006 Act 715 • National HIV/AIDS STI Policy, 2004 • National Action Plan on Policy for Gender Mainstreaming in Energy Access (2025-2030).	The Ghana EIA study requires the assessment of the vulnerable as part of the process. The 1992 Constitution features an elaborate and comprehensive human rights regime: Chapter five is entirely devoted fundamental human rights and freedoms consistent with the International Bill of Rights. These include political and civil rights as well as economic, social, and cultural rights.	***Complies:*** Gender Based Violence, Sexual Exploitation and Workplace Sexual Harassment are the key gender and vulnerability impact related to the project constructional activities and this is discussed. The project will implement requirements of a Gender Action Plan that has been rolled out by the VRA. There are no issues of impact on indigenous persons relevant to this project.

National Legal Requirement	General Requirement	Relevance/Applicability
EIB ESS Standard 8: Labour Rights		
• 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) • Factories, Shops & Offices Act, 1970, Act 238. (As amended by the Factories, Offices and Shops (Amendment) Law, 1991 (PNDCL 275) • Public Procurement Act, 2003 (Act 663) • Ghana National Data Protection Act, 2012 (Act 843) • Criminal Code, 1960 (Act 29) • National Employment Policy, 2014 • Alternative Dispute Resolution Act 2010 (Act 798) • Ghana Local Content Policy (2010) • Energy Commission (Local Content & Local Participation (Electricity Supply Industry) Regulations, 2017 (LI 2354)	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.	***Complies:*** The implementation of the project will result in the creation of employment, both on the local and national level. VRA is to ensure labour conditions are appropriate for its staff and has prepared a **Labour & Working Conditions Management Plan** for the project, to this EIS Report. The Contractor will also be required to submit a **Labour Management Plan** for the project. Clients are required to develop and implement written labour management procedures applicable to the project. All staff engaged are enjoined to comply with the conditions of service of VRA, which is drafted along the requirements of the labour Act. Contractors are mandated to do same with their staff.
EIB ESS Standard 9: 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) • Public Health Act, 2012 (Act 851) • 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)	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 circumstances, may be vulnerable.	***Complies:*** Implementation and operations of the project is being done in consonance with Factories, Offices and Shops Act (1970) Act 328. Health and safety issues are paramount in project implementation and weekly safety educational programmes and

National Legal Requirement	General Requirement	Relevance/Applicability
• Driver & Vehicle Licensing Authority Act, 1999 (Act 569) • Dam Safety Regulations, 2016 (LI 2236) • Ghana National Building Regulations, 1996, LI 1630 • Environmental Sanitation Policy, Revised 2010 • Road Traffic Acts, 2004, Act 683 • National Road Safety Policy, 2007 • Health, Safety, Security & Environmental manual for Energy Sector Organisations		inspections underway at the KGS. 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, Security & Env. Mgt. Plan** for project construction purposes. Issues on community safety has also been considered.
EIB ESS Standard 10: Cultural Heritage		
• National Museums Act, Act 387 of 1969 (formerly National Museums Decree (1969) NLCD 387) • National Museums Monument Instrument, 1972 (EI 42) • National Museums Regulations, 1973 (EI 29)	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:*** No culturally sensitive areas identified in this project. However, mechanisms are in place under the National Museums Decree (1969) NLCD 387 to ensure any chance finds effectively managed. In case of any findings, any chance finds at the project site must conform to the requirements of the National Museums Act, Act 387 of 1969.

2.4 EIB Environmental & Social Standards (2022)

The Environmental and Social Standards (2022) are guidelines and requirements set by the EIB to ensure that the projects it finances are environmentally and socially sustainable. The Standards aim to ensure that projects financed are sustainable and comply with environmental and social norms and are essential for guiding projects towards sustainability, ensuring that they contribute positively to environmental protection and social well-being. These standards reflect the EIB's commitment to promoting sustainable development, environmental protection, and social equity.
The relationship between the national legal framework and this standard, are detailed in Table 2-1.

As a requirement to the EIB ESS, proponents are to include a gap analysis indicating the differences between the relevant national legislation and EIB standards, as applicable. Generally, the EIB Environmental and Social Standards (2022) provide a more comprehensive and detailed guidelines compared to the Ghana Environmental Regulations LI 1652. It is also noted that the EIB standards cover a broader range of issues with more stringent requirements, particularly in areas such as social impacts, climate change, biodiversity, cultural heritage, and labour standards. However, the Ghana EPA has developed specific guidelines in support of the requirements of the LI 1652 for eight sectors, namely, Transportation, Mining, Tourism, General Construction & Services, Energy, Manufacturing, Agriculture and Health. The guidelines provide details of the environmental management and social requirements to be considered when performing an EIA for each sector.

Table 2-2 provides an overview of the requirement of the EIB ESS standards as compared to the Ghana EIA Regulations (LI 1652), and analyses that gaps as pertains and strategies the project seeks to adopt to address such gaps. To align Ghana's regulations more closely with EIB standards, enhancements in social impact assessments, climate change measures, biodiversity protection, cultural heritage preservation, and labour standards would be required and various strategies to achieve this under this EIS has been put in place and indicated in **Table 2-2**.

Table 2-2: Analysis of Gaps between EIB Standards & Ghana EIA Regulations

Overview of EIB Standards	Gap between EIB Standards and Ghana EIA Regulations		Gap Redressor
Standard 1: Environmental and Social Impact and Risks			
Ensure that projects financed by the EIB are environmentally and socially sustainable. Projects must undergo a comprehensive environmental and social impact assessment (ESIA). This includes identifying, assessing, and managing potential impacts and risks.	**EIB Standards** have a broader scope, including explicit requirements for social impacts, human rights, and alignment with international standards. Essential ingredients are: • Comprehensive EIA for projects with significant environmental impacts. • Includes guidelines for screening, scoping, assessment, and reporting. • Emphasizes cumulative and transboundary impacts.	**Ghana Regulations** are more focused on environmental impacts within the national context and may not explicitly cover all social aspects. Essential ingredients are: • Mandates EIA for certain categories of projects. • Provides a detailed procedure for EIA including screening, scoping, public participation, and review. • Focuses on national-level impacts.	EIB standards include a broader scope of social impacts and include transboundary impacts, whereas Ghana LI 1652 is more environmentally focused and concentrates more on national impacts. A detailed Social Impact Assessment will not be required due to the scope of the project. In addition, there are no transboundary impacts for consideration. Cumulative impacts haven been assessed and discussed in this EIS report. VRA will include the EIS / Permit in the contractual requirements for all contractors.
Standard 2: Stakeholder Engagements			
Promote meaningful and inclusive stakeholder engagement. Projects must engage with stakeholders, including affected communities, throughout the project lifecycle. This includes providing timely information, seeking feedback, and addressing concerns.	**EIB**: Requires meaningful and inclusive stakeholder engagement throughout the project lifecycle. Essential ingredients are: • Meaningful stakeholder engagement throughout the project lifecycle. • Emphasizes transparency, inclusiveness, and free, prior, and informed consent (FPIC).	**Ghana LI 1652**: Public consultation is required, but the depth and inclusivity may vary. • Mandates public consultation during the EIA process. • Focuses on informing and involving affected communities.	EIB standards emphasize more comprehensive and inclusive stakeholder engagement, whereas the **Ghana Regulations** focus on consultation during the EIA process. The project will engage stakeholders effectively throughout the project. Inclusive is the need to consider the EIB Group's Complaints Mechanism and how stakeholders can access them. A project specific **Stakeholder**

Overview of EIB Standards	Gap between EIB Standards and Ghana EIA Regulations		Gap Redressor
			Engagement Plan has also been prepared.
Standard 3: Resource Efficiency & Pollution Protection			
Minimize pollution and its harmful effects on human health and the environment. Projects must implement measures to prevent, reduce, and control pollution. This includes managing air emissions, water discharges, waste, and hazardous materials.	EIB: Strict guidelines on pollution prevention, waste management, and abatement measures. Essential ingredients are: • Sets stringent pollution prevention and control measures. • Aligns with EU environmental quality standards. • Promotes best available techniques (BAT) • The adoption of circular economy as a waste management tool is recommended	**Ghana LI 1652**: Includes pollution control measures but may not be as stringent or detailed as EIB standards. Essential ingredients are: • Establishes national standards for pollution control. • Focuses on preventing, reducing, and controlling pollution from projects.	**Gap**: EIB standards are more stringent and comprehensive in pollution prevention and abatement. Aside 4R', the project shall adopt the circular economy strategy for waste management.
Standard 4: Biodiversity and Ecosystems			
Protect and conserve biodiversity and ecosystems. Projects must avoid, minimize, and mitigate negative impacts on biodiversity and ecosystems. Special attention is given to critical habitats, protected areas, and endangered species.	**EIB**: Detailed requirements for biodiversity conservation and ecosystem protection. Essential ingredients are: • Requires biodiversity assessments and conservation plans. • Promotes the sustainable use of natural resources. • Aligns with international biodiversity conventions	**Ghana LI 1652**: Addresses biodiversity but lacks the detailed and specific measures found in EIB standards. Essential ingredients are: • Requires consideration of biodiversity impacts in the EIA process. • Focuses on national conservation priorities and legal frameworks.	EIB provides more specific guidelines for biodiversity and ecosystem protection. The Standards are more aligned with international biodiversity conventions, while Ghana Regulations focus on national priorities and does not provide for opportunities for monetising ecological benefits. The KGS / Lake serves as an ecotourism facility and has been monetised by the VRA as part of its activities as it serves as a source for recreation and ecotourism.

Overview of EIB Standards	Gap between EIB Standards and Ghana EIA Regulations		Gap Redressor
Standard 5: Climate Change			
Address climate change by reducing greenhouse gas emissions and enhancing climate resilience. Projects must assess and manage climate-related risks and impacts. This includes adopting low-carbon and climate-resilient technologies and practices.	**EIB**: Emphasizes climate change mitigation and adaptation measures. Essential ingredients are: • Requires climate risk and vulnerability assessments. • Emphasizes mitigation and adaptation measures. • Supports projects that contribute to climate resilience and low-carbon development.	**Ghana LI 1652**: Limited explicit focus on climate change, although some measures may indirectly address it. Essential ingredients: • Considers climate impacts as part of the EIA process. • Encourages adaptation measures for projects vulnerable to climate change.	EIB has a more explicit and comprehensive focus on climate change as well as a more structured approach to climate resilience and low-carbon development, while **Ghana Regulations** integrate climate considerations within the EIA process. Curenlty, VRA has embarked on a **"Climate Change Risk Assessment Risk for the Akosombo & Kpong Generating Stations".** Meanwhile, the feasibility studies and the "Project Action document" submitted to the EIB has captured the economic case of the project.
Standard 6: Involuntary Resettlement			
Avoid or minimize involuntary resettlement and mitigate its adverse impacts. Projects must develop and implement resettlement action plans that ensure fair and adequate compensation, livelihood restoration, and support for displaced persons.	**EIB**: Detailed procedures and requirements for involuntary resettlement, ensuring fair compensation and livelihood restoration.:	**Ghana LI 1652**: Provides for resettlement but may lack detailed procedures and requirements.	EIB standards are more comprehensive in handling involuntary resettlement. This is however not applicable to the project.
Standard 7: Vulnerable Groups, Indigenous People & Gender			

Overview of EIB Standards	**Gap between EIB Standards and Ghana EIA Regulations**		**Gap Redressor**
Projects must identify and address the specific needs and rights of vulnerable groups, ensuring their inclusion and participation in decision-making processes.	**EIB**: Specific focus on protecting the rights and interests of vulnerable and marginalized groups. Essential ingredients are: • Requires Gender Impact Assessment for projects with significant social impacts. • Ensures protection of vulnerable groups and human rights. • Requires FPIC and specific measures to protect the rights and livelihoods of indigenous peoples.	**Ghana LI 1652**: General protections may exist but are not as detailed or specific as EIB standards. Essential ingredients are: • Implicitly includes gender considerations within the EIA process. • No specific provisions for indigenous peoples. • Does not provide a separate, detailed framework for Gender Impact Assessment (GIA).	EIB standards have a stronger emphasis on vulnerable groups. while **Ghana Regulations** address social impacts within the EIA process without a distinct GIA framework. Th project is in line with the requirements of the "National Action Plan on Policy for Gender Mainstreaming in Energy Access (2025-2030)" as it seeks to provide a cheaper source and reliable electricity to the benefit of the vulnerable in society. VRA has conducted a Gender Impact Assessment within the context of a floating solar power project located at KGS, and findings have been utilised for this EIS report. In addition, VRA in 2023 drew up and is implementing a Gender Action Plan and all components, especially those relating to labour, will be activated as part of this project.
Standard 8: Labour Rights			

Overview of EIB Standards	Gap between EIB Standards and Ghana EIA Regulations		Gap Redressor
Ensure fair and safe working conditions and respect for workers' rights. Projects must comply with national labour laws and international labour standards. This includes preventing child labour, forced labour, discrimination, and ensuring occupational health and safety	**EIB**: Adheres to international labour standards, including fair wages, safe working conditions, and no forced labour. Essential ingredients: • Sets requirements for labour rights, working conditions, and occupational health and safety. • Aligns with international labour standards and conventions.	**Ghana LI 1652**: National labour laws apply, which may not fully align with international standards. Essential ingredients are: • Addresses labour conditions within the broader context of social impacts. • Follows national labour laws and regulations.	EIB standards may be more stringent, aligning with international labour standards while **Ghana Regulations** focus on national labour laws. A Specific Labour & working Conditions Management Plan has been prepared for the project to ensure labour conditions are appropriate for VRA. The Contractor will also be required to submit a **Labour Management Plan** for the project. Contractors are to adhere to ILO Standards in project execution. In this respect, the issue of human rights and considerations of HR risks in assessment process will be considered.
Standard 9: Health & Safety			
Protect the health and safety of workers and communities. Projects must implement measures to prevent accidents, injuries, and health hazards. This includes managing risks related to construction, operation, and decommissioning activities.	**EIB**: Comprehensive guidelines for health, safety, and security for workers and communities. Essential ingredients are: • Requires assessment and management of health, safety, and security risks to communities. Emphasizes emergency preparedness and response.	**Ghana LI 1652**: Includes health and safety regulations but may not be as comprehensive. Essential ingredients are: • Includes provisions for community health and safety within the EIA process. Focuses on mitigating project-specific risks.	**Gap**: EIB provides more detailed and stringent health, safety, and security standards. 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 & Environmental Plan** as

Overview of EIB Standards	Gap between EIB Standards and Ghana EIA Regulations		Gap Redressor
			well as a Risk Management Plan for project construction purposes.
Standard 10: Cultural Heritage			
Preserve cultural heritage, including tangible and intangible heritage. Projects must identify and protect cultural heritage resources. This includes assessing impacts and implementing measures to avoid or mitigate any adverse effects.	**EIB**: Includes protections for cultural heritage and indigenous peoples' rights. The Standard: • Requires assessment and protection of cultural heritage. • Emphasizes the preservation of tangible and intangible cultural resources.	**Ghana LI 1652**: Cultural heritage is considered, but protections may not be as detailed as EIB standards. The Standard: • Considers cultural heritage within the EIA process. • Focuses on national heritage protection laws.	**Gap**: EIB standards offer more robust protections for cultural heritage while **Ghana Regulations** incorporate it within the EIA framework. In case of any findings, cultural assets are to be managed as per the requirements of ESS 10.

3 PROJECT DESCRITPTION

3.1 Introduction

This Chapter provides a description of the KGRP 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 & maintenance stages. Key information has been drawn from the various studies undertaken by consultants to assess the risk of the structural integrity of the dam and these are listed in the reference section as well as site visits to appreciate the project footprint and associated impacts. Figures, maps, and pictures have been provided as illustration for a better understanding of the project description.

3.2 Overview of the Kpong Dam

The construction of the Kpong Generating Station (KGS) was completed in 1982 and comprise of a hydropower plant and dam and is located some 24 km downstream of the Akosombo Generation Station (AGS). KGS has four generating units, each individually rated at 40 MW. The plant is operated in tandem with the Akosombo Hydroelectric Plant as a run-off-the-river plant with Kpong Headpond balancing the Akosombo discharge through daily regulation. The Kpong dam consists of a 258m long concrete gravity overflow gated spillway, 240m River Dam and 6.2 km long zoned earthfill dykes and has a live storage capacity of 15 million m^3. The design head of water at the plant is 11.75 m (38.5 ft).

The earth structures of the KGS, with a design crest elevation of National Level Datum (NLD) 18.25 m, consist of:

a) The West Dyke which flanks the powerhouse and west bulkhead on the west bank of the original river, length approx. 2.1 km.
b) The River Dam which closes the remainder of the original river channel to the east bank, length approx. 240 m
c) The East Dyke which is a continuation of the river dam on the east bank, length approx. 3.2 km

The spillway has a design capacity of 20,670 m^3/s (725,660 cfs) and has 15 radial gates, each 13.50 m wide by 12.6m high, with a total length of 280 m. Other spillway equipment includes one set of vertical lift stoplogs, and a gantry crane. The spillway has been in operation for 42 years and has generally been well maintained with no major overhaul of the gates and/or seal replacements done on the gates to date. Following the completion of an alkali-aggregate reaction (AAR) investigation study in 2012, a convergence meter system comprising six 12 m long convergence meters was installed in the Kpong powerhouse to enable the monitoring of concrete swelling. The control system of the gates was upgraded in 2019 as part of the overall Kpong

Powerhouse Upgrade Project. The original gate control system was replaced with a modern relay type control system with a separate local control cabinet for each gate. The local control systems are integrated into a central Supervisory control and data acquisition system that enables monitoring and control from the powerhouse central control room.

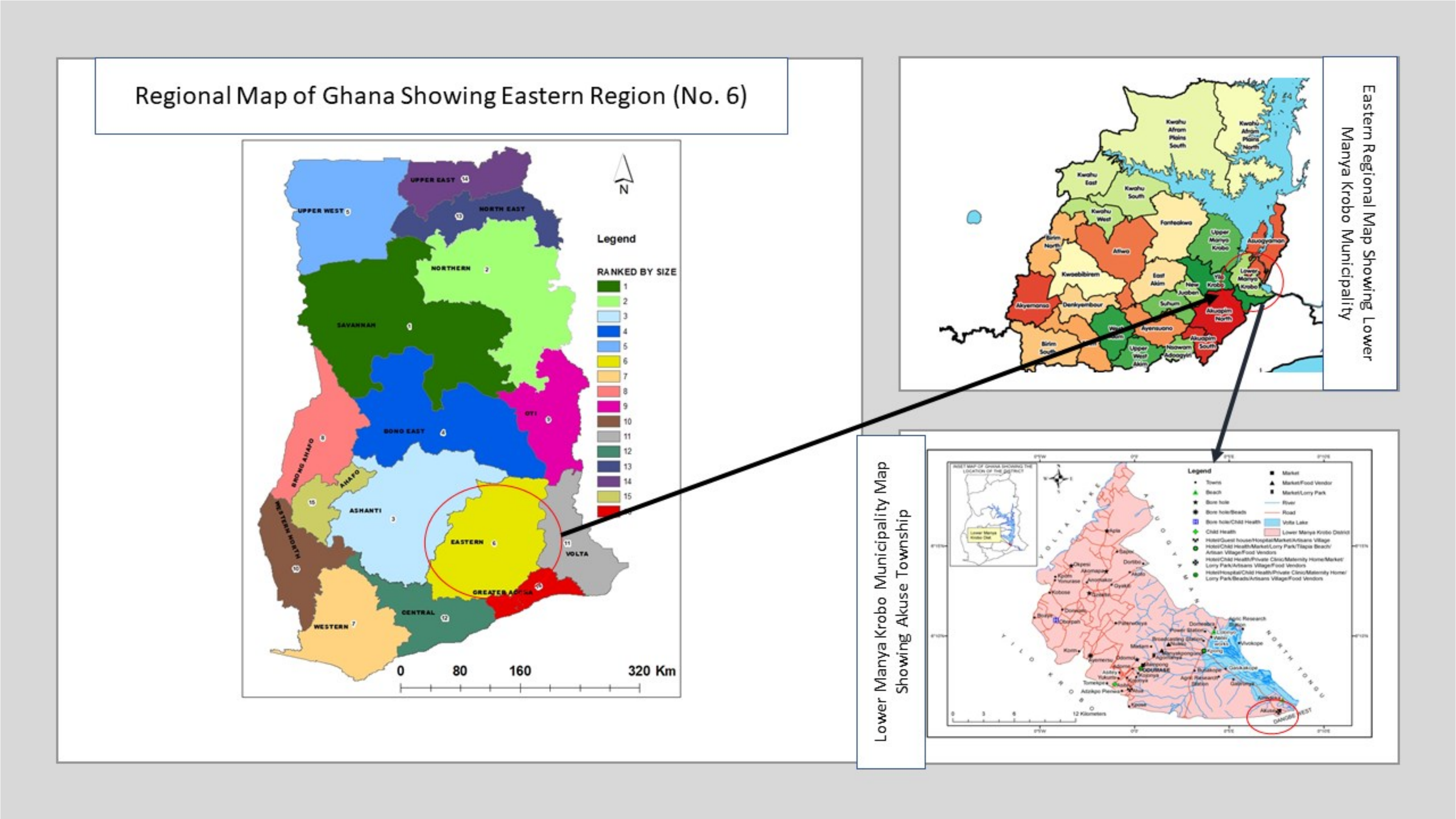
With 160 MW power production capacity, the Kpong Dam represents 12% of the country's hydroelectric production. Besides generating a modest amount of energy and providing water for irrigation, the main purpose is to control the water surface elevation downstream of the Akosombo Dam with the goal of minimizing fluctuations in the level of restitution to optimize hydropower production by Akosombo. A drone imagery of the Kpong Dam is shown Plate 3-1 and the layout provided in Appendix 3.

Plate 3-1: Drone Imagery of the Kpong Dam

3.3 Geographic Location

The KGS infrastructure is located within the VRA designated office enclave in Akuse Township, which lies between latitude 6º6’0”N and longitude 0º8’0”W at an elevation of approximately 18m. The work office location for both contractors and consultants, including areas for major works such as sandblasting and other minor works associated with the repairs of the spillway gates are expected to be set up within this location close to the dam, i.e., in Akuse. Administratively, Akuse township belongs to Lower Manya Krobo Municipality in the Eastern Region of Ghana. **Figure 3-1** shows the location of Akuse, within the context of both the Lower Manya Krobo Municipality and the Eastern Region in Ghana.

Figure 3-1: Location of Akuse Township within the Context of Ghana



3.4 Accessibility to Project Site

The dam is located about 4 km upstream of Akuse. The main access route to the project site will be via the Tema-Akosombo N2 Highway, some 90km from Accra and some 70km from Tema (travel time by car about 1½ hour from Accra and 1 hour from Tema). At Okwenya Junction, (about 55 km north of Tema harbour), the access is via the minor arterial highway of the Akuse road, about 8 km before turning into the VRA Offices at the VRA junction in Akuse. Main access to the dam site and the dykes is by a private asphalted road leading to the KGS and approximately 1.7km from the T-Junction to the residential enclave of the VRA Akuse Township, which houses staff of the VRA (See **Plate 3-2**). For the purposes of this project, transportation of boulders will be along the Okwenya Junction to Akuse Road.

Plate 3-2: Main Access Road to the Kpong GS

Both the West and East Dykes are accessible and are used as normal access route by the public. The dykes are also used by locals to access farms and fishing areas within the project site. Aside the normal access route, the East dyke can also be accessed from the 17 km stretch Juapong to Akuse Road, off the Atimpoku – Juapong Road, whilst the West Dyke can be accessed from a 3.7km unpaved road running through the Natriku Community, about 7.5km off the Okwenya Junction to Akuse Road (See **Plate 3-3**). From the West Dyke, one can also access the waterfront from the landing sites at Natriku and the Akuse Watermanship Training Camp, a restricted military zone used by the Ghana Navy. The access route to KGS via the Okwenya Junction –

Akuse Road, as well as available routes to the waterfront for the loading of boulders on floating barges is provided in Appendix 3.

Plate 3-3: Unpaved Road Network Through Natriku Community to Landing Sites

A three-day traffic assessment was done on the river dam and the Natriku – West Dyke Road to assess the baseline information in terms of vehicular load and periods on these roads and to inform traffic management strategies to be adopted on the project. On both routes, motorcycles were the most used transport, followed by private cars and taxis. Heavy trucks on these roads were minimal, ranging from 2-9 per day on the Natriku-West dyke road, and none on the river dam as VRA restricts heavy trucks on the river dam. In terms of period, traffic flow was quite low between 10:00 - 14:00 hours GMT on the River dam, indicating this could be the most appropriate period to close the access for the removal of the spill gates.

3.5 Key Associated Facilities

Associated facilities are those facilities or activities that are not funded as part of the project and are: (a) directly and significantly related to the project; (b) carried out, or planned to be carried out, contemporaneously with the project; and (c) necessary for the project to be viable and would not have been constructed, expanded, or conducted if the project did not exist.

Associated with the KDRP, will be the rehabilitation of a 10km stretch of road from the Okwenya Junction to the Akuse Town, which serves as part of the access road to the project site. The intended rehabilitation of the dykes of the dam and repair of the spillway gates of the plant would require the transportation of heavy equipment and haulage of substantial volumes of materials. The current poor state of the road would make transportation unsafe and would likely cause accidents on the road. Thus, to prevent further deterioration of the road and enhance safe transportation to the plant and its environs, it is important to undertake the rehabilitation of the road, and this is critical to allow for the smooth haulage of materials and equipment during the project execution. The rehabilitation of the road will form part of the social benefit of the project.

The road rehabilitation works will be supervised by the Ghana Highway Authority, the nationally designated body responsible for the administration, control, development, and maintenance of all public highways and related facilities in Ghana. Communication to such effect has been concluded with the Ghana Highway Authority and issues indicated under Chapter 5.0.

3.6 Project Planning & Design

3.6.1. Repair of the Displaced Rockfill on the Upstream Slope of the Kpong Dam

Currently, defects have been observed on the upstream face of the dykes and river dam (See **Plate 3-4**) and it was noted that the defect was quite pronounced on the West Dyke as compared to the East Dyke and the River Dam. As part of the planned maintenance regime of the Kpong Dam, investigations were initiated in 2023 to investigate the cause(s) for this defect and recommend appropriate remedial measures. The study concluded that the problem or observed defects was because of poor grading of coarse rockfill used during construction. Therefore, it is required to take remedial measures to forestall further deterioration which could lead to possible geotechnical failure, hence a breach. It was recommended that the placement of an additional rockfill to reduce the slope and increase the stability of the dyke was required, and that if the remedial measure is not undertaken, then the displacement of the rockfill will continue and undermine the stability of the dyke and could lead to a dam failure. Based on geotechnical analyses, making the slope less steep by constructing the face to 1:2.5 was required.

Till date, the requisite detailed engineering designs, including materials, dimensions, and construction methods as well as technical conceptual design drawings has been completed for adoption. The standard procurement documents for the engagement of a competent Contractor for the implementation of the recommended and approved remedial measure is now under preparation. Procurement shall be in line with both the Ghanaian procurement requirement and that of EIB. The design and construction of the dyke will be undertaken in accordance with international standards as outlined in the "**Rock Manual - 2017 Construction Industry Research & information Association**" (CIRIA)".

Plate 3-4: Comparison of Location with Observed Defects

Left: ***Typical well pronounced bench at the West Dyke of the Kpong Dam (picture of 2019)***
Right: ***The benches are eroded and have become less pronounced (picture 2023).***

3.6.2. Rehabilitation of Kpong GS Spillway Gates

As part of the operational maintenance activities, VRA in Feb. 2024, undertook a study to conduct a routine inspection and condition assessment of the spillway to determine the integrity of the spillway gates and the associated infrastructure. The following typical grading system, adopted from the American Society of Civil Engineers (ASCE) as shown in **Table 3-1**, was used to evaluate the overall condition and integrity of the equipment that was inspected. A summary of the overall condition of the gates is provided in Table 3-2 [2]. Based on these findings, it was proposed that the repair works will involve the supply and installation for the replacement and refurbishment of various parts of the gates as well as the manufacturing of new precast concrete cover slabs for the upstream stoplog slots and new downstream stoplogs. The cleaning of all anchor blocks and the ends of the post-tensioned tendons to protect against further corrosion is also to be done. Pictures of the key components of the radial gates are shown in Appendix 3.

[2] Source: Condition and integrity assessment report Kpong Dam Spillway Gate Rehabilitation, March 2024

Table 3-1: Grading System for Evaluation of Spill Gate Equipment

Grade	**Description**	**Maintenance/Action**
Very good	Fit for purpose	
	The infrastructure is typically new or recently rehabilitated. A few elements show general signs of deterioration that require attention. Meets modern standards for functionality and is resilient to withstand most disasters and severe weather events.	Only normal scheduled maintenance is required. No action required.
Good	Adequate for now	
	The infrastructure is in good to excellent condition. Some elements show signs of general deterioration that requires attention. A few elements exhibit significant deficiencies. Safe and reliable, with minimal issues and minimal risk.	Some minor maintenance needed. Keep monitoring.
Fair	Mediocre, requires attention	
	The infrastructure is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.	Action required. Overall repairs needed.
Poor	At risk	
	The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Conditions are of serious concern with strong risk of failure. System not functional.	Significant repairs/ renewal/upgrades required.
Very poor	Failing/critical, unfit for purpose	
	The infrastructure is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure. System unsafe.	Major repair or replacement required to restore function.

Table 3-2: Summary of the overall condition of the Gates

Observation	Very Good	Good	Fair	Poor	Very Poor
Housekeeping		•			
Access ladders, handrails, and walkway platforms				•	
Pier fencing			•		
Hoist chains			•		
Gearbox and drive system			•		
Synchronizing shafts				•	
Power reticulation			•		
Auxiliary power			N/A		
Lighting				•	
Control infrastructure		•			
Braking and fan system			•		
Trunnion			•		
Trunnion yoke			•		

Observation	Very Good	Good	Fair	Poor	Very Poor
Trunnion girders			•		
Trunnion arms			•		
Gate skin plates				•	
Gate docking systems			•		
Gate sealing plates			•		
Gate seals				•	
Gate wheels and pressure plates			•		
Upstream stoplogs			•		
Upstream stoplogs embedded sealing plates				•	
Upstream stoplog grapple			•		
Upstream stoplog slots cover slabs				•	
Downstream stoplogs and sealing plates			•		

3.7 Pre-Construction Activities

3.7.1. Environmental Impact Assessment Study

As indicated under Section 1.6, the acquisition of Environmental Permit is mandatory to allow for the commencement of the physical construction for such a project. Various activities have been undertaken regarding this, including the formal notification of the EPA in May 2024 of the project and the preparation of this Draft EIS Report. Following the public disclosure and review of the Draft EIS, VRA shall prepare the Final EIS to the EPA for the Environmental Permit. The Permit is expected to outline various conditions that must be adhered to in project implementation. It must be noted that it is an offence under Regulation 29 of the Environmental Assessment Regulations LI 1652 of 1999 to start a project without an Environmental Permit.

3.7.2. Procurement of Contractors

Tendering will be by International Competitive Bidding in line with the requirements of the national public procurement, whilst adhering to the European Commission Public Procurement Guidelines. Received tenders shall be evaluated and appropriate recommendation for award of for the works shall be made by a well constituted Evaluation Panel. This will end the pre-contract phase of the project. The successful contractor will be expected to develop the listed documentations indicated in Section 1.6.4 as part of the bidding requirements. There may be a few sub-contractors that will be used for the project, and these will include contractors specializing in mechanical works, civil and structural works, electrical works, instrumentation, and control, etc.

The main contractor shall make available all project related documentations to provide sub-contractors with enough detail on the expected standards for the project. Sub-contractors may provide their own plans under the umbrella of these documentations. This EIS Report and the

Environmental Permit to be issued for the project are also expected to give guidelines for project implementation regarding the protection of environment in the construction phase.

During the contract phase, a competent Consultant would be engaged for construction supervision to ensure that they complete the works in accordance with the specifications and time.

3.7.3. Establishment of Office & Lay Down Areas

The Contractors and Consultants would be required to provide and set adequately sized offices, fully furnished with furniture, shelves, computers, etc. as part of the project management requirements. The location of the offices would be agreed with the Contractor prior to the start of works. There is an existing office space of land area 824 m^2 that was utilised by the contractors who undertook the KGS retrofitting project. This facility, which is about 300m from the KGS, is expected to be utilised by the contractors and consultants. Thus, no new office site will be required under the project. A vast area located close to this would be the area dedicated for sandblasting and major repairs activities for the spillgates. It is anticipated that some rehabilitation works, and expansion of the facility would be required to adequately accommodate the Contractors and Consultants.

The Impregilo yard, an area of about 10,140.0 $m^{2,}$ and about 1 km from KGS, is also proposed as the laydown area for the contractor for the storage of materials and minor repair works. The Contractor would be required to rehabilitate some of the existing facilities to make the area fit for purpose. At this stage, the contractor will be required to implement safety measures, including signage, barriers, and the provision of personal protective equipment (PPE) for workers. There shall be no associated work camp and workers will be required to seek accommodation in the nearby communities. Pictures of the facilities of Office & Lay Down Areas are shown Plate 3-5 and a Google Earth Map shown in Appendix 3.

Plate 3-5: Pictures of Office & Lay Down Areas

3.8 Constructional Activities

3.8.1. Repair of the Displaced Rockfill on the Upstream Slope of the Kpong Dam

3.8.1.1. Procurement of Equipment

The rehabilitation of a hydro power plant dyke typically involves significant earthmoving, rockfilling work, and sometimes the installation of specialized components. A list of heavy equipment required for such a project are outlined in **Table 3-3**. Depending on the specific requirements and conditions of the site, additional specialized equipment may also be necessary, and for this project a floating barge may be required to accommodate the excavators on water.

Table 3-3: Heavy Equipment Required & Functions

Equipment	Functions
Excavators:	For digging, removing, and relocating earth and debris.
Bulldozers	To clear and level the site, as well as to push large quantities of soil and rock.
Loaders	For loading materials into trucks or other equipment.
Dump Trucks	To transport excavated material and deliver new materials to the site.
Graders:	For levelling and shaping the surface.
Cranes	For lifting and placing large and heavy components, such as precast concrete sections or steel reinforcements.
Concrete Mixers	For mixing and delivering concrete for dyke construction or repair.

Equipment	Functions
Compactors/Rollers	To compact soil and other materials to ensure stability and prevent settling.
Pumps	To remove water from the construction area, especially if working in or near water.
Piling Rigs	If the project requires deep foundation work, such as driving piles for stability.
Water Trucks	For dust control and sometimes to assist in soil compaction.
Generators	To provide power for various tools and equipment, especially in remote locations
Welding Machines	For assembling and repairing steel reinforcements or other metal components.
Surveying Equipment	For precise measurement and alignment of the dyke construction.

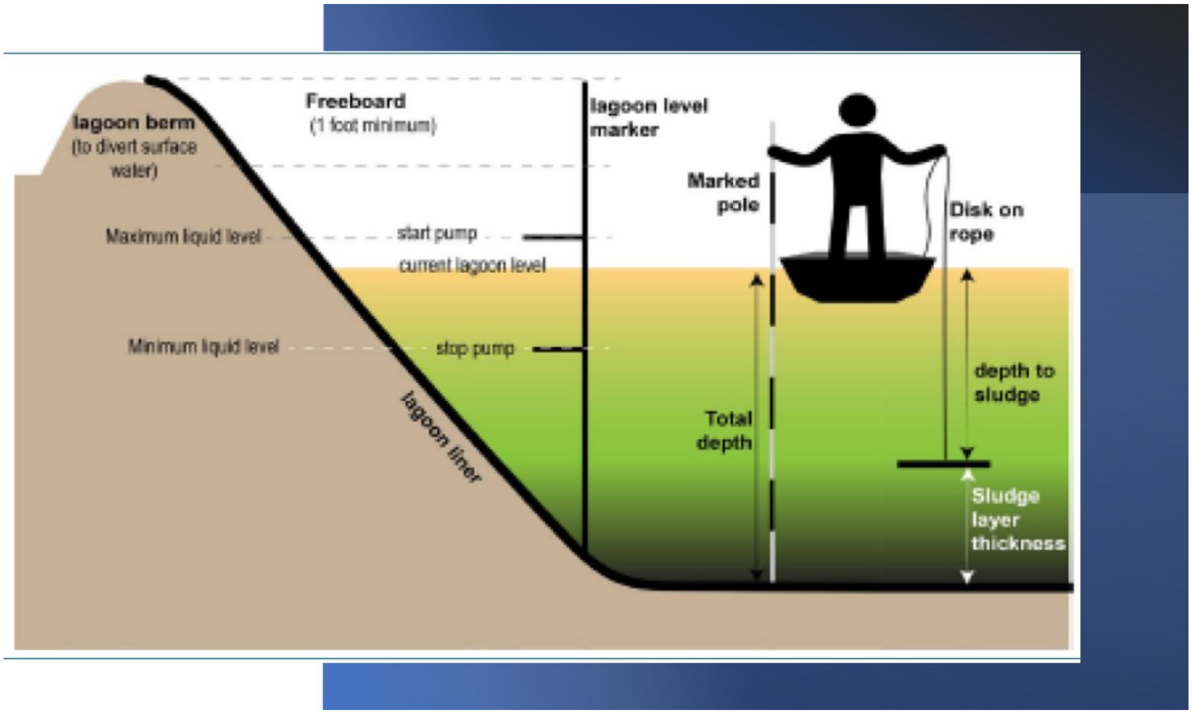
Most of the listed equipment will be procured internally from Ghana as there are many companies that provide such machinery on a hiring basis, and this shall boost the local economy. It is expected that the Project Contractor would source these from highly specialised suppliers, with known track record. In procuring any goods and services for the proposed project, the Contractor will ensure that products and services for the construction phase have been assessed for health and safety impacts to ensure that once construction commences, all information is available and known. Catalogues, certificates, references list, ISO, and OHSAS certificates, etc. are to be provided to VRA for concurrence.

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 VRA and other relevant matters. Manufacturer's authorizations are to be provided showing that the Contractor has been duly authorized by the main manufacturers for this project to supply and install that item in Ghana.

3.8.1.2. Determination of Thickness of Poor-Quality Sediments

There are locations where it seems that sediment is accreting in the foreshore. To address this, it is recommended to measure the sediment thickness of the fines before construction since the dredging and rock volume depends on it. It is also necessary to determine the thickness for construction to guarantee the stability of the revetment. Without measuring it is possible that a layer of fines thicker is left, and this will cause a stability issue for the revetment. The principles of measuring fines/sludge have been discussed in the detailed design report (See **Figure 3-2**), and basically will comprise of the use of rope or pole with a light disk or plate fixed on it which will be let in the water at various distances along the toe of the entire dam.

Figure 3-2: Principles of Measuring Fines/Sludge at the Bottom of the Lake



3.8.1.3. Assembly of Floating Barge

The Contractor shall be responsible for the assembling of a floating barge for use for the dredging exercise. The exercise will involve assembling of the hull, floating device, decking and the superstructure, and these activities are to be done in the water body. Materials such as steel, paints, wood, floaters, are to be utilised.

3.8.1.4. Positioning of the Floating Barge

The positioning of the barge is of utmost importance to be able to build a continuous and level rock layer. The barge should be held in place by studs or four mooring cables. A GPS system is required on the barge or boat attached to the barge. GPS coordinates should be set out for every dumping position and position the barge accordingly. After every dump, there is the need to check-off the coordinate in a log and go to the next one.

3.8.1.5. Transportation of Boulders & Boulders

The contractor shall be required to acquire and transport boulders from nearby quarries, and the most likely ones are those at the Shai Hills, located within 25km – 37km radius from the site. An estimated volume of rock is about 150,000 cubic meters will be required. The Contractor would be responsible for the engagement with the suppliers or owners of the quarry. With respect to the use of heavy goods vehicles (HGV), a typical 20 cubic meter truck is expected to load and cart these rocks fill to site, and an approximately 7500 trips of trucks is anticipated to deliver this volume to site, via the Tema – Akosombo N2 Highway.

The route from potential quarry sites is along the Shai Hills Forest Reserve, which accommodates the monkey sanctuary. Due to this, it is imperative that drivers obey the speed limit and drive with utmost care. However, it must be noted that the N2 Highway is a very busy route and vehicular movements by such HGVs are routine and regular, and therefore the project associated trucks will not have any direct impact on activities of the monkeys.

3.8.1.6. Dredging

Following the determination of the thickness of the silt / poor-soil at the bottom, visible (very) large boulders and flat stones from the current slope will then be removed by dredging. Most of the parts that needed to be dredged are below +11.0m NLD: more than 4 meter under water and therefore will be visible. It is recommended to dredge 0.2 m deeper than the minimal dredging depth as determined by measurements due to uncertainties of the measurement. In addition, the design allows for a small layer of fine sediment up to 0.5 m thick. This is required to deal with dredging uncertainties that are depending on the available equipment.

It is recommended that a river suction dredger located on a floating barge should be used for this activity (See Plate 3-6). By so doing, it is possible to dredge nearly all the fines, even between loose rocks, with the suction dredger. Using a floating pipeline, the dredged material will be dumped 30 m to 100 m further in the lake. By so doing, the risk of building on a layer of fines / poor-quality soil is then almost entirely mitigated. Rocks, from the present revetment, that have slid down can remain at the bottom. Before and after dredging, a bathymetric measurement should be made to verify the depth and to be able to alter the design accordingly.

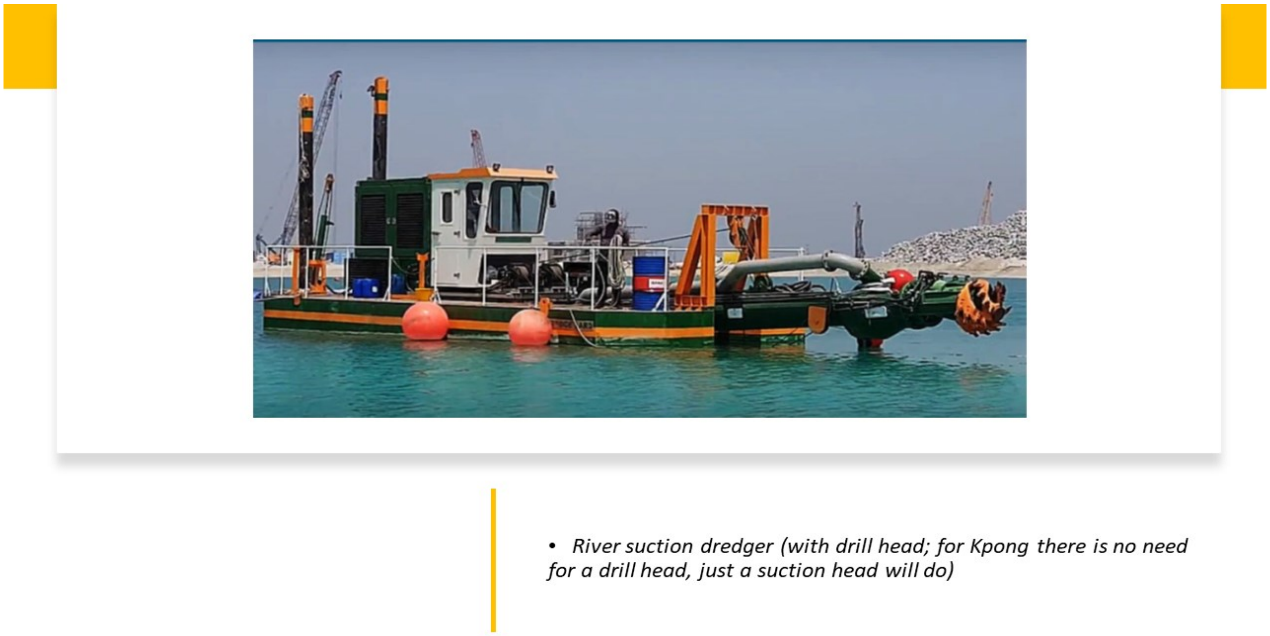


Plate 3-6: River Suction Dredger

3.8.1.7. Rock Placement

Rock placement is a proven technique in dyke rehabilitation, ensuring the resilience and longevity of hydropower dam structures against natural and man-made forces. It involves using rocks or riprap to stabilize and protect the dyke from erosion and other forms of degradation. This method is crucial for maintaining the structural integrity of the dam and ensuring its long-term functionality. This activity will be done using an excavator on a floating barge (See **Figure 3-3**), where about 5 to 40kg and the 45/125mm light grading rock will be placed overboard, as required.

Per the design, the dumping of rock is to be done per meter, and to get (at least) a 0.5m thick rock layer with a 5 to 40kg grading there should be 860 kg of rock dumped on every square meter. To dump the filters layers in deep water, at a water depth of more than 4m, large pipes will be used to guide the rock down to the bottom. The 60 to 300kg rock will be placed by a (bucket) excavator and will not be dumped to avoid the 5 to 40kg layer beneath being pushed out or damaged, which could result in losing the interlocking between the old and new revetment causing a major loss in stability. Placement will be done with an excavator either from the barge and from the crest (See **Figure 3-4**).

After dredging, a multibeam measurement would be made and this is to be done after each grading (45/250mm, 5 to 40kg and the 60 to 300kg). It will involve the use of multibeam echo sounders to map underwater topography and assess the condition and stability of underwater structures.

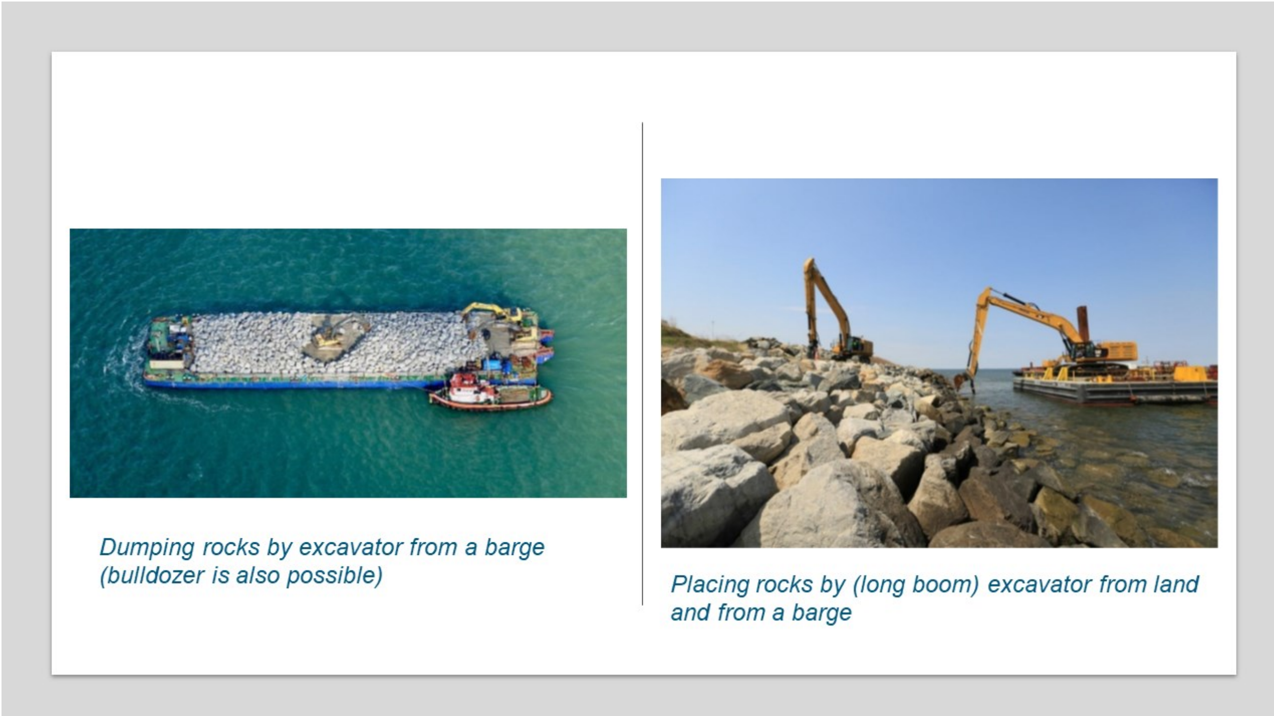


Figure 3-3: Placing rocks by (long boom) excavator from land and from a barge.

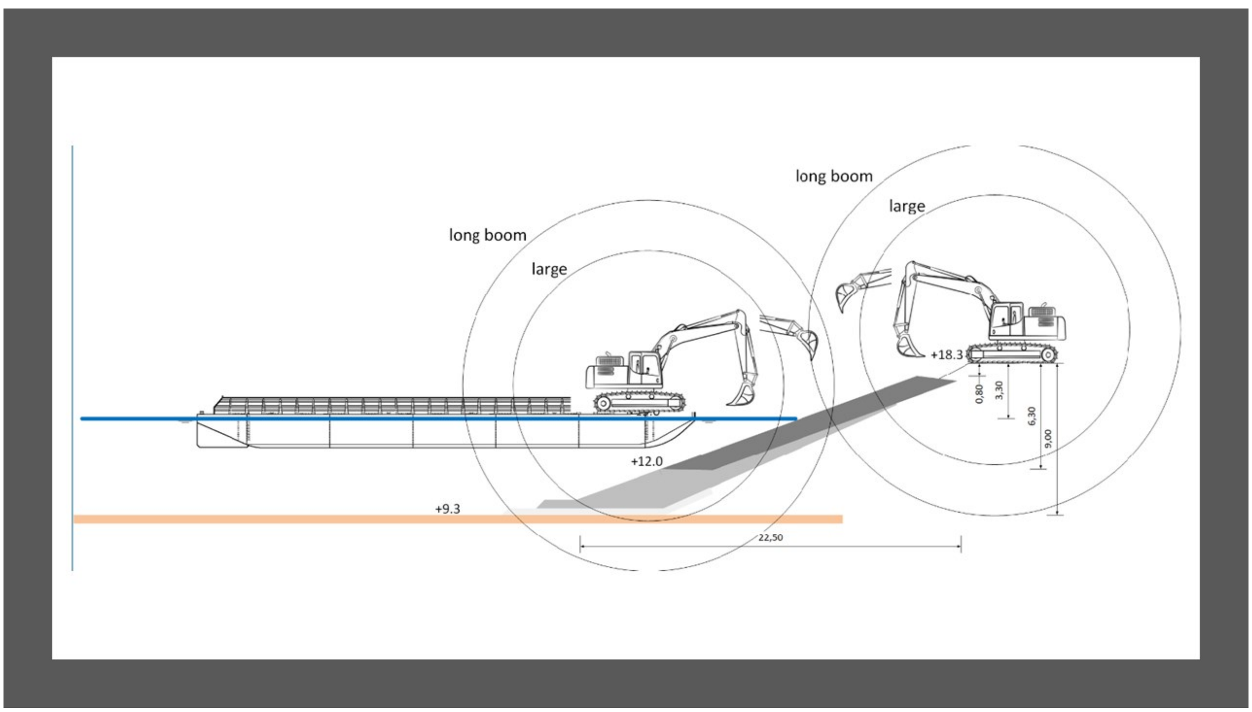


Figure 3-4: Placing Rocks by excavator from the crest and from a Barge.

3.8.1.8. Testing and Commissioning

This shall involve conducting a Structural Integrity test to ensure the rehabilitated dykes meet design specifications and safety standards. There shall also be the need to undertake a hydraulic Performance Testing to evaluate the dykes' ability to handle water flow and prevent flooding.

3.8.2. Rehabilitation of Kpong GS Spillway Gates

3.8.2.1. Purchasing & Importation

Rehabilitation of hydropower spillway gates requires specialized equipment to ensure the safety, efficiency, and longevity of the structures. Using the appropriate equipment for each aspect of the rehabilitation process is crucial to ensure the project is completed safely, efficiently, and to a high standard. A list of equipment required to be procured for the replacement and refurbishment of various parts of the spillway gates and associated infrastructure are outlined in **Table 3-4**. It must be noted that this activity will mostly involve the replacement of parts. Most of the listed components will be procured internationally, as they are not available for purchase in Ghana. It is expected that the Project Contractor would source these from worldwide level suppliers. Manufacturer's authorizations are to be provided showing that the Contractor has been duly authorized by the main manufacturers for this project to supply and install that item in Ghana.

Table 3-4: Major Equipment Required for Spill Gates Refurbishment

Equipment	Functions
Inspection and Assessment Equipment	
Diver Equipment and Remotely Operated Vehicles:	For underwater inspection.
Non-Destructive Testing (NDT) Equipment	Such as ultrasonic testers, magnetic particle testers, and radiographic inspection tools to assess the integrity of the gates and structures.
Laser Scanners and Drones	For precise measurements and detailed inspections of hard-to-reach areas.
Cleaning and Surface Preparation Equipment	
High-Pressure Water Jetting Systems:	To remove debris, algae, and old coatings from the gates.
Abrasive Blasting Equipment:	For surface preparation before applying new coatings.
Chemical Cleaning Agents	For removing rust and other contaminants.
Repair and Maintenance Tools	
Welding Equipment:	For repairing cracks or adding reinforcement.
Hydraulic Jacks and Lifting Equipment:	To lift and support gates during repair.
Grinding and Cutting Tools	For precision cutting and shaping of metal components.
Coating and Corrosion Protection Equipment	
Spray Guns and Applicators:	For applying protective coatings and paints.

Equipment	Functions
Curing Equipment:	Such as heat lamps or curing blankets for certain types of coatings.
Installation and Alignment Tools	
Laser Alignment Tools:	To ensure precise alignment of gates and components.
Hydraulic Torque Wrenches:	For assembling and disassembling bolted connections.
Crane and Hoisting Equipment	For moving large components into place.
Control and Automation Equipment	
PLC (Programmable Logic Controller) Systems:	For controlling gate operations.
Sensors and Actuators:	To monitor and control the position and movement of gates.
SCADA (Supervisory Control and Data Acquisition) Systems	For remote monitoring and control.
Safety Equipment	
Personal Protective Equipment (PPE):	Such as helmets, harnesses, and life vests.
Temporary Barriers and Safety Nets	To protect workers and equipment.
Environmental Protection Equipment	
Containment Booms and Silt Curtains:	To prevent contamination of the waterway.
Water Treatment Systems	To manage and treat any contaminated water resulting from the rehabilitation process
Documentation and Monitoring Tools	
Data Loggers and Monitoring Sensors:	To record environmental and structural data during and after rehabilitation.
Inspection Cameras and Endoscopes	For internal inspection of gate components.

3.8.2.2. Refurbishment Plan & Activities

The repair works are not expected to have any significant impact on the power generation of the AGS or the KGS. For the purposes of reservoir management, the repair works on the gates would be planned to ensure that adequate number of gates are always available to allow for managing the reservoir if required. The Contractor shall be required to carefully dismantle and remove the existing gates and ensure safe handling and disposal of old materials. The removal of the gates will be done once every quarter (i.e., about four times in a year), and this will be between the hours of 10am – 2pm, where traffic on the dyke has been assessed to be low. There will be no movement of public transport, except motorbikes, during the removal of the spillway gate, and advance notice will be given to the public to avoid any inconveniences.

The contractor shall be therefore required to develop a comprehensive work plan outlining each phase of the rehabilitation process, following which equipment, materials, and personnel will be mobilized to the site. Prior to this, VRA shall engage the Contractor to discuss the proposed scope of work to enable the prioritisation and ranking of the refurbishments and to inform the final selection of the rehabilitation scope of work and subsequent cost estimates.

Proposed step by step approach will be as follows:

- Removal and Safety Measures.
- Surface Preparation
- Structural Repairs
- Hydraulic and Mechanical Repairs
- Coating and Protection

It is also expected that certain design improvements work will be included as part of the refurbishments. Unlike the dyke rehabilitation works, associated works of the spillways are largely expected to be confined to the project site within the sandblasting area and the lay down area at the Impregilo Yard.

3.8.2.3. Testing and Re-commissioning

Testing and re-commissioning will involve conducting a rigorous testing of the rehabilitated gates to ensure proper operation. It must be ensured that the hoisting mechanisms, control systems, and safety features have all been tested and functioning appropriately, prior to reintegrating the gate into the dam's control systems and test remote operation, if applicable.

3.8.2.4. Final Inspection and Handover

The Contractor shall perform a final inspection with VRA to verify compliance with standards as well as document the rehabilitation process and provide necessary training to the plant operators.

3.9 Site Restoration

Upon completion of the rehabilitation works, the Project Contractor shall be responsible for all demobilisation activities in accordance with the requirements of the contract agreement documents, especially at the dykes, the sandblasting and the Impregilo Yard, where materials and minor repairs are to be undertaken. Equipment and material may be salvaged for resale, scrap value or disposal, depending on market conditions, in line with the circular economy waste management strategies. All waste and excess materials will be disposed of in accordance with regulations of the Lower Manya Krobo Municipal Assembly. Waste management will focus on adoption of circular economy strategies. Waste that can be recycled under municipal programs will be done accordingly. Waste that requires disposal will be disposed of by licensed haulers. All hazardous waste on site will be removed from site and disposed of in accordance with national requirements. The project area will be restored to its pre-development state, subject to environmental requirements and the conditions of the contract. For safety and security, the security fence will be the final component dismantled and removed from the site.

3.10 Training & Development

The contractor shall be mandated to provide training to the VRA Team on the new systems and maintenance procedures, including any new instrumentations that have been installed All relevant documentation, including as-built drawings, maintenance manuals, and operation guidelines, are to be handed over to the VRA.

3.11 Operation and Maintenance

The VRA Operational & Maintenance Team is responsible for monitoring the dam and its related dykes/spill gates, including but not limited to the various instrumentations on the dam. The instruments include but not limited to the following:

- Piezometers
- Alkali-Aggregate Reaction Monitoring Equipment
- Air Gap Monitoring Equipment

Dust deposits on these instruments are periodically cleaned and, depending on the condition of the relief wells, the rodding of the wells is also undertaken to prevent them from clogging. Currently, VRA has engaged the services of a maintenance contractor who is responsible for controlling the growth of weeds on the dykes. The work of the contractor is monitored by the VRA Dam Safety Technicians. Upon completion of the project, weed growth, especially on the upstream face of the dyke would be curtailed.

Regular maintenance of the spillway gates is crucial for the safe and efficient operation of the dam. Various maintenance activities are performed on the spillway gates hoisting system at the Kpong Generating Station. Essentially, the activities include but not limited to visual inspections, lubrication of gears, lubrication of chains, operation of the gates and the maintenance of the spillway stoplogs. Adhering to the specified maintenance schedule helps in early detection of issues and prevents potential failures, ensuring the longevity and reliability of the spillway gates. **Table 3-5** outlines details of both the mechanical and electrical maintenance tasks, the maintenance schedule, etc, that are undertaken at the Spillway Gates at the plant.

Ongoing regular and scheduled inspections shall be conducted to monitor the condition of the dykes and the spillway gates to identify any signs of wear or damage. The 5-Year inspection activity of the Dam Review Board will continue. VRA shall continue to implement a preventive maintenance program to address minor issues before they become major problems. Regarding this, it is recommended to implement yearly a bathymetric survey and if possible, take under water drone images. The environmental management on the facility will be guided by the facility's EMP, which are prepared every three years for the purpose of Environmental permitting.

Table 3-5: KGS Spillway Gates Maintenance Schedule

Maintenance Activity	Maintenance Schedule	Special Resources	Responsible Unit
Visual Inspection	Monthly	-	Mechanical
Gear Lubrication	Monthly	Omala Gear Oil	
Chain Lubrication	Two Yearly	EP3 Grease	
Operation of Gates	Two Yearly	-	
Spillway Stoplogs Maintenance	Annual	-	
Control Panel Inspection	Biannual	-	Electrical
Ohmic/Winding Resistance Tests	Biannual	-	
Insulation Resistance Tests	Biannual	-	

3.12 Resource Requirements

3.12.1. Land Take Requirements

A total of 15,354 m^2 (1.534 Ha) land area is required for use as Office and Lay down areas for sandblasting, minor repairs, material storage and the breakdown are shown in **Table 3-6**. As indicated, these areas belong to the VRA and are to be used temporally for the project by the contractors. There is therefore no land acquisition associated with the project.

Table 3-6: Project Land Take Requirements

Area	Land Size (m^2)
Existing Facility for Offices (Former Retrofit Office)	824.0
Sandblasting Area (used under KGSRetrofit Project)	3,500.0
Space Between Existing Offices and Sandblasting Area	890.0
Material Storage and Minor repairs	10,140.0
Total	15,354.0

3.12.2. Estimated Manpower Requirements

The maximum local workforce to be employed during the constructional phase by both contractors and consultants will be up to approximately 70. This workforce will comprise both skilled (70%) and unskilled labour (30%), with at least 25% of the local workforce being females. The Contractor and Consultant direct workers staff on site will comprise of about 6 expatriates and 17 Ghanaians. This work force will be employed on short term basis during the project. Working hours will be from 8am to 4pm, with a 1-hour break, and for five days in a week. It must be noted that these hours could vary depending on the work schedule for the assignment, and various shifts could be run to ensure timely completion. However, any additional period will be considered as overtime and will be duly compensated. Manual labour will be sourced from the local communities, and hence, there is no need for a workers' accommodation camp identified at this stage. It is expected that engineers and other personnel from outside will be housed in existing accommodation facilities at VRA or in Akuse town.

During the operational phase, the existing staff at KGS, totalling 82 in all and including the Director as at close of July 2024, will be responsible for the upkeeping of the facility. VRA has currently outsourced security and cleaning tasks to local firms and these are supervised by the O&M Team, and this shall continue. Estimated labour requirements for the project during the various phases is illustrated in Table 3-7.

Table 3-7: Estimated Project Related Labour Requirements

Type of labour	No. of Personnel				
	Pre-Constructional	Constructional Phase			O&M Phase
	VRA	VRA	Contractor	Consultant	VRA
Project Director	1	1	1	1	1
Other Directors	2	2	0	0	0
Plant Manager	1	1	0	0	1
Supporting Managers	1	1	1	1	3
Site Engineers	0	0	1	1	0
Office Engineers	3	4	3	1	8
HSE Officers	1	1	1	0	1
Auxiliary Staff	2	2	2	0	15
Tech. Engineers	3	3	3	1	53
Local Contract Workers	0	0	50	3	0
Total	**14**	**15**	**62**	**8**	**82**

3.12.3. Electric Power Requirements

Power for construction and project activities will be obtained directly from KGS, and this will mainly be for site works, office, and lighting purposes.

3.12.4. Water Requirements

Water to KGS is supplied by VRA and this shall be utilised for personal use. Sachet/bottled water will be purchased for drinking purposes. The estimated volume for worker requirements was calculated using the Water Science Activity Center Water Requirements,[3] and this is

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

estimated at 16.24 gallons per worker/day, considering each worker drinks 4 glasses of water each day (8oz per glass), washes hands/face four times, and flushes the toilet four times.

3.12.5. Raw Materials Requirements

The major raw material requirement for the works will be the boulders, and this can be locally procured. Quarry operation in the country requires state permitting, therefore, the Contractor will most likely procure the boulders from already established quarry operating sites, as appropriate.

3.12.6. Cultural Heritage Resources

Based on desktop research as well as a field investigation undertaken by the EIA Team, no archaeological or cultural heritage material is found within the project facility. It must however be noted that in case of any chance finds at the project site, VRA shall conform to the requirements of the National Museums Act, Act 387 of 1969.

3.13 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 to allow for immediate resolution of the risk without schedule interruption. Competent personnel shall be included in risk assessments to ensure that risks are correctly identified, assessed and appropriate mitigation measures recommended. The responsibility of risk management in the proposed project lies with the Contractor and would involve developing a detailed site risk assessment and control to cover all aspects of the work and this is to be approved by the VRA. Monitoring and reporting by the VRA Project Management Team will ensure that contractor processes are being implemented fully and effectively. Stakeholders will be updated on any associated risks as appropriate.

3.14 Project Financing Detail

VRA funded the consultancy services to establish the causes of the failure of the dykes, including this EIS Report. The study to establish the repair works required on the spillway gates was funded by EIB. The constructional activities are being co-funded by the EIB and the EU. The EU strategy is to support the electricity sector in Ghana on priority projects of all dimensions in a complementary way with other member states and developing partners. Currently the financials for the different work components available are only high-level estimates and this is about €60.0 Million.

3.15 Project Schedule

The Schedule for the work required would be provided by the Contractor to be procured for the assignment. The rehabilitation of the dyke would be scheduled to be completed within 18 months and the spillway gates repair works within four years. The project is expected to commence in

Q4 of 2025 for a period of four (4) years. Tentatively, the schedule for the various works including the pre-contract phase, is shown in Table 3-8.

Table 3-8: Expected Construction Schedule

Project Components	**2024 Qtr**				**2025 Qtr**				**2026 Qtr**				**2027 Qtr**				**2028 Qtr**				**2029 Qtr**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Dykes																								
Procure Contractor and Consultant																								
Commencement of assignment																								
Mobilization																								
Removal of sedimentation																								
Supply and placement of boulders																								
Spillway Gates																								
Procure Contractor and Consultant																								
Commencement of assignment																								
Mobilization																								
Removal, refurbishment, and reinstallation of gates																								

4 DESCRIPTION OF EXISTING ENVIRONMENTAL

4.1 Introduction

This Chapter provides a detailed report covering all aspects of the existing physical and biological environment, ecological sensitive areas as well as socio-economic conditions. It provides information specifically on the impact area of influence which are dependent on various factors, including the specific characteristics of the project, the surrounding environment, and the potential impacts.

The project is specific to KGS, and the immediate impact area or the Area of Influence (AoI), has been generally assessed by the EIA Team to be within 5km distance of the project site, with the Natriku and Akuse Communities being the most impacted. Site specific data on the project site, such as noise, air, and water quality has been provided. Based on the project footprint, taking into consideration the transportation of boulders, lay down areas, and the rehabilitation activities, it is noted that the environmental and social influence will mainly affect areas in the Lower Manya Krobo Municipality, and this has been defined as the broader impact area.

4.2 Data Collection Methodology

A study on the existing biophysical and social environment has been undertaken and this was achieved through the collection of both primary and secondary data. For primary data, a site reconnaissance visit was done to collect baseline data in the context of physical and ecological environment as well as socio-economic and land use. Baseline data on noise, air and water quality has been obtained from progress reports emanating for the routine monitoring activities of the VRA within the project area in line with the conditions of the existing EMP for the facility as well as onsite monitoring activities undertaken in August 2024, as part of this EIA study. The secondary data with maps and figures to supplement the primary social was collected through a literature review on the project as well as the project area and referenced as required.

4.3 General Site Information

4.3.1. Geographical Location

The KGS is located at Akuse, which is one of major townships in the Lower Manya Krobo Municipality (LMKM) in the Eastern Region of Ghana. Figure 4-1 shows the geographic location of Akuse within the LMKA. The LMKA is one of the 26 administrative districts in the Eastern Region of Ghana. The Municipality is strategically located at the Eastern corner of the Eastern Region, and it lies between latitude 6.05N and 6.30N and longitude 0o08W and 0.20W with an altitude of 457.5m above sea level. The Municipality has about 235 settlements and covers an area of 304.4 sq km, constituting about 1.7 % of the total land area of the Eastern Region.

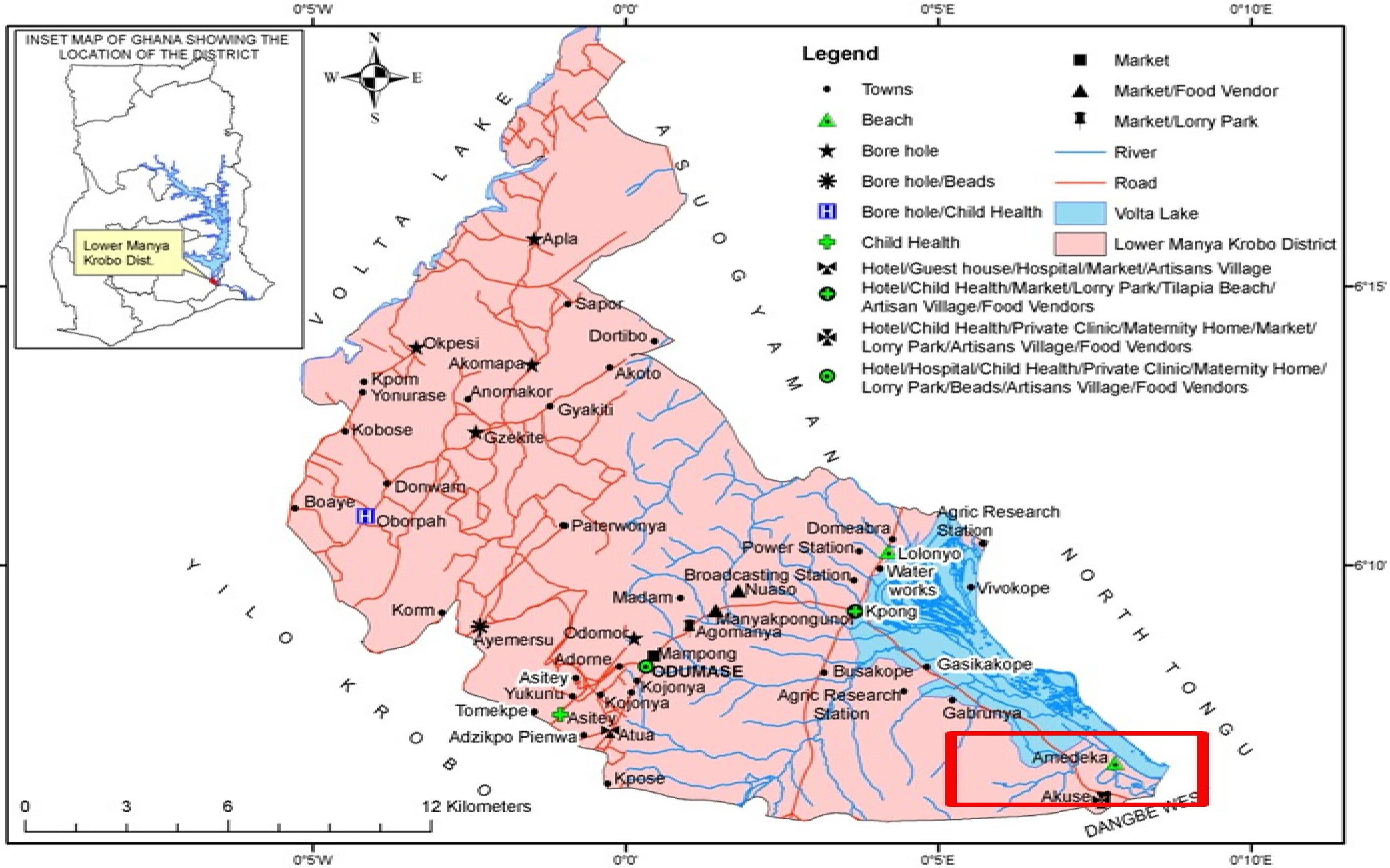


Figure 4-1: Map Showing Geographic location of Akuse within LMKA

LMKA is bounded at the North-west with Upper Manya Krobo District, North-east with Asuogyaman District, South-eastern part is North Tongu District, and the South are Yilo and Dangme West Districts respectively. The major towns in the district include the capital, the Odumase township (which incorporates Atua, Agormanya and Nuaso), Akuse and Kpong in the Lower Manya area.

4.3.2. Land Use

There are various communities and settlements in the vicinity of KGS and these include both planned residential areas and informal settlements, housing the workers of the power station and the local population engaged in various economic activities. Notable amongst them are the VRA Township, Akuse, Natriku, Fodzoku, Nuaso, Torgorme, Okwenya and Nyiflakpo. Within these communities are various sensitive receptors such as churches, mosques, prisons, and schools. The neighbouring / sensitive community facilities within a 5km stretch south of the KGS and their coordinates as well as distances from the site are provided in Table 4-1 and a satellite view provided in Appendix 4.

Table 4-1: Neighbouring Community Facilities to KGS

Distance from Dam Site (km)	Neighboring Sensitive Facility	Latitude	Longitude
1.92	Presby Church, Akuse	N006° 06'06.87"	E000° 07'41.59"
1.92	Messiah Preparatory School, Akuse	N006° 06'06.14"	E000° 07'39.48"
2.00	New Covenant Apostolic Church, Liberty Temple, Akuse	N006° 06'00.73"	E000° 07'29.65"
2.10	Greenhouse Gas Facility	N006° 06'29.76"	E000° 06'31.01"
2.11	Natriku Landing Site	N006° 06'37.90"	E000° 06'25.72"
2.14	New Anointing, Assemblies of God, Akuse	N006° 05'57.78"	E000° 07'31.28"
2.16	Church of Pentecost, Central, Akuse	N006° 05'56.12"	E000° 07'28.72"
2.36	Akuse Watermanship Training Camp	N006° 06'49.63"	E000° 06'12.46"
2.40	Mount Olive Methodist Church, Akuse	N006° 05'49.14"	E000° 07'34.92"
2.41	Jehovah's Total Salvation Chapel (JETSC), Natriku	N006° 06'8.14"	E000° 06'40.12"
2.47	Church of Christ, Akuse	N006° 05'47.02"	E000° 07'22.47"
2.51	Akuse Methodist Senior High & Technical School	N006° 05'46.61"	E000° 07'34.68"
2.60	EP Church, Akuse	N006° 05'43.12"	E000° 07'22.84"
2.64	Methodist School, Akuse	N006° 05'41.69"	E000° 07'35.56"
2.66	JW Kingdom Hall, Akuse	N006° 05'41.99"	E000° 07'14.30"
2.67	Fire Service, Akuse	N006° 05'42.40"	E000° 07'07.08"
2.72	Hydro City Development Company, Natriku	N006° 05'56.35"	E000° 06'39.60"
2.91	Akuse Police Station	N006° 05'35.22"	E000° 07'03.47"
2.92	Alvic Farms, Natriku	N006° 05'52.75"	E000° 06'34.04"

Distance from Dam Site (km)	Neighboring Sensitive Facility	Latitude	Longitude
2.93	Church of Pentecost- English, Akuse	N006° 05'38.25"	E000° 06'52.33"
2.95	Holy Family Catholic Church, Akuse	N006° 05'38.51"	E000° 06'50.09"
2.95	Akuse Prisons	N006° 05'34.94"	E000° 06'59.02"
3.10	Bok Nam Kim's Agricultural School and Farm, Akuse	N006° 05'52.62"	E000° 08'31.86"
3.22	Akuse Grade School	N006° 05'36.77"	E000° 06'32.34"

Electricity generated from the KGS is fed into the GRIDCo Bulk Substation located within the vicinity for further transmission as required. The dam's reservoir helps in regulating river flow, providing water for irrigation, and controlling floods and this has influenced some of the land uses in the project area. Municipal water supply is abstracted at Kpong town in the upstream part of the reservoir. The water supply scheme is operated by Ghana Water Company Limited. Within the project area is the Kpong Irrigation Scheme, which is a 3000 Ha irrigation scheme owned and operated by the Government of Ghana. The discharge into the scheme is 7.2 m3/s continuously year-round. There are two major irrigation canals with intakes on each side of the Kpong dam. The irrigation water is used for rice cultivation and these canals run through the area all the way to the Asutuare community in the Lower Volta Area, and provide water for farmers, including the activities of the Kpong Farms Limited, a subsidiary of the VRA.

Per the Volta River Development Act, 1961 (Act 46), lands within the area of the dam are property of the VRA. Pursuant to this law, all communities within the project area (most of whom were resettled from other communities) respect the right of VRA as owners of the lands. Community members are allowed to farm on some parcels of land within the river on a limited basis. The communities also rely on the river and the reservoir for fishing, farming, and other livelihoods. The flat terrain is conducive to agriculture, and much of the land around the dam is predominantly used for agriculture. This includes farming of annual crops such as maize, cassava, and vegetables (See Plate 4-1), as well as aquaculture due to the proximity to the Volta River and its reservoirs. Aside from this, perennial crops such as coconut, palm trees plantain and palm-nut are available and scattered in the area.

Plate 4-1: Agricultural Activities Around KGS

There are two fishing landing sites upstream and located close to the dam, and these two-landing sites are the areas that could possibly be utilized for onshore loading of boulders onto floating barges for the placement activities. With regards to land uses, the landing site is utilised by the Natriku community for fetching water, washing, and for berthing of canoes for the fishing activities (See **Plate 4-2**).. It includes a small slipway, which was constructed by VRA many years ago, as well as some shelters and premix fuel tanks. The Natriku fish landing site on average has about 7 to 15 fishermen and fish processors per day during peak seasons This site therefore serves as a key area that supports the livelihoods of the community members. The origin and history of the slipway is disputed between the community and VRA. While the Natriku community claims that the landing site was established as part of a previous resettlement package, VRA management is of the view that the facility is an abandoned structure used during the construction of the Kpong dam which the community is now making use of.

The other fishing landing site is close to the Akuse Watermanship Training Camp, which is under the Wajjr Barracks of the Engineering Training School of the Southern Command of the Ghana Armed Forces headed by the Commanding Officer (See **Plate 4-3**). The facility is used for training by the Command and the presence of the onsite army personnel provides restrictions to access, and this was obvious at the time of visit due to the absence of locals as against the other landing site and the presence of military trucks and security personnel.

Plate 4-2: Uses of the Natriku Community Landing Site

Plate 4-3: Restricted Zone of the Watermanship Training Camp Landing Site

Within the dam area are nomads who take their cattle to graze daily and are located at areas where they need to cross over the dykes to access pastures to graze. The continuous usage of the lower points of the dykes by the cattle caused dislodgement of the protective outer layer of the dykes. The design solution was to allow the continual passage of the cattle without the continual erosion of the dykes. A ramp was then proposed at 4 points in total on the east and west dykes and these have been completed. The ramps have a gentle slope to enable cattle cross and materials utilized are such that they blend in with the environment and the dyke's appearance (See Plate 4-4).

Plate 4-4: Cattle Crossing Ramp Over Kpong Dam

There is also a greenhouse facility close to the Kpong west dyke. An abandoned facility meant for hospitality business can also be found close Akuse Watermanship Training Camp. This belongs to the Suntaa Hospitality who began their constructional activities in 2022 to develop a lake view resort. Suntaa Hospitality intends to divert water by constructing inlet and outlet canals from the Lake and the creation of an artificial lake for use as waterfront facility for the said hotel. This facility involves the construction and operation of 36 prefabricated wooden cabins with facilities such as water park, swimming pool, green park, spa, tennis court etc on a 4.59 ha of land and the facility is to be totally walled as part of the security measures. The facility is in place based on land lease by the VRA and permitting from the EPA and the Water Resources Commission.

The Akuse oxidation ponds are located within 2 km the KGS and nearby VRA offices, including the former Retrofit Project Office,) as well as Akuse township (See **Figure 4-2**). The Akuse Oxidation ponds were constructed in 1981 by VRA for the centralized storage, treatment, and disposal of liquid waste in the Akuse Township and comprises of a pair each of anaerobic and facultative ponds and one aerobic maturation pond (fishpond). All liquid wastes are channeled into underground sewer lines in the township and eventually discharged into the stabilization ponds which are located on the northern boundary of the Amedeka community. It is expected that domestic waste from works under the proposed project will be initially stored in this pond for treatment prior to discharge into the water.

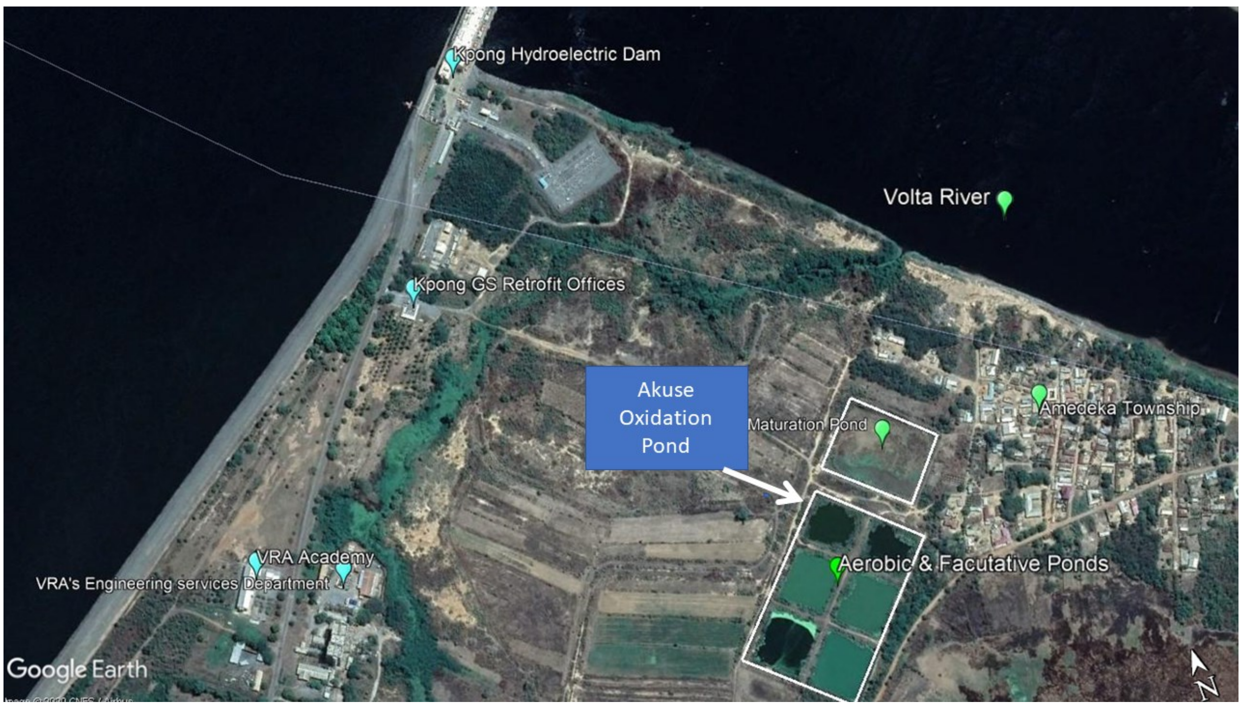


Figure 4-2: Google Map showing KGS and nearby Akuse Oxidation Pond

The scenic environment around the dam and the Volta River provides opportunities for recreational activities, including fishing, boating, and tourism, and this is motivating various developments especially along the Okwenya - Akuse Road. Currently, various hotels have been developed along the Okwenya-Akuse route designed to attract tourists and locals alike. This area is also fast developing with residential facilities. Local markets and small-scale businesses are scattered around the area. These include shops, eateries, and other service-based businesses catering to the needs of the residents and visitors.

4.4 Physical Environment

4.4.1. Atmospheric & Climatic Conditions

A ten (10) year Average Climatic data for Rainfall, Temperature, Wind Velocity and Visibility covering years 2014-2023 from the nearest national synoptic weather station at Akuse Weather Station: **654600 (DGAK)** Latitude: 6.1 | Longitude: 0.11 | Altitude: 17 has been obtained[4], and a diagrammatic representation of the results provided in Appendix 4b. For the said period, the monthly temperatures vary between 27.2ºC and 31ºC with the lowest around August and the highest being observed around March and April. The relative humidity is high averaging between 76.9 and 80% during the rainy seasons and around 60% during the dry seasons of the year. The area experiences double maxima rainfall pattern. The main rainy season is between March and September with the minor between October and December. Much of the rainfalls are in intense storms of short duration, especially at the beginning of the season resulting in heavy runoff and erosion. The dry season or harmattan season with lowest rainfalls of 2.34mm occurs between November – March. The harmattan season is also the period of low visibility due to windy and dusty conditions.

Climatic factors are critical in informing project activities and scheduling. The rainy season also affects the rural road networks as most of the communities' access roads develop gullies and potholes due to erosion. The main dry season begins in December and ends in February. Thus, project implementation schedule should take cognisance of the rainfall pattern and its effects on the road conditions.

Climate risks in Ghana are diverse and significant, impacting various sectors and communities across the country. Ghana frequently experiences flooding, windstorm, rainstorm, drought, and bushfires. According to the World Bank "Climate Risk Country Profile", temperatures across Ghana has experienced rising temperatures over the past decades. Higher temperatures can lead to heat stress, affecting both human health and agricultural productivity. Ghana have risen at an average of 0.21˚C per decade since 1960, with the increase in temperature lower in the southwest (where the project is located) than in Northern Ghana. The average number of 'hot' days per year have increased by 4 days over the period 1961-2003, whilst the number of 'cold' days reduced by 12 days during the same period. Ghana will continue to get warmer with mean temperatures projected to increase by 1.0ºC to 3.0ºC, by mid-century and by 2.3ºC to 5.3ºC by end of the century. Projected warming will likely occur more rapidly in the norther and inland areas than the coastal regions. Across all emission scenarios, temperatures will continue to rise within Ghana through the end of the century.

[4] Source: https://en.tutiempo.net/climate/ws-654600.html

Additionally, changes in 1 to 5-day rainfall maxima trends will likely increase in some areas but are expected to decrease in others. More erratic and intense rainfall during the wet season is expected, along with lower precipitation levels during the dry season and larger decreases in the southern regions. Intense rainfall events are also likely to result in flooding and flash floods, as well as riverbank erosion. The country faces unpredictable rainfall patterns, leading to prolonged dry spells and droughts, particularly in the northern regions. While rainfall is overall expected to decline in the future across Ghana, the high variability across the country poses a significant challenge to hydro power generation. This unpredictability affects water availability for agriculture, livestock, and human consumption. Increased intensity and frequency of rainfall can cause severe flooding, especially in urban areas with poor drainage systems. Coastal areas are also at risk due to rising sea levels and storm surges.

Currently, the VRA has embarked on a study to assess the risk of Climate Change on the Akosombo and Kpong Hydro Generating Stations. The study is to carry out a Climate Change Resilience Assessment (CCRA), in accordance with the processes and recommendations of the Climate Resilience Guide of the Hydropower Sector of the International Hydropower Association. The specific objectives of the study are to:

a. Develop adaptation and monitoring strategies through iterative risk assessment and risk methodologies consistent with the potential sensitivity of the project to climate and other risks.
b. Propose, at the end of the CCRA, the alternative technical operations necessary to ensure the resilience of the dams to climate change.

4.4.2. Air Quality

The Ghana Standards for Environment and Health Protection – Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236:2019) provides for the maximum allowable concentration levels of various air pollutants that represent safe levels that avoid specific adverse health effects associated with each pollutant. Six pollutants (i.e., Sulphur dioxide, nitrogen oxides, ozone, carbon monoxide, particulate matter, and lead) are termed as the criteria air pollutants (CAP) for their abundances as pollutants in the atmosphere and ability to harm human health, plants, and properties. Per the standard, the maximum permissible levels for ambient air pollutant are shown in Table 4-2.

Table 4-2: Ghana Standards (GS1236:2019) – Requirements for Ambient Air Quality

#	Substance	Maximum Limits	Averaging Time
1	Carbon Monoxide	100 mg/m^3	15 minutes
		60 mg/m^3	30 minutes
		30 mg/m^3	1 hour
		10 mg/m^3	8 hours

#	Substance	Maximum Limits	Averaging Time
2	Sulphur Dioxide (SO_2)	520 µg/m^3	1 hour
		150 µg/m^3	24 hours
3	Nitrogen Oxides (measured as NO_2)	250 µg/m^3	1 hour
		150 µg/m^3	24 hours
4	Total Suspended Particulate	150 µg/m^3	24 hours
		100 µg/m^3	1 year
5	PM_{10}	70 µg/m^3	24 hours
		70 µg/m^3	1 year
6	$PM_{2.5}$	35 µg/m^3	24 hours

Per the EPA Permit Conditions for KGS, VRA from 2022 undertakes on bi-annual basis, the monitoring of the air quality levels within KGS using methodology specified in the GS1236:2019. For this EIA study, air quality data has also been collected by an independent service provider within the immediate area of impact and the detailed report on the analysis provided as part of Appendix 4. The pollutants of concern are sulphur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter (PM_{10} and $PM_{2.5}$). Introductory notes on the characteristics, sources, and health impact potential of each of the pollutants of concern are provided in the detailed report and therefore are not repeated here.

Field sampling for baseline assessment was conducted at three (3) locations and these include residential properties and road locations which represent sensitive receptors and worst-case areas respectively. A meteorological station was deployed at Site C, which continuously recorded the weather regime for a 48-hour period during the monitoring and is representative of meteorological conditions (wind, temperature, humidity, rainfall) across the study area. The GPS locations of the 3 sites are shown in Table 4-3, and location map and pictures shown in **Figure 4-3** and Plate 4-5 respectively.

Table 4-3: GPS coordinates for the Air Quality monitoring locations

Location	Description	Latitude	Longitude
Site A	Near the Akuse Main Junction	N 6.093944'	E 0.044556'
Site B	Near the Enam's Collection Building	N 6.094139'	E 0.097000'
Site C	Near the Dam Site	N 6.118122'	E 0.124227'

Figure 4-3: Map of Ambient Quality Monitoring Locations

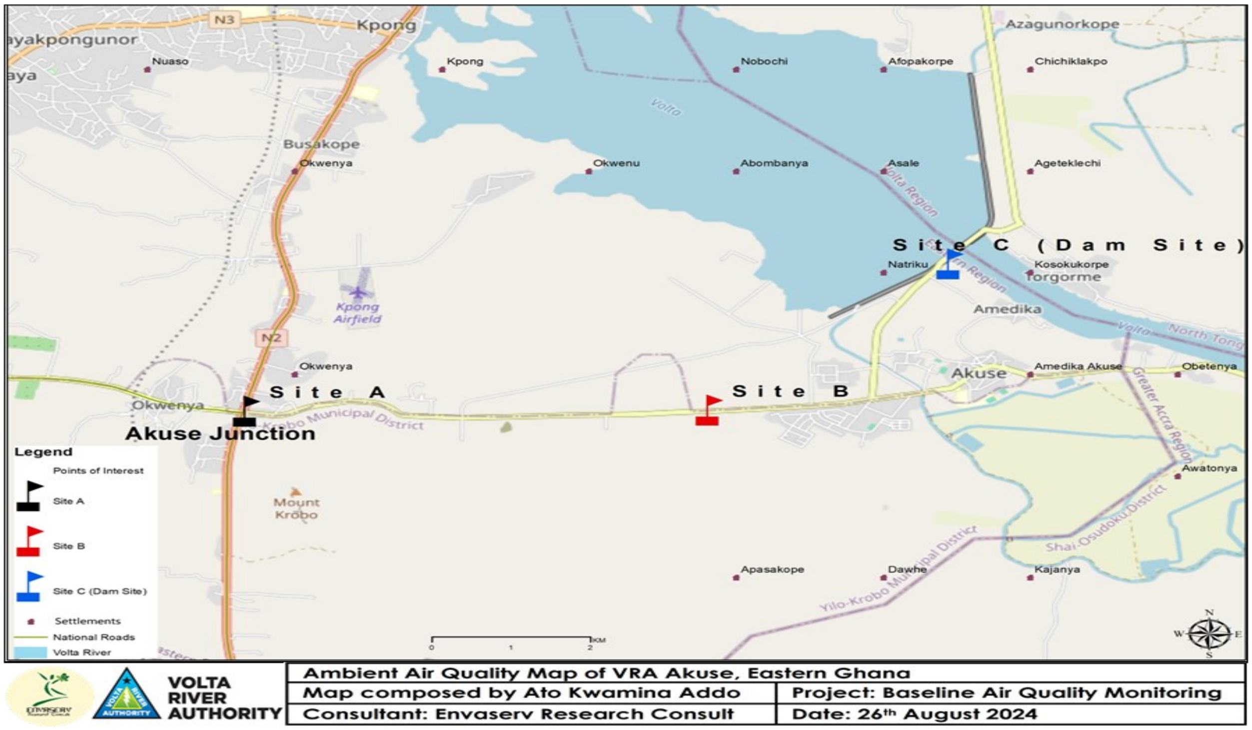


Plate 4-5: Site for Ambient Air / Noise Monitoring

Detailed hourly data is outlined in the report and the summary provided in Table 4-4.

Table 4-4: Ambient Air Quality of Project Area

	Monitored Parameters (24-Hour Averages and 8 –Hour Average for CO)									
		SO_2	NO_2	CO	PM_{10}	$PM_{2.5}$	WS	WD	T	RH
Monitored Sites	**Year 2024**	**(µg/m³)**	**(µg/m³)**	**(mg/m³)**	**(µg/m³)**	**(µg/m³)**	**(m/s)**	**(°)**	**(°C)**	**%**
Site A (Near Akuse Main Junction)	Aug. 7-8	12.51	4.89	0.46	27.44	23.55				
Site B (Near Enam Collection Building)	Aug. 6-7	9.76	2.61	0.26	26.22	20.93				
Site C (Near KPG Dam Site)	Aug. 6-7	6.05	1.71	0.20	7.02	2.10	1.02	248.31	26.30	76.55
Ghana Standards (GS 1236:2019)		150	150	10	70	35				

The summary of the monitoring results showed that 24-hour mean carbon monoxide (CO), nitrogen dioxide (NO_2) and Sulphur dioxide (SO_2) levels at all the monitored locations during the entire monitoring period were below the Ghana Standards GS 1236:2019 thresholds and the proposed project related activities are not likely to increase the levels of NO2, SO2 and CO above the permissible limits. Particulate Matter ($PM_{2.5}$ and PM_{10}) for 24-hour average were within acceptable limits. All the monitored locations during the monitoring period did not exceed Ghana Standards limit of 70 µg/m^3 for PM_{10} as well as recorded $PM_{2.5}$ levels (35 µg/m^3). However, the background PM2.5 concentrations at Site A and Site B areas are already 60-67% of the permissible limit, which raises concerns about air quality during construction.

4.4.3. Ambient Noise

The Ghana Standards for Health Protection – Requirements for Ambient Noise Control (GS 1222: 2018) provides guidance for the classification of receptors and their corresponding noise level limits. It does not apply to sounds generated by nature without human intervention. The Ghana Standards 1222:2018 provides maximum allowable limits for two-time brackets (i.e., Day (06:00 am -10:00 pm) and Night (10:00 pm - 06:00 am)) under seven receptor categories (Zone A, B, C, D, E, F and G) as shown in Table 4-5. The maximum allowable noise levels of relevance for this monitoring are detailed in Zones A & C and highlighted in

Table 4-5: below.

Table 4-5:Ghana Standards: Requirements for Ambient Noise Control (GS 1222:2018)

Zone	Description of Area of Noise Reception	Permissible Noise Level dB(A)	
		DAY 6:00 am -10:00 pm	NIGHT 10:00 pm - 6:00 am
A	Residential areas	55	48
B	Educational (school) and health (hospital, clinic) facilities, office, and courts	55	50
C	Mixed used (Residential areas with some commercial or light industrial activities)	60	55
D	Areas with some light industry, places of entertainment or public assembly and places of worship	65	60
E	Commercial areas	75	65
F	Light industrial areas	70	60
G	Heavy industrial areas	70	70

Per the requirements of the EPA Permit Conditions, VRA undertakes and report on bi-annual monitoring of the noise levels within KGS using methodology specified in the GS1222:2018. This involves carrying out of day-time noise levels within the North, South, East and West corridors of KGS itself. For this EIA study, noise data within the immediate area of influence was also collected by the independent service provider at the three sites mentioned earlier. The prevailing noise levels were obtained using the Class 1 Cirrus MK 427 sound level meter which meets the requirements of IEC 61672-1, operates in the A-weighting network, and programmed to record equivalent sound pressure level (LAeq). The sound level metre was calibrated before the measurements and its calibration checked after, using Cirrus Sound Level calibrator (CR518) The sound level meter was set at a height of 1.2m above ground level. Noise measurements were undertaken for a 24-hour period at each monitored location to cover the regulatory requirements (i.e., day and night-time).

The Class 1 Cirrus MK 427 noise monitor was integrated in the AQM 65, and data logged onto the embedded PC which serves as a data storage system for the entire monitoring duration. The analysis of various noise descriptors (LA_{eq}, LA_{min}, LA_{max}, LA_{90}, LA_{50}, LA_{10}) were computed in Microsoft Excel using the noise monitoring data logged. A summary of the results is presented in **Table 4-6** and detailed report provided as part of Appendix 4. The noise assessment across the three sites -Site A (Akuse Main Junction), Site B (Enam Collection Building) reveals a varied noise environment, with each site experiencing different levels of noise pollution relative to the

GS 1222:2018 allowable limits for mixed use and residential areas. Any additional noise from construction and rehabilitation activities is likely to exacerbate the existing noise conditions, leading to cumulative noise impacts.

Table 4-6: Noise data Within Project Area

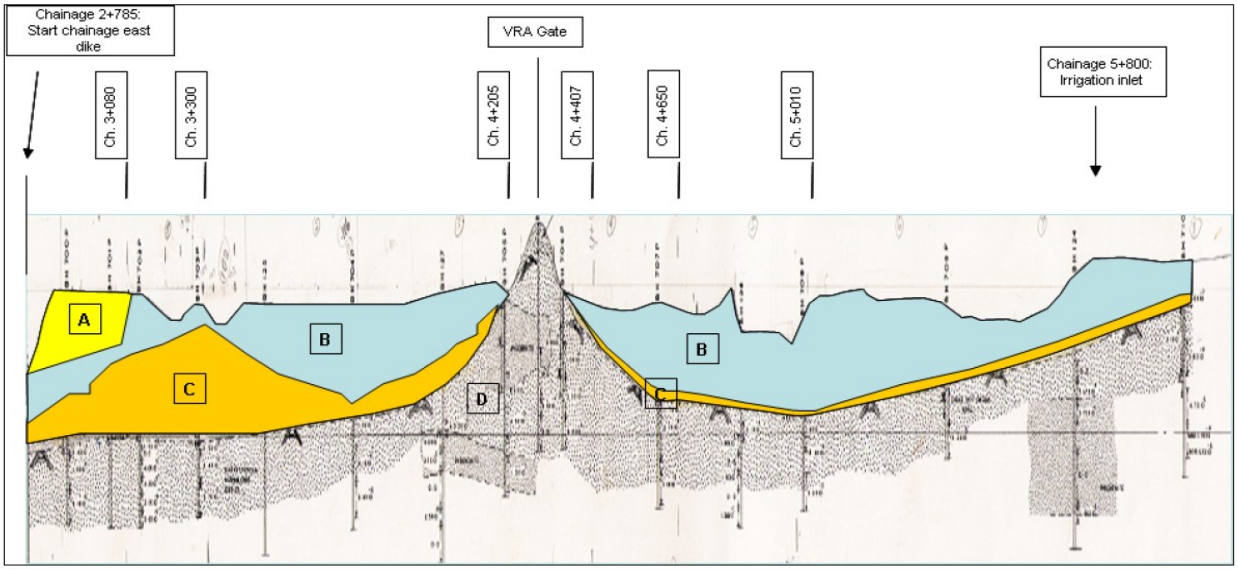
Monitored Sites	Noise levels (dBA)								
	24hr Leq	**Lmax**	**Lmin**	**Daytime**	**Night-time**	**La5**	**La10**	**La50**	**La90**
Site A (Near Akuse Main Junction)	64.6	71.0	57.4	66.6	60.7	69.7	68.7	65.7	58.7
Site B (Near Enam Collection Building)	61.5	66.6	56.2	62.9	58.8	64.0	63.7	62.5	57.7
Site C (Near KPG Dam Site)	57.2	63.3	50.7	59.7	52.1	63.3	63.0	56.7	51.5
Ghana Standards Limit (GS 1222:2018) Zone C-Heavy Industrial				60	55				
Ghana Standards Limit (GS 1222:2018)-Zone A-Residential				55	48				

4.4.4. Geology & Soils

With respect to geology, the area around Kpong and Akuse is underlain by the Dahomeyan Formation, which occurs as alternating belts of acidic and basic gneisses. The Acidic Dahomeyan consists mainly of muscovite-biotite gneiss, quartz-feldspar gneiss, augen gneiss and minor amphibolites, which decompose to slightly permeable calcareous clays. The basic Dahomeyan is very uniform, coarse-grained, and usually of well-foliated garnet hornblende gneiss, with minor layers of biotite schist. When decomposed, the basic Dahomeyan rocks become grey, calcareous clay and silt which, when wet, become plastic, but shrink and crack when dry.

The geotechnical site investigations carried out prior to construction of the dykes consisted of core drillings. The core logs show that sediments overlying the rock comprise of sand, silts, and clay. The core logs indicate variations of layering and properties of the layers over the area. Generally, the sediments are coarser with depth, with generally sand of variable grading and silt content overlying rock. Above the coarser sediments, the sediments seem to be finer with less sand and more silt and clay (See Figure 4-4).

Figure 4-4: Soil Profile of the Kpong Dam



Where:
A. Silty sand (exist only at surface level between Ch. 2+875 and Ch. 3+100);
B. Clayey silt and silty clay;
C. Sand, silts gravely (under layer B);
D. Bedrock.

Source: VRA Project Documents

The layering and properties of the soil indicate generally higher permeability in the lower layer(s) than in the upper part of the sediment deposit; however, some boreholes indicate silt and clay also in the lower layers. Hydrogeological, the underlying basement rock is massive with few fractures. The porosity and permeability of the rocks are very low, and this has given rise to low groundwater potential in the sections underlain by this rock formation. Groundwater only occurs in porous fractured media with yielding capacity in the range of 0.2-8.2 m3/hr.

The predominant soil type in the municipality can be divided into five major groups. These are soils developed over sandstone (Yaya-Pimpimso-Bejna association), soils developed over Buem such as sandstone, shales, and mudstones (Akosombo association), soils developed over acidic gneiss (Simpa-Aquantaw complex) and soils developed over basic gneiss and pyroxenite (Akuse-Bumbi associations) as well as laterite. The Voltain formation which takes its origin from the continuous deposition of sediments through the activities of the Volta River over a period. This mainly consists of sandstone, shale, and limestone etc.

Granite gneiss formation is one of the oldest formations and it consists mainly of metamorphic rocks deposit on the Krobo Mountain. Soils developed over sandstone (Yaya-Pimpimso-Bejna association) group are the predominant soils in the Municipality. They stretched from southern part of the Municipality. With suitable drainage, the soils are considered good for the cultivation of rice, food crops, sugarcane, and vegetable etc. The Municipality can also boast of a typical soil called Buem such as shales and mudstones (Akosombo association).

4.4.5. Seismic Activities & Natural Hazards

With respect to seismicity, Ghana, in general, experiences low to moderate seismic activity, with occasional earthquakes that are usually minor. The most significant historical seismic event in Ghana was the Accra earthquake of 1939, which had a magnitude of 6.4 and caused considerable damage in Accra, including fatalities. The epicenter of this earthquake was near the Akwapim fault zone. The Kpong Hydropower Dam was constructed with consideration for the region's seismic characteristics, given the proximity to the Akwapim fault zone. Since the dam's construction, there have been no significant seismic events reported specifically within the Kpone Hydropower Dam area. Any minor seismic activities that may have occurred would likely have been of low magnitude and not significantly impactful to the dam's structural integrity.

Flooding remains the most significant natural disaster in the region, often exacerbated by dam operations because of controlled release of water from the dam, particularly in the Lower Volta area, including the Kpong Headpond. The construction of the Akosombo Dam upstream in 1965 led to the creation of Lake Volta, one of the world's largest artificial lakes. This damming altered the natural flow of the Volta River, reducing the frequency of seasonal floods downstream. The Kpong Headpond and Lower Volta area are now shaped by both natural and human-induced changes and continue to be sensitive to these fluctuations, especially as climate change impacts become more pronounced. In 1968 and 1991, significant flooding occurred in the Lower Volta region, including areas around the Kpong Headpond, due to the release of water from the Akosombo Dam. These events caused extensive damage to crop, homes, and infrastructure.

One of the most significant floods occurred in 2023, when heavy rains in the Volta River Basin, combined with releases from the Akosombo and Kpong Dams, led to widespread flooding. This event displaced thousands of people and destroyed large areas of farmland. About 192 towns and villages in nine (9) Municipalities and Districts downstream of the Dam in the Volta, Eastern and Greater Accra Regions with about 39,333 people displaced and many livelihoods affected. From the 2023 dam spillage event from the Akosombo and Kpong Dams, programme, it was noted that the number of people living downstream of the dam and impacted by flooded have increased since the last spillage in 2010.

The Volta Basin, including the Lower Volta area, experienced severe droughts in the early 1980s. These droughts led to reduced water levels in the Volta River and Lake Volta, impacting water availability for irrigation, hydropower generation, and domestic use. The 1990s saw fluctuating rainfall patterns, leading to periodic low water levels in the Volta River system. From 2006-2007, Ghana experienced another significant drought, which again impacted the Volta

River's flow. Water levels in the Akosombo and Kpong reservoirs dropped, leading to energy shortages due to reduced hydropower output. This period is often associated with the broader energy crisis in Ghana, where load shedding became common. The 2010s have seen increased variability in rainfall, with some years experiencing below-average precipitation.

4.4.6. Topography & Landscape

The Kpong Dam is in a region of low-lying, gently undulating terrain with significant riverine features influenced by the Volta River and the reservoir created by the dam. The area's topography has been shaped by both natural processes and human intervention, particularly the construction of the dam. The construction of the dam has significantly altered the natural topography of the area, particularly upstream where the reservoir now exists. The dam has also impacted the downstream flow regime, affecting the floodplain dynamics and sediment deposition.

The area around the Kpong Dam is characterized by flat to gently undulating terrain. The dam itself is situated in a region that is generally between 50 to 100 meters above sea level. The elevation around the Kpong Dam is relatively low, with the surrounding landscape gently sloping towards the river. The Kpong Dam creates a reservoir upstream, known as the Kpong Reservoir, which spreads over a wide area and contributes to the flatness of the landscape. This is typical of regions adjacent to large river systems, where the landscape has been shaped by the river's meandering course over time.

Within the broader area of influence, the topography of the Lower Manya Krobo Municipality at the southern part is relatively flat with isolated hills partition the municipality from the center north-western point to the east. But the landscape of the northern part is generally undulating with several streams, most of which drain into the Volta Lake. Much of the eastern boundaries of the municipality constitute the shores of the Volta Lake. The lowest area, which is located at the southern part of the municipality, is about 50 meters above sea level.

The average height of the land is about 452 meters above sea level. The north-eastern and southern parts of the Municipality are generally low lying with one beautiful and historically important isolated hill in the extreme southern part, which rise to 350 meters above sea level (Krobo Mountains). Underlying these landmasses are several rocks or parent rocks from which several rocks have developed. Some of the hills are capped with minerals, which can be tapped to generate employment and overall development of the Municipality.

4.4.7. Relief & Drainage System

The reservoir's creation has led to the inundation of previous low-lying areas, turning them into water bodies. Within the vicinity of the dam are floodplains, which are areas prone to seasonal flooding, especially during periods of heavy rainfall or high river flow. These floodplains have been formed by sediment deposits from the Volta River over millennia. The drainage system of the dykes at the Kpong Dam is crucial for managing water flow and preventing erosion, which could potentially compromise the structural integrity of the dam. The drainage system is designed to handle both surface and subsurface water to prevent water from accumulating around the dykes. This includes systems like drainage channels and pipes that direct water away from the dykes and into designated discharge areas. Regular maintenance is critical to ensuring the drainage system functions effectively since with time, sediment build up, vegetation growth, and wear and tear can impact the drainage capacity. VRA conducts regular inspections identify and address any blockages or damage, and as part of its, has over the past five years undertaken various major projects downstream to enhance the drainage system.

The Municipality is drained with several rivers such as the River Volta, Ponpon, Ayermesudo. The rivers and their tributaries exhibit mainly spiral pattern of flow and constitute important resources for the people since most of them depend on them for household use, fishing, and farming. The Volta River is the major river that drains the Municipality and marks the end of the Municipality with North Tongu and Asuogyaman Districts. Except for the Volta River, almost all these rivers are seasonal with most of them overflowing their banks during the rainy season.

The Volta River also creates large expanse of riverbanks that offer enviable advantage for river sports for tourist attractions, rice, and vegetables cultivation under irrigation. The general flat nature of the southern part of the Municipality, coupled with the closeness of the Municipality to the Volta River present great potential for irrigation especially around the low land areas, which stretches from Kpong to Amedeka (all along the Volta River). This has led to the development of Kpong Irrigation canals within the area. Some part of the municipality falls within a dissected plateau. The land has natural channels and valleys due to vertical or horizontal erosion taking place annually.

4.4.8. Surface Water

The Kpong head pond is an artificial water body which has existed since the impoundment of the Kpong (Akuse) dam. The headpond covers an area of about 48 square kilometers. The depth varies, with maximum depths reaching around 18 meters with a total volume being approximately 120 million cubic meters. While not being a pristine water environment, the reservoir supports aquatic life and is used for water supply (the raw water is abstracted from the upstream/opposite part of the reservoir away from the proposed project site).

The flow in the Kpong Headpond is regulated by the Akosombo Dam upstream and the Kpong Dam downstream, which influences the water levels and discharge rates. Primary water sources include inflows from the Volta River, local rainfall, and runoff from the surrounding catchment area. The Surface water temperatures typically range between 25°C and 30°C, influenced by seasonal variations. The pH of the surface water is usually neutral to slightly alkaline, ranging from 6.5 to 8.5. Levels of dissolved oxygen are generally good, often exceeding 5mg/L, supporting aquatic life. With respect to turbidity**,** water clarity can be affected by sediment loads, especially during the rainy season, leading to higher turbidity levels. The Nutrient levels (nitrogen and phosphorus) can vary, with higher concentrations often observed during periods of increased agricultural runoff.

The management of the Kpong Headpond falls under the jurisdiction of the VRA and other agencies such as the Water Resources Commission and the EPA. Regular monitoring of water quality parameters is essential to ensure the health of the aquatic ecosystem and the safety of water for various uses. In line with the requirements of the EMP for the operations of the Kpong Hydropower Dam, VRA is mandated to undertake bi-annual assessment of quality of water at the dam area and submit report to the EPA. Subsequently, the water quality of the Kpong head pond have been recorded at the dam intake and tail race on a semi-annual basis since 2010. These data are part of a larger monitoring campaign along the Volta River undertaken by VRA for many years. The water quality characteristics are generally favourable and within the Ghana Standards for drinking water (surface water) (GS175:2017) except for coliforms.

Data on bi-annual water quality monitoring undertaken from 2020 – 2024, which are done in June and December each year has been presented in **Table 4-7**. Seventeen parameters were used to investigate water quality at the intake and discharge (tailrace) points. Sample collection and analysis was carried out per guidelines from Standard methods for the examination of water and wastewater, 22nd edition and analysis performed at the VRA Public Health Laboratory and that of the Water Research Institute of the CSIR, Accra.

A summary of the results indicates the following:

a. Turbidity levels ranged from 0.11 NTU – 4.43 NTU at the intake points and 1.02 NTU – 3.83 NTU at the tailrace sampling points deviating marginally from the WRC(Ghana) Maximum Permissible Levels for Raw Water guideline of 1.0 NTU.
b. Tailrace waters had reduced Phosphorus levels at the tailrace waters throughout the years under review. The intake levels ranged from 0.04 mg/l - 0.84 mg/l while tailrace waters ranged from 0.02 mg/l - 0.26 mg/l.
c. Iron concentrations at the tailrace waters were generally within the set guideline of 0.1 mg/l. The only deviation occurred at the tailrace in June 2022 recording a value of 0.13 mg/l.
d. Microbial contaminant levels at the tailrace area were higher than at the intake points throughout the years 2022 to 2024. Values obtained ranged from 14 CFU/100 ml – 30 CFU/100 ml.

e. Temperature levels did not change significantly throughout the period under review as water moved from the intake point to the tailrace. Temperature readings ranged from 27.4 ^{0}C - 30.2 ^{0}C.
f. Dissolved oxygen levels ranged from 4.20 mg/l in June 2022 to 6.74 mg/l at tailrace waters. This was sufficient to take care of aquatic life in the area under review since no dead fish was spotted in the years under review.
g. Conductivity levels were below the set guideline of 700 µS/cm. Conductivity levels before and after entering the turbines did not change significantly. Levels ranged from 67.0 µS/cm – 81.1 µS/cm and 70.1 µS/cm – 78.8 µS/cm at the intake point and tailrace respectively.

From the results, it is noted that generally, turbidity levels did not meet the set guideline of 1.0 NTU at most of the sites, but this notwithstanding, generally, the tailrace waters had reduced levels. Anthropogenic activities of the riverine community (Torgorme) may be the cause of increased microbial levels at the tail race waters. Generally, the hydro-generating activities at KGS did not have any negative impact on quality of water at the tailrace. VRA spillage in 2023 enhanced water quality by increasing the oxygen levels at the tailrace waters.

Detailed report on the water quality monitoring activities under the EMP for Years 2022 and 2023 are provided as part of Appendix 4. As of 2021, the Kpong and Sogakope rivers in the main and Lower Volta basins in Ghana registered the highest water quality index scores (**Figure 4-5**). These reached 82.11 points and 81.14 points, respectively, meaning that their water quality was good or unpolluted. Rivers in the country with good water quality included Ajena, Bamboi, and Daboya, all in the Volta basin. The index measures the quality of surface water, where, for instance, scores between 25 and 50 indicate poor quality of water, and scores greater than 80 points represent good or unpolluted water. This collaborates the results of the VRA water quality analysis indicating the state of the water quality in the Kpong Headpond.

Table 4-7: Results of Biannual Water Quality Monitoring at Kpong GS (2020 – 2024)

YEAR	Location /Parameters	Temp ⁰C	pH	Cond µS/cm	DO mg/l	TDS mg/l	Turbidity NTU	BOD mg/l	NO3 mg/l	NO2 mg/l	NH4 mg/l	PO4 mg/l	CI mg/l	SO4 mg/l	Fe mg/l	SiO₂ mg/l	Total Coliform CFU/100 ml	Faecal Coliform CFU/100 ml
	Ghana raw water criteria guidelines for domestic use	-	6 – 9	700.0	-	450	1.00	6*	6.00	-	1.00	0.05*	100.0	200	0.10	-	5	0
June 2022	Kpong dam intake	28.4	7.10	71.4	4.84	35.7	0.11	2.23	0.50	0.003	0.02	**0.84**	0.0	1	**0.18**	4.58	4	**0**
	Kpong dam tailrace 1	29.0	7.17	71.1	4.20	35.6	**1.94**	2.07	0.04	0.04	0.06	**0.26**	2.5	0	**0.13**	12.0	**20**	**4**
Dec. 2022	Kpong dam intake	28.8	7.33	72.8	6.43	36.4	**1.35**	0.63	0.03	0.008	0.01	0.04	0.2	0	**0.14**	3.0	0	0
	Kpong dam tailrace 1	27.4	7.47	74.6	6.74	37.3	**1.02**	3.06	0.01	0.040	0.01	0.03	0.5	1	0.09	15.0	**14**	**6**
June 2023	Kpong dam intake	29.5	7.34	71.9	6.47	35.9	**2.60**	4.05	0.061	0.004	0.11	**0.08**	2.38	0.3	0.08	9.0	**10**	**0**
	Kpong dam tailrace 1	29.6	7.13	72.6	4.92	35.8	**1.26**	3.29	0.01	0.001	0.00	0.02	2.91	2.0	0.01	2.0	**20**	**0**
Dec. 2023	Kpong dam intake	29.1	7.24	81.1	5.83	40.6	**1.13**	1.68	0.001	0.001	0.001	**0.32**	2.48	1	0.01	11.6	**25**	**10**
	Kpong dam tailrace 1	30.2	7.12	78.8	6.13	39.4	**1.13**	4.07	0.03	0.001	0.00	0.03	2.48	1	0.01	12.0	**30**	**5**
June 2024	Kpong dam intake	29.7	7.79	79.3	6.03	39.6	**4.43**	**6.70**	0.08	0.005	0.11	**0.18**	4.49	1.6	**0.13**	18.3	5	0
	Kpong dam tailrace 1	29.2	7.44	80.2	6.34	40.1	**3.83**	**6.76**	0.16	0.011	0.27	**0.17**	0.50	2.1	0.09	21.4	**20**	**6**

Note

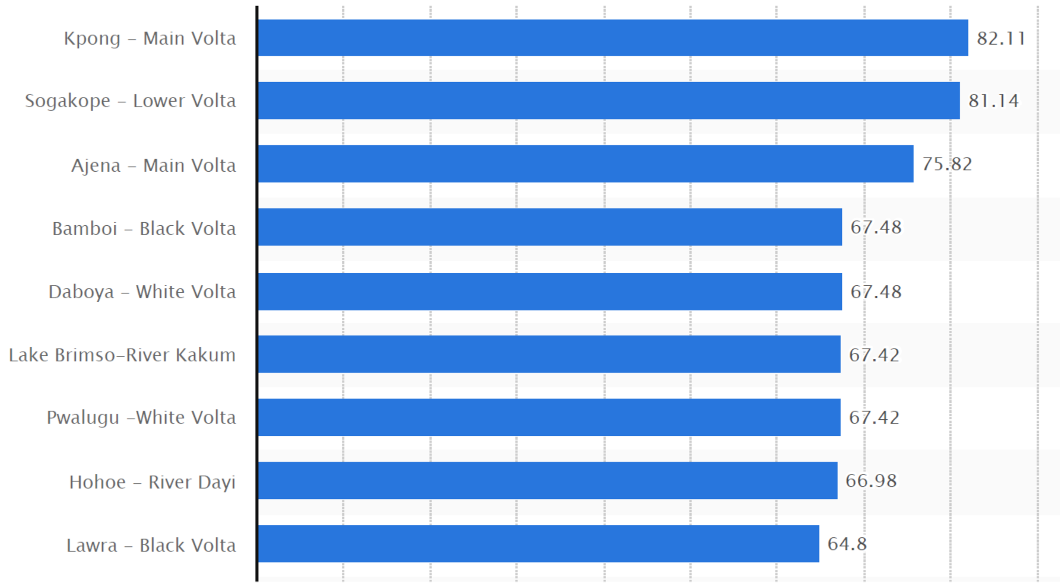
*WHO recommended raw water quality criteria

- Shaded Portion in yellow – Values above WRC(Ghana) Maximum Permissible Levels for Raw Water/WHO recommended raw water quality criteria
- Shaded Portion in green – WRC(Ghana) Maximum Permissible Levels for Raw Water/WHO recommended raw water quality criteria

Table 2

LOCATION	Coordinates
Kpong dam intake	N 06⁰ 07' 17.1" E 000⁰ 07' 25.4"
Kpong dam tailrace 1	N 06⁰ 06' 51.6" E 000⁰ 07' 56.0"

Figure 4-5: Rivers with the Best Quality Index in Ghana



Source:https://www.statista.com/statistics/1445727/rivers-with-the-highest-water-quality-in-ghana

4.4.9. Greenhouse Gas Emissions

VRA in 2016 initiated a "Corporate Carbon Footprint Management Programme" (CFMP) as part of its Corporate Strategic Objectives to allow for the measuring and publishing of its Greenhouse gases (GHG) emissions and strengthen its green credentials in the marketplace. VRA has since produced annual GHG, covering the period from 2012 -2023, with 2015 designated as the baseline year. VRA has focused on quantifying and reporting Scope 1 emissions, comprising of both combustion and mobile emissions. Emissions resulting from Scope 2 are not considered because power consumed by VRA is from its own generation station and has already been considered in Scope 1. Scope 3 emissions, particularly those resulting from employee business air travel, have also been calculated. Copies of the annual Corporate GHG reports are available on the VRA website, www.vra.com.

A comparison of corporate GHG emissions from all sources from 2012 to 2023 is presented in **Figure 4-6**. Scope 1 emissions decreased significantly by 28.6% compared to 2022 (2,022,889.20 tCO_2e) and by 19.9% compared to our baseline year of 2015 (1,803,414.89 tCO_2e). This decrease was primarily due to the increased use of natural gas in combine cycle mode for power generation instead of diesel fuel oil and light crude oil in single cycle mode. Total Scope 1 GHG emissions for the years 2012-2023 is 16,497,689.02 tCO_2e with a net emission of 16,448,036.5 tCO_2e.

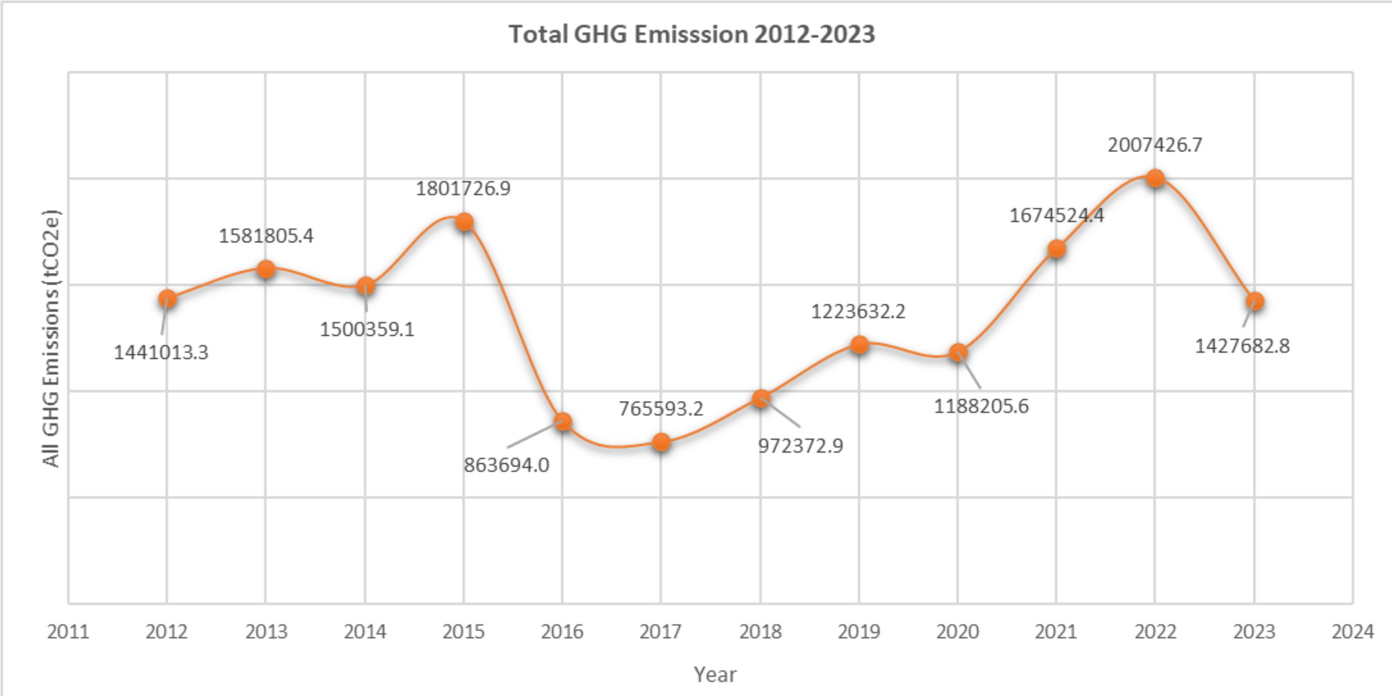


Figure 4-6: GHG Emission comparison from all sources per year (2012-2023)

On the national level, and according to the Fourth Biennial Update Report to the UNFCCC, Ghana recorded 51.78 MtCO2e (million tonnes carbon dioxide equivalent) total net greenhouse gas emissions in 2021, representing 12% higher than the 2019 levels. Since 2010, energy has remained Ghana's largest greenhouse gas emissions source. Across the 2010 and 2021 period, the energy sector has averagely contributed 41% to the total national emissions. In 2021, the sector breakdown of the total emissions was 51.2% from the energy sector, followed by Agriculture (23%), LULUCF (15.3%), Waste (7.3%) and IPPU (3.2%) as shown in **Table 4-8**.

When the net emissions from LULUCF are excluded from the national totals, the overall emissions amounted to 43.87 MtCO2e in 2021. In this respect, the energy sector was still the most dominant source, making 60.4% of the country's greenhouse gas emissions. Agricultural emissions (livestock, soil, and crop) constituted 27.2% of the total emissions without LULUCF then followed by the waste sector (8.6%) and IPPU (3.8%). Generally, the total national emission levels steadily rose over three decades (1990-2021). Ghana's total greenhouse gas emissions have increased by 372.3% from 10.36 MtCO2e in 1990 to 51.78 MtCO2e in 2021 at an annual growth rate of 5.1% (Figure 5). In the latest near decade (2021-2010), the emissions showed a rising trend with an increase of 69.1% compared to the 2010 levels at a 4.9% growth rate. Since the recent inventory was published in 2019, the total emissions increased by 11.6%.

Table 4-8: Trends of GHG in Ghana by Sectors

Emissions by sources/Removals by sinks	Total emissions ($MtCO_2e$)							Percentage Change
	1990	2000	2010	2012	2016	2019	2021	[2019-2021]
National Emissions with LULUCF	10.96	20.68	30.62	35.09	33.68	46.42	51.78	16%
National Emissions without LULUCF	8.74	111.93	22.42	26.12	28.82	36.12	42.21	19%
Energy	2.86	4.07	10.82	13.64	14.06	19.36	26.52	22%
Industrial Processes and Product Use	1.96	0.90	0.94	2.02	1.69	1.82	1.66	3%
Agriculture, Forestry, and Other Land Use	5.11	14.23	15.85	16.21	13.68	20.37	19.83	11%
Waste	1.02	1.48	3.01	3.23	4.25	4.87	3.77	13%

4.5 Biological Ecological Environment

4.5.1. Terrestrial Vegetation

The project site is situated within the Southern Forest-Savanna Transition Zone between the moist, deciduous Southern Marginal Vegetation Zone and the Coastal / North Guinea Savanna Zone which support similar habitats. They comprise plant species typical of these vegetation zones, including *Anogeissus leocarpus* (Kane tree), *Zanthoxylum zanthoxyloides* (Kanto tree), *Margaritaris discoidea* (Duabo tree), *Azadirachta indica* (Neem tree), *Andropogon gayanus* (gamba grass) and *Encephalartos barteri* (an endemic gymnosperm). Most of these areas, however, are highly modified, consisting of a mosaic of cultivated ground and fallow ground, charcoal burning areas and settlements. The cultivated land is mainly cassava, chilli, pepper, and maize. This human influence, particularly through clearance of areas for shifting cultivation, has resulted in a habitat that lacks the larger tropical tree species that are found in less modified areas, such as *Triplochiton scleroxylon* (Wawa) and *Khaya anthotheca* (forest mahogany).

The vegetation within and around the immediate environs of the KGS is constituted mainly by degraded farmlands, patches of thickets and grasslands. The major plant occurring at or near the KGS site include scattered trees of *Cocos nucifera*, *Mangifera indica, Carica papaya* and *Terminalia catappa*. Their abundance is however limited to only about five trees of each species. Other trees include *Zanthoxylum zanthoxyloides*, *Leucaena glauca*, *Grewia carpinifolia*, *Millettia thonningii* and *Gardenia ternifolia*, while the common herbaceous species are *Chromolaena odorata*, *Vernonia cinerea* and *Bignonia purpurea*. The densest stand of vegetation outside the proposed project footprint occurs along the dam's embankment and is dominated by *Tectona grandis* and *Cassia siamea*. Other less dominant trees include *Moringa oleifera*, *Ceiba pentandra*, *Azadirachta indica* and *Khaya senegalensis*.

The list of plant species found at the project site is provided in **Table 4-9**. All but one of the recorded plant species are classified as 'Least Concern' (LC) according to the IUCN Red List of Threatened Species. This is the mahogany tree *Khaya senegalensis* which is a 'Vulnerable' (VU) species due to logging and local exploitation in parts of its global range (it is widespread in western and central Africa). It should be noted that there will be no tree clearing activity associated with the project implementation phases.

Table 4-9: Plant species at the KGS Site

Scientific name	Abundance	IUCN status
Typha domingensis	Dominant	LC
Eicchornia crassipes	Frequent	LC
Nephrolepis biserrate	Abundant	LC
Nymphaea lotus	Dominant	LC
Cocos nucifera	Frequent	LC
Mangifera indica	Frequent	LC
Carica papaya	Rare	DD
Zea mays	Frequent	LC
Commelina diffusa	Frequent	LC
Plantago major	Frequent	LC
Clitoria ternatea	Abundant	LC
Terminalia catappa	Abundant	LC
Zanthoxylum zanthoxyloides	Abundant	LC
Leucaena glauca	Abundant	LC
Grewia carpinifolia	Frequent	LC
Millettia thonningii	Frequent	LC
Gardenia ternifolia	Frequent	LC
Chromolaena odorata	Abundant	LC
Vernonia cinerea	Abundant	LC
Bignonia purpurea	Abundant	LC
Tectona grandis	Dominant	LC
Cassia siamea	Dominant	LC
Moringa oleifera	Frequent	LC
Ceiba pentandra	Frequent	LC
Azadirachta indica	Frequent	LC
Khaya senegalensis	Occasional	VU

Source: Draft EIA Report for Kpong Floating Solar PV Project, March 2024

4.5.2. Aquatic Vegetation

The proliferation of Aquatic Weeds on the Volta River system has been quite prolific over the past 30yrs. The Kpong head pond currently also supports aquatic vegetation, including *Typha domingensis*, *Eichhornia crassipes*, *Nephrolepis biserrate* and *Nymphaea lotus*. The aquatic vegetation consists of 47 emergent, 12 free floating and four submerged species. Some invasive alien species (*Eichhornia crassipes*, *Cyperus papyrus* and *Salvinia molesta*) which were hitherto not present in the Volta River system have also invaded the waterbody. These aquatic weeds, especially when they occur as floating "islands", are prevented from entering the power station by a floating boom which has been placed in front of the turbine intakes.

From June 2023, VRA has mobilized its marine assets, including an excavator on a barge, at Kpong Wharf to mechanically harvest and collect aquatic plants in the Kpong head pond. Plate 4-6 shows the aquatic vegetation on the Kpong Headpond and the KGS intake. The harvested aquatic weeds are recycled for the use of organic compost through a collaborative venture between VRA and the Accra Compost Recycling Plant as well as the Volta River Estates Limited, and banana growing company located along the Volta River. This is in line with the corporate efforts in promoting a circular economy.

Plate 4-6: Floating Aquatic Vegetation at Kpong Headpond & KGS Intake

4.5.3. Fauna

Except for birds, the Kpong head pond and its environs is not home to any wildlife of conservation value. This is due to the intensive land use and human presence. The only species recorded at the project site was the Ghana rufous-nosed rat (*Oenomys ornatus*) while three reptiles were reported by the locals (tree snakes, puff adders and pythons). Importantly, there are no large aquatic animals in the Kpong head pond, such as crocodile and hippopotamus, which may have posed a risk to the health and safety of workers and the public. There is also no evidence of otters (e.g., Spotted-necked Otter or African Clawless Otter) at Kpong.

Birds frequenting the dam and its immediate surroundings surveyed separately in 2022 and 2023 recorded a total of 41 bird species were recorded (**Table 4-10**). The flock of birds commonly found on the surface waters of the Kpong Headpond (See **Plate 4-7**) is often dominated by cormorants. Specifically, the Great Cormorant (Phalacrocorax carbo) is known to frequent the lake in large numbers, forming visible flocks. Birdwatching enthusiasts often visit the Volta Lake region for its diversity in aquatic bird species.

Plate 4-7: Flock of birds on the Kpomg Headpond Near West Dyke

Due to the nature of the project, special attention was given to waterbirds, which may be at high risk of the project's impact. Fourteen bird species that are frequently found in or around waterbodies were recorded. Apart from the White-faced Whistling Ducks, Long-tailed Cormorants, Green-backed Herons, Grey Herons and Squacco Herons, all other species foraged at the edges of the dam, mostly within the vegetated areas. The White-faced Whistling Ducks were recording swimming in the open water. The Cormorants and Herons stood still on fish cages within the water and intermittently dived to pick up spotted preys. The most abundant species (Little Swift) nest under the bridge over the dyke. In Ghana, this species commonly nests under bridges across rivers.

No migrant bird species were recorded. This is much expected as the surveys were conducted at a period outside of the migrant birds' wintering season in Ghana. The wintering season for birds in Ghana starts from September and peaks around November - December. Although the Squacco Heron, Cattle Egret, Little Egret, Intermediate Heron, and Grey Heron do migrate, the population at the project site do not migrate.

All the species recorded are categorised as 'Least Concern' (LC) based on the IUCN Red List of Threatened Species. However, eight species (*Bubulcus ibis, Egretta garzetta, Egretta intermedia, Ardeola ralloides, Butorides striata, Ardea cinerea, Milvus migrans parasitus* and *Kaupifaco monogrammicus*) are listed under Schedule I of the Wildlife Conservation Regulation, 1971, as wholly protected in Ghana (i.e., their hunting, capture or destruction is always prohibited).

Table 4-10: Birds Present at The Project Site from Two Field Surveys

Common name	Scientific name	IUCN status	Number	
			Sept 2022	June 2023
White-faced Whistling Duck	*Dendrocygna viduata*	LC	10	179
Long-tailed Cormorant	*Phalacrocorax carbo*	LC	12	23
Cattle Egret	*Bubulcus ibis*	LC	0	10
Little egret	*Bubulcus ibis*	LC	2	2
Intermediate egret	*Egretta intermedia*	LC	3	12
Squacco Heron	*Ardeola ralloides*	LC	0	5
Green-backed Heron	*Butorides striata*	LC	0	6
Grey Heron	*Ardea cinerea*	LC	0	3
Black Crake	*Amaurornis flavirostra*	LC	0	10
African Jacana	*Actophilornis africanus*	LC	4	17
Common Moorhen	*Gallinula chloropus*	LC	0	5
Spur-winged Lapwing	*Vanellus spinosus*	LC	4	11
Pied Kingfisher	*Ceryle rudis*	LC	2	7
Senegal Thick-knee	*Burhibus senegalensis*	LC	0	9
Yellow-billed Kite	*Milvus migrans parasitus*	LC	0	7
Lizard Buzzard	*Kaupifaco monogrammicus*	LC	0	7
Double-spurred Francolin	*Francolinus bicalcaratus*	LC	0	8
Red-eyed Dove	*Streptopelia semitourquata*	LC	8	13

Common name	Scientific name	IUCN status	Number	
			Sept 2022	June 2023
Yellow-crowned Bishop	*Euplectes afer*	LC	2	5
Yellow-mantled Widowbird	*Euplectes macroura*	LC	3	7
Village Weaver	*Ploceus cucullatus*	LC	35	21
Yellow-crowned Gonolek	*Laniarius barbarus*	LC	4	8
Bronze Mannikins	*Spermestes cucullata*	LC	5	13
Zitting Cisticola	*Cisticola juncidis*	LC	2	3
Laughing Dove	*Spilopelia senegalensis*	LC	6	14
Vinaceous Dove	*Streptopelia vinacea*	LC	3	9
Black-crowned Tchagra	*Tchagra senegalus*	LC	3	6
Western Grey Plantain-eater	*Crinifer piscator*	LC	2	2
African Thrush	*Turdus pelios*	LC	0	10
African Pied Wagtail	*Motacilla aguimp*	LC	5	5
Blue spotted Wood Dove	*Turtur afer*	LC	1	7
African Green Pigeon	*Treron calvus*	LC	0	4
Rose-ringed Parakeet	*Psittacula krameri*	LC	0	12
Levaillant's Cuckoo	*Oxylophus levaillantii*	LC	0	1
Klaas's Cuckoo	*Chrysococcyx klaas*	LC	0	3
Senegal Coucal	*Centropus senegalensis*	LC	0	5
Little Swift	*Apus affinis*	LC	0	>500
Malakite Kingfisher	*Alcedo cristata*	LC	0	2
Woodland Kingfisher	*Ceryle rudis*	LC	0	6
Broad-billed Roller	*Eurystomus glaucurus*	LC	0	12
Common Bulbul	*Pycnonotus barbatus*	LC	0	9

Source: Draft EIA Report for Kpong Floating Solar PV Project, March 2024

4.5.4. Aquatic Ecology

Fishery

The aquatic ecosystem of the Kpong reservoir is recognised for its rich diversity of fish species, contributing significantly to both local economies and ecosystem health. The fish fauna of the Kpong head pond has been the subject of numerous studies, both prior to and following the impoundment. Whilst Vanderpuye (1982) and Dankwa (1982) conducted a pre-impoundment investigation which established a baseline assessments of fish population based on four distinct trophic groups of fish (aufwuch-detritus and herbivores, semi-pelagic omnivores, benthic omnivores (known as forage fishes), and piscivores), Antwi & Ofori-Danson (1993) subsequently conducted post-impoundment studies that identified changes in various aspects of the fish fauna.

Quarcoopome et al. (2011) conducted an inventory of known fish species in the Kpong area to showcase the dynamic changes that occurred in the ecosystem over a span of 25 years following impoundment. They assessed the fish fauna according to disappeared species, important and dominant species, common/permanent species, declined species, and appeared species:

Disappeared Species**:** These species occurred in the first impoundment study by Vanderpuye (1982) or Dankwa (1982) but disappeared after subsequent studies 25 years after impoundment. They include several species such as*Aplocheilichthys normani, Barbus leonensis, Brycinus nurse, Caecula cephalopeltis, Eleotris senegalensis, Epiplatys senegalensis, Gerres melanopterus, Gobius guineensis, Marcusenius furcidens, Paradistichodus dimidiatus, Parailia pellucida, Sierrathrissa leonensis, Synodontis courteti, Synodontis nigrita and Synodontis violaceus.* These extinctions or local extirpations could be attributed to habitat changes, altered water flow, or other ecological factors.

Important and dominant species**:** These are species that emerged as important and dominant players that adapted well to the post-impoundment conditions and might have found niches that suited their requirements. Examples include *Barbus macrops, Brycinus longipinnis, Chrysichthys maurus, Chrysichthys nigrodigitatus, Distichodus rostratus, Hemichromis bimaculatus, Hemichromis fasciatus, Hippopotamyrus psittacus, Hyperopisus bebe, Mormyrops deliciosus, Oreochromis niloticus, Sarotherodon galileus, Schilbe intermedius, Steatocranus irvinei, Tilapia guineensis and Tilapia zillii.*

Common/Permanent Species: These species occurred in all pre-impoundment and post-impoundment studies. Species such as Barbus macrops, Chrysichthys auratus, Chromidotilapia guntheri and Chrysichthys nigrodigitatus became common, indicating their ability to thrive and potentially exploit new ecological niches.

Declined Species: These species were present in large numbers in the pre-impoundment study by Vanderpuye (1982) but now occur in relatively lower numbers and weight. Species such as Distichodus spp., Bagrus bajad, Clarias anguillaris and Ctenopoma petherici declined.

Appeared Species:These are species that occurred for the first time in the studies of Quarcoopome et al. (2007) but were not present in the pre-impoundment and other post impoundment studies. Some these species include Campylomormyrus tamandua, Brienomyrus brachyistius and Heterotriches longifilis.

Béné (2007) also conducted a diagnostic study of the Volta Basin fisheries and identified common fish species as Tilapias (mostly *Sarotherodon galilaeus, Oreochromis niloticus* and *Tilapia zillii*), Citharinus (*C. citharus, C. latus*), Labeo (*L. senegalensis, L. caubie*), Distichodus (*D. rostratus, D. engycephalus*), Characidae (*Alestes baremoze A. dentex, Brycinus nurse*), *Schilbe intermedius, Schilbe mystus, Chrysichthys nigrodigitatus, Microthrissa, Physailia pellucida, Hydrocynus* spp. and *Lates niloticus*. In recent times, Aboagye et al. (2020) identified common species caught in artisanal fisheries to be Tilapia (*Oreochromis niloticus*), African catfish (*Clarias gariepinus*), and sardinellas (*Sardinella aurita*).

The species highlighted above were validated by data from the Fisheries Commission in Akosombo, providing statistics on landed species and production information at the Kpong fishing grounds over the past 5 years. According to the data, the main species landed from the Kpong fishing grounds are as follows: *Auchenoglanis, Bagrus, Chana africanus, Chrysichthyes* spp.*, Clarias, Gymnarchus, Hermichromis, Heterotis, Hydrocynus, Mormyrus* spp.*, Odaxothrissa, O. niloticus, Pellonulla, Sierrithrisa, Synodontis* sp.*, and Tilapia* sp.

A complete list of fish species occurring before and after the impoundment of the Kpong dam is given in Table 4-11[5]. A total of 43 fish species had been confirmed to occur in the Kpong head pond after 25 years of impoundment as compared to 50 species prior to impoundment (Quarcoopome et al. 2007).

Table 4-11: List of Fish species in the Kpong Reservoir

Species	Pre-Impoundment [1]	25 years after Impoundment [2]	IUCN Conservation Status	Comment[3]
Aplocheilichthys normani	x		LC	Disappeared
Auchenoglanis occidentalis		x	LC	
Bagrus bajad		x	LC	Declined
Barbus leonensis	x		LC	Disappeared
Barbus macrops	x	x	LC	Important and common
Brienomyrus brachyistius		x	LC	Appeared
Brycinus leuciscus		x	LC	Important
Brycinus longipinnis	x	x	LC	
Brycinus nurse	x		LC	Disappeared
Caecula cephalopeltis	x		LC	Disappeared
Campylomormyrus tamandua		x	LC	Appeared
Chromidotilapia guntheri	x	x	LC	Common
Chrysichthys auratus	x	x	LC	Common
Chrysichthys furcatus	x		DD	
Chrysichthys maurus	x	x	LC	
Chrysichthys nigrodigitatus		x	LC	Important and common
Chrysichthys walkeri	x	x	VU	Important
Clarias anguillaris	x	x	LC	Declined
Ctenopoma petherici	x	x	LC	Declined

[5] [1] Vanderpuye (1982); [2] Quarcoopome et al. (2007); [3] Quarcoopome et al. (2011)

Species	Pre-Impoundment [1]	25 years after Impoundment [2]	IUCN Conservation Status	Comment[3]
Distichodus rostratus	x		LC	
Distichodus spp.		x	LC	Declined
Doryichthys aculeatus	x		DD	Disappeared
Eleotris senegalensis	x		LC	Disappeared
Epiplatys senegalensis	x		LC	Disappeared
Gerres melanopterus	x			Disappeared
Gobius guineensis	x			Disappeared
Gymnarchus niloticus		x	LC	
Hemichromis bimaculatus	x	x	LC	Important
Hemichromis fasciatus	x	x	LC	Important
Hepsetus odoe	x	x	LC	
Heterobranchus longifilis		x	LC	Appeared
Hippopotamyrus psittacus	x		LC	Declined
Hydrocynus forskalii		x	LC	
Hyperopisus bebe	x	x	LC	Important
Malapterurus electricus	x		LC	Declined
Marcusenius furcidens	x		LC	Disappeared
Marcusenius senegalensis	x		LC	
Mormyrops deliciosus	x	x	LC	Important
Odaxothrissa mento	x	x	LC	
Oreochromis niloticus	x	x	LC	Important
Parachanna obscura	x	x	LC	
Aplocheilichthys normani	x		LC	Disappeared
Auchenoglanis occidentalis		x	LC	
Bagrus bajad		x	LC	Declined
Barbus leonensis	x		LC	Disappeared
Barbus macrops	x	x	LC	Important and common
Brienomyrus brachyistius		x	LC	Appeared
Brycinus leuciscus		x	LC	Important
Brycinus longipinnis	x	x	LC	
Brycinus nurse	x		LC	Disappeared
Caecula cephalopeltis	x		LC	Disappeared
Campylomormyrus tamandua		x	LC	Appeared
Chromidotilapia guntheri	x	x	LC	Common
Chrysichthys auratus	x	x	LC	Common
Chrysichthys furcatus	x		DD	
Chrysichthys maurus	x	x	LC	
Chrysichthys nigrodigitatus		x	LC	Important and common
Chrysichthys walkeri	x	x	VU	Important
Clarias anguillaris	x	x	LC	Declined

Species	Pre-Impoundment [1]	25 years after Impoundment [2]	IUCN Conservation Status	Comment[3]
Ctenopoma petherici	x	x	LC	Declined
Distichodus rostratus	x		LC	
Distichodus spp.		x	LC	Declined
Doryichthys aculeatus	x		DD	Disappeared
Eleotris senegalensis	x		LC	Disappeared
Epiplatys senegalensis	x		LC	Disappeared
Gerres melanopterus	x			Disappeared
Gobius guineensis	x			Disappeared
Gymnarchus niloticus		x	LC	
Hemichromis bimaculatus	x	x	LC	Important
Hemichromis fasciatus	x	x	LC	Important
Hepsetus odoe	x	x	LC	
Heterobranchus longifilis		x	LC	Appeared
Hippopotamyrus psittacus	x		LC	Declined
Hydrocynus forskalii		x	LC	
Hyperopisus bebe	x	x	LC	Important
Malapterurus electricus	x		LC	Declined
Marcusenius furcidens	x		LC	Disappeared
Marcusenius senegalensis	x		LC	
Mormyrops deliciosus	x	x	LC	Important
Odaxothrissa mento	x	x	LC	
Oreochromis niloticus	x	x	LC	Important
Parachanna obscura	x	x	LC	

LC = Least Concern, VU = Vulnerable, DD = Data Deficient

The number of fish species appears to have reduced in recent years according to the data collected by the Fisheries Commission. Currently the number of fish species in Kpong is only 28. Fish species like *Barbus macrops and Chromidotilapia guntheri*, which according Quarcoopome et al. (2011) were common species, have disappeared. Other important species like *Petrocephalus bovei and Sarotherodon galileus* are also not present in the Fisheries Commission data, suggesting that these species also might have disappeared. The only new species, which was not recorded in previous studies by Vanderpuye (1982), Dankwa (1982) and Quarcoopome et al. (2011), is *Heterotis* spp. This species now appears in the Fisheries Commission records and was also recorded by Nunoo and Asiedu (2013).

The only threatened fish species recorded in the Kpong reservoir is *Chrischthys walkeri*, which is categorised as 'Vulnerable' (VU) because its population is suspected to be declining due to water pollution from mining activities, agriculture, deforestation, and human sewage (Dankwa 2020). However, according to Paugy et al. (2003), this species is known from the Pra basin in south-western Ghana, and its presence in the Kpong head pond represents an expansion of its geographic range.

Macro-invertebrates

Macro-invertebrates are animals without a backbone that can be seen with the naked eye. They are significant in contributing to the food web and nutrient cycling within aquatic ecosystems. This group includes a diverse range of organisms, such as insects, molluscs, and crustaceans. Aquatic plants normally provide ideal habitat for macro-invertebrate colonisation (Sharitz & Batzer 1999, Masifwa et al. 2001).

The "Dams, Development, and Downstream Communities" publication (Ntiamoa-Baidu et al. 2017) serves as a valuable source of information regarding the composition and behaviour of macro-invertebrate fauna found in the Kpong area. The study offers insights into the composition, abundance, and diversity of macro-invertebrates at ten sampling stations within the Lower Volta. The study indicates that the macro-invertebrate community in the Kpong area is dominated by four (4) families and eight (8) species:

- The Annelida family (*Tubifex* sp.) plays a crucial role in nutrient cycling by decomposing organic matter in the water, which helps maintain water quality and sustains other organisms.
- The Diptera family (*Chironomous formosipennis, Chironomous imicola*), resembling small flies, are essential in the food chain. These macro-invertebrates serve as a source of food for other creatures, contributing to the energy flow within the ecosystem in the Kpong reservoir.
- The Gastropoda family (*Melanoides tuberculata, Pseudocleopatra voltana, Bulinus truncatus, Melanoides manguensis*) plays diverse roles in the Kpong ecosystem. Some, like *Melanoides tuberculata* and *M. manguensis*, help maintain water clarity by feeding on algae and organic matter. Others, such as *Bulinus truncatus*, play a crucial role in the ecosystem as they can host parasites that affect both animals and humans (including schistosomiasis).
- The Odonata family (*Bradinopyga strachani*) preys on smaller insects, controlling their populations and helping to maintain the balance of the ecosystem.

4.5.5. Protected Areas

There are no protected areas or key biodiversity areas in the immediate proximity to KGS. The closest conservation areas are shown in **Figure 4-7** and these are the Shai Hills Forest Reserve, Kalakpa Resource Reserve, Keta Lagoon Ramsar site and the Songhor Ramsar Site.

Figure 4-7: Closest Conservation Areas to Project Site

Source: Draft EIA Report for Kpong Floating Solar PV Project

It should be noted that they are all too far from the actual constructional site to be significantly affected directly by the project activities. However, information has been provided on the Shai Hills Forest Reserve, which accommodates the monkey sanctuary, and is along the Accra – Tema N2 Highway, the route for the transportation of boulders and boulders to the project site. The Kpong GS is located about 20 km from the Shai Hills Resource Reserve. The Shai Hills Resource Reserve was declared a Forest Reserve in 1962 with an area of 46.7 km2 and was extended to 51 km2 in 1973. It is in the Shai Osudoku District of the Greater Accra Region, between latitude 5.85° - 5.97° north, and longitude 0.0381° - 0.0906° east, and lies along the Tema-Akosombo N2 Highway, the main route for the transportation of the boulders.

The reserve is a wildlife reserve that is home to species such as kob, bushbuck, oribi, baboon, various monkeys and a plethora of birds and reptiles. It supports over 402 vascular plant species including two endemics, 175 bird species, 31 mammal species and 13 reptile species. The reserve was the home of the Shai people up until 1892, when they were driven off the hills by the British Colonial government. As a result of the Shai culture, the reserve is a major archaeological site with excavations that have revealed large amounts of pottery, glass beads and bone fragments of large mammals such as elephant and buffalo. The hills are dotted with the remnants of defence walls, grinding stones and pottery shards. There is also an interesting cave with a roost of Tomb Bats.

4.6 Socio-economic & Cultural Environment

4.6.1. Overview

The Ghana EIA 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 brief description of the social and economic characteristics of the project area. It is anticipated that the most significant socio-economic impacts will occur within the Lower Manya Krobo Municipal and its environs within the Eastern Region of Ghana. For this reason, the discussion of baseline socio-economic conditions was looked at within the context of this Municipality.

4.6.2. Governance Structure

Traditional Authority

The Manya-Krobo's are the traditional custodians of the land making up the municipality. The Manya's pay allegiance to a paramountcy situated at Odumase-Krobo. The Municipal traditional governance is led by the Paramount chief called Kornor who is resident at Odumase-Krobo and over sees all the communities in the municipality. The Konor holds significant influence and is a key figure in maintaining the cultural heritage and traditions of the Krobo people. Thus, the Odumase-Krobo chief is the traditional leader of the indigenes and rules the entire Municipality with support from sub-chiefs Wetsomantsemei. The traditional authority in the Lower Manya Krobo Municipality is integral to the social, cultural, and economic life of the area, blending customary governance with modern administrative structures to serve the community.

Political Authority

The Lower Manya Krobo Municipal Assembly is the highest Political and Administrative body in the municipality. The Assembly is made up of a Forty-Five (47) Member General Assembly consisting of Twenty-Five (31) elected members, Eleven (14) government appointees and the Municipal Chief Executive and one Member of Parliament. The General Assembly has both deliberative and executive functions presided over by the Presiding Member who is elected by at least two-thirds of the members of the General Assembly from among themselves. The Assembly works through its Executive Committee with Seven (7) members and the Municipal Chief Executive as its chairman.

4.6.3. Land Management & Land Tenure System

For this project, there would not be the need for any land acquisition or involuntary resettlement. Notably, access to land by men and women seems not to be a challenge for the communities of Natriku, Fodzoku and Aforkpa Kope. The land is mainly used for agriculture and settlements. As a result, issues of land acquisition, restrictions on land/water use and involuntary resettlement are minimal since there is no conflict over lands within the project area.

For the general area, land in Lower Manya Krobo is predominantly owned and controlled by families, clans, and stools (chiefly institutions). The family or clan heads, known as "abusuapanyin" and chiefs or stools, play a significant role in land administration. Land is often inherited through matrilineal or patrilineal systems, depending on the specific traditions of the clan or family. The land tenure system in the Lower Manya Krobo area, like in many parts of Ghana, is deeply rooted in traditional customs and practices. Understanding the land tenure system in Lower Manya Krobo requires appreciating the balance between traditional practices and modern statutory regulations, as well as the ongoing efforts to address the challenges posed by this dual system.

In the Krobo area, inheritance can be complex, involving both male and female descendants. Individuals or families usually have use rights rather than absolute ownership. These rights can be passed down through generations but are subject to the overall control of the family head or chief. Land allocation is managed by the family or clan heads. They decide who gets access to land for farming, building, or other purposes. This process is typically guided by traditional norms and practices. Efforts are being made to improve land tenure security and administration through reforms and projects aimed at encouraging the registration of customary lands to provide legal recognition and protection. While customary lands can be registered under the Land Title Registration Law, 1986 (PNDCL 152), the process is often complicated and not widely practiced in rural areas like Lower Manya Krobo. It must however be noted that under the 1992 Constitution of Ghana and the new State Lands Act, 2020 (Act 1026), the state can acquire land for public purposes and such acquisitions are supposed to be compensated for.

4.6.4. Demographic Profile

The Lower Manya Krobo Municipal population had increased from 89, 246 in 2010 PHC to 121, 478 in 2021PHC with a population density (persons per square kilometer) of 364.7 but the population is projected to reach 126,436 in 2025. This comprised 54, 662 (46.6%) males and 64, 816 (53.4%) females in 2021PHC. The population represented 4.2% of the Eastern Region population of 2,917, 039. The average household size of the Lower Manya Krobo Municipality is 3.2.

The 2010PHC shows that 47, 776 people live in the rural areas than the urban of 41, 473 people. In this, 40,486 males and 7,290 females reside in the rural areas. But there is a reverse statistic in 2021PHC, the urban areas had 91,505 (75.3%) of both males and females while the rural population stands at 29,975 (24.7%). The projected population shares a different picture, the female population in both urban and rural areas dominate the males in the urban areas from 2022 to 2025. This means that there are more females in both urban and rural areas than males. This requires the creation of an enabling environment for them to explore the available opportunities for livelihood. **Table 4-12** shows the census and projected population from 2022 to 2025. **Note:** Eastern Regional annual intercensal population growth rate of 1.0% between 2010 and 2021 used to calculated for the projected population for 2022 to 2025.

Table 4-12: Results of PHC and Projected Populations

Population	**Year**	**Location**	**Population Figure**		
			Male	**Female**	**Total**
Census Population	2010	Urban	34,247	40,486	89, 246
		Rural	7,223	7,290	
	2021	Urban	42,196	49,307	121,478
		Rural	14,466	15,509	
Projected Population	2022	Urban	42,620	49,803	
		Rural	14,611	15,665	122,699
	2023	Urban	43,048	50,303	123, 932
		Rural	14,758	15,822	
	2024	Urban	43,481	50,809	125,178
		Rural	14,907	15,981	
	2025	Urban	43,918	51,319	126,436
		Rural	15,056	16,142	

Source: MPCU projection from 2021PHC, October 2021

4.6.5. Ethnicity and Religion

Krobos' constitutes about 66.00% of the total population, followed by the Ewe 18.00%, Akan 7.00%, Hausa 3%, and others 6.00%. Krobo is the main language spoken in the Municipality. Ewe is spoken widely in the fishing communities which are dotted along the Volta Lake. Krobo language is widely spoken in farming settlements in the Municipality.

The dominant religion in the Lower Manya Krobo Municipality is Christianity (92.8%), followed by Islam (3.7%) and adherents of no religion (2.6%). Less than (1%) of the population adhered to traditional religion (0.4%). Among Christians, a higher proportion belong to the Pentecostal/Charismatic churches (36.1%), followed by Protestant churches (26.5%), other Christians (15.5) and Catholics (11.3%). There was not much difference in the variation of religious affiliation by sex, with the notable exception that a higher proportion of males (3.4%) than females reported having no religion (1.9%).

While Christianity has a significant influence among the Krobo people, traditional religious beliefs and practices still hold sway. Ancestral worship, belief in spirits, and the observance of taboos are integral parts of Krobo spirituality. Traditional priests and priestesses play an essential role in conducting rituals, offering sacrifices, and mediating between the physical and spiritual worlds.

4.6.6. Cultural Heritage & Practices

The Krobo people have a rich cultural heritage that is deeply rooted in their traditions, ceremonies, and social structures. The traditional authorities are the custodians of the culture of the people and of the Krobo culture. These people play various roles in the management of development projects and fostering peaceful co-existence in the various communities. They oversee the celebration of cultural festivals, such as the annual Ngmayem Festival, which marks the end of the yam harvest and serves as a significant cultural event for the Krobo people. The widely known Ngmayem festival is celebrated in last Friday of October each year. This lasts for a week and brings lots of people (citizens and non-citizens) to Odumase-Krobo, presenting an opportunity for development interventions.

Several rites are also performed by the Krobos'. Notable among them are the Dipo, Lapomi and Kadoba Fiame. Dipo is a puberty rite performed for young adolescent girls. It is done to usher the girl into adulthood. In all intents and purposes, Dipo is a positive rite that initiates the young woman into knowing her responsibilities before stepping into marriage hood. This tradition dates centuries back and should be encouraged, but with modification. Lapomi denies fathers of naming rights until some customary rites are performed. This practice appears to have promoted single parenthood and its accompanied constraints. Kadoba Fiame (scarification) is mostly done by traditionalists, herbalists, and spiritualists as part of treatment and healing.

The Krobo people are renowned for their bead-making skills, which have been passed down through generations. Beads are an essential part of Krobo culture, used not only in the Dipo rite but also in other ceremonies and everyday life. They are worn as ornaments, symbols of status, and spiritual protection. The bead-making process involves intricate techniques and is a source of pride and identity for the Krobo community.

Marriage among the Krobo people is a communal affair, often involving elaborate ceremonies and rituals. The payment of bride price, known as "Dowry “, in the local context, is an essential part of the marriage process. Family life is highly valued, with extended families playing a significant role in the upbringing of children and the maintenance of social order. Funerals are significant cultural events in Krobo society, often involving extensive preparations and rituals. The dead are honoured with specific rites that include the performance of traditional songs and dances, the wearing of mourning clothes, and the offering of sacrifices. Funerals are seen as an opportunity to celebrate the life of the deceased and ensure their peaceful transition to the afterlife.

Music and dance are vital components of Krobo culture, serving both ceremonial and recreational purposes. Traditional instruments like drums, flutes, and rattles are commonly used in performances. Dance forms such as Kpanlogo and Klama are popular, often performed during festivals, rites of passage, and other communal gatherings.

4.6.7. Tourism Potential

The Lower Manya Krobo Municipality has five (5) potential tourist attraction sites which are yet to be developed. They are Mountain Yogaga located at Nuaso, Krobo Mountain at Akuse junction, Kpong Airfields at Kpong, Kpong Tilapia Beach and the Beads market located at Kpong and Odumase. The physical, historical, and cultural features could be developed to attract tourists into the municipality. Aside the Krobo Mountain, located close to the Okwenya Junction, all these potential tourism locations are nowhere near the KGS project site.

4.6.8. Social Development

The issues of social development for the district shall cover areas such as education, health, water, sanitation, social protection programmes, disability, gender mainstreaming, vulnerability analysis, poverty, inequality. A base map showing locations of the various social infrastructure in the district is provided in Appendix 4f.

Education Facilities & Related Indicators

The municipality has 180 public schools (44 KG, 46 Primary schools, 38 JHS, 4 SHS and 1 Voc./Tech) and the private has 208 schools (84 KG, 77 Primary schools, 40 JHS, 6 SHS and 1 Voc./Tech). The total enrolment of 21, 968 pupils and students in both public and private schools outweigh the available schools. Most of the existing school infrastructures are not conducive for teaching and learning.

The total enrolment of 13, 044 boys and 16, 944 girls at all levels in the public school while the private school had 8,924 boys and 8,795 girls respectively. The total enrolment for both boys and girls in public schools is more than the enrolment in the private schools. The inadequate school infrastructure, furniture, school toilet and ICT facilities and staffing position had negatively affected teaching and learning subsequent academic performance of BECE (52.70%) and WAEC (50.80%) in 2020.

Health Facilities and Related Indicators

The Municipal Health Administration provides technical and administrative support to health service providers. These include resource mobilization and distribution, training, and research programmes. The Municipal Health Administration ensures that services provided are in line with the National Health Policies.

The Municipal has 48 health facilities (three (3) active Municipal Hospitals, two (1) Clinics, four (4) Health Centres, ten (10) CHPS Compounds, twenty-seven (27) CHPs zones and three (3) laboratories). The three hospitals are in Atua, Agormanya and Akuse while CHPS compounds, clinic and health centres are in the settlements in the four zonal areas to provide curative and preventive services. The Akuse Government Hospital is located about 5 km from the project site and provides the immediate resort to medical care in case of medical emergencies for the project workers.

Typhoid fever and malaria are listed as the top OPD cases followed by dysentery, and hypertension. There is also high prevalence of HIV among the adolescent within community. The most relevant public health issue related to the water include water borne and water related disease vectors. The proliferation of aquatic weeds in the years after river impoundment has caused an increase in schistosomiasis due to improved habitats for the host snails, and there is the risk of infection due to contact with the water body.

The recorded top ten outpatient morbidity cases of 77,733 in 2017 with an increment of 87, 979 in 2018 to 90, 197 in 219 but reduced to43, 135 as at October 2021. The neglected tropical diseases recorded a reduction of 35 in 2017 to 6 as at October 2021. The HIV/AIDs infection rate of 1.20% in 2017 increased to 1.35% but declined to 0.48% as at October 2021. There exists school health problem especially children eyes infections. There is unstable trend of recorded cases of major diseases infections in the municipality. The National Health Insurance and immunization coverage of 90.1% of outpatient attendance and 90.7% of children immunized respectively in 2017 increased to 90.2% of OPD attendance and 98% of children immunized as of October 2021.

The most relevant public health issue related to the Kpong head pond and its potential for work on the water body include water borne and water related disease vectors. The proliferation of aquatic weeds in the years after river impoundment has caused an increase in schistosomiasis due to improved habitats for snails (*Biomphalaria* sp. and *Bulinus* sp.). Schistosomiasis is not considered as a major health risk despite its known occurrence. There have been isolated cases of schistosomiasis in some of the communities along the Kpong head pond. Currently, the VRA has mobilized heavy machinery for the removal of aquatic weeds, and this is expected to contribute to reducing the vulnerability to the disease.

Water And Sanitation Facilities

The municipality has 42 boreholes categorized into 32 Mechanized and 10 Non-mechanized excluding standing Pipes (GWCL). The non-functional boreholes are 13 comprised of 10 mechanized and 3 non-mechanized. The 42 boreholes shared among the four zonal areas in the municipality. The boreholes augmented the GWC supply to the major towns from Kpong and Somanya. However, people in the Middle Belt received their potable water supply from the boreholes scattered in the settlements. The water supply in the municipality is not only inadequate but also unwholesome in some settlements for consumption. The burst water supply pipelines on insanitary gutters affect the quality of water reaching final consumers in the urban areas. Some boreholes in the middle belt have heavy minerals making the water not potable for human consumption. The Municipality is endowed with natural water bodies/Rivers.

There are 44 KVIP/public toilet facilities, 1 final disposal site, 16 communal refuse containers, 4 slaughterhouses and meat shops in the Municipality. The 44 KVIP facilities spread across the four Zones such as Kpong 17, Odumase 23, Akuse 4 and Oborpah none. The municipality has 11 dumping sites which comprised of 9 sites in Kpong zone, 2 sites in Odumase zone.

4.6.9. Gender & Vulnerability

In terms of gender equity, national energy policy recognizes the need for gendered responses to improve energy access. Ghana’s Energy Policy 2010 clearly indicates that women are some of the most important actors in the energy sector, in terms of their use and management of household energy including renewable sources. It therefore seeks to mainstream energy related gender concerns and align them with wider health and safety as well as environmental standards. Similarly, the Renewable Energy Master Plan indicates that the development of policies and strategies should always seek to ensure equitable participation and delivery of energy services to men, women, children and the vulnerable. However, there is still a wide gap between gender-aware text in an energy policy statement and its actual implementation at local level.

A gender diagnosis study for VRA, undertaken in 2023 concluded that VRA gender equality progress stands between the compliance and programmatic phase, where gender equality is perceived as a compliance risk and actions are restricted to addressing compliance risks. It further found that VRA's gender approach is more reactive than proactive, initiatives are disconnected and fragmented, limiting synergies, efficiencies, and impact. However, motivation towards gender equality and compliance to the sectoral gender targets exists, providing opportunities for further grounding and development. It must be noted that the VRA has also drawn up and is implementing a Gender Action Plan and all components, especially those relating to labour, will be activated as part of this project. A summary of this action is attached as Appendix 4g.

On the national level, despite progress in various fields, women's participation rates in economic life including employment and business opportunities vary from country to country in Africa and are typically well below parity. This is mainly due to socio-cultural, institutional, and legal barriers that hinder the economic integration of women. Even with economic incentives in place, women may remain unable to benefit from opportunities due to high demand on their time, as well as limited access to productive assets such as land, credit, networks, education and skills, infrastructure, utilities, and services (for example, health, transport, water, and electricity). Currently, the promotion of gender equality is a cross-cutting issue/concern throughout all project development phases specifically by recognising the rights of women and marginalised groups and providing for their equal participation. Noting this, the Ghana EIA study requires the assessment of the vulnerable as part of the process and this is to be discussed in this EIA Report.

The municipality has 4,165 vulnerable persons, as at close of 2021. This shows that 3.43% of the people in the municipality are vulnerable to social, economic, and environmental shocks due to conditions which affect their resilience. Among these people are aged, children, TB/HIV/AIDs/Covid-19 patients, women, orphans, unemployed youth, Physically Challenged Persons (PWDs), poor persons (PPs) and people at certain locations (flood prone areas). The conditions that cause their vulnerability are blindness, difficulty in walking/talking/hearing, neglected, loss of parents/supporters, sickness, flooding/disasters etc.

The Municipal population has more females of 53.4% than males of 46.6% which require specific projects and programmes to improve the girl-child education, women empowerment, people with disability etc. However, there are factors that negate equal participation in economic processes and decision-making, inequitable distribution of resources across gender composition in the municipality. The Municipal Assembly has put in place measures to educate girls on effects of teenage pregnancy and violence against women, build women entrepreneurial skills and support girls to take part in Science, Technology, Mathematics and Educations (STMEs) to empower them economically, socially, and politically.

Various Social Protection interventions are in place in the Municipality to provide protection for its people against economic, social, and political shocks that may arise. Among the social protection programmes for vulnerable people in the municipality are:

a) Livelihood Empowerment Against Poverty
b) Capitation Grant
c) Persons With Disability
d) National Health Insurance Scheme
e) Ghana School Feeding Project
f) Covid-19 Relief Fund

A summary of Gender analysis and mainstreaming strategies developed by the Municipal social welfare is shown in Table 4-13.

Table 4-13: Gender Analysis & Mainstreaming Strategies in LMKA

Stake-holders	Issues	Concerns/ Expectations	Strategies	Implementing and Collaborating Depts/Agencies
Boys	1. Disparities in Childcare and maintenance 2. Inadequate funding for child development programmes 3. Growing numbers of orphaned and vulnerable children 4. Low awareness and violation of child right	1. Equal materials welfare 2. Enjoy the same level of schooling and encouraged to stay in as girls. 3. Equal access to resources and opportunities	1. Enact and enforce byelaw and children Acts. 2. Create opportunities for all children. 3. Create awareness on children's right. 2. Institute scholarship schemes for needy children	MA/Dept Social Development/ GES
Girls	1. Child labour 2. Teenage pregnancy 3. Disparities in childcare and maintenance 4. Inadequate funding for child development programmes 5. Growing numbers of orphaned and vulnerable children 6. Low awareness and violation of child rights	1. Girls enjoy the same levels of schooling and encouraged to stay in school as boys. 2. Equal access to resources and opportunities	1. Enact and enforce byelaw and children Acts. 2. Create opportunities for all children. 3. Create awareness on children's right. 4. Institute scholarship schemes for needy children	MA/Dept Social Development/ GES
Men	1. High level of poverty 2. High illiteracy rate 3. Lower access to productive resources 4. Heavier burden	3. Increase income generating capacities. 4. Equal materials welfare 5. Equal participation in decision-making 6. Equal access to resources and opportunities	1. Improve the economic empowerment of men through access to credit. 2. Promote non-formal education programmes. 3. Promote men participation in decision-making at all levels	MA/Dept Social Development/ GES/ Dept of Agriculture
Women	1. High level of poverty 2. High illiteracy rate 3. Lower access to productive resources	1. Prevent violence. 2. Increasing income generating activities 3. Equal participation in	1. Improve the economic empowerment of women through access to credit. 2. Promote non-formal education programmes. 3. Promote men participation in decision-making at all	MA/Dept Social Development/ GES/ Dept of Agriculture

Stake-holders	Issues	Concerns/ Expectations	Strategies	Implementing and Collaborating Depts/Agencies
	4. Heavier burden	decision-making 4. Equal materials welfare	levels	
PWDs	1. Inadequate universal access to Disability friendly infrastructure 2. Inadequate appreciation of issues relating to Disability 3. High incidence of poverty among PWDs	1. Equal participation in decision-making 2. Reduce discrimination. 3. Increase income generating. 4. Increase universal access to disability infrastructure.	1. Promote the implementation of the provision of the Disability Act 2. Provide universal access to Disability friendly infrastructure. 3. Support PWDs activities with funds	MA/Dept Social Development/ GES/ NGOs

4.6.10. Economic Development

Agriculture Services and Management

The economy of the Municipality is dominated by agriculture with commerce and industrial sectors least developed. Agriculture accounts for about 65% of the Municipal labour force, commerce account for about 20%, while industry and other sectors account for about 15%. The total output of staples of 159,084.4 mt in 2017 was slightly increased to 159,461 mt in an average of 1,892.7 hectare of land in 2020 while the total output of cash crop of 4,090mt in 2017 increased to 5,280 mt in in average of 440 hectare of land in 2020. The productivity of livestock, poultry and crops is so low because of erratic rainfall, inadequate farm inputs: machinery, processing equipment, planting materials, fruit fly and livestock /poultry infestations. Most residents of nearby townships of Natriku and Akuse are farmers (mainly rice and vegetable cultivation). Few community members rear livestock on a commercial scale but almost every household has some form of livestock.

Fishery Activities

Fisheries activity is a serious business on the waterbody though it is not done on a large scale. Fishers have been operating in the area close to the project site since years back, though is well known that VRA has the rights to the water space in the vicinity. Fishing activities in Kpong reservoir involve various methods, practices, gears, and regulations. Nine main fishing gears and methods have been identified to be in use at Kpong. These include gill nets of different mesh sizes, cast nets, mosquito-proof nets, traps of different types (basins/baskets, wire cages, bamboo/PVC), atidja, harpooning as well as hook and line. The commonly used gear by the fishermen over the whole reservoir is the gill nets. In Kpong reservoir, aquaculture is mainly practiced near the dam along the western shore, presumably because the reservoir is too shallow in most other places.

Fish caught in the Kpong reservoir are not much different from fish caught in other parts of the Volta River. They include Lates, Gymnarchus, Auchenoglanis, Clarias (Catfish), Heterotis, Electric fish, Sierithrissa ("one-man-thousand"), Chrysithyes, Prawns, Puffer fish, Bagrus, Hydrocynus, Mormyrus, Synodonti, and Tilapia. The bamboo fishery in the reservoir is used mostly for Chrysichthys species. The hook and line are used to catch Nile tilapia and giant lates. According to data from the Fisheries Commission (Akosombo Cost Center), the average annual capture of fisheries within the Kpong fishing grounds is estimated to be 29 million tonnes over the last 5 years.

Fish landed is sold mainly at the landing sites called local harbors. Whilst men are mostly involved in fishing, women are engaged in the trading and processing of the fish. Traders send some fish to big markets in other regions for better prices. Landed fish are preserved with ice blocks.

Fishing in the reservoir comes with restrictions along the sections VRA has earmarked as no-go fishing zones, and these are well disseminated in the project area. These are mainly sections closest to the dam (i.e., where the construction activities are expected).

Aquaculture

Aquaculture is principally practiced as semi-intensive or extensive in Ghana. The extensive system is associated chiefly with dams, dug-out, and small reservoirs while the semi-intensive systems including the earthen ponds which are either monoculture or polyculture of tilapia (*Oreochromis niloticus*) especially and African catfish. The cage systems and pen culture are practiced in lagoons, lakes, and rivers, mostly along the lower Volta basin.

In Kpong reservoir, aquaculture is mainly practiced near the dam along the western shore, presumably because the reservoir is too shallow in most other places. Most of the aquaculture farms are not registered or licensed as confirmed by EPA. Several cage pond farms used to be operated in the Kpong reservoir near the project site. However, the number of cage fish farms has reduced significantly over the last few years. The reduction was caused by a rush of investors who spent a lot of money at the construction stage but could not get enough money to operationalize the cages. Around 2016, many investors sought to explore the fish farm business; however, most of those fish farms folded up due to poor management and low profits. Additionally, the tilapia disease outbreak in 2018 affected the profit of most farmers, forcing them to abandon their operations.

Local Economic Development (SMEs development)

As at close of 2021, there were about 806 SMEs covering agro-processing, clothing and textiles, metal and wood works, cosmetics and beautification, health, and service industries. These industries are classified under the three main sectors (agriculture, industry, and service) in the municipal economy. However, these industries are battling limited access to credit facilities, cost of raw materials supply, low patronage, inadequate production facilities/equipment and poor group cohesion. Table 4-14 shows the types of small-scale industries in the municipality.

Table 4-14: Types of Small-Scale Industries

Category of Small-Scale Industries	Industry	No. of people engaged
Agro based	Milling, gari processing, distillery/brewery, fishing/fish mongering, rice milling, chop bars, bakery	206
Wood–based	Carpentry, wood works, wood carving, sawmills	7
Clothing	Tailoring/dressmaking, seamstress, fashion, and design	100
Service	Hair dressing, restaurants/chop bars, guest houses, transport, hotels, filling stations, financial, private schools, public toilet operations, barbering, mobile money transfers	170
Repairs	Bicycle repairing, motorcycle repairers, tyre vulcanizing, car repairing, welding, blacksmithing, electronic gadget repairs, phones etc.	50
Metal-based	Black smith, welding, garages, upholstery, sprayers, vulcanizing, mechanics, auto electrician	50
Art-based	Beads making, basket, weaving, raffia fan weaving etc.	14
Beautician	Hair dressing salons, cosmetic	207
Heath based	Laboratory/medical screening, chemical stores counter medicine sellers, herbal,	2
Total		806

Source: MPCU, October 2021

Financial Institutions

There is one Commercial bank at Akuse and a Rural Bank at Abanse, the rest are saving and loan schemes and many mobile money vendors at various locations in the municipality. This financial institutions in the municipality are inadequate to promote financial inclusion and saving culture.

Markets And Related Facilities

There is one major periodic Agormanya market and eight other daily satellite markets. The Agormanya Market comes off every Wednesday and Saturday while the 8 satellite markets have daily markets across Odumase, Kpong and Akuse zones in the municipality. The Middle Belt has no market.

Settlement Systems/Built Environment

The settlements in the Municipality exhibit linear form of nucleated settlement patterns along the major roads whiles the outskirt has the scattered settlement. The major factors for this can be attributed to the 'Huza' system being practiced by the Krobos and the topography of the municipality. In the older parts of relatively urbanized towns such as Odumase-Krobo, Agomanya, Kpongunor, Kpong, Akuse, Nuaso, etc conditions within the built environment are generally poor due to lack of access roads and inadequate maintenance. Drainage and garbage disposal are visible problems throughout the major towns. In the more rural areas, settlements are detached.

This is traceable to poor spatial planning, poor waste management, lack of bye laws, poor building technology etc. With the low development control machinery in the Municipality, physical development has been haphazard and uncoordinated leading to uneconomic land use especially in the urban and semi-urban settlements of Odumase, Agomanya, Kpongunor, Atua, Kpong, Akuse etc. Poor drainage system in the municipality has exposed most towns and communities to severe erosion resulting in rills and gullies which has exposed foundations of buildings. Worse still the communities along the Limestone mines are being exposed to strong vibration of Dynamites blasting and atmospheric pollutions which need to be checked. Also, port holes believed to have been developed by heavy duty trucks for limestone winning has led to increase in road accidents on the road leading from Odumase-Krobo to Oborpah.

Housing Stock and Conditions

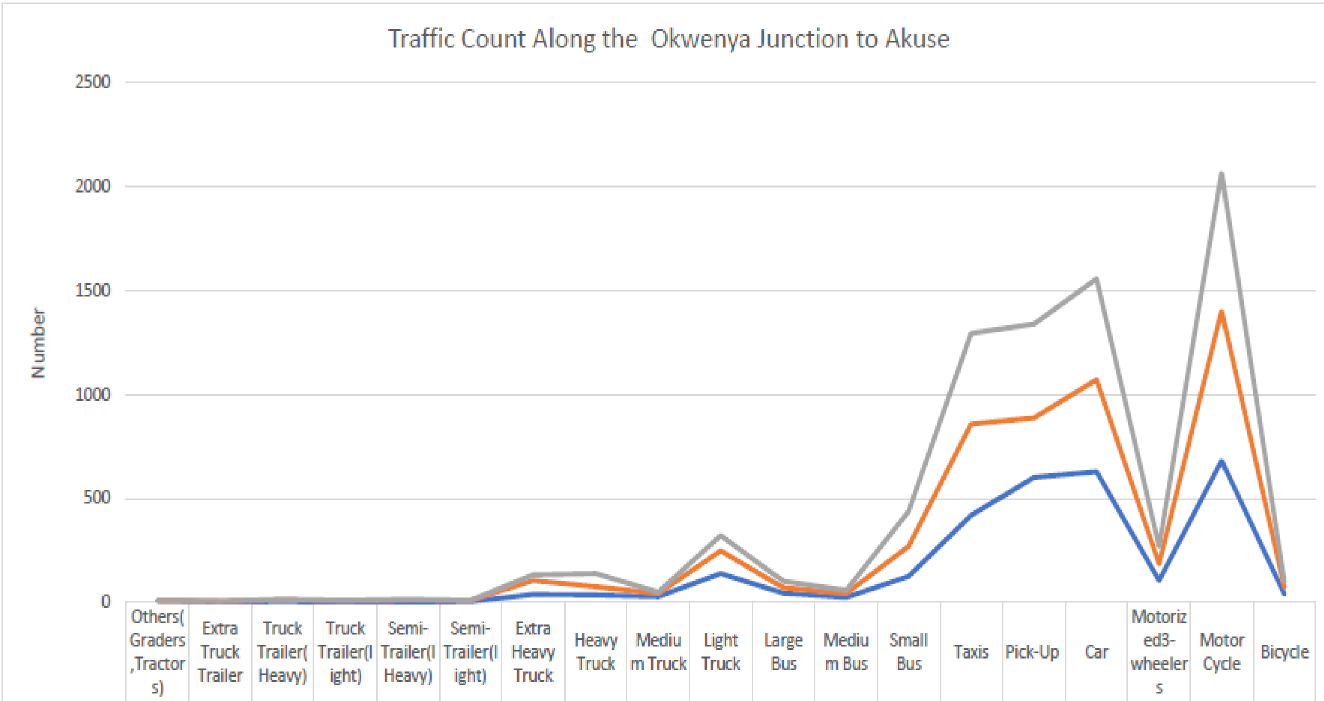
There is a manifestation of traditional building materials (stabilized earth, concrete, iron roofing sheet predominantly) used. Most of the houses are exposed to hazards and disasters such as domestic outbreaks, flooding, collapsing buildings and poor sanitation. However, measures have been put in place to bridge any housing infrastructure deficit and promote maintenance on the existing houses.

Transport Infrastructure & Network

A description of the access road network leading to the KGS from the Okwenya Junction to the project site at KGS has been provided under Section 3.4. The road, which is bituminous surfaced, is approximately 10km from the junction to the Akuse Town. Essentially, the road was designed and constructed in the 1980's as a single lane minor arterial highway, 7.5m wide, with earth ditch drains along most sections of the road. Some reinforced concrete culverts have also been constructed at various locations across the road with the aim of preventing inundation of storm water on the road.

The road, unfortunately, has not undergone any major rehabilitation since its construction. Currently, most sections of the road are in a very deplorable state making driving on the road very unsafe, especially in the night owing to the absence of streetlights. Also, siltation of almost the entire earth drain channels has resulted in the erosion of the road edges, leaving the road very narrow in most sections. Periodic ponding of rainwater has also resulted in the creation of many potholes. The road has over the years served as the corridor for the transportation of vital equipment to the plant. Materials and other essential components that were required for the major retrofitting of the plant were all hauled on this road. Also, the road was the route for the transportation of all the essential tools, equipment and materials that were used during the various phases of the rehabilitation works on the dam. A 3-day traffic count along the route shows motorcycles as the most used mode of transport (See **Figure 4-8**). Indeed, this is now commercialised and due to the poor state and cheaper rate, most commuters prefer the use of these motorcycles, popularly known as Okada.

Figure 4-8: Three Day traffic Count Along Okwenya Junction to Akuse



	Others(Graders ,Tractor s)	Extra Truck Trailer	Truck Trailer(Heavy)	Truck Trailer(l ight)	Semi-Trailer(l Heavy)	Semi-Trailer(l ight)	Extra Heavy Truck	Heavy Truck	Mediu m Truck	Light Truck	Large Bus	Mediu m Bus	Small Bus	Taxis	Pick-Up	Car	Motoriz ed3-wheeler s	Motor Cycle	Bicycle
Day 3	1	0	3	1	4	0	28	63	7	73	31	15	169	436	451	485	85	664	26
Day 2	1	3	7	6	8	5	67	40	15	110	26	19	144	439	287	443	80	719	33
Day 1	8	3	5	3	3	5	38	36	28	139	45	24	125	419	601	629	105	680	39

With respect to the Municipality and surrounding towns, the current roads network and other modes of transport does not facilitate efficient and intra-district or municipal movement for socio-economic exchanges. Apart from the Accra to Kpong and Tema to Akosombo trunk roads, the rest are rough bitumen surfaced roads and unmovable feeder roads during rainy season. The Lower Manya Krobo Municipal has estimated road network coverage of 449 kilometres which comprise of 81km of tarred roads, 271km of untarred roads and 97km of feeder roads. The remaining untarred roads have no drains, a situation which facilitates erosion on the roads. The poor nature of the municipal roads makes movement within and outside the municipality relatively difficult.

The main means of transport is by minibuses (trotro), taxis, large mummy trucks and a few salon cars. The access feeder roads, tracks, paths, and bridges make up the rural transport infrastructure system on which rural dwellers gain access to markets and social services existing in the major towns. Most settlements are accessible by feeder roads while sizeable number also accessible by village tracks. The existing road network does not facilitate effective connectivity due to limited availability of alternative links between major settlements in the Middle Belt due to hilly nature of the area. Most farmers still trek to and from the rural field on footpaths while carrying farm implements, fuel wood, water, and harvested crops.

River transportation is another undeveloped form of transportation in the district. About 7% of the district settlements are located close to the Volta Lake. Accessibility to these settlements by road is very low due to the low access to vehicle plying these bad roads. These communities however are important communities in the production of food and fish. The large volumes of fish and food stuff are therefore transported by canoes and engine boats. Transport on the water reservoir facilitates the movement of goods (agricultural produce, firewood, and charcoal) to markets in Agomenya and Juapong (further away from the Kpong reservoir. Transport services (local boats, canoes, rafts) are a key livelihood for men and the youth across the Kpong dam. Similarly, large cargo trucks and minibuses are sometime use to convey food items from the riverbanks which stretched along the boundary of eastern side of the district with North Tongu District.

5 PUBLIC PARTICIPATION & STAKEHOLDER ENGAGEMENT

5.1. Overview

In Ghana, the requirements for public consultation and disclosure related to EIA for proposed developments is clearly outlined under Section 12(k) of the Environmental Assessment Regulation, LI 1652 of 1999, which mandates the consultation with members of the public likely to be affected by the operations of the undertaking. Indeed, LI 1652 indicates that a public hearing is required if great adverse public reaction is apparent. The need for a public hearing is considered if the project in question involves the dislocation; relocation or resettlement of communities or the EPA considers that the project could have an extensive and far-reaching effect on the environment. The "**EIB ESS Standard 2 – Stakeholder Engagement**" recognises the importance of stakeholder engagement, as a means to ensure respect for the rights to: (i) access to information; (ii) public participation in decision-making processes; and (iii) access to justice.

VRA is thus required to meaningfully consult with stakeholders on the preparation and results of the EIA undertaken for the project and undertake ongoing consultation during each phase of the development. 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.

5.2. Stakeholders Identification

The process of identifying stakeholders begun in July 2024 following the confirmation of the project activities and associated facilities, including the repairs of the 10km road from Okwenya Junction to Akuse. This is to allow the Team in the EIA process to explain to the Interested and Affected Parties (I&APs) how the project may affect them and receive feedback on concerns that they may have, in order that subsequent studies undertaken, and actions can reflect those concerns. The stakeholder identification process is based on an appreciation of the interest and influence of various organizations / institutions / communities/ persons or groups in relation to the project.

Thus, to identify stakeholders for this project, the stakeholder mapping was done to identify those critical to be consulted within these settings. The process involved identifying stakeholders located within the project's proximity as they are the most likely to be impacted upon, like those whose livelihood will be affected by the project, or those who reside and operate in the project area. This was done through a reconnaissance visit to the project area, from the Shai Hills on the Tema - Akosombo N2 Highway, then from the Okwenya Junction through Akuse to the KGS as well as initial engagements to enable identification of key individuals and owners of social/Community properties that need to be consulted.

Aside, the residents and businesses along the Okwenya – Akuse Road that will directly be impacted by the project, it was noted that four major communities will also be impacted by the project activities and require stakeholder engagements. This is because the community members utilise the access route on the dykes as well as the Okwenya Junction to Akuse road daily. The communities are:

1. **Fodzoku:** Located at the Headpond of the Kpong Dam with farmlands by the East dyke, and they are in the North Tongu District.
2. **Torgome:** Located at the Tail race of the Kpong GS Dam but have farms by the East Dyke. They fall in the North Tongu District.
3. **Natriku:** Originally lives on the land where the power plant is currently located but were resettled to lands along the West Dyke. They fall in the Shai Osudoku District. Community members will be directly impact if the unpaved road through the community to access the landing sites.
4. **Akuse**: Located before the dam and the road networks falls within this community, with majority of dam workers reside in this community. They fall in the Lower Manya Municipality.

Based on this, the stakeholder planning, and analysis has at this stage identified four distinct stakeholder groups that should be consulted during the EIA process, and these are outlined in Table 5-1. Stakeholder identification will be an ongoing process throughout the life of the project, requiring regular monitoring, review, and updates.

Table 5-1: Identified Stakeholders Under the Project

Consultee Type	**Consultees Identified**
High Interest / High Influence	
Stakeholders who are directly and/or indirectly impacted by the Project or its component.	• Environmental Protection Agency, for the issuance of project environmental permit. • Lower Manya Krobo Municipal responsible for the political administration and development of the project area, and local communities within the Municipalities • North Tongu District Assembly within which Fodzoku and Torgome communities reside. • Shai Osudoku District Assembly within which the Natriku community reside. • Ghana Highway Authority, due to the rehabilitation of the associated road facility • Water Resources Commission
High Interest / Low Influence	
Stakeholders that have interest in the Project and its component	• Forestry Commission, regulating activities of the wildlife within the Shai Hills Forest Resource • Akuse General Hospital, which serves as the main health

Consultee Type	Consultees Identified
	facility in the project area. • Ghana Prisons Service, and manages the Akuse Prison Facility located close to the VRA Junction at Akuse • Ghana Police Service, to provide security during project implementation. • Ghana National Fire Service, responsible for preventing and managing fires. • Heads of schools, churches, and sensitive facilities within the Natriku Township • Community members within the project area along the road corridor, and likely or possible recipient of project adverse impacts, targeting owners of community/ social infrastructure such as schools, churches, hotels, etc. • Assemblypersons, who are representatives of the project impacted communities of Torgome, Natriku, Fodzoku, and Akuse to assist in implementing project communication plan as well as in the grievance redress process.
Low Interest / High Influence	
Stakeholders that have the potential to influence the Project outcomes	• Traditional authorities and Community leaders within of Torgome, Natriku, Fodzoku, and Akuse, communities that have traditional / cultural oversight of local communities in the project area. • Manya Krobo State Queen Mothers' Association, a women groups within project impacted communities, who have community interest role
Low Interest / Low Influence	
Non state actors with facilities within immediate impact area and has indirect role in the project development process.	• Youth and Women Empowerment (NGO) • Growth Aid (NGO)

5.3. Methodology For Stakeholder Engagement

The engagement process for the project has been designed to meet Ghanaian legal requirements for public participation and to align as far as practically possible with good international industry best practice, based on the project timing and budget. It is also important to note that there are practical and financial limitations to the involvement of all individuals within the engagement process. Hence, the stakeholder engagement was designed to be inclusive of a broad range of societal sectors relevant to the proposed project.

The following documentations were prepared for use in the stakeholder engagements process:

a) A "**Project Communication Plan**" to ensure relevant issues and stakeholders have been captured as much as possible. This plan sought to provide VRA, a communication strategy (messaging and stakeholder engagement action) to proactively manage potential misperceptions, miscommunications and negative reportage that may arise because of the project.
b) A "**Background Information Document**" (BID) to provide information on how one can become involved in the project, receive information, or raise issues which may be of concern and / or interest. This complied of a 2-page flyer, with a bar code to access a detailed brochure on project information. The flyer and brochure are provided as Appendix 5a and 5b.
c) A "**Letter of Invitation to Comment**" from VRA to stakeholders. The letter advised that VRA was 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 EIA Report. Stakeholders were requested to provide input on potential issues to guide in decision making.

Engagements were through formal meetings, one-on-one discussions, and focus group discussions. The use of internet-based communications, such as emails, on-line meetings and social media platforms were also adopted. Specifically, letters of invitation to comment (with BID/Flyer),were emailed to the Heads of the Shai Osudoku District Assembly, North Tongu District Assembly, Manya Krobo State Queen Mothers' Association, Youth & Women Empowerment, Growth AID as well as the Water Resources Commission. A meeting was held with the Water Resources Commission online via Microsoft Teams. Indeed, the Flyer and BID were shared on the existing WhatsApp Platform for the Steering Committee for the EMP of the Akosombo & Kpong Dams. Membership of the Steering Committee is made of representatives from 24 external institutions comprising of fifteen (15) MMDAs, including all the districts within the Lower Volta Basin Area, six (6) Regulatory Agencies and 3 other institutions as listed in Table 5-2.

Table 5-2: Institutional Membership of EMP Steering Committee

Municipal/ District Assembly	
Lower Manya Krobo Municipal	Kpando Municipal
Asuogyaman District	Keta Municipal
Upper Manya Krobo District	South Tongu District
Shai- Osudoku District	Central Tongu District
Ada East District	North Tongu District
Ada West District	North Dayi District
South Dayi District	Biakoye District
Anloga District	

Regulatory Agency	
Environmental Protection Agency	Mineral Commission
Energy Commission	Ghana Maritime Authority
Water Resources Commission	Fisheries Commission
Other Institutions	
VRA Resettlement Trust Fund	Institute of Environment & Sanitation Studies, University of Ghana
Ghana Health Services	

Generally, depending on the stakeholder, key messages as contained in the communication plan were:

a) VRA intends to undertake the rehabilitation works at KGS as part of its operation and maintenance actions. The works include the repair of the displaced rockfill on the upstream slope of the Kpong Dam to ensure the proper operation and function for the next 50 years. It will involve the revision and improvement of the existing slopes as well as the proper rock grading on the 2 dykes and River dam.
b) In addition, all fifteen (15) spillway gates are to be rehabilitated to ensure the proper operation and function of the gates for the next 25 years. The rehabilitation will be done in tandem with the Akosombo GS to ensure effective coordination.
c) The works are necessary to ensure the sustainability of the dam and of the safety of the population surrounding and downstream of the dam in the Lower Volta Area.
d) The project is being co-funded by VRA and the EIB.
e) The project would require the transportation of heavy equipment and haulage of substantial volumes of boulders and will use the Okwenya Junction to Akuse road for this activity. The current state of that road would make transportation unsafe, and the project will therefore include the rehabilitation of this road network.
f) Environmental Assessment studies are ongoing and will be completed by December 2024, with the issuance of an Environmental Permit hopefully by February 2025. Project duration for dyke repairs is 18 months and 4 years for the spill way gates repairs.
g) The project will not interrupt the daily power supply to households and businesses within and around the project area. However, due to the project type and the initial road works, construction activities are likely to have some environmental and social impacts. In view of this, some key stakeholders have been identified to be engaged and provided the required information, which has been summarised in a BID. Stakeholders to channel their concerns, questions and enquiries through the address provided on the BID.
h) This is a national project, and all stakeholders are entreated to collaborate to ensure its successful completion. Grievances should be channelled through their assembly persons, who have been briefed on project implementation strategies. The Assemblypersons are to as much as possible liaise with the Traditional Authority as well as the Municipal Assembly in addressing grievances.

With respect to communication, language to be used will depend on the audience, and will either be English, the national official language, or the local language in the community. English language will be used for engagements with officials of state institutions, whilst the local languages, either Akan, Ewe or Krobo, will be for the locals as required. The VRA Stakeholder Engagement Team has personnel who are proficient in the local languages and therefore will not require interpreters for the various engagements.

5.4. Outcome of Stakeholder Engagements

A total of one hundred and fifteen (115) persons were directly engaged from August – Sept. 2024, and this comprised of 96 males (83%) and 19 females (17%). Out of this number, 19 (17%) were below the age of 30 years, 53 (46%) were within the ages of 30-50 whilst 37 (32%) were above the age of 50 years. From the consultations, stakeholders generally welcomed the plans to rehabilitate the dams and spillway gates, as in their opinion, they serve as key national infrastructure for power generation and there was the need for proper maintenance to keep them effective and functional. Since the project would not directly affect them, those consulted 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 this is provided in Appendix 5e. Notable was apprehension of the state of the dam due to the impact of the 2023 spillage. the associated road repairs, which in their opinion was critical as well as opportunities for employment and benefits from the project. Record of the stakeholder exercise is provided as part of Appendix 5f, and this includes pictures, signed list of participants as well as contact details of all persons consulted.

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. Through these consultations with I&APs and Stakeholders, issues for inclusion within the EIA has been identified and recorded. Based on the issues raised, status quo conditions of the study area and the nature of the proposed development, the key issues of concern identified and that must be considered during project implementation are summarized as below:

<u>Project Development</u>

- Inclusion of repairs of Okwenya Road through Akuse as part of the associated works since that has been of concern to the community.
- Road within the Natriku community can serve as alternative route for the project to the West Dyke and this should be considered under the project for use and repairs.

- Concern about status of proposed floating solar power facility near the Kpong dam and how does the upcoming rehabilitation project impact on that development.
- GHA intends upgrading the Okwenya Road through Akuse to Volivo and there is a need for engagement with the Ghana Highway Authority to ensure smooth implementation.
- VRA needs to ensure that issues raised by WRC during dam safety investigations are strictly addressed.
- Timely Implementation of project to ensure object of the project, i.e., to maintain the integrity of the Kpong dam.

Environmental Impacts

- Need to guard against polluting the water during project activities.

Socio-economic Environment

- Opportunities for employment for community members
- Considerations of the direct benefits of the project through community development activities for livelihood improvement
- Ensure access to waterfront at the Natriku Landing Site for livelihood activities.
- Access to dam access site for commuting purposes
- Concern about the impact of the project on fishing activities by the Natriku community members near the dykes
- Enhancement of CSR actions and assist the impacted communities with more infrastructure.
- Need for VRA to consolidate relationship with Assembly members to ensure smooth information flow to the Community member as part of project grievance resolution process.

Occupational & Public Health & Safety

- Importance of road safety, proposing the installation of speed rumps on access roads to prevent over speeding.
- Sensitization of truck drivers to adhere to speed limits.
- Use of road warning signs to alert drivers.
- Implementation of dust suppression methods for dust suppressions
- Supply of nose masks to community members as protective measure for air pollution if need be
- and requested nose masks for protection.
- Use of reflectors to improve visibility for motorists.
- Effective dissemination of information to educate residents on road safety.
- Use of police officers at checkpoints to regulate traffic flow and ensure driver safety.
- The presence of firefighting officers on standby for emergencies was also discussed.

With respect to the road development, VRA in 2023 had formal engagements with the Ghana Highway Authority and this fed into the submission of the associated cost for the road repairs. Evidence of communication between VRA and GHA is provided as part of Appendix 5. Indeed, during the stakeholder engagements, it was brought to the attention of VRA by the Assembly members that there were plans to upgrade the Okwenya Road through Akuse to Volivo and there is a need for further engagement with GHA to ensure smooth implementation. Subsequent, follow up telephone conversation by the Project Director with the Chief Executive of GHA has confirmed that there are no plans for constructing the Okwenya-Akuse Road. Rather, there are plans to construct the Western corridor road which will pass through the Asutuare Junction (on the Tema-Akosombo Road) to Asutuare and across the Volta River to the Volta Region.

5.5.Public Disclosure

Public disclosure of the EIS Report is critical to offer the stakeholders opportunity to become actively involved in the project. The provision of public disclosure documentations is to ensure accountability, transparency and more importantly extent the project consultations to stakeholders outside the project zone of influence in line with international best practice. Ghana EPA has developed various formats for the disclosure process and VRA is to ensure adherence. The disclosures are to be made in most widely circulating newspapers in Ghana and the communities, in this case the Ghanaian Times and Daily Graphic.

The coordination of an **"Advertisers' Advertisement"** for the public disclosure is the responsibility of the VRA, and a sample document is provided in Appendix 5. The VRA would ensure that the EIS Report is available on the VRA Corporate website at www.vra.com for easy access. Similarly, VRA will make available the Draft EIS document for disclosure by EIB in line with funding requirements. In addition, hard copies will also be made available at the VRA Engineering Services Department and the Environment & Sustainable Development Department, both in Akuse as well as the Head Office Library in Accra. The EPA as part of their mandate is responsible for ensuring distribution to key agencies/stakeholders. In all cases, comments are to be provided to the VRA at the address, Tel. Numbers, or e-mail address as below. The comments received is to assist in decision-making in project implementation.

The Director,
Engineering Services Department
Volta River Authority
PMB 77, Accra, Ghana
www.vra.com
Contact Person: Project Director
Email: dengsd@vra.com
Tel: +233 (0) 30-221-8540 Ext: 3220

5.6. Next Steps in the Stakeholder Engagement 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 Draft EIS Report.
- Make available copies of the Draft EIS to the relevant stakeholders at relevant locations, notably the Lower Manya Krobo Municipal, Shai Osudoku District, North Tongu District and the Traditional authorities of Natriku, Torgorme, Akuse and Fodzoku communities.
- Engagement with Ghana Navy to agree on collaboration for the use of the landing site Akuse Watermanship Training Camp.
- Formal notification of the Lower Manya Krobo Municipal Chief Executive on the period for project commencement. The letter should be copied to the traditional authorities.
- Self-introduction of Contractor to the Lower Manya Krobo Municipal Chief Executive on arrival of onsite prior to project implementation.
- Self-introduction of Contractor to the traditional authorities and community leaders on arrival of onsite prior to project implementation.
- 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 the Ghana Highway Authority with respect to development of road infrastructure.
- VRA / Contractor to 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. VRA 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.
- Continuous engagement with the affected communities and stakeholders

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 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 EPA as part of project implementation reporting.

5.7. Grievance Mechanism

A key element in the planning of such projects is often the establishment of a formal grievance procedure, a standardized set of procedures to follow when someone has a complaint or a problem. It is particularly important to have a grievance procedure when it is likely that people will be affected by the implementation of a project. Grievance resolution procedures should therefore be put in place with the sole objective of minimising disputes that may arise in relation to the industrial actions and conflicts with community members.

Subsequently, the environmental management programme for the project is to include a procedure for receiving and acting upon complaints (Grievance Mechanism). Complaints will be carefully managed, prompt, and effective, and will form a key part of the reporting mechanism. The aims of the Grievance Mechanism (GM) are to:

- Build trust with local communities.
- Provide a credible process for consultation leading to fair and lasting results; and

- Identify and proactively manage emerging issues.

Specific issues addressed in the grievance mechanism include:
- Impacts on transport of boulders to project site
- Expected behaviour of Contractors working on the project.
- Updates on progress of project development, and
- Impact on developmental infrastructure.

The GM will apply to all activities throughout the project life. The key features of the grievance program are as follows:
- Acts as a central point for coordination.
- Provides well known multiple access points.
- Provides a mechanism for reporting back to the community.
- Provides a grievance log to monitor cases and improve organization; and
- Provides a mechanism for evaluating and improving the system.

5.7.1. Responsibility for the Grievance Mechanism

In Ghana, Assembly members represent their communities as legislative members of the District Assemblies. The Assembly member functions are defined in Section 16 of the Local Governance Act, 2016 (Act 936) and performance of these duties are essential for the Assembly's discharge of their deliberative, legislative and executive functions. Assemblymember as part of the stated functions are to take part in communal and development activities in the district. In view of this and for the project, the Assemblymembers as listed in Table 5-3 for the project communities have been consulted and requested to assist with project developmental activities, including grievance redress.

Table 5-3: List of Assemblymen of Project Communities

#	Community	Assemblymen	Contact No.
1.	Akuse	Frederick Kumah	024 277 5188
		Hon. Richard Azianke	024 223 1449
		Hon. Wise Keterwoo	054 400 9401
		Hon. Ibrahim	024 742 5938
		Hon. Amatey	024 164 2213
2.	Natriku	Hon. Ignatius Dodoi	020 909 1700
3.	Fodzoku	Hon. Apeletey Franklin	024 690 8084/053 693 6347
4.	Torgorme	Hon. Gabriel Akpaku	024 390 3644

The Assembly members are to serve as the first point of contact to channel all grievances to VRA for redress, especially related to land acquisition and compensations related issues. These persons shall form the Grievance Redress channel and would be 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 responsibility related to the application of the Grievance Mechanism falls under the Project Director, and the VRA Community Relations Officer (CRO) in Akuse shall coordinate all activities under the GM on his behalf. The CRO shall contact the various local Assemblymen as these persons has valuable information about the area and the communities. The responsibilities will include informing the impacted communities and project affected persons on the grievance mechanism, recording grievances raised, both written and oral, categorising them and seeking solutions within a specified time period; co-coordinating information with relevant stakeholders and the internal responsible Managers; maintaining regular contact with complainants and other stakeholders to investigate and report progress regarding their grievances and ensuring momentum towards resolution; and setting up and maintaining a systematic process for recording grievances;

Good relations with Interested & Affected Persons (IAPS) need to be established and sustained. This will help in the solving of problems and the prevention thereof. Lines of communication should always be open to ensure proper and timeous reaction to complaints. The contact numbers of the Project Director, CRO and Contractor shall be made available to the Assembly members and the IAPs. The reputation of both the Contractor and VRA is at stake and should be the drive for everybody involved to perform in excellence.

5.7.2. Process for receipt and response

The procedures for receipt and response to grievances will enable them to be addressed satisfactorily and in compliance with Ghanaian Law and the best practice. The grievance mechanism includes:

- Provision for communication of grievances to VRA via letters, internet, a logbook to be left at the office of the CRO at Akuse, and/or periodic meetings where grievances can be raised.
- Provision for communicating to the public an update of project activities and actions taken in response to grievances, for example via the meetings cited above, as well as advertisements in local newspapers or on local radio; and
- Response to any complaints or concerns raised through the grievance mechanism within a week at the most.

VRA under its Community Development Programme holds periodic engagements with the traditional authorities within its area of jurisdictions. These and other planned forums are to be held to discuss project progress and hear any grievances that residents may have, as required. Grievances shall also be accepted from workers at the site via the logbook. The grievance procedure is as follows:

- Any grievance or dispute should be brought in the first instance to the Assemblymembers.
- The Assembly members will use their discretion regarding whether and how to involve local/traditional authorities in resolving a dispute. It is possible that a dispute involves, or is against, local/traditional authorities.
- Whether or not traditional/local authorities are consulted, the Assembly member will attempt to resolve the grievance within 21 days, with support from the CRO, if necessary: and
- Only in cases where resolution cannot be resolved locally within 21 days, and as a last resort, will the matter be referred to the local/ traditional authorities for resolution.

In the acknowledgment and receipt of the grievances, VRA Project Management Team will respect the following procedural steps outlined in *Table 5-4*:

Table 5-4: Process for Grievance Mechanism

Step	**Grievance Procedure**
Step 1: Confirm Receipt of Grievance	• Receipt of grievance by CRO in writing within 7 days. • Confirm Notification letter to give reference number, summary of grievance, name, and contact details of Project Director.
Step 2: Investigate Grievance and Seek Resolution	• CRO and Project Director to meet complainant within 14 days. • Meeting may also involve the Assembly member and or local chief (traditional authority). • If not resolved within 7 days of the meeting, Project Director is to inform relevant third parties/state actors
Step 3: Involving Project Director, third party authorities when required:	• Identify parties to be involved - VRA, Assembly member, State actors, etc. • Aim to resolve the grievance with Project Director within 14 days of meeting in Step 2. • Aim to resolve the grievance within 30 days of meeting in Step 2 if local authorities or any state actors involved in resolution. • If third parties involved in resolution, assist claimant in writing a letter to such parties about their grievance. • Facilitate meeting between all relevant parties and claimant to resolve grievance;
Step 4: Close Out	• Corrective action documented and formally closed out
Step 5: Follow Up	• Project Director to ensure actions agreed have been undertaken by following up with individual / group who raised grievance (within 3 months)
Step 6:	• If unable to be resolved, Project Director. to inform individual / group

Step	Grievance Procedure
Legal Redress	of right to take legal action, in line with the Alternative Dispute Resolution Act 2010 (Act 798) • Document advice given and legal outcomes; and • Share documentation with VRA Legal outfit.

6 ANALYSIS OF PROJECT ALTERNATIVES

6.1 Overview

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. Thus, as required, during the entire stage of the project preparation, comprising of screening and detail design preparation, various alternatives were identified in terms of both design and equipment and analysed to help in decision making.

In this respect, alternatives considered in the selection of the relevant project facilities and equipment has been provided, including the 'No Development' alternative which is the option of not implementing the project. Discussions, as listed below, have focused on the dyke rehabilitation works as this is the major component of the project with alternatives considerations:

1. No Development
2. Conceptual Designs of Remedial Measures
3. Route Selection for Transportation of Aggregates
4. Landing Sites at Waterfront of Kpong Dam

6.2 No Development Alternative

If the project is not embarked on, the dykes will remain in its current state. There will be no need to undertake the repairs of the coarse rockfill displacement and benching of the upstream slope of the East and West Dykes and River Dam of the KGS. The requirements for boulders and related truck movements resulting in traffic, health and safety impacts will not occur, however, these boulders are for sale and could be utilised by other contractors for different projects. In addition, the associated road rehabilitation works won't be undertaken, and the social benefits unrealised.

It must be noted that the present revetment at the upstream slope, based on geotechnical analyses, does not meet stability requirements. If the remedial measures are not undertaken, then the displacement of the coarse rockfill will continue and undermine the stability of the dyke and could lead to a dam failure, with its concomitant disastrous effect on power generation, downstream population, livelihoods, and the economy in general. The associated environmental, economic, employment and political/social benefits as summarised under Section 1.5 will not be derived. Thus, the No Development Alternative does not represent an option that ensures the sustainability of the dam and of the safety of the population downstream of the dam and is proposed that the project proceeds.

6.3 Conceptual Design of Remedial Measure

Geotechnical and hydraulic analysis has been carried out for the upstream and downstream faces of the structures, and the results showed that the downstream faces were found acceptable and required no remediation. However, the upstream face did not meet the requirements of current standards and therefore requires remediation. Based on the project planning and design, it was noted that the objective for any remedial work is to present a robust measure that would improve the upstream slope condition and stability compared to the original situation, as the current slopes have proven not to be stable.

The conclusion was that the philosophy of any proposed design should aim at:

- Making the slope less steep by constructing the face to 1:2.5.
- A design lifetime of at least 50 years.
- A design with minimal maintenance.
- An improved geotechnical safety factor FoS of 1.5 in comparison to the FoS of 1.4 of the original design.

Options such as gabions around the waterline or concrete revetments with geotextile as filter material are far more difficult to execute, expensive and limited in lifespan and these were not considered.

In view of the above, any possible identified measures (alternatives) should be in line with the original design and can extend the lifespan significantly based on the proposed design philosophy. Five remedial options were identified with its advantages and disadvantages, and a brief on this is outlined in

Table 6-1. The Remedial Alternative 3 has been selected as the preferred remedial measure for the dyke's rehabilitation based on a sound level of safety, adequate constructability, and the most cost-effective choice assuming that the grading of the boulders and construction tolerances of rock works are similar as in the past. Designing with above considerations results in the use of a fair amount of rock volume, though with relatively low project risks. Extensive monitoring, strict rock grading specifications and the application of new construction methods are avoided in this way.

Table 6-1: Selection of Remedial Options for the Rehabilitation Actions

Remedial Measure Alternative	Advantage	Disadvantage
Alternative 1		
Removing loose boulders and ▪ Overlaying (placing with excavator-bucket from barge)	• Less expensive to implement because some volumes of boulders would be needed.	• Not cost effective • Does not achieve proposed slope of 1:2.5 and does

Remedial Measure Alternative	Advantage	Disadvantage
a new filter layer within exposed or compromised sections. ▪ Placement of a new layer of boulders (with the right grading to get interlocking), including a new toe structure.		therefore not improve the stability of the dam. • A design life span of minimum 50 years is not achieved. • Not a desirable alternative
Alternative 2		
1. Provision and dumping of additional boulders from the crest of the dam as was done during construction to fill up the slumped slope just above the water line. 2. Provision and installation of rockfall nets on top of the boulders with the net extending some few meters into the water.	• Relatively less expensive option to implement as less volume of boulders would be required to dumped.	• The option does not offer much protection to the failing filter layer. • The lifespan of this alternative is also limited to less than 30 years. • Placing the net below the water would pose challenging. • Not a desirable option
Alternative 3 (Preferred)		
Removing loose boulders and dumping of additional boulders to achieve a gentle slope (1:2.5) from the crest of the dam and from a barge. A new toe structure would be required to be constructed prior to the dumping of the boulders.	• Option is the robust choice as it improves on the stability of the dam. • Offers ease and speed in construction. • Most cost-effective since the grading of the boulders and construction is like one deployed during construction. • Extensive monitoring, strict rock grading specifications and the application of new construction methods are avoided in this way. • Desirable option	• Relatively expensive option as it requires the dumping of more volumes of boulders to achieve a gentle slope of 1:2.5.
Alternative 4		
Removing loose boulders and dumping new boulders (from the crest) at locations with observable damages. Work to be undertaken over the years till a gentle slope of 1:2.5 is achieved.	• Low cost to implement as work can be planned in phases over many years.	• Given the general state of the dykes this option is not viable. There are no sections without severe damages. • Cost to implement would be high due to the expected high cost of mobilization and demobilization over the years until completion.

Remedial Measure Alternative	Advantage	Disadvantage
		• Not a desirable option
Alternative 5		

6.4 Route Selection for Transportation of Boulders

From discussions under Section 3.4, three major routes are available for the transportation of materials to both the east and west dykes and any of these can be selected for the project activities. These are the:

Alternative Route - Option 1:
The asphalted 1.7km access road to the KGS and by extension to the east and west dykes of the dam; the road is located on the left of the cross junction, approximately 8km from the Okwenya Junction to Akuse Road, shown in **Plate 3-2**.

Alternative Route - Option 2:
The 3.7km unpaved road leading to the West Dyke and running through the Natriku Community, about 7.5km off the Okwenya Junction to Akuse Road. This road also leads to the possible waterfront landing sites for the offloading of the boulders (See **Plate 3-3**).

Alternative Route - Option 3:
17km Juapong to Akuse Road, off the Atimpoku - Juapong Road, to the East dyke of the Dam

Boulders and other materials required for the works are expected to be delivered from the Shai Hills along the Tema - Akosombo N2 Highway. In view of this, the Okwenya Junction to the Akuse road presents the most feasible option and therefore access through the East Dyke from the Juapong–Akuse Road as indicated in Alternate Route Option 3 is not considered. Therefore, Alternate Routes 1 and 2 are considered and will be based on the methodology to be adopted by the contractor for the placement of the boulders. As indicated earlier, placement of the boulders is to be done with an excavator either from the barge and or from the crest of the dykes. If an excavator is to be placed on a barge for placement, access to the waterfront landing site will be required.

The advantages and disadvantages of the use of the two other alternative routes are outlined in **Table 6-2**. Based on considerations, the asphalted 1.7km access road to the KGS (Alternate 1) will be the preferred option if the placement of boulders is to be done from the crest of the works. However, if the placement is to be done from the floating barge, then the 3.7km unpaved road through the Natriku Community (Alternate 2) will be the preferred choice as it leads directly to the waterfront, where we have the landing sites for the offloading of the boulders onto the barge and avoids the use of the crests. Despite the unpaved nature of the road, mitigative measures could be put in place to minimise the impact of air quality, public health, and safety. Effective stakeholder engagement would be required to avoid community disturbances. This route will also avoid the already asphalted Akuse road and any related damages to the road due to the load of the heavy trucks. Any associated road rehabilitation on the unpaved road will ensure a lasting social benefit from the project.

Table 6-2: Selection of Routes for Transportation of Boulders

Advantages	**Disadvantages**
Alternative Route - Option 1:	
• Provides access to the west and east dyke crest as well as the landing sites at the waterfront. • Asphalted road and so impact on air quality is minimised. • VRA Private property and can be utilised without any community disturbances. • Transportation of aggregates can be done smoothly all through the year due to the quality of road, which would not require any rehabilitation at project onset. • Relatively shorter distance to the dykes	• Possibility of damage of asphalted road and associated cost of repairs. • Increase in traffic density presents public safety and traffic impact issues since it's a throughfare and mitigative measures are required.
Alternative Route - Option 2	
• Provides access to the west and east dyke crest as well as the landing sites at the waterfront. • Leads directly to the waterfront and therefore avoid the potential of causing damages to the asphalted road. • Better option if placement of boulders is to be done from a barge. • Any associated road rehabilitation on the unpaved road will ensure a lasting social benefit from the project.	• Unpaved nature of the road could lead to significant impact on air quality and health related issues if effective mitigation actions are not in place. • Increase in traffic density presents public safety and traffic impact issues since it's a throughfare and mitigative measures are required. • Nature of the action could result in community disturbances due to continuous presence of heavy trucks within the Natriku Community, and stakeholder engagement during this phase is critical to avoid this. • Unpaved nature of road could present transportation challenges during the wet season, and there will be the need for some rehabilitation works with associated costs. • Damage to the unpaved roads and associated cost of repairs.

6.5 Waterfront Landing Sites

As indicated earlier, placement of the boulders is to be done with an excavator either from the barge and or from the crest. Therefore, based on the methodology to be adopted by the contractor for the placement of the boulders, a landing site at the waterfront needs to be accessed for the offloading of the boulders onto a barge. Such locations should be easily accessible by road and should have shallow water depth to allow for the assembly of the floating barge. Currently, there are two already available landing sites with such characteristics that can be accessed at the project area, and both are VRA's properties and can therefore be utilised for this purpose, and these are.

Landing Site Option 1:

Natriku landing site is utilised by the community for fetching water, washing, and for berthing of canoes for the fishing activities (**Plate 6-1**). This site therefore serves as a key area that supports the livelihoods of the community members.

Landing Site Option 2:

Watermanship Training Camp, within the security zone of the 48 Engineering Training Scholl of the Ghana Navy (See **Plate 6-2**). This site is occupied by the Ghana navy with access restrictions.

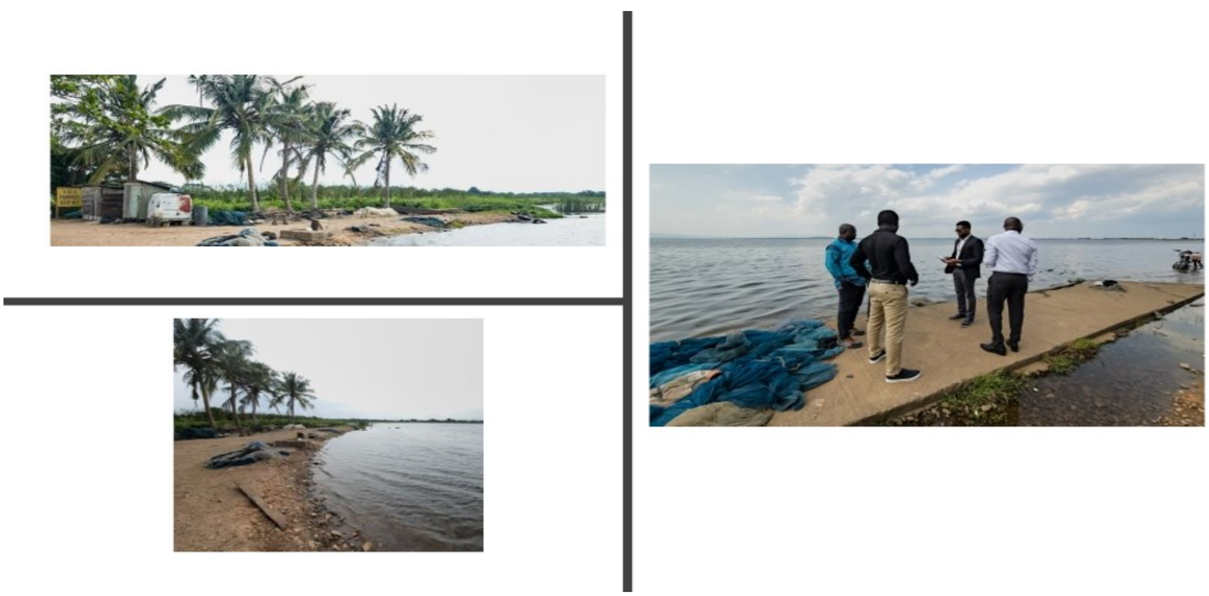


Plate 6-1: Natriku Landing Site

Plate 6-2: Landing Site at Watermanship Training Camp

The advantages and disadvantages of the use of the two other alternative routes are outlined in **Table 6-3**. Utilising Option 1 will mean the temporal takeover of the existing landing site at Natriku during the 18 months period and relocation which would involve the construction of a new landing site (including access road) at a suitable place to the north of the existing facility, i.e., beyond the Navy camp (Watermanship Training Camp). The use of Option 2, within Watermanship Training Camp is preferred since this area is restricted and will not conflict with community livelihood actions. VRA will need to communicate and schedule the works to ensure it doesn't interfere with the training programme of the Ghana Navy, and this shall form part of the stakeholder engagement exercise prior to commencement of actual construction.

Table 6-3: Selection of Alternate Landing Sites for Barge Works

Advantages	**Disadvantages**
Alternative Landing Site - Option 1: **Natriku Landing Site**	
• VRA owned property and no need for land acquisition. • No restricted access and the site are available for use by VRA.	• Temporal takeover of the existing landing site and could result in conflict with community members. • May involve construction of new landing site with associated costs
Alternative Landing Site - Option 2: Watermanship Training Camp **(Preferred)**	
• VRA owned property and no need for land acquisition. • Restricted access with no community interference if utilised	• Restricted access and may conflict with actions of the Ghana Navy, and this will call for stakeholder engagement and effective collaboration

Advantages	Disadvantages
• Will not conflict with community livelihood actions so there will be no need to develop a temporal landing site, with associated costs	

7 IMPACT IDENTIFICATION & PREDICTION

7.1 Overview

As required under the Ghana EA Regulations, the EIA process is expected to identify and discuss the potential impacts, both positive and negative, of the proposed development that occurs during the various phases of the development. For this project, the key issues and impacts have been identified via assessment of the project components, site visits, the environmental status quo of the receiving environment, issues and concerns raised by key stakeholders during the consultation process, as well as available information about the environmental effects of similar developments and infrastructure. This Chapter therefore outlines the assessment methodology and provides detailed information on the potential positive and negative impacts of the project during the various phases of the project.

7.2 Generic Approach to Impact Assessment

To identify the potential impacts, it is important that the nature of the proposed project is well understood so that the impacts associated with the projects can be assessed. In accordance with the Environmental Assessment Regulations LI 1652 (1999), 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.
‘

Based on this, a simple, clearly defined method guided by the Leopold Matrix has been used to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment[6]. The methodology for the predication and assessment of impacts under this EIA Study is provided in Table 7-1[7]. It must be noted that the concept of *“irreplaceable loss of a resource”* is to be considered in the Potential Intensity score of an impact. Again, the concept of “reversibility” is reflected in the duration scoring. i.e., the longer the impact endures the less likely it will be reversible.

Table 7-1: Methodology for Prediction & Assessment of Impacts

Prediction Attribute	Rating	Score
Potential Intensity Description (negative)		
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 sever 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-	2

[6] EIA Technical Review Guidelines: Energy Generation and Transmission, US-EPA/CAFTA-DR, Volume I, July 2011

[7] EIA for Wind Energy facility in Anloga Extension (WPP1), Jan. 2019

	Low	
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
Spatial Extent Description		
Site specific		1
Local (<5 km from site)		2
Regional (within 50 km of site)		3
National		4
International/Global (e.g., Greenhouse Gas emissions or migrant birds).		5
Duration Description		
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 implementation of appropriate mitigation and management actions.		3
Long term (> 15 years but where the impact will cease after the operational life of the activity). The impact is reversible with the implementation of appropriate mitigation and management actions.		4
Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient). This impact is irreversible		5
Probability Description		
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

7.2.1. Risk/Impact Significance

To determine the significance of an identified impact/risk, the consequence is multiplied by the probability, and this provide information if the impact can cause a notable alteration of the environment.

*Significance Rating = Impact Magnitude (Potential Intensity + duration + extent) * Probability*

Table 7-2 shows the scores and their significance of the ratings of negative impacts/effects, and is colour based to guide easy appreciation.

Table 7-2: Significance Ratings of Project Negative Impacts

Scoring	Significance Rating	Description
18-26	Fatally Flawed	The project cannot be authorised unless major changes to the engineering design are conducted 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 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.

7.2.2. Mitigation and Assessing Residual Impacts

As specified in Section 12 of Part II of the EIA Regulations, appropriate mitigation measures are to be identified to eliminate, minimise, or manage identified potential significant environmental effects. Impacts are to 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 EIA team will identify suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the Project design 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 8 of this EIA Report.

7.2.3. 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 9 under Provisional EMP.

7.2.4. Dealing with Uncertainty

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.

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. Impact significance involves a process of determining the acceptability of a predicted impact to society.

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’) to identify the broadest range of residual impacts and necessary mitigation measures.

7.3. Project Positive Impacts

The major positive impacts of the project that shall occur at various phases of the project is detailed below. Such positive impacts are important to highlight and considered before investigating the potential negative environmental and social impacts anticipated from the project. The positive impacts are:

- Increased in Employment Opportunities.
- Stabilization of Electricity
- Reduction of Exposure to flooding
- Production of low carbon electricity

- Promotion of Economic Growth in the Country

Except with "**Increased in Employment Opportunities,"** it must be noted that there are no positive impacts during the pre-constructional and constructional phases of the other issues as they can only be realised when the rehabilitation exercise is completed and operational.

7.3.1. Pre-Constructional / Constructional Phases

7.3.1.1. Increased Employment Opportunities

Various activities have been undertaken at the pre-constructional phase that has required some form of employment opportunities with related payments. This included the project planning and designs studies that have been undertaken by various consultants and the EIA Study done inhouse by VRA. It must however be noted that all these opportunities were to persons 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 and details of the direct work force have been outlined in Section 3.12.

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 to the local people, including women. 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. The duration of the employment will however be within the construction period of four years, and therefore of a short term.

Aside the spatial extent being international, the impact of employment opportunities created during pre-construction/ construction will be definite, the duration will be short term and at a high confidence level, the impact can be described as **MEDIUM POSITIVE,** as shown in **Table 7-3**.

Table 7-3: Summary of Positive Impacts at Preconstruction/Construction Phase

Nature of Positive Impact	Potential Intensity	Spatial Extent	Duration	Probability	Impact rating	Impact Significance
Increase in Employment Opportunities	Medium Low	Global	Short Term	Definite	9	MEDIUM POSITIVE

7.3.2. Operational Phase

7.3.2.1. Increased Employment Opportunities

There is not expected to be any additional direct employment during the operational phase. The VRA O&M Team currently in place shall continue to be responsible for the project. However, the project shall ensure continuous electricity availability to help businesses which are often constrained by a lack of reliable power to produce more, consume more inputs from other sectors, and hence create additional employment, both locally and internationally.

Thus, looking at the opportunity and numbers involved, the potential intensity on employment is medium, spatial extent is international and of long-term nature in duration and most probable to occur. The impact is assessed as **MEDIUM POSITIVE** in nature.

7.3.2.2. Stabilization of Electricity

With 160 MW power production capacity, Kpong dam represents 12% of the country's hydroelectric production. The proposed rehabilitation works is estimated to consolidate hydroelectric production at KGS by at least 25 years, at a lower cost at a time when Ghana needs to rebalance the financing of its electricity sector. This shall lead to more reliable electricity generation, minimizing outages and providing a steady power supply to consumers both in and outside Ghana. Consistent electricity supply improves the quality of life for residents by powering homes, schools, hospitals, and public services and this benefit will not only be local but also with the country’s export market. Reliable energy supply can encourage balanced regional development by supporting industries and services both within and outside the country. This reduces regional economic disparities and promotes inclusive growth. It also supports advancements in technology and communication.

As indicated, the project aligns with Ghana’s most urgent needs in the energy sector and complements the programmes targeting technical and commercial losses to address the issues impairing the sustainability of the sector. With regards to stabilisation of electricity, the potential intensity can be described as medium, spatial extent on the international level due to the export market, and the duration is long term. Stabilisation of electricity can be described to be definite and at a high confidence level, assessed as **HIGH POSITIVE.**

7.3.2.3. Reduction of Exposure to Flooding

Due to climate change-exacerbated rainfalls, flow regulation by dams will play a crucial role to reduce the average number of people exposed to flooding below the dam but also to protect the power station itself, which has been recently renovated. This action will allow additional necessary works on the Spillway gates and the dykes, to ensure the safety of the dam and of the population surrounding the dam. Properly functioning dykes and spillway gates are essential for controlling water flow and preventing floods.

The dykes and spillway gates play a role in managing water levels and flow and it's expected that the rehabilitation works will help reduce flooding impacts on the downstream population due to heavy rains and spillage from the dam. This is achieved through:

a) Enhancing the structural integrity of the dam, dyke, and spillway, and this can enhance its resilience against extreme weather events, such as heavy rains and droughts, which are becoming more frequent due to climate change thus reducing the risk of failures.
b) Improving the management of water resources, reducing the risk of flooding downstream and ensuring better water availability during dry seasons.

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With respect to the reduction of exposure to flooding, the potential intensity is seen as medium low, spatial extent to be regional and the duration is long term. Reduction in exposure of flooding can be described as definite and at a high confidence level, with a **MEDIUM POSITIVE.**

7.3.2.4. Production of Low Carbon Electricity

KGS as a hydropower facility is a renewable energy source, and stabilizing its production can reduce the need for fossil fuel-based power plants, thereby lowering greenhouse gas emissions and contributing to climate change mitigation. The KGS Rehabilitation Project 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 which results from fossil-based power facilities.

Indeed, the underlying intervention logic for the rehabilitation works is that if all the 15 spillway gates are rehabilitated and the 2 dykes improved, and the standard operations procedures on the spillage is revised, then the life span of the dam will improve allowing continued 160 MW capacity of green energy production for the next 25 years. With a more stable and efficient hydropower facility, there is a reduced reliance on alternative, often less sustainable, energy sources. This contributes to energy security by ensuring a consistent and renewable source of electricity. By consolidating hydroelectric production, the action paves the way to the clean and just energy transition planned by Ghana and the European Union thus contributing to a greener economic recovery.

The potential intensity of the rehabilitation works achieving a low carbon electricity by ensuring the minimisation of GHG emissions can be described as very high, the spatial extent is global in nature as low carbon help in the reduction in the Global GHG emissions, with the over 25 years duration extension defined as long-term as it will continue as the KGS is in operation.

Thus, at a high confidence level, the significance of the positive impact of the production of low carbon electricity 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 and beyond during operations.

7.3.2.5. Promotion of Economic Growth in the Country

The associated positive impacts with the rehabilitation of the dykes and spillway gates of the Kpong Generating Station described earlier can all boost the country's economic growth. Stabilized power supply can attract investments (both local and foreign), stimulate industrial growth, and create job opportunities. Improved dam infrastructure protects agricultural lands, residential areas, and infrastructure from flood damage, reducing economic losses and ensuring the safety of communities. This will boost agricultural productivity and food security, further contributing to economic growth.

The rehabilitation project itself can create jobs, both during the construction phase and for ongoing maintenance. This can provide a boost to the local economy through increased employment and spending. The project may also involve training and skill development for local workers, which can have long-term benefits for the workforce and contribute to the overall economic development. With more reliable electricity, public services such as healthcare, education, and transportation can function more effectively, leading to improved quality of life and contributing to human capital development, which is crucial for economic growth.

In summary, the rehabilitation of the dykes and spillway gates at the Kpong Generating Station can be a catalyst for economic growth in Ghana by ensuring a stable energy supply, supporting industrial and agricultural activities, creating jobs, and contributing to the overall development of the region. At a high confidence level, the impact of the project in the promotion of economic growth during the 20 - 25 years of its operations can be said to be **MEDIUM POSITIVE** as it is national and of long term in nature and definite.

Summary

A summary of impact ratings of positive impacts at the Operational Phase is provided in **Table 7-4**, with an average significance rating assessed as **HIGH POSITIVE** confirming the need for project implementation.

Table 7-4: Summary of Positive Impacts at Operational Phase

Nature of Positive Impact	Potential Intensity	Spatial Extent	Duration	Probability	Impact Rating	Impact Significance
Increase in Employment Opportunitie s	Medium Low	International	Long Term	High Probable	8.25	MEDIUM
Stabilisation of Electricity	Medium -	International	Long Term	Definite	13	HIGH
Reduction of Exposure to flooding	Medium Low	Regional	Long Term	Definite	9	MEDIUM
Production of low carbon electricity	High	Global	Long Term	Definite	17	HIGH
Promotion of Economic Growth in the Country	Medium Low	National	Long Term	Definite	10	MEDIUM
		AVERAGE			11	HIGH

7.4. Project Negative Impacts

Project actions at the construction stage have been described under Sectio 3.8 and includes civil, mechanical, and electrical works. Generally, with respect to the dyke's rehabilitation, the works will involve the hauling of materials, equipment installation (including a barge and excavator on the Kpong Headpond), excavation works, transportation of boulders and boulders over about 35 km, strengthening or reconstructing sections of the dykes to enhance their structural integrity and prevent breaches. The Spillway Gates Rehabilitation will involve the overhauling the spillway gates, including the mechanical and electrical components, to ensure they function optimally, and repairing or replacing the hoisting mechanisms, motors, and control systems of the spillway gates. All such works are to be done within the confines of the KGS. Additional works is required to reinforce or rebuild the foundations of the dykes and spillway gates as needed to support the rehabilitated structures as well as upgrading or installing new automation systems for better control and monitoring of the spillway operations.

Assessing the above actions, the negative environmental impacts of these activities are mostly localized and temporary. There is no land acquisition associated with the entire project. Both occupational and public health and safety issues will be paramount. The potential for negatively impacting on the identified and environmental and social receptors, especially within the 5km of anticipated immediate project impact area, during this phase is discussed below. Impacts that are accessed as being "**VERY LOW NEGATIVE"** are screened out and no further mitigation measures recommended.

7.4.1. Preconstruction Phase

Pre-construction phase activities that have already been completed include the conduct of feasibility studies, involving a comprehensive assessment of the current condition of the dykes and spillway gates to identify structural deficiencies, wear, and areas needing reinforcement.as well as relevant hydrological and geotechnical surveys. It also includes this EIA Study to understand and mitigate any potential negative environmental impacts of the rehabilitation activities. Other activities that still need to be completed are the preparation of detailed engineering designs for the rehabilitation work, including structural modifications, materials selection, and construction methodologies, followed by the procurement of contractors for the works.

There is no land acquisition associated of the project. The 1.534 Ha hectare land which will be temporarily used during construction for temporary facilities, (i.e., storage yard, vehicle and equipment parking area, sandblasting, minor repairs, corridors, and easements) is owned by VRA. Due to the extent of flooding experienced under the 2023 controlled spillage, the key impact at this stage will be general apprehension by the public about the structural integrity of the dam, possible loss of access to lands, access to employment opportunities as well as water supply/irrigation interruptions and this may lead to speculations and adverse perceptions about the project and to conflicts. There is therefore the need for an effective stakeholder engagement process throughout these phases to address these concerns and to provide opportunities to input into the design and plans of the project. The level of stakeholder engagement undertaken at this stage has been discussed under Chapter 5 of the Report.

The potential intensity of such general apprehension by the public is expected to be high, **spatial extent** regional in nature with most of such people being those living within along the Kpong Headpond and downstream, temporal in nature and since there is a high probability of this occurring, the impact can be assessed to be **MEDIUM NEGATIVE,** as shown in Table 7-3.

Table 7-5: Summary of Negative Impacts at Preconstruction Phase

Nature of Negative Impact	Potential Intensity	Spatial Extent	Duration	Probability	Impact rating	Impact Significance

General Apprehension by Public	High	Regional	Temporal	High Probable	9	MEDIUM

7.4.2. Constructional Phase

7.4.2.1. Physical Environment Risks & Impacts

a) Impact on Climate Change

Both the Ghana EIA Regulations (LI 1652) and the EIB ESS recognizes the need for the EIA exercise to address climate change by reducing GHG emissions during project implementation. In addition, the ESS Standards requires projects to build the resilience and adaptive capacity of people, nature, and assets to cope with current and future climate change-induced impacts, and such information are clearly distinguishable and identifiable in the EIA report.

For the KGRP, associated construction activities leading to fossil fuel consumption and emissions from transport can contribute significantly to GHG emissions and have broader implications for climate change. The use of heavy machinery and equipment such as excavators, bulldozers, and trucks typically rely on diesel or gasoline, leading to CO_2 and other GHG emissions. Again, the transporting of boulders and other materials to and from the construction site, particularly if they are sourced from long distances, also contributes to GHG emissions.

Land clearing activities during construction can result in the loss of vegetation, which acts as a carbon sink, and these releases stored carbon into the atmosphere and reduces the landscape's capacity to absorb CO_2. For this project, it is considered that emissions from removal of herbaceous vegetation on the surface of the dykes during the construction is insignificant and hence GHG sequestration that will be lost annually can be neglected.

Debris and waste generated during construction, if not properly managed, can result in methane emissions, especially if disposed of in landfills. Implementing strategies to recycle or reuse materials can reduce the carbon footprint associated with waste management, and this is discussed under the section of waste management. Associated supply chain, including the extraction, processing, and transport of raw materials, contributes indirectly to the overall GHG emissions. Again, the rehabilitation of the dyke might alter the dam's operational efficiency or hydrology, which can influence downstream ecosystems and potentially affect the dam's overall contribution to GHG emissions.

As indicated, boulders will be sourced from the Shai Hills area, a total distance of about 70km to be covered by each truck per trip, and a total of 7500 trips expected to be made within the 18 months period of project construction of the dykes. An excavator located on a floating barge or on the dyke is to be utilised for the placement of the boulders. It is also expected that about three new pickups will be acquired for use by the contractors during the dyke rehabilitation works whilst 2 pickups will be used during the spill gates repairs. Based on these assumptions and using the Greenhouse Gas Protocol Mobile Combustion GHG Emissions Calculation Tool, Version 2.6 adopted by the VRA, a total 1299.491 Tons CO_2e of GHG emissions is estimated from vehicular emissions and excavator use during the constructional phase. Assumptions used in arriving at this estimation is provided in Appendix 6a.

With 1299.491 Tons CO2e of GHG emissions over a four-year period, 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.**

b) Increase in Ambient Noise & Vibrations

Noise is generated mainly from excavation and earth filling activities by equipment, transport vehicles, etc. Temporary increases in noise levels along truck delivery routes would also occur. Noise levels will also be affected using welding, grinding, cutting and excavator machinery during the construction. The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. It can affect workers in the working areas harmfully and causes discomfort for people who live in neighbouring regions. Exposure to high level of noise for a long time will lead to decrease of audibility, fatigue, stress, insomnia as well as reducing labour productivity; if people bear too noisy level continuously for 8 hours and lasting for many years, they may be influenced as blood pressure increase, nervous system, and occupational deafness disease, etc.

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. 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 and these have been indicated in **Table 4-5**. 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 accomplished through such guidance and legislation and is normally implemented by the EPA.

It is 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. An assessment of noise levels based on routine monitoring and site survey has been undertaken to identify impacts of noise from the proposed project. Noise levels were all within the permissible EPA values. The noise levels were influenced by moving vehicles in the project area. Due to the site specificity of the rehabilitation activities, which will be confined to the premises of the Kpong dam, noise generated from constructional activities will mostly be confined within the project site and will affect the workers mostly. It is not expected that communities outside the project site will be affected in any way.

Table 7-6 outlines the possible equipment used in the general construction industry 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 for residential areas within 500 m from the activity or piece of operational equipment. As shown in the **Table 4-1**, the sensitive infrastructure to the KGS is located within the neighbouring townships of Akuse, Natriku and Fodzoku Communities with the nearest facility being 1.9km away and therefore, aside vehicular noise, noise and vibrational noise from the rehabilitation works will have very little effect on the community members.

Table 7-6: 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
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					

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
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
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

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
	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 the N2 Highway will not have any impact on traffic noise as the highway already has heavy vehicular movements. An estimated number of twenty-eight trucks per day is expected for a year duration whilst official pick-ups, not exceeding five (5No), will be available for use by the project, comprising of contractors, consultant and the VRA team during the four-year period. The key issue with traffic noise will be the daily traffic movements of trucks with boulders along the Okwenya-Akuse and the Natriku Road if selected as the alternative. Community members have raised such concerns during the stakeholder engagements exercise. The potential therefore exists for impacts to be felt by commuters along this access routes due to this change, especially for the community members along the stretch. It is expected that total traffic volumes due to delivery requirements for workforce and materials will be restricted to daytime only, and relevant signages and road safety measures put in place, including the use of the police, if required.

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**.

c) Degradation of Air Quality

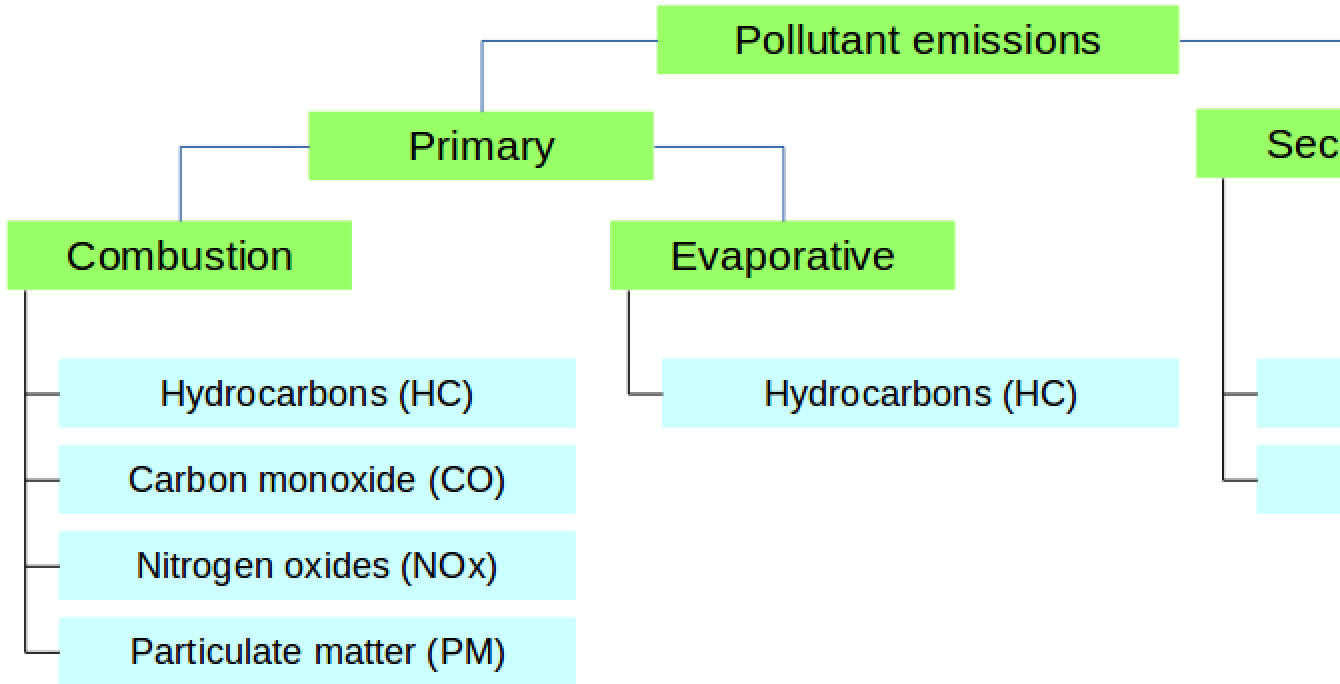
Air quality is the highest priority of site management with respect to worker health and safety and impacts on neighbours and the public when it comes to such major constructional works. Of key interest are activities that lead to dust generation which can significantly impact ambient air quality. For the KGRP, activities such as transport of boulders, stockpiling, excavations, movement of earth materials, and other construction activities can lead to the generation of significant amounts of dust, which can degrade air quality. Welding fumes are also expected from welding operations during construction works, and this will be typical for the spillway gates repair works.

Impacts from particulate matter emissions are related to its size (e.g., whether it is less than 2.5 microns in diameter), its main impurities and components (e.g., silica, silicates, carbonates, asbestos). Inhalation of dust particles can cause respiratory and cardio-vascular problems, as well as eye and skin irritations. Dust settling on soil and water bodies can lead to contamination, affecting plant growth, water quality, and overall ecosystem health. High dust levels in the air can reduce visibility, contributing to hazardous driving conditions and affecting general outdoor visibility. Prolonged exposure to poor air quality can lead to respiratory issues, particularly in vulnerable populations such as children, the elderly, and those with pre-existing conditions. Dust and odors from the site can become a nuisance for nearby communities, potentially leading to complaints or even health-related issues.

Dust emissions are exacerbated by dry weather and high wind speeds as the impact of dust depends on the wind direction and the relative locations of dust sources and receptors. Thus, any work schedule during the dry season in the project area, from December through March, could result in the wind picking up as loose earth and construction materials thus spreading particulate matter over a wide area. In the wet season, April – August, it is likely that the regular and intense rainfall in the area would significantly reduce the frequency and severity of impacts from to dust generated by the works, by maintaining an elevated level of moisture within exposed soils and by washing deposited material from surfaces.

The use of various vehicles and machinery during project development can also result in the releases of various type of pollutant emissions as shown in Figure 7-1. Vehicle exhaust emissions such as Carbon Monoxide (CO), Nitrogen Oxides (NOx), Sulphur Oxides (SOx) and fugitive hydrocarbons will also result from use of vehicles transporting material to and from the site. The airshed over the project area at KGS is not considered to be degraded given the rural nature of the project area. From the airshed monitoring programme, the existing pollutant concentrations of $PM_{2.5}$, PM_{10}, CO, NO_2 and SO_2 were found to be well below relevant national standards. Except $PM_{2.5}$ and PM_{10}, which were relatively high along the Okwenya Junction to the Akuse Road, but still within the national limits as determined by the GSA. Thus, considering the poor state of this stretch of road, the use of the trucks will result in high dust generation within the immediate vicinity of this area. However, this will not be the case from Akuse to the KGS project site, as this stretch of the road is asphalted.

Figure 7-1: Types of pollutant emissions from vehicles with internal combustion engines



Source: https://x-engineer.org/effects-vehicle-pollution-human-health/

Particulate matter on the neighbouring communities could increase during the construction phase. For this project, this could be caused by the movement of vehicles and equipment and the construction activities in general. Based on the project schedule, a total of 7500 trips are expected to be delivered for a period of one year, beginning 2026Q1. Considering work is performed 23 days, in a month, then a total of 276 would be required to cart the required volume of boulders to site, averaging about twenty-eight trucks in a day, as compared to the average of 215 of trucks per day (13%) on the route. The average distance to transport materials from the supplier to the project is 35 km.

The impacts related to increased generation of dust during the construction phase are expected to be short term and site specific. The increase in particulate matter on the neighbourhood would decrease gradually over the construction period and may be minimal if transportation of the boulders is targeted during the wet season. There will also be insignificant changes in the air quality parameters such as SOx, NOx, VO, CO from emissions of machineries, excavators, and other key equipment. 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 high probability to occur.

d) Impact on Topography & Drainage

A description of the topography and drainage around the Kpong Dam has been provided in Section 4.4.6. As indicated, the Kpong Dam is in a region of low-lying, gently undulating terrain with significant riverine features influenced by the Volta River and the reservoir created by the dam. The area around the Kpong Dam is characterized by flat to gently undulating terrain. The drainage system of the dykes at the Kpong Dam is crucial for managing water flow and preventing erosion, which could potentially compromise the structural integrity of the dam. The drainage system is designed to handle both surface and subsurface water to prevent water from accumulating around the dykes. Currently, the construction of the dam has significantly altered the natural topography of the area, particularly upstream where the reservoir now exists. The dam has also impacted the downstream flow regime, affecting the floodplain dynamics and sediment deposition.

The rehabilitation works can potentially impact the topography and drainage in the project area. Rehabilitation involving significant earthworks, such as excavation, grading, or filling, at the upper surface can alter the natural landforms and slope patterns in the area and this can lead to changes in elevation and the reshaping of the landscape. The deposition of boulders can create new topographical features or modify existing ones. Modifying the dykes could also change how water flows through the area, and this can potentially lead to changes in local drainage patterns. If during the rehabilitation exercise, the dykes prevent water from naturally draining out of certain areas, it could lead to waterlogging or localized flooding, particularly in low-lying areas.

The works on spillway gates will not have any impacts/effects on the topography. During the repair, water flow through the dam might be temporarily altered. If the spillway gates are removed or partially functional, it could lead to controlled releases of water, which may affect downstream water levels. Changes in water flow can also cause erosion of riverbanks downstream, potentially leading to further alterations in the drainage network. In cases where water cannot be released as usual, water levels in the reservoir might rise, leading to potential overtopping and unregulated discharge. However, with appropriate planned engineering designs, impact of the spillway gates repairs on drainage is most unlikely to occur.

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

e) Impact on Geology & Soils

Assessment of the soils in the area shows show that sediments overlying the rock comprise of sand, silts, and clay. Using an excavator for construction work, especially in areas with sand, silt, and clay, can have significant environmental and geotechnical impacts. Excavation and laying of boulders for such rehabilitation activities can result in exposed soils being vulnerable to erosion, especially during heavy rainfall and wind. The use of excavator on the dyke crest can compact soils, reducing its porosity and permeability. This affects water infiltration, leading to increased surface runoff and further erosion. There is also the increased risk of landslides, especially in areas with sloping terrain, where the excavation can destabilize slopes, especially in clay-rich soils, which can lead to landslides or soil slumping. It must however be noted that the dam is a highly compacted infrastructure, and such works are also to be undertaken by professional and with strict supervision, and the impact of the proposed action on the geology and soils will be negligible.

An estimated volume of 150,000 cubic meters rock will be required for the works. The associated quarrying activities, especially open-pit mining, can cause severe erosion, leading to the alteration of natural landscapes and slopes. This can destabilize geological formations and increase the risk of landslides. Removing large amounts of rock can lead to instability in the surrounding geology. This can result in collapses, rockfalls, and the destabilization of nearby infrastructure. Quarrying strips away topsoil, leading to increased erosion, especially if the area is left exposed and unrehabilitated. The lack of vegetation exacerbates soil erosion through wind and water runoff. The contractor would be responsible for the engagement with the suppliers or owners of nearby quarries where such activities are already ongoing.

Based on the above, the intensity of the proposed action on the geology and soils is expected to be medium low, site specific, short term and have a definite probability of occurring and therefore significant rating of the impact on geology and soils is **LOW NEGATIVE.**

f) Impact on Water Resources

Data on lake water quality has been assessed and it is noted that generally, aside turbidity levels, most parameters were within the set guidelines of the WHO. Water in the Kpong Headpond had a water quality index of over 80 points representing good or unpolluted water. It is therefore imperative to ensure that construction activities do not negatively impact on the water quality since it serves as a source of drinking water, especially for the downstream community of Torgome.

Associated activities with the rehabilitation of dykes can have environmental impacts on the surface water. Activities such as assembly and movements of the floating barge, excavation, material placement, can disturb the lakebed, increasing turbidity levels. This can lead to the suspension of sediments in the water, reducing light penetration and affecting aquatic life, especially photosynthetic organisms like phytoplankton. If the sediments contain pollutants like heavy metals or organic contaminants, their disturbance can release these substances into the water, affecting both water quality and the health of aquatic organisms.

Constructional activities associated with the spill gates repair works will include use of grease, paints, anti-rust, etc, which not properly contained could contaminate both surface and ground water resources. The repair works are to be done in areas off the water surface. Due to the low volumes of such materials, any spillage of such chemicals may not cause measurable changes in the ground water quality.

Wastewater from construction workers, assuming a peak of 20 workers on site, if discharged directly into the environment will not be able to comply with the national standards for wastewater. However, both the assigned office and lay down areas have washrooms facilities that are linked to the existing Waste Stabilisation Ponds in Akuse, and such domestic wastewaters will not find its way directly into the water body. Wastewater from the washings of equipment will be insignificant source of pollution, except in cases of accidental spillage of fuel or oil into the Kpong Headpond. Wastewater from washing the vehicles and machinery will contain high levels of oil and suspended solids. It must be noted that these machines will not be concentrated in one place but scattered, thus, the amount of water used to wash the machines will not be regular and substantial.

The significance rating of the impact on ground water is **"VERY LOW NEGATIVE"** and insignificant and is not considered. Impact on water surface and water quality 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 to local, short term in nature and is definite to occur.

g) Impact on Landscape Value and Visual Intrusion

Visual impacts relate to the changes that arise in the composition of available views because of changes to the landscape, to people's responses to the changes, and to the overall effects with respect. The KGS has been in existence since 1982 and the surrounding communities are very conversant with the infrastructure. In addition, various rehabilitation projects of similar nature with respect to dyke rehabilitation have taken place over the past 5 years. Again, the project location is also within a restricted zone, and hence, few people will be exposed to any potential aesthetic impacts.

Based on the above, the intensity of the proposed action on the landscape and visual intrusion is expected to be low, spatial extent will be local, duration is permanent, but unlikely to occur and therefore significant rating of the impact **VERY LOW NEGATIVE,** and therefore screened out for further discussion.

7.4.2.2. Impact on Waste Generation

Waste generation during the rehabilitation works can have various environmental, social, and economic impacts. The use of machinery and equipment during rehabilitation works may lead to the generation of hazardous wastes like oils, lubricants, and other chemicals. If these are spilled or improperly disposed of, they can infiltrate the soil, causing long-term contamination. Improperly managed waste can generate leachate that may seep into the Volta River. This leachate could contain harmful substances that degrade water quality, affecting aquatic life and human populations relying on the river for drinking water and other purposes. Again, construction activities often lead to an increase in sediment load in nearby water bodies due to soil erosion. The disposal of excavated materials near water sources could exacerbate this issue, leading to turbidity, which affects aquatic ecosystems.

A list of waste streams comprising of non-hazardous and hazardous wastes associated with the various phases of the project is outlined in Table 7-7.

Table 7-7: 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	√	√
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	√	√

		Project Phase	
Category	**Example Types**	**Constructional**	**O&M**
Fluorescent tubes/ bulbs	Bulbs,	√	√
E-wastes	Cartridges, Fridges, and Electronics such as Computers, Lab Tops, Printers, 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	√	√
Solvents, non-halogenated		√	√
Spill absorbents	Oil and fuel absorbents, general purpose absorbents, floor sweeps	√	√
Black water	Waters contaminated with human waste, e.g., sewage	√	√

Due to the nature of the site and the works to be undertaken, general construction wastes and hazardous wastes are predicted to be low. The number of workers concentrated at the construction site at the maximum would be twenty people. Sewage wastes will be treated in the nearby oxidation ponds prior to discharge. On average, a worker will generate a waste of about 0.3 - 0.5 kg per day. Consequently, the amount of waste discharged by twenty people during this period is of about 6-10 kg per day, in which the organic matters accounts for 60-70%, other components including paper, plastic, packaging etc. are about 30 – 40%.

Construction can generate hazardous waste such as fluorescent light bulbs, batteries, mops involving oil, waste oil, etc. Uncontrolled disposal of these wastes could cause land/soil degradation within the construction site vicinities (i.e., landscape becoming unsafe, elevated concentration of heavy metals, death of microorganisms affecting yield of plant, etc..). 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 adoption of circular economy in waste management is strongly proposed under the project.

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 occurring is definite.

7.4.2.3. Biological Risks and Impacts

a) Impact on Terrestrial Ecology

The rehabilitation and repair works can have significant impacts on terrestrial flora and fauna, depending on the scale, location, and methods used. Any associated vegetation clearing activities can lead to direct habitat loss for plant species and the animals that depend on them. Animals may be displaced during construction, potentially leading to a decline in their population, especially if suitable alternative habitats are not available. The dykes can act as physical barriers, restricting the movement of terrestrial animals and leading to habitat fragmentation. This can affect breeding patterns, access to food, and genetic diversity.

As indicated, all but one of the recorded plant species is classified as 'Least Concern' according to the IUCN Red List of Threatened Species. This is the mahogany tree *Khaya senegalensis* which is a 'Vulnerable' species due to logging and local exploitation. This species will not be impacted by project activities. Land requirements for the project is estimated at about 15,364m^2. Within this area, there is not expected to be any vegetation clearing activities.

Excavator activities on the dykes' surfaces will impact on the herbaceous vegetations. Other possible 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.). Also, the small population of birds, reptiles, rodents, and insects will likely migrate to nearby vegetated areas. In general, the noise and daily commotion of construction activities will temporarily drive the animals further away from construction site but are expected to return once the construction activities wind down.

The overall significance of the impact on the terrestrial ecology during construction 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, and this has been screened out.

b) Impact on Aquatic Ecosystems

The aquatic ecosystem of the Kpong reservoir has been discussed under Section 4.5.4. Project constructional activities that can affect such aquatic ecosystems include the assembly of the floating barge, the offloading of boulders, and the use of excavator for the placement of the boulders on the dykes. The use of machinery and materials during construction can lead to accidental spills of oils, lubricants, or other hazardous substances, which could contaminate the water and harm aquatic organisms. Noise, vibration, and physical disturbances from construction can stress or displace aquatic fauna, including fish and invertebrates.

Construction activities might disrupt existing natural drainage channels, potentially leading to waterlogging or the redirection of water flow. If the rehabilitation impacts water flow or the physical structure of the water, it could affect natural habitats and the migration patterns of fish.

Barriers to migration can lead to a decline in fish populations. In addition, the spillway removal and re-fixing works will be directly within the water body. Such repair process involves machinery and materials that could temporarily degrade water quality, affecting both aquatic life and human use, especially members of Torgorme community.

If the rehabilitation works are not carefully managed, they could lead to the loss of species, particularly those that are sensitive to changes in water quality or flow. The disruption of breeding grounds or the introduction of pollutants can have long-term impacts on biodiversity. However, considering the duration and nature of the works, this is most unlikely to occur.

The overall significance of the impact on the aquatic ecosystem 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 local. The duration of the impact will be short term and there is high probability to occur.

c) Impacts on Endangered and Threatened Species and Habitats

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 not affect bird activity in the area. Aside possible hunting activities by workers, bird species will not be impacted on by project actions. Eight bird species (*Bubulcus ibis, Egretta garzetta, Egretta intermedia, Ardeola ralloides, Butorides striata, Ardea cinerea, Milvus migrans parasitus* and *Kaupifaco monogrammicus*) in the project area are listed under Schedule I of the Wildlife Conservation Regulation, 1971, as wholly protected in Ghana (i.e., their hunting, capture or destruction is always prohibited). Thus, it is critical that hunting of such birds by contractors' staff is prohibited, and this shall be strongly enforced.

The overall significance of the impact on the endangered and threatened species during construction is **VERY LOW NEGATIVE.** The intensity of any such impact can be defined as low, the spatial extent of the impact will be site specific. The duration of the impact will be short term and there is unlikely probability to occur and is screened out.

d) Impacts on Protected Areas

As indicated, there are no protected areas or key biodiversity areas in the immediate proximity to KGS. It is only the Shai Hills Forest Reserve, located about 20 km from the KGS, which accommodates the monkey sanctuary, and is along the Accra – Tema N2 Highway, the route for the transportation of boulders to the project site. Due to this, it is imperative that drivers obey the speed limit and drive with utmost care. However, it must be noted that the N2 Highway is a very busy route and vehicular movements by such HGVs are routine and regular, and therefore the project associated trucks will not have any direct impact on activities of the monkeys.

The overall significance of the impact on the protected areas such as the Shai Hills Forest Reserve during construction is **VERY LOW NEGATIVE.** The intensity of any such impact can be defined as low, the spatial extent of the impact will be site specific. The duration of the impact will be short term and there is low probability to occur and is screened out.

7.4.2.4. Impact Health & Safety

a) Occupational Health & Safety

The development of the proposed project 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, use of drills and machinery for cutting, welding, handling of electricals, delivery of equipment, and use of vehicles. Materials and equipment used for the construction work could be harmful, when not handled with care.

Occupational health and safety hazards associated with such works include respiratory hazards, fire, noise, and physical hazards. Physical hazards represent potential for accident or injury or illness due to repetitive exposure to mechanical action or work activity. Occupational exposure to dust and fine particulates is associated with activities such as abrasive blasting, cutting, drilling, grinding, and stockpiling. Workers with long term exposure to fine particulate dust are at risk for benign pneumoconiosis, emphysema, bronchitis, and fibrosis. Long-term exposure to silica dust may cause silicosis. Workers are also exposed to physical injuries such as slips, trips, falls, impact with moving machinery. Other potential hazards include injury from sharpened tools and instruments and dust effect on workers.

The most relevant public health issue related to the water include water borne and water related disease vectors. The proliferation of aquatic weeds in the years after river impoundment has caused an increase in schistosomiasis due to improved habitats for the host snails, and there is the risk of infection due to contact with the water body. Staff working in and around the water body could be at risk to schistosomiasis infection, and appropriate PPE's is required.

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 Contractor. The duration is temporal with a high probability to occur.

The significance rating of the impact of the project on worker health and safety can be described as **LOW NEGATIVE**.

b) Risk of Fire Hazards

During the constructional phase, the use of electrical machinery poses risk to fire. The smoking of cigarettes by workers poses threat to the risk of fires. The workers will not be allowed to set fires for any form of activity. Project monitoring activities will include risk of fire hazards to ensure that fire is not used for the said activities.

The general fire precautions to be taken during construction shall include:

- The posting of "no smoking" signs at fire sensitive areas
- Provision of appropriate and adequate number of fire extinguishers at all areas.
- Proper storage of rags used in cleaning hands and containing flammable liquids (e.g., in metal containers for safe disposal)
- Handling of flammable materials by competent persons only
- Provision of emergency fire alarm systems at the project site.

The effectiveness of response during emergencies depends on the amount of planning, training, and drilling previously performed. Identifying key elements of a fire emergency preparation plan starts with the development of a fire emergency preparedness planning. The project will therefore carry out fire prevention training for employees. All staff are to be familiar with all elements in the plan to enable employees have a clear understanding of their roles in fire emergencies. At the end of the training, personnel are to have adequate knowledge of all fire prevention systems.

The significance rating of the impact fire hazards during the construction phase is said to be **LOW NEGATIVE**. This is because the potential intensity of impact will be high, spatial extent being local, temporal in nature and low probability to occur.

7.4.2.5. Socio-economic Risks & Impact

Based on the status quo conditions of the study area and the nature of the proposed development, as well the outcome of the stakeholders' engagements, the following socio-economic impacts are anticipated:

- Impact on livelihood, especially fishing
- Access to waterfront for domestic activities
- Impacts due to increased traffic.
- Expectations regarding jobs.
- Creation of temporary jobs during construction (including local jobs).

- Influx of job seekers.
- Local spending.
- Impact on health, including, incidence of HIV/AIDS infections.
- Skills training for local workers during construction.
- Creation of long-term jobs during operations and skills training.
- Job losses at the end of the project life cycle.

These anticipated socio-economic impacts have been summarised into five major areas and these are discussed, below.

a) Labour & Working Conditions

Labour use on the project shall comprise of full-time and part-time. International safeguards basically categorize workers into direct workers, contracted workers, community workers and primary supply workers. Estimated labour requirements for the project during the various phases is discussed under Section 3.12. Employees from VRA and Contractor/Consultants delegated to the project will generally be required full time and around the year for the project duration. Contract workers is required for the placement of boulders 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 18 months for the dykes' rehabilitation and 4 years for the spillway gates repairs. 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 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 used 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 Practices
- Gender & Vulnerability
- Grievance Mechanism
- Non-Employee Workers and Supply Chain

Given the significant 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 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 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 National Labour Commission 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.

The local workforce is expected to elect leaders to represent them regarding industrial relationship with the project contractor.

Employees of Contractor and sub-contractors will be housed, most likely in hotels and or hired accommodation within Akuse for the duration of the project. The presence of such persons in the locality typically can a raise in demand for goods and services which can result in a rapid expansion in supply chain businesses operating in the area. The impacts that may arise from the presence of such persons may comprise of 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 expatriate 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 and VRA has in place various practices to deal with risk associated with primary suppliers. 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 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**.

b) Community Health & Safety

Construction and rehabilitation activities could expose local populations to increased health and safety risks, including vehicular traffic, accidents, falling materials, dust, emissions, noise, and water contamination, debris, construction wastes and possible new diseases due to the influx of construction workers from other places. Residents, especially children could venture into areas of operating equipment, especially during the loading of boulders at the waterfronts, as well as nomads crossing with their cattle.

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 with boulders. The intensity of this impact can be said to be medium low and affecting only the locals. The duration is temporal with a high probability to occur. The significance rating of the impact of the project on community health, safety can be described as **LOW NEGATIVE**.

c) Traffic & Transportation

Constructional impacts due to traffic and transport generally can occur in the form of:

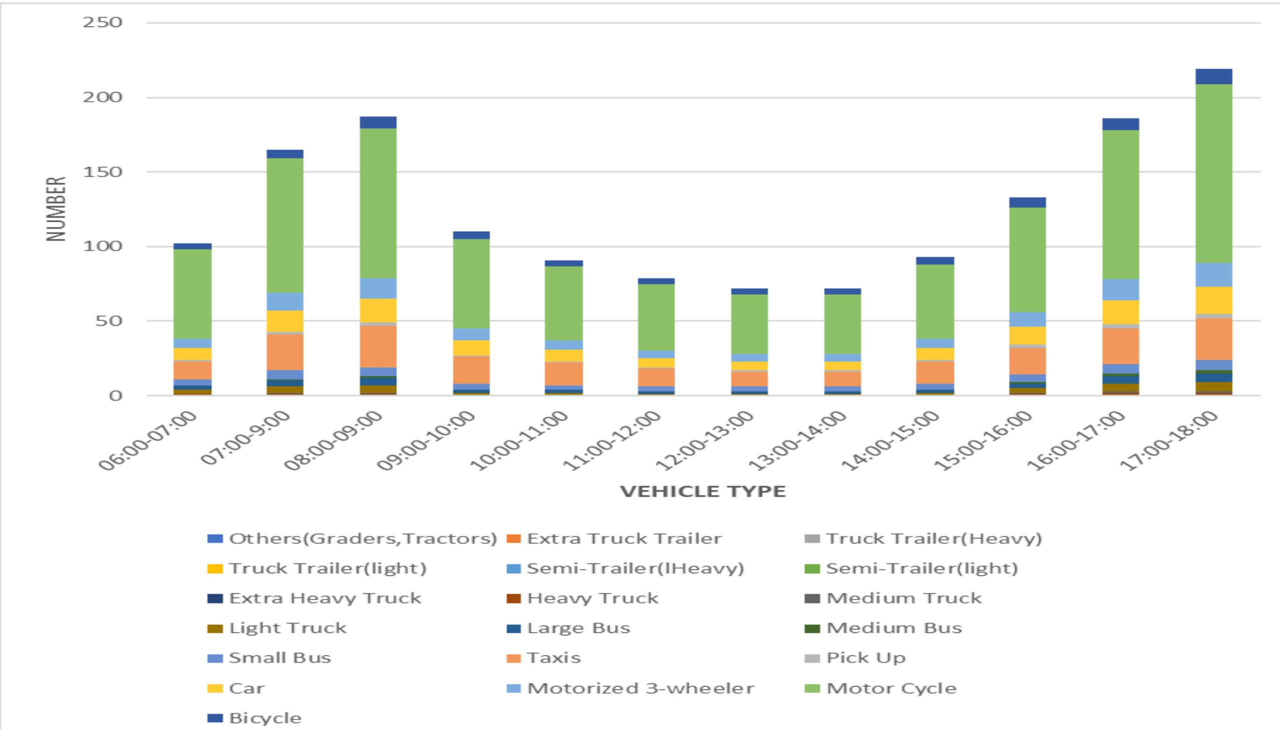
- Disruption of transport links, including delays and congestion brought about by an increase in overall traffic numbers due to construction traffic movements.
- Conflict with other road users, including pedestrians and public transport (buses, taxis, etc.) because of delivery of equipment and plant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

The construction phase will witness vehicular movements to and from the project area and will raise the risk of accidents. The use of about 5 pick-ups by the project will not pose any additional risk as such vehicles are common on the roads and will be few. However, the HGV for material transportation, specifically for the boulders will pose safety risks. An approximately 7500 trips by HGV is anticipated to deliver this volume to site, via the Tema – Akosombo N2 Highway, bringing it to between 28-30 trucks a day. The N2 Highway accommodates the monkey sanctuary along the Shai Hills. This is however a very busy route and vehicular movements by such HGVs are routine and regular, and therefore the project associated trucks will not have any direct impact on activities of the monkeys. These risks will be minimized through adherence to speed limits and placing adequate road signs in the area.

The key issue will be the Natriku road where daily, between 2-9 heavy trucks ply the route. The about 30 trucks a day will result in about 200% increment in HGV on the roads. This road runs close to various schools and churches and therefore poses additional safety risks to the community members. Again, such vehicular movements will pose health risks due to the dusty nature of the said road, and this has been discussed earlier. Again, it is expected that the access roads on the river dam will be closed to traffic anytime the spillway gates are to be removed for repairs. This is expected once every quarter (three months) for the 4-year period. This can cause anxiety amongst road users, which are mostly members from neighbouring communities and prior information on such activities to the community members is critical.

From the 3-day traffic assessment as shown in Figure 7-2 , it is noted that Traffic load is low during the hours of 10:00 – 14:00 GMT on the river dam and is recommended that such works are performed during such periods. It must however be noted that motorcycles which are the most frequently used means of transportation will not be affected by such road closures.

Figure 7-2: Graph Showing Hourly Vehicular Trends on River Dam



The impact of traffic and transportation will therefore 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. The probability of the impact occurring is definite. The significance rating of the impact of the project on traffic and transports can be described as **HIGH NEGATIVE.**

d) Gender & Vulnerability

Gender refers to roles, responsibilities and relationships that are socially ascribed to men, women, boys, and girls. They are determined by many parameters including sex, age ethnicity, religion, tribe, physical location, and politico-economic status. Cultural perceptions and male aggression against females result in creating gender issues. It has been observed that the complementary role that both sexes should play to ensure rapid and balanced development of all the citizenry is undermined by male domination of all spheres of life. Cultural and social considerations make the female a subordinate to her male counterpart.

VRA recognises gender equality between men and women as a human right and a prerequisite for sustainable development. For VRA, the promotion of gender equality is a cross-cutting issue in project planning and implementation, and a key priority is to provide for equal participation and benefits for women and marginalised groups.

Apart from the workplace risks, the main gender risks in the communities are associated with discriminatory practices, safety, and security. Discrimination is mostly observed in the exclusionary cultural practices related to decision-making, consultation, and participation. Culturally, the communication protocols exclude women from voicing their opinions and contributions on societal issues that directly affect them. This was very evident during the stakeholder engagements with the four traditional authorities, where women were totally absent at the gatherings. Thus, there is a risk that women will be excluded from project information and disclosure campaigns unless they are specifically targeted.

Males are also the dominant gender in the workforce, and male-owned companies dominate the suppliers in the construction and energy sectors. To ensure equality in participation and exploitation of project benefits, deliberate effort is required to promote the consideration of women for recruitment, training, allocation of responsibility, and consideration of female-owned companies as suppliers. It is expected that by the VRA Gender Action Plan, 25% of the employment under this project will be women.

Again, the issue of Gender Based Violence, Sexual Exploitation and Workplace Sexual Harassment which are the key gender and vulnerability impact related to the project constructional activities, is relevant and must be addressed at this stage. The risk of sexual exploitation and abuse is likely to increase unless specific control measures are instituted. The incidence of child marriages, defilement, and transactional sex is already high in the communities. According to Multiconsult (2023), 30% of girls in Natriku Basic School stay with men in exchange for money and guardianship, and about one-third of the girls take on risky behaviours (transactional sex).

The employment of workers for such short-term periods, will not impact on population in the project area. It however increases opportunities to have sexual relationship with multiple partners, including employees, 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. 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.

The constructional phase will lead to employment of both the community members as well as those from neighbouring 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.

Taking account of the short-term nature of the construction, the intensity of this impact is anticipated to be medium low, the spatial extent of the impact will be regional, and the duration of the impact will be of short 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.**

e) Impact on Livelihood

As indicated, there is no associated acquisition of lands for the project. The lands within the project area have the following categories of land-uses: agricultural lands, potential agricultural lands, or fallow agricultural lands as well as grazing of animals and there are no envisaged changes in such land uses arising from the project. The communities around the Kpong Generating Station depend on fishing for their livelihoods. During the placement of the boulders, movement of fisherfolks will be restricted to the work areas in front of the dykes, and such restrictions are already in force and therefore there are however no aquaculture activities within such areas.

The Natriku landing site is utilised by the community for fetching water, washing, and for berthing of canoes for the fishing activities. This site therefore serves as a key area that supports the livelihoods of the community members. The utilisation of such facility for the loading on floaters will therefore impact negatively on the community members. It is however expected that the landing site at the Akuse Watermanship Training Camp will be utilised for such activity.

If the rehabilitation impacts the quality of the water, it could affect water supply for domestic use, agriculture, and other needs. This is particularly significant if the water body is a source of drinking water for nearby communities, which is the case for the Torgorme community. Again, any changes in water quality and aquatic ecosystems can affect fish populations, leading to reduced catches and impacting local economies. Ongoing monitoring of water quality during the rehabilitation works can help identify any adverse changes and allow for timely mitigation.

Restriction of access to the river dam for commuting purposes will impact on the day’s activities of the neighbouring communities. Individuals may have to vary their day’s work tonsure they are not inhibited in their movements. Effective Stakeholder engagements in the planning and implementation of such works can help address this impact and ensure community buy in.

All the construction routes are available and hence the project does not require construction of temporary roads. The existing roadway, especially from the Okwenya junction to the dam is likely to sustain damage or increase wear and tear from the hauling of embankment materials and mobilization of heavy trucks and other equipment. It should be noted these routes have deteriorated and is planned to rehabilitate the road prior to such works, and this will be a major social benefit of the project.

There are no expected interruptions to any livelihood during the project implementation and therefore the income generating abilities of the communities will not be impacted. However, there will be opportunities for communities to benefit from the procurement of goods and services they offer at the local level. Specifically, the project would stimulate income generating opportunities for food vendors, call cards vendors and other traders.

The significance rating of the impact on Livelihood is said to be **LOW NEGATIVE** The potential intensity of this impact is medium low, the spatial extent of the impact will be specific only to the project site; however, the duration of the impact will be short term and irreversible and there is medium probability of its occurring.

Summary

A summary of impact ratings of negative impacts at the Constructional Phase is provided in **Table 7-8**, with an average significance rating assessed as **LOW NEGATIVE** indicating that 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.

Table 7-8: Summary of Negative Impacts at Constructional Phase

Nature of Positive Impact	Potential Intensity	Spatial Extent	Duration	Probability	Impact Rating	Impact Significance
Ambient Air Quality	Medium	Site Specific	Temporal	High Probable	4.5	LOW
Noise & Vibration	Medium	Site Specific	Temporal	Definite	6.0	MEDIUM
Green House Gas	Low	International	Temporal	Definite	7.0	MEDIUM
Surface Water	Medium	Site Specific	Temporal	Definite	6.0	MEDIUM
Ground water	Low	Site Specific	Temporal	Unlikely	0.3	VERY LOW
Water Quality	Medium	Site Specific	Temporal	Definite	6.0	MEDIUM
Geology & Soils	Medium Low	Site Specific	Temporal	Definite	4.0	LOW
Landscape & Visual Intrusion	Low	Local	Permanent	Unlikely	0.8	VERY LOW
Topography & Drainage	Low	Local	Temporal	Medium	0.4	VERY LOW
Terrestrial Flora	Low	Site Specific	Temporal	Unlikely	0.3	VERY LOW
Terrestrial Fauna	Low	Site Specific	Temporal	Unlikely	0.3	VERY LOW
Aquatic Ecosystems	Medium Low	Local	Temporal	High Probable	3.75	LOW
Endangered and Threatened Species and Habitats	Low	Site Specific	Temporal	Unlikely	0.3	VERY LOW
Protected Areas	Low	Site Specific	Temporal	Low Probable	0.75	VERY LOW
Waste Generation	Medium	Site Specific	Temporal	Definite	4	LOW
Occupational Health & Safety	Medium	International	Temporal	High Probable	7.5	MEDIUM
Fire Hazards	High	Site Specific	Temporal	Low Probable	2.5	LOW
Labour & Working Conditions	Medium Low	International	Short Term	Low Probable	2.23	LOW

Nature of Positive Impact	Potential Intensity	Spatial Extent	Duration	Probability	Impact Rating	Impact Significance
Traffic & Transportation	High	Regional	Temporal	Definite	12.0	HIGH
Livelihood	Medium Low	Site	Temporal	Medium Probable	2.0	LOW
Gender & Vulnerability	Medium Low	National	Short Term	Low Probable	2.0	LOW
Community, Health, Safety and Security	Medium	Site	Temporal	High Probable	4.5	LOW
AVERAGE					3.6	LOW

7.4.3. Operational & Maintenance Phase

It must be noted that the Kpong dam and related infrastructure is an already existing facility, and the main objective of this project is to enhance and maintain the structural integrity of the dam to ensure continuous clean power generation. Section 3.11 has outlined activities under the operational and maintenance phases, relating to the two subprojects, specifically the dyke's rehabilitation and spillway gates repairs, and these are all part of already ongoing actions under this phase. Both direct and indirect impacts related to the existence and operation of the Akosombo and Kpong hydroelectric plants. have been captured in the underlisted documentations that guide the environmental management of the power plant.

b) Environmental Management Plan for Akosombo & Kpong Hydroelectric Power Plants: September 2010 (First edition).

b) Emergency Preparedness Plan for the Akosombo Dam and Kpong Dam, February 2011 (First edition)

These reports are updated every three years for the purpose of Environmental permitting, with the most recent being the 2022-2024 EMP report. As indicated earlier, these are associated reports to this EIS Report and, these impacts are not discussed.

7.5. Transboundary Impacts

The rehabilitation works and all related subprojects shall all be located within Ghana, with all project activities and effects being confined within the country. Thus, there ae no direct transboundary impacts associated with the KGRP.

7.6. Potential Cumulative Impacts

Cumulative Impact Assessment (CIA) is the process of analysing the potential impacts and risks of proposed development in the context of the potential effects of other human activities and natural environmental and social external drivers over time, and proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible. Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. The EIB addresses CIA as part of its broader Environmental and Social Standards, specifically focusing on Standard 1: Environmental and Social Impacts and Risks.

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. Within this context, the cumulative impacts of the planned rehabilitation of the 10km Okwenya Junction - Akuse Road, which serves as transportation route for the project is assessed. As indicated, the KGS is accessed from the minor arterial highway from the Okwenya Junction, along the Tema- Akosombo Highway, to the Akuse township and beyond. The road, unfortunately, has not undergone any major rehabilitation since its construction in the 1980s. In 2013, VRA as part of its Corporate Social Responsibility, repaired most sections of the road to reduce the incidents of accidents that were becoming rampant on the road. Also, the Ghana Highway Authority in 2019 undertook some repair works on the road, especially on the extensively deteriorated areas.

The objective of the road repairs is to improve road safety and accessibility, particularly for transporting goods and materials to the dam during rehabilitation. Generally, works required to rehabilitate the road would include but not limited to the following:

i. Site Clearance and Demolition

   The road width per design is 7.5m. Unfortunately, erosion and siltation have drastically reduced the width substantially within large sections. Some of these eroded sections have been overtaken by weeds and must be cleared during the works.

   Also, some existing concrete structures, particularly, some culverts along the road must be demolished during the implementation of the repair works to make way for the reconstruction of adequately sized ones that would function effectively.

ii. Widening of the road

   Current residential developments along the road, as well as planned developments, requires that the road be widened to include the provision of shoulders and in some areas, pedestrian walkways.

iii. Soft spot improvement

   Years of rainfall ponding within some sections of the road have completely compromised the road structure. Such sections require special treatment prior to surfacing. This would include the ground stabilization of such areas by the placement and compaction of small sized boulders.

iv. Concrete drains/trapezoidal drains

Originally the road was constructed and protected from rainwater by the provision of earth drain channels along most sections of the road. However, with the rapid development along the road and the need to provide accesses to the developed areas, it has become prudent to provide concrete drains to replace the earth channels in most sections. Existing earth channels that would be maintained during the repair works would have to desilted to improve on their functionality of easily accommodating and effectively discharging rainfall runoff.

v. Natural gravel sub-base 200mm thick

The road structure in all eroded areas would be reconstructed by building the subbase with a layer of well compacted natural gravel, averagely 200mm thick.

vi. Stabilized base 200mm thick (40% natural gravel and 60% crushed rock base)

The road base layer would be formed, in most sections, by the placement and compaction of averagely 200mm thick crushed rocks (0-40)

vii. Primer seal

To prevent erosion of the base layer to be built, and enhance the strength of the existing surfaced areas, the entire area of an approximately 10km stretch of the road would be resurfaced.

It must also be noted that the Okwenya Junction-Akuse Road also serves as a critical transportation link for locals, farmers, and tourists accessing nearby attractions. Both projects therefore have the potential to impact shared environmental resources and local livelihoods, particularly considering other existing and planned developments in the vicinity of the Kpong Dam and the Lower Volta Basin. It is however, expected that the road repairs will be done prior to the commencement of the KDRP to allow for the smooth haulage of materials and equipment during the project execution. However, it is also possible that works may coincide.

Key anticipated cumulative effects, both beneficial and detrimental, from the planned road repairs works on the Kpong Dam Rehabilitation Project impacts are described below.

7.6.1. Traffic & Transportation

The rehabilitation of the Kpong Dam and the repair works on the Okwenya Junction to Akuse Road could lead to significant cumulative impacts on traffic and transport. Both projects are critical for infrastructure development but have overlapping timelines and geographic locations, which can exacerbate disruptions. Both the dam rehabilitation and road repairs will involve the movement of heavy equipment, trucks, and construction materials. These vehicles will share the road network with regular traffic, leading to potential bottlenecks, especially on key routes connecting the Kpong Dam to Okwenya Junction and Akuse. Traffic diversions due to construction works could push vehicles onto alternate routes that are not designed to handle such volumes, increasing congestion in adjacent towns and villages.

During certain phases of the Akuse Road repair, parts of the road may be closed, reducing the available lanes, and causing delays. Public transportation like buses and shared taxis will be affected by increased travel times, potentially leading to fewer trips per day. This could create delays for commuters and increase fare prices due to longer trips and fuel consumption. The transport of goods from the Volta River to the surrounding regions will be delayed, impacting businesses dependent on the movement of agricultural produce, fuel, and other materials.

The increased congestion and mix of heavy vehicles, public transport, and private cars could raise the risk of road accidents, especially along the narrow, deteriorating roads around the Akuse area. Increased traffic might also create dangers for pedestrians, especially in towns and villages along the road corridor. Transport delays can lead to higher costs for businesses relying on the timely delivery of goods and services. Agricultural products, which are a major commodity in the area, may face spoilage or delays reaching markets. The additional time spent in traffic could lead to increased fuel costs for transport operators, which may then be passed on to consumers.

Effective planning and coordination between the two projects and local authorities will be critical in mitigating the cumulative impacts on traffic and transport in the region.

7.6.2. Noise & Vibrational Impacts

Assessing the cumulative impact of noise and vibrations due to the two projects involves several factors. Both activities generate noise and vibrations, and when they occur simultaneously, their combined impact could exacerbate local environmental and social conditions. Noise impacts are related to the source of the noise (e.g., vehicles, construction equipment, workers, and project facility components), the proximity to the noise receptor (e.g., humans and wildlife), and the times of day at which noise-producing activities are taking place. Heavy equipment uses during earthworks/ground preparation for road works transportation of boulders as well during construction activities will generate dust, vehicle emissions, and noise, affecting air quality and creating disturbances for nearby communities and wildlife. The simultaneous operation of both projects may increase air pollution and noise levels, exacerbating health and environmental impacts. Schools, hospitals, or wildlife habitats near either project would be highly sensitive to cumulative noise effects. Special mitigation efforts would be needed for these areas.

Vibrations generated from activities like pile driving or drilling can be felt over long distances, depending on the intensity and frequency. In addition to causing discomfort, vibrations could also cause structural damage to nearby buildings or sensitive infrastructure. Roadworks, especially those involving compactors or pavement breakers, generate significant ground vibrations, which can affect nearby structures and human comfort. The simultaneous occurrence of high vibration activities from both projects could lead to the amplification of vibration impacts. This could exacerbate the risk of structural damage to buildings, particularly if they are old or poorly constructed. Prolonged exposure to vibrations, especially in residential or worker camps, could lead to discomfort, health problems (such as hand-arm vibration syndrome), and reduced quality of life.

The cumulative impacts of noise and vibrations from the two projects could have significant environmental and social effects. The combined noise and vibration effects could lead to reduced quality of life for residents living near these projects. Chronic noise exposure can lead to sleep disturbances, stress, and other health issues. Vibration impacts may also contribute to structural damage to homes or other community buildings, leading to economic losses. Proper coordination, mitigation, and compliance with environmental regulations are essential to minimizing these impacts.

7.6.3. Air Quality

The cumulative impact on air quality due to the two projects would be a combination of several factors, particularly during the construction phases of both projects. These factors include dust, emissions from construction vehicles and machinery, and potential release of particulates into the atmosphere. Construction activities during KDRP such as material transport contribute to dust levels. The Road repair and construction typically involve the use of aggregate materials, which generate dust. Activities like grading, paving, and movement of heavy trucks can exacerbate dust levels, especially along the 10 km stretch of the Road.

Thus, both projects occurring simultaneously would lead to higher dust concentrations, especially in areas downwind from both sites. The proximity of these projects would compound air quality concerns in communities located between the dam and the road, leading to higher health risks for local populations. Again, the simultaneous increase in traffic and machinery on both projects would raise the levels of emissions, contributing to smog formation and respiratory issues. Given the shared corridor between the dam and the road, localized air quality could be significantly degraded.

The concurrent projects will elevate particulate matter and gaseous emissions, posing risks to public health and the environment, particularly in the areas directly surrounding the projects. Sensitive groups, including children, the elderly, and those with pre-existing respiratory conditions, would be most at risk. Wildlife and the surrounding ecosystem could also suffer, as elevated pollution levels may affect air and water quality, indirectly impacting local flora and fauna. Continuous monitoring and adherence to environmental regulations will be essential to mitigate these impacts.

7.6.4. Local Livelihoods

Benefits to the local, regional, and national economy through employment and procurement of services have already been identified as part of this EIS Report. The development of the two projects in the area is likely to support the enhancement of these benefits. The cumulative impact of both projects presents both challenges and opportunities for livelihoods in the affected areas. While temporary employment opportunities may arise during the construction phase, the potential displacement, disruption to agricultural and fishing activities, and environmental degradation could negatively affect long-term livelihoods. At the same time, improved infrastructure and energy production might bring longer-term benefits to the local economy, enhancing access to markets, services, and employment opportunities.

Should the projects be constructed sequentially there is the possibility for those who have gained skills working for contractors, subcontractors, or suppliers on one project to transfer these skills and find employment on subsequent projects. However, potential cumulative negative impacts could occur if the projects are constructed concurrently including:

- Disruption to livelihoods, especially for farmers and fishers, could be compounded by both projects, leading to a decline in income and food security.
- Community access to essential services could be restricted during the road construction period.
- Competition for workers during the construction phase if the projects are developed at/around the same time.
- Variances in salary structures for employees within the two projects during construction and if these are not harmonised prior to employment. This could lead to ongoing dissatisfaction with discrepancies in pay between various roles and worker types.
- Variances in procurement practices that lead to discrepancies in pay between contractors and for goods and services that could result in risks to project implementation.

In the long term, the rehabilitation of the dam could result in more stable energy production and water management, which could indirectly benefit local businesses and industries. Improved energy access might promote small-scale industries and stimulate economic growth. Again, the road repair works could have lasting positive impacts on local commerce by improving access to regional markets and reducing transportation costs. Enhanced mobility may also attract investment and development, which can create new livelihood opportunities.

7.6.5. Community Health & Safety

Both projects would likely increase the volume of heavy vehicles (construction trucks, material transport) on the Okwenya Junction - Akuse Road. This can lead to:

- A higher likelihood of road traffic accidents, especially in areas with poor road conditions, limited road capacity, or insufficient signage.
- Increased risks for local communities who use the road for daily commutes, particularly pedestrians and motor cyclists, which are very common on the road.
- Dust emissions from vehicle movement, affecting visibility and respiratory health.

Again, the construction of the two projects either at the same time or overlapping could result in changes in community health. Of particular concern are community-worker interactions related to transport workers and the presence of an external construction workforce. Construction workers are at risk of injuries, respiratory issues, or other health hazards due to both projects. If proper safety protocols are not adhered to, these issues could spill over into community health impacts as well.

7.6.6. Gender & Vulnerability

Both projects, though distinct, can create compounded effects on local communities, particularly vulnerable populations, including women, children, the elderly, and those living with disabilities. The influx of workers from outside the community during dam rehabilitation can increase the risk of gender-based violence, including sexual harassment, exploitation, and abuse. The social dynamics of these workers interacting with local populations, particularly women and girls, heighten this vulnerability. The road repair projects may also involve outside laborers, creating similar risks. Construction workers are often temporary residents who may not have ties to the community, exacerbating security risks for vulnerable women and girls. The cumulative presence of construction workers from both projects can amplify the potential for gender-based violence and other forms of social conflict.

The dyke's rehabilitation project may offer temporary employment, but women and vulnerable groups may face barriers to accessing these opportunities due to gendered roles, lack of skills, or discrimination. Women are often relegated to lower-paying jobs if they are hired at all. Similarly, road repair projects could create jobs, but women and vulnerable groups may not benefit equally due to the same challenges of access and opportunity. Without targeted efforts to include vulnerable populations in the economic benefits of both projects, existing gender disparities and vulnerabilities may be reinforced.

Road repair projects often increase travel times or create barriers to mobility due to detours, heavy machinery, or roadblocks. This can prevent women and vulnerable individuals from accessing healthcare services, educational institutions, or markets. With respect to the KGRP, the closure of the access road on the river dam during the spillgates removal could create similar risks. The combination of both projects can exacerbate mobility constraints, isolating vulnerable groups from essential services.

Addressing these cumulative impacts requires an integrated approach that prioritizes gender and vulnerability as central to the success of both projects.

7.6.7. Labour & Working Conditions

The cumulative impact of the two projects on labour and working conditions in Ghana can be understood by evaluating how both projects intersect and amplify challenges or opportunities in the labour force and working environments. Both projects will likely increase demand for both skilled and unskilled labour in the region. The rehabilitation of the Kpong Dam is a highly technical project that will require engineers, environmental experts, and construction professionals, while the road repair work at Okwenya Junction to Akuse would need civil engineers, machine operators, and road construction laborers. This could have several implications, including employment opportunities. Workers might move from one project to another depending on the demand, which could lead to a fluctuation in workforce stability. Competition for employment opportunities between workers from the Kpong Dam and the road repair project could lead to divisions, affecting the bargaining power of laborers.

The concurrent projects might lead to a strain on local social infrastructure, particularly in housing and healthcare for workers. The influx of temporary workers, if they are not local, could increase demand for accommodation, leading to overcrowding or increased housing costs. Again, Health facilities in the region might be overwhelmed if workers face injury, illness, or work-related stress.

With multiple projects happening at once, there is a risk that labour standards could decline if contractors or subcontractors cut corners to meet deadlines. Subcontracting, which is common in such projects, could lead to labour exploitation (e.g., underpayment or lack of contracts), particularly if there is inadequate oversight from government agencies or worker unions. Enforcement of labour rights, particularly minimum wage, working hours, and benefits, could become difficult with multiple projects drawing on similar labour pools. Monitoring agencies may be stretched thin.

By assessing both projects together, the cumulative impact on labour and working conditions calls for strategic planning and robust labour protection policies to ensure that workers' rights and safety are not compromised.

7.6.8. Conclusion

Both projects are critical for improving local infrastructure and ensuring long-term sustainability. However, their cumulative impacts as identified necessitate careful planning and mitigation efforts. There is however the need for coordinate the timing and execution of both projects to ensure that environmental gains from the dam rehabilitation are not compromised by road repairs. With proper coordination, these projects can deliver positive outcomes for climate resilience and local development while minimizing negative environmental and social consequences.

The mitigation measures proposed in Chapter 8 as well as the requirements of the Provisional Environmental Management Plan outlined in Chapter 9 provide measures to address the combined impacts of both projects. A robust monitoring plan should be implemented to track environmental and social impacts throughout the project lifecycle. In addition, there is a need for all contractors to work together to develop measures related to traffic and transport to avoid congestion and minimise accidents, employment and procurement and their approach to worker community interactions. This will minimise dissatisfaction with the projects and reputational risks.

8 ENHANCEMENT & MITIGATION METHODS

8.1. Overview

As specified in Section 12 of Part II of the EIA Regulations, appropriate mitigation measures are to be identified to eliminate, minimise, or manage identified potential significant environmental effects. 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:

1. Enhancement measures, which outlined measures to be implemented to enhance already positive benefits of the project.
2. 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 for easy transfer into all contractual documents with the Contractor, if required
3. 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).
4. Mitigation of non-significant effects or additional mitigation (management actions to be considered by VRA and relevant authorities).

The identified measures are to be implemented mostly by the 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.

8.2. Recommended Enhancement Measures for Positive Benefits

8.2.1 Pre-Constructional / Constructional Phases

Embedded/In-built Control	*Enhancement Measures*
Increased Employment Opportunities	
▪ Adherence to Labour Act 2003 (Act 651) of 2003 and the Labour Regulations, 2007 (LI 1833) and the National Employment Policy, 2014 ▪ Children’s’ Act, 1998 (Act 560) with regards to child labour. ▪ Resolution of disputes in line with Alternative Dispute Resolution Act	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 neighbouring communities, namely Fodzoku, Akuse, Torgorme, Natriku and specifically in the Lower Manya Krobo District. ▪ Adopt strategies under the previous projects in the

Embedded/In-built Control	*Enhancement Measures*
Increased Employment Opportunities	
2010 (Act 798) ▪ Adherence to the provision of the Ghana Local Content Policy (2010) and the Energy Commission (Local Content & Local Participation (Electricity Supply Industry) Regulations, 2017 (LI 2354)	recruitment of locals under this project. ▪ No child shall be employed on the project. ▪ If possible, 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 places within the project site. VRA shall ▪ Ensure adherence in line with VRA Local Content Policy ▪ Ensure continuous engagement and transparent communication with stakeholders. ▪ Design health and safety programs tailored to both workers and local communities. ▪ Incorporate gender-sensitive approaches in project planning and implementation. ▪ Promote equitable distribution of benefits and access to grievance mechanisms.
*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 will have a **HIGH POSITIVE** significance.*	

8.2.2 Operational & Maintenance Phase

Embedded/In-built Control	*Enhancement Measures*
Increased Employment Opportunities	
▪ 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.*	
Stabilisation of Electricity	
▪ 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	▪ VRA shall undertake regular and routine maintenance of dykes and spillway gates as well as the entire dam infrastructure for continuous operations of the plant to ensure it displaces energy sources from fossil fuels.

Embedded/In-built Control	*Enhancement Measures*
line with national requirements to prevent shut down of the power facility.	
*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.***	
Reduction to Exposure of Flooding	
▪ 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) ▪ Ensure adherence to the Dam Safety Regulations, 2016 (LI 2236) ▪ Ensure adherence to the requirements of Water Resources Commission Act, 1996, Act 522	▪ VRA shall undertake daily monitoring of the movement of the dam through visual inspection and data from relevant instrumentations. ▪ Monitor water levels and ensure early releases downstream to avoid flooding. ▪ Ensure routine maintenance of the spillway gates to ensure they work efficiently. ▪ Continue to work with Dam Review Board and implement recommendations made. ▪ Implement requirement of the EPP for the Kpong Dam, including effective stakeholder engagements with downstream populations ▪ Adhere to requirements of the Health, Safety, Security & Environmental manual for Energy Sector Organisations
*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 significance of the rating will continue to be **HIGH POSITIVE.***	
Production of Low Carbon Electricity	
▪ Collaborate with the Ministry of energy to adhere to requirements of the Renewable Energy Act, 2011 (Act 832) and Renewable Energy Amendment Act, 2020 (Act 1045) ▪ Implementation of VRA REDP to enhance the contribution of the hydropower 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 dam infrastructure for continuous operations of the plant to ensure it displaces energy sources from fossil fuels. ▪ Continue to engage in carbon offsetting projects, such as reforestation or renewable energy investments, to help balance out the emissions generated during construction. ▪ Complete studies on Climate Change Resilience Assessment and implement recommendations in collaboration with stakeholder agencies
*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.***	
Promotion of Economic Growth	

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. ▪ Ensure effective collaboration between the Community Relations Officer and the assembly members. ▪ 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. ▪ Extend Employee Volunteerism Program to the educational institutions in the Lower Manaya Krobo Municipal Assembly
*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.*	

8.3. Mitigation Measures for Negative Impacts on Physical Environment

8.3.1 Pre-Constructional Phase

Embedded/In-built Control	*Enhancement Measures*
General Apprehension by Public	
• Adherence to Right to Information Act, 2019 (Act 989)	VRA shall: • Assign a Community Liaison Officer to liaise with the stakeholders, including Traditional Authorities, and the Municipal Chief Executive upon commencement of the project. • Adherence to the requirements of the project's Stakeholder Engagement Plan. • Institute appropriate grievance mechanisms to address concerns of the public.
*The significance rating of the impacts on land acquisition at the constructional stage is said to be **MEDIUM NEGATIVE**. When the above recommended measures are implemented, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*	

8.3.2 Constructional Phase

Embedded/In-built Control	*Mitigative Measures*
Impacts on Climate Change	
• Integrate climate change adaptation strategies into the project design.	• Implement 4Rs in waste management (Reduce, Reuse, Recycle, Reduce) • Adopt circular economy practices in waste management. • Implementing energy-efficient technologies and practices • Use of well-maintained machinery • Regular servicing of equipment and vehicles • Use of low carbon intensive constructional materials
*The significance rating of the noise impact at the constructional stage is said to be **MEDIUM NEGATIVE**. When the above recommended measures are implemented, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	
Noise & Vibrational Impacts	
▪ Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328). ▪ Compliance to Ghana Standard for 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.	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 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**. When the above recommended measures are implemented, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*	
Air Quality Impacts	
▪ Adherence to requirements of Driver & Vehicle Licensing Authority Act, 1999 (Act 569) by having valid Vehicle Examination Certificate from	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

<table>
<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td>the Driver & Vehicle Licensing Authority to minimise vehicular emissions.
▪ Adherence to Ghana Standard for 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);</td><td>simultaneously to reduce the dust incidents over the construction period.
c) Proper management of stockpiles and excavated material (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.
f) 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.</td></tr>
<tr><td colspan="2">The significance rating of the air quality impact at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to VERY LOW NEGATIVE significance and the residual impact significance will be reduced to negligible.</td></tr>
<tr><td colspan="2">Topography & Drainage</td></tr>
<tr><td>▪ 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 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.</td><td>The Contractor shall:
• Avoid any unnecessary changes in the topography.
• Minimise to the extent possible, disruption/alteration of any micro-watershed drainage pattern.
• If required, to provide appropriate number of cross drainage channels during 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.</td></tr>
<tr><td colspan="2">The significance rating of the topography and drainage impact at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to VERY LOW NEGATIVE significance and the residual impact significance will be reduced to minor.</td></tr>
</table>

<table>
<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td colspan="2">Geology & Soils</td></tr>
<tr><td>Adherence to the requirements of the Land Planning and Soil Conservation Act, 1957 within the designated project areas.</td><td>The 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.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on geology and soils at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will remain at a VERY LOW NEGATIVE significance and the residual impact significance will be negligible.</td></tr>
<tr><td colspan="2">Aquatic Ecosystem</td></tr>
<tr><td>• Adherence to requirements of Water Resources Commission Act, 1996, Act 522
• Ghana Standard for Environmental Protection-Requirements for Effluent Discharge (GS 1212: 2019)</td><td>The Contractor shall:
• Avoid sedimentation during the placement of boulders.
• 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.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on water resources at the constructional stage is said to be MEDIUM NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to LOW NEGATIVE significance and the residual impact significance will be negligible.</td></tr>
<tr><td colspan="2">Waste Generation</td></tr>
<tr><td>▪ Adherence to legal requirements such as the National Environmental Sanitation Policy 2010,
▪ Adherence to the Hazardous &</td><td>The Contractor shall,
Solid Waste
• Implement 4Rs in waste management (Reduce, Reuse,</td></tr>
</table>

Embedded/In-built Control	Mitigative Measures
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 in accordance with any additional instructions outlined by VRA.	Recycle, Reduce) • Adopt circular economy strategy in waste management practices. • 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 Municipal 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, is directed into the municipal drain provided within the project site to prevent waterlog. • Ensure sewage are directed into the existing oxidation ponds. • If necessary, coordinate with respective Municipal 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.

<table>
<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td></td><td>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.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on waste generation at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will remain at a VERY LOW NEGATIVE significance and the residual impact significance will be negligible</td></tr>
<tr><td colspan="2">Aquatic Ecosystems</td></tr>
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<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td>.</td><td>The Contractor shall:
Ensure that activities leading to sedimentation and turbidity are avoided in the water body.
Avoid the release of contaminates and nutrients in the water body.
Ensure the natural flow of water is not altered.
Identify and avoid any fish breeding grounds within the project area.
Timing of construction to avoid breeding or migratory periods.
Use noise-dampening techniques to mitigate impacts on aquatic resources.
Ensure that no fuel and oil seepages occur from the excavator on the floating barge into the water body.
Implement proper management measures to prevent damage to the aquatic ecosystem. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:
Conduct construction activity in a phased manner, in other words, construction activity should not be widespread affecting all habitats at the same time.
Enhance general awareness regarding fisheries and fauna through trainings, posters, etc. among the staff and labourers.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on aquatic ecosystem, at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to VERY LOW NEGATIVE significance and the residual impact significance will be minor.</td></tr>
<tr><td colspan="2">Occupational Health & Safety</td></tr>
<tr><td>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" (2013).</td><td>The 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.
Ensure appropriate PPEs for workers to prevent infection of schistosomiasis.
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.</td></tr>
</table>

Embedded/In-built Control	*Mitigative Measures*
	• Ensure that cranes and other lifting equipment are operated by trained and authorised persons. • 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 because 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 **LOW NEGATIVE**. When the above recommended measures are implemented, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
Fire Hazards	
▪ 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".	The Contractor shall: • Liaise with the Ghana National Fire Service to train staff on how to deal with fire as part of the requirements for the contract. • Conduct training sessions with local fire station personnel. • Create consistent and clear labelling and placarding warnings on all electrical equipment. • Provide system technical contact information for reliably

<table>
<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td></td><td>available key personnel who can assist responding firefighters with technical aspects of the Project.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on fire hazards at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to VERY LOW NEGATIVE significance and the residual impact significance will be negligible.</td></tr>
<tr><td colspan="2">Socioeconomic Impacts – Labour & Working Conditions</td></tr>
<tr><td>▪ 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
▪ Adherence to Factories, Shops & Offices Act, 1970, Act 238 to provide safe and healthy working conditions for workers.
▪ 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.</td><td>The Contractor shall:
• Ensure 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.
• Ensure 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 contracts 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.
• 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.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on Labour and Working Conditions at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are</td></tr>
</table>

Embedded/In-built Control	*Mitigative Measures*
*implemented, When the above recommended measures are implemented, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*	
Socioeconomic Impacts – Community Health, Safety & Security Conditions	
▪ Adherence to Factories, Shops & Offices Act, 1970, Act 238 to provide safe and healthy working conditions for workers.	VRA shall: • Observe all necessary traditional requirements during project implementation. • Ensure the presence of Community Liaison Officer as a designated point of contact for the community. • Give a formal notification of the Lower Manaya Krobo Municipal Chief Executive on the date of project commencement. The letter should be copied to the traditional authorities. • Ensure self-introduction of Contractor to the MCE on arrival of onsite prior to project implementation. • Ensure self-introduction of 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 Municipal Health Service in execution of any health education program for the workers. Contractor shall: • Shall provide training on vehicular safety to the transport workers. • 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.

Embedded/In-built Control	*Mitigative Measures*
	• 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 behaviour 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 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****. When the above recommended measures are implemented, it is expected that the impact will reduce to* ***VERY LOW NEGATIVE*** *significance and the residual impact significance will be negligible.*	
Socioeconomic Impacts – Traffic & Transportation	
▪ 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	The 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.

<table>
<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td>requirements, transportation times etc. In addition, a health and safety management plan for all operating vehicles and machines.
▪ Coordination with the Ghana Highway Authority and Department of Urban Roads in the road repair works.
▪ Follow guidelines of the “Road Reservation Management: Manual for Coordination” (June 2001).</td><td>• Provide training in defensive driving training to drivers.
• Provide site vehicle maintenance services to ensure technical failures do not occur.
• Avoid densest areas of traffic, if possible, through planning and channelling of traffic.
• 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.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on Traffic & Transport at the constructional stage is said to be MEDIUM NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to LOW NEGATIVE significance and the residual impact significance will be minor</td></tr>
<tr><td colspan="2">Gender & Vulnerability</td></tr>
<tr><td>▪ Adherence to National Action Plan on Policy for Gender Mainstreaming in Energy Access (2025-2030).
▪ Adherence to all conditions of contract, targeting issues on gender and vulnerability.</td><td>The Contractor shall:
• Ensure 25% of workers on the project are women.
• Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence.
• Endeavour to eliminate 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</td></tr>
</table>

<table>
<tr><th>Embedded/In-built Control</th><th>Mitigative Measures</th></tr>
<tr><td></td><td>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.</td></tr>
<tr><td colspan="2">The significance rating of the impacts on Gender & Vulnerability at the constructional stage is said to be LOW NEGATIVE. When the above recommended measures are implemented, it is expected that the impact will reduce to VERY LOW NEGATIVE significance and the residual impact significance will be minor.</td></tr>
<tr><td colspan="2">Livelihood</td></tr>
<tr><td>Effective zoning of project area by the Land Use & Spatial Planning Dept. (formerly Town and Country Planning Department).</td><td>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.
• Ensure that on completion of construction activities, land used for temporary facilities, if any, should be restored to the extent possible.
• Undertake activities that will not 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 access road on dam 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.
• Appoint a Community Liaison Officer as a designated point of contact for the community.</td></tr>
</table>

8.4 Mitigative Measures for Cumulative Impacts

Cumulative Impacts Mitigations
Traffic & Transportation
• **Traffic Management Plans**: Implementation of detailed traffic management strategies that include staggered work hours, real-time traffic monitoring, and optimized routing for construction vehicles. • **Public Communication**: Regular updates to the public on expected disruptions and alternative routes could help reduce frustration and ensure smoother traffic flow. • **Phased Construction**: Staggering the works on the road and dam rehabilitation to minimize overlapping impacts. • **Investment in Alternate Routes**: Improving nearby road networks to serve as alternatives during the construction period.
Noise & Vibration
• **Compliance with National Noise Control Standards:** Both projects should comply with the Ghana Standard for Health Protection-Requirements for Ambient Noise Control (GS 1222: 2018) • **Coordinated Scheduling:** To reduce cumulative impacts, the project proponents could coordinate the timing of high-noise and high-vibration activities, so they do not overlap. Scheduling quieter periods and avoiding night-time work can reduce the disturbance to local communities. • **Monitoring:** Continuous monitoring of noise and vibration levels using sensors and public feedback would allow for quick mitigation responses if thresholds were exceeded. • **Buffer Zones:** Creating buffer zones around sensitive areas such as schools, hospitals, or wildlife habitats can help reduce the perceived impact of noise and vibrations. • **Public Communication:** Regularly informing affected communities about the timeline of works and any potential disturbances can improve the relationship between the project developers and residents, mitigating some social tensions.
Air Quality
• **Dust Control Measures:** Regular wetting of work sites, particularly during dry periods, to minimize dust emissions. • **Vehicle Emissions Management:** Use of newer, low-emission construction vehicles and machinery, along with proper maintenance to reduce exhaust pollution. • **Air Quality Monitoring:** Establish real-time air quality monitoring stations to track particulate and gaseous emissions throughout the duration of both projects. • **Traffic Management:** Developing a robust traffic management plan to minimize congestion and emissions from idling vehicles around the construction zones.
Local Livelihoods
• **Stakeholder Engagement**: Early and continuous engagement with the affected

Cumulative Impacts Mitigations
communities and stakeholders to understand their concerns and the potential impacts on their livelihoods. • **Livelihood Restoration**: Ensure restoration of livelihood if any member of the community loose access to businesses due to the dam rehabilitation or road works. • **Compensation for loss of access**: If access to farms, businesses, or homes is impeded by road construction, provide alternative access routes, or offer financial compensation for any temporary loss of income. • **Coordination between projects**: Both the dam rehabilitation and road repair works should coordinate their activities to minimize overlapping impacts. • **Traffic and Accessibility Management**: The road repair works will likely result in traffic diversions or restricted access to local businesses, which could compound the livelihood impacts. Create **traffic management plans** to minimize disruptions. • **Community Involvement:** Involve local communities, traditional leaders, NGOs, and other relevant stakeholders in the planning and execution phases. Transparency and inclusion can help mitigate negative impacts on local livelihoods by aligning project activities with the needs of affected communities. • **Communication Plans**: Keep the community informed about project timelines, potential disruptions, and mitigation efforts. This will help them prepare and adapt. • **Monitoring Programs**: Establish a system for continuous monitoring of the livelihood impacts during the construction phases of both projects. This would allow timely identification of any emerging issues. • **Grievance Redress Mechanism (GRM)**: Create a mechanism for communities to report any negative impacts on their livelihoods and ensure these grievances are addressed promptly. • **Regular Adjustments**: Based on monitoring results, adapt the mitigation strategies as needed to address unforeseen impacts.
Community Health & Safety
• **Coordination between projects**: Harmonize the scheduling and planning of the dam rehabilitation and road works to reduce overlapping impacts, such as staggering construction phases to limit traffic and dust. • **Community engagement**: Ensure transparent communication with local communities regarding construction schedules, road closures, and health risks. • **Monitoring and enforcement**: Regular environmental and health monitoring should be conducted to detect any adverse effects early. Strict adherence to environmental and safety regulations should be enforced. • **Health interventions**: Local health services should be supported to handle any additional burden due to the cumulative impacts of the projects. • **Dust and noise control**: Implement dust suppression techniques, such as water spraying, and limit construction activities during night hours to reduce noise exposure.
Gender & Vulnerability
• **Gender-sensitive planning**: Ensure that project planning includes gender analyses to identify and address specific risks to women and vulnerable groups.

Cumulative Impacts Mitigations
• **Consultation with affected communities**: Engage women, children, the elderly, and disabled persons in decision-making processes. • **Access to services**: Ensure that displacement or disruption of services, particularly healthcare, water, and education, is minimized and alternatives are provided. • **Gender-based violence prevention**: Implement clear policies and programs to prevent gender-based violence, including worker codes of conduct, safety measures, and support services. • **Economic empowerment**: Provide employment opportunities specifically targeted at women and other vulnerable groups to ensure they can benefit economically from both projects.
Labour & Working Conditions
• **Strong Enforcement of Labour Standards**: Both projects must adhere to Ghana's labour laws and international standards for fair wages, safety, and working conditions. Oversight from regulatory bodies, such as the Ministry of Employment and Labour Relations, will be crucial. • **Regular Safety Audits**: Conducting regular audits on both projects to ensure that safety measures are followed and that workers are receiving appropriate training and protection. • **Worker Representation**: Encouraging the establishment or strengthening of labour unions and providing platforms for workers to express concerns regarding their working conditions. • **Collaboration Between Projects**: Ensuring that contractors for both projects communicate and coordinate labour resources in a way that benefits both projects and avoids overburdening workers or creating competition

9 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

9.1 Introduction

The Ghanaian EIA Regulations, LI1657, requires the project proponent to prepare an Environmental Management Plan (EMP) 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 EIB Standard 1 - Environmental & Social Impact and Risks. This section presents a provisional 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 associated with the project. 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. It must be noted that the requirement of this provisional EMP dovetails into the already existing EMP for the Akosombo & Kpong Dam.

9.2 Roles & Responsibilities

This Section summarises the project structure, key roles and responsibilities for environmental and social management and responsibilities proposed for this Project.

9.2.1. Volta River Authority

The overall supervision of the project will be the responsibility of VRA, as project owners. VRA shall include the environmental, health and safety management requirements as part of the contractual clauses for the project and this is to be adhered to by the project contractor. Currently, an EMP Secretariat has been established in the office of the Director, Environment & Sustainable Development who also doubles as the EMP Coordinator. The Director, E&SDD appoints a Monitoring Coordinator for the day-to-day activities of the EMP Secretariat. Focal Point Officers from various internal departments have been formally appointed for the purpose of the implementation of the EMP. Noting that cooperation with other organisation is an important aspect of the success of the EMP, VRA has established a Steering Committee (See **Table 5-2**), made up of representatives from various stakeholder organisations, to ensure monitoring and guidance of the implementation of the EMP. In addition, various Sub-Committee have been established to augment the work of the Steering Committee. The Steering Committee is chaired by the Deputy Chief Executive (Engineering & Operations).

For this specific project, the existing Environmental Monitoring Coordinator (EMC) will be assigned with a defined authority and responsibility for ensuring that the environment requirements are implemented and maintained and would work directly with the VRA Project Engineer. In addition, the existing Community Relations Officer for Akuse area will act as a liaison between VRA and local stakeholders including neighbouring communities. The overall coordination of environmental and social impact activities will be the responsibility of the Director, E&SDD.

9.2.2. Owner's Engineer

Royal Haskoning, DHV of Netherlands is responsible for the Consultancy Contract for Project Management, and this involves preparation of procurements documents for the engagements of a contractor. Following this, VRA shall engage a consulting firm, as Owner's Engineer, responsible for supervising project construction in line with requirements of the EMP. The firm shall work as an independent HSE auditor and conduct environmental audit during the construction phase of the project. The firm, in consultation with VRA, shall also be required in to engage specialist sub-consultants when required for the purpose of ensuring the implementing or monitoring of the EMP requirements.

9.2.3. Project Contractor

The Project Contractor is to undertake all procurements and related works under the Contract. The Contractor shall also be responsible for engaging and execution of contract with local sub-contractors. As a policy all contractors hired by VRA are required to prepare comprehensive method statements for all major construction activities and submit these to VRA and the Contractor shall be expected to do same. During the construction phase, responsibility for many of the environmental and social mitigation and monitoring actions will be passed on to the construction contractors. In these situations, VRA will maintain a monitoring and oversight capability to ensure that contractors are fulfilling their obligations. The Contractor will be responsible for the implementation and compliance with recommendations and conditions of the EMP. The Contractor shall under no circumstances interfere with the property of landowners or nearby Communities.

9.2.4. Environmental Protection Agency

The EPA is the statutory body mandated to ensure that the implementation of all undertakings do not harm the environment. It is expected that the project will abide by statutory requirements and all implementing institutions will liaise sufficiently with the Agency to ensure compliance. Within this context, the Eastern Regional Office of the EPA will have direct responsibility over the environmental supervision of the project.

9.2.5. Financiers/Lenders

Construction activities for the project is being co-funded by the EIB and the European Union. All monthly progress reports from VRA will be copied to the agencies for their information, and they shall be immediately notified of any serious accidents or other Environmental, Social, Health & Safety (ESHS) incidents.

9.3 Mitigation Action Plan

A Mitigation Action Plan has been developed following the delineation of impacts and mitigation measures and this is shown in Table 9-1. These measures will be adopted by VRA and imposed as conditions of contract of the contractor employed for the project. The responsibility for implementation of mitigation plan will primarily lie with the EMP Monitoring Coordinator, and the Director, E&SDD will play a role of supervisor to oversee the project performance pertaining to environment, health, safety, and social issues. The mitigation measures during operational phase are part of ongoing regular maintenance and monitoring schedule and it is not discussed.

Table 9-1: Mitigation Action Plan for Negative Impacts

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
PRE-CONSTRUCTION PHASE						
General Apprehension by Public	Effective stakeholder engagement	▪ Assign a Community Liaison Officer to liaise with stakeholders. ▪ Adherence to the requirements of the project's Stakeholder Engagement Plan. ▪ Institute appropriate grievance mechanisms to address concerns of the public.	Ensure buy in from stakeholders	Zero resistance to project implementation	0.02	VRA
CONSTRUCTIONAL PHASE						
Impacts on Climate Change	Climate Change Mitigation / adaptation Actions	▪ Implement 4Rs in waste management. ▪ Adopt circular economy strategies for waste management. ▪ Use of well-maintained machinery ▪ Regular servicing of equipment and vehicles ▪ Use of low carbon intensive constructional materials	To reduce GHG emissions	Reduction of potential GHG emissions	Part of Project Cost	Contractor
Increase in Noise Levels & Vibrations	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 noise activities. ▪ Operation of only well-maintained equipment on-site.	To reduce and monitor construction noise	Compliance to Ghana Standard for Health Protection – Requirements for Ambient Noise Control (GS 1222:2018).	Part of Project Cost	Contractor
Increase in fugitive dust	Application of basic dust	▪ Regular watering of all active construction areas. ▪ Prevention of idling of vehicles and equipment	To minimise fugitive dust	Compliance Ghana	Part of Project Cost	Contractor

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
and vehicular emissions levels	control and suppression measures	▪ 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.	and vehicular emissions on ambient air quality to acceptable health and safety requirements	Standard for Environment and Health Protection- Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236: 2019).		
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	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	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	Contractor

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
		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.				
Water quality & resources Management	Implement strict erosion and sediment control measures to prevent degradation of water quality in nearby rivers and reservoirs	▪ Avoid sedimentation and turbidity of the water body. ▪ Avoid the release of contaminates and nutrients in the water body. ▪ Ensure the natural flow of water is not altered. ▪ Identify and avoid any fish breeding grounds within the project area. ▪ Ensure that no fuel and oil seepages occur from the excavator on the floating barge into the water body. ▪ Provide impervious storage area for Fuel & lubricant, hazardous waste. ▪ Prevent storage of hazardous materials near natural drainage channels. ▪ Provide equipment and materials for clean ups. ▪ Temporary refuelling tanks should be bunded. ▪ Monitor water quality. ▪ Monitor flow rates and hydrology	To prevent contamination of water resources	Compliance to requirements of Ghana Standard for Environmental Protection-Requirements for Effluent Discharge (GS 1212: 2019)	Part of Project Cost	Contractor
Increase risks to environment and health from waste	Prioritise circular economy strategies in waste management.	▪ Utiliser circular economy strategies in waste management ▪ Construction debris will be utilised for levelling of the land. ▪ Unused debris shall be disposed-off to nearest	To ensure		Part of	

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
generation.		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. ▪ Wastes like wood packaging material, metal, jute, etc. will be sold to scrap dealers/ buyers. ▪ Provision of proper sanitation and sewage facility	constructional waste generation does not pollute the environment.	Zero contamination of soil and water from solid and liquid constructional waste	Project Cost	Contractor
Alteration and displacement of aquatic habitat	Implement proper management measures to prevent damage to the aquatic ecosystem and biodiversity of the site.	▪ Avoid sedimentation during the placement of boulders. ▪ 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.	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	Contractor
▪ Risk of injury and diseases 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 targeting	To prevent injury to workers	Zero injury	Part of Project Cost	Contractor VRA

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
		schistosomiasis. ▪ Undertake health and safety awareness training amongst staff and workers				
▪ Loss of property and lives from fire hazards	▪ Requirements of Emergency Response Programme on coordination with the GNFS	▪ Acquire Fire permit. ▪ Acquire Development Permit ▪ Adhere to Contractor's and VRA SHE Standards for Contractors ▪ No burning on project site	To prevent loss of property and live	Zero injury and no damage to property through fire	Part of Project Cost	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	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. ▪ Fencing of all excavated areas to avoid access to outsiders and wildlife. ▪ Provision of security and warning signages around	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	Contractor

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
		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	Contractor
▪ Gender & Vulnerability	▪ Adherence to conditions of contract, targeting issues on gender and vulnerability. ▪ Adopting a policy to cooperate with	▪ 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. ▪ Site induction and continuous worker education will include workplace bullying, harassment, gender-based violence, need to accept cultural differences, etc.	Minimise gender and vulnerability impact on employees.	▪ Zero harassment ▪ No child labour employed	Part of Project Cost	Contractor

Impact	Identified Mitigation Action	Actual Action	Objective	Target	Budget GH¢ (Million)	Responsibility
	law enforcement agencies in investigating complaints about gender-based violence.	▪ 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.				

9.4 Training and Capacity Building

The key objectives of the environmental training program are to safeguard all employees and contractors and to help implement the EMP. A training and capacity building program will be in place for personnel involved in the project. The VRA Academy situated close to the project site will provide support towards this, regarding venue and other logistics. The project contractors will be responsible for ensuring that all new Employees receive training through Environmental, Health & Safety (EHS) inductions. The Construction Workers must receive basic training in environmental awareness and must also be appraised of the EMP's requirements, including gender based. gender-based violence, including sexual harassment, exploitation, and abuse.

An HIV/AIDs and STI awareness and prevention training programme will be developed and implemented in a culturally sensitive manner. The Contractors may sub-contract specialist service providers to raise awareness and train peer educators, and a focal point person on the Contractor's staff with whom workers may discuss HIV/AIDS related issues. The provision of information and advice including about testing and access to treatment and support would be important aspects to include in a workplace programme.

In addition to the provision for continuous public education during the project and subsequent posting of "Warning Signs", sustained information, education, and communication (IEC) programmes to ensure overall community safety shall be implemented on regular basis. The purpose of the IEC programme is to remind community members about project related risks and activities that will endanger their lives as well as the need to adhere to warning signs.

The Contractor must ensure that the conditions of the EMP are adhered to. Should the Contractor require clarity on any aspect of the EMP, the Contractor must contact the VRA Environmental Monitoring Coordinator for advice.

9.5 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 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 project power projects that will be undertaken by the VRA.

For the purpose of achieving a very high level of compliance regarding implementation of all environmental commitments, the VRA/Contractor shall make budgetary allocations towards all environmental programmes. Financial commitments shall be made from these allocations on a 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.

A description of the environmental monitoring activities showing parameters, methodology, period for monitoring, location, and responsibilities as well as budgetary requirements are provided as part of the Table 9-2.

Table 9-2: Monitoring Plan

Monitoring Parameters		Monitoring Frequency	Methodology	Responsibility	Budget GH¢
	CONSTRUCTIONAL PHASE				
Noise levels	▪ 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 and when required	▪ Noise meter		
	▪ Application of adequate general noise suppressing measures.	▪ As and when 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 and when 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 and when required	▪ Maintenance Schedules		
	PLANNING & CONSTRUCTIONAL PHASE				
Air Quality	▪ Regular watering of all active construction areas.	▪ Daily	▪ Use of Water tankers	Contractor's EHS Officer	▪ 0.01 million
	▪ Emissions & Particulate Matter	▪ Daily	▪ By GSA Standards		
	▪ Regular inspection and scheduled maintenance program for all vehicles, machinery, and equipment	▪ As and when required.	▪ Maintenance Schedules		
	▪ Erection of appropriate signages to checking of vehicular speed	▪ Monthly	▪ No. of Signages		
	▪ Provision of appropriate PPE's	▪ As and when require	▪ Supply of PPEs		
	▪ Visual monitoring of the dust emissions	▪ Daily	▪ Optics		
	▪ Regular health check-ups and treatment of employees	▪ As and when 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 and when required	▪ Std. Ops. Procedure		
	▪ Restriction of diesel generator use to emergencies and power back-up only	▪ As and when required	▪ Std. Ops. Procedure		

	Monitoring Parameters	Monitoring Frequency	Methodology	Responsibility	Budget GH¢
	PLANNING & CONSTRUCTIONAL PHASE				
Flood Risks	▪ Construction of the facility in line with approved design	▪ As and when required.	▪ Constructional Design	▪ Contractor's Engineer	▪ Part of Project Cost
	▪ Immediate restoration of all affected worked areas	As and when required	▪ Std. Ops. Procedure	▪ Project Engineer	
	▪ Provision of appropriate number of cross drainage channels	As and when required	▪ Drainage Channels	Project Engineer	
	▪ Restriction of construction activities to designated work areas.	As and when 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		
	PLANNING & CONSTRUCTIONAL PHASE				
	▪ Monitoring of water quality both upstream and down stream	▪ As and when required.	▪ GSA Standard	EMC	Part of Project Cost
	▪ Monitor water flow rates and hydrology		▪ Std. Ops. Procedure	Project Engineer	
	▪ Prevention of storage of hazardous materials near natural drainage channels.		▪ Std. Ops. Procedure		

Monitoring Parameters		Monitoring Frequency	Methodology	Responsibility	Budget GH¢
Water Quality & Resources	▪ 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		
Waste Generation	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Utilisation of construction debris for levelling of the land	▪ As and when 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		
Occupational	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Implementation of a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan	▪ As and when 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 and when	▪ Routine Safety		

	Monitoring Parameters	Monitoring Frequency	Methodology	Responsibility	Budget GH¢
Health & Safety		required.	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		
Fire Hazards	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Acquire Fire permit	▪ Annual	▪ Fire Permit	Project EHS Officer	▪ 0.04Million
	▪ Acquire Development Permit	▪ Annual	▪ Development Permit		
	▪ Adhere to Contractor's and VRA SHE Standards for Contractors	▪ As and when required	▪ As Required		
	▪ No burning on project site	▪ As and when required	▪ Signages		
	▪ Existing of fire safety warning signages	▪ As and when required	▪ Signages		
	PLANNING & CONSTRUCTIONAL PHASE				
Labour & Working Conditions	▪ 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 and when required	▪ Compliant Register		
	▪ Maintenance of a healthy environment for the labour force	▪ As and when required	▪ Complaint Register		
	PLANNING & CONSTRUCTIONAL PHASE				

	Monitoring Parameters	Monitoring Frequency	Methodology	Responsibility	Budget GH¢
Public Safety	▪ Observation of all necessary traditional requirements prior to project commencement	As and when required	▪ Pacification Rites	▪ Project Engineer	▪ 0.2Million
	▪ Notification to local government/traditional authorities on the date of project commencement.	As and when required	▪ Notification Letter	▪ CLO	
	▪ Institution of public grievance mechanism.	As and when 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 and when required	▪ Waste logbook		
	▪ Disposal through either efficient incineration or disposal in a sanitary landfill.	As and when 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 and when required	▪ Warning signages		
	▪ Briefings to create awareness on public health amongst staff, especially on Sexually Transmitted Diseases and HIV/AIDS.	▪ Monthly	▪ Briefing report		
	PLANNING & CONSTRUCTIONAL PHASE				
	▪ Implementation of TMS	▪ Daily	▪ Std. Ops. Procedure	▪ Contractor Engineer	▪ 0.03 million
	▪ Implementation of traffic control measures	▪ Daily	▪ Speed rumps, signages	▪ Contractor Engineer	
	▪ Training of drivers in defensive driving	▪ As and when required.	▪ Training Report	▪ Project EHS Officer	
	▪ Enforcement of speed limits for heavy good vehicles and workforce transportation vehicles	▪ Daily	▪ Speed limits		

Monitoring Parameters		Monitoring Frequency	Methodology	Responsibility	Budget GH¢
Traffic & Transport	▪ Avoidance of dense areas of traffic through planning and channelling of traffic.	As and when required.	▪ Level of traffic		
	▪ Involvement of local authorities in defining optimum project traffic routes and times for transit	As and when required.	▪ Traffic routes		
	▪ Implementation of a "No Drinking" "No Alcohol" policy on site	As and when required.	▪ Policy on No Drinking and No Alcohol		
	▪ Conduction of periodic and routine alcohol checks for all site drivers and site workers	As and when required.	▪ Report on routine checks		
	▪ Provision of site vehicle maintenance services to ensure technical failures do not occur	As and when required.	▪ Vehicle maintenance site		
	▪ Installation of traffic safety signage at vantage points along access routes with the project sites.	As and when required.	▪ Traffic safety signages		
	▪ Sensitisation programs for communities within the project area on road traffic and risks	As and when required.	▪ Sensitisation Report		
	▪ Removal of speed ramps to be done in collaboration with DAs and Security agencies	As and when required.	▪ # of Speed Rumps		

9.6 Emergency Response Plan

An Emergency Preparedness Plan exists for the Akosombo & Kpong Dams, and this deals with emergency situations that eventually could lead to the failure of the dam, or when expected operational flow release threatens downstream life, property, or economic activities. The requirements of this EPP will be adopted for this project. In addition, emergency response plans shall be prepared to effectively manage a wide range of incidents that may occur at the project site specifically under this project. This includes emergency plans for fire, storm, chemical spills and road accident, and other emergency as identified which may affect the project. The protection of the environment shall be primarily dealt with in these plans.

VRA shall also take all reasonable measures to prevent contamination of water, air, or land because of any incident, to reduce such contamination if it is unavoidable and to remediate any contamination that has occurred during the works. The Contractor is mandated to immediately report any significant incidents to the VRA Project Engineer.

9.7 Stakeholder Engagement Plan

It is important for the Contractor and VRA to maintain constructive relationships with stakeholders on an ongoing basis through meaningful engagement during project implementation. Initial stakeholder engagements have been held with key persons within four neighbouring communities of Torgorme, Fodzoku, Natriku and Akuse as well as residents and businesses along the Okwenya Junction – Akuse Road, as well as the Lowr Manya, Shai Osudoku and North Tongu Districts as part of the EIA Process. VRA recognizes that disclosure of information throughout the project will help to ensure accountability and transparency.

As part of project implementation, VRA has prepared a Stakeholder Engagement Plan (SEP) to outline the key actions and overview of how the consultation and disclosure of information relating to the project has been and will continue to be undertaken. The VRA Community Relations Officer at Akuse shall work with the EMC in the implementation of the SEP.

9.8 Scheduling & Reporting

Reporting the results of environmental management activities allows the responsible agencies to identify if any mitigation measure is not being effective and will enable corrective action to be taken. During construction, the contractors will have the responsibility to ensure environmental reporting procedures are being undertaken. After commissioning and handover, VRA will have ultimate responsibility to ensure that environmental reporting procedures are undertaken.

VRA however has the ultimate responsibility to ensure environmental reporting procedures are being undertaken under the project. From pre-construction to operation/maintenance phases, VRA will carry the ultimate responsibility of ensuring that environmental reporting procedures are undertaken. The Project Team will carry out monthly discussions on the project which will form a forum for discussions on environmental issues, and decision making about further mitigation, monitoring, or changes to project activities. All environmental procedures, periodic statutory reports to regulatory agencies such as the EPA, Energy Commission should be produced and controlled in accordance with the station's document control procedure.

The following types of reports shall be produced:

a) Monthly Regular Report: This shall comprise of monthly activity report which shall provide information on environment protection activities performed during the period.
b) Emergency report: This shall comprise of issues to be submitted promptly in case of emergencies.
c) Topic Report: Report concerning influential environment issues.
d) Quarterly Environmental Progress Reports: To be submitted to the EPA as part of regulatory requirements.
e) Annual Environmental Report: This shall comprise of information on all environmental activities undertaken during the year beginning from January to December and submitted to the EPA.

These statutory reports when finalised must be forwarded to all relevant VRA departments, specifically, all monitoring and reporting documents must be kept on file, as part of VRA/Contractor documentation procedures. An open-door policy must be maintained by all agencies on information regarding all environmental issues; such information can be accessed by any worker for purposes of improving on work output.

9.8.1. Project Environmental Permit

Following the submission of EIS Reports, the EPA issues an Environmental Permit to allow for the physical construction of projects to commence. The Permit outlines various conditions that must be adhered to in project implementation. It must be noted that it is an offence under Regulation 29 of the Environmental Assessment Regulations LI 1652 of 1999 to start a project without an Environmental Permit. VRA shall comply with all project specifications, mitigations, monitoring, and other environmental management provisions that would be indicated in the Environmental Permit for the project. **"Kpone Dam Rehabilitation Project"**. Management shall ensure that all conditions are strictly adhered to. The EMC is directly responsible for implementing the conditions outlined in the permit.

9.8.2. Data and Information Management

Adequate records must be maintained to demonstrate compliance. These records will be available always and readily accessible for independent inspection and audit. As required, modifications to the recordkeeping system shall be made to ensure it is effective and efficient for all levels of employees involved to ensure compliance with the requirements of the EMP.

9.8.3. Non-Compliance Procedures and Emergency Response

Non-Compliances are occurrences when management actions, discharges or emissions do not conform to the objectives and requirements of the EMP. The procedures relating to Non-Compliance are as follows:

- Identification of Non-Compliance, through environmental and social monitoring or internal or external auditing of the EMP.
- Investigation into the root cause of the non-compliance.
- Communication (verbally and in writing) with responsible person.
- Implementation of measures to regain compliance.
- Documenting the incident (if significant) on site log.
- As necessary, employees will be sanctioned in line with the OHS Plan; and
- Future monitoring of the non-compliance.

9.9 Evaluation

9.9.1. Internal Monitoring and Evaluation

It is the responsibility of VRA to conduct regular internal monitoring of the project to verify the results of the Contractor and to audit direct implementation of environmental mitigation measures contained in the EMP and construction contract clauses for the Project. VRA shall utilise the services of certified in-house expertise for internal monitoring. The monitoring should be a systematic evaluation of the activities of the operation in relation to the specified criteria of the condition of approval.

- The objective of internal monitoring and audit will be:
- To find out any significant environmental hazards and their existing control systems in force.
- Meeting the legal requirements as stipulated in the LI 1652

The responsibility for mitigation monitoring during the operation phase will also be with VRA.

9.9.2. External Monitoring and Evaluation

EPA has the overall responsibility for issuing approval for the project and ensuring that their environmental guidelines are followed during project implementation. Its role therefore is to review environmental monitoring and environmental compliance documentation submitted by the implementing authorities and they would not normally be directly involved in monitoring the Project unless some specific major environmental issue arose.

VRA will therefore provide EPA with reports on environmental compliance during implementation as part of their annual progress reports and annual environmental auditing reports. Depending on the implementation status of environmentally sensitive project activities, EPA will perform annual environmental reviews in which environmental concerns raised by the project will be reviewed alongside project implementation.

9.10 Audit

The contractors will have the responsibility for auditing their staff and any subcontractors employed by them for all activities related to the work specified in their contracts. VRA will be responsible for auditing the contractors' performance against the environmental mitigation actions during construction, and for auditing performance against the existing Environmental Management Plan for the operation of the dam.

10 CONCLUSION & RECOMMENDATIONS

10.1 Conclusion

The Kpong Dam Rehabilitation Project is a vital infrastructure development aimed at improving the safety, functionality, and efficiency of the hydropower facility. The rehabilitation of dikes and spillway gates will enhance flood control, water resource management, and energy generation capabilities. Through this Environmental Impact Assessment (EIA), a comprehensive analysis of the potential environmental, social, and economic impacts associated with the project has been conducted.

The findings of the assessment indicate that while the project will yield significant positive outcomes, such as improved energy generation, flood control, and enhanced infrastructure longevity, there are potential adverse impacts on the environment and local communities. The positive impact during the preconstruction/construction phases had an average rating score of 9.0 defined as **MEDIUM POSITIVE**, whilst the operational phase had a positive impact of 11.0 defined as **HIGH POSITIVE.**

The negative impact during construction had an average rating score of 3.6 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. These impacts primarily include temporary disturbances during construction, potential impacts on aquatic ecosystems, and concerns related to waste management, water quality, and occupational health and safety.

Following this, the EIA has also outlined the potential measures to avoid, reduce or remedy any associated negative impact. Subsequently, an EMP has been prepared which provides detailed actions for waste management, pollution control, biodiversity protection, community engagement, and occupational safety. Additionally, the project has been designed to comply with national environmental regulations and international best practices, ensuring that sustainable development principles are integrated into its execution. 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. With the implementation of appropriate mitigation measures, these impacts can be effectively minimized. It shall be ensured that contractors fulfil their obligations under their contracts.

The benefits of the Kpong Dam Rehabilitation Project, including enhanced flood resilience, improved hydropower generation, and regional socio-economic development, outweigh the potential negative impacts. In addition, the EIA has determined that the project is environmentally feasible, provided that the recommended mitigation measures are strictly followed, and ongoing monitoring is undertaken. 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.

10.2 Recommendations

To ensure the sustainable and environmentally responsible implementation of the project, the following key recommendations are made:

10.2.1. Environmental Management and Monitoring

- Implement the Environmental Management Plan (EMP) in full to mitigate identified environmental and social impacts.
- Establish a robust environmental monitoring system to track the effectiveness of mitigation measures, focusing on water quality, biodiversity, and community health.
- Conduct regular audits to assess compliance with national environmental regulations and international best practices.

10.2.2. Biodiversity Conservation

- Protect local aquatic and terrestrial ecosystems by adhering to best practices for managing construction activities, especially near water bodies.
- Restore any disturbed habitats post-construction and ensure biodiversity offsets for any unavoidable loss of habitat.
- Monitor fish populations and water quality during construction and operation phases to mitigate impacts on aquatic life.

10.2.3. Water Quality and Resource Management

- Implement strict erosion and sediment control measures to prevent degradation of water quality in nearby rivers and reservoirs.
- Ensure that waste, particularly construction debris and hazardous materials, is handled and disposed of according to approved waste management protocols.
- Monitor water flow rates and hydrology to maintain the balance of ecosystems and prevent negative impacts on downstream water users.

10.2.4. Social and Community Engagement

- Strengthen engagement with local communities to keep them informed of project activities, timelines, and potential impacts.

- Establish a grievance mechanism to address any concerns from affected communities promptly and transparently.
- Ensure that local communities benefit from job opportunities and other economic spin-offs from the project.

10.2.5. Occupational Health and Safety

- Prioritize worker safety by implementing stringent health and safety protocols, particularly in high-risk activities such as working with heavy machinery and handling hazardous materials.
- Provide adequate training for workers on health and safety standards and emergency response procedures.

10.2.6. Climate Change Adaptation

- Incorporate climate resilience measures into the rehabilitation design, considering potential future climatic conditions such as increased rainfall or extreme weather events.
- Ensure that the spillway gates and dykes are upgraded to handle extreme weather scenarios, thus enhancing the long-term sustainability of the infrastructure.

10.3 Final Recommendation

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 project and shall submit progress environmental reports to the EPA as required. It is recommended that the Kpong Dam Rehabilitation Project proceed with the proposed mitigation measures and monitoring programs in place. This will ensure that the project achieves its intended objectives of enhancing energy security and water resource management while safeguarding environmental and social well-being.

The project shall also remain flexible to adapt to unforeseen environmental or social challenges, ensuring continuous improvement in environmental management and community relations throughout its life cycle.

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Kpong Dam Rehabilitation Project in the Lower Manya Krobo Municipal of the Eastern Region, Ghana

ENVIRONMENTAL IMPACT STATEMENT
List of Appendices

VOLTA RIVER AUTHORITY

SEPTEMBER 2024

LIST OF APPENDICES

:

APPENDIX 1

Environmental Permit for Akosombo Generation Station &Kpong Generation Station

ENVIRONMENTAL PROTECTION AGENCY

Environmental Permit

EPA/EMP/CE 2413/22/0570

(ENVIRONMENTAL MANAGEMENT PLAN)
ENVIRONMENTAL ASSESSMENT REGULATIONS, 1999 (LI 1652)

This is to Certify that

Authorisation has been given to

VRA AKOSOMBO & KPONG HYDRO ELECTRIC POWER PLANT

Located at Akosombo in th Asuogyaman District and Akuse in the Lower Manya Krobo District respectively in the Eastern Region

To continue the operation of an existing 1020MW Akosombo and 160MW Kpong Hydro Electric Power Generation Plants

From 1st January 2022 to 31st December 2024

As per attached Schedule

8TH JUNE, 2022
Date of Issue

E. Appah-Sampong
Deputy Executive Director
(Technical Services)
For: Ag. Executive Director

This Permit is only valid with the seal of the Environmental Protection Agency

Pollution Prevention Pays

APPENDIX 2

Appendix 2a	VRA Notification Letter to the Environmental Protection Agency
Appendix 2b	Environmental Protection Agency response to project notification

VOLTA
RIVER
AUTHORITY

Our Ref: EXR/041/011/1142
Your Ref:
Date: May 29 2024

The Executive Director
Environmental Protection Agency
P. O. Box M326
Accra

Dear Sir,

AKOSOMBO & KPONG HYDROELECTRIC POWER PLANTS:

REQUEST FOR OPINION ON ENVIRONMENTAL REGULATORY REQUIREMENTS FOR THE KPONG REHABILITATION PROJECT

We write in connection with the Environmental Permit No: EPA/EMP/CE.2413/22/0570 issued for the operational and maintenance phase of the Akosombo and Kpong Hydroelectric Power Plants.

The Volta River Authority intends to undertake the Kpong Rehabilitation Project, which involves the following activities as outlined in the attached project concept note:

1. ***Repair Of the Displaced Rockfill on The Upstream Slope of The Kpong Dam***
   During a routine dam safety inspection of the Kpong dam, it was observed that the rockfill on the upstream slope of the dam had been displaced, causing the benching of the dam along various sections of the West and East dykes of the dam. This is caused by the constant wave action on the face of the dykes, and the situation is likely going to worsen if not immediately addressed.

   The rehabilitation will therefore involve the placement of an additional rockfill on the upstream face of the Kpong Dyke to reduce the slope and increase the stability of the dyke. The rehabilitation work is expected to start in early 2025.

2. ***Rehabilitation Of Kpong GS Spillway Gates***
   An inspection of the spillway gates at the Kpong Generation station during the retrofit project (2014-2020) observed that the radial gates for the spillway and their supporting struts/structures had corroded extensively. Accordingly, the fifteen (15) spillway gates must be rehabilitated to address the above defects. This will involve dismantling the gates and replacing or refurbishing the electrical and mechanical components.

Currently, the European Union (EU), working with the European Investment Bank, is providing a loan for the project. In line with this, the EU requires information on the national environmental regulatory requirements for such activities.

We have indicated to the EU that, within the context of the Environmental Assessment Regulations, LI 1652 of 1999, and the Environmental Guidelines for the Energy Sector, 2011, existing projects such as the Kpong GS are mandated to submit Environmental Management Plans to be issued with an Environmental permit. VRA has subsequently complied with this, and EPA has an Environmental Permit for the Kpong Hydropower Station. The Permit mandates the VRA to notify the EPA of any changes in the existing operations, including system modifications and alterations. Thus, the proposed project will have to be officially communicated to the EPA, which will be done as part of progress annual environmental reporting.

In addition, the VRA intends to develop an Environmental & Social Management Plan (ESMP) specific to the Kpong Dam Rehabilitation Project to bring the project into compliance with applicable national legislation and regulations of Ghana as well as satisfy the requirements of the Environmental & Social Standards (February 2022) of the EIB Group. The ESMP will be a working document and will be accompanied by the following documentation:

a) Environmental Management Plan for Akosombo & Kpong Hydroelectric Power Plants (2022-2024), February 2022.
b) Emergency Preparedness Plan for the Akosombo and Kpong Dams, February 2011.
c) VRA Safety, Health and Environment Standards for Contractors, January 2013.

A sample format of the outline of the proposed ESMP is attached.

Again, the contractor shall be required to develop the underlisted plans, among others, to guide their work under the project:

- Health, Safety and Environmental Plan
- Waste Management Plan
- Risk Assessment Report
- Quality Assurance & Management Plan

Accordingly, we request the EPA's opinion on the appropriateness of our approach to addressing the environmental impacts of the Kpong Rehabilitation Project, which aligns with the national regulation, to enable us to conclude the loan arrangements with the EU.

Mr. Benjamin Sackey, Director of Environment & Sustainable Development has been assigned to coordinate this activity with your outfit and can be contacted at ben.sackey@vra.com.

Yours faithfully,

Ebenezer Tagoe
DEPUTY CHIEF EXECUTIVE (FINANCE)
For: CHIEF EXECUTIVE

Encl.

Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
E-mail: info@epa.gov.gh
Ghana Post (GPS): GA-107-1998

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra, Ghana
Website: http://www.epa.gov.gh

Our Ref: CE/2413/02/07 **20th June 2024**

VOLTA RIVER AUTHORITY
EXECUTIVE REGISTRY
RECEIVED
26 JUN 2024
HEAD OFFICE

The Deputy Chief Executive (Finance)
Volta River Authority
28th February Road, Electro Volta House
P.O. Box MB 77
Accra

Dear Sir,

RE: REQUEST FOR OPINION ON ENVIRONMENTAL REGULATORY REQUIREMENTS FOR THE KPONG DAM REHABILITATION PROJECT

We acknowledge receipt of your letter dated 9th May, 2024 with reference **EXR/041/011/1142** and the Project Concept Note (PCN) on the above subject for the purpose of obtaining environmental approval in accordance with the Environmental Assessment Regulations, 1999 (LI 1652).

We also refer to the field verification visit to the site and wish to indicate that the scope of works for the project, the key issues, concerns, and decision areas in the Project Concept Note (PCN) have been adequately addressed and should serve as the Terms of Reference (TOR) for the EIA study.

We wish to inform you that 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 measures consider in order to ensure sound decision-making and sustainable development of the project.

You are therefore required to conduct an Environmental Impact Assessment (EIA) study and submit six (6) hard copies to the Agency for review prior to permitting.

It is important to note that the Environmental Impact Statement must contain information on the consultants who prepared the report. 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 EPA Head Office **(Room 304/5)** or via **E-mail:** eaa.dept@epa.gov.gh for any assistance or guidance you may require in this regard.

Yours faithfully,

Enanatetteh

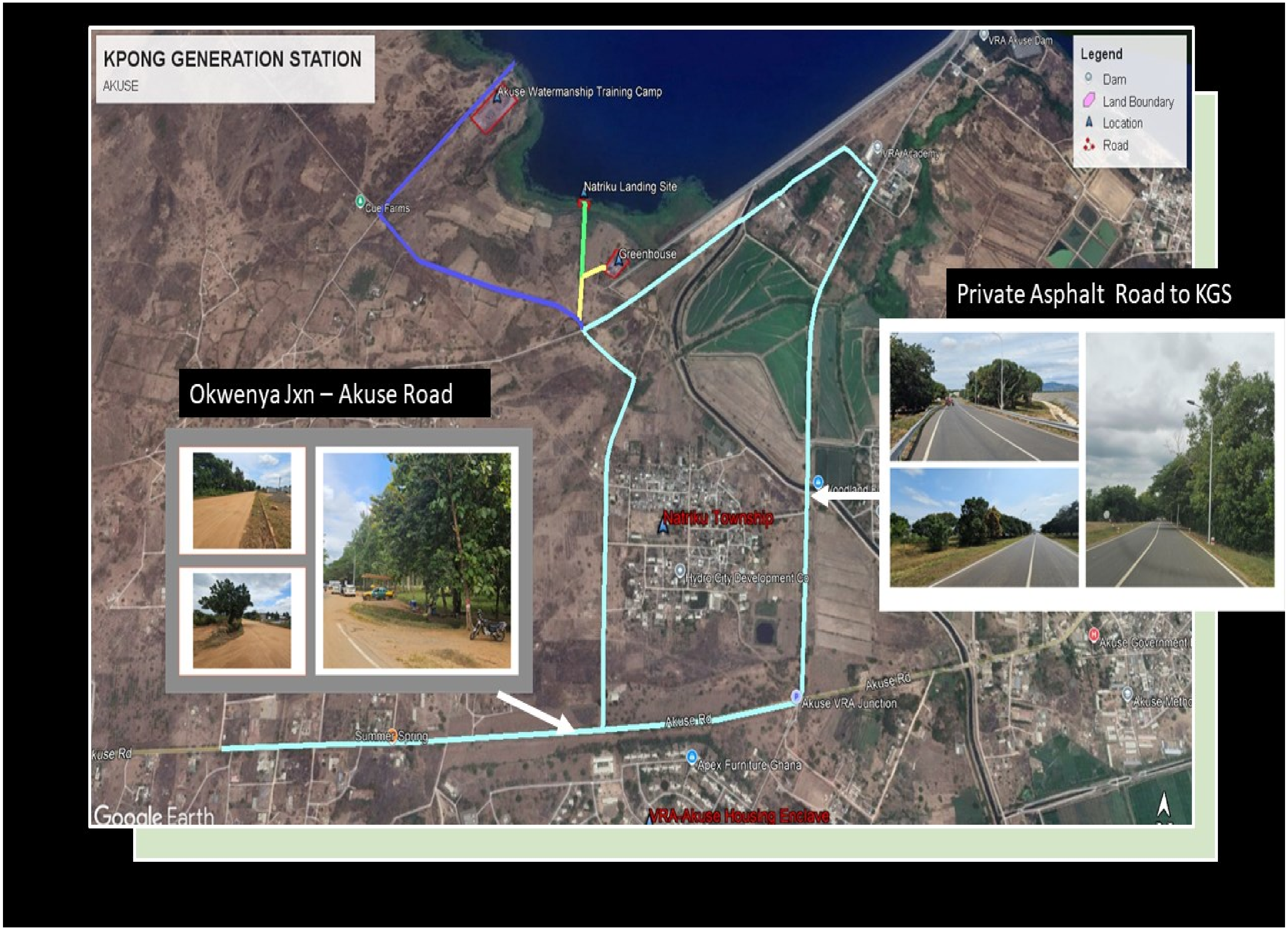
ING. ESI NANA NERQUAYE-TETTEH
AG. DEPUTY EXECUTIVE DIRECTOR/TECHNICAL SERVICES
FOR: EXECUTIVE DIRECTOR

Attached:
CC: Director EA&M Department, Head Office, Accra
The Director, EPA Eastern Regional Office, Koforidua

APPENDIX 3

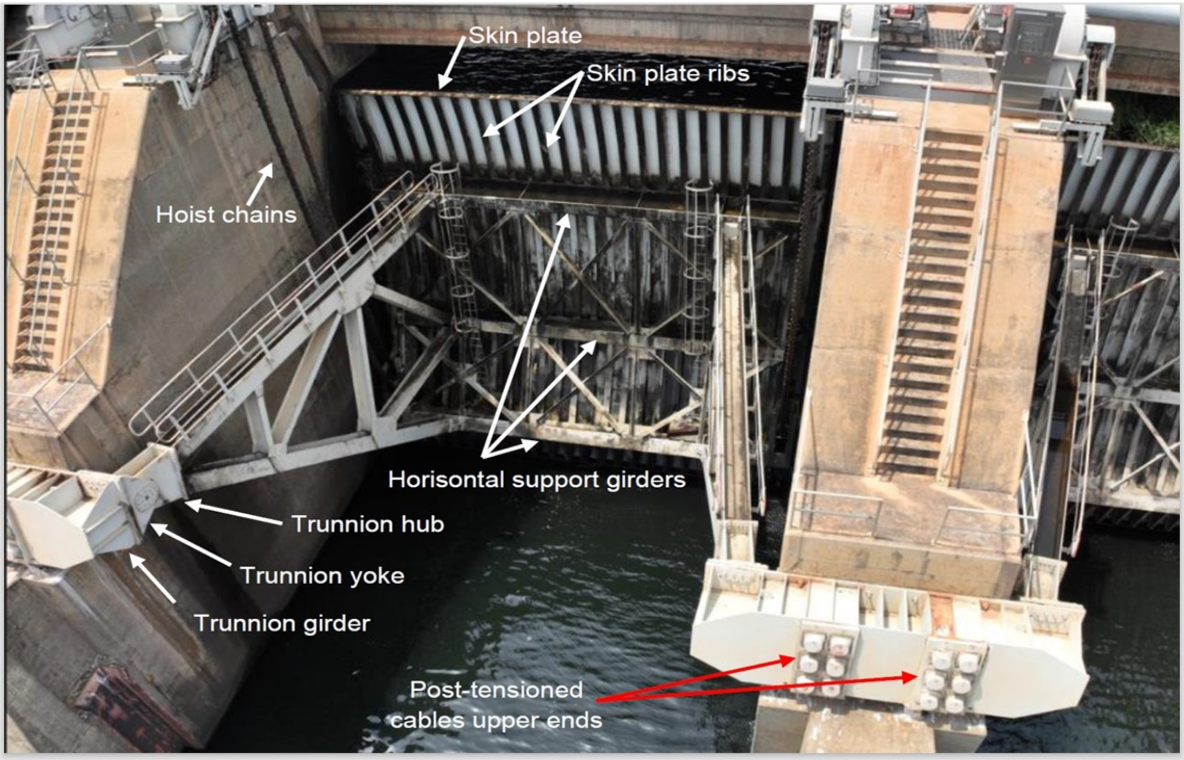
Appendix 3a	Google Earth Map of Layout of Kpong Generation Station
Appendix 3b	Access Routes to Kpong GS
Appendix 3c	Pictures of the Components of Spillway Gates
Appendix 3d	Google Earth Map of Office & Lay Down Areas

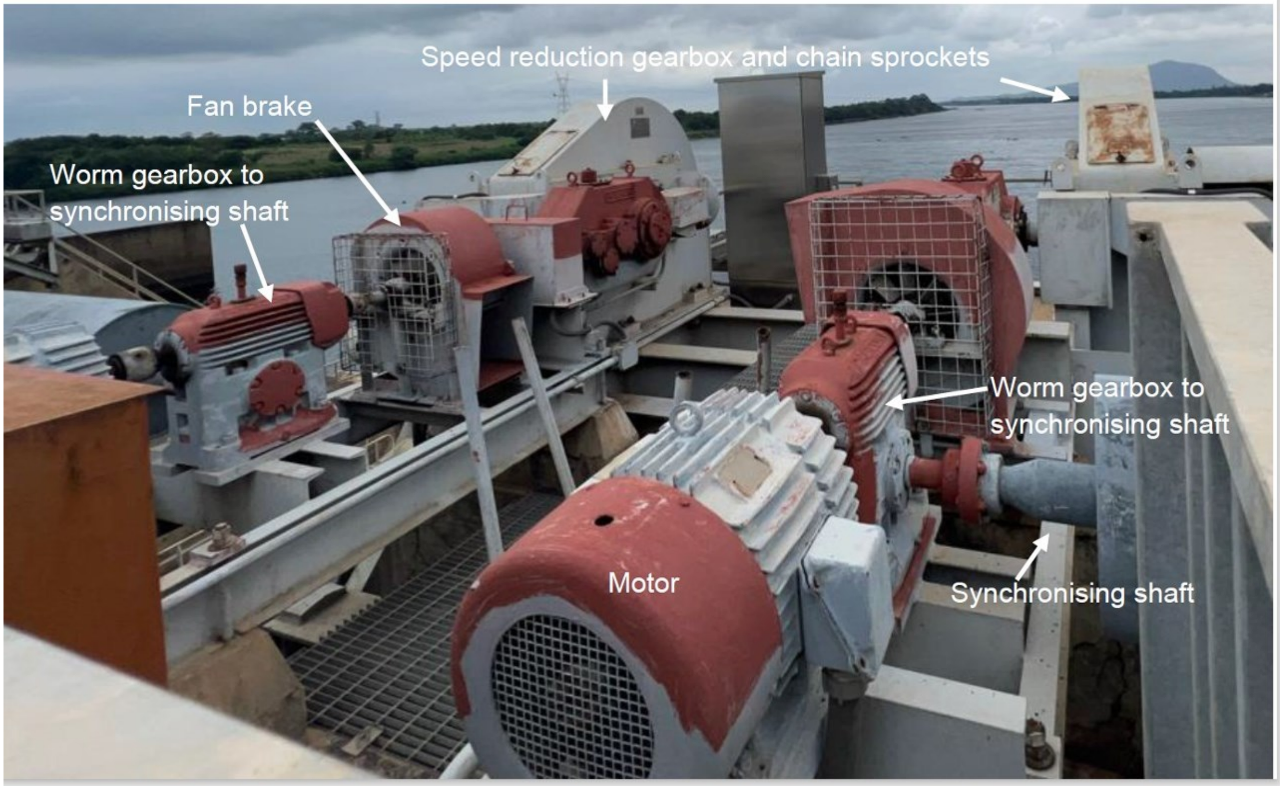
KPONG DAM LAYOUT
Legend
East Dyke – 3.2km
Spillway
Powerhouse
River Dam – 0.45km
West Dyke – 2.1km
Volta River
Volta River
EASTERN REGION
Google Earth
N
1 mi

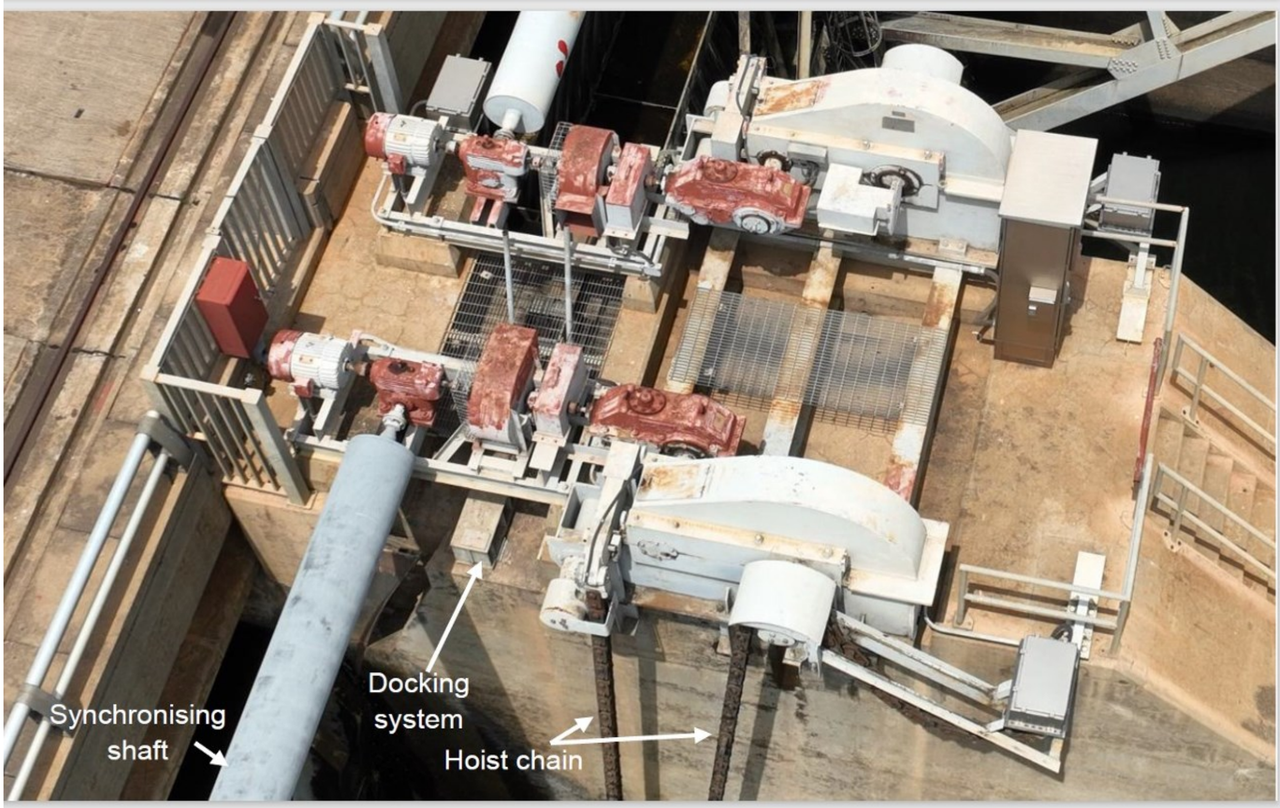


KPONG GENERATION STATION
AKUSE
Legend
Dam
Land Boundary
Location
Road
Akuse Watermanship Training Camp
Natriku Landing Site
Greenhouse
Cue Farms
VRA Akuse Dam
VRA Academy
Private Asphalt Road to KGS
Okwenya Jxn – Akuse Road
Natriku Township
Hydro City Development Co
Akuse VRA Junction
Akuse Rd
Summer Spring
Apex Furniture Ghana
VRA-Akuse Housing Enclave
Google Earth

Pictures of the Components of Spillway Gates



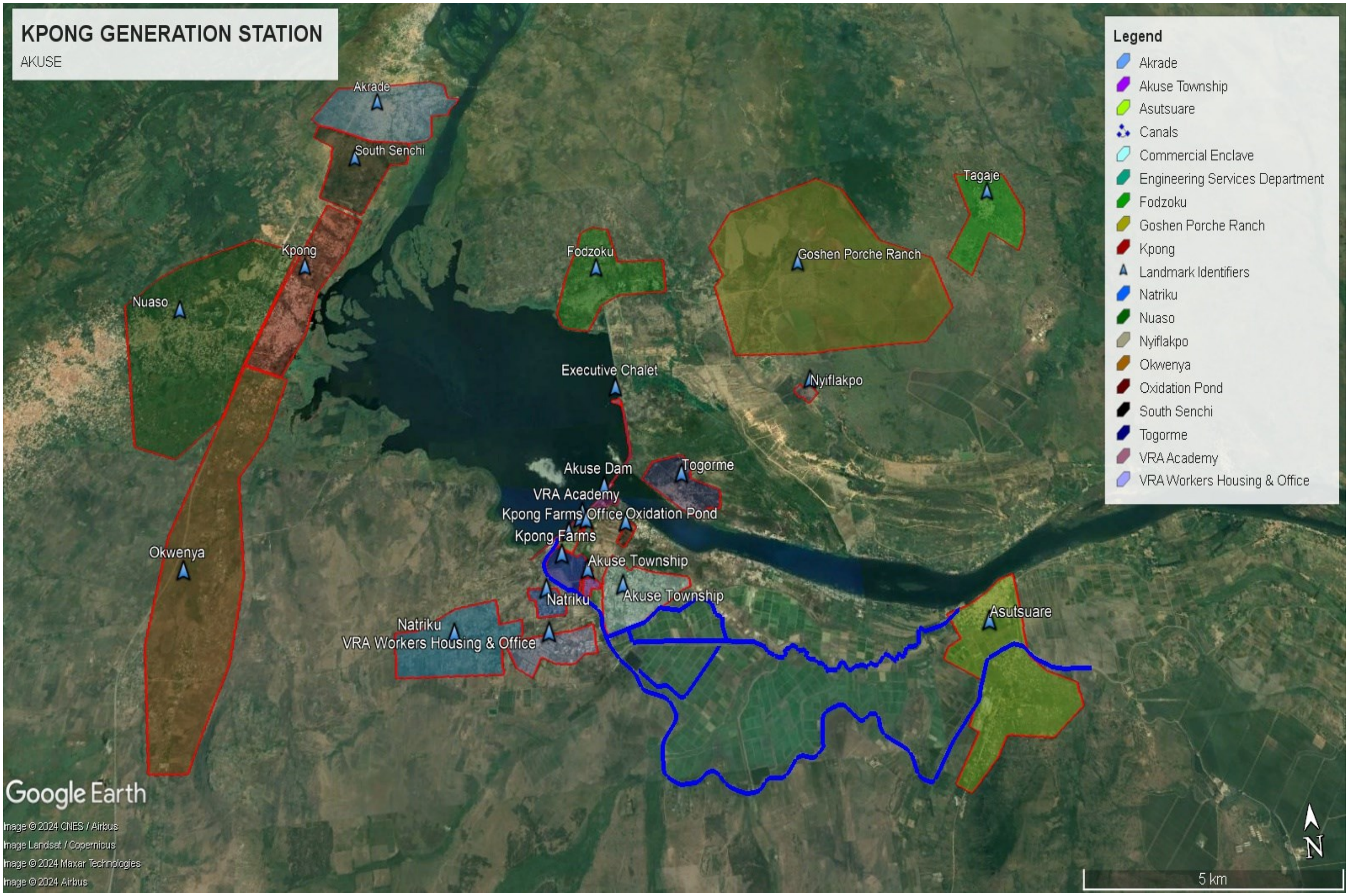

Speed reduction gearbox and chain sprockets
Fan brake
Worm gearbox to synchronising shaft
Worm gearbox to synchronising shaft
Motor
Synchronising shaft


Synchronising shaft
Docking system
Hoist chain


Legend
Area
Kpong Dam
Volta River
Sandblasting Area
Office (624sq.m)
Laydown Area (20,187sq.m)
Google Earth

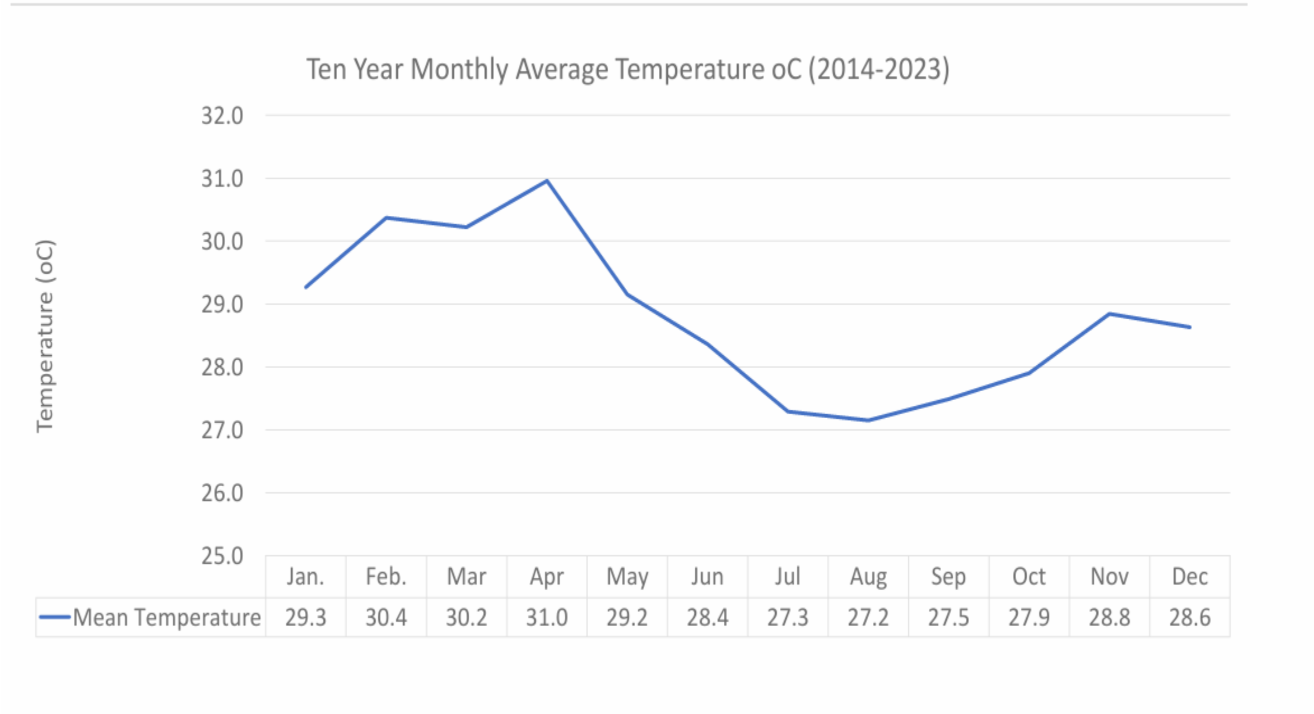
APPENDIX 4

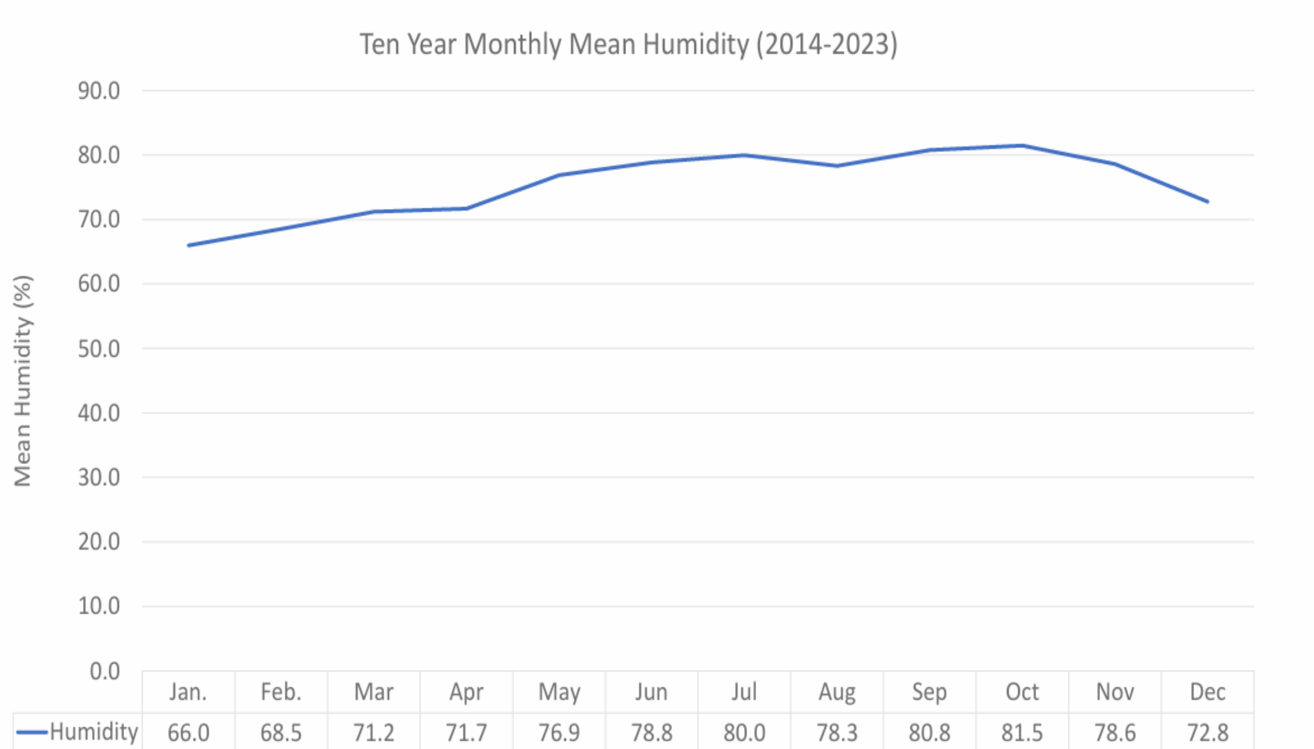
Appendix 4a	Google Earth Map of General Land Uses Around Kpong Generation Station
Appendix 4b	Diagrammatic representation of 10 years Climate data in Akuse Area
Appendix 4c	Noise and Air Quality Baseline Assessment Report
Appendix 4d	2022 VRA Lake Water Quality Pollution Monitoring Report
Appendix 4e	2023 VRA Lake Water Quality Pollution Monitoring Report
Appendix 4f	Facility Base Maps of the Lower Manaya Krobo Municipality
Appendix 4g	Overview of VRA Gender Action Plan

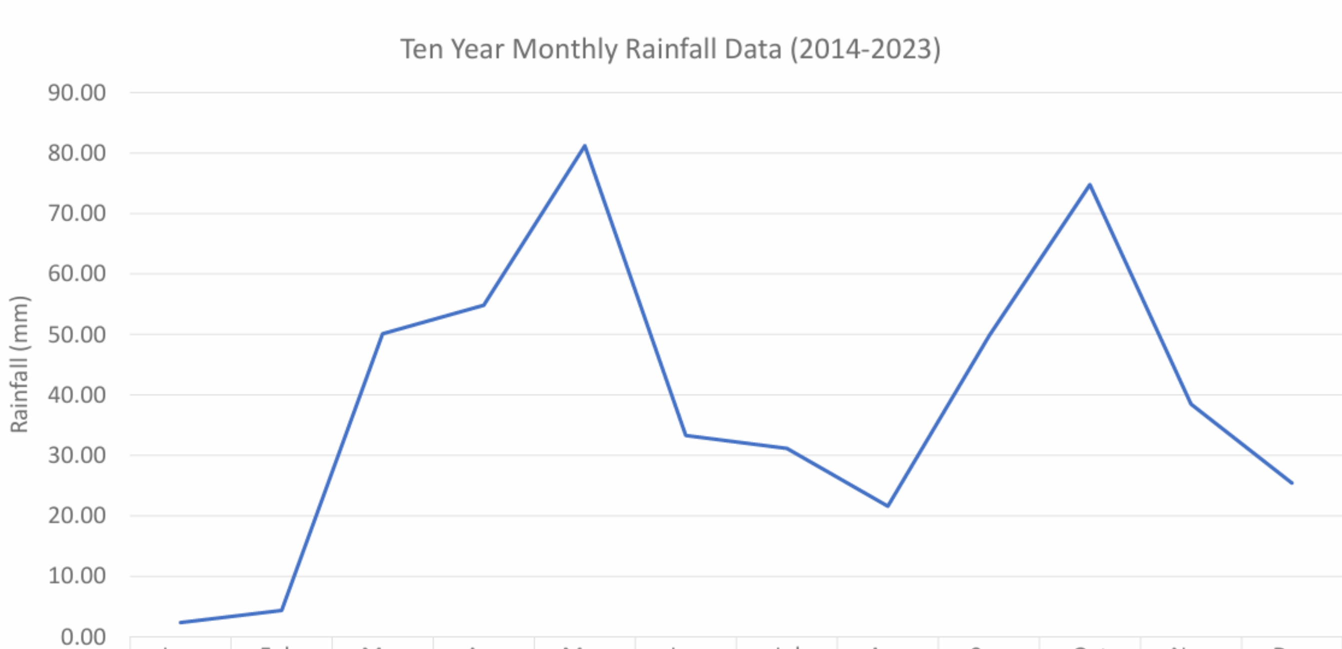


KPONG GENERATION STATION
AKUSE
Legend
Akrade
Akuse Township
Asutsuare
Canals
Commercial Enclave
Engineering Services Department
Fodzoku
Goshen Porche Ranch
Kpong
Landmark Identifiers
Natriku
Nuaso
Nyiflakpo
Okwenya
Oxidation Pond
South Senchi
Togorme
VRA Academy
VRA Workers Housing & Office
Akrade
South Senchi
Kpong
Nuaso
Fodzoku
Goshen Porche Ranch
Tagaje
Executive Chalet
Nyiflakpo
Akuse Dam
Togorme
VRA Academy
Kpong Farms Office
Oxidation Pond
Kpong Farms
Okwenya
Akuse Township
Natriku
Akuse Township
Natriku
VRA Workers Housing & Office
Asutsuare
Google Earth
Image © 2024 CNES / Airbus
Image Landsat / Copernicus
Image © 2024 Maxar Technologies
Image © 2024 Airbus
N
5 km

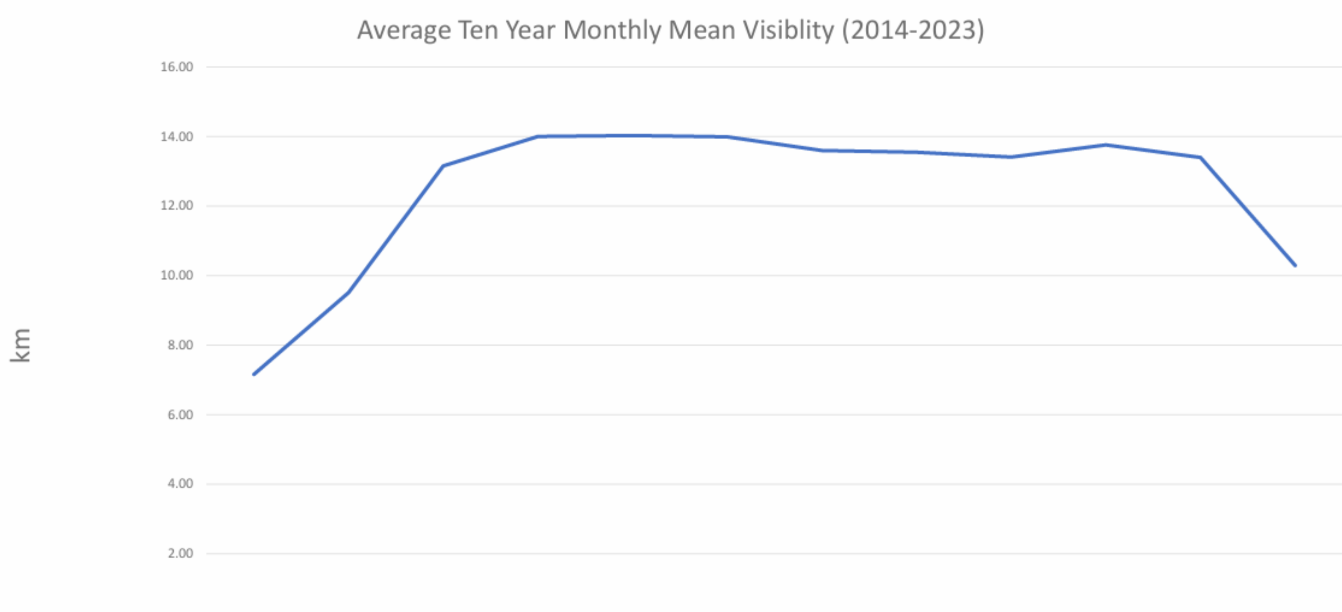
Appendix 4b : Diagrammatic Representation of 10 years Climate data



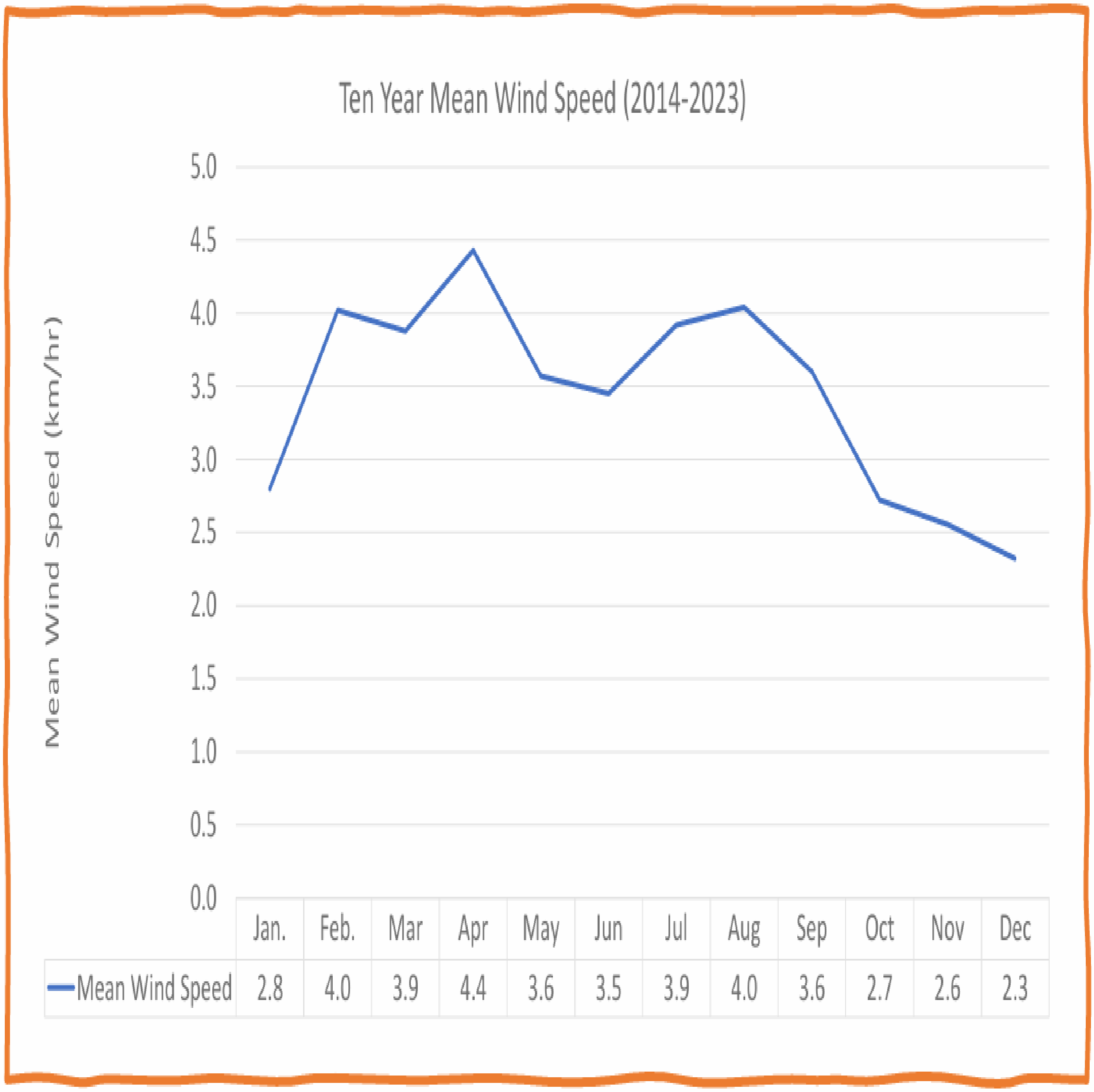




	Jan.	Feb.	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	2.34	4.34	50.12	54.81	81.21	33.30	31.17	21.59	49.73	74.79	38.50	25.40



	Jan.	Feb.	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Visibility	7.16	9.51	13.16	14.00	14.03	13.99	13.60	13.55	13.41	13.76	13.40	10.29


Ten Year Mean Wind Speed (2014-2023)
Mean Wind Speed (km/hr)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan.
Feb.
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Mean Wind Speed
2.8
4.0
3.9
4.4
3.6
3.5
3.9
4.0
3.6
2.7
2.6
2.3

ENVIRONMENTAL BASELINE MONITORING

Kpong Power Generation Akuse

Volta River Authority

Final Report

Ref: ERC529063

Prepared by

ENVASERV Research Consult

Prepared for

VOLTA RIVER AUTHORITY

August 2024

+233 30 292 5173 / www.envaservconsult.com / info@envaservconsult.com

Technical Report

Environmental Baseline Monitoring

Final Version

Prepared for

Kpong Generation Station
Volta River Authority

by

ENVASERV RESEARCH CONSULT Ltd.
P.O. Box 3797 Accra, Ghana
www.envaservconsult.com

Ref : ERC 529063

August, 2024

Document Control					**Document No. Ref : ERC529063**	
Version	**Date**	**Comment**	**Author**	**Checked**	**Approved**	**Client**
V0.1	14/08/2024	Original, for internal review	Osei Sarpong	L. Allotey/E. Ampong	L. Allotey	VRA
V0.2	27/08/2024	Draft, issued to client	Osei Sarpong	L. Allotey/E. Ampong	L. Allotey	VRA
V0.3	30/8/2024	Final report, after client review	Osei Sarpong	L. Allotey	L. Allotey	VRA

EXECUTIVE SUMMARY

This Baseline Air Quality and Noise Monitoring Report is prepared by Envaserv Research Consult for the Kpong Generation Station Rehabilitation Project. This report presents the baseline air quality and noise monitoring undertaken between August 6-9 2024 at three locations in order to better characterize the baseline air quality and noise in the vicinity of the Kpong dam.

The full set of results from the monitoring is summarized as follows:

The baseline air quality levels of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$) at all monitoring stations (Site A, Site B and Site C) were generally low and below the specified Ghana Standards (GS 1236:2019) limits. The 24-hour average SO_2 concentrations ranged from 6.05 to 12.51 µg/m³. NO_2 levels fluctuated between 1.71 and 4.89 µg/m³ but were well below the GS 1236:2019 limit of 150 µg/m³. The 8-hour average CO levels ranged from 0.20 mg/m³ to 0.46 mg/m³ respectively. The spatial trend indicated that the highest concentrations of SO_2, NO_2 and CO were observed at the roadside location of Site A (near to Akuse Main Junction). Wind patterns during the monitoring showed that the vicinity of the project experience wind from the south west direction.

The 24-hour average $PM_{2.5}$ and PM_{10} concentrations at the monitored locations did not surpass the Ghana Standards limits of 35 µg/m³ and 70 µg/m³ respectively. The measured 24-hour average PM_{10} levels were about 10-39% of the limit level of 70 µg/m³ while $PM_{2.5}$ were approximately 60-67% of the limit levels of 35 µg/m³. This suggests that an increase in $PM_{2.5}$ levels during the road construction and rehabilitation works could exacerbate the existing levels at receptors Site A and Site B if not controlled. The coarse PM_{10} dominate in the contributions to PM concentrations at all times during the 24-hour period. The primary source of particulate matter during the monitoring included windblown of loose particles from exposed surfaces and unpaved road and intermittent vehicle entrainment.

The noise assessment across the three sites -Site A, Site B and Site C reveals a varied noise environment, with each site experiencing different levels of noise pollution relative to the GS 1222:2018 allowable limits for mixed use and residential areas. The measured baseline daytime and night-time noise levels at the receptor locations of Site A and Site B were moderately high and exceeded the GS 1222:2018 limits for mixed used and residential areas respectively. Therefore, any additional noise from construction and rehabilitation activities is likely to exacerbate the existing noise conditions, leading to cumulative noise impacts. However, at the monitoring location Site C, classified as a mixed-use zone, noise levels did not exceed the GS 1222:2018 limits for both day (65 dBA) and night (55 dBA).

The primary sources of noise during the monitoring period were vehicular and motor bike traffic, audible music, entertainment activities, human conversations and bird chirping.
Based on the foregoing the following measures are recommended to be implemented when the project commences:

- Regularly apply water on construction sites and exposed surfaces, particularly sections of the Akuse road with heavy machinery to minimize airborne dust particularly $PM_{2.5}$
- Enforce low speed limits for construction vehicles within and around construction site to reduce dust generation
- The contractor must schedule most noise intensive activities to daytime hours and use machinery and equipment designed to operate lower noise emissions
- Implement continuous air quality and noise monitoring particularly $PM_{2.5}$ levels and noise levels to assess the effectiveness of dust and noise control measures
- Carryout community engagement to inform residents about project schedule including potentially noisy and dust generation activities and provide a channel for complaints.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ACRONYMS

AOI	Area of Influence
AQ	Air Quality & Noise Monitoring location
CO	Carbon monoxide
dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network.
EHS	Environment, Health and Safety
EPA	Environmental Protection Agency
ERC	Envaserv Research Consult
GS	Ghana Standard
IFC	International Finance Corporation
KGS	Kpong Generation Station
Leq	Equivalent continuous noise level
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_5, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that equalled or exceeded 5%, 10%, 50% and 90% of the time during the measurement
NE, NW	North East and North West Areas
NO_2	Nitrogen dioxide
PEL	Permissible Exposure Limit
PM_{10}, $PM_{2.5}$	Particulate Matter 10 and Particulate Matter 2.5
SE, SW	South-East and South-West Areas
SO_2	Sulphur dioxide
TSP	Total Suspended Particulates
TWA	Time Weighted Average
VRA	Volta River Authority
WHO	World Health Organization

CHAPTER ONE

1.0 Introduction

1.1 Background

The Volta River Authority (hereinafter "VRA") proposes to undertake a major rehabilitation project of the Kpong Generation Station (KGS) Dam near Akuse. The Volta River Authority was established on April 26,1961, under the Volta River Development Act, Act 46 of the Republic of Ghana, with the mandate to generate, transmit, and distribute electricity. The Authority owns and operates a total installed capacity of 2,532 MW of electricity generation capacity. The two main hydro plants on the Volta River, Akosombo and Kpong Generating Stations, have 1,020 MW and 160 MW, respectively. The Kpong Dam (Akuse Dam) is a hydroelectric power generating dam on the lower Volta River constructed between 1977 and 1982. It has a capacity of 148 MW near Akuse. Additionally, the dam also provides irrigation water for agriculture and municipal waste supply. Following years of operation, VRA intends to rehabilitate the dam which includes the construction of the Akuse to Okonya road. To assess the air quality and noise impacts of the rehabilitation and construction works, it was considered necessary to determine the existing ambient air quality and noise in the vicinity of the Kpong Dam.

Envaserv Research Consult (ERC) Ltd was commissioned by VRA to conduct baseline monitoring in order to characterize the baseline air quality and noise in the vicinity of the Dam and along the Akuse to Okonya road. This report provides the results of the baseline air quality and noise monitoring measurements undertaken.

1.2 Scope of Work

Specifically, the monitoring program was designed to achieve the following objectives:

- Conduct ambient air quality measurements at three selected sites within the vicinity of the Kpong Dam and along the Akuse to Okonya road.
- Determine the existing pollutants of primary concern (carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), Particulate Matter (PM_{10}) and Particulate Matter ($PM_{2.5}$)) in order to characterize the existing air quality
- Conduct noise measurements at the three selected monitoring locations to assess variations and identify any potential impacts on the communities
- Determine the meteorological conditions of wind speed, wind direction, rainfall, atmospheric temperature and relative humidity.
- Preparation and submission of the comprehensive environmental report.

1.3 Structure of Report

The outcome of the baseline ambient air quality and noise levels assessment is structured in a comprehensive report as follows:

A non-technical executive summary provides a synopsis of the assessment.

- Chapter 1 provides general background information as well as the scope of the study, a description of the project and also examines the assessment criteria and regulatory context.
- Chapter 2 explains the approach and methodology
- Chapter 3 provides the outcome of the results
- Chapter 4 provides conclusion and recommendation of the report.

1.4 Regulatory Framework and Assessment Criteria

1.4.1 National Ambient Air Quality Standards

The Ghana Standards for Environment and Health Protection – Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236:2019) provides for the maximum allowable concentration levels of various air pollutants that represent safe levels that avoid specific adverse health effects associated with each pollutant (Table 1).

Table 3: Ghana Standards (GS1236:2019) – Requirements for Ambient Air Quality

#	Substance	Maximum Limits	Averaging Time
1	Carbon Monoxide	100 mg/m³	15 minutes
		60 mg/m³	30 minutes
		30 mg/m³	1 hour
		10 mg/m³	8 hours
2	Sulphur Dioxide (SO_2)	520 µg/m³	1 hour
		150 µg/m³	24 hours
3	Nitrogen Oxides (measured as NO_2)	250 µg/m³	1 hour
		150 µg/m³	24 hours
4	Total Suspended Particulate	150 µg/m³	24 hours
		100 µg/m³	1 year
5	PM_{10}	70 µg/m³	24 hours
		70 µg/m³	1 year
6	$PM_{2.5}$	35 µg/m³	24 hours

1.4.2 Noise

The Ghana Standards for Health Protection – Requirements for Ambient Noise Control (GS 1222: 2018) provides guidance for the classification of receptors and their corresponding noise level limits. The Ghana Standards 1222:2018 provides maximum allowable limits for two-time brackets (i.e., Day (06:00 am -10:00 pm) and Night (10:00 pm - 06:00 am)) under seven receptor categories (Zone A, B, C, D, E, F and G) as shown in Table 2. The maximum allowable noise levels of relevance for this monitoring are detailed in Zones A & C and highlighted in

Table **4** below.

Table 4: Ghana Standards: Requirements for Ambient Noise Control (GS 1222:2018)

Zone	Description of Area of Noise Reception	Permissible Noise Level dB(A)	
		DAY 6:00 am -10:00 pm	**NIGHT** 10:00 pm - 6:00 am
A	Residential areas	55	48
B	Educational (school) and health (hospital, clinic) facilities, office, and courts	55	50
C	Mixed used (Residential areas with some commercial or light industrial activities)	60	55
D	Areas with some light industry, places of entertainment or public assembly and places of worship	65	60
E	Commercial areas	75	65
F	Light industrial areas	70	60
G	Heavy industrial areas	70	70

1.5 Criteria Air Pollutants

Six pollutants (i.e. sulfur dioxide, nitrogen oxides, ozone, carbon monoxide, particulate matter and lead) are termed as the Criteria Air Pollutants (CAP) for their abundances as pollutants in the atmosphere and ability to harm human health, plants and properties. For this project, the pollutants of concern are sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter (PM_{10} and $PM_{2.5}$). The following sections presents introductory notes on the characteristics, sources and health impact potential of each of the pollutants of concern.

1.5.1 Nitrogen dioxide (NO_2)

Nitrogen oxides (NOx) in the ambient air consist primarily of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a yellowish-orange to reddish brown gas with a pungent, irritating odor and is a strong oxidant. Excessive concentrations of NO_2 in the atmosphere can lead to significant environmental problems. These problems include photochemical smog, global warming, stratospheric ozone depletion and acid formation. Gaseous oxides of nitrogen also exhibit a greenhouse effect. Approximately 1% of total NO_2 levels in the atmosphere is formed from natural processes (i.e., lightning and by-product of photosynthesis). NO_2 are released into the air from motor vehicle exhaust or the burning of coal, oil, diesel fuel and natural gas especially in electric power plants. The major anthropogenic sources of NO_2 are combustion engines. Exposure to high levels of nitrogen dioxide can cause rapid burning and swelling of tissues in the throat and upper respiratory tract, difficult breathing, throat spasms and fluid buildup in the lungs. It can also interfere with the blood's ability to carry oxygen through the body, causing headache, fatigue, dizziness and blue color to the skin and lungs.

1.5.2 Sulphur dioxide (SO_2)

Sulphur dioxide is a major air pollutant typically found in the combustion products of materials and fuel containing sulfur. In the atmosphere, sulfur dioxide can be transformed into sulfuric acid or sulfates by a variety of processes (WHO, 1979) and can be precipitated as acid rain. Atmospheric sulfur dioxide, a major oxide of sulfur can be formed from both anthropogenic and natural sources. The primary anthropogenic source of sulfur dioxide gas is fuel combustion from power generation and industrial sources. Fossil fuels account for 75-85% of man-made sulfur dioxide emissions on global scale; industrial process such as refining and smelting account for the remainder (HSDB, 1998). The major adverse health effects associated with exposure to SO_2 pertain to the upper respiratory tract. SO_2 is a respiratory irritant with constriction of the bronchioles occurring with inhalation of SO_2 at 5 ppm or more. *(ACGIH, Threshold Limit Values for Chemical Substances 2023)*

1.5.3 Carbon Monoxide (CO)

Carbon monoxide (CO) is a colourless, odourless, tasteless and poisonous gas formed during incomplete burning of fuel. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiency of engines. CO enters the bloodstream through the lungs, where it displaces oxygen delivered to the organs and tissues. Elevated levels can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in the completion of complex tasks. CO also alters atmospheric photochemistry that contributes to the formation of ground-level O_3, which can trigger serious respiratory problems. Those who suffer from cardiovascular (heart and respiratory) disease are most at risk of exposure to elevated levels of CO. People with angina and peripheral vascular disease are especially at risk, as their circulatory systems are already compromised and less efficient at carrying oxygen. However, elevated CO levels can also affect healthy people. CO is often a by-product of incomplete combustion-if there is too little oxygen or too much carbon present when something burns, the burning produces carbon monoxide instead of carbon dioxide.

1.5.4 Particulate Matter (PM)

Particulate matter (PM) is a collective term used for every small solid and/or liquid particles found in the atmosphere. Particulates are divided into different particle size categories with Total Suspended Particulates (TSP) associated with nuisance impacts and the finer fractions of PM_{10} i.e., inhalable particulate matter (particulates with a diameter less than 10µm) and $PM_{2.5}$ i.e., respirable particulate matter (diameter less than 2.5 µm) linked with potential health impacts. Particulate matter and suspended particulate come from either natural or anthropogenic processes including pollen, salt spray, erosion, transportation, fuel combustion in stationary sources, industrial processes, land cleaning, wildfires and solid waste disposal (Vakeva et al., 1999, Adachi and Tainosho, 2004). PM_{10} is primarily associated with mechanically generated dust whereas $PM_{2.5}$ is associated with combustion process. The main hazard of particulate matter (fine particles) is the ability to penetrate deep within the lungs. On the other hand, the main adverse effect associated with TSP is dust nuisance, primarily due to soiling of clothes or building surfaces, reduce visibility but, depending on its physical or chemical characteristics, it may also cause surface deterioration of materials due to its abrasive or corrosive properties.

1.5.5 Environmental Noise

Ambient noise is generally defined as unwanted sound and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise propagation varies depending on several factors including source type (point or line), distance from source, wind conditions, presence of obstacles such as buildings, barriers and others such as terrain, humidity and precipitation. Noise energy does not accumulate either in the body or in the environment but can have both short-term and long-term adverse effects on people including sleep disturbance, annoyance, interference with speech and other daily activities, hearing impairment, effects on cardiovascular system and other related physiological health effects. According to the WHO (1999) noise above 80 dBA may also reduce helping behavior and increase aggressive behavior. Generally, annoyance is considered a major effect on community, as it is known to reflect the community dislike of noise and their concerns about the full range of potential negative effects. Sound levels are usually measured and expressed in decibels (dB) with 0 dB corresponding to the threshold of hearing. The A-weighting method is commonly used to quantify environmental sounds. This method consists of evaluating all of the frequencies of a sound in accordance with a weighting that reflect the facts that human hearing is less sensitive at low frequencies and extreme high frequencies than in the frequency mid-range (Roberts, 2013). Time varying character of environmental noise is commonly determined using statistical noise descriptors such as L5, L10, L50 and L90. They are the weighted noise levels equaled or exceeded during 5%, 10%, 50% and 90% of a stated time period respectively. The Leq is used to describe the average A-weighted noise level during a stated period of time. Generally, time periods are used to account for expected differences in daytime and night-time noises. It should be noted that exterior background noises are generally higher in daytime hours, however during night-time exterior noise becomes very noticeable. In this regard, a day/night average sound level which divides the 24-hour day into daytime of 06:00-22:00 and the night-time 22:00-06:00 is used to account for human sensitivity to night-time noise levels. With regard to public perception on increases in noise levels, it is reported that a change of only 1dBA in sound level cannot be perceived and that at least a change in sound level of 5 dbA is required before any noticeable change in community response would be expected (Cowan, 1994).

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 Study Area

The Kpong Dam is located in Akuse in The Eastern Region of Ghana. The dam is about 24 kilometers downstream of the Akosombo Dam. The land use around the dam includes agricultural, power generation activities and residential/communities. A number of villages closer to the Dam site include Natriku, Fodzoku and Akuse Town. Along the Akuse to Okonya is a mixed-use area with predominantly individual residences. -The baseline environmental assessment was conducted at three pre-established locations within the vicinity of the Kpong Dam and located at an equidistant of 5km apart.

2.1.1 Sampling stations

Field sampling for baseline assessment was conducted from 6th August to 8th August, 2024. The locations were chosen after prior discussions with VRA. Locations of the three (3) stations are shown in Table 3. The selected monitoring locations include residential properties and road locations which represent sensitive receptors and worst-case areas respectively. The baseline air quality monitoring locations are briefly described in Table 4 whilst Figure 1 provide a location map. Photographic record of the site locations is shown in Plate 1.

Table 3: GPS coordinates for the Air Quality monitoring locations

Location	Description	Latitude	Longitude
Site A	Near the Akuse Main Junction	N 6.093944'	E 0.044556'
Site B	Near the Enam's Collection Building	N 6.094139'	E 0.097000'
Site C	Near the KGS Dam Site	N 6.118122'	E 0.124227'

2.1.2 Emission Sources

Identification of emission sources within the vicinity of the Kpong Dam is critical part of this baseline assessment. Qualitative characterization of possible emissions was conducted through observations made during monitoring activity. The under-listed constitute various possible pollution sources around the Dam and along the Akuse road. Vehicular exhaust was the primary source of gas pollutants. Wind-blown dust contributed to the particulate matter levels. Other potential sources include but not limited to the following:

- Vehicular emissions on the Accra to Akosombo road and the Akuse to Okonya road
- Drifting emissions from other activities
- Domestic activities involving burning
- Wind-blown dust of exposed surfaces
- Vehicle entrainment of unpaved roads

The full description of the potential emission sources is presented in Table 4.

Table 4: Site description and observations during the monitoring

Station ID	Site Description/Observations
Site A Located at the Akuse Main Junction	This monitoring site is located at the Akuse Junction near the Redemption hotel. The immediate area is partly unpaved. Emissions to air generated by road traffic movements on the Accra-Atimpoku Road have the potential to affect monitoring location. Passing vehicles observed. Noise impact from domestic noises such as loud music, human speeches, alarm and horns of moving trucks and vehicles. No rainfall experienced during the monitoring at this location.
Site B Located along the Akuse – Okonya Road	This is a roadside monitoring site is located 5km south of the dam along the Akuse-Okonya road. Immediate surrounding is unpaved. This site was selected to represent the sensitive receptor close to the proposed road construction route. Surrounding land uses in the vicinity of the monitoring location include residences. Passing motorbikes and vehicles observed. Audible noise from domestic activities and adjacent residences.
Site C Located near the Dam Site. KGS	This location is the dam site. The general area is paved. Surrounding land uses in the vicinity include power generation and offices. Vehicle movement observed. No rainfall recorded during the monitoring period. Primary noise sources at the location include vehicle reverse alarms and horns of moving vehicles, human speeches and birds chirping.

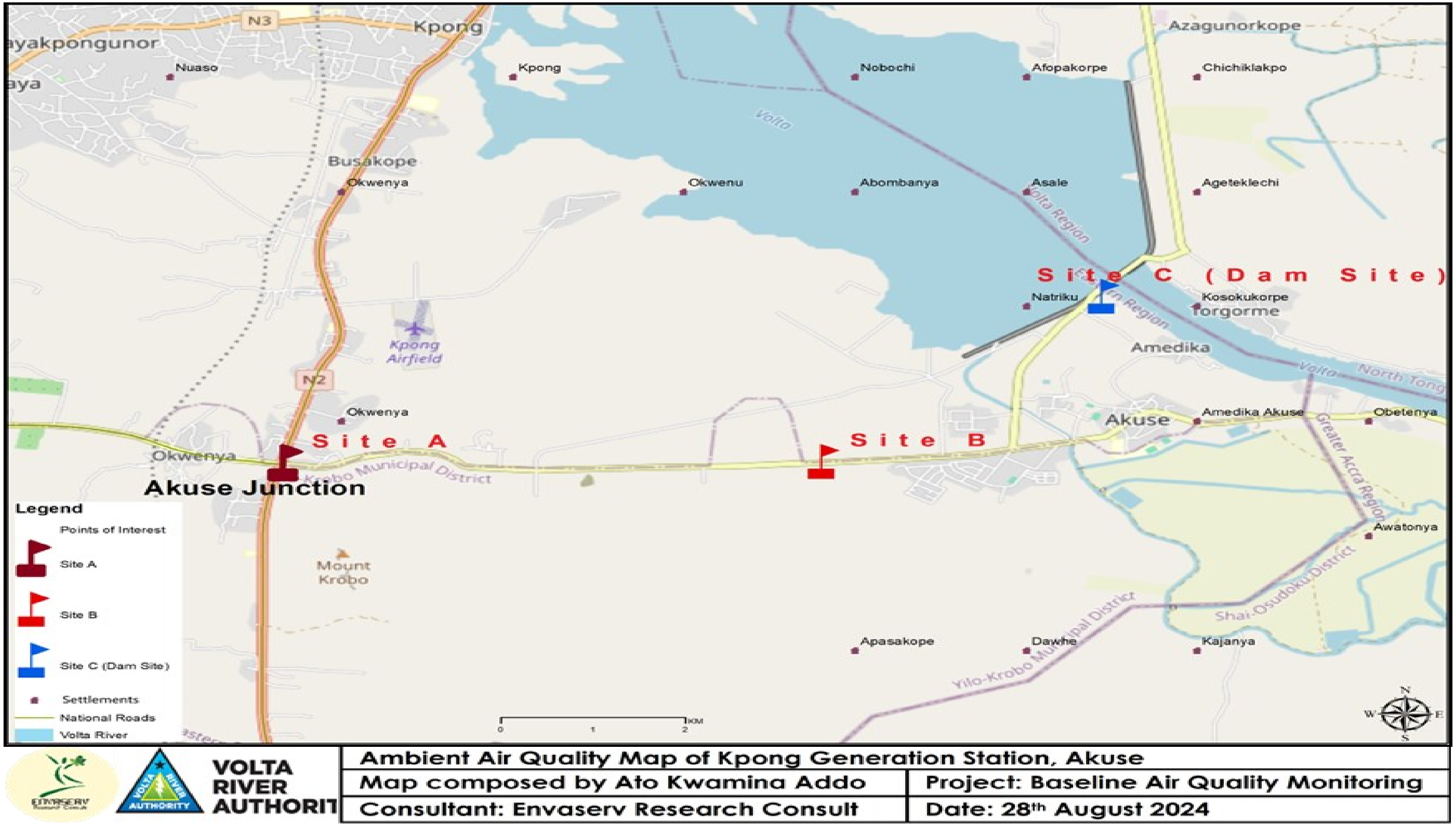


Figure 1: Map of AQ Monitoring Locations

2.2 Data Collection Methodology

The baseline data on ambient air quality and noise levels was collected between Tuesday August 6, 2024 and August 8, 2024. The baseline measurements were carried out with the Aeroqual AQM65 Air Quality Station, Vaisala weather station and Cirrus Mk 42S sound level meter for a 24-hour period at three geo-referenced monitoring locations.

2.2.1 Ambient Air Quality

An AQM65 Air Quality Station was used to measure the pollutants of concern. The AQM65 provides continuous real-time measurements of common air pollutants including carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon dioxide (CO_2), volatile organic compounds (VOCs) and particulates (TSP, PM_{10}, $PM_{2.5}$ & $PM_{1.0}$). The ambient air quality concentrations were taken at 1-minute interval for the 24-hour period of monitoring, from which hourly concentrations and 24-hour average concentrations were computed. The various analyzer modules in the AQM65 continuously measure the respective gas pollutants. Each module uses a technology that is most suited to the target parameter. NO_2 measurement modules are based on analytic Gas Sensitive Semiconductor (GSS) technology whiles CO, SO_2 measurement modules are based on Electrochemical Sensitive (GSE) technology. These technologies (NDIR, GSS and GSE) are a combination of smart measurement techniques and mixed metal oxide semiconductor sensors that exhibit an electrical resistance change in the presence of the target gas. Particulates measurement modules are based on the Optical Particle Counter Technology (OPC). The OPC uses a light source (laser diode), to illuminate particles and a photodetector to measure light scattered, absorbed, or emitted by those particles. Prior to the deployment the equipment zero calibration was performed on the AQM65 at each location.

2.2.2 Ambient Noise

The prevailing noise levels were obtained using the Class 1 Cirrus MK 427 sound level meter which meets the requirements of IEC 61672-1, operates in the A-weighting network and programmed to record equivalent sound pressure level (LAeq). The sound level metr was calibrated before the measurements and its calibration checked after, using Cirrus Sound Level calibrator (CR518) The sound level meter was set at a height of 1.2m above ground level. Noise measurements were undertaken for a 24-hour period at each monitored location to cover the regulatory requirements (i.e. day and night time). The Class 1 Cirrus MK 427 noise monitor, was integrated in the AQM 65 and data logged onto the embedded PC (ePC) which serves as a data storage system for the entire monitoring duration. The analysis of various noise descriptors (LA_{eq}, LA_{min}, LA_{max}, LA_{90}, LA_{50}, LA_{10}) were computed in Microsoft Excel using the noise monitoring data logged.

2.2.3 Meteorology

A meteorological station was deployed at Site C, which continuously recorded the weather regime for a 48-hour period during the monitoring and is representative of meteorological conditions (wind, temperature, humidity, rainfall) across the broader project area. The meteorological data was recorded with the Vaisala weather Transmitter WXT530 mounted at a height of about 10 meters above the ground. The Weather Transmitter WXT530 is a complete weather station that measures seven parameters simultaneously. It measures wind speed and direction, precipitation, air temperature, barometric pressure and relative humidity. The transmitter is IP65/IP66 rated. The weather station is interconnected with the AQM 65 which has an embedded PC serving as a storage system for logged data.

2.3 Quality Control & Assurance

2.3.1 Air Quality

Rigorous and comprehensive quality control/quality assurance (QA/QC) was implemented to ensure the accuracy and precision of the results. A documented quality assurance and control program, maintenance and calibration were implemented to ensure reliable and credible results. Both span and zero calibrations were carried on the AQM65 prior to field monitoring. The span calibration is meant to confirm the accuracies of the respective gas sensors by supplying the AQM65 equipment with a certified standard gas concentration.

The zero-air calibration is to ensure that the gas sensors are well activated and that recorded readings are stable and consistent. The zero-air calibration involves the introduction of a zero air into the AQM 65 equipment using the AirCal 1000 Portable calibrator. The span calibration was performed prior to field deployment whereas the zero calibrations was done *in-situ*. Prior to calibration, the equipment was adequately warmed to ensure effective and reliable results after calibration.

2.3.2 Noise

In order to ensure that the quality of the measurement was maintained and improved against set benchmarks and to ensure that any errors encountered were either eliminated or reduced, the following steps were taken for quality control and assurance for the noise monitoring.

- Calibration was performed with a calibrated sound calibrator in an environment where the ambient noise level according to the manufacturer's specification and standard procedures.
- Routine daily visits were carried out at all monitoring locations by a trained engineer to ensure that the equipment is operating at optimal levels and to perform any maintenance if required,

- The microphone of the noise meter was installed at a height of 1.5 meters above the ground level and 3m away from any reflecting surface, obstacles and building walls.

2.3.3 Meteorology

In order to ensure strict adherence to quality control and assurance, the mounting of the weather station was installed according to the manufacturer's specification.

Plate 1 : Images showing the air quality and noise monitoring

CHAPTER THREE

3.0 MONITORING RESULTS

3.1 Meteorological conditions

Ghana has a tropical climatic condition with two main seasons namely, the wet and dry seasons. The northern part of Ghana experiences rainy season from April to mid-October while the southern sector experiences rain from March to mid-November. The dry season is accompanied by dry desert wind (harmattan) which blows from North East of Ghana from December to March thereby lowering the humidity and causing hotter days and cooler nights in the Northern part of Ghana.

Meteorological factors such as wind speed, wind direction, pressure, relative humidity, temperature and rainfall play important roles in the transportation and distribution of air pollutant thereby influencing population exposure and risk of impact. The meteorological data (wind speed and wind direction) was obtained from the use of the Vaisala Weather Transmitter WXT530 during the monitoring period. Table 5 shows the meteorological data recorded at Site C.

Table 5: Meteorological measurements at the Site C (Kpong Generation Station Dam)

	Wind Speed (m/s)			Wind Direction (°)		
	Max	Min	Average	Max	Min	Average
DAY 1	1.94	0.37	1.02	293.50	110.70	248.30
DAY 2	2.23	0.54	1.22	290.90	125.80	258.35
	Temperature (°C)			Relative Humidity (%)		
DAY 1	30.50	23.80	26.30	88.60	58.70	76.55
DAY 2	31.10	23.90	26.61	89.60	55.20	76.06

3.1.1. Temperature

Temperatures follow the expected seasonal pattern of cycling between warmer temperatures in the dry season and cooler temperatures in wet season. The minimum average hourly temperature was 23.80 °C at (04:00 GMT) on August 07, 2024. While the maximum was 30.50 °C at (14:00 GMT) and on August 06, 2024. Temperature inversions are a result of other weather conditions in an area. They occur most often when a warm, less dense air mass moves over a dense, cold air mass. Temperature inversions affect air pollution because they change the dynamics of air movement. Warm air rises in the atmosphere because it is less dense and, therefore, more buoyant than the cooler air above it. This smothering effect traps air pollutants and allows their concentrations to increase. According to Doug (2020), surface inversions are responsible for producing smog, trapping the pollutants produced by vehicles, fires and industrial activities. Furthermore, the hydrocarbons and nitrogen oxides present in these trapped pollutants are converted into harmful ozone by sunlight, which reduces air quality.

3.1.2 Relative Humidity

Generally, relative humidity affects the natural deposition process of particulate matter (PM), whereby moisture particles adhere to particulates, accumulating atmospheric PM concentration. With increasing humidity, moisture particles eventually grow in size to a point where dry deposition occurs, reducing PM_{10} concentrations in the atmosphere. PM_{10} tend to be low even when there is increase in relative humidity and high when there is decrease in relative humidity (Hernandez, G et al, 2017). The hourly relative humidity measurements typically fluctuated between 58.70% and 88.60%. The average relative humidity during the monitoring period was 76.55%

3.1.3 Rainfall

During the entire monitoring period, there was no rainfall at the monitored locations. Therefore, no rainfall levels were recorded during the baseline monitoring assessment.

3.1.4 Local Wind Regime

The local metrology largely determines the pattern of off-site air quality impact on receptors. The effect of wind on dispersion patterns can be examined using distributions at the project site. The winds at a site are most readily displayed by means of wind rose. Wind direction is an indicator of the direction from which wind originates and blows and provides better perspective in understanding the behavior and impact of air pollutants. A wind rose plot has been generated to give a succinct view of how *wind* speed and direction are typically distributed within the project area of influence (Figure 2).

Figure 2 indicates that the vast majority of winds come from the west with varying wind speeds including some strong winds with proportions from both northwest and southwest. The average wind speed during the monitoring period was 1.04m/s. Wind speed has a great effect on the air flow and pollutant dispersion (Hao Zhang et al., 2015). In terms of poor dust conditions, the incidence of light winds is important for poor dispersion, while the strongest winds create the most wind erosion. As seen in the wind rose, most of the light winds (0-0.50 m/s) originate from the south-west. The strongest winds have the vast majority with a north-westerly component suggesting sensitive receptors west and southwest of the site will be most vulnerable. There were no calms recorded which implied that there was no stagnation of wind speed hence possible dilution of pollutants.

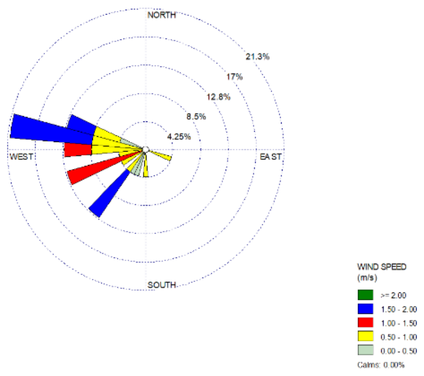


Figure 2: Wind blowing from

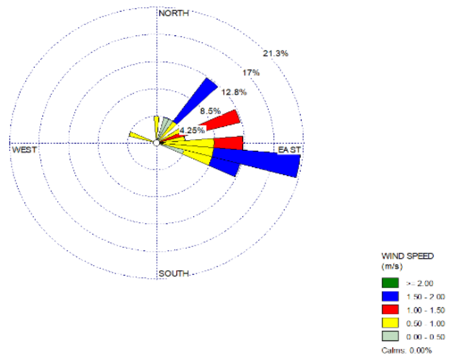


Figure 3: Wind blowing to

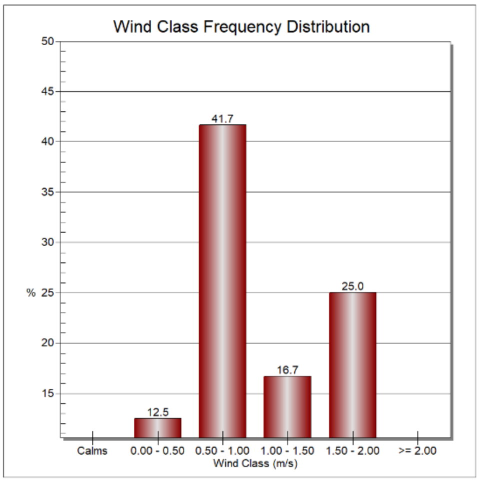


Figure 4: Wind Class Frequency Graph

3.2 Existing Ambient Air Quality

3.2.1 Carbon monoxide (CO)

The 8-hour mean CO measurements conducted at the three monitoring locations ranged from 0.20 mg/m^3 to 0.46 mg/m^3 (Figure 5). The highest average CO level was recorded at Site A – Akuse Main Junction with 0.46 mg/m^3 during the monitoring period. The elevated CO levels at Site A are attributed to domestic activities involving burning and drifting emissions from passing vehicles, heavy duty trucks and motorbikes. The measured average CO levels at the monitored locations during the monitoring period were below the Ghana Standards limit of 10 mg/m^3. Figure 6 shows the 8 hour variations in Co levels within the vicinity of the dam.

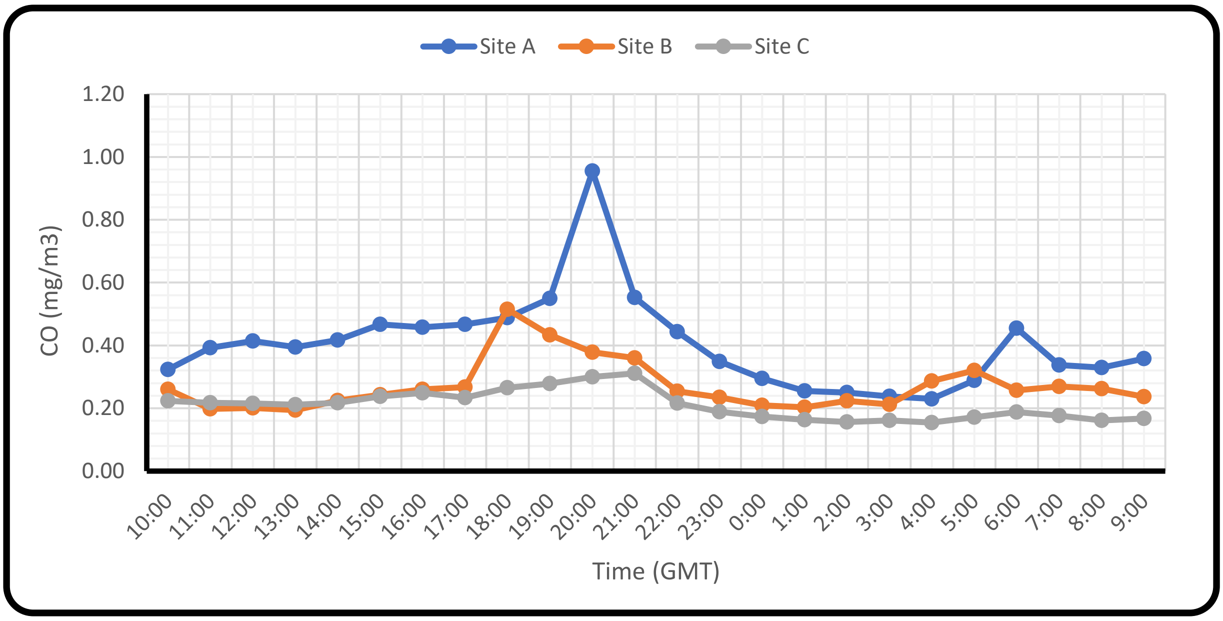


Figure 5: Hourly CO Variations at the monitored locations

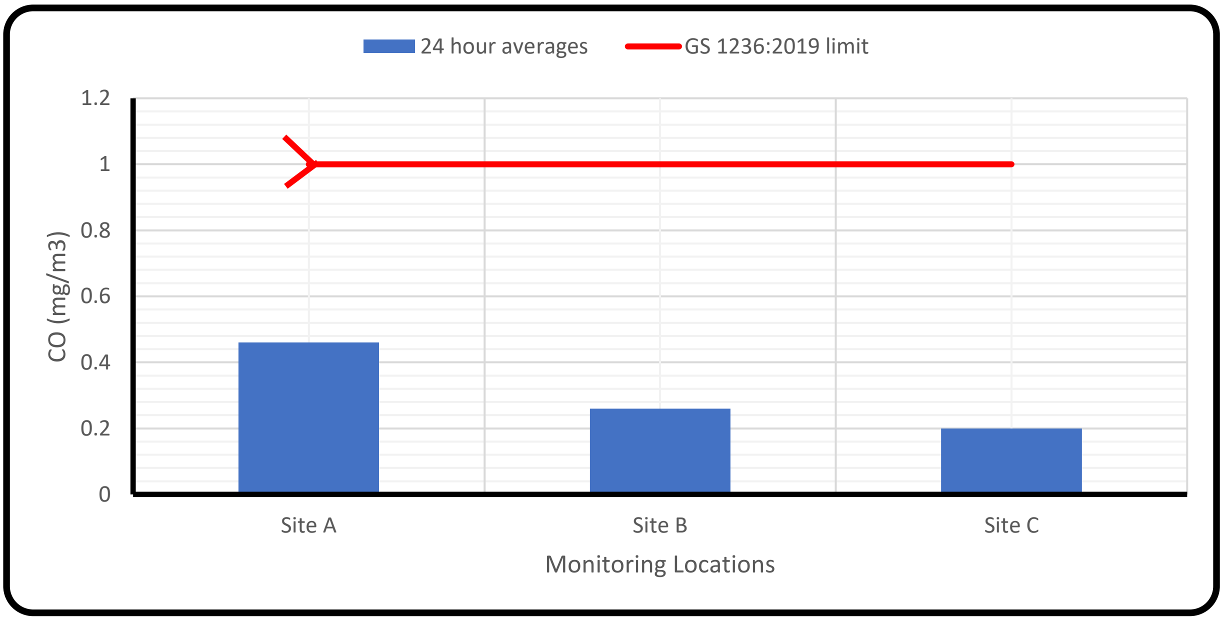


Figure 6: 8-hour CO Variations at the monitored locations (GS 1236:2019 Limit CO – 10 mg/m^3)

3.2.2 Nitrogen Dioxide (NO_2)

Figure 7 illustrates the hourly NO_2 concentrations recorded within the vicinity of the Dam. Figure 8 illustrates the daily 24-hour average NO_2 concentrations. The 24-hour average nitrogen dioxide (NO_2) levels varied from 1.71 µg/m^3 at Site C to 4.89 µg/m^3 at Site A. Comparatively, higher NO_2 levels were recorded at Site A, likely due to emissions from vehicle and motorbike traffic and domestic activities involving burning. Site A is a roadside location which has regular vehicular traffic. High levels of nitrogen dioxide can cause damage to the human respiratory tract and increase a person's vulnerability to, and severity of respiratory infections and asthma.

Long exposure of the elevated measured levels can cause chronic lung diseases. Nonetheless, maximum NO_2 levels measured at all the monitored locations during the monitoring periods were below the Ghana Standards permissible limit of 150 µg/m³.

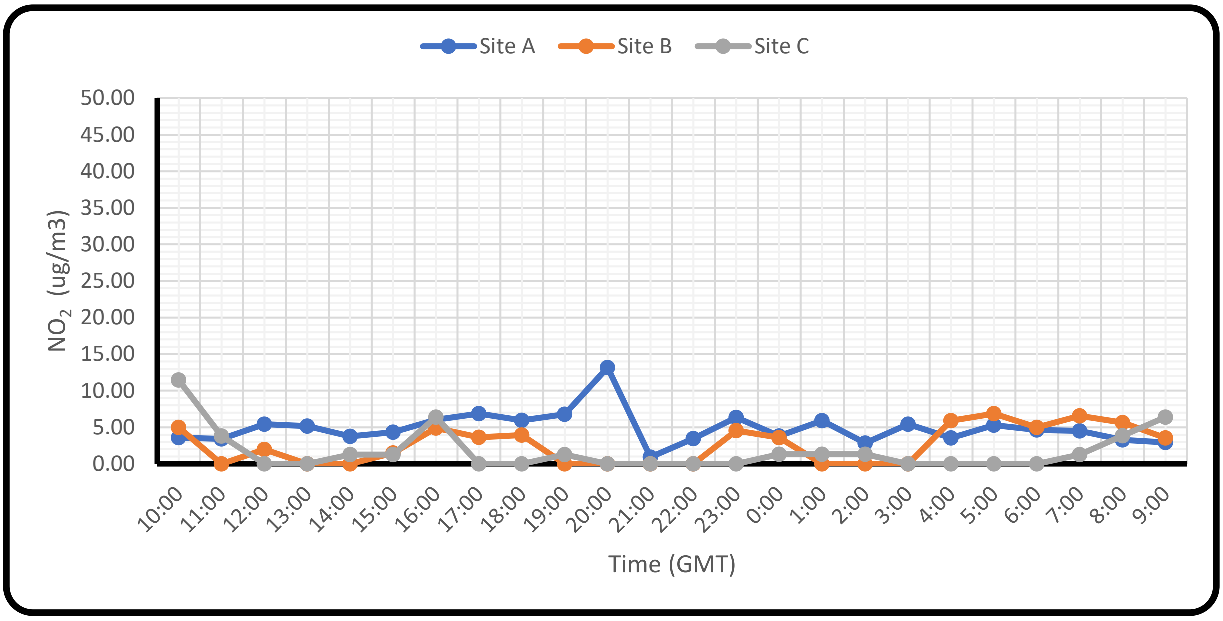


Figure 7: Hourly NO_2 Variations at the monitored locations

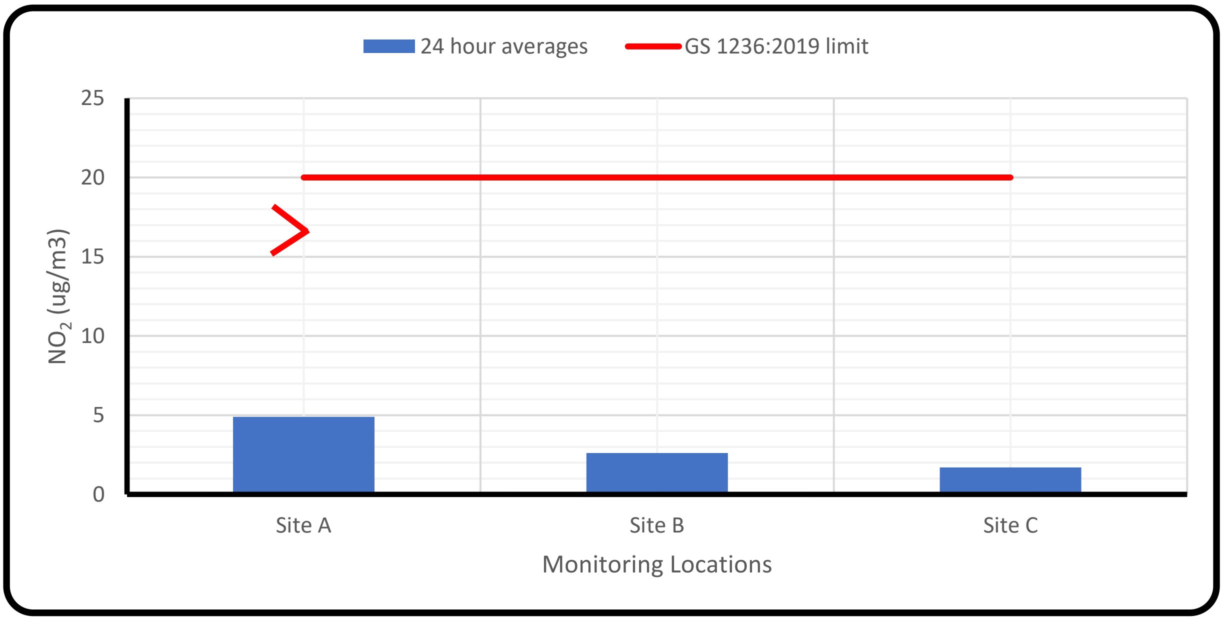


Figure 8: 24 Hour NO_2 Variations at the monitored locations (GS 1236:2019 Limit – 150 µg/m³)

3.2.3 Sulfur Dioxide (SO_2)

Variations in SO_2 concentrations were in a range of <2.56 µg/m³ to 28.5 µg/m³ (Figure 9). The 24-hour average SO_2 concentrations were 6.05 µg/m³ at Site C, 9.76 µg/m³ at Site B and 12.51 µg/m³ at Site A. The peak concentration was recorded at Site A (Figure 10). The Dam area (Site C) recorded the lowest concentration of SO_2 and the other gases. The 24-hour mean SO_2

levels measured at all the sites for the entire period were below the GS 1236:2019 of 150µg/m³. Figure 8 illustrates the hourly SO_2 variations at the monitored locations.

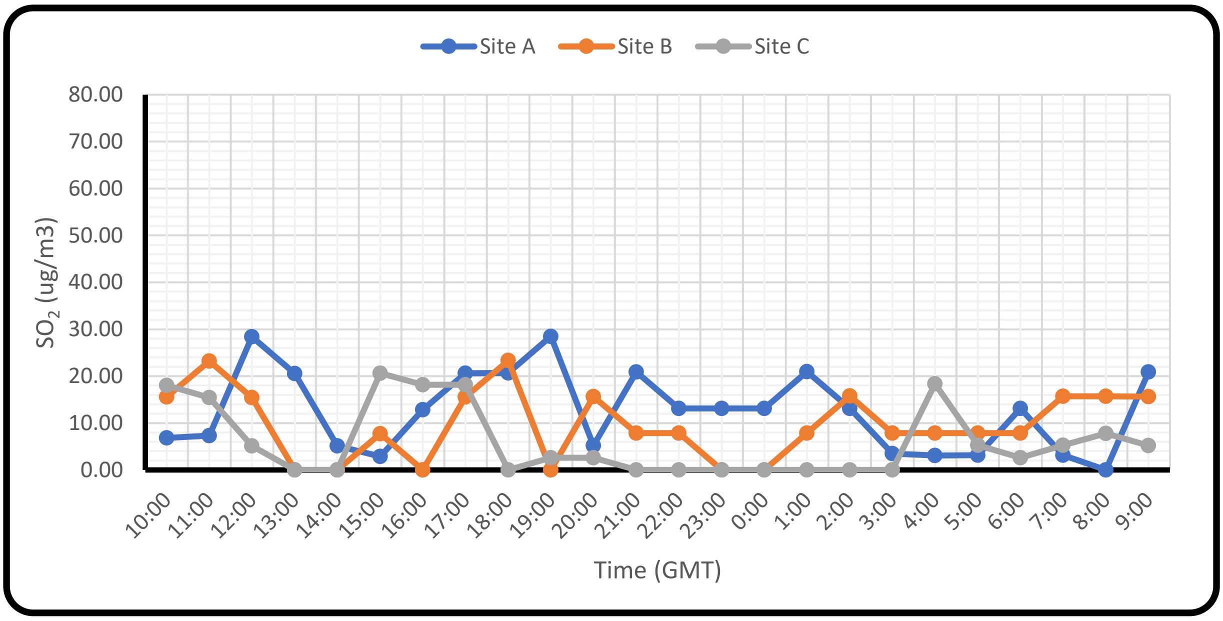


Figure 9: Hourly SO_2 variations at the monitored locations

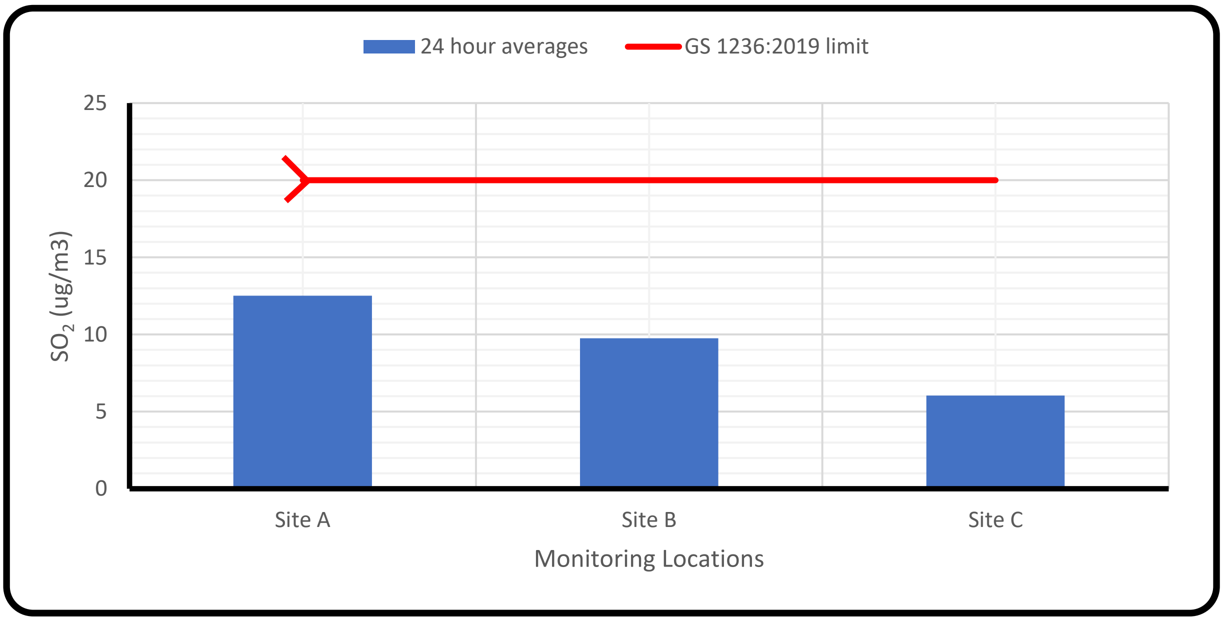


Figure 10: 24 Hour SO_2 variations at the monitored locations (GS 1236:2019 Limit – 150 µg/m³)

3.2.4 Particulate Matter (PM_{10} & $PM_{2.5}$)

$PM_{2.5}$

Mean hourly $PM_{2.5}$ concentrations varied from 1.58 µg/m³ and 116.85 µg/m³ (Figure 10) with 24-hour average $PM_{2.5}$ concentrations of 23.55 µg/m³, 20.3 µg/m³ and 2.10 µg/m³ at Site A, Site B and Site C respectively. Episode of relatively high $PM_{2.5}$ concentrations is discernible at 20:00 GMT at Site A. The definitive cause of this elevated concentration is not known but it is likely to be due to emissions from a vehicle exhaust or windblown dust. The primary sources of $PM_{2.5}$

during the entire monitoring period were windblown dust of exposed surfaces and vehicular emissions. The results indicate that background $PM_{2.5}$ concentrations at Site A and Site B are elevated, accounting for approximately 60-67% of the permissible limit of 35 µg/m³. During the rehabilitation works and the road construction, if not properly controlled, the main sources of PM2.5 are expected to exacerbate these levels at these receptors due to the already relatively high background concentrations. The current $PM_{2.5}$ concentrations were still below the GS 1236:2019 limit of 35 µg/m³.

PM_{10}

The 24-hour average PM_{10} concentrations at all the monitored locations were found to be below GS 1236:2019 limit of 70 µg/m³. The daily average PM_{10} concentrations during the monitoring period ranged from 7.02 µg/m³ at Site C to 27.44 µg/m³ at Site A (Figure 13). The hourly trend in PM_{10} concentrations showed a similar trend as observed with the $PM_{2.5}$. It can be seen that in general the PM_{10} concentrations were comparatively higher for a greater part of the monitoring at Site B, except for the single episode of elevated PM_{10} concentration recorded at Site A at 20:00 GMT. Site A and Site B are road side locations it is plausible the relatively high PM_{10} concentrations at these locations are influenced by wind-blown dust of exposed surfaces and vehicular movements. The measured 24-hour average PM_{10} levels were about 10-39% of the limit level of 70 µg/m³ The main sources of dust and particulate matter for the proposed project are likely to be road construction phase and vehicle movements to and from project site. Figures 11 – 14 illustrate the hourly and daily mean variations particulate matter ($PM_{2.5}$ and PM_{10}) levels recorded at the monitored locations.

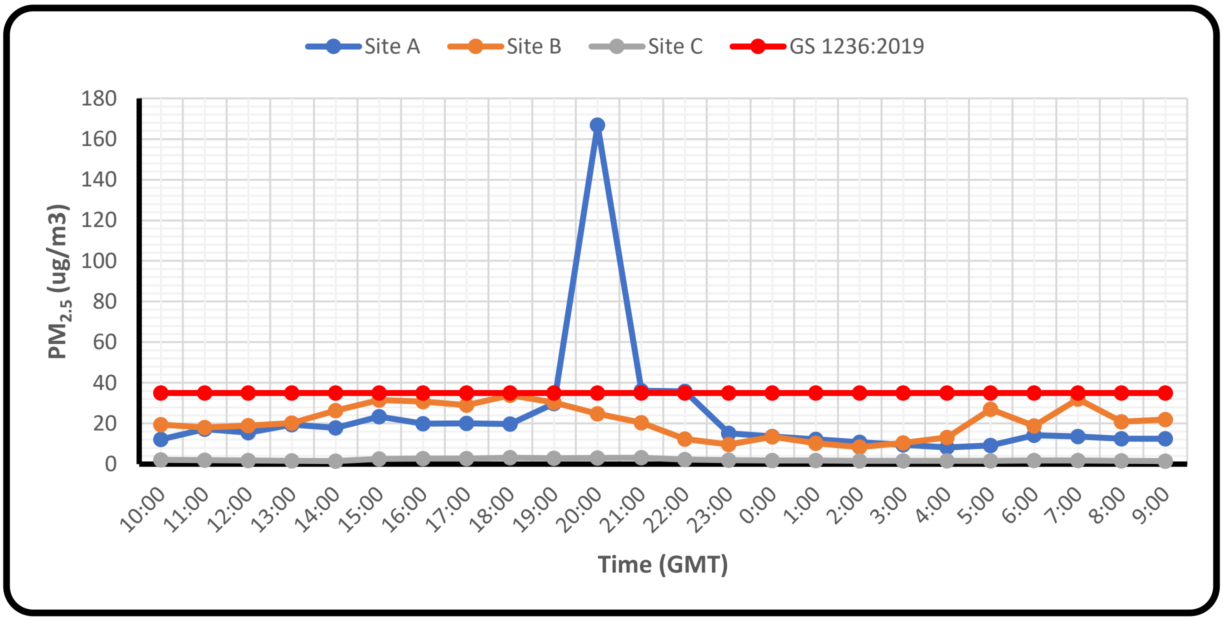


Figure 11: Hourly $PM_{2.5}$ variations at the monitored locations

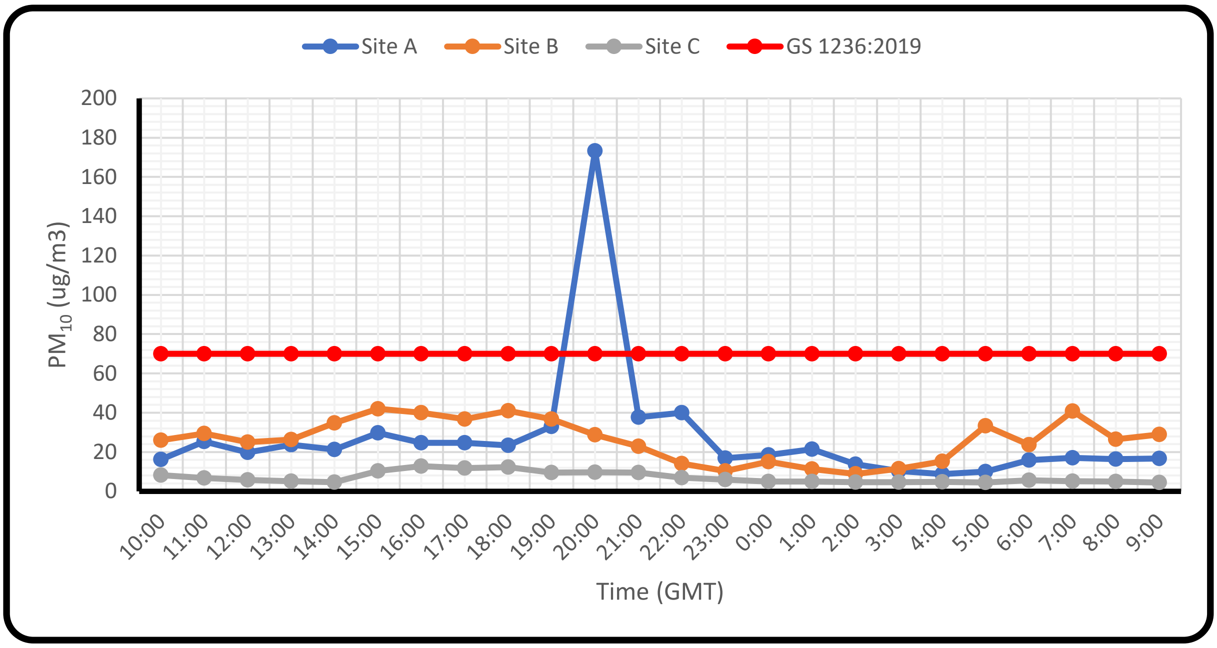


Figure 12: Hourly PM_{10} variations at the monitored locations

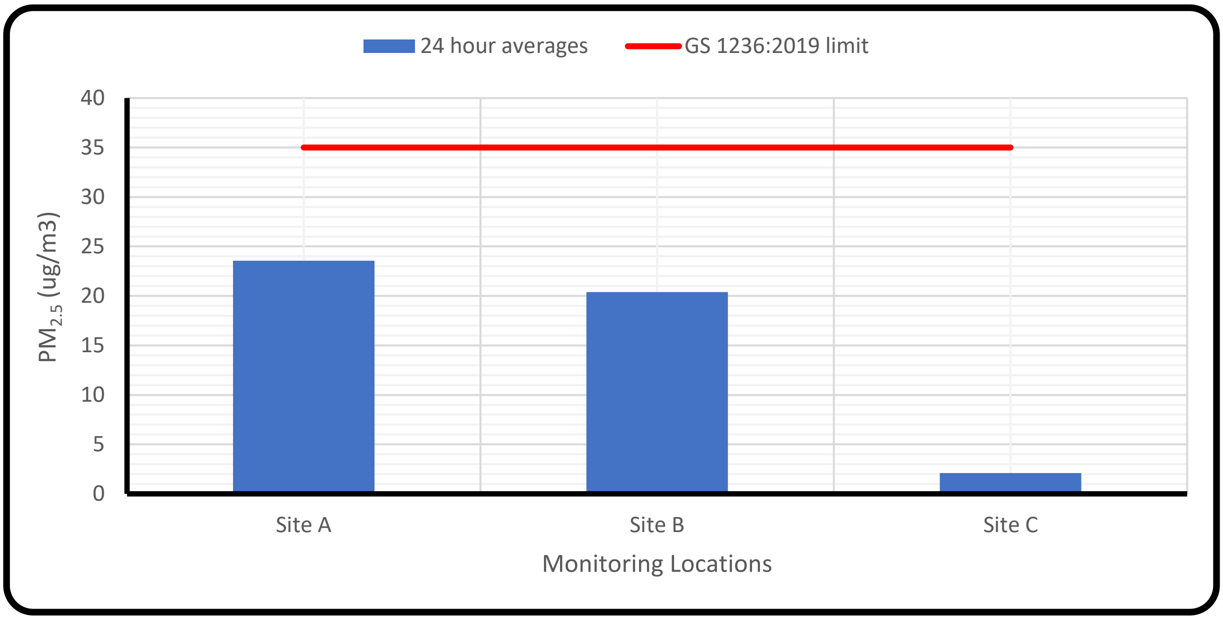


Figure 13: 24 Hour $PM_{2.5}$ variations at the monitored locations – (GS 1236:2019 Limit – 35 µg/m^3)

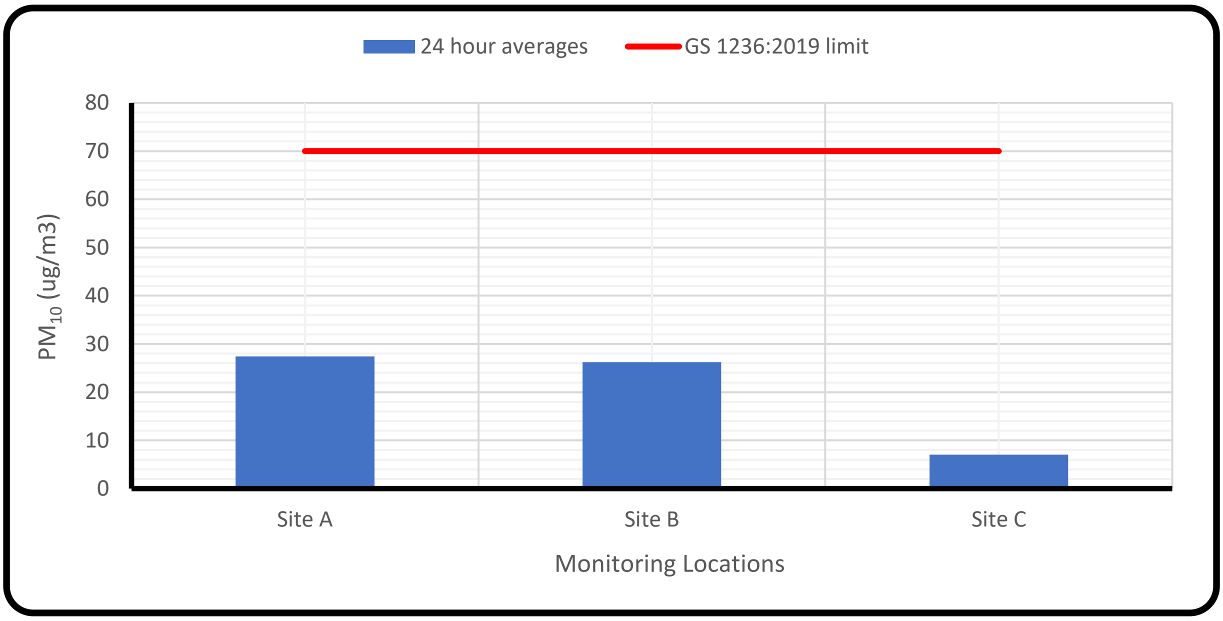


Figure 14: 24 Hour PM_{10} variations at the monitored locations – (GS 1236:2019 Limit – 70 μg/m³)

Table 6: Ambient Air Quality Results

Monitored Parameters (24-Hour Averages and 8 –Hour Average for CO)						
Monitored Sites	**Date**	**SO_2 (µg/m³)**	**NO_2 (µg/m³)**	**CO (mg/m³)**	**PM_{10} (µg/m³)**	**$PM_{2.5}$ (µg/m³)**
Site A (Near Akuse Main Junction)	7-8/08/2024	12.51	4.89	0.46	27.44	23.55
Site B (Near Enam Collection Building)	6-7/08/2024	9.76	2.61	0.26	26.22	20.93
Site C (Near KGS Dam Site)	6-7/08/2024	6.05	1.71	0.20	7.02	2.10
GHANA STANDARDS (GS 1236:2019)		**150**	**150**	**10**	**70**	**35**

3.3 Ambient Noise Results

Site A (Akuse Main Junction)

The hourly noise level at this location typically ranged from 57.4 dBA to 71.1 dBA with average noise level of 66.6dBA during the daytime and 60.7 dBA during nighttime. The background noise level (L90) at this location was 58.7 dBA. The observation that the background level is lower than the daytime and nighttime noise level at this receptor suggest there are periods of increased activity or noise sources such as traffic and human activities during both day and night. These noise sources are likely to be intermittent or periodic that elevate the overall noise levels above the background noise. Therefore, the receptor could be described as a mixed-use area comprising residential areas and commercial. The current noise levels at this location are above the GS 1222:2018 allowable limit of 60 dBA and 55 dBA for a mixed-use area. However, when the L_{90} results are used in order to eliminate the intermittent road traffic noise, the noise levels at this location adhered to the daytime (60 dBA) but exceeded the nighttime (55 dBA). The noise sources at this location included passing vehicles, human and commercial activities, and public information systems.

Site B (Enam Collection Building)

This receptor is typically a residential area. The daytime and nighttime noise levels recorded at Site B were 62.9 dBA and 58.8 dBA (Figure 15). Noise at this location were lower than levels reported at Site A but exceed the maximum allowable limits of 55 dBA and 48 dBA for a residential area. The daytime and nighttime noise levels are higher than the background noise level L90) of 57.7 dBA suggesting that Site B experiences higher noise levels during both day and nighttime due to periodic noise sources that increases the overall noise levels. At this location it is anticipated that the combination of existing noise sources and the new rehabilitation and construction-related noise could result in cumulative noise levels that exacerbate the already higher than background noise environment where they become disruptive to daily life.

Site C (Kpong Generation Station Dam)

Site C is relatively the quieter location among the three Site bur represent a mixed-use receptor. Hourly noise levels typically ranged between 50.7 dBA to 63.3 dBA (Figure 14). The average noise measurements were 59.7 dBA during daytime and 52.1 dBA during nighttime. The overall L90 at this location is 51.1 dBA which matches the L90 recorded during the nighttime but is slightly lower than the L90 recorded during the daytime (53.9 dBA). This indicates that the nighttime represents the baseline environment noise during the quieter periods and there are persistent noise sources such as the dam operation and natural sounds that maintain a relatively noise throughout the area, however daytime experiences slightly more noise from ongoing activities such as vehicular movements, general human activity that are consistent but louder than the quietest. The daytime and nighttime noise levels at Site C adhered to the GS 1222:2018 maximum allowable noise limit of 60 dBA and 55 dBA for mixed use area.

The primary source of noise during the monitoring period included vehicular movement, vehicle reverse alarms, human conversations, chirping birds and audible sound from the dam operation. Figures 15-17 show the hourly, day and night time noise levels variations recorded at the monitored locations.

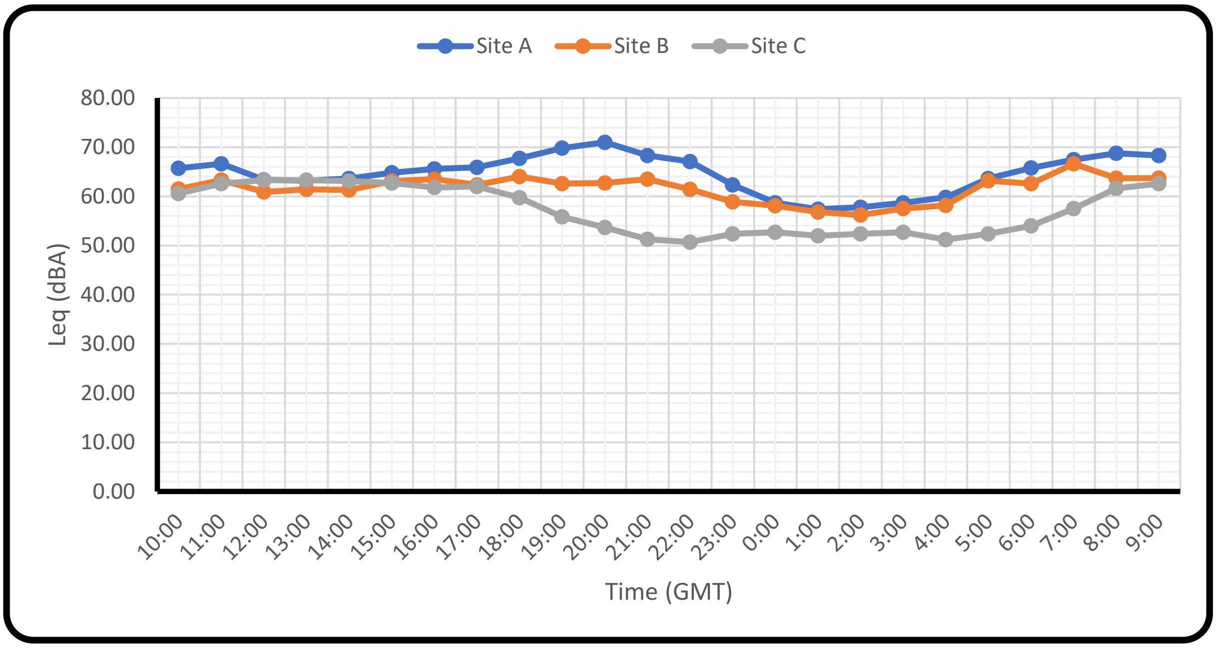


Figure 15: Hourly noise level variations at the monitored locations

Table 7: Summary of Ambient Noise Levels Monitoring Results

Monitored Sites	Noise levels (dBA)								
	24hr Leq	Lmax	Lmin	Daytime	Night-time	La5	La10	La50	La90
Site A (Near Akuse Main Junction)	64.6	71.0	57.4	66.6	60.7	69.7	68.7	65.7	58.7
Site B (Near Enam Collection Building)	61.5	66.6	56.2	62.9	58.8	64.0	63.7	62.5	57.7
Site C (Near KGS Dam Site)	57.2	63.3	50.7	59.7	52.1	63.3	63.0	56.7	51.5
Ghana Standards Limit (GS 1222:2018) Zone C-Heavy Industrial				**60**	**55**				
Ghana Standards Limit (GS 1222:2018)- Zone A-Residential				**55**	**48**				

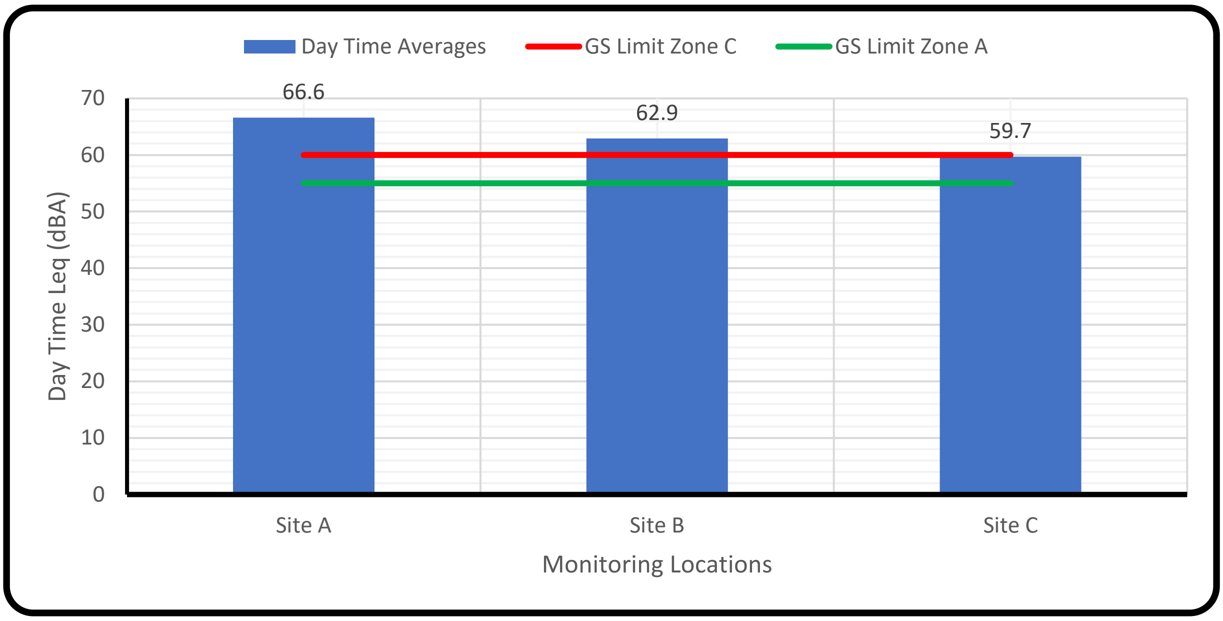


Figure 16: Mean day time variations at the monitored locations

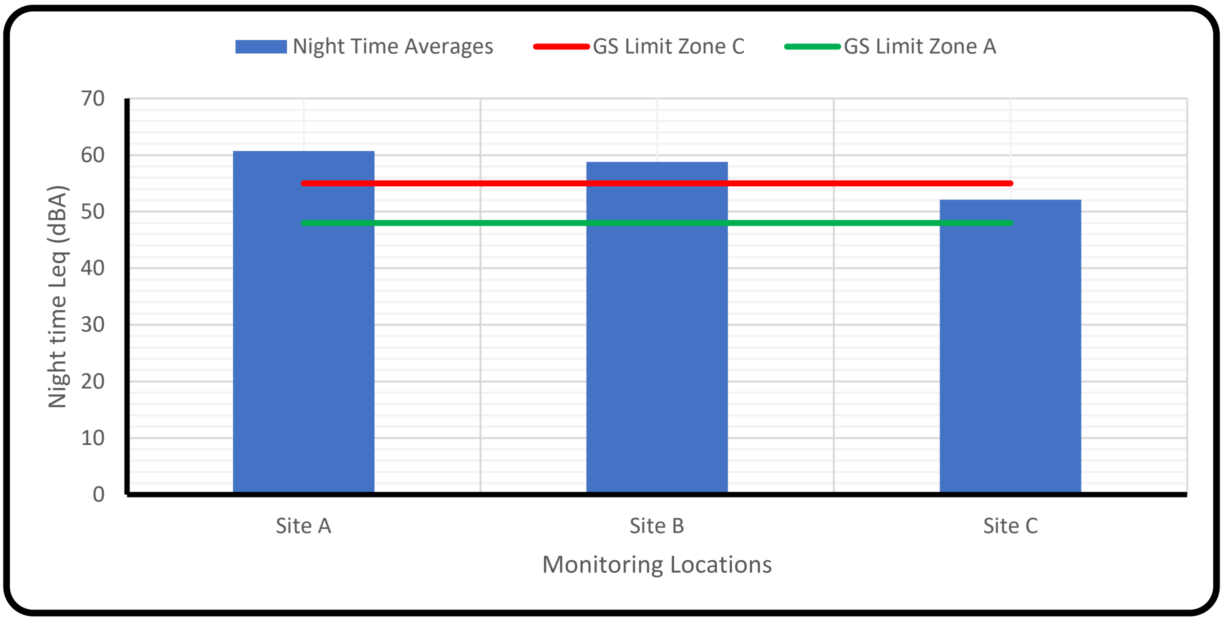


Figure 17: Mean night time variations at the monitored locations

CHAPTER FOUR

4.0 CONCLUSION AND RECOMMENDATION

This environmental baseline assessment presents the ambient air quality and noise assessment carried out at three (3) pre-established monitoring locations within the vicinity of the VRA Kpong Generation Station dam at Akuse to characterize the existing air quality and noise environment within the project catchment area.

4.1 Conclusion

The summary of the monitoring results showed that 24-hour mean carbon monoxide (CO), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) levels at all the monitored locations during the entire monitoring period were below the Ghana Standards GS 1236:2019 thresholds and the proposed project related activities are not likely to increase the levels of NO_2, SO_2 and CO above the permissible limits. Particulate Matter ($PM_{2.5}$ and PM_{10}) for 24-hour average were within acceptable limits. All the monitored locations during the monitoring period did not exceed Ghana Standards limit of 70 µg/m^3 for PM_{10} as well as recorded $PM_{2.5}$ levels (35 µg/m^3). However, the background PM2.5 concentrations at Site A and Site B areas are already 60-67% of the permissible limit, which raises concerns about air quality during construction.

The noise assessment across the three sites -Site A (Akuse Main Junction), Site B (Enam Collection Building) reveals a varied noise environment, with each site experiencing different levels of noise pollution relative to the GS 1222:2018 allowable limits for mixed use and residential areas. Any additional noise from construction and rehabilitation activities is likely to exacerbate the existing noise conditions, leading to cumulative noise impacts.

4.2 Recommendations

Based on the foregoing the following measures are recommended to be implemented when the project commences:

- Regularly apply water on construction sites and exposed surfaces, particularly sections of the Akuse road with heavy machinery to minimize airborne dust particularly $PM_{2.5}$
- Enforce low speed limits for construction vehicles within and around construction site to reduce dust generation
- The contractor must schedule most noise intensive activities to daytime hours and use machinery and equipment designed to operate lower noise emissions

- Implement continuous air quality and noise monitoring particularly $PM_{2.5}$ levels and noise levels to assess the effectiveness of dust and noise control measures
- Carryout community engagement to inform residents about project schedule including potentially noisy and dust generation activities and provide a channel for complaints.

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APPENDIX – HOURLY AVERAGES

SITE C										
Time	CO (mg/m³)	NO_2 (µg/m³)	SO_2 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	WS (m/s)	WD (°)	AIR T (°C)	AIR RH (%)	Leq (dBA)
10:00	0.22	11.46	18.06	2.04	8.30	1.81	276.10	29.10	63.20	60.60
11:00	0.22	3.81	15.44	1.93	6.70	1.94	275.60	29.90	59.80	62.60
12:00	0.22	0.00	5.14	1.74	5.78	1.65	278.50	30.00	59.80	63.30
13:00	0.21	0.00	0.00	1.59	5.10	1.65	288.00	30.10	61.00	63.30
14:00	0.22	1.27	0.00	1.50	4.68	1.39	252.90	30.50	58.70	63.10
15:00	0.24	1.27	20.64	2.56	10.35	1.47	218.70	29.10	66.60	62.70
16:00	0.25	6.39	18.13	2.81	12.83	1.47	220.30	27.90	71.00	61.80
17:00	0.23	0.00	18.13	2.74	11.85	1.22	250.30	27.80	71.70	62.00
18:00	0.26	0.00	0.00	3.14	12.25	1.12	249.10	26.60	76.90	59.70
19:00	0.28	1.29	2.61	2.95	9.58	0.69	183.80	25.50	81.60	55.80
20:00	0.30	0.00	2.62	3.13	9.65	0.52	110.70	24.70	85.20	53.70
21:00	0.31	0.00	0.00	3.14	9.48	0.48	223.80	24.10	88.60	51.30
22:00	0.22	0.00	0.00	2.31	6.88	0.75	275.00	24.20	85.00	50.70
23:00	0.19	0.00	0.00	1.98	6.00	0.78	274.50	24.20	84.90	52.40
0:00	0.17	1.29	0.00	1.76	5.05	0.55	274.30	24.20	85.00	52.70
1:00	0.16	1.30	0.00	1.75	4.98	0.37	197.30	24.00	86.00	52.00
2:00	0.16	1.29	0.00	1.67	4.73	0.42	291.70	24.20	85.00	52.40
3:00	0.16	0.00	0.00	1.66	4.70	0.51	293.50	23.90	86.60	52.70
4:00	0.15	0.00	18.38	1.68	4.83	0.73	281.70	23.80	86.80	51.20
5:00	0.17	0.00	5.25	1.59	4.55	0.40	209.70	24.00	85.40	52.40
6:00	0.19	0.00	2.62	1.78	5.58	0.46	234.80	24.10	84.40	54.00
7:00	0.18	1.29	5.23	1.75	5.18	0.81	255.40	25.10	80.90	57.50
8:00	0.16	3.86	7.81	1.68	5.05	1.34	267.50	26.40	74.20	61.60
9:00	0.17	6.40	5.18	1.50	4.48	1.88	276.30	27.70	68.80	62.60

SITE B						
Time	CO (mg/m³)	NO_2 (µg/m³)	SO_2 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	Leq (dBA)
11:00	0.20	0.00	23.22	17.96	29.5	63.3
12:00	0.20	1.97	15.44	19.03	24.95	60.9
13:00	0.19	0.00	0.00	20.17	26.27	61.4
14:00	0.22	0.00	0.00	26.34	34.82	61.3
15:00	0.24	1.50	7.70	31.57	42.04	63.1
16:00	0.26	4.92	0.00	30.81	40.03	63.5
17:00	0.27	3.65	15.54	29.03	36.74	62.3
18:00	0.52	3.93	23.32	33.88	40.92	64
19:00	0.43	0.00	0.00	30.26	36.72	62.6
20:00	0.38	0.00	15.66	24.79	28.78	62.7
21:00	0.36	0.00	7.85	20.35	22.85	63.5
22:00	0.25	0.00	7.87	12.41	14.07	61.4
23:00	0.24	4.56	0.00	9.72	10.35	58.9
0:00	0.21	3.59	0.00	13.42	15.06	58.1
1:00	0.20	0.00	7.87	10.32	11.35	56.8
2:00	0.22	0.00	15.74	8.35	8.86	56.2
3:00	0.21	0.00	7.87	10.42	11.49	57.5
4:00	0.29	5.92	7.87	13.2	15.28	58.2
5:00	0.32	6.87	7.88	27.05	33.33	63.2
6:00	0.26	4.99	7.87	18.86	23.72	62.6
7:00	0.27	6.58	15.74	32.03	40.86	66.6
8:00	0.26	5.63	15.68	20.8	26.43	63.7
9:00	0.24	3.53	15.62	21.97	28.97	63.7
10:00	0.26	4.98	15.55	19.48	26	61.5

SITE A						
Time	**CO (mg/m³)**	**NO_2 (µg/m³)**	**SO_2 (µg/m³)**	**$PM_{2.5}$ (µg/m³)**	**PM_{10} (µg/m³)**	**Leq (dBA)**
12:00	0.41	5.43	28.37	15.49	19.82	63.4
13:00	0.40	5.17	20.58	19.43	23.66	63.2
14:00	0.42	3.78	5.14	17.84	21.33	63.6
15:00	0.47	4.33	2.86	23.37	29.67	64.8
16:00	0.46	6.04	12.84	19.92	24.64	65.6
17:00	0.47	6.86	20.64	20.04	24.65	65.9
18:00	0.49	5.97	20.72	19.7	23.43	67.7
19:00	0.55	6.78	28.50	29.85	33.04	69.8
20:00	0.96	13.17	5.20	166.85	173.18	71
21:00	0.55	0.92	20.88	36.07	37.74	68.3
22:00	0.44	3.46	13.09	35.75	39.94	67.1
23:00	0.35	6.33	13.11	15.11	16.87	62.3
0:00	0.30	3.80	13.11	13.58	18.55	58.7
1:00	0.26	5.89	20.98	12.26	21.46	57.4
2:00	0.25	2.87	13.11	10.77	13.73	57.8
3:00	0.24	5.42	3.46	9.44	10.42	58.7
4:00	0.23	3.52	3.11	8.22	8.78	59.8
5:00	0.29	5.28	3.12	9.27	10.05	63.6
6:00	0.46	4.65	13.13	14.27	15.89	65.8
7:00	0.34	4.49	3.12	13.53	17.01	67.5
8:00	0.33	3.30	0	12.46	16.46	68.8
9:00	0.36	2.93	20.91	12.54	16.75	68.3
10:00	0.32	3.58	6.83	12.13	16.15	65.7
11:00	0.39	3.43	7.34	17.28	25.37	66.6

POLLUTION MONITORING ON THE KPONG HEADPOND, LOWER VOLTA AND VOLTA GORGE SEGMENTS OF THE VOLTA LAKE

2022 ANNUAL REPORT

VOLTA RIVER AUTHORITY

JULY 2023

TABLE OF CONTENTS

Figures

Tables

EXECUTIVE SUMMARY

The Environmental Management Plan (EMP) for the operation of the Akosombo and Kpong Hydropower Dams requires regular water quality monitoring at various potential water pollution sites, also referred to as "hot spots" along the Volta River. To achieve this, a bi-annual water quality monitoring of the Volta River has been established to collect the necessary data to provide stakeholders with regular updates on status of water quality and as well seek the necessary remedial action where required. This report provides 2022 annual assessment of quality of water in the Lower Volta, Kpong Headpond and the Gorge area segments of the Volta River and status of recommendations from the 2021 Annual report.

Summary of levels of various pollution indicator parameters as revealed from tests conducted is provided in below:

Levels of various pollution indicator parameters

Water Quality Indicator	Threshold	Segment of River above threshold	
Chemical Oxygen Demand (COD)	10mg/l	• Kpong community drain • Akosombo Paper Mill • Akosombo Industrial Company Limited (AICL)	• Sajuna Beach Resort • Ayikpala water contact site • Ada and Kpong dam tail • Akosombo storm drains
Microbial Contaminants	5 CFU/100ml	• Atimpoku Slaughterhouse • Kpong community drain • Kpong Wharf area • Ada	• Akosombo storm drains • Sajuna Beach Resort • Ayikpala water contact site
Phosphorus	0.05mg/l	• Kpong Headpond • Gorge	• Lower Volta River
Turbidity	1.0 NTU	Kpong Headpond	• Gorge • Lower Volta segment
pH	9.0 units	• AICL	
Iron	0.1mg/l	• AICL • All resorts and hotels • Ayikpala,	• Kpong Wharf • Kpong community drain • Lower Volta Segment • Kpong dam (intake &tail race)
Fluoride	1.0 mg/l	• AICL • Ayikpala • Akosombo storm drains • Akosombo Paper Mill Limited	• Sajuna Beach Resort • Kpong Community drain • Lower Volta Segment • Gorge area

Findings from the monitoring conducted is as follows:

- The shores along the Akosombo Industrial Company Limited (AICL) continue to exhibit high levels of conductivity, colour, iron, phosphorus, turbidity, COD, BOD and faecal matter.
- The Akosombo Waste Stabilization Ponds continued to improve in performance after renovation works. Presently microbial contaminant is the only analyte that exceeded the allowable limit.
- Ada has consistently, since 2021 recorded conductivity, chloride, turbidity and faecal pollutant levels exceeding the set guideline. This could be due to inflow of seawater into the Volta River during high tidal period, coupled with anthropogenic activities of riverine communities.
- Leachates from dilapidated KVIP, Kpong refuse damp and Atimpoku slaughterhouse could be source of leaked faecal matter into the Volta River.

An action plan was developed to ensure the implementation of recommendations made in 2021 Report. The status of the action plan is as follows:

Recommendation	Action Required	Responsibility	Timeline	Status	Challenges
Relocate Atimpoku slaughterhouse from the waterfront to prevent the direct discharge of faecal matter into the Volta Lake	Sensitize slaughterhouse workers on the need to protect waterbody	Asuogyaman District Assembly	Dec. 2022	On-going	Atimpoku butchers continue to deposit faecal matter close to the shores of the Volta River
	Construct waste holding chamber for the slaughter	Asuogyaman District Assembly	June 2022	Old holding chamber renovated	Renovated chamber not able to contain wastewater from slaughter activities
	Engage chiefs for land and on the need for relocation of slaughterhouse	EPA, WRC and Asuogyaman District Assembly	Dec. 2023	Chiefs have been engaged and land proposed for relocation	
	Relocate slaughter shed	Asuogyaman District Assembly	Dec. 2024	Not due	No available funds in the District Assembly's 2023 budget
	Acquire land and relocate Atimpoku slaughterhouse	Asuogyaman District Assembly	Dec. 2024	On-going	Assembly is yet to conclude on land acquisition process
Manage disposal of waste along the Kpong beach to minimize leachates	Provide four skip bins to temporary receive and contain waste	Volta River Authority	Dec. 2022	Done	

Recommendation	Action Required	Responsibility	Timeline	Status	Challenges
with high nutrient load into the Lake	Evacuate existing refuse before bin installation	Volta River Authority	Dec. 2022	Done	
	Consult with Zoomlion to guarantee continuous evacuation of waste to final dumping site	Lower Manya Krobo Municipal Assembly	Jan. 2023	Municipal assembly has agreed in principle to ensure Zoomlion continuously evacuate waste to final dumping site	Skip bins donated to Lower Manya Krobo Municipal Assembly yet to installed resulting in refuse being damped on cleared site at Kpong Wharf
	Sensitize fishmongers on the need to keep Kpong Wharf clean	Lower Manya Krobo Municipal Assembly	Feb. 2023	Technical Services has engaged the fishmongers on the need for their relocation. They have bought-in the idea and have agreed to move to a new site	
	Relocate refuse damp during reconstruction of beach road	Lower Manya Municipal Assembly	Dec. 2024	Not due	
KVIP's sited close to the Kpong shoreline needs to be rehabilitated or relocated, to prevent discharge of faecal matter into the Volta River	Engage Lower Manya Krobo Municipal Assembly on the way forward	Volta River Authority	Feb. 2023	New KVIP under construction to replace old one	

Recommendation	Action Required	Responsibility	Timeline	Status	Challenges
Regulatory agencies must ensure regulatory compliance of solid and liquid waste disposal, especially along the shoreline of the Volta Lake System.	Ensure stakeholders take the necessary measures to comply with the relevant regulations regarding discharge of effluent	EPA and WRC	Dec. 2023	On-going	
The upspringing of aquaculture facilities in the Kpong Headpond must be investigated to ensure compliance with regulatory requirements.	Scout for aquaculture facilities in the Kpong Headpond and issue out list to EPA	Volta River Authority	April 2023	Done	
	Invite Ministry of Fisheries to future stakeholder engagements on the EMP for the dams	Volta River Authority	Dec. 2022	Done	

The report concludes that:

a. Quality of water throughout the sampling sites, ranging from Dodi Island area to Ada has not changed significantly since 2021 investigated level of pollution.

b. Water quality in resident reservoir indicated water is mildly polluted. The source coming from aquaculture operations.

c. Quality of water in the Kpong Headpond is being compromised by point-source discharges of industrial set-ups (manufacturing industries) and anthropogenic activities of riverine communities which are likely to impact on the general ecosystem function of the water body.

d. Quality of tailrace water at both Akosombo and Kpong Generating Stations suggests no contamination from power generation sources.

e. The Ada area continues to register significant microbial contaminants due to activities of riverine communities.

The following are recommended to address challenges identified.

i. EPA and WRC should intensify their on-going supervisory role over stakeholders' activities and monitor water quality within the area to identify aquaculture companies that may be causing the pollution.
ii. Lower Manya Municipal Assembly should continue to engage the fish market leaders and conclude the planned relocation from the waterfront.
iii. Lower Manya Krobo Municipal Assembly should install the skip bins to prevent indiscriminate dumping of refuse around.
iv. EPA and WRC should engage Akosombo Industrial Company Limited to discuss the issue of pollution from their facility.
v. Ministry of Fisheries & Aquaculture Development should intensify regulatory oversight responsibilities

1. INTRODUCTION

The Volta River Authority (VRA) is required to conduct monitoring of the water quality in some parts of the main Volta Lake, the Kpong Headpond, and the Lower Volta River in accordance with the conditions of the Environmental Permit issued based on the preparation of the Environmental Management Plan (EMP) guiding the operations of the Akosombo and Kpong Hydropower Dams. The water quality monitoring, among other considerations, is to aid in preserving the Volta Lake's integrity for optimal ecosystem services, including long-term water resources for hydropower generation. The water quality monitoring program is to cover the Kpong Headpond, the Volta Gorge segment of the main Volta Lake and Volta Lake's Lower Volta portion.

To achieve this, a Water Quality Monitoring Programme comprising of a bi-annual assessment of the resident reservoir water, the tailrace water discharge of the Akosombo and Kpong generating plants, as well as receptacles of potential pollutant-laden effluents from point-source discharges of industrial set-ups (manufacturing and hospitality), run-offs from agricultural fields, and other anthropogenic activities, has been instituted. Reports from these assessments are shared with relevant stakeholders and regulatory agencies, such as the Environmental Protection Agency (EPA) and Water Resources Commission (WRC) and the local government administrations.

Additionally, a working group comprising of representatives from VRA, EPA, WRC, Ministry of Fisheries & Aquaculture Development (MOFAD), Asuogyaman District Assembly and Lower Manya Krobo Municipal Assembly was constituted in March 2022 to ensure recommendations made in the water quality assessment reports are implemented.

2. MONITORING ACTIVITIES

The 2022 monitoring activity was undertaken in June and December of the year. The water quality assessment results were gauged against the Ghana Raw Water Quality Guidelines and WHO water quality standard. Methodology adopted and the results obtained are provided below.

2.1. Sample Collection and Analysis

Sample collection and analysis were undertaken per guidelines from *Standard methods for the examination of water and wastewater, 22nd edition.* Sample analyses were performed at the VRA Laboratory. The main sampling sites and their GPS coordinates are listed in Table *1* below:

Table 1: Sampling Sites and their GPS Coordinates

No.	Sampling Area/ Potential Pollution Sites	Point Source
1	Resident reservoir (Akosombo Dam)	N 06^{0} 29’ 45.4"/E000^{0} 06' 16.7" N 06^{0} 24’ 16.5"/E000^{0} 06' 36.2" N 06^{0} 20’ 37.2"/E 000^{0} 05' 20.6" N 06^{0} 18’ 25.6"/E 000^{0} 03' 45.7"
2	Akosombo dam intake	N 06^{0} 18' 25.6" E 000^{0} 03' 45.7"
3	Akosombo dam tail race	N 06^{0} 17' 45.6" E 000^{0} 03' 42.3"

No.	Sampling Area/ Potential Pollution Sites	Point Source
4	Kpong dam intake	N 060 07' 17.1" E 0000 07' 25.4"
5	Kpong dam tail race	N 060 06' 51.6" E 0000 07' 56.0"
6	Akosombo Industrial Company Ltd. (AICL)	N 06^{O} 16’16.3” / E 000^{O} 04’13.9
7	Akosombo Paper Mill Limited	N 06^{O} 14’59.6” / E 000^{O} 04’56.0”
8	Sajuna Beach Resort	N 06^{O} 13’13.1” / E 000^{O} 05’24.7”
9	Royal Senchi Hotel	N 06^{O} 13’10.1” / E 000^{O} 05’25.0”
10	Akosombo Continental Hotel	N 06^{O} 14’34.0” / E 000^{O} 05’35.2”
11	Atimpoku Slaughterhouse	N 06^{O} 14’12.0” / E 000^{O} 05’37.1”
12	Adi Lake Resort	N 06^{O} 14’44.2” / E 000^{O} 05’31.5”
13	Aylos Bay Resort	N 06^{O} 14’39.0” / E 000^{O} 05’33.1”
14	Akosombo Waste Stabilization Ponds /Storm drain	N 06^{O} 16’20.3” / E 000^{O} 04’23.2”
15	Kpong Community Drain	N 06^{O} 09’24.7” / E 000^{O} 03’51.5”
16	Kpong Wharf	N 06^{O} 09’38.6” / E 000^{O} 03’54.6”
17	Ayikpala	N 06^{O} 09’48.6” / E 000^{O} 03’57.6”
18	Lower Volta (Ada)	N 050 46’ 37.4" E 0000 38' 58.3"

2.2. Results of the Water Quality Analysis

A summary of the results is provided in Appendix 1 and details of individual findings is as below:

2.2.1. pH

Generally, pH levels are within the guideline ranging from 6.5 to 7.80 as indicated in *Figure 1* below. The pH of water sampled at AICL shores is 11.0, exceeding the guideline value of 9.00.

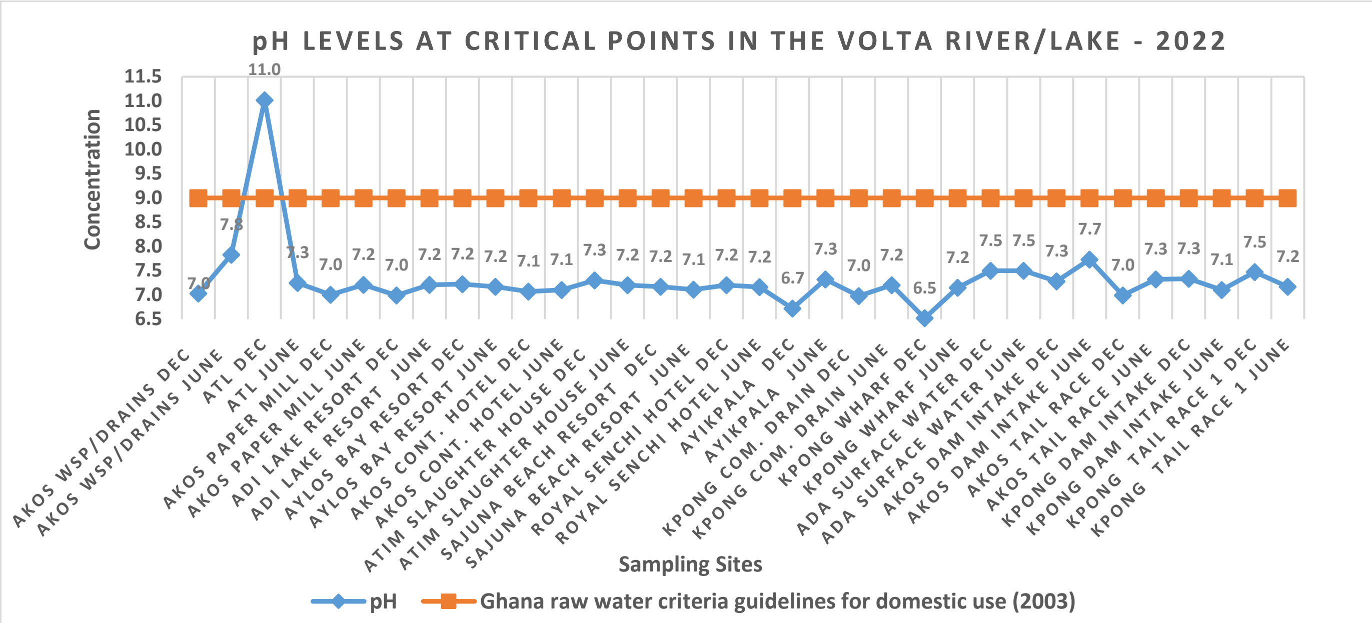


Figure 1**:** pH levels at potential pollution sites

2.2.2. Colour

Colour of water from the potential pollution sites were within acceptable limits except Akosombo Industrial Company Limited as shown in *Figure 2* below.

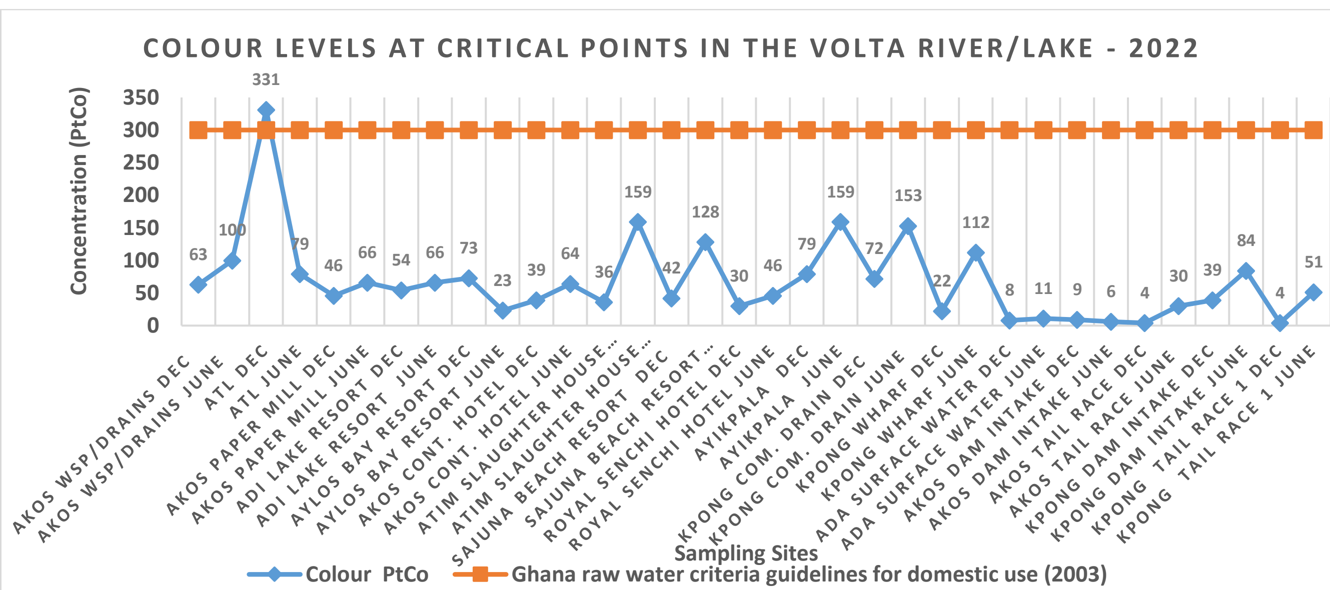


Figure 2 **:** Levels of colour at potential pollution sites

Except for Akosombo Industrial Company Limited that recorded a value of 331 PtCo units (Dec. 2022), all “hot spots” along the monitoring stretch: Kpong Headpond, Gorge area, and Lower Volta area were within the set guidelines of 300 PtCo units.

2.2.3. Conductivity

AICL and Ada are the only sites that recorded conductivity levels above the guideline value 700 µS/cm as shown in *Figure 3* below.

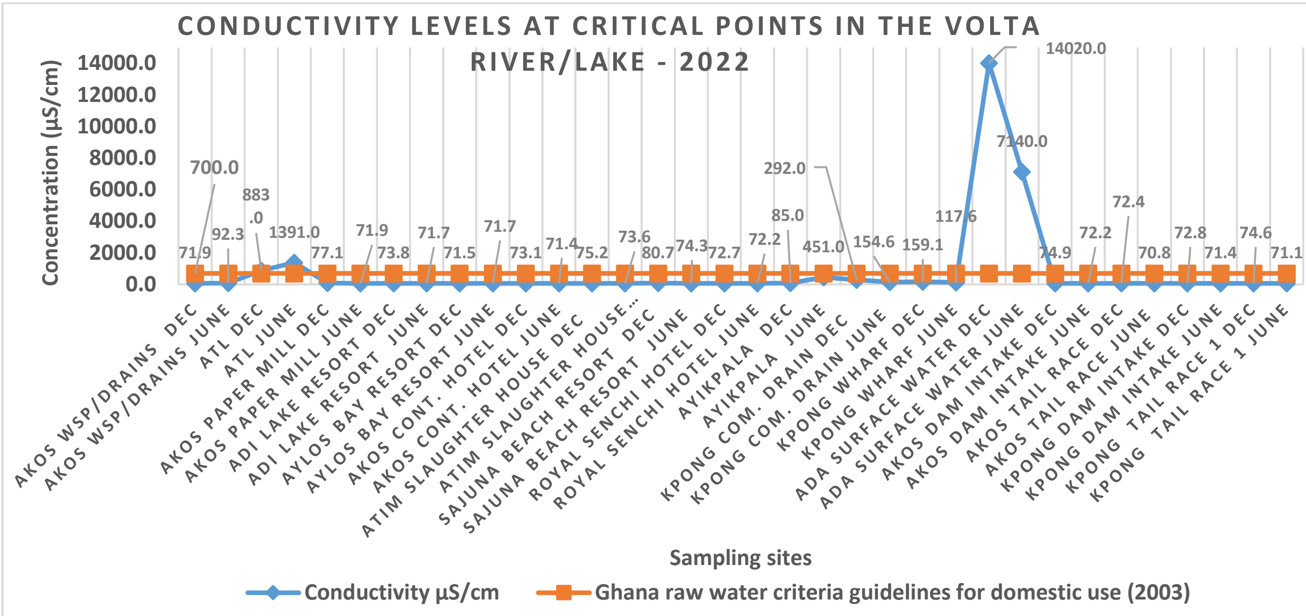


Figure 3**:** Conductivity levels at potential pollution sites

2.2.4. Microbial Contamination

Kpong community drain, Ayikpala, Kpong wharf and Atimpoku slaughterhouse recorded extremely high microbial levels as illustrated in Figure 4 below. The shoreline along the Kpong Wharf area, Atimpoku Slaughterhouse, Akosombo Storm Drains, Ayikpala, Kpong community drains and Ada recorded significantly high levels of microbial load with Kpong community drains having the highest (136,000 CFU/100ml).

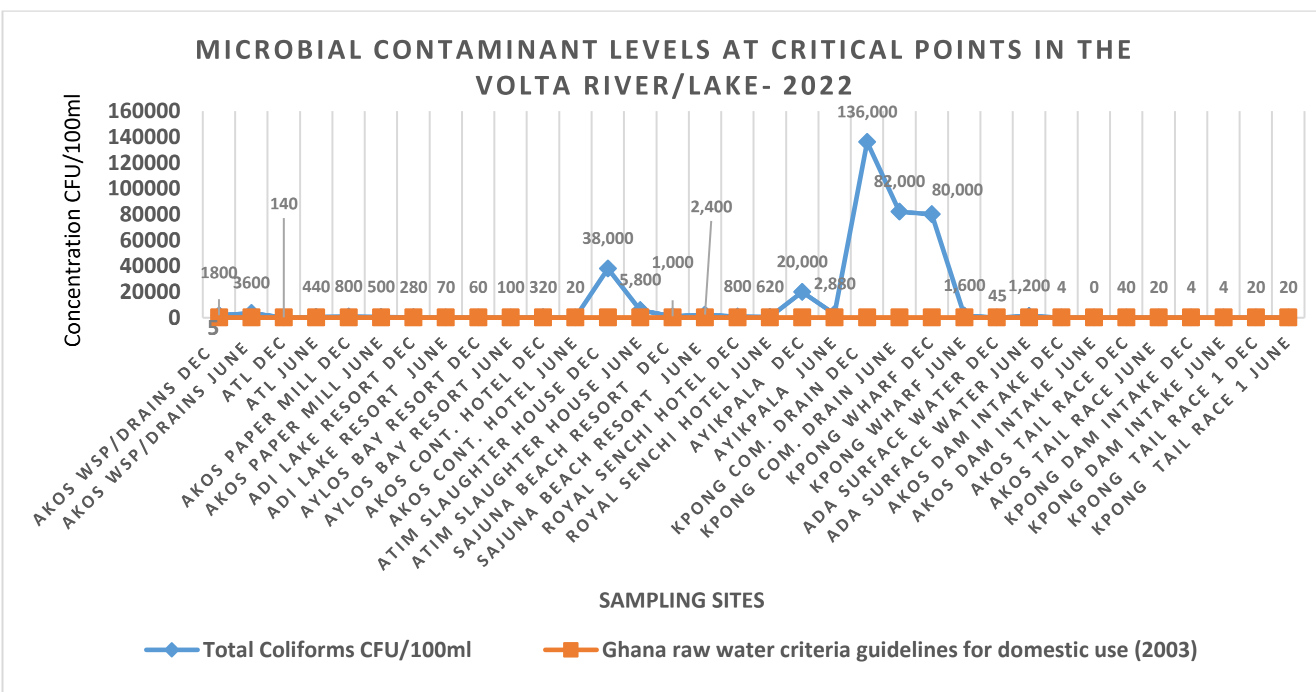


Figure 4: Microbial contaminant levels at potential pollution sites

2.2.5. Turbidity

Turbidity levels were high, much exceeding the allowable limit of 1.0 NTU as with Akosombo Storm Drains and Kpong Community Drain, Ayikpala and ATL recording a value of 40.60 NTU. as shown in *Figure 5* below.

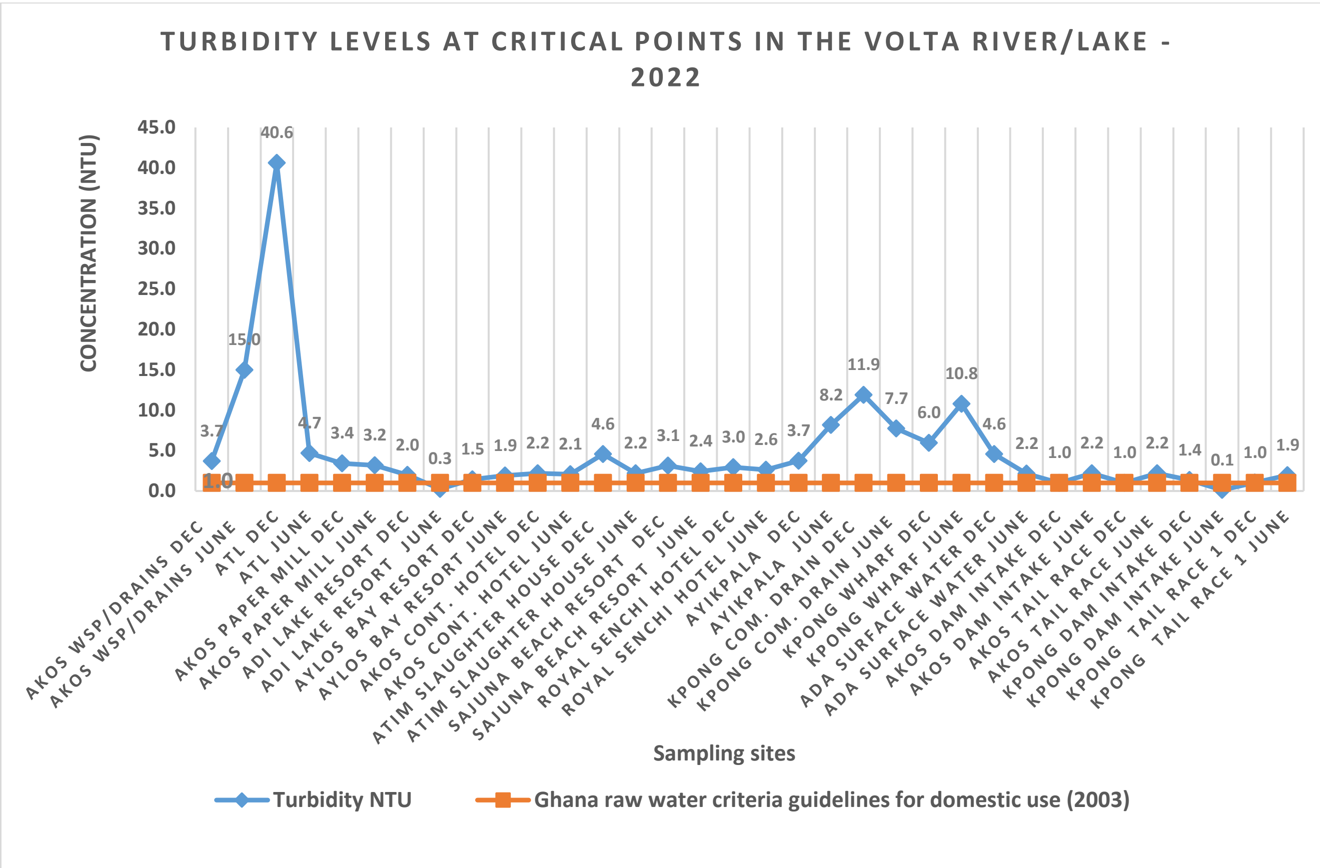


Figure 5: Turbidity levels at potential pollution sites

2.2.6. Iron

Exceptionally high iron levels were recorded at the following areas: Akosombo Industrial Company Limited, Royal Senchi Hotel, Kpong Wharf, Ayikpala, Kpong Community Drain and Ada areas, as indicated in *Figure 6* below.

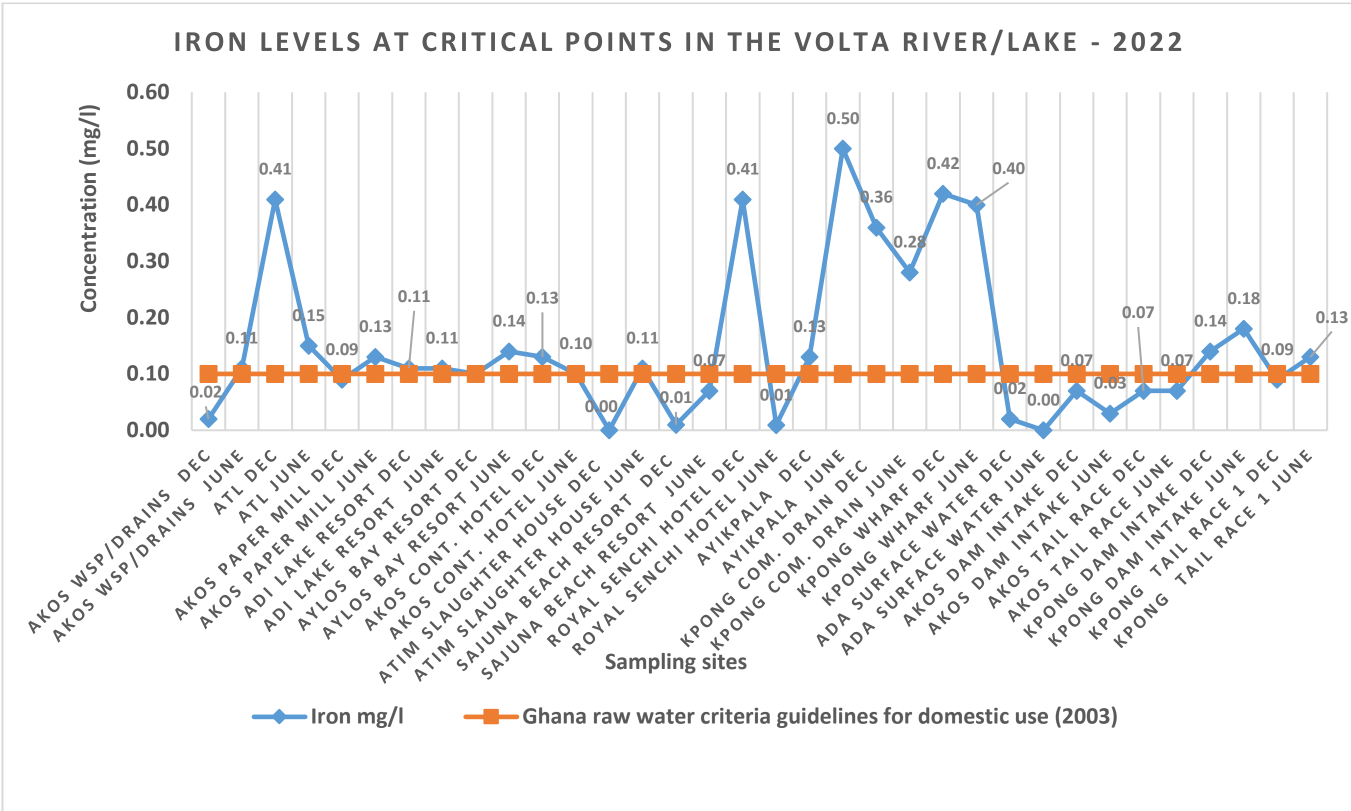


Figure 6: Iron concentration levels at potential pollution sites

2.2.7. Fluoride

Fluoride concentration levels at potential pollution sites were marginally high at Akosombo Industrial Company Limited, Sajuna Beach Resort and Ada as shown in *Figure 7* below.

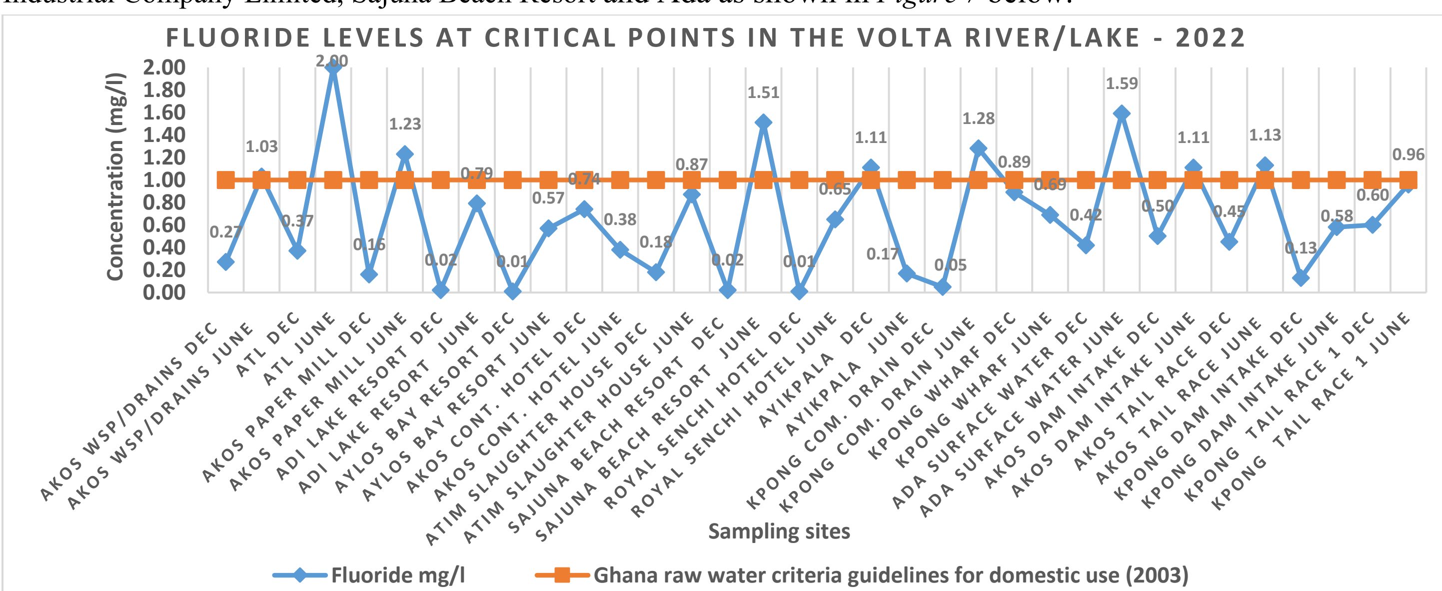


Figure 7: Fluoride concentration levels at potential pollution sites

2.2.8. Chemical Oxygen Demand (COD)

COD indicates concentration of organics that can deplete dissolved oxygen in water leading to negative environmental and regulatory consequences. COD concentration levels along the shores of Akosombo Industrial Company Limited is significantly high. Akosombo Paper Mill Limited, Akosombo Strom drains, Sajuna Beach Resort, Ayikpala and Kpong Community Drain also recorded values that are above the maximum permissible level as shown in *Figure 8* below.

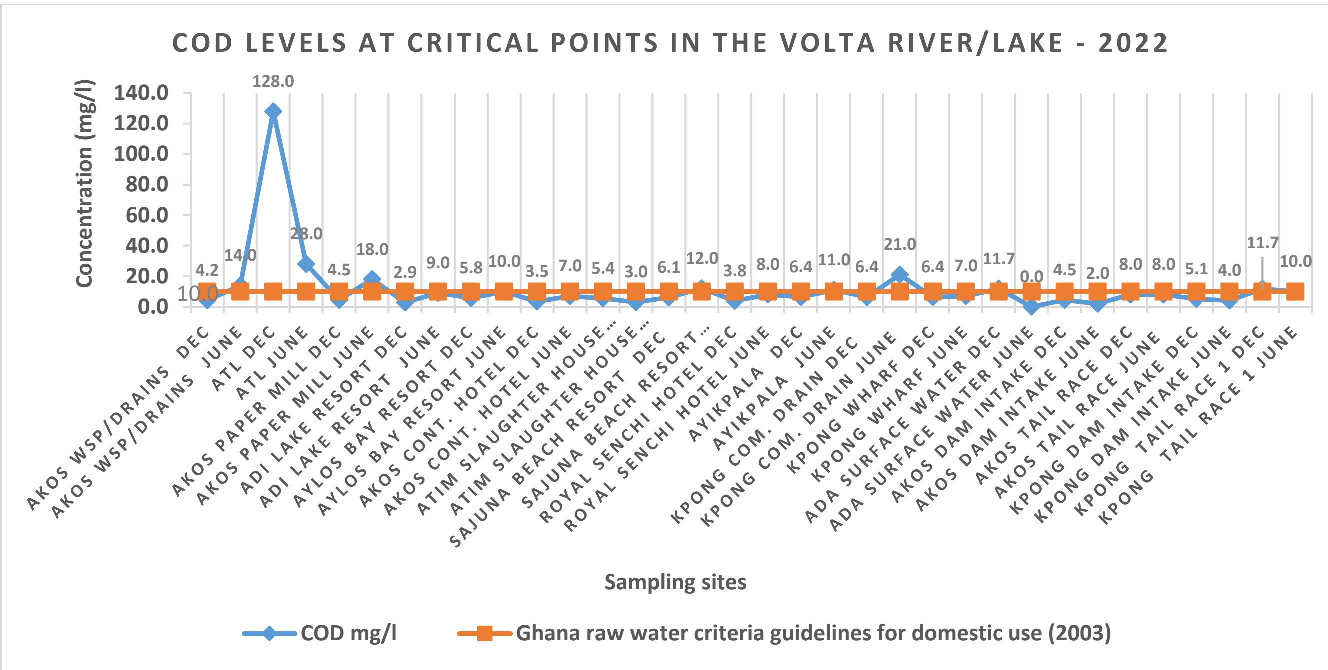


Figure 8: COD concentration levels at potential pollution sites

2.2.9. Phosphorus

Phosphorus levels at all potential pollution sites were above the guideline value of 0.05 mg/l in the first half of the year but reduced significantly during the second half as shown in Figure 9 below. Phosphorus levels in the Kpong Headpond, Gorge area and the Lower Volta ranged from 0.01 mg/l to 1.42 mg/l. Levels exceeding 0.05 mg/l accelerates eutrophication. Use of fertilizers and introduction of fish feed into the Volta River could be the source of phosphorus build-up.

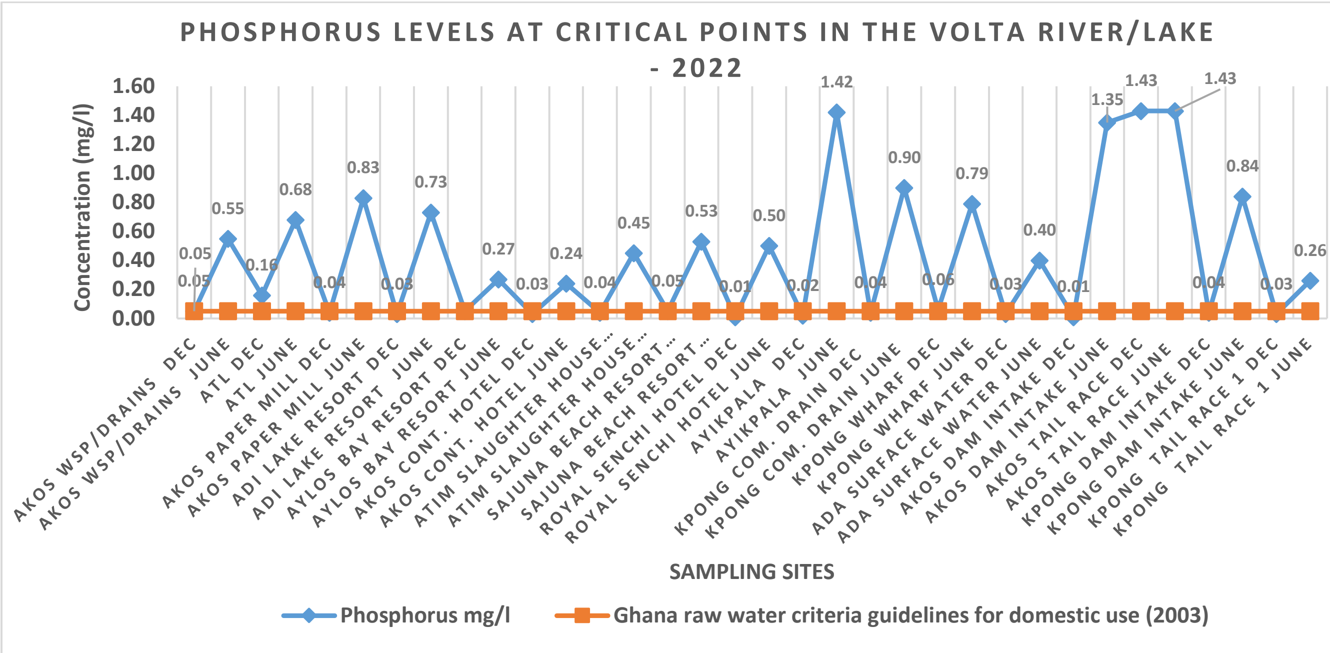


Figure 9: Phosphorus concentration levels at potential pollution sites

2.3. Summary of key findings

a. The shores along the Akosombo Industrial Company Limited (AICL) continue to exhibit high levels of conductivity, colour, iron, phosphorus, turbidity, COD, BOD and faecal matter.

b. The Akosombo Waste Stabilization Ponds continued to improve in performance after renovation works. Presently microbial contaminant is the only analyte that exceeded the allowable limit.

c. Ada has consistently, since 2021 recorded conductivity, chloride, turbidity and faecal pollutant levels exceeding the set guideline. This could be due to inflow of seawater into the Volta River during high tidal period, coupled with anthropogenic activities of riverine communities.

d. Leachates from dilapidated KVIP, Kpong refuse damp and Atimpoku slaughter house could be source of leaked faecal matter into the Volta River.

2.4. Key Observations during Monitoring

Coloured water sample from the shores of Akosombo Industrial Company Ltd (ATL)

Stray animals have access to exposed slaughterhouse shed at Atimpoku

Unkempt shores at Kpong Wharf fish mongers' site

Mini refuse damp at Ayikpala shores

3. STATUS OF 2021 ACTION POINTS

An action plan was developed to ensure the implementation of recommendations made in 2021 Report. The status of the action plan is as follows:

Recommendation	Action Required	Responsibility	Timeline	Status	Challenges
Relocate Atimpoku slaughterhouse from the waterfront to prevent the direct discharge of faecal matter into the Volta Lake	Sensitize slaughterhouse workers on the need to protect waterbody	Asuogyaman District Assembly	Dec. 2022	On-going	Atimpoku butchers continue to deposit faecal matter close to the shores of the Volta River
	Construct waste holding chamber for the slaughter	Asuogyaman District Assembly	June 2022	Old holding chamber renovated	Renovated chamber not able to contain wastewater from slaughter activities
	Engage chiefs for land and on the need for relocation of slaughterhouse	EPA, WRC and Asuogyaman District Assembly	Dec. 2023	Chiefs have been engaged and land proposed for relocation	
	Relocate slaughter shed	Asuogyaman District Assembly	Dec. 2024	Not due	No available funds in the District Assembly's 2023 budget
	Acquire land and relocate Atimpoku slaughterhouse	Asuogyaman District Assembly	Dec. 2024	On-going	Assembly is yet to conclude on land acquisition process
Manage disposal of waste along the Kpong beach to minimize leachates with high nutrient load into the Lake	Provide four skip bins to temporary receive and contain waste	Volta River Authority	Dec. 2022	Done	
	Evacuate existing refuse before bin installation	Volta River Authority	Dec. 2022	Done	
	Consult with Zoomlion to guarantee	Lower Manya Krobo	Jan. 2023	Municipal assembly has	Skip bins donated to Lower Manya Krobo Municipal

Recommendation	Action Required	Responsibility	Timeline	Status	Challenges
	continuous evacuation of waste to final dumping site	Municipal Assembly		agreed in principle to ensure Zoomlion continuously evacuate waste to final dumping site	Assembly yet to installed resulting in refuse being damped on cleared site at Kpong Wharf
	Sensitize fishmongers on the need to keep Kpong Wharf clean	Lower Manya Krobo Municipal Assembly	Feb. 2023	Technical Services has engaged the fishmongers on the need for their relocation. They have bought-in the idea and have agreed to move to a new site	
	Relocate refuse damp during reconstruction of beach road	Lower Manya Municipal Assembly	Dec. 2024	Not due	
KVIP's sited close to the Kpong shoreline needs to be rehabilitated or relocated, to prevent discharge of faecal matter into the Volta River	Engage Lower Manya Krobo Municipal Assembly on the way forward	Volta River Authority	Feb. 2023	New KVIP under construction to replace old one	

Recommendation	Action Required	Responsibility	Timeline	Status	Challenges
Regulatory agencies must ensure regulatory compliance of solid and liquid waste disposal, especially along the shoreline of the Volta Lake System.	Ensure stakeholders take the necessary measures to comply with the relevant regulations regarding discharge of effluent	EPA and WRC	Dec. 2023	On-going	
The upspringing of aquaculture facilities in the Kpong Headpond must be investigated to ensure compliance with regulatory requirements.	Scout for aquaculture facilities in the Kpong Headpond and issue out list to EPA	Volta River Authority	April 2023	Done	
	Invite Ministry of Fisheries to future stakeholder engagements on the EMP for the dams	Volta River Authority	Dec. 2022	Done	

4. CONCLUSION AND RECOMMENDATIONS

4.1. Conclusions

a. Quality of water throughout the sampling sites, ranging from Dodi Island area to Ada has not changed significantly since 2021 investigated level of pollution.

b. Water quality in resident reservoir indicated water is mildly polluted. The source coming from aquaculture operations.

c. Quality of water in the Kpong Headpond is being compromised by point-source discharges of industrial set-ups (manufacturing industries) and anthropogenic activities of riverine communities which are likely to impact on the general ecosystem function of the water body.

d. Quality of tailrace water at both Akosombo and Kpong Generating Stations suggests no contamination from power generation sources.

e. The Ada area continues to register significant microbial contaminants due to activities of riverine communities.

4.2. Recommendations

i. EPA and WRC should intensify their on-going supervisory role over stakeholders' activities and monitor water quality within the area to identify aquaculture companies that may be causing the pollution.

ii. Lower Manya Municipal Assembly should continue to engage the fish market leaders and conclude the planned relocation from the waterfront.

iii. Lower Manya Krobo Municipal Assembly should install the skip bins to prevent indiscriminate dumping of refuse around.

iv. EPA and WRC should engage Akosombo Industrial Company Limited to discuss the issue of pollution from their facility.

v. Ministry of Fisheries & Aquaculture Development should intensify regulatory oversight responsibilities over aquaculture operators.

APPENDICES

APPENDIX 1: Analytical Results of Potential Pollution Sites in the Volta Lake: December 2022

LOCATION/ PARAMETER	pH	Temp. ^{O}C	Cond. µS/cm	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total PO_4^{3-} mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100ml
Ghana raw water criteria guidelines for domestic use (2003)	**6 – 9**	**-**	**700**	**450**	**300***	**1.0**	**-**	**6.0***	**1.0**	**6.0**	**100**	**1.0**	**-**	**-**	**200**	**0.1**	**0.05 ***	10*	**-**	**5**	**0**
100 m above Akosombo Sewage/drains outfall + Volta	6.98	28.6	71.3	35.7	15	**1.01**	3.95	-	-	-	-	-	-	-	-	-	-	-	-	**10**	0
Akosombo Sewage/drains outfall + Volta	7.03	28.8	71.9	35.9	63	**3.70**	3.88	0.76	0.04	0.05	0.4	0.27	0.013	8	3	0.02	0.05	4.16	20	**1,800**	**500**
100 m below Akosombo Sewage/drains outfall + Volta	7.02	28.6	70.9	35.4	22	**6.16**	3.79	-	-	-	-	-	-	-	-	-	-	-	-	**120**	**40**
100m above ATL	7.00	29.1	71.3	35.7	14	**1.59**	3.55	-	-	-	-	-	-	-	-	-	-	-	-	**40**	**0**
ATL	**11.02**	29.6	**883.0**	**442**	**331**	**40.60**	3.07	**20.5**	0.07	0.37	19.5	0.37	0.122	58	14	**0.41**	**0.16**	**128**	11	**140**	**0**
100m below ATL	7.28	28.6	81.5	40.7	5	**2.98**	3.66	-	-	-	-	-	-	-	-	-	-	-	-	**200**	**0**
100m above Akosombo Paper Mill	7.04	28.5	75.3	37.6	41	**1.46**	3.95	-	-	-	-	-	-	-	-	-	-	-	-	**360**	**160**
Akosombo Paper Mill	7.00	28.5	77.1	38.6	46	**3.42**	5.24	0.93	0.0	0.02	0.8	0.16	0.043	81	1	0.09	0.04	4.48	9	**800**	**200**
100m below Akosombo Paper Mill / Adi Lake Resort	6.99	28.8	73.8	36.9	54	**1.98**	5.08	1.35	0.0	0.12	1.1	0.02	0.006	9	1	**0.11**	0.03	2.88	6	**280**	**80**
Aylos Bay	7.22	28.8	71.5	35.7	73	**1.45**	4.58	1.73	0.01	0.01	0.2	0.01	0.002	2	2	**0.10**	0.05	5.76	11	**60**	**20**
Continental Hotel	7.07	29.3	73.1	36.5	39	**2.20**	5.12	1.02	0.04	0.04	0.2	0.74	0.007	11	1	**0.13**	0.03	3.52	10	**320**	**16**
100 m below Continental Hotel	7.16	29.0	71.4	35.7	65	**2.85**	4.17	-	-	-	-	-	-	-	-	-	-	-	-	**20**	**0**
100m above Atimpoku Slaughter house	7.13	29.7	72.8	36.4	58	**2.41**	7.63	-	-	-	-	-	-	-	-	-	-	-	-	**24,000**	**15,200**
Atimpoku Slaughter house	7.30	29.8	75.2	37.6	36	**4.55**	5.20	1.54	0.04	0.02	0.04	0.18	0.008	4	1	**0**	0.04	5.44	3	**38,000**	**18,000**
100m below Atimpoku Slaughter house	7.18	29.3	71.2	35.6	64	**2.97**	4.81	-	-	-	-	-	-	-	-	-	-	-	-	**440**	**180**
LOCATION/ PARAMETER	**pH**	**Temp. ^{O}C**	**Cond. µS/cm**	**T.D.S. mg/l**	**Colour PtCo**	**Turbi-dity NTU**	**D.O. mg/l**	**BOD_5 mg/l**	**NH_4^+ mg/l**	**NO_3^- mg/l**	**Cl^- mg/l**	**F^{-1} mg/l**	**Nitrite mg/l**	**T S S mg/l**	**SO_4^{2-} mg/l**	**Total Fe mg/l**	**Total PO_4^{3-} mg/l**	**COD mg/l**	**SiO_2 mg/l**	**Total Coli. CFU/100 ml**	**Faecal Coli. CFU/100ml**

Ghana raw water criteria guidelines for domestic use (2003)	**6 – 9**	**-**	**700**	**450**	**300***	**1.0**	**-**	**6.0***	**1.0**	**6.0**	**100**	**1.0**	**-**	**-**	**200**	**0.1**	**0.05***	10*	**-**	**5**	**0**
100m above Sajuna Beach	7.12	28.7	72.0	36.0	38	**1.98**	4.13	-	-	-	-	-	-	-	-	-	-	-	-	**560**	**140**
Sajuna Beach Resort	7.17	29.6	80.7	40.3	42	**3.14**	5.65	1.47	0.04	0.06	4.1	0.02	0.007	5	1	0.01	0.05	6.08	1.0	**1,000**	**520**
Royal Senchi / 100 m below Sajuna Resort	7.20	29.0	72.7	36.5	30	**2.95**	5.31	1.55	0.01	0.26	0.7	0.01	0.007	3	0	**0.41**	0.01	3.84	4.0	**800**	**400**
100 m below Royal Senchi	7.12	29.0	71.7	35.8	23	**2.90**	4.99	-	-	-	-	-	-	-	-	-	-	-	-	**1,200**	**520**
Ayikpala Water Contact Site	6.72	29.2	85.0	42.5	79	**3.74**	2.72	1.11	0.01	0.02	0.8	**1.11**	0.011	5	0	**0.13**	0.02	6.40	1.0	**20,000**	**800**
Kpong Community Drain	6.98	28.2	292.0	146.0	72	**11.90**	3.30	1.85	0.03	0.05	11.9	0.05	0.005	4	15	**0.36**	0.04	6.40	2.0	**136,000**	**7,200**
Kpong Wharf/ 100 m above Kpong Community drain	6.52	29.0	159.1	79.5	22	**5.96**	2.72	3.53	0.20	0.01	6.9	0.89	0.002	7	3	**0.42**	**0.06**	6.40	5.0	**80,000**	**6,400**
Ada 30cm below surface	7.50	26.7	**14020.0**	**7010.0**	8	**4.57**	7.70	5.73	0.01	0.008	**114.8**	0.42	0.03	8	121	0.02	0.03	**11.70**	10.0	**45**	**10**
Ada 2 m below surface	7.52	28.3	**31700.0**	**1580.0**	47	**7.09**	8.10	4.95	0.02	0.006	55.2	0.60	0.02	6	130	**0.41**	0.02	**10.8**	9.0	**60**	**20**

Midstream samples December 2022

Location /Parameters	pH	Temp. ^{O}C	Cond. µS	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total $PO4^{3-}$ mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100ml
Ghana raw water criteria guidelines for domestic use	**6 – 9**	**-**	**700**	**450**	**300***	**1.00**	**-**	**6.0***	**1.0**	**6.0**	**100**	**1.0**	**-**	**-**	**200**	**0.1**	**0.05***	10*	**-**	**5**	**0**

Lake nr 1 (up), upstream of gorge	7.17	30.4	72.4	36.2	1	**1.01**	7.35	1.84	0.02	0.02	1.3	0.21	0.006	16	0	0.07	0.01	6.08	4.0	0	0
Lake nr 2 (up), upstream of gorge	7.30	32.2	73.7	36.8	11	1.00	7.75	1.52	0.03	0.02	1.01	0.53	0.000	9	1	**0.13**	0.03	5.44	1.0	0	0
Lake nr 3 (up), upstream of gorge	7.11	30.5	73.9	36.9	2	**1.37**	8.28	1.97	0.01	0.01	0.9	1.00	0.01	12	0	0.01	0.01	6.72	0.0	2	0
Akosombo dam intake (up)	7.28	30.0	74.9	37.40	9.0	1.00	7.96	0.69	0.00	0.01	2.1	0.50	0.003	10	1	0.07	0.01	4.48	2.0	4	**2**
Akosombo dam tail water	6.99	28.6	72.4	36.2	4	1.00	4.26	1.69	0.01	0.03	0.1	0.45	0.008	9	1	0.08	**0.08**	7.36	5.0	**40**	**0**
Akosombo township	6.89	28.7	72.5	36.3	36	**3.52**	4.38	1.38	0.02	0.06	11.8	0.19	0.004	19	2	0.10	0.03	4.80	3.0	**120**	0
ATL	7.02	28.9	71.5	35.7	9	**2.02**	4.35	1.15	0.01	0.02	0.3	**1.31**	0.005	27	1	0.10	**0.06**	2.56	6.0	**24**	**8**
Akosombo Paper Mill	7.02	28.9	72.1	36.0	31	**1.68**	4.00	2.09	0.01	0.04	0.7	0.02	0.000	2	1	**0.66**	**0.07**	4.50	9.0	**20**	**0**
Atimpoku Slaughter house	7.29	28.8	71.9	35.9	42	**1.16**	5.27	0.71	0.01	0.04	0.4	0.24	0.007	7	1	0.03	0.03	3.52	10.0	**140**	**10**
Fishfarm 1	7.03	29.0	72.5	36.2	4	**1.04**	5.62	1.40	0.00	0.04	0.1	0.48	0.012	3	1	0.01	0.03	3.52	2.0	**10**	**0**
Fishfarm 2	7.39	29.6	72.1	36.1	42	**1.54**	5.57	1.07	0.01	0.02	0.2	0.05	0.007	1	1	0.09	0.05	4.16	0.00	**20**	**0**
Kpong Water works	7.09	28.9	72.1	36.1	41	**1.48**	5.53	0.56	0.01	0.08	0.1	0.11	0.000	5	2	0.03	0.04	2.88	6.0	**8**	**0**
Tree trunk wood	7.56	28.9	72.9	36.4	11	**1.43**	5.74	1.21	0.09	0.01	0.1	0.16	0.006	16	16	0.06	**0.15**	3.84	1.0	5	0
Kpong dam intake	7.33	28.8	72.8	36.4	39	**1.35**	6.43	0.63	0.01	0.03	0.2	0.13	0.008	6	0	**0.14**	0.04	5.12	3.0	**0**	0
Kpong dam tail 1 water	7.47	27.4	74.6	37.3	4	**1.02**	6.74	3.06	0.01	0.01	0.5	0.60	0.040	7	1	0.09	0.03	**11.70**	15.0	**14**	**6**
Kpong dam tail 2 water	7.47	27.3	74.4	37.2	2	**2.94**	6.85	1.3	0.02	0.011	0.6	0.96	0.04	7	0	0.09	0.02	**10.8**	5.98	**28**	**10**

Note

* WHO recommended raw water quality criteria

- Shaded Portion in yellow – Values above WRC(Ghana) Maximum Permissible Levels for Raw Water/WHO recommended raw water quality criteria
- Shaded Portion in green – WRC(Ghana) Maximum Permissible Levels for Raw Water/WHO recommended raw water quality criteria
- Ambient Temperature – 33/34^{O}C

APPENDIX 2: Analytical Results of Potential Pollution Sites in the Volta Lake: June 2022

Shoreline samples June 2022

LOCATION/ PARAMETER	pH	Temp. ^{O}C	Cond. µS/cm	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total PO_4^{3-} mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100 ml
Ghana raw water criteria guidelines for domestic use (2003)	**6 – 9**	**-**	**700**	**450**	**300***	**1.0**	**-**	**6.0***	**1.0**	**6**	**100**	**1.0**	**-**	**-**	**200**	**0.1**	**0.05***	10*	**-**	**5**	**0**

100 m above Akosombo Sewage/drains outfall + Volta	7.19	29.4	71.9	35.9	90	**4.62**	5.25	-	-	-	-	-	-	-	-	-	-	-	-	**100**	0
Akosombo Sewage/drains outfall + Volta	7.83	29.8	92.3	46.2	100	**15.0**	6.06	5.90	0.00	0.65	1.8	**1.03**	0.007	17	28	**0.11**	**0.55**	**14**	29	**3,600**	**90**
100 m below Akosombo Sewage/drains outfall + Volta	7.25	29.8	72.0	36.0	79	**4.03**	5.51	-	-	-	-	-	-	-	-	-	-	-	-	**20**	**10**
100m above ATL	7.25	30	71.3	35.7	72	0.23	5.29	-	-	-	-	-	-	-	-	-	-	-	-	**60**	**30**
ATL	7.25	30.1	**1391**	**696**	79	**4.67**	4.85	3.92	0.02	0.55	1.1	**2.00**	0.05	12	7	**0.15**	**0.68**	**28**	12	**440**	**180**
100m below ATL	7.30	30.1	75.4	37.7	15	0.27	4.92	-	-	-	-	-	-	-	-	-	-	-	-	**30**	**0**
100m above Akosombo Paper Mill	7.35	29.9	71.6	35.8	84	**2.10**	5.24	-	-	-	-	-	-	-	-	-	-			**120**	0
Akosombo Paper Mill	7.21	29.8	71.9	35.9	66	**3.16**	5.27	4.72	0.02	0.03	0.8	**1.23**	0.06	16	10	**0.13**	**0.83**	**18**	6	**500**	**20**
100m below Akosombo Paper Mill / Adi Lake Resort	7.21	29.8	71.7	35.8	66	0.25	5.26	2.95	0.02	0,42	0.6	0.79	0.001	18	5	**0.11**	**0.73**	9	23	**70**	**10**
Aylos Bay	7.17	29.5	71.7	35.8	23	**1.90**	5.50	2.09	0.06	0.46	0.3	0.57	0.002	14	1	**0.14**	**0.27**	10	12	**100**	**0**
Continental Hotel	7.10	29.8	71.4	35.7	64	**2.06**	4.45	2.71	0.02	0.52	0.5	0.38	0.003	10	2	**0.10**	**0.24**	7	14	**20**	**0**
100m below Continental Hotel	7.13	29.9	71.5	35.7	72	**6.80**	2.68	-	-	-	-	-	-	-	-	-	-	-	-	**72**	**0**
LOCATION/ PARAMETER	**pH**	**Temp. ^{O}C**	**Cond. µS**	**T.D.S. mg/l**	**Colour PtCo**	**Turbidity NTU**	**D.O. mg/l**	**BOD_5 mg/l**	**NH_4^+ mg/l**	**NO_3^- mg/l**	**Cl^- mg/l**	**F^{-1} mg/l**	**Nitrite mg/l**	**T S S mg/l**	**SO_4^{2-} mg/l**	**Total Fe mg/l**	**Total $PO4^{3-}$ mg/l**	**COD mg/l**	**SiO_2 mg/l**	**Total Coli. CFU/100 ml**	**Faecal Coli. CFU/100 ml**
Ghana raw water criteria guidelines for domestic use	**6 – 9**	**-**	**700**	**450**	**300***	**1.0**	**-**	**6.0***	**1.0**	**6**	**100**	**1.0**	**-**	**-**	**200**	**0.1**	**0.05***	10*	**-**	**5**	**0**
100m above Atimpoku Slaughter house	7.11	30.0	72.4	36.2	146	**1.69**	4.37	-	-	-	-	-	-	-	-	-	-	-	-	**180**	**60**
Atimpoku Slaughterhouse	7.20	30.0	73.6	36.8	159	**2.17**	4.68	5.22	0.03	0.51	1.0	0.87	0.005	7	1	**0.11**	**0.45**	3	5	**5,800**	**4,200**
100m below Atimpoku Slaughter house	7.14	30.6	72.0	36.0	95	0.20	4.91	-	-	-	-	-	-	-	-	-	-	-	-	**800**	**100**

100m above Sajuna Beach	7.25	29.8	72.0	36.0	100	**1.67**	4.31	-	-	-	-	-	-	-	-	-	-	-	-	**380**	**280**
Sajuna Beach Resort	7.11	30.3	74.3	37.1	128	**2.42**	4.61	4.29	0.01	0.33	1.2	**1.51**	0.04	10	7	0.07	**0.53**	**12**	19	**2,400**	**1,800**
Royal Senchi / 100 m below Sajuna Resort	7.16	30.3	72.2	36.1	46	**2.62**	4.77	2.76	0.04	0.31	1.0	0.65	0.006	9	3	0.009	**0.50**		17	**620**	**20**
100 m below Royal Senchi	7.06	30.6	107.4	52.7	75	**6.30**	2.62	-	-	-	-	-	-	-	-	-	-	-	-	**1,800**	**600**
Ayikpala Water Contact Site	7.32	29.4	451.0	225	159	**8.15**	3.82	5.92	**1.28**	0.11	8.0	0.17	0.16	17	1	**0.50**	**1.42**	**11**	16	**2,880**	**600**
Kpong Community drain	7.20	29.8	154.6	77.3	153	**7.73**	4.85	**6.02**	0.23	0.12	2.8	**1.28**	0.16	17	47	**0.28**	**0.90**	**21**	16	**82,000**	**10,000**
Kpong Wharf/ 100 m above Kpong Community drain	7.15	30.8	117.6	58.8	112	**10.8**	5.48	2.93	0.07	0.4	4.3	0.69	0.003	9	11	**0.40**	**0.79**	7	35	**1,600**	**250**
Ada 30cm below surface	7.50	28.9	**7140.0**	**3570.0**	11	**2.15**	5.47	**6.13**	0.02	0.04	**300**	**1.59**	0.004	-	1	0.00	**0.40**	-	16.0	**1,200**	**260**
Ada 2 m below surface	7.56	28.8	**7100.0**	**3550.0**	13	**2.02**	4.51	5.25	0.05	0.04	**250**	**2.58**	0.018	-	1	0.02	**0.23**	-	11.0	**600**	**100**

Midstream samples June 2022

LOCATION/ PARAMETER	pH	Temp. ^{o}C	Cond. µS	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total $PO4^{3-}$ mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/ 100ml	Faecal Coli. CFU/ 100ml
Ghana raw water criteria guidelines for domestic use	**6 – 9**	**-**	**700**	**450**	**300***	**1.0**	**-**	**6.0***	**1.0**	**6**	**100**	**1.0**	**-**	**-**	**200**	**0.1**	**0.05***	10*	**-**	**5**	**0**
Lake nr 1 (up), upstream of gorge	7.63	30.3	71.6	35.8	11	**2.25**	7.27	1.28	0.01	0.02	1.4	**3.57**	0.012	-	0	0.06	**0.47**	-	16.00	2	0
Lake nr 2 (up)	7.82	30.3	71.2	35.6	13	**4.99**	7.45	1.87	0.01	0.02	1.00	**2.01**	0.01	-	0	0.02	**2.43**	-	13.00	4	0
Lake nr 3 (up)	7.71	29.3	71.8	35.1	10	**2.58**	7.04	1.99	0.02	0.01	0.8	**3.03**	0.00	-	0	0.03	**1.07**	-	13.00	2	0
Akosombo dam intake (up)	7.73	29.1	72.2	36.1	6.0	**2.15**	7.33	1.89	0.01	0.010	2	**1.11**	0.008	-	0	0.03	**2.00**	-	14	0	0

Akosombo dam tail water	7.32	30.5	70.8	35.4	30	**2.20**	5.34	2.09	0.01	0.02	1.5	**1.13**	0.004	-	4	0.07	**1.43**	-	13	**20**	**0**
Akosombo township	7.26	29.5	71.2	35.6	-	0.14	5.72	2.92	0.01	0.03	1.5	**1.98**	0.002	-	6.9	0.04	**0.9**	-	0.0	**30**	**6**
ATL	7.25	29.6	71.4	35.7	-	0.20	5.29	3.12	0.02	0.04	0.50	**1.43**	0.000	-	0.4	0.08	**1.01**	-	17.0	**25**	**0**
Akosombo Paper Mill	7.34	30.2	71.3	35.7	-	0.12	4.28	3.09	0.03	0.02	0.5	0.54	0.012	-	0.6	0.06	**0.99**	-	7.0	**10**	**5**
Atimpoku Slaughterhouse	7.07	29.2	71.2	35.6	-	**2.69**	4.58	4.96	0.06	0.03	1.7	0.15	0.001	-	0.4	**0.19**	**0.87**	-	15.0	**270**	**50**
Fishfarm 1	7.10	29.5	71.1	35.5	-	0.23	4.61	3.55	0.07	0.01	0.6	**1.12**	0.006	-	0.2	0.01	**0.55**	-	39.0	**18**	**0**
Fishfarm 2	7.08	29.5	71.6	35.8	-	**3.20**	4.83	2.19	0.01	0.56	0.2	**2.09**	0.003	-	0.2	0.05	**1.27**	-	17.00	**100**	**10**
Water works	7.05	29.1	71.6	35.8	-	0.11	4.91	2.06	0.00	0.23	1	**1.71**	0.006	-	0.1	0.03	**0.89**	-	12.0	**120**	**80**
Tree trunk wood	7.09	28.6	71.7	35.8	-	0.33	4.83	1.96	0.01	0.26	0.5	**1.82**	0.001	-	0.2	0.06	**0.72**	-	16.0	**40**	**8**
Kpong dam intake	7.10	28.4	71.4	35.7	30	0.11	4.84	2.23	0.02	0.5	0	0.58	0.003	-	1	**0.18**	**0.84**	-	4.58	4	**0**
Kpong dam tail race 1	7.17	29.0	71.1	35.6	51	**1.94**	4.20	2.07	0.06	0.04	2.5	0.96	0.04	15	0	**0.13**	**0.26**	10.0	12	**20**	**4**
Kpong dam tail race 2	7.17	28.6	70.3	35.1	31	0.96	4.17	1.96	0.02	0.04	2.1	0.66	0.04	23	1	0.08	**0.06**	**12.0**	13	**28**	**8**

Note

* WHO recommended raw water quality criteria

- Shaded Portion in yellow – Values above WRC(Ghana) Maximum Permissible Levels for Raw Water/WHO recommended raw water quality criteria
- Shaded Portion in green – WRC(Ghana) Maximum Permissible Levels for Raw Water/WHO recommended raw water quality criteria
- Ambient Temperature – 32/33^{O}C

POLLUTION MONITORING ON THE KPONG HEADPOND, LOWER VOLTA AND VOLTA GORGE SEGMENTS OF THE VOLTA LAKE

2023 ANNUAL REPORT

VOLTA RIVER AUTHORITY

JULY 2024

EXECUTIVE SUMMARY

The Environmental Management Plan (EMP) for the operation of the Akosombo and Kpong Hydropower Dams requires regular water quality monitoring at various potential water pollution sites, also referred to as "hot spots" along the Volta River. To achieve this, a bi-annual water quality monitoring of the Volta River was established and is ongoing. This monitoring activity is aimed at gathering relevant data to provide stakeholders with regular updates on the status of water quality to ensure remedial actions are taken when required. This report provides 2023 annual assessment of water quality in the Lower Volta, Kpong Headpond and the Gorge area segments of the Volta River and status of recommendations from the 2021-2022 Annual reports.

Summary of levels of various pollution indicator parameters as revealed from tests conducted is provided in the table below:

Table 1: Levels of various pollution indicator parameters

Water Quality Indicator	Threshold	Segment of River above threshold	
Chemical Oxygen Demand (COD)	10mg/l	All except • Akosombo dam tailrace • Kpong waterworks	• Kpong dam intake
Microbial Contaminants	5 CFU/100ml	• Atimpoku Slaughterhouse • Kpong community drain • Kpong Wharf area • Lower Volta segment	• Akosombo storm drains • All resorts and hotels • Ayikpala water contact site
Phosphorus	0.05mg/l	• Kpong Headpond • Gorge	• Lower Volta segment
Turbidity	1.0 NTU	Kpong Headpond	• Gorge • Lower Volta segment
pH	9.0 units	• AICL	
Iron	0.1mg/l	• AICL • All resorts and hotels • Ayikpala water contact site	• Kpong Wharf • Kpong community drain • Lower Volta segment
Fluoride	1.0 mg/l	• AICL • Ayikpala • Akosombo storm drains • Akosombo Paper Mill Ltd.	• Wharf
Colour	300 PtCo	• AICL	
BOD$_5$	6.0 mg/l	• Atimpoku Slaughterhouse • Kpong community drain • Kpong Wharf area • AICL • Lower Volta segment	• Akosombo storm drains • Akosombo Paper Mill Limited • Adi Lake Resort • Sajuna Resort • Royal Senchi Hotel

The status of the action plan to ensure the implementation of recommendations made in 2021 – 2022 Reports has been provided.

The report concludes that:

a. Anthropogenic activities in riverine communities, coupled with influx of saline water into the Volta River are the driving forces promoting poor water quality in the Lower Volta area (Ada).
b. Kpong Headpond stands out as the most polluted of all the segments investigated. Discharge of effluents from manufacturing industries, township drains, and surface run-offs from riverine communities into the Volta River is a major cause.
c. The Gorge area in the Volta Lake, though the least polluted amongst the three segments assessed continues to be impacted negatively by activities of aquaculture operatives.
d. Hydropower operations have not impacted adversely on water quality at the Tailrace of the two Hydropower dams.

The following are recommended to address challenges identified:

a. The Lower Manya Krobo Municipal Assembly should mount the last skip bin in addition to the 3No. already mounted to prevent dumping of refuse along the shores of the river.
b. The Ministry of Fisheries & Aquaculture Development (MoFAD) should intensify its regulatory oversight responsibilities by placing a ban on the use of metallic barrels as floaters by aquaculture operators in the Gorge area. Metallic floaters are likely to increase iron levels in the river.
c. Volta River Authority should speed up with the construction of the fish mongers' shed to have them relocated from the waterfront.
d. EPA, WRC, and VRA should team up and stop Klos & Haus Company Ltd. from operating.

Contents

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

1.0 INTRODUCTION

The Volta River Authority (VRA) is required to undertake monitoring of the water quality in some parts of the main Volta Lake, the Kpong Headpond, and the Lower Volta River. This is in line with the conditions of the Environmental Permits issued by the Environmental Protection Agency (EPA) based on the preparation of the Environmental Management Plan (EMP) guiding the operations of the Akosombo and Kpong Hydropower Dams. The water quality monitoring, among other considerations, is to aid in preserving the Volta Lake's integrity for optimal ecosystem services, including long-term water resources for hydropower generation. The water quality monitoring programme is to cover the Kpong Headpond, the Volta Gorge segment of the main Volta Lake and Volta Lake's Lower Volta portion.

To achieve this, a Water Quality Monitoring Programme comprising of a bi-annual assessment of the resident reservoir water, the tailrace water discharge of the Akosombo and Kpong generating plants, as well as receptacles of potential pollutant-laden effluents from point-source discharges of industrial set-ups (manufacturing and hospitality), run-offs from agricultural fields, and other anthropogenic activities, has been instituted. Reports from these assessments are shared with relevant stakeholders and regulatory agencies, such as the Environmental Protection Agency (EPA) and Water Resources Commission (WRC) and the local government administrations.

Additionally, a working group comprising of representatives from VRA, EPA, WRC, Ministry of Fisheries & Aquaculture Development (MoFAD), Asuogyaman District Assembly and Lower Manya Krobo Municipal Assembly was constituted in March 2022 to ensure recommendations made in the water quality assessment reports are implemented.

2.0 MONITORING ACTIVITIES

The 2023 monitoring activity was undertaken in June and December of the year. The water quality assessment results were benchmarked with the Ghana Raw Water Quality Guidelines and WHO water quality standard. Methodology adopted and the results obtained are provided below.

2.1 Sample Collection and Analysis

Sample collection and analysis were undertaken per guidelines from *Standard methods for the examination of water and Wastewater, 22nd edition.* Sample analyses were performed at the VRA and Water Resources Institute (WRI) Laboratories respectively. The main sampling sites and their GPS coordinates are listed in Table 1 below:

Table 2: Sample sites and their GPS Coordinates

No.	Sampling Area/ Potential Pollution Sites	Point Source
1	Akosombo Sewage/ drains outfall +Volta	N 06^0 16’20.3” E 000^0 04’23.2”
2	Industrial Company Ltd. (AICL) or ATL	N 06^0 16’16.3” E 000^0 04’13.9”

No.	Sampling Area/ Potential Pollution Sites	Point Source
3	Akosombo Paper Mill Limited	N 06^{0}14’59.6” E 000^0 04’56.0”
No.	**Sampling Area/ Potential Pollution Sites**	**Point Source**
4	Adi Lake Resort	N 06^0 14’44.2” E 000^0 05’31.5”
5	Aylos Bay Resort	N 06^0 14’39.0” E 000^0 05’33.1”
6	Akosombo Continental Hotel	N 06^0 14’34.0” E 000^0 05’35.2”
7	Atimpoku Slaughterhouse	N 06^0 14’12.0” E 000^0 05’37.1”
8	Sajuna Beach Resort	N 06^0 13’13.1” E 000^0 05’24.7”
9	Royal Senchi Hotel	N 06^0 13’10.1” E 000^0 05’25.0”
10	Ayikpala water contact site	N 06^0 09’48.6” E 000^0 03’57.6”
11	Kpong Community Drain	N 06^0 09’24.7” E 000^0 03’51.5”
12	Kpong Wharf	N 06^0 09’38.6” E 000^O 03’54.6”
13	Ada 30 cm below surface (Lower Volta)	N 05^0 46’ 37.4” E 000^0 38' 58.3"
14	Ada 2m below surface (Lower Volta)	

Table 3: Midstream samples Sites and their GPS Coordinates

No.	Sampling Area/ Potential Pollution Sites		Point Source
1	Lake nr 1 (up)	Resident reservoir (Akosombo Dam)	N 06^0 29’ 45.4" E 000^0 06' 16.7"
2	Lake nr 2 (up)		N 06^0 24’ 16.5" E 000 06' 36.2"
3	Lake nr 3 (up)		N 06^0 20’ 37.2" E 000^0 05' 20.6"
4	Akosombo dam intake		N 06^0 18’ 25.6" E 000^0 03' 45.7"
5	Akosombo dam tail		N 06^0 17’ 45.6" E 000^0 03' 42.3"
6	Akosombo township		N 06^0 16’ 57.6" E 000^0 03' 39.2"
7	Akosombo Industrial Company Ltd. (AICL) formerly ATL		N 06^0 16’ 20.3" E 000^0 04' 23.2"
8	Akosombo Paper Mill/Toilet Paper Factory		N 06^0 15’ 45.6" E 000^0 04' 56.0"
9	Atimpoku Slaughterhouse		N 06^0 13’ 16.5" E 000^0 06' 20.2"
10	Fish Farm 1		N 06^0 10’ 50.3" E 000^0 05' 10.8"
11	Fish Farm 2		N 06^0 10’ 50.3" E 000^0 05' 10.8"
12	Kpong Water Works		N 06^0 09’ 50.2" E 000^0 04' 23.9"
13	Tree trunk wood		N 06^0 08’ 22.2" E 000^0 06' 10.4"
14	Kpong dam intake		N 06^0 07’ 17.1" E 000^0 07' 25.4"
15	Kpong dam tail race 1		N 06^0 06’ 151.6" E 000^0 07' 56.0"
16	Kpong dam tail race 2		N 06^0 06’ 58.0" E 000^0 07' 47.8"

2.2 Results of the Water Quality Analysis

A summary of the results is provided in Appendix 1 and details of individual findings are as below:

2.2.1. pH

pH levels generally are within the guideline ranging from 6.63 to 8.88, however, AICL's shores had a value of 11.28 units in June 2023 exceeding the guideline value of 9.00.

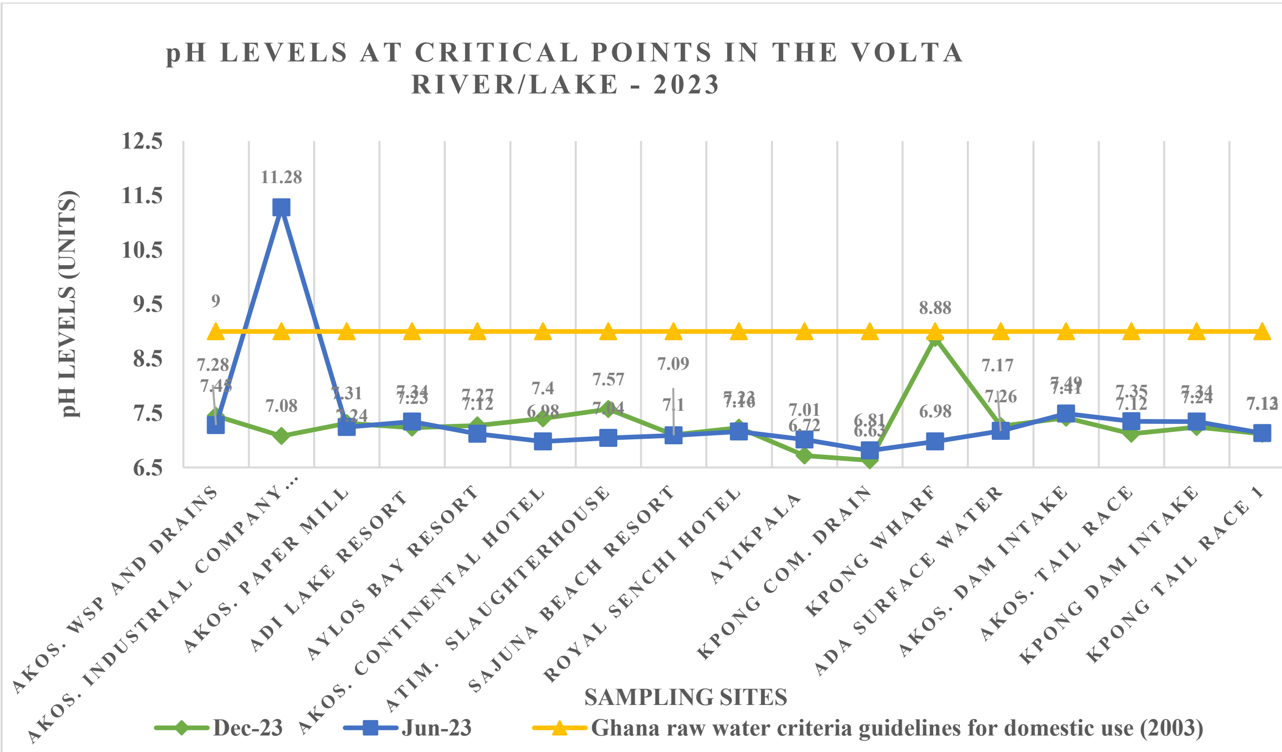


Figure 1: pH levels at critical Points of the Volta River

2.2.2. Colour

AICL is the only site that had colour levels that were above the set guideline of 300 PtCo units (June 2023). All other sites within the monitoring stretch thus Gorge Area, Lower Volta and Kpong Headpond had values well below the set guideline of 300 PtCo units.

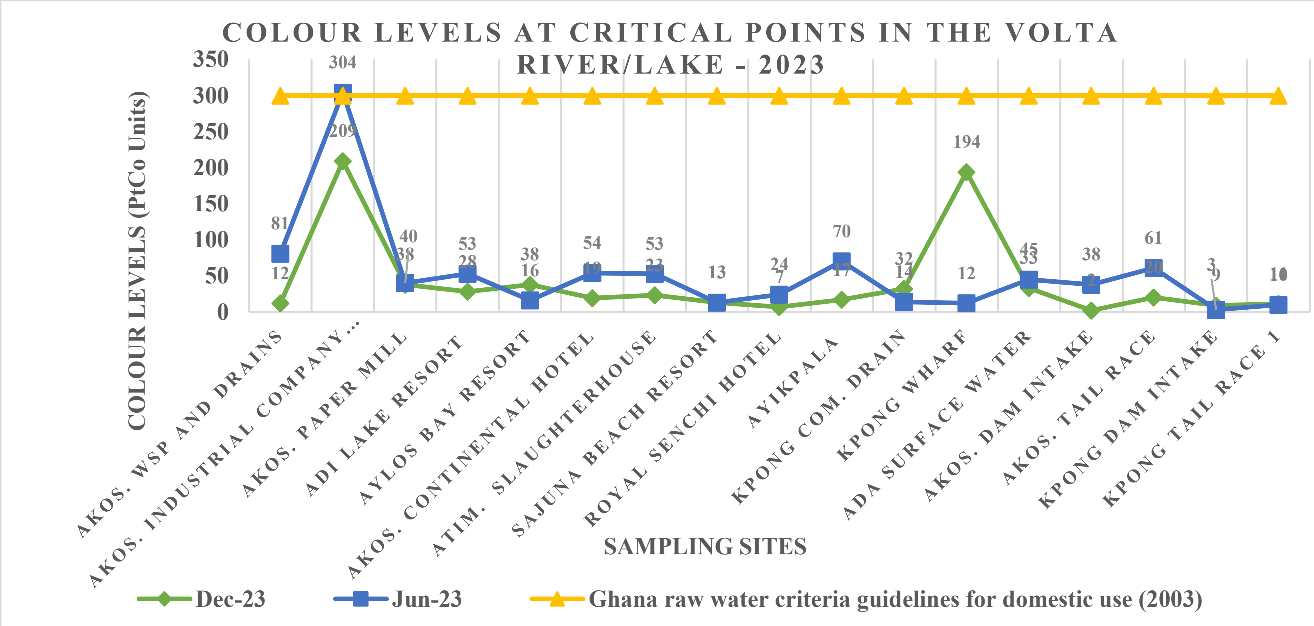


Figure 2: Colour levels at potential pollution sites

2.2.3. Conductivity

Conductivity levels within the monitoring stretch were within the set guideline of 700 µS/cm except AICL and Ada. Ada had conductivity values ranging from 852 µS/cm (low tide) to 9,400 µS/cm (high tide) while AICL had conductivity levels of 1,200 µS/cm and 1753 µS/cm (December and June respectively) at its shores. The exceptionally high conductivity levels at the Ada are attributed to tidal influx of saline water into the Volta River.

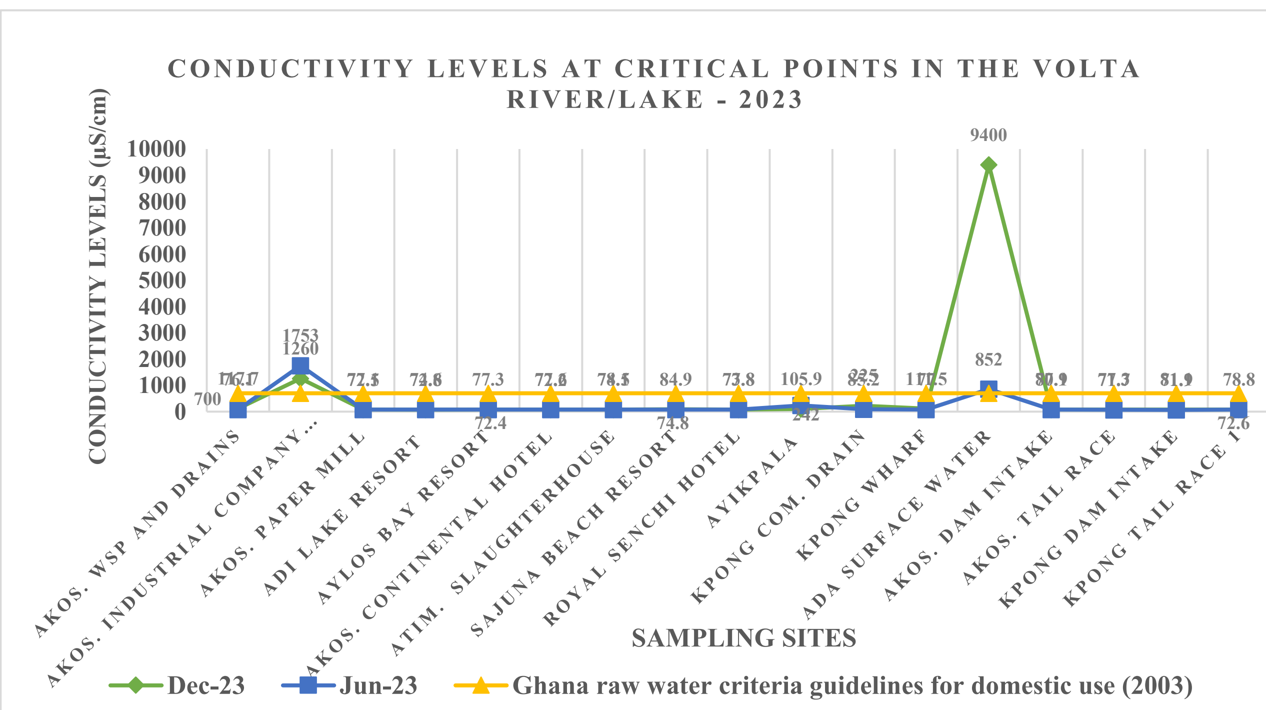


Figure 3:Conductivity levels at potential pollution sites

2.2.4. Microbial Contamination

Microbial contaminant levels within the Kpong Headpond exceeded levels in both Gorge area and the Lower Volta Area. Significantly high levels were obtained at Atimpoku Slaughterhouse, Kpong Community Drain and Kpong Wharf in the Kpong Headpond. Kpong Community Drain had a value of 100,000 CFU/100 ml in the year 2022 as compared to 60,000 CFU/100 ml in year 2023, and this shows a reduction of 40% in contaminant levels.

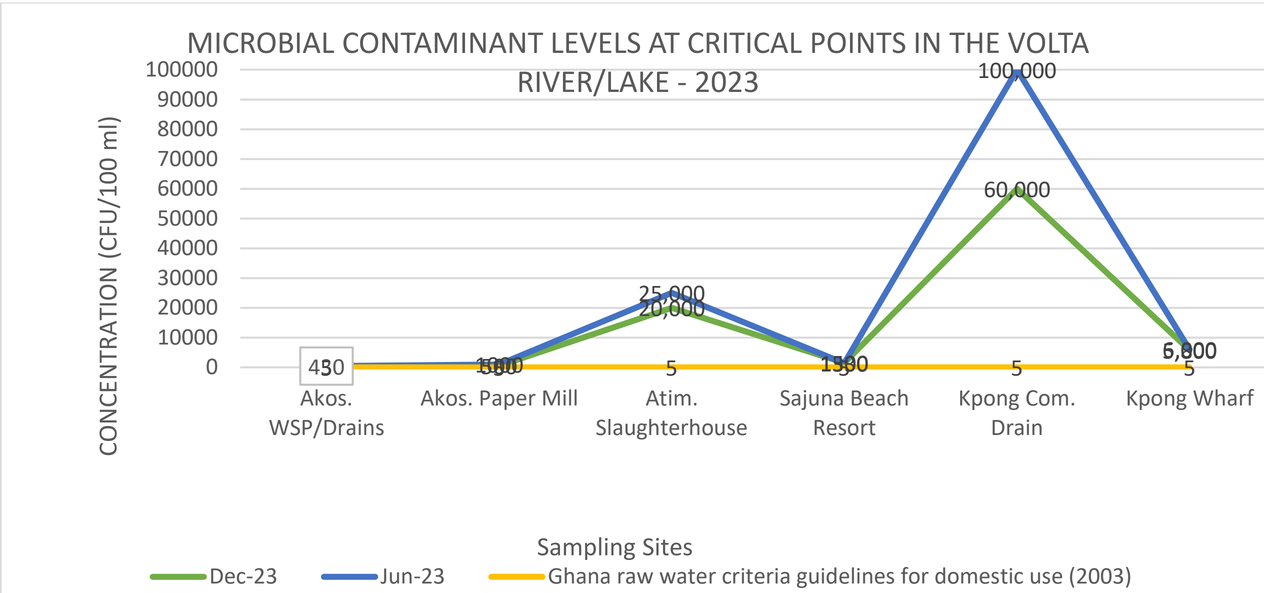


Figure 4: Microbial contaminants levels at potential pollution sites.

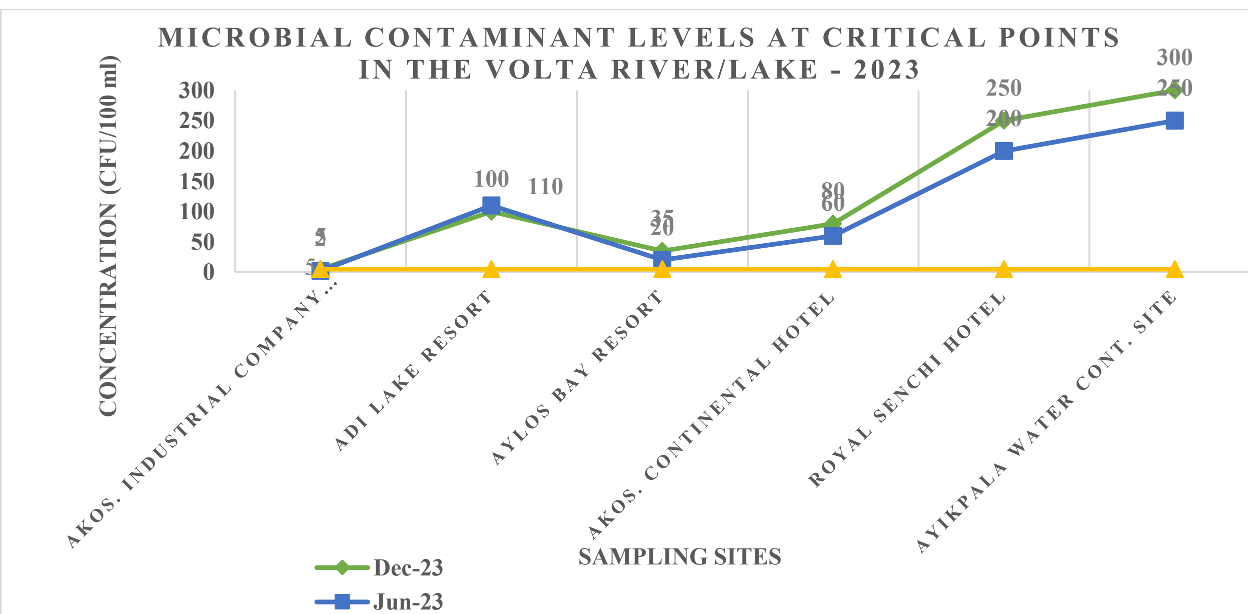


Figure 5:Microbial contaminants levels at potential pollution sites.

2.2.5. Turbidity

Turbidity levels plunged in December after the spillage in October. AICL which recorded 21.6 NTU units during the pre-spillage period in June 2023 had reduced to 1.68 NTU units in December 2023.

Though there were significant reduction in turbidity levels, values exceeded the allowable limit of 1.0 NTU as shown in the figure below.

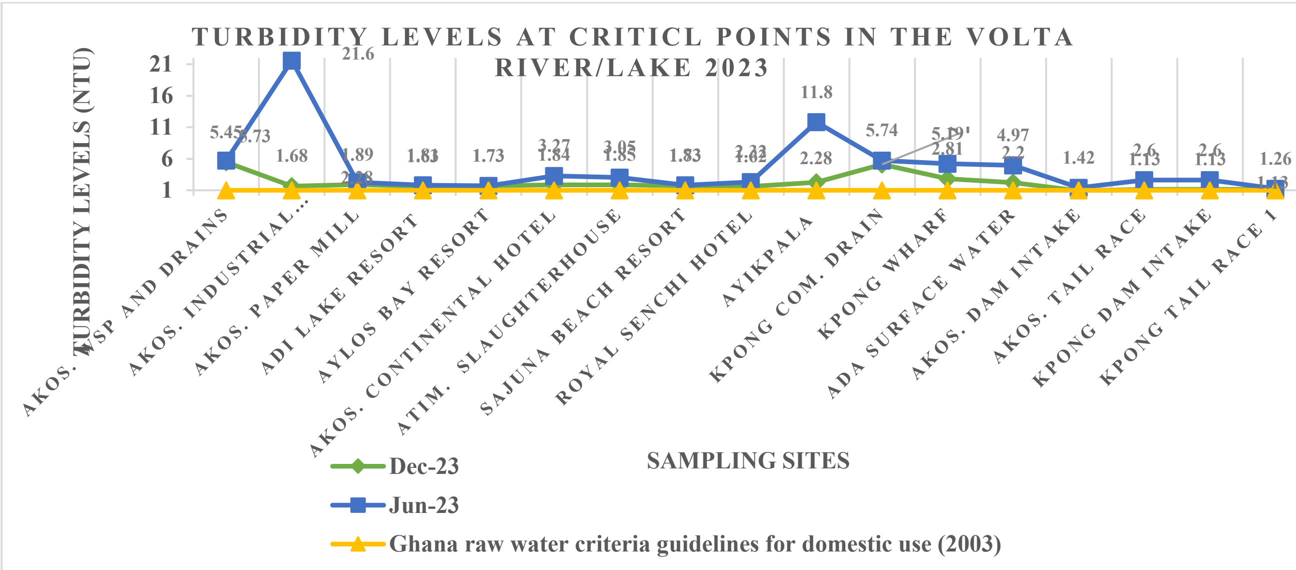


Figure 6:Turbidity levels at potential pollution site

2.2.6. Iron

Generally, iron levels were significantly higher than the set guideline of 0.1 mg/l. AICL, Ayikpala, and Ada recorded values of 0.71 mg/l in December 2023, 1.11 mg/l in June 2023 and 1.27 mg/l in December 2023 respectively.

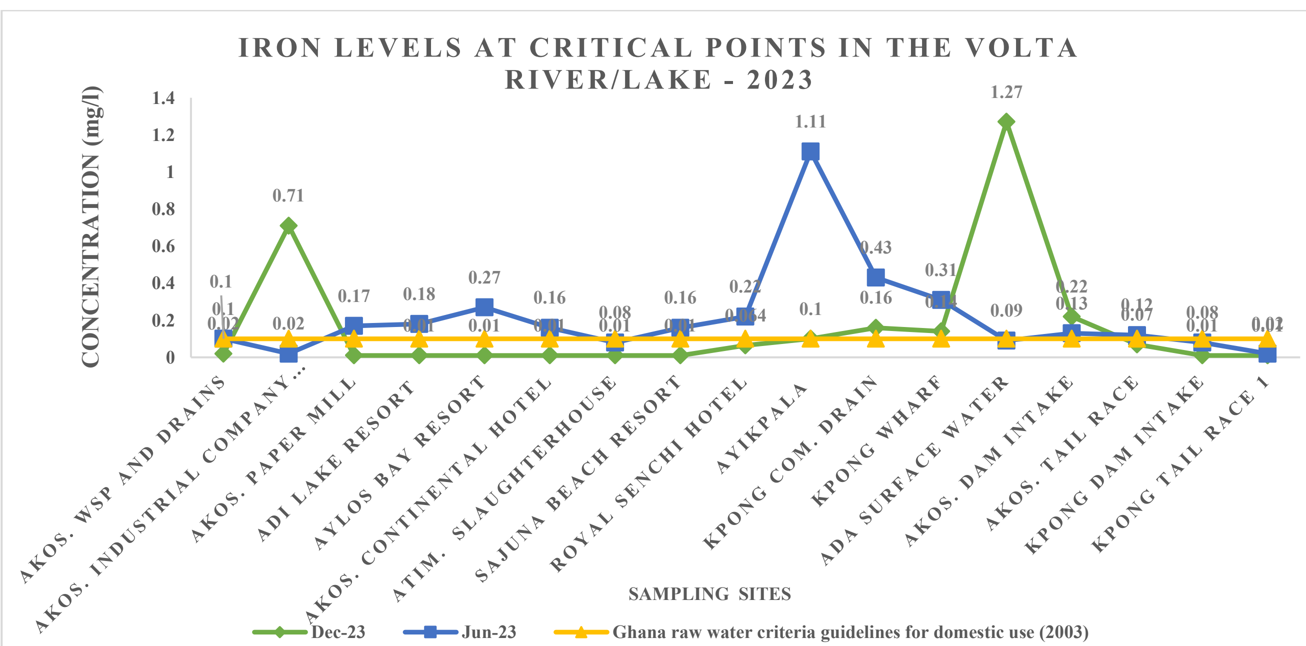


Figure 7: Iron levels at potential pollution sites

2.2.7. Fluoride

Fluoride concentrations were higher before the spillage period; June 2023 but dropped considerably during the spillage in December 2023.

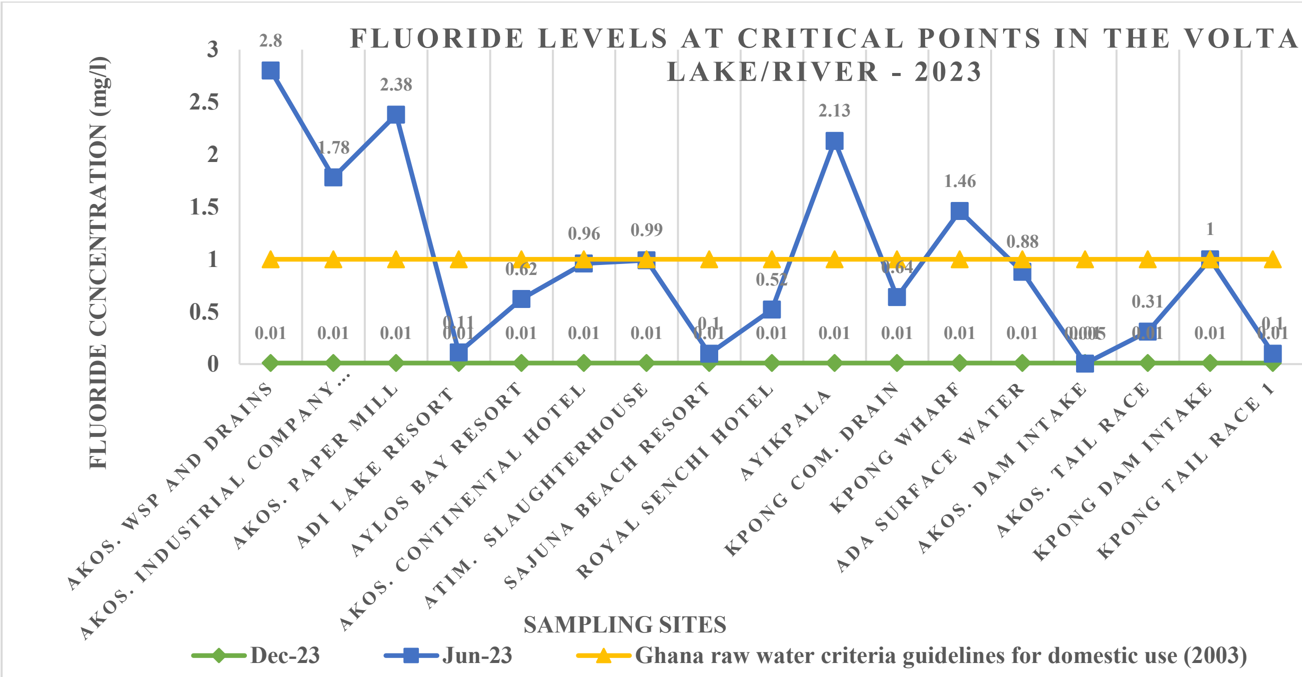


Figure 8: Fluoride levels at potential pollution sites

2.2.8. COD

COD describes the amount of oxygen required to chemically break down pollutants. It is used to gauge the short-term impact wastewater effluents will have on the oxygen levels of receiving water bodies. COD levels at potential pollution sites were generally higher than the GS set guideline of 10 mg/l with Atimpoku Slaughterhouse having the highest value of 141 mg/l, which exceeds the set guideline.

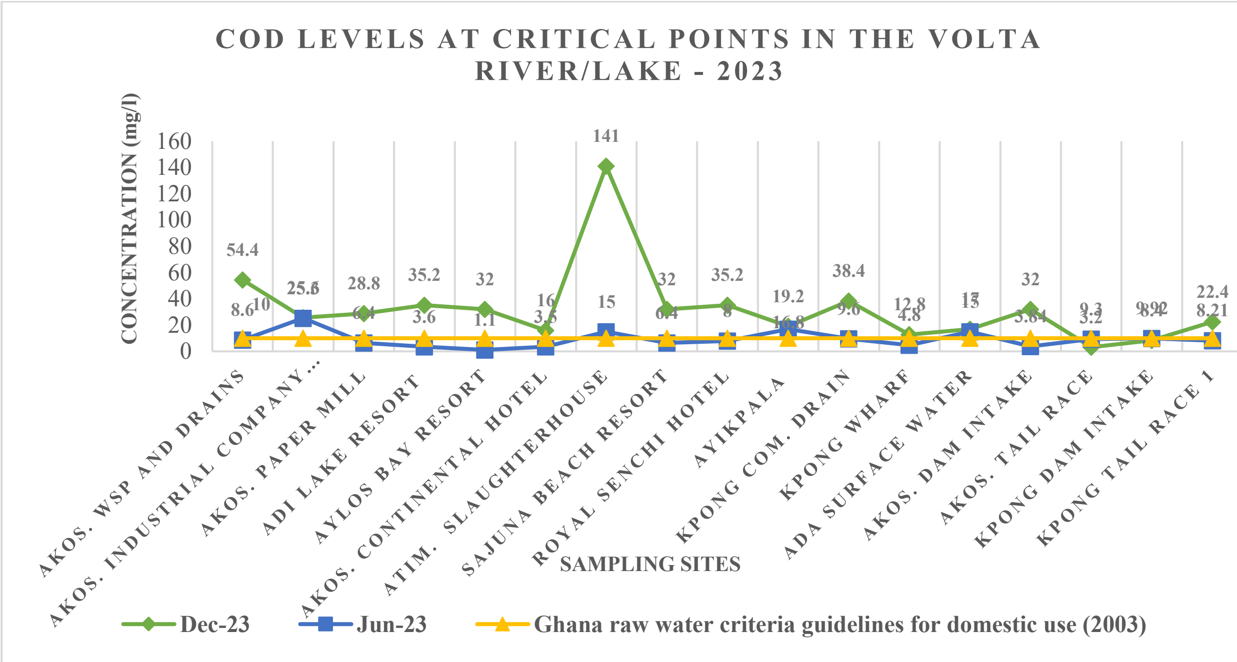


Figure 9: COD levels at potential pollution sites

2.2.9. Phosphorus

Phosphorus levels were generally higher than the set GS guideline of 0.05 mg/l. Phosphorus levels at Kpong Community Drain recorded values of 0.37 mg/l and 0.274 mg/l in June and December respectively as shown in figure 9 below. Phosphorus is an essential element to plant life, this notwithstanding when there is too much of it in water it can speed up eutrophication.

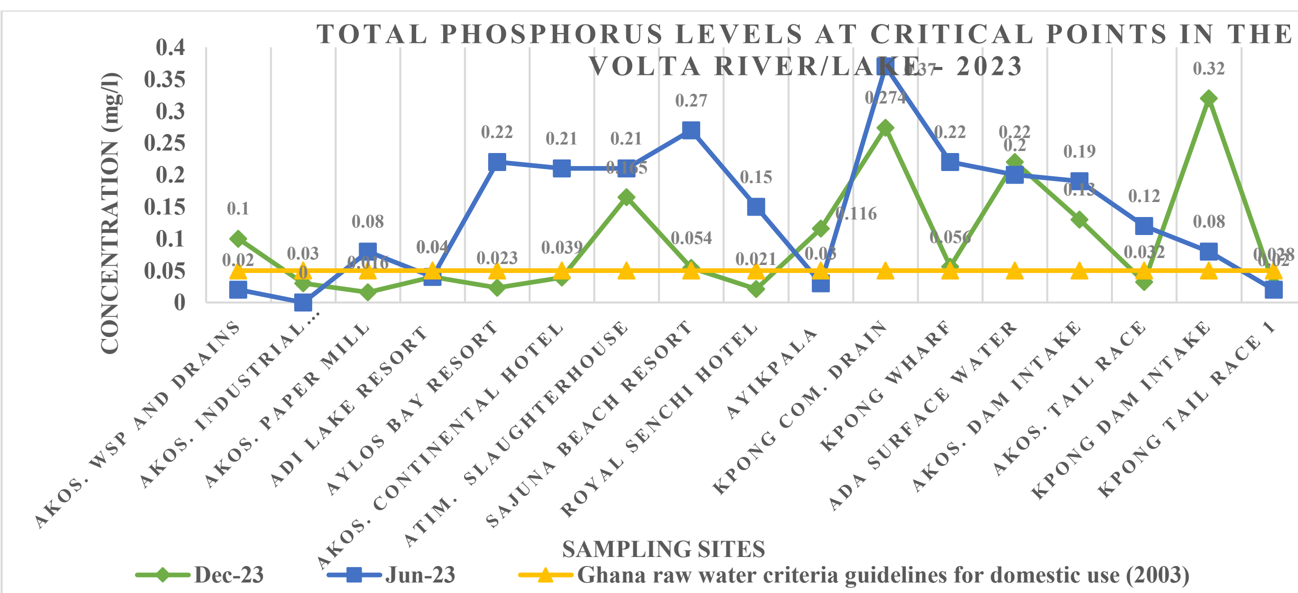


Figure 10: Phosphorus levels at potential pollution sites

2.2.10. BIOCHEMICAL OXYGEN DEMAND (BOD_5)

BOD of water determines the impact of decaying matter on species in a specific ecosystem. It tests how much oxygen is needed by bacteria to break down the organic matter. Higher BOD indicates more oxygen is required, which indicates that there is less oxygen for oxygen-demanding species to feed on and this signifies lower water quality. Generally, BOD levels in December 2023; during the spillage period (1.68 mg/l – 29.6 mg/l) were lower than in June 2023 (2.38 mg/l – 62.8 mg/l).

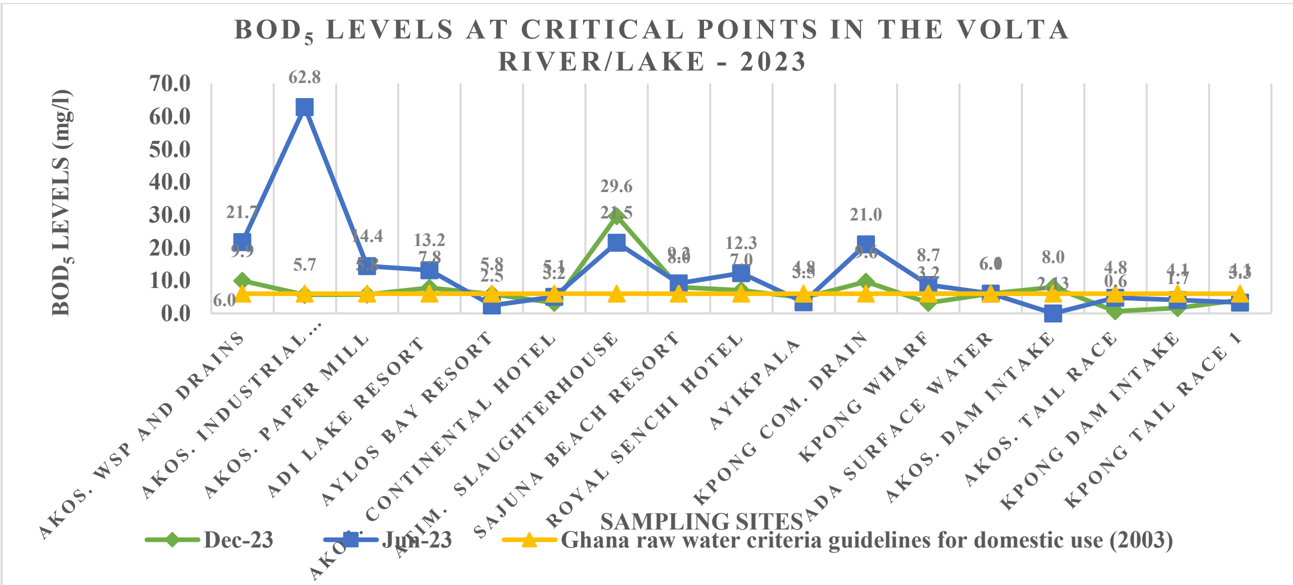


Figure 11: BOD_5 levels at potential pollution sites

2.3. Summary of key findings

a. High microbial contaminants, conductivity, TDS, turbidity, BOD, Iron, COD, and phosphorus levels were obtained in the Ada area.

b. Akosombo Industrial Company Ltd's (AICL) shores have continuously shown high levels of conductivity, TDS, colour, turbidity, BOD, fluoride pH and COD.

c. Water quality at the Akosombo and Kpong hydropower dams's tailrace generally met the Ghana raw water criteria guidelines for domestic use.

d. Atimpoku slaughterhouse shore samples had high levels of turbidity, BOD, COD, phosphorus, and microbial contaminants. However, microbial contaminant levels declined from 38,000 CFU/100 ml in the year 2022 to 25,000 CFU/100 ml in year 2023.

e. Akosombo sewage and storm drains' outfall showed some non-conformity as turbidity, BOD, COD, phosphorus, fluoride, and microbial contaminants levels were significantly above the Ghana raw water criteria guidelines for domestic use.

f. Kpong community drain and a dilapidated toilet facility at the Kpong Wharf area are the major contributors of microbial contaminants and phosphorus discharge into the Volta River.

2.4 Key Observations during Monitoring

Plate 2: Construction of a new toilet facility close to Kpong Wharf is on hold due to legal issues.

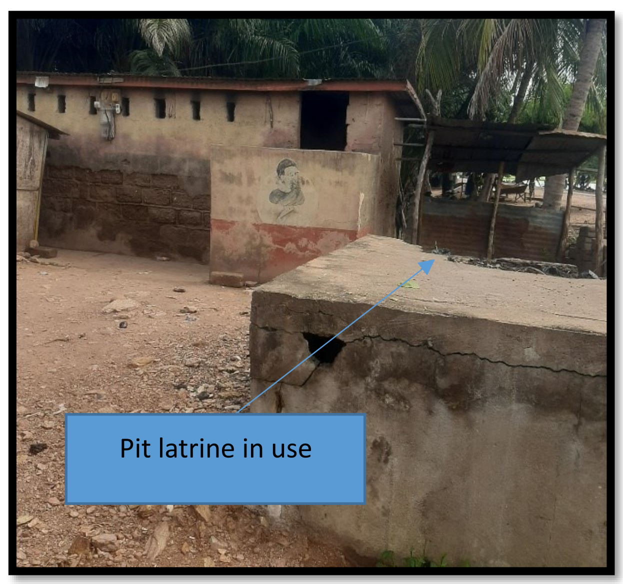


Plate 1: Dilapidated Toilet facility close to Kpong

Plate 4: Newly constructed Bridge at Senchi has begun trapping aquatic weeds.

Plate 3: Use of metallic barrels as floaters by Aquaculture operatives in the Gorge

Plate 5:One out of four skip bins donated to Lower Manya Krobo Municipal Assembly is yet to be mounted.

Plate 6: Proposed site for construction of fish mongers shed ready for use.

3.0 STATUS OF 2022 ACTION PLAN

An action plan was developed to ensure the implementation of recommendations made in 2021 2022 Reports. The status of the action plan is as follows:

Recommendation	Action Required	Responsibility	Timeline	Status	Further action required
Relocate Atimpoku slaughterhouse from the waterfront to prevent the direct discharge of faecal matter into the Volta Lake	Sensitize slaughterhouse workers on the need to protect waterbody	Asuogyaman District Assembly (ADA)	Ongoing	Sensitization ongoing	Continue with sensitization
	Acquire land and relocate Atimpoku slaughterhouse	Asuogyaman District Assembly	Ongoing	Old slaughterhouse to be rehabilitated.	Consultation with ADA
Manage disposal of waste along the Kpong beach to minimize leachates with high nutrient load into the Lake.	Provide four (4) skip bins to temporarily receive and contain waste.	Volta River Authority	Jun-24	Completed	Mount the last skip bin in addition to the 3No. already mounted.
	Evacuate existing refuse before bin installation			Completed	
	Consult with Zoomlion to guarantee continuous evacuation of waste to the final dumping site	Lower Manya Krobo Municipal Assembly		Completed	
	Sensitize fishmongers on the need to keep Kpong Wharf clean.			Kpong fishmongers have agreed to relocate to the area cleared of refuse after engaging with VRA and LMKMA	
	Relocate refuse damp during the reconstruction of Beach Road	Lower Manya Municipal Assembly	Dec. 2024	Completed.	
				Refuse damp evacuated	

Pollution Monitoring on The Kpong Headpond, Lower Volta and Volta Gorge Segments of The Volta Lake

Recommendation	Action Required	Responsibility	Timeline	Status	Further action required
	LMKMA is to engage the Ministry of Roads and Highways and advise on the road designs regarding the drainage of liquid waste into the lake.	Lower Manya Municipal Assembly	Dec. 2024	A new road is to be constructed along the wharf to prevent direct discharge of effluent into the lake.	
Toilet facilities sited close to the Kpong shoreline needs to be rehabilitated or relocated, to prevent discharge of faecal matter into the Volta River	LKMA to resolve legal issues and proceed to construct new toilet facility.	Lower Manya Krobo Municipal	Dec. 2024	Legal issues on-going.	
Regulatory agencies must enforce regulatory compliance with respect to disposal of solid and liquid waste, especially along the shoreline of the Volta Lake System	Fisheries Commission is to schedule a trip in collaboration with VRA and responsible regulatory agencies to decommission illegal aquaculture cages on the Volta River.	EPA, WRC & Fisheries Commission	Dec. 2024	Activity on-going. The EPA is currently undertaking compliance and enforcement monitoring to ensure necessary measures are taken to comply with required regulations.	
	Fisheries Commission is to give feedback to VRA on the initiative to coordinate engagements with other regulatory agencies.	Fisheries Commission		Fisheries Commission has issued letters to aquaculture farmers directing them to decommission illegal cages and acquire the required regulatory permit for operation by the end of 2023.	

Pollution Monitoring on The Kpong Headpond, Lower Volta and Volta Gorge Segments of The Volta Lake

Recommendation	Action Required	Responsibility	Timeline	Status	Further action required
Regulatory agencies must enforce regulatory compliance with respect to disposal of solid and liquid waste, especially along the shoreline of the Volta Lake System	Asuogyaman District Assembly is to put on hold the activities of Klos & Haus Company Ltd., a Limestone Quarry Company at Sedorm.	ADA		Klos & Haus Company Ltd. operates close to the Volta River. VRA has requested that their license is revoked.	
	VRA is to write to EPA to subsequently monitor activities at the quarry site.	VRA		Ongoing	
	EPA is to conduct similar pollution monitoring activities at 'hotspot' areas during the first and third quarters of each year, share the outcome of the monitoring with VRA and make a presentation to the committee at the next meeting	EPA	Dec. 2024		

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

a. Anthropogenic activities in riverine communities, coupled with influx of saline water into the Volta River are the driving forces promoting poor water quality in the Lower Volta area (Ada).
b. Kpong Headpond stands out as the most polluted of all the segments investigated. Discharge of effluents from manufacturing industries, township drains, and surface run-offs from riverine communities into the Volta River is a major cause.
c. The Gorge area in the Volta Lake, though the least polluted amongst the three segments assessed continues to be impacted negatively by activities of aquaculture operatives.
d. Hydropower operations have not impacted adversely on water quality at the Tailrace of the two Hydropower dams.

4.2 Recommendations

a. The Lower Manya Krobo Municipal Assembly should mount the last skip bin in addition to the 3No. already mounted to prevent dumping of refuse along the shores of the river.
b. The Ministry of Fisheries & Aquaculture Development (MoFAD) should intensify its regulatory oversight responsibilities by placing a ban on the use of metallic barrels as floaters by aquaculture operators in the Gorge area. Metallic floaters are likely to increase iron levels in the river.
c. Volta River Authority should speed up with the construction of the fish mongers' shed to have them relocated from the waterfront.
d. EPA, WRC, and VRA should team up and stop Klos & Haus Company Ltd. from operating.

APPENDICES

APPENDIX 1: Analytical Results of Potential Pollution Sites in the Volta Lake: December 2023

Shoreline samples December 2023

LOCATION/ PARAMETER	pH	Temp. °C	Cond. µS/cm	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total PO_4^{3-} mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100 ml
Ghana raw water criteria guidelines for domestic use (2003)	6 – 9	-	700	450	300*	1.0	-	6.0*	1.0	6	100	1.0	-	-	200	0.1	0.05*	10*	-	5	0
100 m above Akosombo Sewage/drains outfall + Volta	7.32	28.8	79.2	39.6	8	1.61	6.63	-	-	-	-	-	-	-	-	-	-	-	-	10	2
Akosombo Sewage/drains outfall + Volta	7.45	28.9	117.7	58.9	12	5.45	6.46	9.89	0.409	0.047	9.23	<0.010	0.010	11	<1.00	0.017	0.10	54.4	11.0	450	25
100 m below Akosombo Sewage/drains outfall + Volta	7.35	28.1	84.2	42.1	9	1.89	5.54	-	-	-	-	-	-	-	-	-	-	-	-	20	0
100m above Akosombo Industrial Company (ATL)	7.22	29.3	76.1	38.1	8	1.73	5.28	-	-	-	-	-	-	-	-	-	-	-	-	40	20
Akosombo Industrial Company (ATL)	7.08	29.3	1260	630	209	1.68	5.75	5.69	<0.001	0.027	2.48	<0.010	0.041	62	30.8	0.714	0.030	25.6	15.4	5	0
100m below Akosombo Industrial Company (ATL)	7.28	29.3	78.3	39.2	56	1.59	5.47	-	-	-	-	-	-	-	-	-	-	-	-	650	300
100m above Akosombo Paper Mill	7.21	28.9	76.8	38.4	39	3.85	5.47	-	-	-	-	-	-	-	-	-	-	-	-	1000	250
Akosombo Paper Mill	7.31	29.3	77.1	38.5	38	1.89	5.35	5.76	<0.001	0.077	2.68	<0.010	0.008	5	<1.00	<0.010	0.016	28.8	11.5	500	5
Adi Lake Resort/100m below Akosombo Paper Mill	7.23	29.1	72.8	36.4	28	1.63	5.91	7.82	0.880	0.019	2.58	<0.010	<0.001	4	<1.00	<0.010	0.040	35.2	13.7	100	25
Aylos Bay	7.27	28.9	77.3	38.7	38	1.73	5.74	5.82	0.030	0.009	2.98	<0.010	<0.001	5	<1.00	<0.010	0.023	32.0	0.023	35	0
Continental Hotel	7.40	29.4	77.6	38.8	19	1.84	5.61	3.20	0.871	0.045	2.08	<0.010	<0.001	7	<1.00	<0.010	0.039	16.0	10.1	80	15
100 m below Continental Hotel	7.21	29.2	76.4	38.2	12	1.64	5.34	-	-	-	-	-	-	-	-	-	-	-	-	30	5
100m above Atimpoku Slaughterhouse	7.28	29.5	77.0	38.5	9	2.35	5.37	-	-	-	-	-	-	-	-	-	-	-	-	200	80
Atimpoku Slaughterhouse	7.57	29.4	78.1	39.1	23	1.85	5.78	29.6	<0.001	0.067	4.57	<0.010	0.008	12	<1.00	<0.010	0.165	141	14.1	20,000	9,000

Pollution Monitoring on The Kpong Headpond, Lower Volta and Volta Gorge Segments of The Volta Lake

100m below Atimpoku Slaughterhouse	7.26	29.6	76.4	38.2	12	2.23	5.53	-	-	-	-	-	-	-	-	-	-	-	-	500	250
LOCATION/ PARAMETER	pH	Temp. ^{o}C	Cond. µS/cm	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total PO_4^{3-} mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100 ml
Ghana raw water criteria guidelines for domestic use (2003)	6 – 9	-	700	450	300*	1.0	-	6.0*	1.0	6	100	1.0	-	-	200	0.1	0.05*	10*	-	5	0
100m above Sajuna Beach	7.08	29.6	76.5	38.3	11	1.38	5.22	-	-	-	-	-	-	-	-	-	-	-	-	500	100
Sajuna Beach Resort	7.10	29.6	84.9	42.5	13	1.73	5.82	8.0	<0.001	0.002	4.17	<0.010	<0.001	8	<1.00	<0.010	0.054	32.0	8.82	1500	500
Royal Senchi / 100 m below Sajuna Resort	7.23	29.4	77.8	38.9	7	1.62	5.61	7.04	<0.001	0.097	2.48	<0.010	<0.001	9	<1.00	0.064	0.021	35.2	15.3	250	110
100 m below Royal Senchi	7.25	29.4	77.3	38.6	15	1.27	5.24	-	-	-	-	-	-	-	-	-	-	-	-	450	90
Ayikpala Water Contact Site	6.72	26.2	105.9	52.9	17	2.28	2.22	4.80	<0.001	0.032	3.08	<0.010	<0.001	10	<1.00	0.100	0.116	19.2	12.9	300	100
Kpong Community Drain	6.63	24.6	225	112.5	32	5.10	6.04	9.60	3.07	0.278	17.4	<0.010	0.041	17	2.76	0.155	0.274	38.4	13.7	100,000	12,500
Kpong Wharf/ 100 m above drain from Kpong Community	8.88	27.6	111.5	55.8	194	2.81	2.13	3.20	0.439	0.031	3.97	<0.010	<0.001	32	<1.00	0.141	0.056	12.8	13.4	5,800	1,500
Ada 30cm below surface	7.26	31.0	9,400	4700	33	2.20	6.34	6.05	0.010	0.03	0.37	0.51	0.003	12	30	1.27	0.22	17	3	150	70
Ada 2 m below surface	7.39	31.1	9,590	4795	36	10.9	6.21	6.42	0.010	0.02	0.30	0.15	0.004	15	51	0.50	0.21	14	19	180	90

Pollution Monitoring on The Kpong Headpond, Lower Volta and Volta Gorge Segments of The Volta Lake

Midstream samples December 2023

Location /Parameters	pH	Temp. ^{0}C	Cond. µS	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total $PO4^{3-}$ mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100 ml
Ghana raw water criteria guidelines for domestic use	6 – 9	-	700	450	300*	1.00	-	6.0*	1	6	100	1	-	-	200	0.1	0.05*	10*	-	5	0
Lake nr 1 (up), upstream of gorge	7.22	30.8	78.4	39.2	5	1.04	7.79	2.56	0.855	0.071	2.98	<0.010	<0.001	6	<1.00	0.022	0.095	12.8	13.1	5	0
Lake nr 2 (up), upstream of gorge	7.30	31.2	77.3	38.7	1	1.22	7.93	7.82	0.037	0.205	2.48	<0.010	<0.001	8	<1.00	<0.010	0.085	35.2	12.9	0	0
Lake nr 3 (up), upstream of gorge	7.22	31.1	77.3	38.7	6	1.97	7.96	4.98	<0.001	0.039	2.28	<0.010	<0.001	9	<1.00	0.426	0.072	22.4	7.37	10	0
Akosombo dam intake (up)	7.41	31.2	77.9	39.9	2	0.923	8.13	8.00	<0.001	<0.001	3.57	<0.010	<0.001	9	<1.00	0.222	0.127	32.0	0.127	15	0
Akosombo dam tail water	7.12	29.4	77.3	38.6	20	1.13	5.94	0.64	<0.001	0.069	2.48	<0.010	<0.001	12	40.0	0.073	0.032	3.20	13.4	40	10
Akosombo township	7.25	28.9	77.0	38.5	6	1.79	5.58	7.11	<0.001	0.067	2.98	<0.010	<0.001	17	<1.00	<0.010	0.077	32.0	11.4	200	40
Akosombo Industrial Company (ATL)	7.08	29.5	76.8	38.9	25	1.68	5.46	6.40	<0.001	0.037	2.48	<0.010	<0.001	7	1.87	0.023	0.058	35.2	12.5	100	0
Akosombo Paper Mill	7.31	29.2	77.9	38.4	10	2.28	5.94	6.40	0.171	0.057	2.68	<0.010	0.030	6	1.07	0.026	0.047	32.0	15.2	10	0
Atimpoku Slaughterhouse	7.26	29.4	78.3	39.2	15	1.49	5.91	6.40	<0.001	0.226	4.57	<0.010	<0.001	15	<1.00	0.050	0.143	163	11.9	20	5
Fish farm 1	7.32	29.4	78.2	39.1	6	1.38	5.42	10.4	<0.001	0.044	5.96	<0.010	0.002	9	<1.00	0.053	<0.001	41.6	14.4	35	8
Fish farm 2	7.17	28.9	78.0	39.0	3	1.69	5.41	6.40	<0.001	0.053	3.28	<0.010	0.035	7	<1.00	0.020	0.039	32.0	11.7	80	10
Kpong Waterworks	7.12	29.4	78.1	39.1	14	1.24	5.25	0.80	<0.001	0.162	5.56	<0.010	<0.001	9	<1.00	<0.010	0.139	5.20	13.5	10	0
Tree trunk wood	7.29	28.9	79.0	39.5	12	1.41	5.23	8.53	<0.001	0.137	2.98	<0.010	<0.001	5	3.46	<0.010	0.038	38.4	15.0	10	0
Kpong dam intake	7.24	29.1	81.1	40.6	9	1.13	5.83	1.68	<0.001	<0.001	2.48	<0.010	<0.001	8	<1.00	<0.010	0.317	8.40	11.6	25	10
Kpong dam tail 1 water	7.12	30.2	78.8	39.4	11	1.13	6.13	4.07	<0.001	0.034	2.48	<0.010	<0.001	9	<1.00	<0.010	0.028	22.4	12.0	30	5
Kpong dam tail 2 water	7.15	29.8	81.7	40.9	13	1.02	5.57	6.98	0.142	0.069	7.44	<0.010	<0.001	8	<1.00	0.011	0.126	38.4	10.9	10	0

Note
*WHO recommended raw water quality criteria

- Shaded Portion in yellow – Values above WRC(Ghana) Maximum Permissible Levels for Raw/WHO recommended raw water quality criteria.
- Shaded Portion in green - WRC(Ghana) Maximum Permissible Levels for Raw/WHO recommended raw water quality criteria.
- Ambient Temperature – 34/35^{O}C

APPENDIX 2: Analytical Results of Potential Pollution Sites in the Volta Lake: June 2023

Pollution Monitoring on The Kpong Headpond, Lower Volta and Volta Gorge Segments of The Volta Lake

Shoreline samples June 2023

LOCATION/ PARAMETER	pH	Temp. ^{O}C	Cond. µS/cm	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total PO_4^{3-} mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100 ml
Ghana raw water criteria guidelines for domestic use (2003)	6 – 9	-	700	450	300*	1.0	-	6.0*	1.0	6	100	1.0	-	-	200	0.1	0.05*	10*	-	5	0
100 m above Akosombo Sewage/drains outfall + Volta	7.15	28.8	71.8	38.4	54	1.60	3.93	-	-	-	-	-	-	-	-	-	-	-	-	5	0
Akosombo Sewage/drains outfall + Volta	7.28	28.7	76.1	38.1	81	5.73	4.12	21.7	0.03	0.317	4.37	2.80	0.010	8	1	0.10	0.02	8.6	36	430	30
100 m below Akosombo Sewage/drains outfall + Volta	7.25	28.7	71.7	35.8	52	2.00	3.77	-	-	-	-	-	-	-	-	-	-	-	-	10	0
100m above Akosombo Industrial Company (ATL)	7.35	28.7	71.7	35.8	48	2.96	3.58	-	-	-	-	-	-	-	-	-	-	-	-	54	26
Akosombo Industrial Company (ATL)	11.28	30.6	1,753	876	304	21.6	2.82	62.8	0.00	0.001	53.6	1.78	0.117	34	10	0.02	0.00	25.3	0	2	0
100m below Akosombo Industrial Company (ATL)	7.37	28.6	42.6	36.3	51	1.51	3.69	-	-	-	-	-	-	-	-	-	-	-	-	960	500
100m above Akosombo Paper Mill	7.39	28.4	75.5	37.7	45	3.57	3.13	-	-	-	-	-	-	-	-	-	-	-	-	1,200	360
Akosombo Paper Mill	7.24	28.7	72.5	36.2	40	2.28	3.38	14.4	0.02	0.092	2.58	2.38	0.013	10	0	0.17	0.08	6.4	4	1,000	0
Adi Lake Resort/100m below Akosombo Paper Mill	7.34	28.2	74.6	37.3	53	1.81	4.31	13.2	-	0.101	1.99	0.11	0.008	7	0	0.18	0.04	3.6	11	110	20
Aylos Bay	7.12	28.6	72.4	36.2	16	1.73	1.89	2.45	0.02	0.164	4.37	0.62	0.013	10	1	0.27	0.22	1.1	4	20	0
Continental Hotel	6.98	29.2	72.2	36.1	54	3.27	2.42	5.05	0.06	0.114	2.78	0.96	0.005	7	1	0.16	0.21	3.5	0	60	20
100 m below Continental Hotel	7.10	29.0	72.5	36.2	31	1.51	2.66	-	-	-	-	-	-	-	-	-	-	-	-	30	0
100m above Atimpoku Slaughterhouse	7.04	28.9	72.4	36.2	10	1.61	1.95	-	-	-	-	-	-	-	-	-	-	-	-	120	90
Atimpoku Slaughterhouse	7.04	29.5	74.5	37.2	53	3.05	2.66	21.5	0.04	0.065	1.59	0.99	0.007	4	0	0.08	0.21	15.0	0	25,000	10,000
100m below Atimpoku Slaughterhouse	7.22	29.2	72.4	36.2	16	1.52	3.01	-	-	-	-	-	-	-	-	-	-	-	-	640	240

Pollution Monitoring on The Kpong Headpond, Lower Volta and Volta Gorge Segments of The Volta Lake

LOCATION/ PARAMETER	pH	Temp. ^{o}C	Cond. µS/cm	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total PO_4^{3-} mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100 ml
Ghana raw water criteria guidelines for domestic use (2003)	6 – 9	-	700	450	300*	1.0	-	6.0*	1.0	6	100	1.0	-	-	200	0.1	0.05*	10*	-	5	0
100m above Sajuna Beach	7.04	28.8	72.4	36.2	14	1.91	2.07	-	-	-	-	-	-	-	-	-	-	-	-	450	130
Sajuna Beach Resort	7.09	29.4	74.8	37.4	13	1.83	2.63	9.15	0.08	0.072	4.57	0.10	0.013	9	0	0.16	0.27	6.4	5	1,330	460
Royal Senchi / 100 m below Sajuna Resort	7.16	29.2	73.8	36.9	24	2.32	2.70	12.3	0.10	0.109	2.18	0.52	0.109	10	1	0.22	0.15	8.0	8	200	100
100 m below Royal Senchi	6.93	29.0	72.4	36.2	11	1.54	2.68	-	0.10	-	-	-	-	-	-	-	-	-	-	440	80
Ayikpala Water Contact Site	7.01	28.4	242	121	70	11.8	1.43	3.45	2.30	2.66	17.3	2.13	0.008	2	1	1.11	0.03	16.8	8	250	100
Kpong Community Drain	6.81	29.0	85.2	42.6	14	5.74	2.05	21.0	0.09	0.812	3.77	0.64	0.009	11	0	0.43	0.37	9.6	7	60,000	10,000
Kpong Wharf/ 100 m above drain from Kpong Community	6.98	29.1	77.0	38.5	2	5.19	3.00	8.65	0.06	0.145	3.57	1.46	0.005	6	1	0.31	0.22	4.8	6	6,000	1,200
Ada 30cm below surface	7.17	29.3	852	426	45	4.97	5.92	6.01	0.04	0.02	0.35	0.88	0.003	4	29	0.09	0.20	15	9	130	8
Ada 2 m below surface	7.27	29.5	1490	745	99	5.24	7.10	6.23	0.04	0.01	0.29	0.89	0.004	4	49	0.10	0.21	11	10	530	120

Midstream samples June 2023

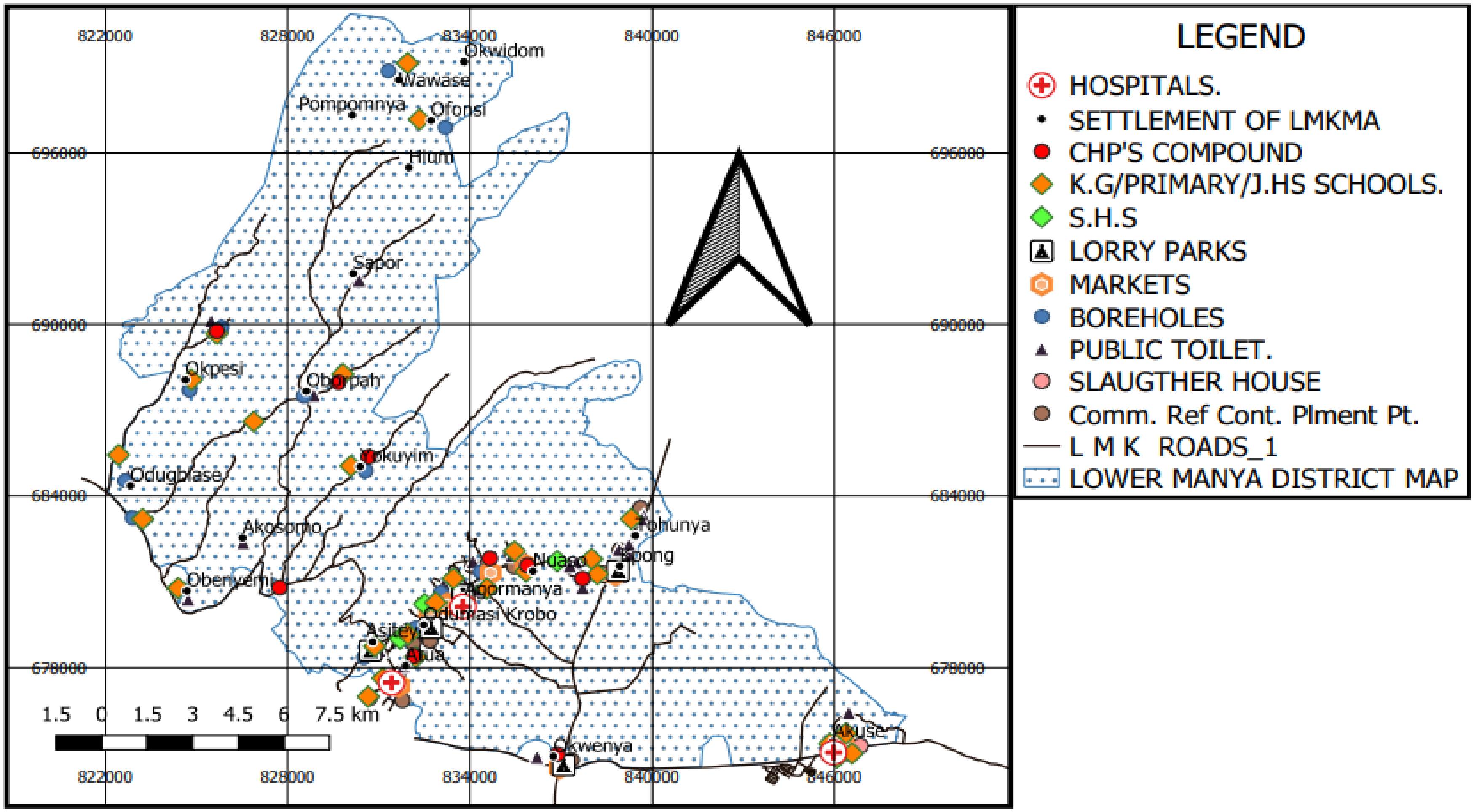
Location /Parameters	pH	Temp. ^{O}C	Cond. µS	T.D.S. mg/l	Colour PtCo	Turbi-dity NTU	D.O. mg/l	BOD_5 mg/l	NH_4^+ mg/l	NO_3^- mg/l	Cl^- mg/l	F^{-1} mg/l	Nitrite mg/l	T S S mg/l	SO_4^{2-} mg/l	Total Fe mg/l	Total $PO4^{3-}$ mg/l	COD mg/l	SiO_2 mg/l	Total Coli. CFU/100 ml	Faecal Coli. CFU/100ml
Ghana raw water criteria guidelines for domestic use	6 – 9	-	700	450	300*	1.00	-	6.0*	1	6	100	1	-	-	200	0.1	0.05 *	10*	-	5	0
Lake nr 1 (up), upstream of gorge	7.47	30.1	79.1	39.6	19	1.71	7.02	1.96	0.11	0.098	3.57	0.005	0.013	1	1.0	0.24	0.29	7.04	15	0	0
Lake nr 2 (up), upstream of gorge	7.48	29.5	78.2	39.1	32	1.46	6.64	1.60	0.05	0.064	5.36	0.005	0.012	12	1.0	0.32	0.27	8.00	12	0	0
Lake nr 3 (up), upstream of gorge	7.43	29.5	78.0	39.0	13	1.30	6.47	1.38	0.07	0.077	5.56	0.005	0.001	2	1.0	0.20	0.20	4.48	15	6	0
Akosombo dam intake (up)	7.49	29.3	80.1	40.1	38	1.78	6.34	2.38	0.05	0.071	4.57	0.005	0.001	3	1.0	0.13	0.19	3.84	12	2	0
Akosombo dam tail water	7.35	28.8	71.7	35.8	61	1.42	4.50	4.8	0.01	0.089	2.78	0.31	0.010	1	0.12	0.12	0.12	9.3	6	30	4
Akosombo township	7.38	28.7	72.2	36.1	56	1.25	4.29	6.0	0.02	0.093	4.17	0.20	0.011	2	0.18	0.12	0.12	3.8	10	300	50
Akosombo Industrial Company (ATL)	7.36	28.6	72.0	36.0	26	1.66	3.91	5.60	0.01	0.101	1.99	0.15	0.012	1	0.15	0.04	0.04	3.6	7	450	27
Akosombo Paper Mill	7.21	28.4	72.5	36.2	45	1.59	3.75	14.8	0.01	0.095	1.79	0.21	0.001	1	0.19	0.07	0.07	9.3	5	100	0
Atimpoku Slaughterhouse	7.11	29.0	72.5	36.2	1	1.82	3.13	21.5	0.06	0.065	1.59	0.25	0.006	0	0.23	0.01	0.01	15.0	6	5	0
Fish farm 1	7.07	28.9	71.9	35.9	25	1.77	2.09	24.5	0.01	0.094	2.98	0.38	0.011	2	0.19	0.11	0.11	16.3	9	10	0
Fish farm 2	7.02	28.8	72.8	36.4	16	1.74	2.75	8.75	0.02	0.059	1.79	0.91	0.012	2	0.20	0.04	0.04	5.8	9	55	0
Kpong Waterworks	7.04	28.8	72.9	36.4	28	1.34	2.42	2.10	0.03	0.108	2.17	0.17	0.010	1	0.21	0.29	0.29	1.1	5	5	0
Tree trunk wood	7.09	28.8	72.8	36.4	2	2.05	3.42	12.6	0.02	0.096	3.37	0.40	0.009	2	0.18	0.00	0.00	7.04	8	12	4
Kpong dam intake	7.34	29.5	71.9	35.9	3	2.60	6.47	4.05	0.11	0.061	2.38	1.00	0.004	2	0.25	0.08	0.08	9.92	9	10	0
Kpong dam tail 1 water	7.13	29.6	72.6	35.3	10	1.26	4.92	3.29	0.00	0.01	2.91	0.10	0.001	1	2	0.01	0.02	8.21	2	20	0
Kpong dam tail 2 water	7.12	29.3	71.6	35.9	19	1.25	4.09	4.13	0.03	0.01	3.03	0.05	0.000	5	0	0.00	0.04	8.92	6	30	5

<u>Note</u>

*WHO recommended raw water quality criteria

- Shaded Portion in yellow – Values above WRC(Ghana) Maximum Permissible Levels for Raw/WHO recommended raw water quality criteria.
- Shaded Portion in green - WRC(Ghana) Maximum Permissible Levels for Raw/WHO recommended raw water quality criteria.
- Ambient Temperature – 34/35^{O}C

LOWER MANYA KROBO MUNICIPAL ASSEMBLY FACILITY BASE MAP.



ANY QUESTIONS ON GENDER EQUALITY?

"Women and men are different. They complement each other"

Seeing men and women only as "complementary" without opportunity to switch roles maintains strict gender norms where the man is the breadwinner and the woman is the children's caregiver.
Gender equality does not mean that women and men will become the same.
It means that they will have the same access to rights and opportunities. Gender equality brings more opportunities for individuals to develop their potential and societies to thrive.

"Women are already welcome in our organization. There is no discrimination"

Most organizations, like VRA, have gender-neutral recruitment policies and do not discriminate women intentionally.
The limited representation of women in technical and leadership roles stems from gender-based stereotypes that are pervasive in the society and assign different roles to men and women.
VRA needs to develop specific targets and activities to attract and retain the best talents, independently from their sex!

Does gender equality benefit women only? What is there for men?

By promoting equal opportunities and better work conditions for all, gender equality benefits both female and male staff.
For instance, VRA will develop a paternity leave that will benefit fathers. VRA mentorship program will equally benefit female and male leaders. VRA gender-based violence and sexual harassment policy will create a violence-free work environment for everybody!

QUIZ: ARE YOU A CHAMPION FOR GENDER EQUALITY?

I believe gender equality does not progress spontaneously but requires constant and targeted efforts and interventions.

YES OR NO

I think that increased gender equality in the workplace is beneficial for both women and men in the organization.

YES OR NO

I think that men have a role to play in improving gender equality in the workplace.

YES OR NO

If your answers are mostly "yes", then you're a champion for gender equality!

If your answers are mostly "no", we'll be happy to discuss gender issues with you in one of VRA sensitization sessions. Everybody is welcome!

For more information on VRA Gender commitment and GAP, please contact:

sechrd@vra.com

ld&tm@vra.com

VRA STANDS FOR GENDER EQUITY

Fostering gender equity to drive business success!

Creating equal opportunities for males and females to contribute!

VOLTA RIVER AUTHORITY

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

Aets

GENDER EQUALITY: EQUAL OPPORTUNITIES FOR ALL!

Gender equality means the **same rights, opportunities and responsibilities** for all individuals, independently from their sex.

Gender equality is a human right recognized by Ghana. **The 1992 Constitution of Ghana** prohibits discrimination of persons on the basis of gender.

Gender equality is good for business: it benefits public and private companies by improving their reputation and attractivity and fostering performance-based management!

The 4 pillars of gender equality

1. **Equal Workforce**
2. **Equal Leadership**
3. **Positive & Violence Free Work Culture**
4. **Equal Pay**

OUR PATHWAY TOWARDS GENDER EQUALITY: BUILDING GENDER KPIs

In 2023, the Volta River Authority decided to commit to gender equality by designing a Gender Action Plan (GAP) in partnership with the Agence Française de Développement (AFD).

VRA GAP Design Workshop in July 2023

VRA Gender Action Plan (GAP) was co-designed by VRA management and staff and will benefit everybody!

- Early 2023: over 50 female and male staff, managers and executives, together with women's organizations and VRA Academy teams, assessed VRA gender gaps, with the support of the consulting firm AETS.
- The GAP analysis pointed out that VRA is still a male-dominated organization with about 24% of women in the workforce, very few women at the technical and leadership roles and gender-based stereotypes still exists at the generating station.
- In July 2023, over 60 female and male participants designed VRA gender KPIs and VRA GAP.

OUR COMMITMENT TO IMPROVE GENDER EQUALITY

From 2023 to 2026, we commit to increase the representation of women:

- In total workforce: from 24% to 28%
- Among executives (C suite): from 0% to 25%
- Among Directors and Managers: from 18% to 25%
- Among female engineers: from 16% to 24% and among technician engineers from 3% to 9%
- 25% of energy Projects Implementation Units (PIU) team will be female
- 70% of procurements will be gender inclusive

The GAP now consists of 40 activities covering:

- Childcare solutions
- Gender inclusive infrastructure (changing rooms for female technicians and engineers)
- Gender sensitization and trainings for VRA staff in partnership with VRA Academy
- A new mentorship program, in partnership with VRA Academy, to boost male and female high potentials' careers
- Gender inclusive job adds to prevent any discriminations
- A paternity leave, a work life balance policy to improve staff well being
- A gender-based violence and sexual harassment policy
- Gender inclusive communications
- STEM outreach activities in education institutions to attract female and male students more equally
- VRA Gender Steering committee will oversee the implementation of GAP

APPENDIX 5

Appendix 5

Appendix 5a	Flyer on Background Information Document on Kpong Dam Rehabilitation Project
Appendix 5b	Background Information Document on Kpong Dam Rehabilitation Project
Appendix 5c	VRA letter to the Ghana Highway Authority on Road Rehabilitation Works
Appendix 5d	GHA letter to VRA on Road Rehabilitation Works
Appendix 5e	Record of Stakeholder Engagement
Appendix 5f	Summary of Main Inquiries from Stakeholder Engagements
Appendix 5g	Public Disclosure Advertisers Announcement of EIA for Kpong Dam Rehabilitation Project

KPONG DAM REHABILITATION PROJECT LOWER MANYA KROBO MUNICIPALITY, EASTERN REGION, GHANA

BACKGROUND

TThe Volta River Authority is undertaking a major rehabilitation of the Kpong Dam with co-funding from the European Investment Bank. The project focuses on strengthening the rock fill dyke and upgrading the dam's spillway to significantly enhance its safety and extend its operational lifespan by over fifty years.

PROJECT HIGHLIGHTS

The Kpong Dam, located on the Volta River at Akuse, 80 km northeast of Accra, Ghana, will undergo repairs including displaced rockfill on the upstream face, rehabilitation of 15 spillway gates, and reconstruction of an 10 km access road. The project will start in Q4 2025 and last four years.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

- AQUATIC ECOSYSTEMS

- Increased sedimentation and turbidity affecting fish and other aquatic organisms.
- Impact on local biodiversity due to habitat alteration.
- Changes in water flow potentially reducing water availability for downstream ecosystems.

- TERRESTRIAL ECOSYSTEMS

- Loss of terrestrial habitats affecting local wildlife.
- Soil erosion and loss of plant species due to vegetation clearing.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

- SOIL AND LAND

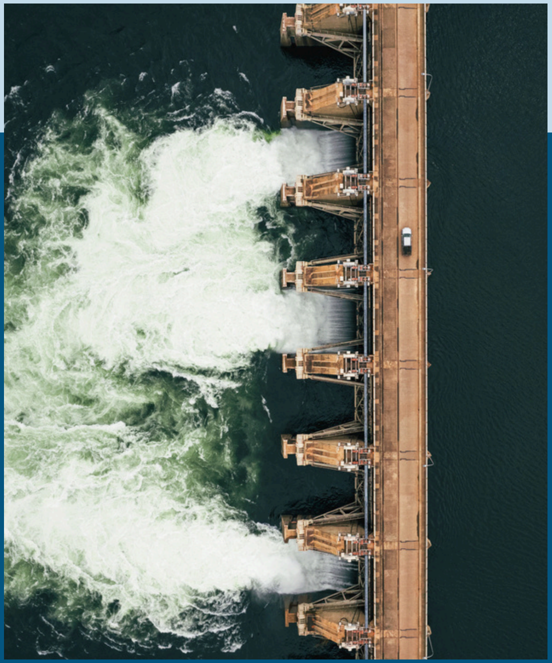
- Increased erosion risks from soil disturbance.
- Potential soil contamination from construction materials and machinery.

- WATER RESOURCES

- Significant water use affecting local water resources.
- Risk of water pollution from construction materials, fuel, and lubricants.

- CLIMATE

- Increased greenhouse gas emissions from machinery and construction activities.



EIA STUDY MILESTONES

- PROJECT NOTIFICATION (MAY-JUNE 2024)

Notify EPA and receive directive for EIAs

- PUBLIC CONSULTATION (JULY 2024 - AUGUST 2024)

Stakeholder Engagement and submission of initial draft EIS Report to EIB

- DRAFT EIA REPORT (OCT. 2024)

Submission of Draft to EPA and public disclosure of EIS document

- EPA'S FEEDBACK ON EIS (NOV. 2024)

Receipt of EPA Review comments and stakeholder feedback

- FINAL EIA REPORT SUBMISSION (DEC. 2024)

Incorporate feedback and submit the final EIS to the EPA for review.

- EPA ENVIRONMENTAL AUTHORISATION (FEB. 2025)

Receive the EPA's decision and notify all registered stakeholders.

STAKEHOLDER ENGAGEMENT

- STAKEHOLDER IDENTIFICATION AND REGISTRATION

Identify and register all I&APs to ensure their involvement throughout the process.

- INFORMATION DISSEMINATION

Provide regular updates through meetings, letters, and online platforms to keep stakeholders informed.

- PUBLIC CONSULTATION MEETINGS

Conduct meetings to present project details, potential impacts, and mitigation measures.

- FEEDBACK AND RESPONSE MECHANISM

Establish channels for stakeholders to submit comments, suggestions, and concerns.

- DOCUMENTATION AND REPORTING

Establish channels for stakeholders to submit comments, suggestions, and concerns.

LEARN MORE

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Engineering Services Department
Volta River Authority
PMB 77, Accra, Ghana
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SCAN FOR MORE INFORMATION →

KPONG DAM REHABILITATION PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

VOLTA RIVER AUTHORITY

Background Information

This Document aims to provide all Interested and/or Affected Party (I&AP), with background information regarding the application for Environmental Permitting as well as the required environmental studies to be undertaken for the "Kpong Dam Rehabilitation Project" in the Lower Manya Krobo Municipality, Eastern Region of Ghana. The project is being implemented by the Volta River Authority (VRA) with co-funding support from the European Investment Bank (EIB). Any individual, land user, farmer, landowner, organisation, company, traditional authority, Municipal & District Assembly, Interest Group, Civil Society Organisations, or other entities that might be directly or indirectly affected by the proposed activity can register as an Interested or Affected Party (I&AP).

This Background Information Document (BID) further indicates how one can become involved in the project, receive information, or raise issues which may concern and / or interest you. The sharing of information forms the basis of the Stakeholder Engagement Process under the project development and offers one the opportunity to become actively involved in the project from the outset. Input from I&APs ensures that all potential environmental issues are considered within the context of the proposed development.

Project Location & Terrain

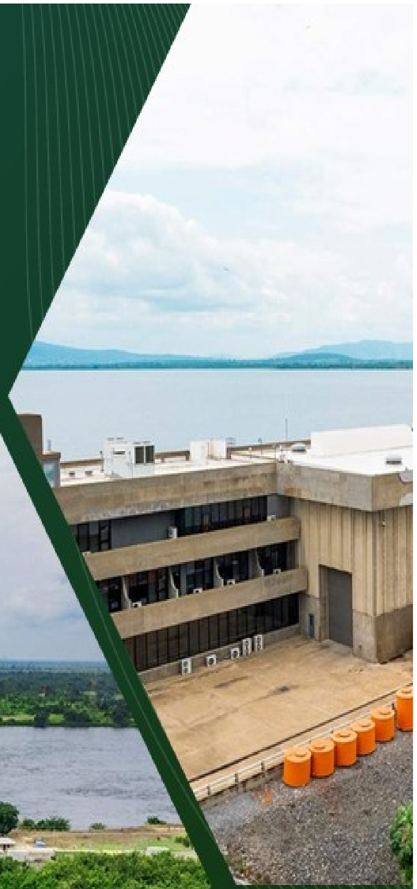
The Kpong Generating Station (KGS) is situated on the Volta River at Akuse, about 20Km downstream of the Akosombo dam and its approximately 80 kilometres northeast of Accra, the capital of Ghana. The dam is located upstream of the town of Akuse (about 4 km distance by road). Electricity generated from the KGS is fed into the GRIDCo Bulk Substation located within the vicinity for further transmission as required. The dam's reservoir helps in regulating river flow, providing water for irrigation, and controlling floods. Municipal water supply is abstracted at Kpong town in the upstream part of the reservoir. The water supply scheme is operated by Ghana Water Company Limited (GWCL).

The main access route to the project site is minor arterial highway from the Okwenya Junction – Akuse Township, along the Tema-Akosombo N2 Highway, some 90km from Accra and some 70km from Tema (travel time by car about 1½ hour from Accra and 1 hour from Tema).

Apart from the hydroelectric power station, there are other office / accommodation facilities for staff involved the maintenance and support of the power infrastructure. The area surrounding the Kpong Dam is predominantly use for agriculture. This includes crop farming, such as maize, cassava, and vegetables, as well as aquaculture due to the proximity to the Volta River and its reservoirs.

There are several communities and settlements in the vicinity of the station. These include both planned residential areas and informal settlements, housing the workers of the power station and the local population engaged in various economic activities. Notable amongst them are Akuse, Natriku, Nuaso, Torgorme, Okwenya and Nyiflakpo.

There are two major irrigation canals with intakes on each side of the Kpong dam. The irrigation water is used for rice cultivation in the Lower Volta basin. These canals run through the area all the way to the Asutuare community, and provide water for farmers, including the activities of the Kpong Farms Limited, a subsidiary of the VRA



The scenic environment around the dam and the Volta River provides opportunities for recreational activities, including fishing, boating, and tourism. Local markets and small-scale businesses are scattered around the area. These include shops, eateries, and other service-based businesses catering to the needs of the residents and visitors. Currently, various hotels have been developed along the Okwenya-Akuse route designed to attract tourists and locals alike. This area is fast developing with residential facilities.

The construction of the KGS was completed in 1982 and involved the hydropower plant and the Kpong Dam, which is operated by the VRA, a public electric power utility company in Ghana. The rehabilitation work is being undertaken as part of operation and maintenance actions at KGS and shall comprise of:

a)Repair of displaced rockfill on the upstream slope of the Kpong Dam and the placement of additional rockfill of suitable grading to enhance its stability and extend its life by a minimum of fifty years

b) Rehabilitation of all fifteen (15) spillway gates to ensure the proper operation and function of the gates for the next 25 years.

The works on the Spillway gates and the dykes are necessary to ensure the sustainability of the dam and of the safety of the population surrounding and downstream of the dam in the Lower Volta Area.

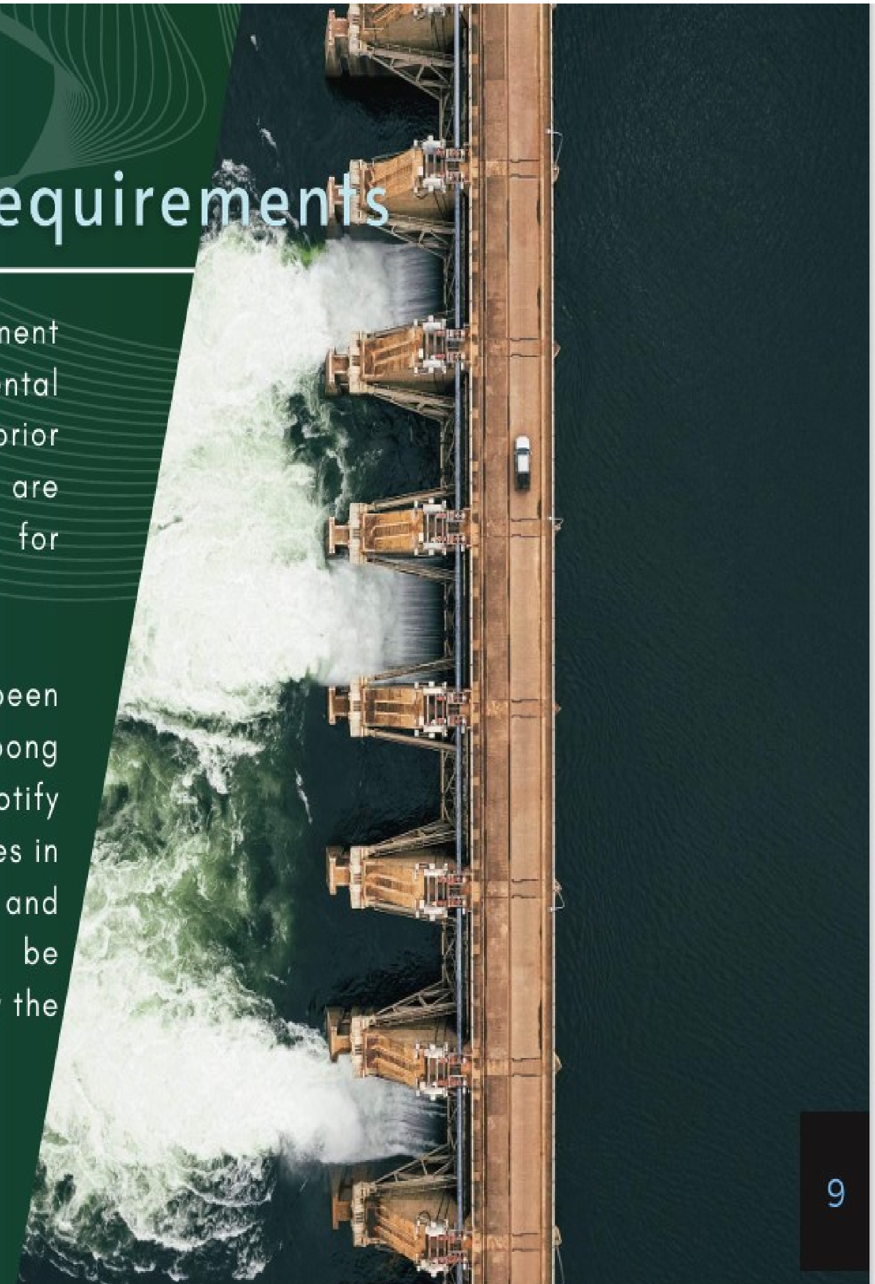
Also associated with the project will be re-construction of approximately 10km of the access road from the Okwenya Junction VRA junction to the Akuse township. The reconstruction of the road is critical to allow for the smooth haulage of materials and equipment during the project execution to ensure that any damage associated with the use of the road during project development is repaired.

VRA has internally funded all feasibility studies, including the EIA Study. The construction activity is to be co-funded by the EIB. The project is expected to commence in Q4 of 2025 for a period of four (4) years.

Environmental Clearance Requirements

- Within the context of the Environmental Assessment Regulations, LI 1652 of 1999, and the Environmental Guidelines for the Energy Sector, 2011, existing projects prior to the promulgation of the law such as the Kpong GS are mandated to submit Environmental Management Plans for the purposes of being issued with Environmental permit.

- VRA has subsequently complied with this and has been issued with an Environmental Permit for the Kpong Hydropower Station. The Permit mandates the VRA to notify the Environmental Protection Agency (EPA) of any changes in the existing operations, including, systems modifications and changes. Thus, the proposed project will have to be communicated to the EPA, and this was done officially by the VRA in May 2024.



In response, the EPA in June 2024 indicated that the project falls into the category for which an EIA is required. VRA was subsequently requested to undertake the EIA and submit the EIS for review.

As part of the requirements of the Loan Agreement for the project, VRA is mandated to adhere to the requirements of the Environmental & Social Standards (February 2022) of the EIB Group, which requires proponents to undertake an ESIA whenever the national requirements mandate so. To ensure adherence to both the Ghana EPA and EIB environmental requirements, an in-house team of experts from VRA is coordinating the EIA assignment.

To achieve the objectives of the EIA requirements, a detailed baseline survey is to 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 to be complimented with stakeholder engagements and desk top studies from similar work done in the project area. Identified impacts will then be analysed to enable the potential mitigation measures to be put in place.

POTENTIAL IMPACTS

The Kpong Dam Rehabilitation Project can have significant environmental and social impacts during project construction. Addressing these impacts through careful planning, community engagement, and sustainable practices can help ensure the project is both environmentally and socially responsible. Below is an outline of some of the key impacts to be considered in this project:

ENVIRONMENTAL IMPACTS

A. AQUATIC ECOSYSTEMS

- Water Quality: Rehabilitation activities can lead to increased sedimentation and turbidity in the water, affecting fish and other aquatic organisms.
- Biodiversity: Alteration of habitats can impact local biodiversity, partico
- Flow Regime: Changes in water flow can affect downstream ecosystems, potentially reducing water availability for wetlands and other habitats.

B.TERRESTRIAL ECOSYSTEMS

- Habitat Loss: Construction activities can lead to the loss of terrestrial habitats, affecting local wildlife.
- Vegetation: Clearing vegetation for construction can lead to soil erosion and loss of plant species.

C.SOIL AND LAND

- Erosion: Disturbance of soil during construction can increase erosion risks.
- Contamination: Use of construction materials and machinery can lead to soil contamination.

D.WATER RESOURCES

- Water Use: Rehabilitation might require significant water use, affecting local water resources.

- Pollution: Risk of water pollution from construction materials, fuel, and lubricants.

E.CLIMATE

- Greenhouse Gas Emissions: Machinery and construction activities can increase greenhouse gas emissions.

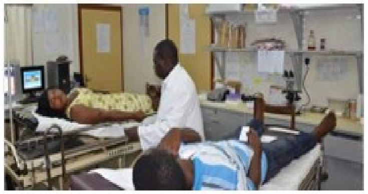
SOCIAL IMPACTS

A. Community Displacement

- It must be noted that there are no associated permanent land take requirements associated with this project. All land requirements will be within the existing facility of the KGS, belonging to the VRA.

B. Livelihoods

- Agriculture and Fishing: Local livelihoods dependent on agriculture and fishing can be impacted by changes in water availability and quality.
- Employment: Rehabilitation projects can create temporary employment opportunities but might also disrupt existing local economies.

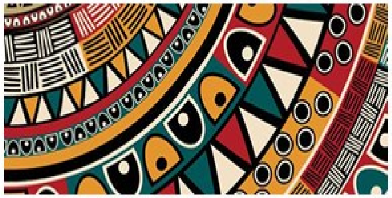


C. Health and Safety

- Public Health: Construction activities can impact public health through noise, dust, pollution, COVID and STDs
- Worker Safety: Ensuring the safety of workers involved in the rehabilitation process is crucial.

D. Infrastructure

Rehabilitation activities can temporarily disrupt use of the associated infrastructure like roads and bridge



E. Cultural Heritage

Archaeological Sites: Risk of disturbing or destroying archaeological sites and culturally significant areas.

EIA STUDY MILESTONE

May 2024

- Notification of EPA of Project

June 2024

- EPAs Directive for EIA

Jul-Aug 2024

- Stakeholder Engagement
- Submission of Initial Draft EIS Reprt to EIB

Oct. 2024

- Submission of Draft EIS to EPA
- Public Disclosure of EIS Document

Nov. 2024

- Receipt of EPA Review Comment
- Stakeholder Feedback

Dec. 2024

- Submission of Final EIS Report to EPA/EIB

Feb 2025

- EPA Environmental Authorisation

STAKEHOLDER ENGAGEMENT PROCESS

The stakeholder engagement process offers interested and affected parties the opportunity to become actively involved in the EIA process by assisting stakeholders to identify issues of concern and possible suggestions for this project. The process involves the following:

1.CONSULTATIONS

From July – August 2024, stakeholders will be informed about the EIA and the proposed project by means of letters, and public participation meetings. Stakeholders will have the opportunity to comment and raise potential issues of concern. The issues raised will be captured in an Issues and Response Report.

3. FINAL NOTIFICATION

Once the EPA has issued the Environmental Permit, all registered and interested and affected parties will be notified of the authorities' decision and of the procedure to follow should they wish to appeal the decision.

2. EIS REPORT

The EIS Report together with the Issues and Response Report will be made available for comment to I&APs once completed. This will be done though an Advertisers Announcement in the most widely circulating newspapers in Ghana and the communities, in this case the Ghanaian Times and Daily Graphic, as part of the public disclosure process. The provision of public disclosure documentations is to ensure accountability, transparency and more importantly extend the project consultations to stakeholders outside the project zone of influence in line with international best practice.

This report will contain a preliminary description of the proposed project, its potential impacts, and a record of all the issues raised by I&APs. The report will also be submitted to the relevant authorities. A six (6) weeks period will be given for I&APs to comment on these reports. After the comment period, the Environmental Impact Assessment Report will be prepared, incorporating any inputs received during the comment period.

YOUR COMMENT IS IMPORTANT

Your comment on the proposed kpong Dam Rehabilitation project and the potential issues that may need to be invested will assist in determining the scope of the environmental studies required and assist the authorities in their decision-making. All comments should be made available through writing to the contact address/email provided below.

CONTACT DETAILS

The Director, Engineering Service Department

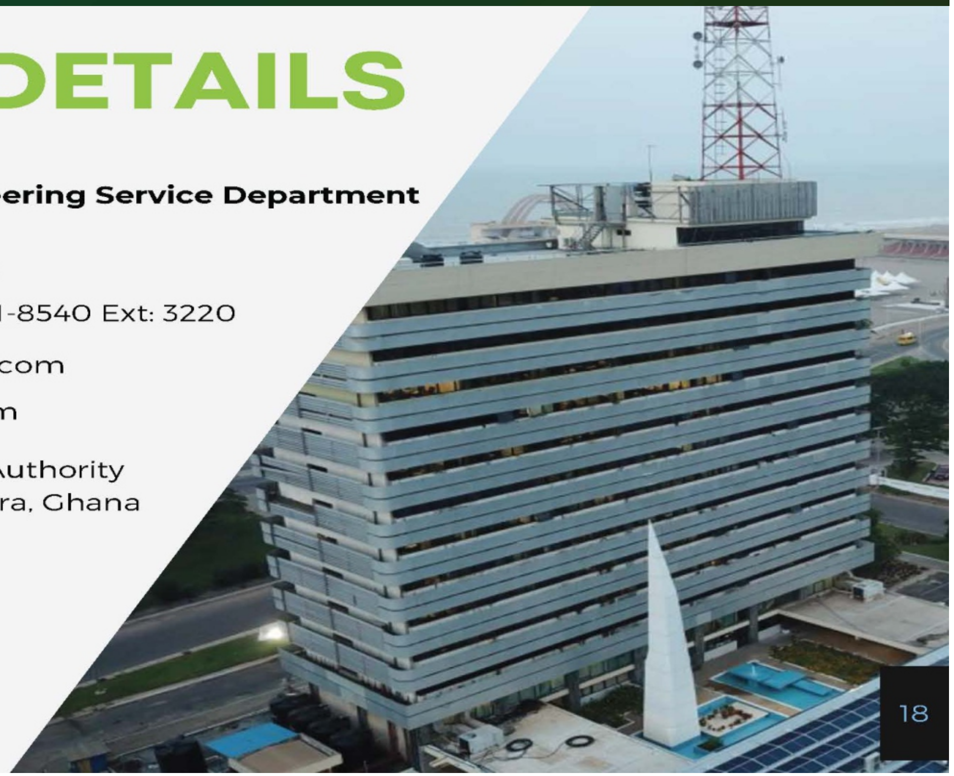
Kwaku Wiafe

+233(0) 30-211-8540 Ext: 3220

dengsd@vra.com

www.vra.com

Volta River Authority
PMB 77, Accra, Ghana



DTI-VRA
DIGITAL TRANSFORMATION & INNOVATION, VRA

VOLTA
RIVER
AUTHORITY

Our Ref: EXR/1011/1868

Your Ref:

Date: December 1, 2022

The Deputy Chief Executive (Dev't.),
Ghana Highway Authority,
P. O. Box 416,
Head Office,
Accra.

Attn: Mr. Collins Donkor

Dear Sir,

REHABILITATION OF OKWENYA JUNCTION - AKUSE - ASUTSUARE ROAD

REQUEST FOR COST ESTIMATE

We wish to request the Ghana Highway Authority (GHA) to carry out an assessment of Okwenya Junction – Akuse – Asutsuare road and submit a cost estimate for its rehabilitation.

Following the recent demonstration by the youth from Akuse and Asutsuare over the poor state of the road networks, VRA amongst other business entities within the enclave have met to discuss possible remedial measures to make the 17.5km road motorable and safe.

The assignment is being handled as a Corporate Social Responsibility Project by the entities and will therefore require the services of GHA in pursuing the project since it falls within your jurisdiction. Therefore, we kindly request GHA to undertake an assessment of the road, prepare the requisite designs, specifications and Bills of Quantities for the rehabilitation works.

You may contact our Ing. Alphonse X. Voegborlo, Manager of Infrastructural Services, Engineering Services Department on (cell phone no. 0243 116 603) who is the contact person for this assignment, should you require any further assistance or clarification on the assignment.

We would therefore be grateful to receive response regarding the assignment by December 12, 2022.

Counting on your usual co-operation.

Yours faithfully,

Edward E. Obeng-Kenzo
DEPUTY CHIEF EXECUTIVE
(ENGINEERING & OPERATIONS)

038

Our Ref: GHA/CE/023/79/03
Your Ref. No.............................

Email: ce@highways.gov.gh
Website: www.highways.gov.gh
Digital Address: GA-107-2101

HIGHWAYS

GHANA HIGHWAY AUTHORITY

RECEIVED 25/1/2023 VOLTA RIVER AUTHORITY

CHIEF EXECUTIVE'S OFFICE RECEIVED 20 JAN 2023 VOLTA RIVER AUTHORITY

19-01, 2023

THE DEPUTY CHIEF EXECUTIVE (ENGINEERING & OPERATIONS)
VOLTA RIVER AUTHORITY
ACCRA

VOLTA RIVER AUTHORITY RECEIVED 20 JAN 2023 D.C.E. (E & O)

20/01/23

ATTENTION: EDWARD OBENG-KENZO

Dear Sir,

REHABILITATION OF OKWENYA JUNCTION-AKUSE-ASUTUARE ROAD (AKUSE JUNCTION -ASUTUARE ROUNDABOUT ROAD (KM 0-17.5)

SUBMISSION OF ESTIMATE

Reference is made to your letter No. EXR/1011/1868 dated 1st December 2022, and wish to submit cost estimate for the above-mentioned works for your consideration and further direction.

The scope of the works include.

1. Clearing
2. Widening of the road
3. Soft spot treatment
4. Concrete drains/trapezoidal drains
5. Natural gravel sub-base 200mm thick
6. Stabilized base 200mm thick (40% natural gravel and 60% crushed rock base)
7. Primer seal
8. Traffic signs and road markings

Ing. Sagbe - DCA 27/1/23
fyfa, plse
Alphonse
26/1/23

26/1/2023
(5) MSA Inf
See (3) & letter
prepare a proposal
Executive
26/1/23

The total estimated cost of works is **Fifty-Eight Million, Two Hundred and Sixty-Three Thousand, Seven Hundred and Twenty-Eight Ghana Cedis, Sixty-Eight Ghana Pesewas (GH¢58,263,728.68)** to be executed by the Mobile Maintenance Unit (MMU II) based in Suhum and the base date of the estimate is December 2022.

(4) D/ESD 26/1
Pls, discuss
24/01/23

(3) DCE 24/01/23
Pls review & submit a proposal on this matter.
23/1/2023

(2) CE
Pls, proposal submitted for your clearance
20/01/23

Mr. Thompson
fyfa, pls. DCA 27/1/23

26/1/23


Lower Manya Krobo
Municipal Assembly


Engagement with traditional authorities of Fodzoku


2. Engagement with Traditional Authority of Akuse
Engagement with Traditional
Authorities of Akuse


• Engagement with Traditional Authorities of Natriku


Engagement with traditional Authorities of Torgorme


GrowthAid
WHAT WE DO
• Rural and Urban Water Systems
• Sanitation
• Hygiene Promotion
• Neglected Tropical Diseases-
Schistosomiasis, Lymphatic Filariasis,
Soil Transmitted Helminthiasis,
• Engagement with growth AID (NGO)

Engagement with Facility manager of Legacy Girls College, Akuse

- Engagement Wildlife Division Staff of Shai Hills Forest Reserve

Engagements with Residents & Businesses

Engagement with the Ghana Police Service, Akuse

Engagement with Staff of Akuse General hospital

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	**Responses by VRA Team**
1. Engagement with Lower Manya Krobo Municipal Assembly	Aug. 19, 2024, at the Office of the MCE, Odumase
• The Municipal assembly in full support of the project as it is a proactive step to maintain the integrity of the Kpong dam. • Appreciation to VRA to include road repairs as part of the associated works since that has been of concern to the community. • The need to conduct engagement with all stakeholders to be affected by the project, including the road repairs to ensure acceptance. • Poor state of the access road due to actions of sand winners from neighbouring Shai Osudoku District Assembly	• Appreciation by VRA for the support and will continue to provide the Municipality with the project information as and when required to enable them take relevant action, if need be. • Stakeholder engagement is key to the success of the project, and VRA has included that in the feasibility studies
2. Engagement with Traditional Authority of Akuse	Aug. 19, 2024, at the Residence of Divisional Chief in Odumase
• Representing the Paramount Chief and will inform him accordingly on issues discussed. • VRA is seen as a partner in development and the traditional authority is grateful for the collaboration over the years. • Land issues are critical, and it's noted that no additional land is required for the project. • Appreciation to VRA to include road repairs as part of the associated works since that has been of concern to the community. • Issue of payment of royalties for the dam to the traditional authority needs to be visited as its of key concern to the Paramountcy	• Appreciation by VRA for the support and will continue to provide project information as and when required to enable them take relevant action, if need be. • Noted the issue of payment of royalties and this should be brought to the attention of VRA during annual engagement with the Paramountcy.
3. Engagement with Traditional Authorities of Fodzoku	Aug. 21, 2024 at the Premises of the Fodzoku Community Library
• The traditional authority is grateful to VRA for providing them with the project information and will ensure feedback to the community. • Grateful that the Akuse road rehabilitation has been consider as part of the project. • VRA should consider repairs of the Senchi-Fodzoku-KGS road, due to the extent of its damage.	• Appreciation by VRA for the support and will continue to provide project information as and when required to enable them take relevant action, if need be. • Noted the issue of road rehabilitation and there is the need to engage the relevant stakeholder agencies on the subject, using the District Chief Executive and Member of Parliament.
5. Engagement with Traditional Authorities of Torgorme	Aug. 21, 2024, at the residence of the Mankrado in Torgorme
• Efforts to sustain the integrity of the dam very laudable since the	• Appreciation by VRA for the support and will

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses by VRA Team
impact of dam break cannot be fathomed. • Destruction of Torgome road due to heavy trucks used by Sinohydro in the earlier dykes' repair work is of great concern to the community. • VRA should relook at their CSR actions and assist the impacted communities with more infrastructure. • VRA should consider the provision of free or subsidised electricity to impacted communities	continue to provide project information as and when required to enable them take relevant action, if need be. • VRA management is aware of the issue of state of the Senchi-Fodzoku-KGS road. • VRA has limited resources but will do its possible best to provide relevant support as and when required. • Any request for assistance under our Community Development Programme should be formalised and submitted to the Chef executive
6. Engagement with Traditional Authorities of Natriku	Aug. 21, 2024, at the Chief's residence in Natriku
• Appreciation to VRA to include road repairs as part of the associated works since that has been of concern to the community. • How will the project impact on community access to the dam for commuting purposes? • Road within the community can serve as alternative route for the project to the West Dyke and this should be considered under the project for use and repairs. • Concern about the impact of the project on fishing activities by the community members near the dykes • Need for community members to be considered for employment. • Status of proposed floating solar power facility near the Kpong dam and how does the upcoming rehabilitation project impact on that development. • GHA intends upgrading the Okwenya Road through Akuse to Volivo and there is a need for engagement with the Ghana Highway Authority to ensure smooth implementation.	• Appreciation by VRA for the support and will continue to provide project information as and when required to enable them take relevant action, if need be. • Access route through the dam will still be available to the public. • Any road closure required will be communicated to the community and will be of a short period. • Consideration has been given to the sue of the unpaved road for the project, and any damage caused will be restored. • VRA will ensure that the livelihood of the community regarding activities at the Natriku landing site are not impacted. • Feasibility studies of the Floating PV Project is underway and VRA will ensure smooth implementation of both projects.
7. Engagement with Assembly members of Fodzoku, Natriku, Torgorme and Akuse	Aug. 21, 2024, at the VRA Club House in Akuse
• Need for community members to be considered for employment. • The need to ensure the project does not impair the rehabilitated road, thus leaving it in a worse state prior to the project.	• Employment issues will be at the discretion of the contractor and community members are urged to take advantage of the project.

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	**Responses by VRA Team**
• Earlier rehabilitation works by Sinohydro has resulted in the damage Senchi-Fodzoku-KGS Road, and VRA should consider rehabilitating that section. • Need for VRA to consolidate relationship with Assembly members to ensure smooth information flow to the Community members. • Concern about the safety of the Kpong dam and possible dam break and the readiness of VRA to manage that situation. • Need for impacted communities to enjoy free electricity from the VRA as incentive. • VRA should consider supporting the Akuse Hospital with Solar Power facility to boost power supply	• Strategy for road rehabilitation is to leave the road in a much better shape. • Assembly members are to assist in grievance resolution and the VRA will than the project will liaise with them, through the Community Relations Officer, on the subject. • The project is being implemented to ensure the safety of the dam. Any request for assistance under our Community Development Programme should be formalised and submitted to the Chef Executive, through the VRA Community Relations Officer for Akuse area
8. Engagement with the Water Resources Commission	• Online Via Microsoft Team on August 28, 2024
• In attendance were Daniel Avafia (Senior Dams Safety Engineer) and James Aggrey (Senior Engineer/EMP Steering Committee Rep.) • It's important that VRA ensures the structural integrity of the dams due to the disastrous impact in the event of a dam break. • WRC understands recommendations made in their dam's safety review report, mainly the construction of path for cattle crossing and re-enforcement of the dykes have been completed. • WRC as a regulator will formally pay a working visit to understand the scope of the work and also use the opportunity to inspect ongoing works at Akosombo. • VRA needs to provide WRC copies of the updated Emergency Preparedness Plan and EMP for the Akosombo & Kpong Dams. • VRA needs to ensure that the requirements of the license issued by the WRC are strictly adhered to.	• VRA grateful for continued collaboration with WRC in Dams collaboration evidenced by membership on EMP Steering Committee and the Board of WRC. • VRA will be grateful if WRC could formally respond to the invitation to comment. • WRC should put in a formal request to have a site visit for a first had information on proposed project as well as ongoing works at Akosombo HEP. • WRC is a regulator and should be able to demand any information require from the VRA as and when it desires. • VRA will provide WRC with the updated Dams EPP and Inundation Maps, and going forward, copy WRC in all its communication with the EPA and Energy Commission.
9. Engagement with Natriku Community Members	Aug.24, 2024, through House to house visits
• Members expressed a strong desire for local youth to be prioritized for employment opportunities during the project. • They also emphasized the importance of road safety, proposing the installation of speed rumps on access roads to prevent over speeding. • Additionally, the community suggested employing local divers for	• Employment issues will be at the discretion of the contractor and community members are urged to take advantage of the project. • Installation of speed rumps to enhance road safety and acknowledge the value of using local divers for

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses by VRA Team
repair works	repair work will be considered
10. Engagement with Natriku Okada Riders	Aug.24, 2024 at the Natriku Okada Station
• The riders were concerned about the potential impact of truckloads on road conditions and their business operations. • They proposed sensitizing truck drivers to adhere to speed limits and suggested using road warning signs to alert drivers. • To reduce dust emissions, they recommended implementing dust suppression methods and requested nose masks for protection. • They also emphasized the need for reflectors to improve visibility for motorists	• The VRA Team committed to sensitizing truck drivers on speed limits and confirmed that road warning signs would be used. • Implementation of dust suppression methods and providing nose masks to motorists will be considered where applicable. • Reflectors to enhance visibility were also endorsed. • Access routes through the dam will still be available to the public.
11. Engagement with Ghana Police Service	Aug. 26, 2024, at their office in Akuse
• They proposed that police officers be stationed at checkpoints to regulate traffic flow and ensure driver safety. • Officers highlighted the need for effective dissemination of information to educate residents on road safety.	• The VRA Team agreed to facilitate public education on road safety and endorsed the use of road warning signs. • Appreciation by VRA for the support and will continue to provide education as recommended.
12. Engagement with Ghana National Fire Service	Aug. 26, 2024, Office of Ghana Police Service , Akuse
• Officers highlighted the need for effective dissemination of information to educate residents on road safety. • The presence of firefighting officers on standby for emergencies was also discussed. • Additionally, they recommended the use of road warning signs to indicate potential dangers	• The VRA Team agreed to facilitate public education on road safety and endorsed the use of road warning signs. • • Appreciation by VRA for the support and will continue to provide education as recommended.
13. Engagement with Ghana Prisons Service	Aug. 26, 2024, Office of GNFS, Akuse
• Officers highlighted the need for effective dissemination of information to educate residents on road safety. • Additionally, they recommended the use of road warning signs to indicate potential dangers	• The VRA Team agreed to facilitate public education on road safety and endorsed the use of road warning signs. • Appreciation by VRA for the support and will continue to provide education as recommended.
14. Engagement with Residents & Business Along Okwenya-Akuse Road	• Aug. 26, 2024, at their Individual facilities
• The community stressed the importance of prioritizing local youth for employment during the project. • They also proposed the rehabilitation of the project site access road to	• Employment issues will be at the discretion of the contractor and community members are urged to take advantage of the project.

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses by VRA Team
address existing damage and ensure better control over its condition. • Additionally, they suggested installing speed rumps to enhance safety and employing community divers for repair works	• VRA has limited resources but will do its best to provide relevant support as and when required. • Installation of speed rumps for road safety and employ local divers for repair works will be considered though employment will be at the discretion of the contractor.
15. Akuse-Okwenya Taxi Rank Drivers	• **Aug. 26, 2024, At the Akuse Junction Taxi Station**
• Taxi drivers were concerned about the impact of truckloads on roads and their business operations. • They proposed sensitizing truck drivers on speed limits and suggested using road warning signs to alert motorists about the commencement of the project. • They also recommended dust suppression methods to curb emissions and requested the rehabilitation of already damaged roads.	• The VRA Team assured the drivers that truck drivers would be sensitized on speed limits and that road warning signs would be used. • Installation of speed bumps for road safety. • VRA has limited resources but will do its best to provide relevant support as and when required
16. Engagement with Legacy Girls College	• **Aug. 26, 2024, at office of the Facility Manager, Legacy Girls, Akuse**
• Stakeholders from sensitive facilities expressed concerns about the impact of truckloads on roads and their business operations. • They requested advance notice of project commencement and proposed the use of dust suppression methods. • They also recommended installing speed bumps to reduce speed, particularly in areas where children cross. • Additionally, they suggested deploying safety officers to control traffic in these areas.	• The VRA Team assured stakeholders that they would be notified in advance of the project's start. • Implementing dust suppression methods, installing speed bumps, and sensitizing truck drivers, especially in school zones
17. Engagement with VRA Akuse Hospital	• **Sept 3, 2024, OPD, Akuse General Hospital, Akuse**
• Concerns about dust generated from rehabilitation activities and its potential health impact on on-site workers. • Inquiries about compensation for any health impacts or occupational hazards experienced by site workers.	• In the construction of the road VRA will recommend that the contractor regularly waters the roads to control dust levels and reduce any potential health impacts. • The use of protective equipment like nose masks for workers on site will be recommended. • Moreover, there is a compensation policy in place to support anyone affected by occupational hazards

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses by VRA Team
	resulting from the project
18. Engagement with Shai Hills Resource Reserve	Sept 4, 2024, Office of HR, Shai Hills Resource Reserve, Doryumu Junction
• Concerns about securing truckloads of materials to prevent accidents during transport. • Enforcement of speed limits for heavy trucks transporting materials. • Potential delays for tourists due to road traffic from rehabilitation work. • Impact of increased traffic on wildlife and the environment within the resource reserve. • Communication strategy for notifying tourists and the reserve about road usage and delays.	• VRA Will Coordinate with the Contractor to ensure that all trucks will be equipped with proper securing mechanisms and regular inspections will be conducted to ensure compliance with safety regulations. • A strict speed limit will be enforced for all vehicles transporting materials. • Coordination with tour operators to schedule work during off-peak hours to minimize disruptions. • Measures will be implemented to protect wildlife, including wildlife crossings, road signages and restricted working hours. • Regular updates will be provided to the reserve and tourists regarding road usage, expected delays, and safety protocols
19. Engagement with Youth and Women Empowerment (YOWE)	• Sept. 10, 2024. YOWE Office, Somanya
• Addressing gender-related issues in employment practices and ensuring fair treatment. • Concerns about managing local employee temperament and ensuring a positive work environment. •	• Although Employment is at the contractor's discretion, VRA Will collaborate with the contractor to enforce policies to prevent discrimination and ensure fair hiring practices, providing equal opportunities for all, regardless of gender. And also offer gender sensitivity training to all employees. • Regular training and workshops to promote teamwork, conflict resolution, and stress management among local employees. The goal is to create a respectful and inclusive workplace for everyone involved.
20. Engagement with Growth Aid Ghana.	• Sept. 10, 2024. Gorwth AID Office, Community 25, Tema
• Concerns about the potential increase in water-related tropical diseases, such as schistosomiasis, and plans for prevention and management.	• Health Facilities in the Project area are well informed of the project and implement preventive

Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses by VRA Team
• Engagement with organisations that build boreholes to ensure they are flood-resistant due to possible spillage. • Concerns about noise levels at Government Hospital and ensuring proper acoustics to maintain noise levels below 72 decibels.	measures, such as public education on safe water use and regular monitoring of water body engagement with the Paramountcy. • VRA will actively engage with organizations responsible for building boreholes to ensure they are designed to withstand flooding and minimize contamination risks. • VRA will coordinate with contractors to limit noisy activities during critical hours and explore options for installing noise barriers or soundproofing materials to maintain noise levels below 72 decibels

VOLTA RIVER AUTHORITY

LOWER - MANYA DISTRICT.

KPONG DAM REHABILITATION PROJECT
STAKEHOLDER ENGAGEMENT

LOCATION: LOWER MANYA MUNICIPAL ASSEMBLY
VENUE: MCE'S OFFICE
TIME: 2:50 PM

Date: AUGUST 19, 2024

No.	Name	Institution	Job Title	Email	Signature
1	SIMON KWEKU TETTEH	LOWER MANYA KROBO	M.C.E	skwekuteteh@yahoo.com	
2	Selom K. Tibu	Lower Manya Krobo MA	MCD	kwamitibu@gmail.com	
3	Michael T. Kwameh	Lower Manya Krobo Municipal Ass.	Assistant Director	Kwamekt10@yahoo.com	
4	Nene Asada Ahor	Akuse	Divisional Chief of Akuse	0245663261	
5	Ricky Dosu	Akuse	Stool	0245853846	
6	Atteh Teye	Akuse	Stool	—	

(REGISTRATION FORM)

NAME OF PROJECT: KPONG DAM REHABILITATION

Community: AKUSE District: LOWER MANYA MUNICIPAL Region: EASTERN REGION

Date: AUGUST 19, 2024 Time: 3:40pm Venue: NENE ASADA AHOR'S RESIDENCE

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1	Afrim Alfred Abraham	Akuse	Otseame	0546639130		✓				✓
2	Samuel Aeu	Akuse	Stool Elder	0249306195		✓			✓	
3	Nene Asada Ahor	Akuse	Akuse Mantse	0245663261		✓				✓
4	Ricky Dosu	Akuse	Stool	0245853846		✓			✓	
5	Atteh Teye	Akuse	Stool	—		✓				✓
	TOTAL									

(REGISTRATION FORM)

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT

Community: FODZOKU District: North Tongu Region: Volta Region

Date: AUGUST 21, 2024 Time: 10:40am Venue: Fodzoku Community Library

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1.	Torgbe Nangbadzi III	Fodzoku	Traditional Council	0248430594		✓				✓
2.	Zikpuito Amewuga	Fodzoku	"	0248297681		✓				✓
3.	Akufo Blikaku	Fodzoku	"	0540554776		✓				✓
4	Israel Bosonyaku	Fodzoku	"	059755[illegible]		m				✓
5.	Ernest Asare	Fodzoku	"	0248589720		/				✓
6.	Ben Sewornu	Fodzoku	"	024551156		✓				✓
7.	Memayor Asiwome	Fodzoku	"	0242265340		✓			✓	
8.										
9.										
10										
	TOTAL									

(REGISTRATION FORM)

NAME OF PROJECT: KPong Dam REHABILITATION PROJECT

Community: Torgorme District: North Tongu Region: Volta Region

Date: 21/08/2024 Time: 12:10pm Venue: Residence of the Mankralo - Togbui Gi

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50 — 70
1.	Tobgbui Gidi IV	Torgorme	Chief - Manklalo	0243388715		✓				✓
2	Akpaku Gabriel	"	Traditional Council	0243903644		✓			✓	
3	Hon. Sakpaku Promise	"	Assembly - Alabonu	0553263383		✓		✓		
4	Torgbui Tokloplizo III	"	"	0246688026		✓		✓		✓
5	Torgbe Vette III	"	"	0555682788		✓		✓		
6	Nyagble Kofi	"	"	0245163332		✓				✓
7	Kwasi Ananiga	"	"	0243654266		✓				✓
	TOTAL									

NAME OF PROJECT: Kpong Dam Rehabilitation Project

Community: Natriku   District: Shai-Osudoku   Region: Eastern Region

Date: 21/08/2024   Time: 1:22pm   Venue: Residence of Nene Tetteh Amoako

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1.	NENE TETTEH AMOAKO IV	Natriku	Chief	0242840925						
2	James Tekpor	"	Elder	0243102528		✓			✓	
3	Emmanuel Amanor	"	Elder	0542137791		✓				✓
4	Kofi Awudza	"	Elder		K. A.	✓				✓
5	John Dunyo	"	Elder	0244304744		✓				✓
6	Daniel Akumani	"	"	0246471004		✓				✓
7	Andrews Quansah	"	"	0242786890		✓			✓	
8	Moses Apafo	"	"	0247860829		✓				
9.	Solomon Leigh	"	"	024126587		✓			✓	
10	Eric Adzowu	"	"	0246783285		✓			✓	
	TOTAL									

NAME OF PROJECT: Kpong Dam Rehabilitation Project

Community: Natriku   District: Shai-Osudoku   Region: Eastern Region

Date: 21/08/2024   Time: 1:22pm   Venue: Chief's Palace

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
11	M.T. Tekpor	Natriku	Stool Elder	0246020630		✓				✓
12	Stephen Kwao	"	"	0247299269		✓				✓
13	Paul Obroni	"	"	0595279633		✓				✓
14	Kwesi Krepori	"	"	0542547059		✓				✓
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT

Community: AKUSE District: LOWER MANYA Region: EASTERN

Date: 21/08/2024 Time: 2:44pm Venue: CWB HOUSE-AKUSE

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1	Apletey Frandin	Fafadan	ASSEMBLYMAN	0246908884		✓			✓	
2	AKpaku Gabriel	Tergonma	ASSEMBLYMAN	0243903644		✓			✓	
3	Mulumwa Amartey	AKUSE	AKUSE DEV. NETWORK	0243690022		✓			✓	
4	Amartey George	AKUNU	Assemblymember	0241642213		✓			✓	
5.	AWUDU Ibrahim.	Osorkutu	ASSEMBLYMAN	0244425538		✓			✓	
6	FREDERICK Kuman Musamuy	AKUSE ZONGO	IONGO	0242775188		✓			✓	
7.	ERNEST NAMULI KPELI	Akuse Salom	Salom	0246399663		✓			✓	
8	KETORWOO WISE	AKUSE	BUNGALOW	0544009401		✓			✓	
9	IGNATIUS DORDOE	NAIRIKU	ASSEMBLY MEM.	0249372558		✓			✓	
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT

Community: NATRIKU   District: LOWER MANYA / SHAI OSUDOKU DISTRICT   Region: EASTERN

Date: 24TH AUGUST, 2024   Time: 3:00pm – 4:30pm   Venue: RESIDENTS AND INFRASTRUCTURE WITHIN THE PROJECT AREA.

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
	Daniel Noagbe	Natrika	Corn Miller	055613799	DNL	✓				
	Siabi Millicent	Natriku	Seller	0240328650	Mill		✓	✓		
	Samuel Vandd[illegible]			0598647960	[illegible]	✓			✓	
	Charles Danso	Natriku	Prison officer	0209305386	[illegible]	✓			✓	
	Amponsah Padmond	Natriku	Prison officer	0500342201	[illegible]	✓			✓	
	Joseph Adjoka	Akuse	Fire Service	0243416708	[illegible]	✓			✓	
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT.

Community: NATRIKU   District: SHAI OSUDOKU DISTRICT   Region: EASTERN

Date: 24/8/2024   Time: 11:00am – 12:30pm   Venue: RESIDENTS CLOSE TO THE CHIEF'S PALACE CLOSE TO ASSOCIATED ROAD

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
	GIZTY ACQUAH	Natriku	Prison officer	0547444217	[illegible]		✓		✓	
	Solomon Selorm Collins	Natrika	Miami Spot	0246228850	[illegible]	✓			✓	
	Ayitah Henry	Natrika	Miami Spot	0594667444	[illegible]	✓				
	Kofi Agawu	Natrika	Miami Spot	0597033765	[illegible]	✓				
	Bendy Angee	Natrika	Miami Spot	0247734280	[illegible]		✓			
	Ofudzafo Precious	Amedeka	Taxi Driver	0277158777	[illegible]	✓			✓	
	Willson Kuponi	Natrika	Okada Rider	0595922151		✓		✓		
	Amevor Michael	Natrika	Okada Rider	0598651348	[illegible]	✓		✓		
	Desmond Hogosu	Natrika	Okada Rider	0245515945		✓			✓	
	Dame Ludy	Natrika	Okada Rider	0531150378	[illegible]	✓		✓		
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT

Community: NATRIKU District: SHAI OSUDOKU DISTRICT Region: EASTERN REGION.

Date: 24/08/2024. Time: 11:00am-12:30pm Venue: RESIDENTS BY THE ROAD

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1	Wiafiwa Anita	Namiku		0541251401			✓	✓		
2	Ekow Agyeiwoo	Natriku	Farmer	0245317807		✓			✓	
3	Elizabeth Kootin	Natriku	Seamstress	054424481			✓	✓		
4	Aziator Victor	Natriku	worker	0247497067		✓		✓		
5	Vincent Wornyo	Natriku	Farmer	050908425		✓			✓	
6	Simon Sosah	Natriku	Farmer	0277755571		✓				✓
7	Korse Ahoni	Natriku	Seller	02431102			✓		✓	
	Sabutey Isaac	—	~~Dam~~ Driver	024300355		✓				
	Benjamin Vidiroe	—	Auto Mechanic	0244468492		✓				
	Sefokor Gbor	—	Hair dresser	0555440829	Sd					
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT

Community: AKUSE District: Lower Manya Region: EASTERN

Date: 24/08/2024. Time: 2:30pm - 3:00pm Venue: RESIDENCE FROM NATRIKU-AKUSE JUNCTION TOWARDS LEGACY GIRLS

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
	Elijah Tetteh	Akuse	GRIDCO DRIVER	0242322141		✓		✓		
	Gifty Oklu	Akuse	Seller	0543542049			✓			✓
	Tetteh Eric	Akuse	Brick layer	0555280028		✓		✓		
	Rejoice M. Amevor	Akuse/Cross	Account officer	0548091915			✓		✓	
	~~Charles Damso~~	~~Natriku~~								
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT

Community: NATRIKU District: SHAI OSUDOKU DISTRICT Region: EASTERN REGION

Date: 24/08/24 Time: 1:00pm-2:30pm Venue: CHURCHES

#	Name of Participant	Community	Designation	Contact	Signature	Sex		Age Group		
						M	F	<30	30-49	>50
1.	REV. FR MICHAEL TETTEY WELEDJI	NATRIKU	ANGLICAN CHURCH PRIEST	0249584080		✓			✓	
	DEACON AZARIAH BIBAH	NATRIKU	PENTECOST CHURCH DEACON	0249831714		✓			✓	
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT
Community: AKUSE
District: LOWER MANYA
Region: EASTERN
Date: 26/08/2024
Time: 3:47 pm
Venue: Akuse Junction (Residence along Akuse road)

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1.	Faustina Nty Ntumy	Akuse jun.	Trader	0535489171			✓		✓	
2.	Georgina Hordjie (Mrs)	Akuse junc.	Business Woman	0546424113			✓			✓+
3.	Fosuwaa Elizabeth	Akuse junc.	Hair stylist	0241079134			✓		✓	
4.	Otelia Ajaho	Akuse junc.	Hair stylist	0550048324			✓	✓		
5.	Bediako Grace	Akuse jun.	Student	0559559908			✓			✓
6.	Kon Osei Poku	Akuse junc.	Marketer	0540583176		✓				✓
7.	Kingsley Ampomah	Akuse jun.	Business Man	0245646443		✓				✓
8	Landzo Bright	Akuse jun.	Vendor	0242926142		✓		✓		
9	Ali Muneez	Akuse Jun. Akuse		0553472185		✓		✓		
10	Gloria Akwetteh	Akuse jun.	Phone Engineering	0551755080			✓	✓		
	TOTAL									

NAME OF PROJECT: KPONG DAM REHABILITATION PROJECT
Community: AKUSE
District: LOWER MANYA
Region: EASTERN
Date: 26/8/2024
Time: 2:00 pm
Venue: LEGACY GIRLS; Police barrier post OKWENYA JUNCTION TAXI RANK.

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
	EDMUND K. KWARTENG	AKUSE	FACILITIES MANAGE	0249770539		✓			✓	
	Asante Sylvester	Akuse	Police officer	0534801733		✓			✓	
	Inspr. Frank Dante	Akuse	police officer	0209286608		✓			✓	
	Emt. Peter Akwetey	Okwenya	Emergency Med. Tech	0242072574		✓			✓	
	Joshua Akwetey	Okwenya	Driver	0245923429		✓			✓	
	John Wa R Ntumy	Okwenya	Driver	0244118775		✓			✓	
	George Tamakloe	Okwenya	Driver	0554035966		✓			✓	✓
	Isaac Nii	Akuse	Driver	0542228032		✓				✓
	WINSON TENGEY	AKUSE	✓	0245793564		✓				✓
	TOTAL									

NAME OF PROJECT: KPOIOGE DAM REHABILITATION PROJECT.

Community: SHAI HILLS District: Dangme West Region: Greater Accra

Date: 4/9/2024 Time: 10:45am Venue: SHai Hills Resource Reserve

#	Name of Participant	Community	Designation	Contact	Signature	Sex M	Sex F	Age Group <30	Age Group 30-49	Age Group >50
1.	EBENEZER K. ANSONG	SHAI HILLS	ACCOUNTING OFFICER	0242731150	[signature]	✓			✓	
2.	PAUL ASIMENG	SHAI HILLS	LAW ENFORCEMENT OFFICER	0243987573	[signature]	✓			✓	
3.	Lily Mbir-Bondzie	SHai Hills	HR Officer	0542441758	[signature]		✓		✓	
	TOTAL					2	1	0	3	0

SHeet 16

ADVERTISER'S ANNOUNCEMENT

KPONG DAM REHABILITATION PROJECT

The Volta River Authority (VRA) has submitted to the Environmental Protection Agency for review, an Environmental Impact Statement (EIS) Report for its "***Kpong Dam Rehabilitation Project***", in line with the EPA Act 490, 1994 and the LI 1652, 1999.

The project involves the repair of the displaced rockfill on the upstream slope of the Kpong Dam as well as the rehabilitation of all fifteen (15) spillway gates to ensure the proper operation and function of the gates. The works on the spillway gates and the dykes are necessary to ensure the sustainability of the dam and of the safety of the population surrounding and downstream of the dam in the Lower Volta Area. Hard copies of the EIS Reports are available at the EPA Head office in Accra as well as VRA Head office in Accra. 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	AND	The Executive Director Environmental Protection Agency P. O. Box M 326, Accra
Tel No: +233-302-664941-9 Email: corpcomm@vra.com		Tel No: +233-302-664697/8 Email: info@epa,gov.gh

VOLTA RIVER AUTHORITY

Not later than October 31st, 2024

APPENDIX 6

Appendix 6 Assumptions in GHG Emissions

GHG ESTIMATION FROM FUEL CONSUMPTION BY HAULAGE TRUCKS AND PICK-UPS FOR THE KPONG DAM DYKE AND SPILLWAY REPAIRS

Assumptions

Trucks

1. Number of Trips: 7,500 trips.
2. Round Trip Distance: 70 km.
3. Fuel Economy for Unloaded Trucks: 9 gallons/100 km.
4. Fuel Economy for Loaded Trucks: Twice the fuel consumption of unloaded trucks, i.e., 18 gallons/100 km.
5. Fuel Type: Diesel.
6. Diesel GHG Emission Factor: 10.21 kg CO_2e/gallon (WRI GHG Protocol).

Pick-ups

1. Number of Pick-ups: 5
    - 3 Pick-ups for Dyke Works: Assigned for 2 years
    - 2 Pick-ups for Spillway Works: Assigned for 4 years
2. Fuel Consumption per Pick-up: 2 gallons per day
3. Working Days per Year: Assuming 365 days/year (continuous operation)

Calculation Steps:

1. **Total Distance Travelled by Trucks:**
    - Each truck makes a trip of 70 km.
    - Total distance for all trips = 7,500 trips × 70 km/trip = 525,000 km.
    - Since each round trip consists of a loaded and an unloaded leg, we split the total distance evenly between these two conditions:
        i. Distance Traveled While Loaded: 525,000 km / 2 = 262,500 km.
        ii. Distance Traveled While Unloaded: 525,000 km / 2 = 262,500 km

2. **Fuel Consumption for Trucks:**
    a. **For Loaded Trucks:**
        - Fuel consumption = 18 gallons/100 km.
        - Total fuel consumption (loaded) = (18 gallons/100 km) × (262,500 km) = 47,250 gallons.

    b. **For Unloaded Trucks:**
        - Fuel consumption = 9 gallons/100 km.
        - Total fuel consumption (unloaded) = (9 gallons/100 km) × (262,500 km) = 23,625 gallons.

3. **Total Fuel Consumption (Trucks):**
    a. Total fuel consumption = 47,250 gallons (loaded) + 23,625 gallons (unloaded) = 70,875 gallons.

4. **Fuel Consumption for Pick-ups**
    - **Dyke Works**
        - Number of pick-ups = 3.
        - Duration = 2 years.
        - Fuel consumption per pick-up per day = 2 gallons.
        - Total fuel consumption = 3 pick-ups × 2 gallons/day × 365 days/year × 2 years = 4,380 gallons.

    - **Spillway Works Pick-ups:**
        - Number of pick-ups = 2.
        - Duration = 4 years.
        - Fuel consumption per pick-up per day = 2 gallons.
        - Total fuel consumption = 2 pick-ups × 2 gallons/day × 365 days/year × 4 years = 5,840 gallons.

    - **Total Fuel Consumption for Pick-ups:**
        - Total = 4,380 gallons (Dyke Works) + 5,840 gallons (Spillway Works) = 10,220 gallon

5. **Excavator Fuel Consumption**
    - **Dyke Works**
        - Duration = 276 days.
        - Average Fuel consumption per day = 647 Litres
        - Total fuel consumption for the period = 647 × 267 = 178,572 litres.