

PROJECT: EASTERN CORRIDOR ROAD DEVELOPMENT PROJECT

COUNTRY: GHANA

SUMMARY OF THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Appraisal Team	<p>Team Leader: M. T. Wadda-Senghore, Principal Transport Engineer, GHFO/OITC1</p> <p>Team Members: M. Wadda, Principal Transport Engineer, COGH S.E. Akyea, Senior Transport engineer, COGH A. Karanga, Chief Transport Economist, RDGS E. Amissah-Arthur Social Development Specialist, COGH T. Karikari, Senior Agriculture & NRM Officer, COGH M. Kinane, Environmental Officer, RDGW4 P. Doghle, Principal Financial Manag. Specialist, COGH J. Tetteh-Cofie, Disbursement Assistant, COGH D. TSISE, Procurement Officer G. Bezabeh, Road Safety Specialist, PICU1 T. Ouedrago, Consultant Gender Specialist, RDGW0 A. Fall Trade Facilitation Officer, PITD2</p>
---------------------------	--

Project Title: Eastern Corridor road Development project
018

Country: Ghana

Division: PICU-1

SAP Code: P-GH-DB0-

Department: PICU

Project category: 1

1.0 INTRODUCTION

The proposed project is the construction of the Ghana Eastern Corridor Road (N2) which lies east of the country and is approximately 695 km in length. It commences from Tema Roundabout through the regions of Greater Accra, Volta, Northern Regions and ends at

Kulungugu in the Upper East Region. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages during the rainy season making travel difficult. The GoG intends to develop a targeted section of the Eastern Corridor which traverses eight (8) districts and one (1) metropolis in three (3) regions. The project zone will cover Yilo Krobo, Manya Krobo, Asuogyaman districts (in the Eastern Region); Dangme West and Dangme East districts (in Greater Accra Region); South Tongu, North Tongu, Adaku-Anyigbe in the Volta Region and Ho metropolis (in the Volta Region).

The project involves engineering feasibility, social and economic viability studies for the construction of the road. Baseline information on the project area of influence was collected through studies, field surveys and consultations with various stakeholders. Information collected included population of major settlements, climate, air quality and noise levels, topography and drainage, geology and soils, water resources, flora and fauna, land-use and socio-economic activities, gender issues, existing road conditions, sensitive ecosystems, resources and developments. The project was classified as a category 1, given the type of works to be undertaken and the potential direct and indirect impacts it could generate especially on sensitive ecosystems. In conformity with the environmental policy requirements of the African Development Bank and Republic of Ghana, an environmental and social impact assessment (ESIA), of which this section is a summary, was requested to: (i) identify the potential risks on the physical, biological, sociocultural and socio-economic environment, and (ii) propose measures to mitigate or offset any adverse impacts of the project on the environment.

The report is presented in twelve (12) main chapters and annexes. Chapter one gives a general introduction and background of the project, chapter two provides the policy, legal and administrative framework that apply to the project, chapter three gives a detailed description and justification, chapter four describes the project environment, chapter five gives project alternatives, chapter six presents the potential impacts and corresponding mitigation measures, chapter seven gives the environmental and social risk management, chapter eight presents the environmental and social follow-up projects, chapter nine provides information on monitoring, chapter ten provides information on public consultations and disclosure, chapter eleven presents the environmental and social management measures including actions, roles and responsibilities, time frames, monitoring costs and costs of implementation of the environmental and social management plans and a brief conclusion.

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The ESIA has been prepared in line with the Ghanaian Environmental Assessment Procedures, and Environmental and Social Policies and Procedures of the African development Bank. Below are the key requirements applicable to the project.

2.1 National requirements

2.1.1 Main applicable policies

The main policies applicable to this project are: (i) Ghana's Environmental Policy which aims at managing the environment to sustain society at large; (ii) Environmental Assessment Regulations LI 1652, 1999 - To provide guidance for Environmental Impact Assessments in

Ghana; (iii) Environmental Protection Agency Act (Act 490) of 1994 establishes the Environmental Protection Agency with functions to inter alia issue environmental permits and pollution abatement notices for controlling the volume, types, constituents and effects of pollutants and of substances which are hazardous or potentially dangerous to the quality of the environment or a segment of the environment; (iv) Water Resources Commission Act 522 (1996) - provides for the preparation of comprehensive plans for the regulation, utilization, conservation, development and improvement of water resources and develops policy framework for water resources management in the country; (vi) the Lands Statutory Way Leaves Act 186, 1963- This Land Statutory Way Leaves Instrument is the most relevant Act with regard to Land acquisition for road construction.

2.2 Main International requirements

2.2.1 African Development Bank

AfDB's Integrated Safeguard System with its five Operational Safeguards as indicated in table 1 below, as well as other applicable policies.

Table 1: Operational Safeguards applicable to the project

Operational Safeguards (OSs)	Triggered	Reasons
<u>OS1.</u> Environmental and Social Assessment	Yes	This OS is triggered through the mandatory E&S Screening Process through which the project was assigned a Category 1
<u>OS2.</u> Involuntary resettlement	Yes	This OS is triggered because the project involves resettlement
<u>OS3.</u> Biodiversity and Ecosystem Services	Yes	This OS is triggered
<u>OS4.</u> Pollution prevention and control, hazardous materials and resource efficiency	Yes	This OS is triggered because the project involves the use of various hazardous materials
<u>OS5.</u> Labour conditions, health and safety	Yes	This OS is triggered because the project involves the establishment of temporary workforce during the works.

2.2.2 Other international requirements

Other international requirements include those of the following conventions which have been ratified by Ghana: (i) African Convention on the Conservation of Nature and Natural Resources 1969 Its objectives are "to encourage individual and joint action for the conservation, utilization and development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view."; (ii) ILO applicable standards on Occupational safety and health in particular the Occupational Health Services Recommendation, 1985 (No. 171), the hours of work and rest in the transport sector, Using the ILO Code of Practice on HIV/AIDS and the world of work - Guidelines for the transport sector.

2.3 Institutional Framework

The entities below are the key institutions that will be involved in preparing and approving the ESIA for this project as well as in implementing, monitoring and auditing the ESMP as required:

- **Environmental Protection Agency (EPA):** The EPA has the mandate to decide on project screening, guide the conduct of any Environmental Assessment (EA) studies and to grant environmental approval for road sector projects to commence. Its mandate also covers monitoring of implementation phase of road projects to ensure compliance with approval conditions, mitigation measures, and other environmental commitments and quality standards;
- **Ministry of Roads and Highways (MRH):** The MRH has the specific task of coordinating and guiding the activities of the three main executing agencies in the road sector under the Ministry; The Ghana Highway Authority, and Department of Urban and Feeder Roads. The other related organizations namely under the ministry include the Road Fund Secretariat (RFS). The MRH has a Deputy Director in charge of Road Safety and Environment (RSE);
- **Ghana Highway Authority (GHA):** The GHA is a semi-autonomous body with a responsibility for the provision and management of trunk roads. Since the GHA Act 540 of December 1997, its role has been limited to the planning administration, control, development and maintenance of trunk roads and related facilities subject to the policies of the MRH.
- **Resource Management Institutions:** The Water Resources Commission (WRC) and the Forest Services Division (FSD) of the Forestry Commission (FC) are the water and forest resources management institutions respectively. These institutions become relevant whenever such resources under their management are likely to be impacted on or implicated in a proposed road project;
- **Utility Service Providing Institutions:** The Electricity Company of Ghana (ECG), Ghana Grid Company (GRIDCo) Ghana Water Company Limited (GWCL) Ghana Community Water and Sanitation Agency, Bulk Oil Storage and Telecom Companies are public /private institutions that provide and/ manage utility services including electricity, water and petroleum transmission and storage infrastructure, and telecommunication.
- **Metropolitan/District Assembly (M/DA):** The Projects fall under the jurisdiction of one (1) Metropolitan, eight (8) District Assemblies and three (3) Regions. The Metropolitan Assembly is Ho and the District Assemblies are: Yilo Krobo, Manya Krobo and Asuogyaman (in Eastern Region); Dangme West and Dangme East (in the Greater Accra Region) and South Tongu, North Tongu, Adaku-Ayigbe (in Volta Region). The Metropolitan/District Assemblies are the highest political authorities in the metropolis and districts. The Assembly members also act as witnesses during payment of Supplemental Assistance to PAPs

3.0 PROJECT DESCRIPTION AND JUSTIFICATION

3.1 Project Location

The Eastern Corridor which lies east of the country and is approximately 695 km in length. It commences from Tema Roundabout through the regions of Greater Accra, Volta, Northern Regions and ends at Kulungugu in the Upper East Region. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages during the rainy season making travel difficult. The GoG intends to develop a targeted section of the Eastern Corridor which traverses eight (8) districts

and one (1) metropolis in three (3) regions. The project zone will cover Yilo Krobo, Manya Krobo, Asuogyaman districts (in the Eastern Region); Dangme West and Dangme East districts (in Greater Accra Region); South Tongu, North Tongu, Adaku-Anyigbe in the Volta Region and Ho metropolis (in the Volta Region).

The Proposed Project Roads are the following sections:

Section 1: Asutuare Junction – Volivo (28.3km)

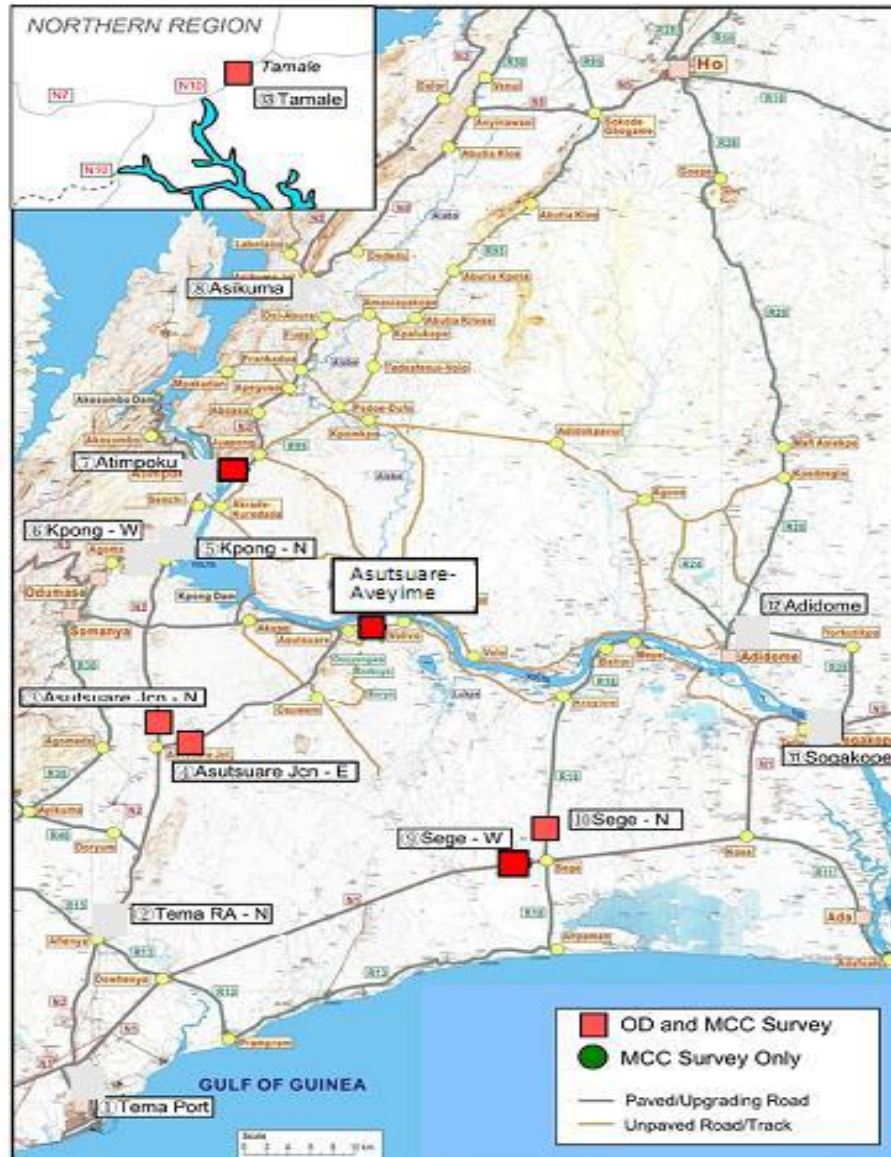
This 28.3km road branches eastwards from Tema-Akosombo road at Asutuare Junction and passes through agricultural and commercial towns/villages in the Eastern region to Volivo.

Section 2: Asutuare-Aveyime Road (24km)

This 24km section stretches southwards from Asutsuare through agricultural and commercial towns/villages in the Volta region to Aveyime.

Section 3: Dufor Adidome – Asikuma Junction (38.4km)

This section currently does not exist and would have to be built through a virgin area.



Map showing the project location

3.2 Project Justification

The volume of international cargo, meant for Ghana's neighboring landlocked countries has been increasing in recent times. However, there are challenges which the nation would have to deal with in facilitating transit of vehicles from the neighboring countries, such as chronic congestion in and around Accra and Kumasi cities. The situation currently hampers fast and efficient movement of cargo to the neighboring landlocked countries necessitating that an alternative route is identified and developed to facilitate transit and trade. The alternative international transit route to Burkina Faso is the Eastern Corridor (N2). The Eastern Corridor lies to the east of the country, and is approximately 695 km in length and commences from Tema Roundabout through Accra, Volta, Northern Regions and ends at Kulungugu in the Upper East Region. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages

during the rainy season making travel difficult. The Ghana Government, has put a high priority on Eastern Corridor Road development under the Road Sector Medium-Term Development Plan and is actively promoting its development. The development of the Eastern Corridor is expected to contribute to the economic revitalization and the reduction of poverty in the area along the corridor and the neighboring countries by reducing transport cost and facilitating regional trade.

3.3 Project activities

3.3.1 Pre-Construction Phase Activities

The following pre-construction phase activities are required for the project:

- Feasibility Study.
- Project Roads Identification and Location
- Project Roads Survey
- Identification of Site Offices and Site Camps
- Acquisition of RoW
- Consultations
- Materials Mobilization
- HIV/AIDS, Ebola and Cholera Awareness Training
- Road Safety Awareness Education
- Environmental Protection Training

3.3.2 Construction Phase Activities

The following construction phase activities are required for the project:

- Excavations for drainage works.
- Excavations for Volta River suspension bridge anchorages (anchor blocks) foundations.
- Drainage works improvement for flood prone or low-lying areas.
- Construction of the Volta River suspension bridge structure.
- Construction of roads protection structures.
- Improvements of sections of access roads leading into selected project roads.
- Installation of road signs and markings and relevant traffic control devices.
- Construction and/or treatment and sealing of shoulders or pavement works improvements.
- Construction and/or improvement of roads geometric features.
- Construction and/or upgrading the existing project roads to asphaltic surface.

3.3.3 Post – Construction Phase Activities

The following post-construction phase (decommissioning, operation and maintenance) activities are required for the project:

- Decommissioning of Site Offices and Lay-Down Areas.
- Drainage Maintenance.
- Bridge Inspection and Maintenance Programs.
- Surface Maintenance on Paved Roads.
- Road Side Maintenance.
- Road Side Furniture Maintenance.

3.4 Project inputs

Within the project area and the adjoining municipalities, there will be new and existing burrow and quarry pits that can be sourced for the construction materials for this project.

3.4.1 Construction Water

There are several water abstraction points or water tanker services in the area where water for the project will be sourced from. It is expected that upon project commencement, the Contractor will prepare project activities schedule to share with the Client including necessary authorizations for water abstraction.

3.4.2 Construction Camp Establishment and labour

Appropriate land for construction camp sites will be sought for by the Contractor(s) to house the following: (i) Main Camp Sites (Consultants' offices, Contractors' offices, Fuel farms, Truck parking yards); (ii) Materials Holding and Batching plants; (iii) Pre-cast yards.

3.4.3 Location of Animal Crossings

Some portions of the project roads experience movements of animals, such as cattle and goats, at crossing points on Asutuare Jn – Volivo Road Project Road) and Asutuare – Aveyime Road. To ensure safe passage of animals, animal crossings will be installed at selected locations within the project enclave. Safety fences will be erected at affected locations. Safety fences will be raised over certain lengths before and after the crossing points to prevent animals straying to the project roads.

4.0 DESCRIPTION OF BASELINE ENVIRONMENT OF THE PROJECT

4.1 Area of Influence

The Section 1 (Asutuare Junction – Volivo Road (28.3km)), Section 3 (Dufor Adidome – Asikuma Junction (38.4km)) and Section 2 (Asutuare - Aveyime Road (24.0km)) of the project roads have immediate impact on over 5.4 million inhabitants, majority of whom live below the poverty line. The road traverses an area that is noted for its production of cassava, corn, tomatoes as well as cash and food crops for consumption and exports. The current state of two of the roads if not improved shall result in the total deterioration of the road with the resultant prohibitive capital cost for a total rehabilitation and its social effects.

4.2 Location

The roads project traverse one (1) Metropolitan, eight (8) District Assemblies and three (3) Regions. The Metropolitan Assembly is Ho (in the Volta Region) while the District Assemblies are: Yilo Krobo, Manya Krobo and Asuogyaman (in the Eastern Region); Dangme West and Dangme East (in the Greater Accra Region) and South Tongu, North Tongu, Adaklu-Ayigbe (in the Volta Region).

Section 1: The Asutuare – Aveyime Road (24.0 km) will be upgraded to pass through existing alignment of agricultural and commercial townships and rural villages some of which are in the Volta Region of Ghana and end up at Aveyime. This is a gravel road with highly deteriorated and distressed surface conditions will be upgraded to asphaltic highway to serve as a major feeder into the Eastern Corridor international transit route (N2).

Section 2: Sections of the Asutuare Junction – Volivo Road (28.3km) connects existing light settlement zone following the existing alignment and diverts through green field of agricultural farmlands and ends at Volivo township. At Volivo township, a JICA Suspension Bridge (1.25km) will be erected over the Volta River to end at Dufor Adidome.

Section 3: Dufor Adidome – Asikuma Junction Road (38.4km) pass through agricultural farmlands and undeveloped fallow fields to end at Asikuma Junction township. The Section1 (Asutuare Junction – Volivo Road (28.3km)) and Section 2 (Dufor Adidome – Asikuma Junction Road (38.4km)) form sections of the Eastern Corridor International transit system.

4.3 Physical environment

- **Asuogyaman District**

The district lies within the Dry Equatorial Climate Zone which experience substantial amount of precipitation. It exhibits double maxima rainy season which reaches its peak period in May–July and the minor season occurs in the period of September–November. Annual rainfall usually starts in April with the peak in June and ends in November. The dry season starts in November–December and ends in March. The annual rainfall is between 67mm and 1130mm. Temperatures are warm throughout the year with maximum monthly mean of 37.2oC and a minimum of 21oC. Relative humidity is generally high ranging from the highest of 98% in June to 31% in January.

- **Dangbe West District**

The district lies in the Coastal Savannah Zone with double maxima rainy season pattern. The rainfall averages between 762.5mm and 1220mm. The first rainy season is in April and ends in August, while the second rainy season begins in September and ends in November. The coldest months are between July and August. In November, the mean temperature is 30°C but in March it is about 40°C. The relative humidity is 65% to 98% in the day and night respectively.

- **North Tongu District**

The average annual rainfall varies from 900 mm to 1100 mm with more than 50% of it falling in the major season of April through July. The mean temperature is about 27oC. The maximum and minimum temperatures vary from 22oC to 33oC respectively.

4.4 Air Quality, Dust

- **Asuogyaman, Dangme West and North Tongu Districts**

Generally, the air ambient quality at the project sites will be punctuated by vehicular exhaust fumes, total suspended particulate and inhalable particulate matter (PM10). Moreover, the intensity of such emissions will increase with the increasing number of vehicular traffic movement during peak rush hours (6am and 8am in the mornings; 4pm and 6pm in the evenings) on market days.

4.5 Hydrography and Water Resources

- Asuogyaman District

The critical area of the Volta gorge is situated in this district. The Volta Lake flows through definite channels within the gorge area but spread upstream, after Gyakiti and Boso into the Volta Lake. The Volta Lake is heavily braided at Atimpoku as it flows over the low-lying areas of the district and begins to meander its way into the sea at Ada. The flow of the Volta River through the undulating landscape of the district creates an extensive lakefront good for tourism development.

- Dangme West District

The very seasonal nature of most of the streams caused by high temperatures and equally high evaporation levels have encouraged the construction of artificial dams and ponds. These water holding systems of varying sizes are used for irrigation and for watering of livestock.

- North Tongu District

The district is drained by Alabo, Kolo, Aklakpa, Gblor and Nyifla streams and their numerous tributaries into the Volta River, running north-south through the district. The Todze and its western tributaries drain the eastern part of the district into the Avu Lagoon. During the rainy season, these streams overflow their banks, causing damage to roads and farms. Inland creeks include Kebena, Dear, Dove, Aklamada, Amido and Akplordodi. Several ponds and dugouts have been created with major ones located at Atiteti, Adudomu, Mafi Kumase, Adidokpavu and Teleafenu.

4.6 Flora Species

- Asuogyaman District

The predominant vegetation type of the area is of the short grass savannah interspersed with shrub and short trees, a characteristic of the Sub-Saharan type. The vegetation is dense along the Volta River and along the stream basins.

- Dangme West District

A large portion of the flora community remains dry for most parts of the year, except for the short rainy season. Along the Dodowa River basin (outside the project roads corridor), higher vegetation cover ranges from thickets to light forest which form vegetative colony around the river basin. But the dry season depreciate the quality of this vegetation cover within the river basin since the Dodowa River then dries up.

- North Tongu District

The vegetation type is Tropical Savannah Grassland, which is dense along the Volta River and stream basins. The vegetation consists of mangrove, oil palms, baobab, silk cotton, acacia, etc. Away from rivers/streams the vegetation is sparse, predominantly grassland, interspersed with neem trees and guinea grass, digitaria, decumbent and fan palms, which dot Mafi Kumase and Agohome-Avetakpo areas. Neem and other trees harvested for fuel and charcoal burning (provides revenue but destroy the vegetation cover with subsequent ecological problems). Major affected areas are Alabo, Mafi Kumase, Volo, Dorfor Aklakpa and Dedukope. Shrub and grassland areas which are suitable for cattle grazing make the district one of the largest cattle producing areas in the country. But uncontrolled grazing and frequent bushfires are gradually, reducing such areas into desert lands.

4.7 Wildlife Species

- Asuogyaman District

Harvesting of trees for lime and charcoal production in the district including poaching activities have caused wildlife decimation. Wildlife such as antelopes, monkeys, hogs and others have fled for other reserves either close to or away from the project roads corridor to avoid poaching by humans. Partridges are however still common in the area.

- Dangme West District

The fauna content home to the vegetation cover includes wildlife species such as antelopes, deer, grasscutter and rodents. The fauna species are hunted for protein food source to improve the nutritional value of the human population within the district.

- North Tongu District

The Kolo and Akalakpa Reserves have been destroyed through trees harvesting for lime and charcoal production at Battor, Volo and Darfor. Wildlife poaching activities have reduced the numbers of elephants, antelopes, monkeys and hogs. But partridges are still common.

Noise Levels

- **Asuogyaman, Dangme West and North Tongu Districts**

There will be increase number of vehicular traffic at project zone during peak rush hours (6am to 8am in the morning; 4pm to 6pm in the evening) on market days lead to a higher level of noise pollution and auditory nuisance.

Sacred Sites

- **Asuogyaman, Dangme West and North Tongu Districts**

The proposed roads lie outside the three (3) notable, highly sensitive forest reserves. These forest reserves are Shai Hills Resource Reserve, Kalakpa Resource Reserve and Dodowa Forest Reserve. These protected natural biodiversity resources all lies outside the proposed roads domain of influence. The Shai Hills Resource Reserve is well managed by Ghana Wildlife Division and attracts eco-tourists. However, due to limited access to the Kalakpa Resource Reserve, it has been left with minimal care. But the Dodowa Forest Reserve, because of its historical, cultural and heritage influence enjoys both local and international tourist patronage.

4.8 Transportation

- Asuogyaman District

Transport facilities in the district include road and water transport. Road transport is by far, the most important mode of transport in the district. The Tema-Akosombo portion of the road is asphalt. The road network from Atimpoku to Anum Boso is bitumen surfaced. The rest of the road network in the district is basically feeder roads. Akosombo has an inland water port at Marine managed by the Volta Lake Transport Company. The company has ferries which transport goods and people on the Lake to Afram Plains and Yeji in the North. The lake

also provides opportunities for farmers who use canoes to the big market centre at Dzemeni in the South Dayi district of the Volta Region.

- Dangme West District

The district has about 252 kilometers of road network; 40 percent is surfaced while the rest are feeder roads. Tracks and footpaths also link villages. The total road network when compared to other districts appears to have a good spatial distribution. Apart from the central portion of the district, which is devoid of roads, the rest of the district is fairly linked up. The road surface condition of the national trunk roads is of an appreciably good condition. However, the local arterials such as the Dodowa-Afiencya road and Doryumu-Agomeda road need urgent improvements. Most of the feeder roads that give access to the more rural centres are unsurfaced and need regular resurfacing especially after the rainy season. There is a disused 14.8 kilometers railway line from Tema through Afiencya to the Shai Hills used for the construction of the Tema Harbor. This line can be rehabilitated for urban transport.

- North Tongu District

The District has a tarred road linking from the main Accra-Aflao road through Sege. Other communities such as Juapong are along the main Accra-to Ho road. There are also some motorable feeder roads within The District. Another form of transportation in the District is by river. The District is divided by a stretch of the Volta lake with communities such as Torgorme, Volo, Vome Battor and Mepe among others lying along the river.

4.9 Equity and Mainstreaming

- Asuogyaman, Dangme West and North Tongu Districts

Marginalisation Of Women

Generally, females are being marginalized in the area resulting in the fact that their views are not adequately captured in decision making and therefore making them vulnerable in the project area. A larger proportion of female head households exists due to migration of the male counterpart, child neglect etc. Most of the women however have no regular source of remittance. The domestic roles of women include taking care of children. Women are therefore saddled with the responsibility of providing food, clothes and in some cases the payment of school and hospital fees. The low income earned by these women, therefore inadequate to meet the needs of their households hence their disadvantaged positions economically

Social problems faced by women who have some relationships with poverty include the traditional social systems, fertility, conflicts and gender equity in personal and social relations. Also, in traditional legal systems, the perceptions of female roles combine to ensure that allocation of resources favour male authority and interest still exist. Some negative traditional practices, restrictions on pregnant and lactating mothers as well as serving the best and largest parts of the meal to the male members of the household, all conspire in no small measure towards worsening the lot and the general poverty-stricken position of most women in the district. Women generally have lower access to land. When land allocations are made to women, they are normally given smaller acreages no matter their individual capabilities.

The District Assemblies ensured that on the basis of gender analysis, gender concerns are addressed in all planning activities when setting priorities, allocating resources and identifying actions and activities.

- **Gender Mainstreaming**

Specific gender mainstreaming activities include the following: provision of adequate sanitary facilities for both male and female at all public places especially schools and health facilities due to the special needs of girls; analysis of development proposals in the light of how it affects both male and female and provide each facility adequately to address their needs; organization of sensitization programs for men and women to encourage cross gender participation in local governance; encourage more female aspirants to take political and public positions; form school clubs for girls to build their confidence and capacity to bridge the gap between boys and girls; supporting women trades groups in the districts in accessing resources for their activities; addressing the issue of women access to land for farming

5.0 PROJECT ALTERNATIVES AND RESULTS OF THE COMPARISON

5.1 No Project Development Option

The “No-Action” Alternative is defined as a decision not to undertake the proposed Eastern Corridor N2 Project by use of African Development Fund of the AfDB. In the absence of adequate local funds and/or other international funding sources to undertake the Planned Project, the “No Action” would result in the continued diseconomies in the Government of Ghana financial management systems for planned development project under the Road Sector Medium-Term Development Plan. This alternative also implies that the proposed road project will not be undertaken and that the traffic situation will be left to become worse over time. All positive benefits would be foregone. In the long-run, failure to undertake the Eastern Corridor N2 Project Initiative would severely cripple Ghana development efforts. Therefore, the “No-Action” Alternative is imprudent in the best interest of Ghana economic sustainability effort and road sector development and expansion. More importantly, the volume of international cargo for neighboring landlocked countries will continue to increase in the future, while chronic congestion in and around Accra and Kumasi will continue to persist. The hampering of fast and efficient movement of cargo to neighboring landlocked countries will not require the necessity of an alternate route identification and development to facilitate transit and trade. A possible alternate international transit route to Burkina Faso will not be the Eastern Corridor N2 project under the Road Sector Medium-Term Development Plan. No development of the Eastern Corridor N2 project is expected without contribution to the economic revitalization and the reduction of poverty within the corridor and the neighboring countries by reducing transport cost and regional trade facilitation.

6.0 Alternative routes considered

The alternative routes selected are as follows:

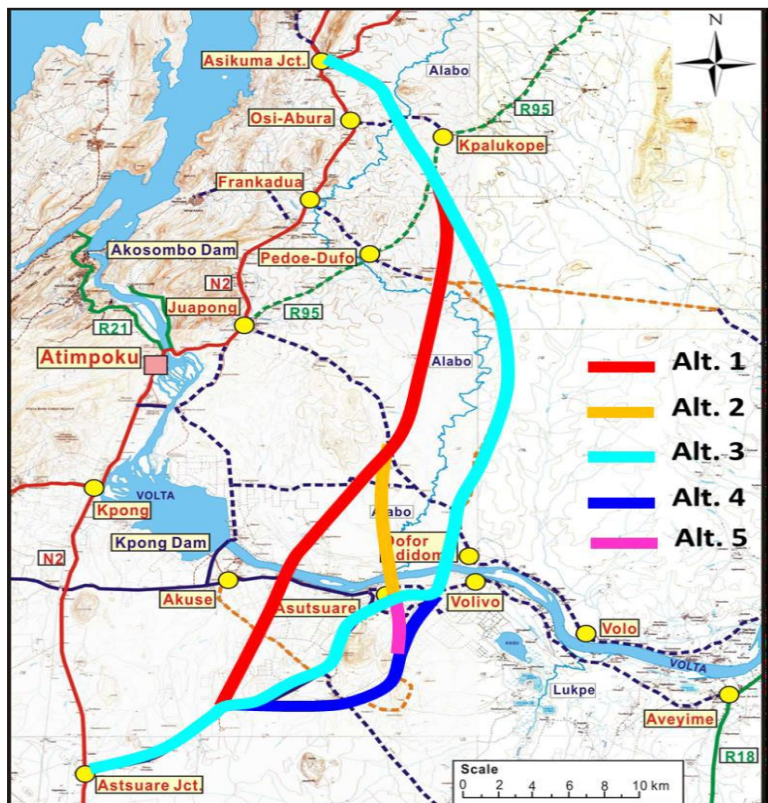
Alt. 1 Route passing between Asutsuare and Akuse, crossing the Volta River, turning toward the northeast, crossing the Alabo River once, turning north, crossing the Alabo River a second time, and connecting Asikuma Jct.

Alt. 2 Route following the existing Asutsuare Jct. – Asutsuare Road alignment and then crossing the Volta River on the eastern side of Asutsuare, going north and joining Alt. 1.

Alt. 3 Route following the existing Asutsuare Jct. – Asutsuare Road alignment, going toward the eastern direction., crossing the Volta River on the western side of Volivo township, turning north on the eastern side of the Alabo River, and joining Alt. 1 after crossing under the high-voltage transmission line.

Alt. 4 Route passing on the eastern side of Osuyongwa Mountain, turning toward the eastern direction, and joining Alt. 3.

Alt. 5 Route following Alt. 4 until near the banana estate, and directly joining Alt. 2.



Map showing the alternate routes considered

However, four were (4) possible alternative locations for a new bridge over the Volta River were similarly considered. The selection of alternative road alignment was carefully coordinated with the selection of possible locations of a bridge. Moreover, between Volta River and Asikuma Junction on the N2, three (3) possible alternative routes were examined. These were N-1, N-2 and N-3. But alternative routes N-1 and N-2 were screened out because they require upgrading of the existing N2, which passes through several townships and this upgrading scheme is not covered by the Program of Study.

Selected Development Option.

In terms of sustainability and the optimization of goods and passenger traffic the Asutsuare – Aveyime Road option is selected and will mean maintaining the existing road alignment as much as possible within the entire road corridor. There will also be surface condition improvement and drainage systems enhancement. This option involves: strengthening of existing pavement, double bituminous wearing course, bituminous and granular base course, granular sub-base and rip and recompact in-situ existing material; construction of roadside

drains and improvement of some existing structures; provision of toll-booths, laybys-busbays, pedestrian crossings and walkways on both sides of the road.

7.0 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

7.2 Potential environmental and social impacts of the selected option

7.2.1 Potential Positive Impacts during construction Phase

Employment and Income: The project is expected to create opportunities for both skilled and unskilled labour. These may include engineers, masons, carpenters, food vendors, consultants etc. Security persons will be needed to safeguard contractor's equipment, construction materials, and supplies. Other activities such as surveying, road marking, and traffic regulation will also create jobs. Labourers may be hired from the project environs and will be beneficial to the communities. The presence of a labour force will also increase economic and employment opportunities for residents through the sale of goods (such as food/drink, crafts, wood etc.) and other services.

Enhance skills for Local Artisans The local artisans like the carpenters, masons, welders, will have the opportunity to be trained by the contractor. This training will enhance their skills on the job and push them to a higher level in their field or career.

Increase revenue for the District/Municipal Assembly: During the construction phase trucks carting materials to the site will be required to pay toll fees which will bring some revenue to the District and Municipal assemblies. Revenue can also be generated by the respective Municipal and District assemblies from traders who sell or trade around the project site to workers through ticketing.

Gender Issues

Women are traditionally most active in the day-to-day upkeep of rural life. Women move about carrying more than 50kg per day of load over distance of 4km, spend 75% of total transport time walking along distances to and from farms and other production units, and walking constitute the major transport means. The situation becomes more difficult for pregnant women and lactating mothers, aged vulnerable people and small children who also walk long distances to access basic social services. This is partly due to inadequate and poor transport service caused by poor rural transport infrastructure like the Asutuare-Aveyime Road. The improvement of the roads project in project zone is expected to reduce this physical and emotional burden on women while increasing their productivity and overall wellbeing.

7.2.2 Potential Positive Impacts during Operational Phase

Much of the potential positive impacts of the proposal will be experienced on a long-term basis through induced characteristics. These induced transformation events are more socio-economic and cultural in perspective. The potential key expected positive impacts of the project include the following:

1. The contribution to improvement of trade among people in the project area
2. Improved transport conditions in the relevant roads sections
3. The internal opening up and improved access to basic socio-economic infrastructure for the populations within the project roads enclave

4. The creation of direct and indirect jobs and employment during the construction, operation and maintenance phases of the project roads implementation program
5. The development of tourism potential
6. Improved and enhanced living conditions and social facilities for vulnerable populations served by the project roads
7. Improved safety around schools, health centers, churches, mosques and other social amenities along the project roads catchment zones
8. Suppression of dust through bituminous surfacing of the project roads pavements
9. Reduction in greenhouse gas (GHG) emissions
10. Reduction in travel time and costs
11. Reduced traffic congestion resulting from flooded road section conditions on the Asutuare-Aveyime Road during heavy rainfall
12. Improved travel time, safety and comfort
13. Increased land values within the roads project enclave

7.2.3 Potential Negative Impacts during Construction Phase

Water Resources: Construction activities generate spills and other waste which when improperly disposed may pollute the rivers and stream. Surface run-off from construction sites and camps may include but not necessarily be limited to hydrocarbons such as waste oil and lubricants. In addition, discharge of wastewater from construction camps will also contribute to polluting the stream.

Soil Erosion and Sedimentation: Road construction will intensify the effects of natural soil erosion due to vegetation removal, soil disturbance, and exposure of bare soil surface. If appropriate measures are not taken, the increased erosion loss could be significant over the construction period.

Air Quality: The major sources of air pollutants are the emissions from construction machinery and dust from moving vehicles not only in the working area but also along roads to borrow pits, sand pits as well as disposal sites for spoils and waste. Major air pollutants (dust, gaseous emissions and particulate matter) produce air pollution and impact adversely on human health, flora and fauna and on the built environment. These impacts are considered negative and significant, especially to residential and commercial establishments located close to project during the construction phase mitigation measures are required to reduce the impacts on air quality within the project area. Dust pollution from construction activities will however cease in the operation phase.

Noise and Vibration: Uninterrupted movement of heavy and light vehicles may cause increase in ambient noise levels on the project road. It may have negative environmental impacts on the sensitive receptors close to the project road especially residences. During the construction phase of the road, the major sources of noise pollution are vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are anticipated to produce noise levels in the range of 80 - 95 dB (A). The construction equipment will have high noise levels, which can affect the personnel operating the machines. The noise likely to be generated during excavation, loading and transportation of material will be in the range of 90 to 105 dB (A) and this will occur only when all the equipment operate together and

simultaneously. This however is a remote possibility. The workers in general are likely to be exposed to an equivalent noise level of 80 to 90 dB (A) in an 8-hour shift.

Landscape Modification: Excavations quarry and borrow materials stockpiling as well as the parking of construction equipment are also expected to take place during the construction phase. The impact of such on the aesthetic and visual quality and value of the landscape is thus considered negative. However, the interchange itself will add some aesthetic value to the area.

Traffic Congestion: Travelers and commuters may experience possible inconvenience on the road diversions during the construction period. The traffic diversion could result in traffic blocks, increased periods of waiting and traffic accidents. There could also be dangerous driving conditions where construction vehicles interfere with local traffic on existing roads. The impact on road users would be significant and negative.

Construction Camps Temporary construction camps will be required for storing construction vehicles, equipment, fuel and road-building materials. Establishing new construction camps may involve the bulldozing and levelling of a piece of ground, and erection of temporary housing units. This could destroy an area, leading to obvious consequences on soil erosion and water quality, if the camp is poorly sited and or constructed. Indiscriminate dumping of engine oils, fuel, lubricants or other solvents can contaminate soil and leach into subsoil water. Construction workers are not expected to live on site therefore it would not be necessary to provide them with housing facilities. They will most like commute from their own homes.

Construction Wastes: Non hazardous solid wastes (excavated materials, domestic solid waste), and liquid wastes would be generated whilst rehabilitating the road. Poor sanitation and solid waste disposal in construction camps and work sites are likely to have negative impacts on human health. The improper handling and disposal of construction wastes would have a negative impact on the environment.

Impacts on Loss of Assets and Compensation Payment

Significant number of sandcrete buildings of residential and commercial properties, crops/farms and bare farmlands will be affected by the construction process on all the project roads (Section 1: Asutsuare Jn-Volivo Road; Section 3: Dufor Adidome- Asikuma Jn Road and Section 2: Asutsuare-Aveyime Road). During the construction, any affected temporary structures like wooden kiosks in the RoW will be moved further away from the roads or relocated further down the roads, if possible. The displacement of bare fallow lands, farmlands, crops and non-economic shrubbery trees will occur predominantly at several sections on the Section 1: Asutsuare-Volivo Road and Section 3: Dufor Adidome – Asikuma Jn Road. Generally, the impact of scenarios involving temporary structures relocation, permanent structures demolition, and trees, crops, bare fallow lands and farmlands take will be highly significant and negative. Mitigation measures are required, including residual impacts significance

Vehicular-Pedestrian Conflicts: Conflicts will occur between the pedestrian traffic and the activities at the working area. Such conflict will be most pronounced in the settlements. The safety of vehicular road users and pedestrians may be endangered by an increased risk of accidents resulting from collisions with road-building equipment or unsafe road conditions. The impacts are considered to be significant and negative in the construction phase. Mitigation measures are therefore required in the construction phase.

Public Health: Stagnant water in excavated places near the road is a health hazard to nearby residents since they serve as breeding sites for vectors of disease such as mosquitoes which transmit malaria. An influx of construction workers into the area could increase the risk of spreading sexually transmitted infections (STIs) and AIDS to inhabitants.

7.2.4 Potential Negative Impacts during Operation Phase

Land Use Changes: During the operational phase, several land use changes may occur which may include: (i) Potential unplanned developments along the corridors attracted by easy transportation; (ii) Increased demand for residential, schools, recreation facilities and health facilities effects on public resources; (iii) Potential increase in traffic flow into the areas.

Health, Safety and Security: The construction of the road will allow higher traffic speed which may have subsequent impacts such as: (i) Elevated noise levels to the residential, commercial and institutional facilities; (ii) Potential increased road accidents as the road users adapt to new road use trends; (iii) Potential immigration of business, institutions and residential facilities; (iv) Increased chances of higher infections and spread of HIV/AIDS and other communicable diseases.

Air quality: There will be increase in gaseous emissions, especially the nitrogen oxides NO_x, SO₂. On the one hand, the improved condition of the road will generate more traffic, implying an increase in sources of emissions, namely vehicles. On the other hand, construction of the road will lead to an increase in average vehicle speeds resulting in more fluid traffic and emission ratios which are generally lower than those of the scenario without the project speeds (air emission ratios are generally inversely proportional to vehicle speeds up to an optimal of 70-80 km/h).

7.2.5 Cumulative impacts

The overall objective of the project is to enhance mobility, promote efficient, affordable transport services along the project area, improve livelihoods of people in the project area of influence and to ease traffic congestion from Accra to Kumasi and vice versa. Some positive cumulative impacts are stated below:

- An improvement in travel time will be observed as travel time will be reduced. This will especially be beneficial in terms of enhancement of accessibility and commercial activities thereby facilitating regional economic integration
- Efficient vehicular movement arising from an improvement in travel may also lead to a reduction in emissions, especially CO₂. Cumulatively, this will contribute to Climate Change mitigation,
- Safety of the road users also stands to be improved. With the provision of the route and with enhanced signage and information, cases of road accidents will be significantly reduced;
- The road also has a potential to enhance appreciation of land and property values in the road section and the immediate neighbourhoods. Among the appreciation will include value addition to commercial and economic investments and potential for institutional development.

7.2.5.1 Negative cumulative impacts:

- Road projects may pose increased social risks with respect to among others HIV/AIDS and other social challenges unless strategic and appropriate mitigation strategies are formulated to guide all the projects.

8.0 MITIGATION /ENHANCEMENT MEASURES AND COMPLEMENTARY INITIATIVES

The following mitigation measures will be done to reduce the negative impacts:

8.1 Pre-construction requirements

- **Selection and recruitment of contractors:** environmental and social clauses will be included in the bidding documents (BDs). A rating system will also be defined in the BDs to give preference to firms with the necessary resources and approach to management environmental and social impacts during the works.
- **Fair, equitable and prior compensation** of persons affected by the project for property identified in the Full Resettlement Action Plan (RAP). The estimated budget for the implementation of the RAP is GH¢21,632,409.69. This amount shall be paid by the Government of Ghana prior to start-up of the works.
- **Contractor's undertaking:** the works contractor shall prepare a Contractor's Environmental and Social Management Plan, including environmental compliance clauses, that it undertakes to comply with. It will be recommended that each contractor submit for approval by the supervising engineer's environmentalist a Site-Specific Environmental Protection and Management Plan (SEPP) no later than 60 days after contract notification. These documents shall contain as a minimum: (i) the organization chart of personnel assigned to environmental and social management, indicating the project's environmental and social officer; (ii) a description of the biophysical and socio-economic environmental impact mitigation methods; (iii) the management and restoration plan for borrow areas and where applicable quarries, including the necessary authorizations for existing queries and pits; (iv) the water resources management plan; (v) erosion, drainage and sedimentation management plan; (vi) location of storage and equipment areas; (vii) liquid and solid waste management plan; (viii) all the site protection measures and implementation programme; (ix) the general site and location plan drawn to scale; (x) a description of methods for the prevention and reduction of pollution, fires and road-related accidents; (xi) an emergency response plan including health facilities and access to them in emergency situations; (xii) site regulation regarding environmental protection and security; (xiii) the interim site rehabilitation plan upon completion of the works and handing over of equipment, where applicable to local authorities and communities; (xiv) diversion and traffic management plan; (xv) communication and consultation strategy with local community and road users.

Capacity building of the key actors: in light of the project's scope, training sessions on the environmental and social management of the project will be organized for the main local stakeholders prior to works start-up. In particular, this will entail 3-days training sessions for the administration's staff (Experts from the PCU at GHA etc) to better understand AfDB safeguard procedures, their roles and responsibilities prior and during the works, etc.

8.2 Mitigation Measures during construction phase

Water Quality: The contractor must ensure that waste chemical substances that can potentially contaminate stream are disposed of properly and away from the stream. Fuel trucks servicing equipment and vehicles on site will be obliged to carry at all times, anti-spill trays and a supply of suitable material, such as sawdust, for absorption of minor spills. Where possible, buffer zones of vegetation should be provided between work sites and water bodies. As indicated above the contractor will submit a water management plan to protect water resources.

Soil Erosion and Sedimentation: Earthworks should be planned and executed with due diligence to prevent soil erosion. The provision and streamlining of appropriate drains and their associated outfalls will go into reducing erosion.

Air Quality: Dust generated during construction can be reduced by periodic watering of exposed surfaces, and/or by enforcing lower speed limits within the work zone. Trucks carrying and transporting sand and other construction materials must be well covered. The contractor must also make sure that the equipment and vehicles used are in good condition to ensure minimal emissions. Regular monitoring of PM, TSP, CO_x, NO_x, etc. should be done during construction.

Noise and Vibration: The project implementation agency, the Department of Urban Roads must educate and ensure that the contractor controls pollution and maintain construction equipment regularly in accordance with the manufacturer's specifications with particular regard to control of noise. The contractor is expected to plan and execute the works so that it does not become a nuisance to the general public where possible. Mixing plants would be located at least 500m from any community along the project roads. Contractor will be prevented from working in settlement areas after the hours of darkness. Construction workers should be provided with relevant safety gear including ear plugs at all times while at work and enforces application.

Landscape Modification: The contractor must endeavour to avoid cutting down of trees where possible.

Traffic Congestion:

In order not to disrupt movement of people unduly as a result of the contractor's activities, the contractor should inform the public and road users about the road works and any access problems through meetings, road signs, the media and any other means. In addition, a construction traffic diversion plan has been developed by the consultant as presented below.

Traffic Diversion during Construction:

Motorized and non-motorized traffic within the project zone is very significant and as such managing their movement through the construction zone is critical. A detailed traffic management plan will be prepared by the Contractor based on their construction work program and sequence of activities to be reviewed by the Consultant. The Consultant will ensure that traffic management is done jointly with the relevant road agencies, the local authorities and the Contractor with a view to keeping inevitable traffic disturbances and safety hazards to a limited extent. Recommendations for staging of construction works and the likely traffic diversion routes are presented in the following sections.

Standards and Specifications for Traffic Management

All traffic management and safety measures will comply with applicable standards and specifications.

Traffic Control during Construction: The Consultant will recommend on-Site, off-Site and miscellaneous traffic management strategies to control traffic during construction. Off-site strategies would be used where construction will significantly impact the traffic flow away from the work

On-Site and Off-Site Traffic Management Strategies

Both on-site and off-site strategies would involve the application of the following: (i) Changeable Message Signs; (ii) Additional Information Panel Signs; (iii) Manual Traffic Control; (iv) Temporary Work Zone Speed Limits; (v) Arrow Boards.

Miscellaneous (On-Site) Traffic Management Strategies

In addition to the above, the following miscellaneous on-site strategies would be recommended during project execution: (i) Incident Management – Consideration would be given to the use of on-site tow trucks for work zones with limited or no shoulders available. They would also be considered where a crash or break-down will seriously impact the roadway and cause significant backups and delays. Consideration would also be given to the provision of Turnarounds for access through temporary concrete barrier and for tow trucks and the Police to park; (ii) Police Patrols for Speed Control - Police patrols in work zones may be required to ensure vehicular speeds are at or below the posted speed or for other safety reasons. This typically will require coordination with the MTU of the Police Department; (iii) Pedestrians – The project area is characterized by medium to high level of pedestrian activity. Pedestrian access would also be provided during construction. This will require providing temporary crossing points, sidewalks, protection from drop-offs, etc.

Construction Camps: Sites for camps shall be done in consultation with the local authority and local community; this will help to deal with social upheavals. The camp sites should be located away from residential areas. The contractor shall provide adequate office accommodation for his own staff and those of the Engineer's representative, workshops for his own use and those of his workers. Facilities to be provided should be maintained up to adequate standards.

Construction Wastes The contractor must ensure that construction wastes are disposed off in an appropriate manner and location. The construction site must also be served with waste disposal facilities for domestic solid waste and toilet facilities should be provided on site for use by workers. **Public Utilities** Affected utility providers will be consulted to plan and realign displaced utility services, as well as discuss possible means of providing services in the interim to reduce inconveniences as much as possible. Public notices will be issued in advance to inform the general public about possible disruptions. This report does not cover the relocation of the public utilities. The assessment of possible relocation zones and relocation of utilities will be undertaken by the following:

UTILITY	ORGANIZATION RESPONSIBLE
High Tension Lines	GRIDCO
Water Lines	Ghana Water Company Limited (GWCL) Community Water and Sanitation

Telecommunication Lines	Telecommunication companies
-------------------------	-----------------------------

Vehicular-Pedestrian Conflicts: The contractor shall establish traffic and safety barriers, proper markers and signage where required. Appropriate speed limits should be put up as visibly as possible to allow for drivers to slow down especially when approaching the construction site.

Public and Occupational Health and Safety: Pools of stagnant water around the construction site must be filled to prevent mosquitoes from breeding in them. GHA will be responsible for organizing AIDS and STI's awareness campaign at construction camps and settlements along the road corridor. Injuries resulting from falling from heights and falling objects, as well as from the (mis) use of equipment and tools, cuts from stepping on sharp objects such as nails and other metal off-cuts and injuries resulting from clashes between vehicles and the workers as they both operate within the same space are likely to occur during the implementation of the project. This impact is considered significant since it affects human lives and would therefore require adequate mitigation measures. The Contractor must also implement a comprehensive Occupational Health and Safety (OHS) policy.

83 Mitigation measures – Operational Phase

Land Use Changes: The successful mitigation of this impact rests greatly on the Municipal and District Assemblies. They should enforce land use zoning regulations in the municipality.

Health, Safety and Security : The following health and safety measures will be implemented: (i) Road safety awareness campaigns should be organized to sensitize people on road safety and protection of the road signage and information; (ii) Ensure improvement and protection of signage, guard rails and other features that contribute to road safety; (iii) Strict monitoring compliance with traffic use and speed limits; (iv) Enhanced Information and awareness of HIV/AIDS

9.0 EXPECTED RESIDUAL EFFECTS AND ENVIRONMENTAL HAZARD MANAGEMENT

With the implementation and strict adherence to mitigation measures it is expected that residual impacts will be of low significance.

Environmental hazard management: The failure of environmental mitigation can result in serious impacts such as erosion, increased road accidents and disruption of the community lifestyles. Construction of a road also involves occupational health and safety risks to road workers, primarily in the areas of storage and handling of materials, and operation of heavy machinery. The anticipated risks in this project include: (i) Exposure to excessive dust particles or toxic fumes from bitumen and other chemicals used in road works; (ii) Potential collapse of trenches; (iii) Risk of accidents involving passing traffic; (vi) Risk of rock falls during blasting; (vii) Risk of fuel spills and therefore contaminating water bodies.

The risks can be mitigated to a large extent through: (i) Strengthening staff skills and training in environmental management; (ii) Monitoring environmental actions and responsibilities and

making provision for remedial actions; (iii) Planning for remedial measures in case initial planned actions are not successful; (iv) Limiting time of exposure to dust particles, chemicals and noise; (v) Provision of Personal Protective Equipment (PPE); (vi) Establishing safety and inspection procedures in materials handling, operating heavy equipment and constructing trenches; and (vii) Safe handling of chemicals and explosives.

Environmental Emergency Response Plan: An emergency response plan should be put in place to deal with environmental /public health emergencies associated with accidents. An area will be designated as assembly point in the event of emergencies where all activities will be halted and workers move to the assembly points in an orderly manner. While the emergency services are contacted. Where first aid must be administered, a trained first aider will carry it out whilst arrangements are made with the health facility for the injured to be taken to. The best way to avert any emergency is through prevention. However there are emergencies which are beyond prevention such as natural disasters. All workers will be given environmental and safety inductions to enable go about their respective duties in a safe and environmental sound manner. Appropriate PPEs must be provided to assist in dealing with environmental, health and safety issues. Individual responsibilities will call for everyone to be alert when going their duties. Further training will be given to workers working for instance at a height. Personnel from fire service will be contacted to give some fire drills, rescue and containment. Specialist first aider will be contacted to train foremen on administering first aid in the event of emergencies. All incidents will be recorded and investigated for corrective actions to be put in place to avert/ prevent future occurrence. When accidents occurs the person who caused it or finds it will take the following environmental, Health & Safety Incident Recording Procedure will be followed. The emergency phone numbers are provided below.

EMERGENCY PHONE NUMBERS

Environmental Protection Agency	0302 664697/8
Ghana Police Service	191
Ghana National Fire Service	192

10.0 MONITORING PROGRAM

Environmental monitoring ensures that the impacts have been accurately predicted and that mitigation measures are being implemented as planned and has the assumed effects. The monitoring exercise will ensure that the remedial actions recommended in the assessment are incorporated in the project and maintained throughout the operation life where appropriate. It will also identify additional remedial measures and corrective measures or redesign remedial measures if they are not sufficiently effective.

10.1 Surveillance and Monitoring Responsibilities

All major stakeholders in the project have a monitoring responsibility of some kind. However, only the Supervising Engineer, the Ghana Highways Authority Environmental Unit, The EPA, the Department of Forestry and the Contractor are allocated specific and formal monitoring obligations. Traffic Police, Health Authorities and other public authorities will automatically monitor some of the effects of the project during their daily work. Periodic interviews with

the beneficiaries of the projects will also be undertaken to assess their opinions about the effect of the implementation of the project.

Table 1: Summary of Monitoring Responsibilities and Output

Party Responsible	Parameters to be Monitored	Output
EPA	Overall Environmental Performance of the Project	Regular monitoring to ensure compliance. Instructions to Contractor and the Engineer
Department of Forestry	Tree felling	Instructions to Contractor and the Engineer
GHA (Environment Unit)	<ul style="list-style-type: none"> • Overall Environmental Performance of the Project • Community relations • Payment of appropriate compensation 	Quarterly Environmental reports
The Engineer	<ul style="list-style-type: none"> • Construction methods and materials • Environmental management of construction sites • Implementation of mitigation measures for air, water, soil, traffic, Occupational Health and Safety, etc. • Environmental management of construction camps • Contractors waste management/Staged rehabilitation of impact areas • Community relations • Accidents (traffic, spills etc.) • Environmental performance of mitigation measures 	Monthly Environmental reports. Incident Reports as and when required (spills, accidents and the like)
The Contractor	<ul style="list-style-type: none"> • Environmental performance of equipment and plants • Implementation interim/permanent mitigation measures • Occupational Health and Safety measures • Base Camp Management • Waste Management Plans • Air and Water quality • Accidents of any kind 	Maintenance records Accident Reports Mitigating actions e.g. sprinkling of water, traffic signs, safety barriers
Traffic Police	<ul style="list-style-type: none"> • Traffic nuisances • Traffic safety measures • Traffic accidents 	Police reports and instructions to Contractor
Affected district	• Specific duties for various sectors of	Reports to Contractor/GHA
Health Authorities	<ul style="list-style-type: none"> • Change of frequency of diseases • Occurrence of new diseases in the area 	Health reports.

Party Responsible	Parameters to be Monitored	Output
Local Communities	<ul style="list-style-type: none"> • Negative environmental impacts • Social disturbance 	Complaints to Contractor and Supervising Engineer

10.2 ESMP cost estimates

The ESMP cost is estimated as 6,489,342.38 million United States Dollars broken down as follow: (i) Road safety 155,744.22 for measures recommended for Road Safety; (ii) GHC 26,292,463.89 of Compensation and Resettlement and of which GHC 4,563,154.89 is earmarked for RAP implementation and monitoring (iii) 129,786 United States Dollars for HIV AIDS campaign and in addition to the above mention cost, gender-mainstreaming activities have been included with a provision of 804,678 United States dollars.

Table showing ESMP cost estimates

RECOMMENDED MEASURES	Amount (GHS)
Construction Traffic Diversion Plan	Item for clauses in contract documents
Establishment of camps, signage, etc	Item for clauses in contract documents
Waste Management Plan	Item for clauses in contract documents
Occupational Health & Safety Plan	Item for clauses in contract documents
Erosion and drainage management plan	Item for clauses in contract documents
Alternative for water tankers:	Item for clauses in contract documents
Compensation in line with Resettlement Action Plan (RAP) including monitoring	As above
Sensitization on road safety and HIV/AIDS	As above
Related and Improvement Works	
Institutional Support	
Training (GHA)	75,000
GRAND TOTAL	6,489,342.38 US Dollars

11.0 PUBLIC CONSULTATIONS AND DISCLOSURE

Public consultation shall be held prior to the approval of the ESIA for a proposed project in line with the EPA and AfDB's requirements. According to AfDB's ISS, the borrower or client is responsible for conducting and providing evidence of meaningful consultation (i.e., consultation that is free, prior and informed) with communities likely to be affected by environmental and social impacts, and with local stakeholders, and also for ensuring broad community support especially for Category 1 projects.

11.1 Stakeholders consultation as part of the ESIA preparation and approval

Public and community consultations were done where discussions/ informal interviews were held with relevant stakeholders on issues such as: project design, project works,

environmental and social concerns, ancillary and enhancement works, effects on local economy and resettlement/ compensation issues.

Relevant stakeholder consultations and engagements for the proposed roads project were conducted to capture the significant concerns associated with the project from all concerned and interested parties. The process ensured that these groups were given the platform to voice their opinions and views. The process also gave prior disclosure of relevant and adequate project information to stakeholders. The study teams held six (6) public meetings on 18/10/2014, 05/12/2014, 06/12/2014, 26/06/2015, 27/06/2015 and 13/11/2015 along the roads project enclave during the development of the ESIA and RAP Reports. The Study Team, GHA and AfDB Project Design Teams held Stakeholders Community Needs Assessment public meetings on 18/04/2018 at Asutuare Junction, Asutuare, Volivo, Aveyime and Dofor Adidome along the project roads corridor. Finally, study Teams, GHA and AfDB Teams held Stakeholders awareness Education public meetings on 20/04/2018 at Asutuare Junction, Asutuare, Volivo and Aveyime.

The participants of the various public meetings included representatives of community-based associations, Ghana Private Road Transport Union (GPRTU), Drivers, Taxi Owners, Market Women, Rice Traders, Teachers, Parents, Home Owners, Property Developers, Nurses, Assembly Men and Women, Elders, Rice Farmers, Fruits and Vegetable Farmers, Project-Affected-Persons (PAPs) and Project Community Residents. The stakeholder consultative and engagement meetings provided views, opinions and suggestions on the most appropriate considerations on the construction and use of the proposed roads project.

Results of the ESIA will be disclosed to the local populations in the project area to enhance transparency and accountability and also to encourage public support and active participation. Twelve copies of the ESIA report would be submitted to the EPA and additional copies would be made available at the Agency's head office and the Northern Regional office for public review and comment.

11.2 Public Grievance Mechanism

The objective of the Grievance Redress Procedure is to address and resolve grievances or complaints from affected persons promptly, fairly, and in a manner that is, to the extent possible, acceptable to all parties. The following principles will be applied: (i) Provide straightforward and accessible ways for affected persons to voice complaints or resolve any disputes that might arise related to Project implementation; (ii) Seek solutions to any tensions and conflicts early on, to avoid the use of a 'firefighting' approach; (iii) Identify and implement appropriate and mutually acceptable actions to address complaints; (iv) Respond in a timely manner, and with sensitivity to the needs of complainants; (v) Ensure that claimants are satisfied with outcomes of the corrective actions, and maintain a dialogue with them to the extent possible; and (vi) Avoid resorting to higher levels of adjudication, such as judicial proceedings, as much as possible.

All grievances will be received by the Grievance Committee (GC), through two designated PAP representatives who are member of the Grievance Committee. The GC will have a membership of seven (7) drawn from GHA, the District Assemblies within which the project falls. Three (3) PAPs will serve as the representatives for all the PAPs, one from each

community and one representative from an NGO will be selected to complete the GC team. The GC will respond to any grievances that the PAPs may have during the RAP implementation.

There will be two contact people from the GC to attend to all complaints as the first step by recording all complaints. The record will include name and contact of complainant, issue of complaint, date and time and receiving officer. The complainant will verify that the complaint lodged has been appropriately captured on the complaints sheet (to be designed and provided by GHA Environmental Unit).

The grievances most likely to occur during the implementation of the RAP may include the following: (i) Disagreement over compensation amount assigned; (ii) Delays in receiving compensation; (iii) Disagreement over asset ownership; (iv) Disagreement over proportionate sharing of assets with joint ownership; (v) How PAPs with lost identity documents can receive their compensations.

The Committee will meet fortnightly to consider all lodged complaints and propose measures to address them. It is expected that all grievances would be addressed amicably at the committee level. However, in the unlikely case that a particular issue proves difficult to address, the complainant has the option of seeking redress at a higher level i.e. court of law and the committee members will co-operate.

11.3Future Consultations

The initial consultations during the design phase and ESIA study should be followed by more consultations during the construction and operation phases. At contractor's level, consultation will be made with relevant stakeholders prior to the beginning of the works. As indicated under the RAP implementation schedule the RAP will be implemented using a participatory process under the lead of GHA and the Municipal Assembly. During the works, the contractor will inform surrounding communities as needed to minimize the inconveniences.

12.0 INSTITUTIONAL CAPACITY AND STRENGTHENING PLAN

This chapter details the capacity strengthening plans that will be needed to improve or aid the ability of some key agencies with regard to the implementation of the ESMP.

GHA: The overall implementation, project supervision and monitoring falls under the purview of the Environmental Unit of the GHA. It will be in charge of overseeing the implementation of the ESMP. In order for this to be done successfully, it is necessary that their capacity be strengthened to improve their function with regards to environmental and social management. An overall cost has been estimated for this purpose and this includes mainly trainings and support in Environment and Social Monitoring.

EPA: EPA will play a key role in the monitoring of the project. In the course of its duties, there is an amount to be given

13.0 CONCLUSION

The ESIA has evaluated the potential impacts of the project. The assessment of the management of the project. The assessment of the impacts will occur as a result of the project. The environmental and social impact will not be disclosed.

14.0 REFERENCES AND CONTACTS

List of documents consulted

- Environmental and Social Impact Assessment report, 2015
- Social Impact Assessment report, 2015
- Environmental and Social Management Plan (ESMP) report, 2015
- Resettlement Action Plan report, 2015

For the African Development Bank

- Mam Tut Wadda-Senghor, **Principal Transport Engineer**, AfDB Ghana Office, E-mail: m.wadda@afdb.org
- Modeste Kinane, **Principal Environmental Engineer**, AfDB Headquarters, Cote d'Ivoire
- Moses DUPHEY, **Environmental Engineer**, AfDB Headquarters, Cote d'Ivoire

AfDB and GHA

Consultancy Services for Detailed Engineering Design for Asutwara junction-Asutwara-Volivo Road (28.3km), Dufor Adidome-Asikuma junction (38.4km) & Asutwara Aveyime Road (24.0km) – Lot – 1, GHANA

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT (ESIA) REPORT (VOLUME 3)

MSV INTL INC., USA, KE&T & OWA GHANA

Table of Contents

CHAPTER 1	EXECUTIVE
SUMMARY	
...	
...	
...	
...	
...	
.....	
	1.1 PROJECT
BACKGROUND	
...	
...	
...	
...	
...	
...	
.....	
	1.2 PROJECT
OBJECTIVES	
...	
...	
...	
...	
...	
...	
.....	
	1.3 PROJECT DESCRIPTION AND
JUSTIFICATION	
...	
...	
...	
...	
.....	
	1.4 STUDY
METHODOLOGY	
...	
...	
...	
...	
...	
...	
.....	
	1.5 POLICY, LEGAL AND ADMINISTRATIVE
FRAMEWORK	

...
...
...

1.6 PROJECT

ALTERNATIVES

...
...
...
...
...
...

1.7 BASELINE ENVIRONMENTAL AND SOCIAL

FEATURES

...
...
...

1.8 POTENTIAL ENVIRONMENTAL AND SOCIAL

IMPACTS

...
...
...

1.9 MITIGATION/ENHANCEMENT MEASURES AND COMPLEMENTARY INITIATIVES

1.10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

1.11 ENVIRONMENTAL AND SOCIAL MONITORING PROGRAM

...

1.12 STAKEHOLDERS CONSULTATIONS AND DISCLOSURE

...
...

1.13 CONCLUSIONS

...
...
...
...
...
...

.....

2 INTRODUCTION

.....ERROR! BOOKMARK NOT DEFINED.

Bookmark not defined.

Error! Bookmark not defined.

Bookmark not defined.

Bookmark not defined.

Bookmark not defined.

Bookmark not defined.

Error! Bookmark not defined.

Error! Bookmark not defined.

Error! Bookmark not defined.

Error! Bookmark not defined.

Error! Bookmark not defined.

Error! Bookmark not defined.

Error! Bookmark not defined.

3.1	Requirements
-----	------------------	-----	-----	-----	-----	-----	-----	-----

3.2	Institutional Framework
-----	-------------------------	-----	-----	-----	-----	-----	-----

3.3	Overarching Implementation Framework	...	...	...	...
	Error! Bookmark not defined.				
3.3.1	Sub-Contractors Policy	...	...	...	...
	Error! Bookmark not defined.				
3.3.2	Contractors Certification and Commitment Framework	...	...	...	...
	Error! Bookmark not defined.				
3.4	RELEVANT POLICIES, LEGISLATION AND REGULATIONS				
	...				
	...				
	.....ERROR! BOOKMARK NOT DEFINED.				
3.5	Project Regulatory Compliance	...	...	...	...
	Error! Bookmark not defined.				
3.5.1	International Environmental Conventions	...	...	...	...
	Error! Bookmark not defined.				
3.5.2	Legislation Relevant to Biodiversity	...	...	...	...
	Error! Bookmark not defined.				
3.5.3	Conventions Related to Biodiversity Convention	...	...	...	...
	Error! Bookmark not defined.				
3.5.4	National regulatory Compliance Requirements	...	...	...	...
	Error! Bookmark not defined.				
3.6	Environmental and Social Oversight Capacities	...	...	...	...
	Error! Bookmark not defined.				
3.7	Environmental Screening, Determination and Conditions	...	...	...	...
	Error! Bookmark not defined.				
3.7.1	Ghana Environmental Protection Agency Environmental Guidelines				
	Error! Bookmark not defined.				
3.7.2	AfDB Policies, Guidelines and Safeguards	...	...	...	...
	Error! Bookmark not defined.				
Chapter 4	Description of the Project and Justification	...	...	...	Error!
	Bookmark not defined.				
4.1	Introduction	...	...	...	...
	Error! Bookmark not defined.				
4.2	Project Location	...	...	...	...
	Error! Bookmark not defined.				
4.3	Project Components	...	...	...	...
	Error! Bookmark not defined.				
4.4	PROJECT DESCRIPTION				
	...				
	...				
	...				
	...				
	...				

...	.....	ERROR! BOOKMARK NOT DEFINED.		
4.4.1	Field Study Findings of Proposed Alignments (Section 1&3)	...	...
	Error! Bookmark not defined.			
4.4.1.1	Hydrological and Drainage Conditions of Section 1&3	...		
	Error! Bookmark not defined.			
4.4.1.2	Traffic Studies of Sections 1&3 Catchment Zone	...	...
	Error! Bookmark not defined.			
4.4.1.3	Geotechnical Investigations Results for Section 1&3	...	...
	Error! Bookmark not defined.			
4.4.1.4	Bridge Site investigations for Sections 1&3	...	...	...
	Error! Bookmark not defined.			
4.4.2	.....	DETAILED ENGINEERING DESIGNS FOR SECTIONS		
1&3	...			
...	.....	ERROR! BOOKMARK NOT DEFINED.		
4.4.2.1	Geometric Design for Sections 1&3	...	...	...
	Error! Bookmark not defined.			
4.4.2.2	Pavement Design for Sections 1&3	...	...	...
	Error! Bookmark not defined.			
4.4.2.3	Drainage Design for Sections 1&3	...	...	...
	Error! Bookmark not defined.			
4.4.3	Changes to JICA Design by Client	...	...	...
	Error! Bookmark not defined.			
4.4.4	Additional Changes to Engineering Design by Client	...	...	...
	Error! Bookmark not defined.			
4.4.4.1	Revised Final Drainage Structures Design for Section 1&3	...		
	Error! Bookmark not defined.			
4.4.4.2	Final Pavement Structures Design for Sections 1&3	...	...
	Error! Bookmark not defined.			
4.4.4.3	Final Bridge Structure Designs	...	...	...
	Error! Bookmark not defined.			
4.4.4.4	Revised Final Cost Estimate for Sections 1&3	...	...
	Error! Bookmark not defined.			
4.4.5	Field Study Findings of Proposed Alignment Section2	...	...
	Error! Bookmark not defined.			
4.4.5.1	Hydrological/Drainage Structures Findings	...	...	...
	Error! Bookmark not defined.			
4.4.5.2	Traffic and Geotechnical Investigation Results for Section 2	...		
	Error! Bookmark not defined.			
4.4.5.3	Bridge Site Studies, Findings for Section 2	...	...	...
	Error! Bookmark not defined.			
4.4.5.4	Detailed Geometric Design for Section 2	...	...	...
	Error! Bookmark not defined.			
4.4.5.5	Final pavement Design for Section 2	...	...	...
	Error! Bookmark not defined.			

4.4.5.6	.....FINAL DRAINAGE DESIGN FOR						
SECTION							
2	...						
	...						
	...						
	.....ERROR! BOOKMARK NOT DEFINED.						
4.4.5.7	Final Bridges Design for Section 2	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.4.5.8	Final Cost Estimate for Section 2	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.5	Borrow Areas Materials Extraction Measures...	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.6	Logistics Requirements and Associated infrastructure	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.7	Construction Camp Security	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.8	Construction Water Requirements	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.9	Waste Management	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.10	Vegetation Clearance	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.11	Location of Animal Crossings	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.12	Project Activities Description	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.12.1	Pre-Construction Phase Activities	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.12.2	Construction Phase Activities	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.12.3	Post-Construction Phase Activities	...	...	...	...	...	...
	Error! Bookmark not defined.						
4.12.4	Project Justification	...	...	...	...	...	...
	Error! Bookmark not defined.						
	Chapter 5 Description of Project Environment	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.1	Introduction	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.2	Area of Influence	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.3	Location	...	...	...	...	...	...
	Error! Bookmark not defined.						

5.4	Physical Environment ...	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.4.1	.....								CLIM
ATE	...	...	...	...	...	...	...	...	...

	ERROR! BOOKMARK NOT DEFINED.								
5.4.2	Seismicity, Seismic Activities and Geo-Hazards	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.4.3	Topography	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.4.4	Geology and Soils	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.4.5	Hydrology and Water Resources	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.4.6	Air Quality, Dust and Odor	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.4.7	Noise Levels	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.5	Biological/Ecological Environment	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.5.1	Flora	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.5.2	Wildlife	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.5.3	Sacred Sites	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.6	Human Environment	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.6.1	Demography and Settlement Pattern...	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.6.2	Culture, Ethnicity and Religion	...	...	...	...	...	...	...	Error!
	Bookmark not defined.								
5.6.3	Economy and Employment	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.6.4	Agriculture	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								
5.6.5	Education Provision	...	...	...	...	...	...	...	...
	Error! Bookmark not defined.								

5.6.6	Health Care Delivery	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.6.7	Historical, Cultural and Heritage Resources	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.6.8	Water and Sanitation	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.6.9	Energy and Power Resources	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.6.10	Transportation	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.6.11	Vulnerable Group	...	...	...	...	...	...
	Error! Bookmark not defined.						
5.6.12	Gender Equity and Mainstreaming	...	...	...	...	...	...
	Error! Bookmark not defined.						
Chapter 6	Presentation of the Alternatives Considered	...	...	...	...	...	...
	Error! Bookmark not defined.						
6.1	Project Alternatives	...	...	...	...	...	...
	Error! Bookmark not defined.						
6.2	Conceptual Alternatives	...	...	...	...	...	...
	Error! Bookmark not defined.						
6.2.1	Strategies for Dev. of the Road Network in the Study Area	...	...	...	...	...	Error! Bookmark not defined.
6.2.2	DESIGN STANDARDS APPLIED FOR THE STUDY ROADS AND BRIDGES	...	...	...	...	...	Error! Bookmark not defined.
6.2.3	Road Alignment Study	...	...	...	...	...	Error! Bookmark not defined.
6.2.3.1	Basic Concept of the Preliminary Design	...	...	...	...	...	Error! Bookmark not defined.
6.2.4	Road Alignment Study between Asutwae Jct and Volta River	...	...	...	...	...	Error! Bookmark not defined.
6.2.5	Study of Asutwae Bridge Location over the Volta River	...	...	...	...	...	Error! Bookmark not defined.
6.2.6	Road Alignment Study Volta River and Asikuma Jct	...	...	...	...	...	Error! Bookmark not defined.
6.2.7	Further Studies for Selected Alternatives	...	...	...	...	...	Error! Bookmark not defined.
6.2.8	Bridge and Drainage Structure Study	...	...	...	...	...	Error! Bookmark not defined.
6.3	STUDY OF BRIDGE ACROSS THE VOLTA RIVER	...	...	...	...	...	...

	...	.....	Error! Bookmark Not Defined.
6.3.1 Study of Bridge Location	...	...	... Error! Bookmark not defined.
6.3.2 First Screening of Bridge Locations	...	...	... Error! Bookmark not defined.
6.3.3 Study of Bridge Type for Selected Bridge Location	...	...	... Error! Bookmark not defined.
6.3.4 Preliminary Study of the Bridge Across Volta River	...	...	... Error! Bookmark not defined.
6.3.5 Road Alignment Study Between Asutuare and Aveyime	...	...	... Error! Bookmark not defined.
Chapter 7 Results of the Comparision of Alternatives	...	...	... Error! Bookmark not defined.
7.1 INTRODUCTION			
...			
...			
...			
...			
...			
...			
...			
.....			Error! Bookmark Not Defined.
7.2 No-Development Option	...	...	... Error! Bookmark not defined.
7.3 Development Options Considered and Dismissed	...	...	... Error! Bookmark not defined.
7.4 Selected Development Option	...	...	... Error! Bookmark not defined.
Chapter 8 Potential Environmental and Social Impacts	...	...	... Error! Bookmark not defined.
8.1 IMPACT ANALYSIS			
...			
...			
...			
...			
...			
...			
.....			Error! Bookmark Not Defined.
8.2 Direct Negative Impacts	...	...	... Error! Bookmark not defined.
8.2.1 Roads Project Site Preparation Phase Impacts	...	...	... Error! Bookmark not defined.
8.2.1.1 Impact of Survey Works	...	...	... Error! Bookmark not defined.

8.2.1.2	Impact of Work Camps/Site Offices Creation ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.1.3	Impact of Materials Mobilization ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.1.4	Impact on Flora ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.1.5	Impact of Demolition of Structures ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.1.6	Impact on Human Health and Safety ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.1.7	Impact on Air Quality ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2	Roads Project Construction Work Phase Impacts ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.1	Impact on Air Quality ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.2	Impact on Soundscape and Vibration Effects...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.3	Impact of Borrow Pits Generation ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.4	Impact of Soil Erosion and Sedimentation ...	...	...	...	...	...
8.2.2.5	Impact of Waste Generation and Disposal ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.6	Impact on Water Quality and Supplies ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.7	Impact of Concrete Batch plant Waste ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.8	Impact of Construction Camps/Site Offices ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.9	Impact on Biodiversity Loss (Fauna and Flora) ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.10	Impact of Traffic and Transportation ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.11	Impact on Human Health and Safety ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.12	Impact on Visual Quality and Amenities ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.13	Impact on History, Archaeology and Heritage Resources ...	...	...	...	...	...	Error!
	Bookmark not defined.						
8.2.2.14	Impact of Pedestrian-Vehicular Conflicts ...	...	...	...	...	...	Error!
	Bookmark not defined.						

8.2.2.15	Impact on Public Utilities and Services	Error!
----------	---	-----	-----	---------------

Bookmark not defined.

8.2.2.16	Impact on Loss of Assets and Compensation Payment			Error!
----------	---	--	--	---------------

Bookmark not defined.

8.2.2.17.....IMPACT OF INFLUX POPULATION SURGE

...

...

...

.....ERROR! BOOKMARK NOT DEFINED.

8.2.2.18	Impact of GHG Emissions	Error!
----------	-------------------------	-----	-----	-----	-----	---------------

Bookmark not defined.

8.2.2.19	Impact of Quarry and Bituminous Hot-Mix Plants	...		Error!
----------	--	-----	--	---------------

Bookmark not defined.

8.2.2.20	Impact of New Volta River Suspension Bridge	...		Error!
----------	---	-----	--	---------------

Bookmark not defined.

8.3	Roads Project Operation Phase	Error!
-----	-------------------------------	-----	-----	-----	---------------

Bookmark not defined.

8.3.1 IMPACT ON AIR

QUALITY

...

...

...

...

...

.....ERROR! BOOKMARK NOT DEFINED.

8.3.2	Impact on Soundscape and Vibration Effects	Error! Bookmark not defined.
-------	--	-----	-----	-------------------------------------

8.3.3	Impact of Borrow Pits Generation	Error! Bookmark not defined.
-------	----------------------------------	-----	-----	-------------------------------------

8.3.4	Impact of Soil Erosion and Sedimentation	Error! Bookmark not defined.
-------	--	-----	-----	-------------------------------------

8.3.5	Impact of Waste Generation and Disposal	Error! Bookmark not defined.
-------	---	-----	-----	-------------------------------------

8.3.6	Impact on Water Quality and Supplies	Error! Bookmark not defined.
-------	--------------------------------------	-----	-----	-------------------------------------

8.3.7	Impact of Concrete Batch plant Waste	Error! Bookmark not defined.
-------	--------------------------------------	-----	-----	-------------------------------------

8.3.8	Impact of Camps/Site Offices Creation	Error! Bookmark not defined.
-------	---------------------------------------	-----	-----	-------------------------------------

8.3.9	Impact on Biodiversity Loss (Fauna and Flora)	Error! Bookmark not defined.
-------	---	-----	-----	-------------------------------------

8.3.10	Imoact of Traffic and Transportation	Error! Bookmark not defined.
--------	--------------------------------------	-----	-----	-------------------------------------

8.3.11	Impact on Human Health and Safety	Error! Bookmark not defined.
--------	-----------------------------------	-----	-----	-------------------------------------

8.3.12 Impact on Visual Quality and Amenities **Error!**

Bookmark not defined.

[8.3.13 Impact on History, Archaeology and Heritage Resources](#) ... **Error!**

Bookmark not defined.

8.3.14 Impact of Pedestrian-Vehicular Conflicts **Error!**

Bookmark not defined.

8.3.15 Impact on Public Utilities and Services **Error!**

Bookmark not defined.

8.3.16 Impact on Loss of Assets and Compensation Payment ... **Error!**

Bookmark not defined.

8.3.17 Impact of Influx Population Surge **Error!**

Bookmark not defined.

8.3.18 Impact of GHG Emissions **Error!**

Bookmark not defined.

8.3.19 Impact of Quarry and Bituminous Hot-Mix Plants **Error!**

Bookmark not defined.

8.3.20 IMPACT OF NEW VOLTA RIVER SUSPENSION

BRIDGE

...
.....**Error! Bookmark not defined.**

8.4 Climate Change Impacts **Error! Bookmark not defined.**

8.5 Positive Direct and Indirect Impacts **Error! Bookmark not defined.**

8.5.1 RURAL-URBAN INCOME LEVEL

ENHANCEMENT

...
...
.....**Error! Bookmark not defined.**

8.5.2 Gender Issues **Error! Bookmark not defined.**

8.5.3 TRAFFIC SAFETY, ACCIDENT AND

COMFORT

...
...
...
.....**Error! Bookmark not defined.**

8.5.4 Traffic Congestion Dissipation **Error! Bookmark not defined.**

8.5.5 Vehicle Operation and Transportation Costs **Error! Bookmark not defined.**

8.6 Cumulative Impacts and Strategic Considerations **Error! Bookmark not defined.**

Chapter 9 Mitigation/Enhancement Measures and Complementary Initiatives **Error! Bookmark not defined.**

9.1 Overview	Error! Bookmark not defined.
--------------	-----	-----	-----	-----	-----	-----	-----	-------------------------------------

9.2 ROADS PROJECT PRE-CONSTRUCTION PHASE MITIGATION MEASURES

...
9.2.1 Impact of Work Camps/Site Offices	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.2.2 Impact on Flora	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.2.3 Impact of Demolition of Structures	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.3 Roads Project Construction Phase Mitigation Measures	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.3.1 Impact on Air Quality	...	...	...	...	...	...	...	Error! Bookmark not defined.

9.3.2 IMPACT OF SOUNDSCAPE AND VIBRATION

EFFECTS

...
9.3.3 Impact on Borrow Pits Generation	...	...	...	...	...	...	...	Error! Bookmark not defined.

9.3.4 IMPACT OF SOIL EROSION AND

SEDIMENTATION

...
9.3.5 Impact of Waste Generation and Disposal	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.3.6 Impact on Water Quality and Supplies	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.3.7 Impact of Concrete Batch Plant Waste	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.3.8 Impact of Construction Camps/Site Offices	...	...	...	...	...	...	...	Error! Bookmark not defined.
9.3.9 Impact on Biodiversity Loss (Fauna and Flora)	...	...	...	...	...	...	...	Error! Bookmark not defined.

9.3.10 IMPACT OF TRAFFIC AND

TRANSPORTATION

...
9.3.11 Impact on Human Health and Safety	...	...	...	...	...	...	...	Error! Bookmark not defined.

9.3.12	Impact on Visual Quality and Amenities	...	...	...	Error!
Bookmark not defined.					
9.3.13	Impact on History, Archaeology and Heritage Resources	...			Error!
Bookmark not defined.					
9.3.14	Impact Pedestrian-Vehicular Conflicts	...	...	...	Error!
Bookmark not defined.					
9.3.15	Impact on public Utilities and Service	...	...	...	Error!
Bookmark not defined.					
9.3.16	Impact on Hydrology and Drainage System	...	...	...	Error!
Bookmark not defined.					

9.3.17 IMPACT ON PROJECT COMMUNITIES

ACCESS

...	
...	
.....	ERROR! BOOKMARK NOT DEFINED.

9.3.18 IMPACT ON LOSS OF ASSESTS AND COMPENSATION

PAYMENT

.....	ERROR! BOOKMARK NOT DEFINED.
-------	------------------------------

9.3.19 IMPACT OF INFLUX POPULATION

SURGE

...	
...	
...	
.....	ERROR! BOOKMARK NOT DEFINED.

9.3.20 IMPACT OF GHG

EMISSIONS

...	
...	
...	
...	
.....	ERROR! BOOKMARK NOT DEFINED.

9.4 ROADS PROJECT OPERATION PHASE MITIGATION

MEASURES

...

.....ERROR! BOOKMARK NOT DEFINED.

9.4.1	Impact on Air Quality	...	...	...	...	...
9.4.2	Impact on Soundscape and Vibration Effects			...	...	...
9.4.3	Impact on Borrow pits Generation		...	...	...	...
9.4.4	Impact of Soil Erosion and Sedimentation			...	...	...
9.4.5	Impact of Waste Generation and Disposal			...	...	...
9.4.6	Impact on Water Quality and Supplies	...		...	...	...
9.4.7	Impact of Concrete Batch Plant Waste	...		...	...	...
9.4.8	Impact of Camps/Site Offices	...	...	...	...	...
9.4.9	Impact on Biodiversity Loss (Fauna and Flora)			...	...	...

9.4.10	Impact of Traffic and Transportation	...	...	...	...	...	...
9.4.11	Impact on Human Health and Safety	...	...	...	...	...	...
9.4.12	Impact on Visual Quality and Amenities	...	...	...	...	...	...
9.4.13	Impact on History, Archaeology and Heritage Resources	...	...	...	...	...	...
9.4.14	Impact of Pedestrian-Vehicular Conflicts...	...	...	...	...	...	...
9.4.15	Impact on Public utilities and Services	...	...	...	...	...	...
9.4.16	Impact on Hydrology and Drainage Systems	...	...	...	...	...	...
9.4.17	Impact on Project Communities Access	...	...	...	...	...	...
9.4.18	Impact on Loss of Assets and Compensation Payment	...	...	...	...	...	...
9.4.19	Impact of Influx Population Surge	...	...	...	...	...	...
9.4.20	Impact of GHG Emissions	...	...	...	...	...	...
9.4.21	Climate Change	...	...	...	...	...	...
9.5	Complementary Initiatives	...	...	...	...	...	...
9.6	New Suspension Bridge Project Over Volta River	...	...	...	...	...	...
Chapter 10	Expected Residual Effects and Environmental Hazard Management						
10.1	Introduction	...	...	...	...	...	...
10.2	Construction Phase Risk	...	...	...	...	...	...
10.2.1	Location of Fueling Operations	...	...	...	...	...	...
10.2.2	Location of Wheel washing Facilities	...	...	...	...	...	...
10.2.3	Location of Sand and Aggregate Storage Provisions	...	...	...	...	...	...
10.2.4	Air Quality	...	...	...	...	...	...
10.2.5	Water Quality	...	...	...	...	...	...
10.2.6	Noise and Vibration Effects	...	...	...	...	...	...
10.2.7	Location of Liquid and Toxic Material Storage	...	...	...	...	...	...
10.2.8	Waste or Spoil Storage and Disposal	...	...	...	...	...	...
10.2.9	Operation of Excavators, Trucks and Dumpers	...	...	...	...	...	...
10.2.10	Gas and Electrical Welding Operations	...	...	...	...	...	...
10.2.11	Unpredictable Escalation of Construction Cost	...	...	...	...	...	...
10.2.12	Emergency Response Plan (ERP)	...	...	...	...	...	...
10.3	Operation Phase Risk	...	...	...	...	...	...
10.3.1	Air Pollution	...	...	...	...	...	...
10.3.2	Noise Pollution	...	...	...	...	...	...
10.3.3	Drainage Channels Siltation	...	...	...	...	...	...
10.3.4	Fire Hazards	...	...	...	...	...	...
10.4	Decommissioning Phase Risk	...	...	...	...	...	...
Chapter 11	Environmental and Social Monitoring Program	...	...	...	...	...	...

11.1	Overview	...	...	...	...	...	...	...
11.2	Monitoring of Various Components	...	...	...	...	...	...	...
11.3	Sites Monitoring Roles and Responsibilities	...	...	...	...	...	...	...
Chapter 12	Public Consultation and Community Participation	...	...	...	...	...	...	...
12.1	Introduction	...	...	...	...	...	...	...
12.2	Summary of Stakeholder Community Needs Assessment ...	...	...	...	...	...	...	...
12.3	Stakeholder Community ESIA/RAP Reports Awareness Education	...	...	...	...	...	...	...
Chapter 13	Environmental and Social Management Plan (ESMP)	...	...	...	...	...	...	...
13.1	Introduction	...	...	...	...	...	...	...
13.2	Implementation of ESMP	...	...	...	...	...	...	...
13.3	Construction Specific ESMP	...	...	...	...	...	...	...
13.4	Institutional Arrangement for Monitoring	...	...	...	...	...	...	...
13.5	Capacity Development	...	...	...	...	...	...	...
13.6	Estimated Cost of ESMP ...	...	...	...	...	...	...	...
Chapter 14	Institutional Capacities and Strengthening Plan	...	...	...	...	...	...	...
14.1	Introduction	...	...	...	...	...	...	...
14.2	Program-Wide Strategies in the Construction Phase	...	...	...	...	...	...	...
14.3	Guidelines for Environmental and Social Monitoring	...	...	...	...	...	...	...
14.4	Institutional Strengthening	...	...	...	...	...	...	...
14.4.1	Capacity development	...	...	...	...	...	...	...
14.4.2	Training of GHA Staff	...	...	...	...	...	...	...
14.5	Operational Environmental and Social Management	...	...	...	...	...	...	...
Chapter 15	Conclusions	...	...	...	...	...	...	...
15.1	Overview	...	...	...	...	...	...	...
15.2	Lessons from Similar Projects	...	...	...	...	...	...	...
15.3	Operationalization of ESMP	...	...	...	...	...	...	...
15.4	Beneficial and Non-Beneficial Environmental/Social	...	...	...	...	...	...	...
Chapter 16	Recommendations	...	...	...	...	...	...	...
16.1	Overview	...	...	...	...	...	...	...
References	...	...	...	...	...	...	...	...
Appendix A								
Appendix B								
Appendix C								
Appendix D								

List of Tables

Table 1	International Agreements Relevant to Project	...	...	...
Table 2	National Policies Plans and Programs	...	...	...
Table 3	Summary of OS Objectives and Triggers	...	...	...
Table 4	Category definition for AfDB Project	...	...	...
Table 5	Project Components	...	...	...
Table 6	Hydrological/Drainage Findings for Sections 1&3 Roads	...	...	...
Table 7	Traffic Studies and Results for Section 1&3 Roads	...	...	...
Table 8	Construction Materials Survey and Findings	...	...	...
Table 9	Geometric Design for Sections 1&3 Roads	...	...	...
Table 10	Drainage Design for Sections 1&3 Roads	...	...	...
Table 11	Revised Final Drainage Structures Design for Sections 1&3	...	...	...
Table 12	Final Cost Estimate for Sections 1&3 Roads	...	...	...
Table 13	Hydrological/Drainage Structures Field Findings for 1&3	...	...	...
Table 14	detailed Geometric Design for Sections 1&3	...	...	...
Table 15	Construction Machinery and Equipment Schedule	...	...	...
Table 16	Baseline Information on GHG in Ghana	...	...	...
Table 17	Ghana-Sector Specific Effluent Quality Standards	...	...	...
Table 18	Comparison of Ambient Air Quality Standards	...	...	...
Table 19	Ghana's EPA's Ambient Noise Level Guidelines	...	...	...
Table 20	Crops Grown and Major production Areas	...	...	...
Table 21	Areas Planted to Selected Crops	...	...	...
Table 22	Crops Production	...	...	...
Table 23	Average Farm Size of Various Crops	...	...	...
Table 24	Livestock/Poultry Population (2001-2013)	...	...	...
Table 25	Cultivation of Non-Traditional Crops	...	...	...
Table 26	Water and Sanitation Facilities	...	...	...
Table 27	Energy Use in the Asuogyaman District	...	...	...
Table 28	Design Speed for National Road	...	...	...
Table 29	Comparison of Possible Alternative Routes	...	...	...
Table 30	Major Comments from GHA	...	...	...
Table 31	Comparison of Possible Alternative Routes	...	...	...
Table 32	Summary of Alternatives for Further Study	...	...	...
Table 33	Soil Conditions between Asikuma Jct and Asikuma Jct	...	...	...
Table 34	Comparison of Superstructure Types and Standard	...	...	...

Table 35	Comparison of Sub-structure Type and Applicable Height	...	...	...
Table 36	Proposed Structure Types and Bridge Length	...	...	...
Table 37	Design Seismic and Resistance and Required Performance	...	...	...
Table 38	Past Earthquakes and level 1 maximum Response	...	...	...
Table 39	Expected Level II Earthquake	...	...	...
Table 40	Comparison of Superstructure Types and Standard Span	...	...	...
Table 41	Definition of Potential impact Types	...	...	...
Table 42	Determination of Receptor Sensitivity	...	...	...
Table 43	Determination on Impact Severity	...	...	...
Table 44	Determination of Significance	...	...	...
Table 45	Significance Rating Matrix Positive and Negative	...	...	...
Table 46	Summary of Interim Value for Compensation for Section 1			
Table 47	Summary of Interim Value for Compensation for Section 3			
Table 48	Summary of Interim Value for Compensation for Section 2			
Table 49	Summary of Interim Value for Comp. for Sections 1,3&2			
Table 50	Examples of Cumulative Effects	...	...	...
Table 51	IFC Noise level Guidelines	...	...	...
Table 52	Typical Noise Levels	...	...	...
Table 53	Potential Env. & Social Impacts	...	...	...
Table 54	Env. & Social Monitoring Program	...	...	...
Table 55	Organization and Staffing Structure	...	...	...
Table 56	Summary of Stakeholder Community Needs Assessment	...	...	...
Table 57	Summary of Stakeholder Community ESIA/RAP Reports	...	...	...
Table 58	Institutional monitoring Arrangements	...	...	...
Table 59	Capacity development Training Plan	...	...	...
Table 60	Estimated ESMP Budget	...	...	...

List of Figures

Fig	1	Alternative Routes Provided by JICA	...	...	...	...
Fig	2	Map Showing Selected Alignment	...	...	...	...
Fig	3	Ghana Map Showing Connectivity with Project Roads	...	...	...	...
Fig	4	Classified Manual Counts and Origin-Destination	...	...	...	...
Fig	5	Sample Road Plan and Profile for Sections 1&3 Roads	...	...	...	...
Fig	6	Typical Cross-Section of Sections 1&3 Roads	...	...	...	...
Fig	7	Typical Cross-Section of Sections 1&3 Roads	...	...	...	...
Fig	8	Layout of Asutuare Jct Interchange CH 1+245	...	...	...	...
Fig	9	Bridge at CH 1+245 (Asutuare Interchange on Section 1)	...	...	...	...
Fig	10	Layout of Volivo Interchange at CH 29+350 on Section 1	...	...	...	...
Fig	11	Bridge on Volivo Interchange at CH 29+350 on Section 1	...	...	...	...
Fig	12	Layout of Dufor Adidome Interchange CH 29+350 on Section 3	...	...	...	...
Fig	13	Bridge on Dufor Adidome Interchange CH 29+350 on Section 3	...	...	...	...
Fig	14	Bridge on Dufor Adidome Interchange CH 29+350 on Section 3	...	...	...	...
Fig	15	Layout of Asikuma Jct Interchange CH 67+200 on Section 3	...	...	...	...
Fig	16	Bridge on Asikuma Jct Interchange CH 67+200 on Section 3	...	...	...	...
Fig	17	Final Alignments for Sections 1 and 3 Roads	...	...	...	...
Fig	18	Final Alignment for Section 1 Road	...	...	...	...
Fig	19	Final Alignment for Section 3 Road	...	...	...	...
Fig	20	Asutuare-Aveyime Road (Section 2 Road)	...	...	...	...
Fig	21	Sample Plan and Profile of Asutuare-Aveyime Road (Section 2)	...	...	...	...
Fig	22	Typical Cross-Section of Asutuare_Aveyime Road	...	...	...	...
Fig	23	Earthquake Risks Zones in Southern Ghana	...	...	...	...
Fig	24	Asuogyman District Map	...	...	...	...
Fig	25	Present Road Hierarchy in the Study Area	...	...	...	...
Fig	26	Proposed Road Network Configuration	...	...	...	...
Fig	27	Typical Cross-Section of Roads	...	...	...	...
Fig	28	Typical Cross-Section of Bridges	...	...	...	...
Fig	29	Typical Cross-Section for Ordinary Section 2	...	...	...	...
Fig	30	Typical Cross-Section in Township Area Section2	...	...	...	...
Fig	31	Possible Alternative Routes between Asutuare Jct -Volta River	...	...	...	...
Fig	32	Possible Alternative Bridge Locations...	...	...	...	...
Fig	33	Possible Alternative Routes Between Volta River and Asikuma Jct	...	...	...	...
Fig	34	Concept of Intersection at Juapong, Frankadua and Asikuma	...	...	...	...
Fig	35	Alternative Alignment near Asutuare	...	...	...	...
Fig	36	FAO Soil Classification Map of Study Area	...	...	...	...

Fig	37	Relation of Liquid Limit and Free Swell Potential for Soils	...	...
Fig	38	Alternative Possible Bridge Locations...	...	...
Fig	39	Locations of Selected Alternative Bridges	...	...
Fig	40	Expected Level II Earthquake and Active Fault	...	...
Fig	41	Location of Asutuare and Aveyime Road (Section2)	...	...

Chapter 1 Executive Summary

1.1 Project Background

The Eastern Corridor International Transit Route (N2 Project) aims at supporting socio-economic growth in Ghana and foster regional integration through reliable, efficient and seamless transport infrastructure that increases sub-regional trade and the global competitiveness of the Ghana, Burkina Faso, Niger and Mali transportation regional corridor. The proposed project roads are sections of the Eastern Corridor International Transit Route. The denoted sections, **Section 1 {Asutuare Junction – Volivo Road (28.3km)}**, **Section 3 {Dufor Adidome – Asikuma Junction Road (38.4km)}** and **Section 2 {Asutuare – Aveyime Road (24.0km)}** and the traverse locations are indicated in Chapter 2 (Introduction).

The expected outcomes of the Project include (i) reduced transport costs and improved accessibility of communities to social services and market and (ii) improved safety. The development of the N2 Project corridor will enable increased volume of the Ghana, Burkina Faso, Niger and Mali inter-regional trade and will expand market sizes beyond national boundaries. The Project will also contribute to poverty reduction in Ghana by improving accessibility of communities to markets and social services. The Project includes design measures and awareness campaigns that will result in improved road safety.

The Project was classified as a Category 1, given the type of works to be undertaken and the potential direct and indirect impacts it could generate especially on sensitive ecosystems. In conformity with the environmental and social policy requirements of the AfDB and Ghana EPA, an environmental and social impact assessment (ESIA), of which this section is an executive summary, was requested to: (i) identify the potential risks on the physical, biological/ecological, socio-economic and socio-cultural environment, and (ii) propose measures to mitigate or offset any adverse impacts of the project on the environment.

1.2 Project Objectives

The project objectives are the following: (i) to identify issues and evaluate at the impact assessment stage (ii) to identify potential impacts of the proposed project on physical, biological/ecological and socio-economic/socio-cultural environment of the project zone, to predict and evaluate these impacts and determine significance of these impacts with respect to technical and regulatory concerns (iii) to propose appropriate mitigation/enhancement measures that should be incorporated in the design of the project to minimize and/or eliminate the adverse impacts (iv) to assess the compliance status of the proposed activities

with respect to the Environmental and Social Regulation or Legislation of Ghana, Metropolitan/District Assembly By-Laws, African Development Bank (AfDB) Operational Safeguards and Categorization Definitions (v) to develop an Environmental and Social Management Plan (ESMP) to provide an implementation mechanism for the environmental as well as social mitigation measures identified in the study (vi) to detect adverse effects in time for correction through Monitory Program (vii) to identify alternatives to be evaluated at impact assessment stage with the main purpose of focusing the environmental and social assessment on reasonable and feasible alternatives examination (viii) to conduct comprehensive stakeholder consultations as part of public participation process (ix) to develop institutional capacities and strengthening plan.

1.3 Project Description and Justification

The three (3) sections of the Eastern Corridor International Transit Route form the main components of the Project. However, there are other sub-project within the overall context of Eastern Corridor Proposal, consisting of the following components: (i) road construction civil works (ii) road safety (iii) HIV/AIDS/STI/TB/Malaria/Ebola/Cholera mitigation (iv) ESMP implementation (v) gender component (vi) compensation and resettlement of PAPs (vii) consulting services (viii) institutional support and capacity development component.

The volume of international cargo meant for Ghana's neighboring landlocked countries has been increasing in recent times. There are challenges which the nation is facing currently to facilitating transit of vehicles from the neighboring countries such as: (i) chronic congestion in and around Accra, the capital city, and Kumasi, the second largest city and (ii) deficiency in fast and efficient movement of cargo to the neighboring landlocked countries leading to an alternative route identification and development to facilitate transit and trade. An alternative international transit route to Burkina Faso is the Eastern Corridor (N2). The Eastern Corridor which lies to the east of the country, and approximately 695 km in length commences from Tema Roundabout through some important towns in the Greater Accra, Volta, Northern Regions and ends at Kulungugu in the Upper East Region of the country. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages during the rainy season making travel difficult.

1.4 Study Methodology

The project involves engineering feasibility, environmental, social and economic viability studies for the development of the proposed roads project. Baseline information on the project area of influence was collected through field studies, field surveys and consultations with relevant stakeholders. Information collected included population of major settlements, climate, air quality and noise levels, topography and relief, geology and soils, hydrology and drainage systems, flora and fauna, land use patterns, socio-economic and socio-cultural activities, gender issues, existing road conditions, sensitive developments, protected sites, heritage, archaeological and cultural resources.

1.5 Policy, Legal and Administrative Framework

The relevant policy, legal and administrative framework within which the ESIA study was undertaken are reviewed as follows: (i) Ghana ESIA procedures (ii) Environmental Protection Agency (EPA), Act 199 (iii) Environmental Assessment Regulations 1999 (LI 1652) (iv) Environmental Assessment (Amendment) Regulations 2002 (LI 1703) (v) National Building Regulations, 1996 (LI 1630) (vi) Planning Permission – Local Construction Act, 1993 (Act 462) (vii) Energy Commission Act (1997) Act 54 (viii) Factories, Offices and Shops Act (1970) Act 328 (ix) Forestry Commission Act (1999) Act 571 (x) Wild Animals Preservation Act (1961) Act 43 (xi) National Museums Decree (1969) NLCD 387 (xii) Water Resources Commission Act (1996) Act 552 (xiii) Fire Protection Act (1994) and Fire Protection Regulations 2004 (LI 724) (xiv) Ghana Water Company Limited Act (1993) (xv) State Lands Act, 1962 (Act 125) (xvi) State Lands Regulations, 1962 (LI 230) (xvii) National Development Planning Act, 1994 Act 479 (xviii) Local Government Act 1993, Act 462 (xix) Road Reservation Management Manual for Coordination, 2001 (xx) Environmental and Social Management Framework (ESMF) for the Road Sector, 2010 (xxi) Resettlement Action Framework for the Road Sector, 2010

The EPA Act mandates the Agency to ensure compliance with the EA Regulations which makes it an offence to commence development projects without prior ESIA and Environmental Permit. Development control functions are primarily carried out under the Local Government Act 1993, Act 462, Town and Country Planning Law Cap 84 of 1945 and the building Regulations 1996, LI 1630. In case of a chance find of any archaeological artifact during the roads project implementation, the National Museums Decree, 1969 (NLCD 387) will apply.

The construction of the project roads raises issues of acquisition of way-leaves (RoW). The determination of the route and acquisition of the RoW of the project will be done within the Lands (Way Leaves) Act. The Roads Reservation Management Manual for Coordination is a comprehensive document developed among the various utility service providers and the relevant statutory and regulatory agencies, for the efficient management of road reservations for the installation of public utility services. Specifically, the manual outlines procedures for the handling of disruptions of utilities.

The ESMP provides a corporate environmental and social safeguard policy framework, institutional arrangements and capacity available to identify and mitigate potential safeguard issues and impacts of the roads project. The ESMP also represents a statement of policy, guiding principles and procedures of reference, agreeable to all key stakeholders such as Ghana EPA, MoT, GHA and other implementing agencies.

The Environmental and Social Policy of AfDB sets out the broad strategic and policy framework under which all Bank Group lending and non-lending operations will be made to promote environmentally and socially sustainable development in Africa. Its overall goals include helping preserve and enhance the ecological capital and life-support systems across the continent. The Bank's policy on disclosure requires that all the people residing in the given areas of a project have the right to be informed of the proposed development project. The Bank Group involuntary resettlement policy is intended to address the involuntary displacement of people caused by Bank funded operations in public and private sectors.

1.6 Project Alternatives

These analyses have been captured with regards to these factors: (i) **conceptual alternatives** (strategies for development of the roads networks in the study areas; design standards applied for the study roads and bridges; roads alignment study; roads alignment study between Asutuare Junction and the Volta River; study of alternative bridge location over the Volta River; road alignment study between the Volta River and Asikuma Junction; further studies for selected alternatives; bridge and drainage structure study; study of bridge across Volta River; road alignment study between Asutuare and Aveyime) (ii) **no-development option** (meaning that the proposals should not be constructed; no analysis of alternatives in environmental and social investigations) (iii) **development options considered and dismissed** (proposed alternative routes and bridge locations) (iv) **selected development options** (sustainable optimization of goods and passengers traffic with regards to cost/benefit compromise of all the options proposed).

1.7 Baseline Environmental and Social Features

The description of existing project zone environmental and social features cover the following components: (i) **physical aspects** (climate, seismicity, topography, geology and soils, hydrology and drainage systems, air quality and noise levels) (ii) **biological/ecological aspects** (flora and fauna species, protected areas and animal migration routes) (iii) **socio-economic, socio-cultural aspects** (demography and settlement patterns, culture, ethnicity and religion, economy and employment, agriculture, education provision, health care delivery, historical, cultural and heritage resources, transportation, vulnerable group, gender equity and main streaming)

1.8 Potential Environmental and Social Impacts

Positive Direct and Indirect Impacts: The potential positive impacts are induced characteristics of socio-economic and cultural nature. The potential key expected positive impacts of the proposals are: (i) the contribution to improvement of trade among project influence populations (ii) improved transport conditions of goods and populations in the relevant project roads sections (iii) the internal opening up and improved access to basic socio-economic infrastructure for the populations within the project roads enclave (iv) the creation of direct and indirect jobs and employment during the construction, operation and maintenance phases of the project roads implementation program (v) development of tourism potential (vi) improved and enhanced living conditions and social facilities for vulnerable populations served by the project roads (vii) rural-urban income level enhancements (viii) gender component enhancement (ix) vehicle operation and transportation cost reduction and (x) traffic congestion dissipation.

Pre-Construction, Construction and Operation Phases Negative Impacts:

This section highlights the following: impact analysis; potential negative impacts for the roads project consideration under **pre-construction phase** (survey works; work camp and site offices; removal of trees; demolition of structures, air quality, human health and safety); **construction and operation phases** (air quality; soundscape and vibration; borrow pits generation; soil erosion and sedimentation; waste generation and removal; water quality and

supplies; concrete batch plant waste; construction camps and site offices; biodiversity; traffic and transportation; human health and safety; visual quality and amenities; history, archaeology, heritage resources; pedestrian-vehicular conflicts; public utilities and services; hydrology and drainage systems; project communities access; loss of assets and compensation payment; influx population surge; greenhouse gas (GHG) emissions). Climate change and complimentary initiatives, including gender issues have been discussed in detail under the **operation phase**.

1.9 Mitigation/Enhancement Measures and Complimentary Initiatives

Mitigation for Air Quality: (i) construction vehicles maintenance (ii) watering of exposed surfaces (iii) cover vehicles carrying spoil (iv) install and maintain equipment mufflers.

Mitigation for Soundscape and Vibration: (i) installation of no horn signs postings at very sensitive receptor zones within the projects catchment areas (ii) trees and shrubs planting within the projects enclave to serve as noise control barriers (iii) comply with relevant legislations associated with noise and vibrations including any health impacts (iv) conduct surveys for noise nuisance and vibration compliance with Ghana EPA permissible levels within sensitive receptors corridor.

Mitigation for Borrow Pits Generation (i) all stagnant pools and ponds will be filled up with spoils using spoils from cuts, re-alignments and vegetation removal operations (ii) backfilling of all excavations will be undertaken (iv) stocked up topsoil will be utilized to re-contour the borrow areas.

Mitigation for Soil Erosion and Sedimentation: (i) use vegetation cover on exposed surfaces around the project's sites (ii) use improved drainage and storm-water structures to minimize runoff during precipitation events (iii) direct turnouts from drains into approved water systems by use of silt traps (iv) educate the project populations to continuously de-silt drains and other drainage structures from choking.

Mitigation for Waste Generation and Disposal: (i) develop an Anti-Litter Program Projects wide (ii) treated leachate and other liquid effluents from the projects enclave will meet sound Best Industrial Practice Guidelines requirements (ii) develop a Waste Disposal Policy for the projects sites and ongoing monitoring of compliance (iii) the policy will detail the schedule collection, minimize waste handling, and maximize waste containment, control odors and loss of waste, include recovery facilities and proper maintenance of collection vehicles to ensure safe collection and transportation of waste (iv) chemicals and oils to be delivered in bulk where possible to reduce the number of containers requiring disposal.

Mitigation for Water Quality and Supplies: (i) potable water supply needs for drinking by construction crew and GHA supporting staff will be provided by the contractor(s) (ii) quality of drinking water will be tested to ensure International Standards compliance such as Ghana EPA/ WHO and other regulatory compliance requirements.

Mitigation for Concrete Batch Plant Waste: (i) remove all damaged top soil from the concrete batch plant sites and dispose of according Ghana EPA regulations and district/metropolitan Bye-Laws (ii) re-contour sites to its original states and landscape where applicable (iii)

implement Concrete Waste Management and Contaminated Soil Management Plans where applicable.

Mitigation for Construction Camps and Site Offices Creation (i) complete dismantling and removal of construction camps/offices through decommissioning activities (ii) dismantled or removed construction camps/office recyclable materials will be recycled for reuse to deviate or direct waste materials disposal at landfill sites (iii) no waste, toxic materials or deteriorating structures remaining at camp sites after construction and operation phases.

Mitigation for Loss of Fauna and Flora: (i) re-vegetated areas monitored and maintained until there is evidence of stable cover by self-sustaining vegetation community growth (ii) Weed Management Plan implementation and no new weeds or increase in weed cover during monitoring period (iii) ensure stable landform without significant soil erosion (iv) develop and implement Re-vegetation Plans.

Mitigation for Traffic and Transportation: (i) construct and monitor projects roads to a safe and stable flow standard (ii) minimize the erosion caused by the construction and operation of the projects roads (iii) minimize the impact on flora and fauna during maintenance of projects roads and water course crossings.

Mitigation for Human Health and Safety: (i) use of adequate projects roads improvement measures to reduce accident rates (ii) minimize risks/hazards to project roads users (iii) strengthen roads safety campaigns programs to be run in collaboration with National Road Safety Commission (NRSC).

Mitigation for Visual Quality and Amenities: (i) ensure compatibility and cohesion in terms of engineering designs, scale, massing and siting of the new roads alignments and site camps/office buildings (ii) ensure that all the proposed projects roads trees plantings will comply with the GHA Projects Aesthetic and Landscape Guidelines (iii) follow a Lighting Plan developed by GHA (in consultation with stakeholders) for the Projects site camps/offices prior to the installation or replacement of any light standards on and around the Projects from lights on them.

Mitigation for History, Archaeology and Heritage Resources: (i) any projects road heritage and historic resource find in the construction and operation phases expansion works will be documented and reported to the Ghana Museums and Monument Board, through the Department of Archaeology and Heritage Studies of the University of Ghana, Legon (ii) all archaeological features will be given, where necessary, a predictable low probability of impact and occurrence at the operation stage.

Mitigation for Pedestrian-Vehicular Conflicts: (i) improved roads conditions will introduce roads side commercial, industrial and settlement developments requiring Traffic Management Plan implementation by GHA to control pedestrian-vehicular conflicts (ii) schools, health centers, churches and mosques, entertainment centers development will create human and vehicular traffic management by GHA (iii) motorists enticed to increase vehicular speed because of improved projects roads conditions leading to accident rates shoot up requiring traffic police intervention.

Mitigation for Public Utilities and Services: (i) opening-up of new settlement communities due to completed project roads will require increase in public utilities and services provision (ii) new commercial businesses, residential outlets, schools, health posts, etc. development will demand expansion in public utilities and services provision (iii) rural-urban sprawl emergence due to in-out migration patterns requiring new development schemes.

Mitigation for Hydrology and Drainage Systems: (i) runoff from projects roads will be directed into drainage channels and discharged into approved waterbodies located further away from settlement areas (ii) runoff from project roads will be channeled away from fertile agricultural farmlands to avoid damage to food crops and economic trees (iii) erosion protection works like grassed or stabilized slopes will be maintained constantly and inspected frequently to ensure effective operation.

Mitigation for Project Communities Access: (i) deploy traffic control devices, equipment and installations to warn motorists, pedestrians, cyclists, inform road users, guide road users. (ii) modify road user's behavior through traffic education (iii) protect road users and their vehicles, bicycles, motorbikes (iv) ensure safe passage to road users (v) provide a safe project's working zones.

Mitigation for Loss of Assets and Compensation Payment: (i) ensure the provision of detail guidelines for easy implementation of the RAP program (ii) deliver the entitlement to the PAPs and support the restoration of their livelihood in accordance with 2010 Resettlement Policy Framework of the Ministry of Transport (MoT) (iii) ensure timely compensation payment to PAPs to avert any social uproar and unrest from the PAPs (iii) identify strategies for effective public information dissemination, public consultation and participation of the PAPs to ensure success of the RAP program (iv) ensure that the standard of living of PAPs is improved or at least restored (v) compensation payments will be made to **1,475 PAPs** whose affected properties range from building/structures, crops and bare farmlands. The total interim compensation payment sum is about **GHc 26,292,463.89 (including GHc 4,563,154.89 for implementation and monitoring cost).**

Mitigation for Influx Population Surge: (i) GHA will develop and operate Influx Management Plan (IMP) to address projects induced migration incidence (ii) discourage the in-migration of prospective job seekers into the Projects enclave by enforcing "No Employment" signs at the Projects as a policy to prevent them from camping outside the Projects boundaries.

Mitigation for Greenhouse Gas (GHG) Emissions: (i) meet GHG requirements by completing GHG analysis and a discussion of the energy improvement related to the Projects (ii) include an assessment of GHG emissions generated by both stationary and mobile sources using standard methods and modeling assumptions.

Mitigation and Adaption for Climate Impacts: (i) selection of appropriate and adequate type of pavement (ii) proper design of drainage facilities or structures (iii) proper levels of roads embankments (iv) provision of dugouts and boreholes where appropriate (vi) increase the capacity of carbon sinks (through reforestation and/or planting trees along the project roads) (vii) achieve some reduction in GHG, mostly CO₂ emissions from transportation, a special focus on transport demand management needs to be adopted that seeks to influence changes

in management practices or consumer behavior (viii) protecting the naturally available carbon sinks like forests and trees, or creating new sinks through silviculture at sites to be identified along the roads alignment.

Complementary Initiatives

Road Safety Campaign and Children's Traffic Education: (i) construction of foot bridges at designated crossings (ii) conduct, in collaboration with National Road Safety Commission (NRSC), road safety campaigns for communities and schools in the project areas both during construction and implementation (iii) finance production of propaganda materials for inclusion as extra-curricular activities in schools and introduction of Safety Wardens to assist children cross project roads.

Disruption to Utilities (Water Provision, Power Lines and Communication): (i) GHA, ECG and GWCL will set out service standards guiding the maximum period which each of the utilities can be disrupted before being reinstalled (ii) critical paths of importance are water supply systems and power lines.

HIV/AIDS and Communicable Diseases: (i) incorporate HIV/AIDS and Communicable Diseases Awareness and Education Campaigns as an effective way of dealing with a variety of HIV/AIDS or Health issues without stigmatization (ii) Wellness Centers will be attached to Hospitals, Clinics and CHPS Compounds within the project enclave to become a one-stop-shop for HIV testing and counselling, blood group matching, malaria testing, diabetic checks, STI testing and others.

Gender Mainstreaming Plan of Action: (i) develop a Project Specific Gender Plan of Action (ii) provision of ablution corners (iii) adequate and secure accommodation for women (iv) resting space dedicated for women (v) code of conduct to prevent abusive language and unwanted approaches at work place (vi) consideration of particular needs of both men and women especially during resettlement and compensation (vii) in the design and determination of activities aimed at the control of the spread of HIV/AIDS and STI (viii) construct market stalls at designated locations for the women trading in rice, maize, fresh foods (fruits and vegetables) (ix) sensitization program for host communities with regards to gender mainstreaming and equity in all aspects including participation of women during roads construction (x) education and awareness creation on prevention of gender based violence in the project areas.

Youth Involvement Program: (i) ensure youth involvement in various aspects of the project through apprenticeship training program at local garages along the project corridor (ii) youth will be sensitized to register their skills into database (iii) GHA/District and Municipal Assemblies/Association of Auto-Mechanical Garages will establish a mechanism to identify the youth who qualify for training to attend artisan courses at the Ho Technical University or Accra Training Institute (iv) trained youth will be given opportunities during construction to gain experience (v) the District and Municipal Assemblies/National AIDS Commission has a database on orphaned and vulnerable youth in the project areas that are qualified to work on the construction sites or be employed in the Wellness Centers (vi) GHA/District and Municipal Assemblies will ensure that trained youth and orphans are employed on the project.

Landscaping and Trees Planting Program: (i) replacing trees that may be cut down during construction (ii) protection of the roads reservation (iii) planting trees that will contribute towards sequestration carbon emissions (iv) GHA will engage a Landscape Architect to develop a suitable design and specifications for the roads project setting.

Resettlement/Compensation (RAP): (i) during consultations and engagement with the PAPs, the impacts of the project and proposed mitigation measures were explained to them and they individually gave assurances that they will cooperate to ensure smooth implementation of the project (ii) further consultations and engagements will be held prior to the payment of compensations to the individual PAPs (iii) PAPs will be notified about compensations due them and where to collect the compensation (iv) PAPs will also be notified of the start date of civil works.

1.10 Environmental and Social Management Plan (ESMP)

The ESMP depicts the implementation schedule of the proposed mitigation measures for potential impacts associated with the project cycle environmental and social issues of concern. The ESMP embodies the environmental and social costs needed to implement the recommended mitigation measures. The engineering designs have already captured some of the mitigation measures recommended in this ESIA Report. The additional measures espoused in the ESMP are meant as enablers to ensure that the roads project execution methods are more environmentally and socially friendly and acceptable.

ESMP Implementation: (i) environmental and social mitigation and enhancement measures disclosed in the detailed engineering design will be attached to the Contract Document (ii) contractor(s) will take stock of the contents of the ESIA Report of the project (iii) contractor(s) will have an Environmental and Social Expert (ESE) with at least ten (10) years' experience in projects of similar nature (iv) ESE will be familiar with the scientific measurement of environmental and social impacts and remedies and enhancement (v) contractor(s) will be supervised by a selected consulting firm (Engineer) (vi) Environmental and Social Specialist (ESS) will be a member of the supervision team as an expert in Environmental and Social Management issues of construction projects (with at least ten (10) years' experience in project of similar nature) (vii) ESS will supervise contractor(s) implementation of mitigation measures proposed in the ESMP during construction and operation phases (viii) ESS will assist the contractor in the implementation of the Environmental and Social Monitoring Plan during construction phase.

Construction Specific ESMP: (i) project specific environmental and social construction guidelines (known as contractor(s) specific construction environmental and social management plan (CESMP) will be developed by the contractor(s) ESE (ii) CESMP will specify precautions and mitigation measures for construction activities (iii) ESMP developed in the ESIA Report will serve as a reference material to comprehend the scope of the CESMP. The total estimated cost for ESMP, excluding RAP estimated cost is **USD 6,489,342.38**.

1.11 Environmental and Social Monitoring Program

The objectives of the environmental and social monitoring, mitigation measures monitoring, responsibilities for mitigation monitoring and external monitoring programs are the following: (i) quantitatively measure the environmental and social effects of the roads project (ii) monitoring environmental and social impacts through pre-construction, construction and operation phases (iii) mitigation monitoring to be undertaken by Contractor(s) Environmental and Social Manager (ESM) and Engineers' Environmental and Social Specialists (ESS), these officers will conduct mitigation monitoring as part of the regular works inspections (iv) weekly inspections will be undertaken by Contractor(s) ESM, when available and appropriate the inspection will also be attended by Engineers ESS, the main Contractor(s) site management staff and their specialist advisors (v) weekly Environmental Compliance Report will be produced following each inspection and will incorporate any actions identified by the client including status of site's compliance and photographs (vi) responsibilities for mitigation monitoring at the operation phase rests with GHA Environmental and Social Division as the implementing agency (vii) GHA will provide AfDB with reports on environmental and social compliance during implementation as part of their annual progress reports and annual environmental and social monitoring reports (viii) depending on the implementation status of environmentally and socially sensitive areas of the project corridor, AfDB will perform annual environmental and social reviews in which environmental and social concerns raised by the project residents will be reviewed alongside project implementation (ix) AfDB requires that an Environmental and Social Audit be undertaken within twelve (12) months of commencement of the project to monitor the implementation of the ESMP (x) Environmental and Social Audits will be part of the continuous monitoring program to help determine the long-term effects of adopted mitigation measures (xi) audits will uncover the actual performance of mitigation measures and allow effective measures to be included in future projects (xii) Environmental and Social Audits will be a responsibility of an AfDB Consultant contracted by GHA.

The estimated cost for monitoring of mitigation measures by the phasing program are disclosed as follows: **pre-construction phase (USD 38,157.33), construction phase (USD 490,594.28) and operation phase (USD 16,353.14)**. The **total estimated cost for monitoring the mitigation measures over the project cycle is USD 545,104.76**.

1.12 Stakeholders Consultations and Disclosure

As part of the stakeholder consultations and engagements program, the KE&T ESIA/RAP Study Teams held six (6) public meetings on 18/10/2014, 05/12/2014, 06/12/2014, 26/06/2015, 27/06/2015 and 13/11/2015 along the roads project enclave during the development of the ESIA and RAP Reports. Moreover, the KE&T ESIA Study Team, GHA and AfDB Project Design Teams held Stakeholders Community Needs Assessment public meetings on 18/04/2018 at Asutware Junction, Asutware, Volivo, Aveyime and Dofor Adidome along the project roads corridor. Finally, KE&T ESIA/RAP Study Teams, GHA RAP and AfDB ESIA/RAP Teams held Stakeholders ESIA/RAP Awareness Education public meetings on 20/04/2018 at Asutware Junction, Asutware, Volivo and Aveyime. The same program was slated to have been held the following day (21/04/2018) at Dofor Adidome but due to funeral celebration, this program could not come on since the project community residents attended the funeral celebration.

The participants of the various public meetings included the following:

- Representatives of community-based associations such as the Ghana Private Road Transport Union (GPRTU), Drivers, Taxi Owners,
- Market Women, Rice Traders, Teachers, Parents, Home Owners, Property Developers.
- Nurses, Assembly Men and Women, Elders, Opinion Leaders.
- Rice Farmers, Fruits and Vegetable Farmers, Project-Affected-Persons (PAPs) and Project Community Residents.

The stakeholder consultative and engagement meetings provided:

- Views, opinions and suggestions on the most appropriate considerations on the construction and use of the proposed roads project.
- Measures to address fears and concerns during construction.
- Assurance that both women's and men's views were taken on board in the project design.
- Means of undertaking public consultations in an all-inclusive manner.
- Community participation and instant feedback into the project design especially related to matters of road alignment, RoW and shoulders design, resettlement and compensation payment.
- Awareness creation and identified positive and negative socio-economic impacts of the roads project, proposed mitigation measures to address the potential impacts during pre-construction, construction and operation phases programs,

The following are some of the issues and concerns raised at the meetings which were responded to and as much as possible with recommendations made which have been incorporated in project design:

- Road safety measures for school children.
- Public appreciation and concerns of the roads project due to their importance.
- High expectations (direct and indirect jobs creation and employment generation from the project, development and improvement of businesses, provision and enhancement of access to social amenities, reduction of travel time).
- Fears and concerns associated with the roads project including increased road accidents and increased HIV/AIDS/STDs.
- Timely and fair compensation payments.
- Road drainage and flooding especially on Asutwae-Aveyime Road and Dofor Adidome-Asikuma Junction low-lying wet land sections.
- Establishment of toll plaza (viii) waste generation and disposal along the project roads corridor
- Traffic management and security provisions for road users during construction.
- Establishment of a Grievance Redress Mechanism for PAPs and all road users and the need for continuous information sharing
- Noise and excessive vibrations during construction.
- Public infrastructure and utilities disturbance or destruction repairs during construction works.

1.13 Conclusions

The negative environmental and social effects are significant but controllable such as: removal of trees/vegetation; air pollution, noise and vibration nuisance; demolition of structures, borrow pits generation; erosion and sedimentation; waste generation; water supplies; concrete batch plant and hot mix asphalt/bitumen; construction camps/site offices; biodiversity loss; traffic control nuisance; public, occupational health and safety; visual impairment; history, archaeology, heritage resource defacement; resettlement issues; projects community access; pedestrian-vehicular conflicts; influx population surge and greenhouse gas (GHG) emission. The prescribed implementable mitigation and management measures will reduce, eliminate or reverse the negative, non-beneficial impacts.

The beneficial outcomes of the Proposal are direct and indirect, positive and significant. They include: human resource development and capacity building; expansion of GHA roads infrastructure; rural-urban income levels enhancement; improvement in rural-urban economy; rural-urban women livelihood improvement; traffic safety and riding comfort improvement; traffic congestion dissipation; vehicle operation and transport cost reduction. These beneficial impacts will ensure that the programs with the accompanying ESMP will be friendly, environmentally and socially acceptable. The implementation of the Projects is highly recommended. The Projects residents, project neighboring populations and future generations will need the Project to boost their socio-economic development.

Chapter 2 Introduction

The proposed project roads are sections of the Eastern Corridor International Transit Route. The denoted sections, **Section 1 {Asutuare Junction – Volivo Road (28.3km)}**, **Section 3 {Dufor Adidome – Asikuma Junction Road (38.4km)}** and **Section 2 {Asutuare – Aveyime Road (24.0km)}**, traverse one (1) Metropolitan, eight (8) District Assemblies and three (3) Regions. The Metropolitan Assembly is HO (in the Volta Region) while the District Assemblies are: Yilo Krobo, Manya Krobo and Asuogyaman (in the Eastern Region); Dangme West and Dangme East (in the Greater Accra Region) and South Tongu, North Tongu, Adaklu-Ayigbe (in the Volta Region). Of the three (3) project roads, the Asutuare – Aveyime Road (24.0 km) will be upgraded to pass through existing alignment of agricultural and commercial townships and rural villages some of which are in the Volta Region of Ghana and end up at Aveyime. This is a gravel road with highly deteriorated and distressed surface conditions will be upgraded to asphaltic highway to serve as a major feeder into the Eastern Corridor international transit route (N2). However, sections of the Asutuare Junction – Volivo Road (28.3km) connects existing light settlement zone following the existing alignment and diverts through green field of agricultural farmlands and ends at Volivo township. At Volivo township, a JICA Suspension Bridge (1.25km) will be erected over the Volta River to connect Dufor Adidome – Asikuma Junction Road (38.4km) through agricultural farmlands and undeveloped fallow fields to end at Asikuma Junction township. The Asutuare Junction – Volivo Road (28.3km) and Dufor Adidome – Asikuma Junction Road (38.4km) form sections of the Eastern Corridor international transit system (N2).

This document is the main Environmental and Social Impact Assessment (ESIA) study of the proposed project roads. It has been prepared based on the ESIA conducted for the Eastern Corridor international transit route (N2) Project. It was devised in accordance with the guidelines and procedures for environmental and social assessment of the African Development Bank (AfDB) for Category 1 projects and existing policies in Ghana.

2.1 Purpose of the ESIA

The proposed project roads require that an Environmental and Social Assessment Procedures (ESAP) of the AfDB and existing Environmental and Social Assessment Regulatory Policies of Ghana EPA for the Proposal be undertaken. More specifically, as part of the developmental procedures of the Program, an Environmental and Social Impact Assessment (ESIA) Report is to be prepared before the commencement of the project roads. Therefore, the GHA is committed to achieving and maintaining environmental and social standards, such that any adverse environmental and social impacts resulting from the construction, operation and maintenance phases of the project roads are minimized or reduced to the barest acceptable levels. Moreover, in consonance with the preservation and conservation of the immediate environment of the project roads sites, the GHA is also committed to working with all the

project neighboring communities and project stakeholders, right from project conceptualization through project implementation stages.

2.2 ESIA Study Objectives

The Terms of Reference (TOR) for the ESIA Study are:

- To identify issues that may need to be evaluated as part-of the Impact Assessment stage.
- To identify likely impacts of the proposed Project on Physical, Biological/ Ecological and Socio-Economic/Socio–Cultural Environment of the project zone, to predict and evaluate these impacts and determine significance of these impacts with respect to technical and regulatory concerns,
- To propose appropriate mitigation measures that should be incorporated in the design of the project to minimize if not eliminate the adverse impacts.
- To assess the compliance status of the proposed activities with respect to the Environmental and Social Regulation or Legislation of Ghana, Metropolitan/District Assembly By-Laws, African Development Bank (AfDB) Operational Safeguards and Categorization Definitions.
- To develop an Environmental and Social Management Plan (ESMP) to provide an implementation mechanism for the environmental as well as social mitigation measures identified in the study.
- To detect adverse effects in time for correction through Monitory Program.
- To identify alternatives to be evaluated at Impact Assessment Stage with the main purpose of focusing the environmental and social assessment on reasonable and feasible alternatives examination.
- To conduct comprehensive stakeholder consultations as part of public participation process.
- To develop institutional capacities and strengthening plan

2.3 Proposed Project Roads Overview and Assessment

Ghana, located on the West Coast of Africa, is bordered by the Gulf of Guinea in the south, Togo in the East, Cote d'Ivoire in the West, and Burkina Faso in the north. The country has been playing a leading role in West Africa since gaining independence in 1957. Ghana has a population of approximately 25 million (United Nations Development Program, 2011) and a land area of 238,537 km².

The economy of the Country has grown in recent times underpinned by a relatively sound economic management, a growing competitive business environment and improving social and economic infrastructure. The country is endowed with natural resources with agriculture accounting for 25% of Gross Domestic Product (GDP) and employing about 50% of the active work force. Gold, cocoa, timber, diamonds, and bauxite are major sources of foreign exchange. The production of Oil in the Country, which began in December 2010 has also helped sustain economic growth. The nation's Gross National Income (GNI) now stands at US\$ 1,230 per capita (World Bank (WB), 2010). The volume of international cargo meant for its neighboring landlocked countries has been increasing in recent times. There are

however challenges which the nation would have to deal with in facilitating transit of vehicles from the neighboring countries, such as chronic congestion in and around Accra, the capital city, and Kumasi, the second largest city.

The situation currently hampers fast and efficient movement of cargo to the neighboring landlocked countries necessitating that an alternative route is identified and developed to facilitate transit and trade. A possible alternative international transit route to Burkina Faso is the Eastern Corridor (N2). The Eastern Corridor which lies to the east of the country, and approximately 695 km in length commences from Tema Roundabout through some important towns in the Greater Accra, Volta, Northern Regions and ends at Kulungugu in the Upper East Region of the country. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages during the rainy season making travel difficult.

2.4 Project Roads Purpose and Needs

The Asutua Junction – Volivo Road (28.3km), Dufor Adidome – Asikuma Junction (38.4km) and Asutua - Aveyime Road (24.0km) have immediate impact over 5.4 million inhabitants, majority of whom live below the poverty line. The road traverses an area that is noted for its production of cassava, corn, tomatoes as well as cash and food crops for consumption and exports. The current state of two of the roads if not improved shall result in the total deterioration of the road with the resultant prohibitive capital cost for a total rehabilitation and its social effects. The vehicle operating cost is high. Increased travel times on the bad state of the roads become disincentive to business.

- **Section 1: Asutua Junction – Volivo (28.3km)**

This 28.3km road branches eastwards from Tema-Akosombo road at Asutua Junction and passes through agricultural and commercial towns/villages in the Eastern region to Volivo. The surface is generally gravel but it has some sections paved. The road is of width 7.3m, at the paved section and of lower width at the unpaved sections.

- **Section 3: Dufor Adidome – Asikuma Junction (38.4km)**

This section currently does not exist and would have to be built through a virgin area. Preliminary road alignment has been developed by the consultant who was engaged for the feasibility study of the road and can be made available.

- **Section 2: Asutua-Aveyime Road (24.0km)**

This 24km section stretches southwards from Asutua through agricultural and commercial towns/villages in the Volta region to Aveyime. The road is gravel surfaced and is distressed in sections. The road is of width 7.3m.

2.5 Content of the ESIA Report

This ESIA Report consists of the following AfDB format with respect to pertinent chapters:

- Executive Summary
- Introduction
- Policy, Legal and Administrative Framework
- Description of Project and Justification
- Description of Project Environment
- Presentation of the Alternatives Considered
- Results of the Comparison of Alternatives
- Potential Environmental and Social Impacts
- Mitigation/Enhancement Measures and Complementary Initiatives
- Expected Residual Effects and Environmental Hazard Management
- Monitoring Program
- Summary of Public Consultations and the Opinions Expressed
- Environmental and Social Management Plan (ESMP)
- Institutional Capacities and Strengthening Plan
- Conclusions
- Recommendations
- Annexes

2.6 Methods Adopted for Assessment

The environmental and social screening process through scoping involved an initial evaluation of the project roads in terms of the need for ESIA study and the level of assessment required. This process also included the use of a checklist to determine the baseline information data gathering through literature review and observation of field characteristics of the entire project roads. The scoping exercise captured the main potential environmental and social issues focusing on direct and indirect effects arising from the project roads implementation process.

2.6.1 Scoping Objectives

The primary scoping objectives of the Proposal are as follow:

- Information gathering on the proposed type of development and its likely environmental and social impacts.
- Assessment of project site and surrounding areas land use patterns and susceptibility to change by the proposed development.
- Consultation and engagement of local communities, institutions and agencies as stakeholders to determine the environmental and social issues of most concern which should be included in the ESIA Study.
- Description of the proposed project highlighting project activities likely to have potential environmental and social significance.
- Policy, Legal and Administrative Framework relevant to Ghana government policies, regulations and laws governing the proposed project, including Metropolitan/District Assemblies Bye-Laws and AfDB Operational Safeguards and Categorization Definition.
- Alternatives consideration to the proposed Project.

- Description of the Present Project Environment.
- Identification of potential environmental and social impacts during the pre-construction, construction, post-construction and maintenance phases of the Project.
- Assessment of Principal Environmental and Social adverse and beneficial impacts of the Project and mitigation considerations.
- Environmental Management Program, Monitoring and Control of activities at constructional and operational stages of the Proposed Project.

2.6.2 Scoping Exercise and Issues Identification

The scoping exercise for this Proposal has been undertaken. But the Proposal is yet to be registered with Ghana EPA (Environmental Protection Agency), using Form EA1. However, field visits to the project location and consultation with all relevant stakeholders' have been carried out. Here, the major objective had been identification and direction of the Environmental and Social Assessment (ESA) Study on the potential environmental and social impacts to focus only on the significant and key issues to be addressed.

2.6.3 Scope of Works for ESIA Study

The scope of works carried out involved these logical steps:

- Environmental and Social Assessment (Field and Desk work).
- Baseline Survey/Studies - data acquisition.
- Conduction of Stakeholders Consultations and Engagement.
- Impact Predictions and Evaluation.
- Provisional Environmental and Social Management Plan Preparation.
- Preparation and Presentation of Draft Final ESIA for Client/AfDB/EPA Ghana Review.
- Preparation and Presentation of Final ESIA for Client/ AfDB/EPA Ghana Review.
- Preparation and Presentation of Final ESIA Report.

2.6.4 Study Approach for Scoping Phase

The following activities or task assignments were adopted at the Scoping Phase:

- Field Inspection and Observational Studies
- Environmental Sampling and Analysis
- Terrestrial and Aquatic Studies
- Land Use Studies
- Socio- Economic and Socio – Cultural Studies
- Consultation Program

2.6.5 Methodology for Data Gathering Scoping Phase

The Scoping Phase resulted in the identification of potential environmental and social impacts that will result from the implementation of the Proposal. This phase also looked at identifying

feasible alternatives related to the proposed project activities. Finally, the Scoping Phase provided reasonable opportunity for relevant stakeholders to be involved in the process.

- **Field Inspections and Observational Studies**

Linear surveys and observation of the project sites were carried out to confirm and establish all relevant baseline environmental and social issues and conditions to be affected or are likely to develop from the proposed project implementation. And through field inspection and observational studies, data were collected and compiled, to develop the baseline or pre-project conditions with regards to the project zone physical, biological/ ecological and human development.

- **Environmental Sampling and Analysis**

An Initial Environmental and Social Examination (IESE) was conducted through project sites observational studies to ascertain whether there were significant triggers and drivers of environmental and social effects, which leads to the development of a full-blown ESIA.

- **Terrestrial and Aquatic Studies**

A walk – through of project sites were undertaken. Primary data on vegetation and natural resources were collected, to depict potential non-perennial wetlands, habitat types and other biodiversity assets of nature. Secondary sources of data were consulted on terrestrial vegetation types, invasion species in coastal vegetation type, species of special concern and flagship species and Important Bird Areas (IBAs) and Biodiversity “HOT” spots.

- **Land Uses Studies**

Detailed field investigations on landscape and land use pattern were undertaken to locate the following features: existing commercial operational zone overview, existing open space and fallow lands, existing land uses, cultural, historical, heritage and archaeological sites. A topographical map (1:50,000) of the project area was used.

- **Socio-Economic and Socio-Cultural Studies**

Observational Studies and interviews of farmers, traders, drivers, GHA officials, project enclave communities’ population were carried out through the administration of questionnaires. Data compilations on socio-economic and socio-cultural issues very likely to emerge as potential impacts of the proposal were undertaken. Supplementary information was sought on respondent’s background information including residents, age, sex profile and demography, ethnicity and cultural practices.

- **Consultation Program**

Consultation with farmers, traders, district/metropolitan assemblies’ officials, GHA officials, drivers, business owners and neighboring community residents and key and relevant stakeholders were undertaken. Specific concerns relating to environmental and social

impacts addressed issues on flora and fauna, construction access roads, dust, noise and vibration pollution, flooding disturbance and construction traffic nuisance.

2.6.6 ESIA Study Approach and Methodology

- **Study Approach**

The study approach involved the adoption of task specific assignments and activities such as:

- ❖ Plugging Data Gaps after Scoping Phase
- ❖ Conducting Specialist/ Professional Studies at ESIA Phase

- **Plugging Data Gaps after Scoping Phase**

This phase covered the following steps:

- Additional Field Visits/ Reconnaissance Studies
- Detailed Environmental and Social Component Examination
- Detailed Terrestrial and Aquatic Studies
- Detailed Socio-Economic and Socio–Cultural Studies
- Additional Stakeholder’s Consultation and Engagement.

- **Conducting Specialist / Professional Studies at ESIA Phase**

This stage captured the following:

- **Biodiversity (Flora and Fauna) Resources Studies**

Detailed impact assessment studies have been conducted to profile the vegetation cover and its accompanying fauna species content congenial to the flora habitat. Any feasible fauna migratory routes present within the project corridor have been discussed, where applicable.

- **Visual and landscape Character Studies**

The character or quality of important aesthetic resources has been captured. A visual impact assessment has been prepared to define the following: visual characteristics of the Project, the Project sites and surrounding areas.

- **Archaeological, Cultural and Heritage Resource Studies**

All archaeological and cultural facilities of interest, within the project zone, have been evaluated and discussed under this headline. An archaeological, historical and cultural desk-based assessment (including consultations with stakeholders) have been undertaken to determine the risk posed to buried-treasure from the proposed development. Reference has been made to historic records held by the GHA. Similar studies were conducted based on information gleaned from previous studies, literature, publications, websites and desk top studies. Such studies included the following:

- Traffic Sensitivity Analysis and Impact Studies.
- Demolition Sensitivity Analysis and Impact Studies.
- Eastern Corridor N2 Project Community Needs Assessment.
- Traffic Congestion Threat Assessment.
- Geo-hydrological, Floods and Runoff Resource Studies
- Roads and Traffic Network Studies.
- Hazardous Chemicals/ Materials Studies.
- Flooding Risks and Impact on Health and the Environment Assessment.
- Risks Associated with Inappropriate Processing and Dumping of Hazardous Waste Assessment.
- Air Quality (Dust, Gas and Odor) Studies.
- Ground or Surface Water Contamination by Leachate Studies.
- Construction Site Debris Studies.
- Nuisance Effects from Vermin and Vector Studies.
- Workers Health and Safety Studies.
- Fire Suppression and Spontaneous Combustion Studies.
- Habitat Loss/Dissection Studies.
- Bridge for Volta River Crossing Studies.
- Compulsory Land Acquisition, Resettlement and Loss of Income/Livelihoods Studies.

2.6.6.1 Methodology of Data Gathering

- **Scoping Phase Data Gaps**

Data gaps emanating from the Scoping Phase were plugged by undertaking the following measures: revisiting of project sites by additional site visits; conducting detail environmental components examination of air, water and noise; conducting detail terrestrial and aquatic studies on freshwater wetland, zone of coastal grassland, shrubs, thicket, insects and butterfly, bird's habitat types, nature conservation and protected areas; conducting detail land use studies on settlement patterns, existing open spaces, existing land use; conducting detail socio-economic and socio-cultural studies on lifestyles, influx of outsiders, social fabric changes, increase employment potential, youth unemployment, poverty level, etc.

- **ESIA Phase Specialist/ Professional Studies**

Comprehensive specialist/ professional studies have been undertaken to gather data for the following relevant areas: biodiversity impact assessment; visual and landscape assessment, archaeological, cultural and heritage resources assessment ; biodiversity threat assessment; geo-hydrological floods and runoff assessment; roads and traffic network assessment; hazardous chemicals materials assessment; air quality assessment; demolition impacts and construction site debris assessment; worker health and safety assessment; fire suppression and spontaneous combustion studies.

Chapter 3 Policy Legal and Administrative Framework.

3.1 Requirements

To set the stage for the necessary requirements of the TOR, the following presentation will be made:

- **Section 3.2: Institutional Framework**, an overview of the major entities consisting of the framework in which the Eastern Corridor N2 Project will be implemented;
- **Section 3.3: Overarching Implementation Framework**, a description of the specific framework, established by the GHA; and
- **Section 3.4: Relevant Policies, Legislation and Regulations**, a description of the laws regulations and standard arrangements that are anticipated at the Project-Level.

With this contextual information as general background, the sections which follow address the stated requirements TOR for the preparation of the ESIA, i.e. the stipulation that the section of the document addressing framework issues shall identify, discuss and/or assess:

- Government of Ghana policies, legislation (including international treaties and obligations) and regulations relevant to the Eastern Corridor N2 Project and Activities. These requirements are addressed in **Section 2.5: Project Regulatory Compliance**.
- Eastern Corridor N2 Project Activities are consistent within the framework of International EHS Guidelines, Performance Standards and Safeguards applicable to the Project. These requirements are addressed in **Section 2.6: International Performance Standards Compliance**.
- Resources and capacity of GHA and of the regulatory and implementing agencies responsible for environmental and social issues relevant to the Eastern Corridor N2 Project. These issues are addressed in **Section 2.7: Environmental and Social Oversight Capacities**.

3.2 Institutional Framework

Ghana has the necessary institutional framework with considerable professional expertise that would be required to implement an undertaking such as the Eastern Corridor N2 Project ESIA Program. The following are the general profiles of key institutions that can be expected to participate and/or provide support in the implementation of the Eastern Corridor N2 Project ESIA Program.

- **Ministry of Transport (MoT)**

MoT was formed from former agencies of two (2) government ministries namely the Ministry of Roads and Highways and the Ministry of Transport and Communication in 2001. After the merger, it was known as the Ministry of Roads and Transport. The name was changed in 2009

to the Ministry of Transport. The purpose for the agency merger was to create an autonomous ministry that could effectively formulate and coordinate transport policies for the country.

- **Ministry of Roads and Highways (MoRH)**

MoRH was established to provide an integrated, efficient, cost-effective and sustainable road transport system responsible to the needs of society, supporting growth and poverty reduction and capable of establishing and maintaining Ghana as a transportation hub of West Africa. It has the core functions of: policy formulation; monitoring, evaluation and coordination with regards to the road infrastructure sector; development and maintenance of road infrastructure; improving the road safety and environment; financing of road maintenance; training of professionals (Engineers and Contractors).

- **Ghana Highway Authority (GHA)**

GHA was formed and continue to exist under GHA Act 1997 (Act 540). It is responsible for the administration, control, development and maintenance of the country's trunk road network totaling 13,367 km and related facilities. GHA's 13,367 km trunk roads make about 33% of Ghana's total road network of 40,186 km.

- **Ministry of Finance and Economic Planning (MoFEP)**

This agency manages the central government's budget. It is responsible for releasing money to be paid to project-affected-person's (PAPs) by GHA under this Proposal. Upon receipt of the approval of the compensation figures, this ministry, subject to the availability of funds releases the total amount to GHA for subsequent payment to the PAPs.

- **Environmental Protection Agency (EPA)**

The EPA formulates the national environmental policy, and coordinates and monitors activities that could have an impact on the environment. The EPA ensures that development plans and programs considering environmental and social concerns through Environmental and Social Impact Assessment (or ESIA). EPA also ensures regular monitoring of pre-determined environmental indicators. Where necessary, EPA enforces the environmental law. It disseminates public information on the state of the environment and carries out non-formal education programs. The Eastern Corridor N2 Project ESIA Program will subject to EPA Ghana review.

- **Ghana Health Services (GHS)**

It is responsible for implementing national policies under the control of the Minister of Health through its governing Council – the Ghana Health Council. It increases access to good quality health and manage prudently resources available for the provision of the health services.

- **Town and Country Planning (TCP)**

The Town and Country Planning is responsible for planning and management of growth and development of cities, towns and villages in the country. It therefore seeks to promote

sustainable human settlements development based on principles of efficiency, orderliness, safety and healthy growth of communities.

- **Electricity Company of Ghana (ECG)**

The ECG is responsible for the provision of quality, reliable and safe electricity services to support the socio-economic growth and development of Ghana.

- **Ghana Water Company Limited (GWCL)**

As a public utility company, GWCL functions as the country's bulk water supplier and oversees the urban water sector. It undertakes capacity building in Water Quality Monitoring and Surveillance in Ghana.

- **Forestry Commission (FC)**

The FC of Ghana is responsible for the regulation of utilization of forest and wildlife resources, the conservation and management of those resources. The Timber Validation Department of the Forestry Commission of Ghana is responsible for verifying the legal origins of timber products harvested in Ghana for local utilization and for export.

- **Metropolitan/District Assembly (M/DA)**

The Projects fall under the jurisdiction of one (1) Metropolitan, eight (8) District Assemblies and three (3) Regions. The Metropolitan Assembly is Ho (in the Volta Region) while the District Assemblies are: Yilo Krobo, Manya Krobo and Asuogyaman (in the Eastern Region); Dangme West and Dangme East (in the Greater Accra Region) and South Tongu, North Tongu, Adaku-Ayigbe (in the Volta Region). The Metropolitan/District Assemblies are the highest political authorities in the metropolis and districts. The Metropolitan/District Assemblies have total of over 70 members, roughly 70 percent of whom are elected and 30 percent are appointed. Assembly members are responsible for deliberation, evaluation, coordination and implementation of programs accepted as appropriate for the metropolis economic development.

- **Non- Governmental Organizations (NGOs)**

There are many local and international NGOs in the country which have been implementing projects in a participatory manner. They are supported by several donor agencies and organizations such as UNICEF, UNDP, DANIDA and Water Aid, among others.

3.3 Overarching Implementation Framework

The GHA has a Corporate Responsibility and Sustainability Policy Framework which underlines her operations with regards to Environmental and Social Performance of Road Sector Infrastructure Facilities and Social Enhancement, Development and Expansion Programs. The Framework's most significant components for the purposes of the ESIA are:

- Understanding the Impact of our Operation on the total environment and social scale through control of Energy, Water, Transport and Carbon Footprint.
- Assessing the impact of our programs on the road corridor fabric, neighboring communities and the total environment and social footprint.

The GHA aims to guide the Eastern Corridor N2 Project with long term sustainability footprint analysis in mind. Moreover, the GHA carries the ultimate responsibility for ensuring that the proposed Project is designed, constructed and operated in conformance with International General EHS Guidelines, EHS Guidelines for Roads Infrastructure, EHS Guidelines for Water and Sanitation and International Performance Standards, including Ghana EPA compliance requirements, GHA Environment and Social Management Framework and Industry Best Practice to achieve the required emission and storm water and run off standards.

3.3.1 Sub-Contractor's Policy Framework

All sub-Contractor(s) to be engaged by any selected contractor(s) on GHA Project will have to be guided by a **Sub-Contractor(s) Policy Objective**, to be developed by GHA which will ensure the following:

- Provision of copies of Construction Environmental and Social Management Plan (CESMP) to be developed by the Contractor(s) and given to the Sub-Contractor(s) staff to ensure compliance with all International EHS Guidelines, AfDB Operational Safeguards, Ghana EPA Requirements applicable to the Project.
- Appointment of Representative of the Contractor(s) to implement the CESMP and ensure that all employees of Sub-contractor(s) are aware of the CESMP and its requirements.

3.3.2 Contractor(s) Certification and Commitment Framework

The Managing Director and the entire management team of the Contractors(s) will have to attest to adherence and enforcement of National and International Laws and Regulations applicable to Occupational Health, Safety and Environmental and Social Protection and Conservation for the Eastern Corridor N2 Project. Moreover, the Contractor(s) team will have to attest to a commitment that ensures that the overall environmental and social quality, integrity and industrial health aspect of contractual obligations will be given the highest priority during project execution.

3.4 Relevant Policies, Legislation and Regulations

In principle, the implementation of the Proposal is expected to comply with Ghana's laws, regulations and standards as well as requirements by which Ghana is bound under international agreements. The process must ensure that the Proposal is undertaken as part of programs funded by AfDB. The Proposal must fulfill environmental and social objectives and targets of other policies and plans while not conflicting with them.

3.5 Project Regulatory Compliance

The roads project with its implementation activities should be consistent with the Ghana EPA regulatory framework. The International EHS Guidelines and AfDB Operational Safeguards are in some instances more stringent than the Ghana Framework, but are not in conflict with the Ghana Framework. The Regulatory Framework is also consistent with the applicable international and environmental and social assessment directives.

3.5.1 International Environmental Conventions

Ghana is a signatory to these applicable international conventions:

- The United Nations Convention of Biological Diversity (the Biodiversity convention).
- United Nations Framework Convention on Climate Change.
- Vienna Protocol for the Protection of the Ozone Layer.
- Montreal Protocol on Substances that Deplete the Ozone Layer.
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal.

3.5.2 Legislation Relevant to Biodiversity

- Land Planning and Soil Conservation Act, 1957
- Town and Country Planning Ordinance 1945 (Cap 74)
- Economic Plants Protection Decree, 1974 (AFRCD 47)

3.5.3 Conventions Related to Biodiversity Conservation to which Ghana is Signatory

- Convention Concerning the Protection of the World Cultural and National Heritage (16th November 1972).
- Convention concerning Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents (26th June 1974).
- Convention Concerning the Protection of Workers Against Occupational Hazards in the working Environment due to Air Pollution, Noise and Vibration (20th June 1979)

3.5.4 National Regulatory Compliance Requirements

- Environmental Protection Agency (EPA), Act 1994
- Environmental Assessment Regulations 1999 (LI 1652).
- Environmental Assessment (Amendment) Regulations 2002 (LI 1703)
- National Building Regulations, 1996 (LI 1630)
- Planning Permission – Local Construction Act, 1993 (Act 462)
- Energy Commission Act (1997) Act 54
- Factories, Offices and Shops Act (1970) Act 328
- Forestry Commission Act (1999) Act 571
- Wild Animals Preservation Act (1961) Act 43
- National Museums Decree (1969) NLCD 387
- Water Resources Commission Act (1996) Act 552

- Fire Protection Act (1994) and Fire Protection Regulations 2004 (LI724)
- Ghana Water Company Limited Act (1993)
- State Lands Act, 1962 (Act 125)
- State Lands Regulations, 1962 (LI 230)
- National Development Planning Act, 1994 Act 479
- Local Government Act 1993, Act 462
- Road Reservation Management Manual for Coordination, 2001
- Environmental and Social Management Framework (ESMF) for the Road Sector, 2010
- Resettlement Action Framework for the Road Sector, 2010.

3.6 Environmental and Social Oversight Capacities

The required description of the resources and capacities of GHA and of the regulatory and implementation units responsible for environmental and social protection and planning for implementation and oversight of environmental and social issues relevant to the Project are shown in **Tables 1.0 and 2.0**.

Table 1.0 International Agreements Relevant to Project

Topic	Strategic Action	Objectives Relevant to Project
Biodiversity	UN Convention Biological Diversity (1992)	Maintain and Enhance Biodiversity.
	Convention of Preservation of Wetlands for Migratory Birds (Ramsar), (1971)	
	The African Convention on the Conservation of Nature and Natural Resources (1968)	
Human Development	WHO Air Quality Guidelines (1999)	To Protect Human Health and the Environment from Harmful.
	Stockholm Convention on Persistent Organic Pollutants	impact of POPs
	Sustainable Development Goals (SDGS)	Eradicate extreme poverty and hunger; Achieve universal primary education; Promote gender equality and empower women; Reduce child mortality; improve maternal health; Combat HIV/ AIDS, Malaria and other diseases; Ensure environmental sustainability, and Develop a global partnership for growth and development.

	Beijing Platform for Action	Enjoins govt's development partners and civil society organizations to mainstream gender in policies, programs and activities.
Water	Ramsar Convention	Protection of Migratory birds
	UN Framework Convention on Climatic Change (Kyoto Protocol), (1997)	Aim of the UN Protocol is to combat climate change.
Climate and Air Quality	Vienna Convention on Protection of Ozone Layer (1987)	To protect human health and environment against adverse effects resulting from modification of the Ozone Layer
	Montreal Protocol on substances that deplete the Ozone (1989)	To protect the Ozone layer by taking precautionary measures to control equitably total global emissions.
Cultural Heritage	UNESCO World Heritage Convention, 1972	To ensure that affection and active measures are taken for the protection, conservation and preservation of cultural and natural heritage.
Sustainable Development	Agenda 21 (1992). Action for Sustainable Development	To promote sustainable development at a local and regional level by taking into account environmental and social protection in the development process.
Waste	Basel Convention	To control trans-boundary movement of hazardous waste and their disposal

Source: KE & T Data Records

Table 2.0 National Policies, Plans and Programs Objectives of Relevance to the Project

Topic	Strategic Action	Objectives Relevant to Project
Regulatory Institution	EPA Act 1994 (Act 490)	Establishes the mandate of EPA to oversee and regulate adverse environmental and social issues for development projects.
Relevant Legislations	Fees and Charges Amendment 2014 (LI 2216)	To ensure sound management of the environment and the avoidance of exploitation of resources in ways that is detrimental to the environment, resulting in irreparable damage.

Revision of Environmental Permitting Fees Charges	Environmental Assessment (Amendment) Regulations 2002 (LI 1703)	To prescribe adequate Environmental Permitting Fees chargeable to development projects.
Regulatory Institution	Water Resource Commission (WRC) Act 552 of 1996	Establishes the mandate of WRC to oversee and regulate national water resources quality and sustainability.
Regulatory Institution	Ghana Water Company Ltd Act 461 of 1993	Establishes the mandate of GWCL to oversee, regulate and ensure the distribution of potable water for drinking.
Regulatory Institution	Energy Commission Act 1997 (Act 541)	Establishes the Energy Commission to oversee the sustainability of energy use through education and awareness creation.
Regulatory Institution	Prevention and Control of Pests and Disease of Plants, Act 307	Establishes Ministry of Agriculture Quality Control Division to oversee, prevent and control plants diseases and pest through fumigation schemes.
Regulatory Institution	National Development Planning Act, 1994 Act 479	Regulates the national developmental agenda through harmonious spatial planning in tandem with human growth indices.
Regulatory Institution	Local Government Act 1993, Act 462	Regulates the metropolitan, municipal and districts assemblies in strategic measures towards governance, planning and development agenda to ensure socio-economic sustainability.

Source: KE & T Data Records.

3.7 Environmental Screening, Determination and Conditions

3.7.1 Ghana Environmental Protection Agency Environmental Guidelines

The EPA requires that an Environmental and Social Impact Assessment (ESIA) be carried out for significant impact undertaking (any enterprise, activity, scheme of development, construction, project, structure, investment plan, program, demolition, rehabilitation or decommission) to provide adequate information on the undertaking as the basis for decision-making and decision-taking. The findings of the ESIA are compiled in an Environmental and Social Impact Assessment (ESIA) Report. Under the Eastern Corridor N2 Project, ESIA Report will be required under the Ghana EPA Guidelines.

3.7.2 African Development Bank's Policies, Guidelines and Safeguards

African Development Bank (AfDB) integrates environmental considerations into major transportation projects, i.e. those exceeding 50 km and needing major rehabilitation or upgrading. They are classified as Category 1 projects which require detailed ESIA investigations. The projects must meet the basic goals and objectives of AfDB environmental and social policies and guidelines. Further AfDB policies relevant to the project include:

- **AfDB Environmental Policy**

AfDB policy framework on environment policy has been anchored in the concept of sustainable development. The policy stresses the anticipatory nature of sustainable development rather than the reactive responses so predominant in development related decisions.

This ESIA report for the project roads was therefore carried out in consideration of sustainable development of the roads project, while identifying possible negative and positive impacts on natural and human environment.

- **AfDB Involuntary Resettlement Policy**

The primary goal of the involuntary resettlement policy is to ensure that when people must be displaced they are treated equitably, and that they share in the benefits of the project that involves their resettlement.

- **AfDB Guidelines on Cooperation with Civil Society Organization**

The AfDB considers the African civil society as a primary stakeholder and help to enhance transparency and accountability due to the need to change information disclosure policies and enhance participation of stakeholders in the bank operations. The civil society includes groups such as the; non- governmental Organization (NGO's), Community Based Organizations (CBO's), people's organization, trade unions and religion groups among others. The civil society organizations are central to the banks efforts to implement the participatory approaches especially in reaching to the poor people and women which are the priority target groups who have little influence and control over decisions and actions that affect their lives.

Africa Development Bank (AfDB) has adopted an integrated approach to environmental assessment in the so-called Integrated Environmental and Social Impact Assessment (IESIA) guidelines. The Guidelines' major objective is to provide reference material on how to adequately consider cross-cutting themes while assessing the environmental and social impacts of a project. The IESIA Guidelines assist in the project design, as many potential adverse impacts can be avoided or mitigated by modifying or adding certain project components to the initial design. They also provide guidance on how to adequately consider cross-cutting themes in both the preparation and assessment phases. The cross-cutting themes prioritized by the Bank are the following: poverty, environment, population, gender

and participation. In addition, the Bank has recently adopted health priorities that are transversal issues by nature: HIV/AIDS and Malaria control. Consequently, health outcomes are also considered as a cross-cutting theme in the IESIA Guidelines. There are several operational principles discussed in the guidelines, including the following:

- ❖ Gaining and providing information: The bank is expected to make available information to the public and draw knowledge, information from them. The regional member country authorities are expected to be responsive to the civil societies' request, issues and concerns on bank supported programs and projects,
- ❖ Involvement of the civil society organizations (CSO) in policy making: The bank collaborates with the civil society organizations and the regional member country to factor in the interest of the stakeholders in both policy and project activities. The bank takes deliberate measures to remove barriers such as gender biases and other inequalities to allow effective participation,
- ❖ Civil Society Participation in operation: It's the responsibility of the region member country to give responsibility to the CSO in programs financed by the bank loans,
- ❖ To foster effective CSO involvement the AfDB request the regional member country to provide institutional support to CSO for capacity building purposes,
- ❖ The AfDB remains optimistic and committed to effective engagement with the CSO in the future.

- **AfDB Policy on Poverty Reduction**

Poverty is not limited to the lack of the physical resources for development, but also rooted in the inability of poor people to influence forces and decisions that shape their lives. AfDB considers the empowering of the poor people to actively participate in the development interventions for sustainable poverty reduction. The main objective of this policy is to provide a framework for action by putting the poverty reduction at the center of bank lending and non-lending activities for the regional member country. There are several guideline principles highlighted in the policy. These include:

- ❖ The bank focuses in the analysis of incidences and in-depth causes of poverty in Africa and these consequently results in formulation of policies and intervention mechanisms,
- ❖ Support of national capacity building, promotion of participatory approach, development on the new forms of partnership and establishment of poverty monitoring systems,
- ❖ Internal policy coherence to strengthen the existing sector policy and fill gaps in specific areas from poverty reduction,
- ❖ Requires a strong partnership that facilitates the consistence between the bank poverty policy and poverty reduction strategies,
- ❖ Handles the new conceptual framework that expands the concept of poverty beyond income measures and its causes; addresses the economic and non-economic causes of poverty.

The objectives of the policy are to ensure that the disruption of the livelihood of people in the project's area is minimized, ensure that the displaced persons receive resettlement

assistance to improve their living standards, provide explicit guidance to Bank staff and to borrowers, and set up a mechanism for monitoring the performance of the resettlement programs. Most importantly, the resettlement plan (RP) should be prepared and based on a development approach that addresses issues of the livelihood and living standards of the displaced person as well as compensation for loss of assets, using a participatory approach at all stages of project design and implementation.

- **AfDB Environmental and Social Assessment Procedures (ESAP)**

The main purpose of the Environmental and Social Assessment Procedures (ESAP) is to improve decision making and project results to ensure that Bank-financed projects, plans and programs are environmentally and socially sustainable as well as in line with Bank's policies and guidelines.

The primary objective of the ESAP is to provide a formal process for the internal and inter-departmental environmental and social review of Bank-financed projects, programs and plans. The procedures highlight the various steps that shall be followed to assess environmental and social risks and benefits along the project cycle.

In addition, the ESAP aim to ensure the integration of environmental and social dimensions into the public sector project cycle from country programming to post-evaluation. An integrated approach allows interrelations between environmental and social issues and to favor a multidisciplinary review of key concerns in a timely manner.

This ESIA project report for the proposed initiative complies with the AfDB ESAP main purpose and primary objectives. Impact areas and mitigation measures raised in the Environmental and Social Management and Monitoring Plan for the project are environmentally and socially sustainable-the main purpose for ESAP.

- **AfDB Environment and Social Safeguards**

- ❖ **Integrated Safeguard System (ISS)**

African Development Bank has established an Integrated Safeguard System (ISS) for comprehensive projects review and ensuring across the board perspectives of environmental and social linkages. The ISS comprises of four components, all that existed separately but with identifiable operational weakness. The components include:

- ❖ Integrated Safeguard Policy Statement (ISPS)
- ❖ Operational Safeguards (OS)
- ❖ Environmental and Social Assessment Procedures (ESAPs)
- ❖ Environmental and Social Impact Assessments (ESIAs)

Integrated Safeguard System (ISS) encompasses into five number (5NO) operational safeguards addressing the following fields:

- Environment

- Involuntary Resettlement
- Gender
- Climate Risk Management and Adaptation
- Civil Society Engagement Framework
- Health
- Integrated Water Resources Management
- Agriculture and Rural Development
- Poverty Reduction

The specific safeguards are briefly described below:

- **Operational Safeguard 1 (OS 1)**

This is the main safeguard that guides environment and social assessment as well as climate issues. The safeguard governs the process of determining a projects environment and social assessment requirement. OS 1 is designed to identify access and manage potential environment and social risks and impacts including climate change issues. More specifically, OS1 achieves the following:

- ❖ Identify and assess risks and impacts,
- ❖ Avoid and/or minimize, risks and impact,
- ❖ Provide for stakeholder's participation.
- ❖ Ensure effective management of risks and impacts
- ❖ Contribute to capacity building elements.

The categorization requirements under OS1 – 5 are also considered as support safeguards. Under the safeguards Environmental and Social Impacts Assessment (ESIA) studies are undertaken on clearly defined projects while environmental and social management framework (ESMF) is prepared for programs or plans with a multiplicity of uncertain projects.

- **Operational Safeguard 2 (OS 2)**

The safeguard focuses on involuntary resettlements, land acquisition, population displacements and requirements and compensation. It consolidates the policy commitment and requirements on involuntary resettlements and incorporates improvements operational effectiveness.

- **Operational Safeguards 3 (OS 3)**

This safeguard is designed to govern biodiversity and ecosystem services for the conservation and promotion of sustainable use of natural resources. Among the focus is on the integrated water resources management where commitments translated into operational requirements.

- **Operational Safeguard 4 (OS 4)**

OS4 governs pollution prevention and control, hazardous materials and resource efficiently. It covers a wide range of impacts arising from pollution, wastes and hazardous materials and particularly those under international conventions and regional standards. This also includes greenhouse accounting. The OS4 principles also support OS1 described above.

- **Operational Safeguard 5 (OS 5)**

Labor conditions, health and safety are a major concern in projects. The Bank therefore, has established OS5 to address requirements concerning works conditions, rights and protection from abuse and/or exploitation.

- **Project Categorization**

The project screening through OS1 and in support of OS 2 - 5 leads to categorization of the project. The project categories are guided by considered linkage levels as follows;

Category 1: Bank Operations Likely to Cause Significant Environmental and Social Impacts

Category 1 projects are likely to induce significant and/or irreversible adverse environmental and/or social impacts, or to significantly affect environmental or social components that the Bank or the borrowing country considers sensitive. Some program-based operations or other regional and Sector program loans have significant adverse environmental or social risks and are deemed to be Category 1. In some cases, projects are included in Category 1 because of their potential cumulative impacts or the potential impacts of associated facilities.

Any project requiring a Full Resettlement Action Plan (FRAP) under the provisions of the Bank's policy on involuntary resettlement is also deemed to be Category 1. Category 1 program-based operations or regional and sector loans require a SESA, and Category 1 investment projects require an ESIA, both leading to the preparation of an ESMP. For a

project requiring a FRAP, the ESIA includes, and if there are no other issues requiring assessment may be limited to, the social assessment needed to prepare the FRAP.

Category 2: Bank Operations Likely to Cause Less Adverse Environmental and Social Impacts than Category 1

Category 2 projects are likely to have detrimental site-specific environmental and/or social impacts that are less adverse than those of Category 1 projects. Likely impacts are few, site-specific, largely reversible, and readily minimized by applying appropriate management and mitigation measures or incorporating internationally recognized design criteria and standards. An operation that involves resettlement activity for which an Abbreviated Resettlement Action Plan (ARAP) is required under the ESAPs is classified as Category 2.

Most program-based operations and regional or sector program loans designed to finance a set of subprojects approved and implemented by the borrower or client are included in this category unless the nature, scale or sensitivity of the intended pipeline of subprojects involves either a high level of environmental and social risk or no such risk. Category 2 projects require an appropriate level of environmental and social assessment (SESA for program operations, investment plans, and some corporate loans, or ESIA for investment projects) tailored to the expected environmental and social risk so that the borrower can prepare and implement an adequate ESMP (for an investment project) or ESMF (for a program operation), to manage the environmental and social risks of subprojects in compliance with the Bank's safeguards.

Category 3: Bank Operations with Negligible Adverse Environmental and Social Risks

Category 3 projects do not directly or indirectly affect the environment adversely and are unlikely to induce adverse social impacts. They do not require an environmental and social assessment. Beyond categorization, no action is required. Nonetheless, to design a Category 3 project properly, it may be necessary to carry out gender analyses, institutional analyses, or other studies on specific, critical social considerations to anticipate and manage unintended impacts on the affected communities.

Category 4: Bank Operations Involving Lending to Financial Intermediaries

Category 4 projects involve Bank lending to financial intermediaries that on-lend or invest in subprojects that may produce adverse environmental and social impacts. Financial intermediaries include banks, insurance, reinsurance and leasing companies, microfinance providers, private equity funds and investment funds that use the Bank's funds to lend or provide equity finance to their clients. Financial intermediaries also include private or public sector companies that receive corporate loans or loans for investment plans from the Bank that are used to finance a set of subprojects. Financial intermediary subprojects equivalent to Category 1 and Category 2 are subject to the relevant OS requirements, as if they were directly financed Category 1 or Category 2 projects. However, if a client will use a Bank corporate loan to finance high-risk investment projects known at the time of loan approval, the loan can be considered Category 1.

3.7.3 AfDB Operational Safeguards

This ESIA will be undertaken to AfDB lenders' requirements. Some financial institutions are either Equator Principles Financial Institutions (EPFIs) or have their own established and highly detailed environmental and social requirements. This ESIA will be completed in line with International EHS Guidelines, Performance Standards and other Sector Specific Guidelines, which take all funding institutes' requirements into account.

- **Classification of Project**

The Eastern Corridor N2 Project can be classified as **"Category 1"** by AfDB project screening under project categorization because the project will have significant environmental and social impacts. Most of the impacts are expected to be very significant or irreversible. The project requires full-blown environmental and social impact assessment to examine the project's potential negative and positive environmental and impacts and recommends any mitigation and monitoring measures to prevent, minimize or compensate performance. In AfDB operation the purpose of Environmental and Social Impact Assessment is to improve decision-making and decision-taking, to ensure that project options under consideration are sound and sustainable, and that potentially affected persons have been properly consulted.

- **Other Applicable Guidelines and Policies of AfDB**

The other applicable guidelines and policies of the AfDB are:

- ❖ **The Bank's Policy on Gender (2001);**
- ❖ **The Engagement Framework Consolidated by Civil Society Organizations (2012);**
- ❖ **The Policy on Dissemination and Access to information (2012);**
- ❖ **The Bank's Policy on Integrated Water Resources Management (2000);**
- ❖ **AfDB's Strategy for Climate Risk Management and Adaptation to Change;**
- ❖ **The Environmental and Social Assessment Procedures for Public Sector Operations of the Bank (2014).**
- ❖ **Handbook on Stakeholder Consultation and Participation in AfDB Projects and Operations (2001)**

Table 3.0 and **Table 4.0** Summaries the Operational Safeguards Objectives and Triggers Implication to the Project Components and Category Definition for AfDB Projects.

Table 3.0 Summary of OS Objectives and Triggers Implication to Project Components

Operational Safeguards	Description	Objectives	Trigger (Yes/No) and How	Implication
OS 1	Environmental and Social Assessment	<p>1.To identify and assess the environmental and social impacts (including gender) and climate change vulnerability issues of Bank lending and grant financed operations in their area of influence.</p> <p>2.To avoid or if not possible minimize, mitigate and compensate for adverse impacts on the environment and on affected communities.</p> <p>3.To ensure that affected communities have timely access to information in suitable forms about Bank operations and are consulted meaningfully about issues that may affect them.</p>	<p>Yes</p> <p>1.This OS 1 is triggered through the mandatory Environmental and Social Screening Process through which the project is assigned a Category 1 based upon its potential environmental and social risks and impacts in its area of influence. These potential risks and impacts include physical, biological, socio-economic, health, safety, localized impacts and global impacts including Greenhouse gas (GHG) emissions and vulnerability to climate change effects.</p> <p>2.For the preparation of feasibility and design studies for all the project components, the planned works are likely to have significant environmental and social direct, indirect or cumulative impacts locally and not at the regional level. This OS 1 will thus be triggered.</p>	Based on the outcome of the pre-feasibility studies, the preparation of feasibility and design studies reports under the project components have determined that a full ESIA is required including management plans (ESMP and Monitoring).
OS 2	Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.	<p>1.To avoid involuntary resettlement where feasible, or minimize resettlement impacts where involuntary resettlement is</p>	<p>Yes</p> <p>1.This OS 2 is triggered since the project components require the involuntary acquisition of land, involuntary</p>	For the pre-feasibility, feasibility, design and ESIA studies these critical requirements will have to be met: 1.A Resettlement Policy Framework

		<p>unavoidable, exploring all viable project design.</p> <p>2.To ensure that displaced people receive significant resettlement assistance, preferably under the project, so that their standards of living, income earning capacity, production levels and overall means of livelihood are improved beyond pre-project levels.</p> <p>3.To set up a mechanism for monitoring the performance of involuntary resettlement programs in Bank operations and remedying problems as they arise to safeguard against ill-prepared and poorly implemented resettlement plans.</p>	<p>acquisition of other assets or restrictions on land use and on access to local natural resources which result in:</p> <p># relocation or loss of shelter by the people residing in the project area of influence.</p> <p># loss of assets or restriction of access to farmlands and natural resources.</p> <p># loss of income sources or means of livelihood due to the project, whether the PAPs are required to move or not.</p> <p>2.The project components implementation will induce RoW acquisition leading to farmlands and landed properties acquisition and destruction of crops. A full RAP document has been prepared to assess and cover resettlement or displacement and compensation issues to be addressed. This OS 2 will thus be triggered.</p>	<p>will have to be prepared or referenced with Grievance Redress Mechanism for the project components.</p> <p>2.Project components will require the preparation of a Full Resettlement Action Plan (FRAP) to address all the issues related to resettlement, displacement or compensation payments.</p> <p>3.A Grievance Redress Mechanism will be required to be defined as part of the FRAP for the project components, taking into consideration the local context.</p> <p>4.The FRAP report of the project components will be disclosed locally, at the national level as well as in the GHA website and the AfDB info-shop.</p>
OS 3	Biodiversity and Ecosystem Services	<p>1.To preserve biological diversity by avoiding, or if not possible, reducing and minimizing impacts on biodiversity.</p> <p>2.In cases where some impacts are unavoidable, to endeavor to</p>	<p>Yes</p> <p>1.This OS 3 is triggered since two of the project components are sited in green fields agricultural farmlands with potential habitat resources for fauna species where</p>	<p>The pre-feasibility studies outcome has established and confirm the need for preparation of feasibility and design studies reports for the project components. Determination has</p>

		<p>reinstate or restore biodiversity including, where required, the implementation of biodiversity offsets to achieve “not net loss but net gain” of biodiversity.</p> <p>3.To protect natural, modified and critical habitats.</p> <p>4.To sustain the availability and productivity of priority ecosystem services to maintain benefits to the affected communities and to sustain project performance.</p>	<p>there may be potential biodiversity impacts or in areas providing ecosystem services upon which potentially affected stakeholders are dependent for survival, sustenance, livelihood or primary income, or which are used for sustaining the project.</p> <p>2.For the preparation of feasibility and design studies for all the project components, the planned works are likely to have moderate to major impacts on nearby critical habitats, shrubland and associated grassland fragments, including borrow areas on the wildlife corridors and any marshlands. This OS 3 will thus be triggered.</p>	<p>already been made to conduct a full-blown ESIA which will include recommendations on suitable mitigation measures to prevent, minimize, mitigate or compensate for such adverse environmental and social performance.</p>
OS 4	Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency	<p>1.To manage and reduce pollutants likely to be caused by a project so that they shall not pose harmful risks to human health and the environment, including hazardous, non-hazardous waste and GHG emissions.</p> <p>2.To set a framework for efficiently utilizing all of a project's raw materials and</p>	<p>Yes</p> <p>1.This OS 4 is triggered since the project components are likely to cause significant adverse environmental or social impacts owing to the emission of pollutants, waste or hazardous materials covered by national legislation, international conventions or</p>	<p>The proposal will involve project component implementation close to the Volta River Basin, therefore the Proposal could not be exempted from any notification requirement. In compliance with OS 4, the technical studies of the proposal will include an analysis of any potential impacts from the</p>

		natural resources especially focusing on energy and water.	internationally recognized standards or by unsustainable resource use. It is also triggered by potentially significant levels of GHG emissions. 2.The project components will be implemented near the Volta River basin leading to potential pollution of the waterbody by construction activities. This OS 4 will be triggered.	project components as well as the identification of potential mitigation measures.
OS 5	Labor Conditions, Health and Safety	<p>1.To protect the workers' rights and to establish, maintain, and improve the employee-employer relationship.</p> <p>2.To promote compliance with national legal requirements and provide due diligence in case national laws are silent or inconsistent with the OS.</p> <p>3.To provide broad consistency with the relevant International labor Organization (ILO) Conventions, ILO Core Labor Standards and UNICEF Convention on the Rights of the Child in cases where national laws do not provide equivalent protection.</p> <p>4.To protect the workforce from inequality, social exclusion, child</p>	<p>Yes</p> <p>This OS 5 is triggered for the project components will involve the engagement or establishment of a temporary or permanent workforce.</p>	A full-blown ESIA study has been conducted to ensure congenial labor working conditions, health and safety of workforce to be engaged or established by the Project.

		labor and forced labor. 5.To establish requirements to provide safe and healthy working conditions.		
--	--	--	--	--

Source: AfDB ESAP Document (2015)

Table 4.0 Category Definition for AfDB Project

Serial Number	Category	Description/Definition
1	Category 1	Bank operations likely to cause significant environmental and social impacts.
2	Category 2	Bank operations likely to cause less adverse environmental and social impacts than Category 1.
3	Category 3	Bank operations with negligible adverse environmental and social risks.
4	Category 4	Bank operations involving lending to financial intermediaries.

Source: AfDB ESAP Document (2015)

Chapter 4 Description of the Project and Justification

4.1 Introduction

The Proposal has the following background information: (i) the Eastern Corridor (N2) is an alternative international transit route identified by the Government of Ghana (GOG) to facilitate transit and trade; (ii) the GOG sought for and obtained support from the Japanese Government to develop the N2; (iii) JICA undertook a feasibility study and established that the implementation of N2 is feasible; (iv) GOG now intends to develop the N2 based on JICA's feasibility studies and designs; (v) JICA's feasibility studies and design yielded five alternative road alignments (see map); (vi) JICA's preliminary road alignment (alternative 3) was selected by the Client for further studies and development (see map).

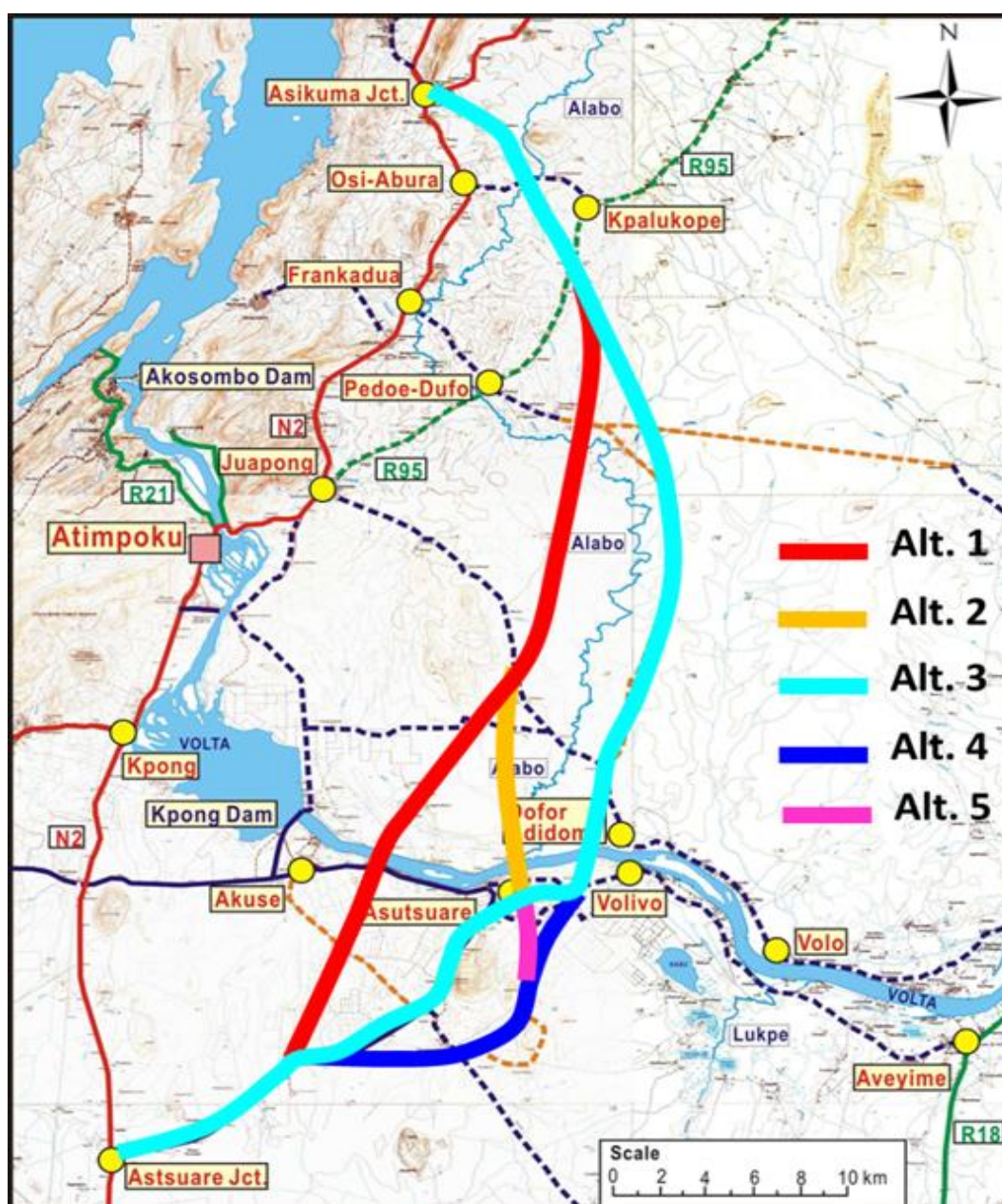


Fig 1 - Alternative Routes Provided by JICA

4.2 Project Location

The Eastern Corridor which lies to the east of the country, and approximately 695 km in length commences from Tema Roundabout through some important towns in the Greater Accra, Volta, Northern Regions and ends at Kulungugu in the Upper East Region of the country. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages during the rainy season making travel difficult. The GoG intends to develop a targeted section of the Eastern Corridor which traverses eight (8) districts and one (1) metropolis in three (3) regions. Therefore, the project zone will cover the following districts: Yilo Krobo, Manya Krobo, Asuogyaman (in the Eastern Region); Dangme West and Dangme East (in the Greater Accra Region); South Tongu, North Tongu, Adaku-Anyigbe (in the Volta Region) and Ho metropolis (in the Volta Region).

The Proposed Project Roads are the following:

- **Section 1: Asutware Junction – Volivo (28.3km)**

This 28.3km road branches eastwards from Tema-Akosombo road at Asutware Junction and passes through agricultural and commercial towns/villages in the Eastern region to Volivo. The surface is generally gravel but it has some sections paved. The road is of width 7.3m, at the paved section and of lower width at the unpaved sections.

- **Section 3: Dufor Adidome – Asikuma Junction (38.4km)**

This section currently does not exist and would have to be built through a virgin area. Preliminary road alignment has been developed by the consultant who was engaged for the feasibility study of the road and can be made available.

- **Section 2: Asutware-Aveyime Road (24km)**

This 24km section stretches southwards from Asutware through agricultural and commercial towns/villages in the Volta region to Aveyime. The road is gravel surfaced and is distressed in sections. The road is of width 7.3m.

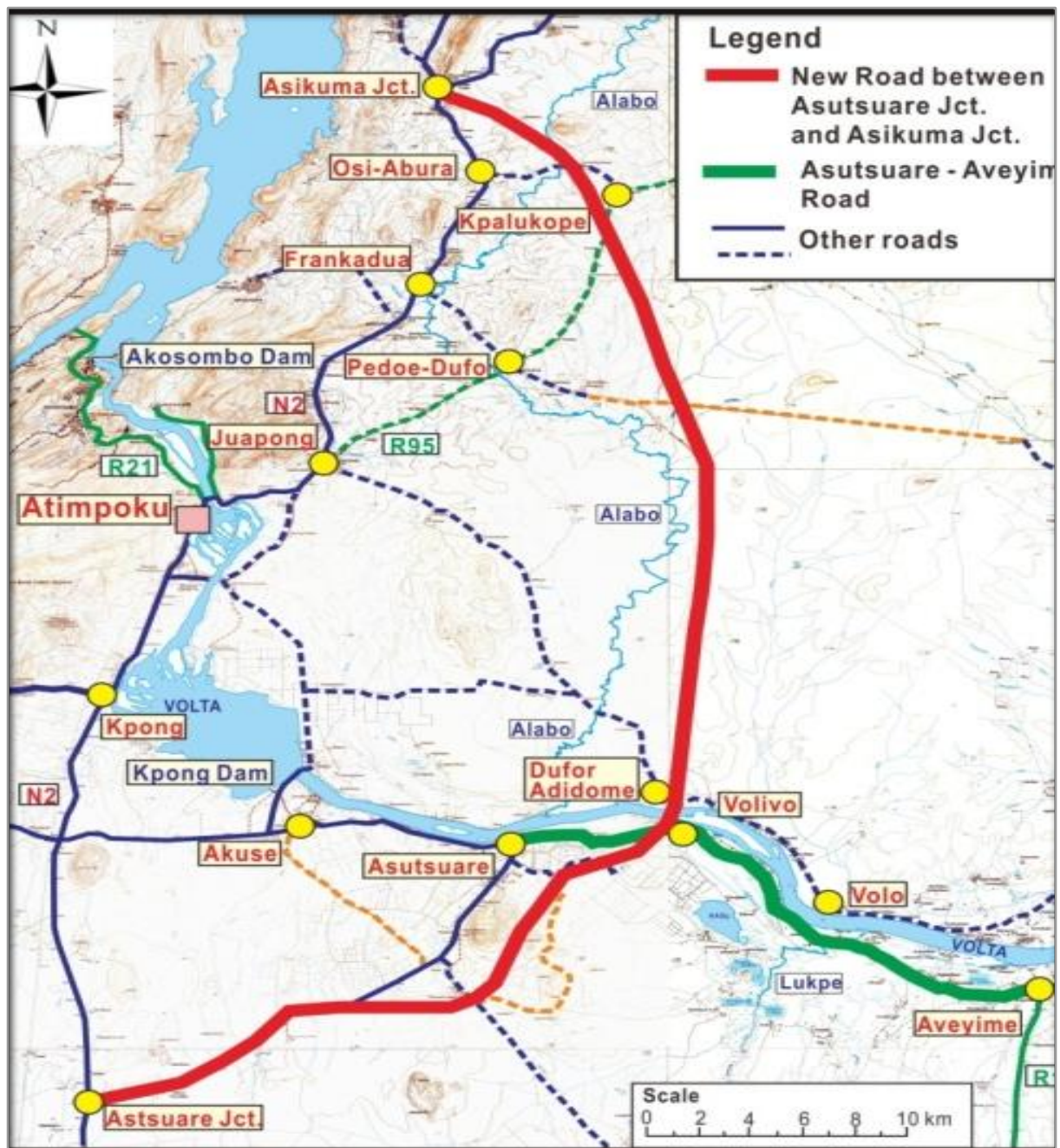


Fig 2 – Map Showing the Selected Alignment

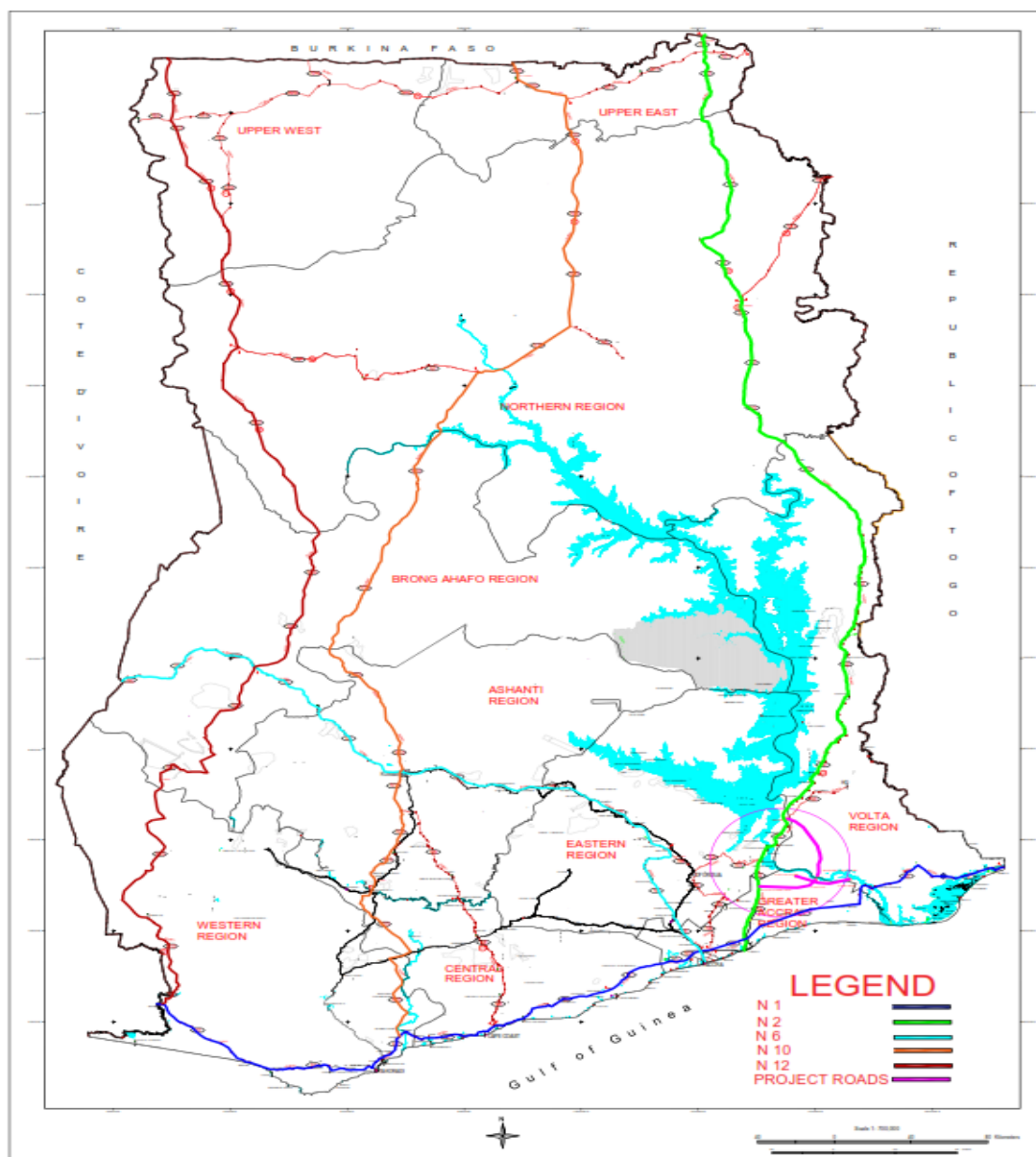


Fig 3 – Ghana Map Showing Connectivity Between Project Roads and the National Road Network

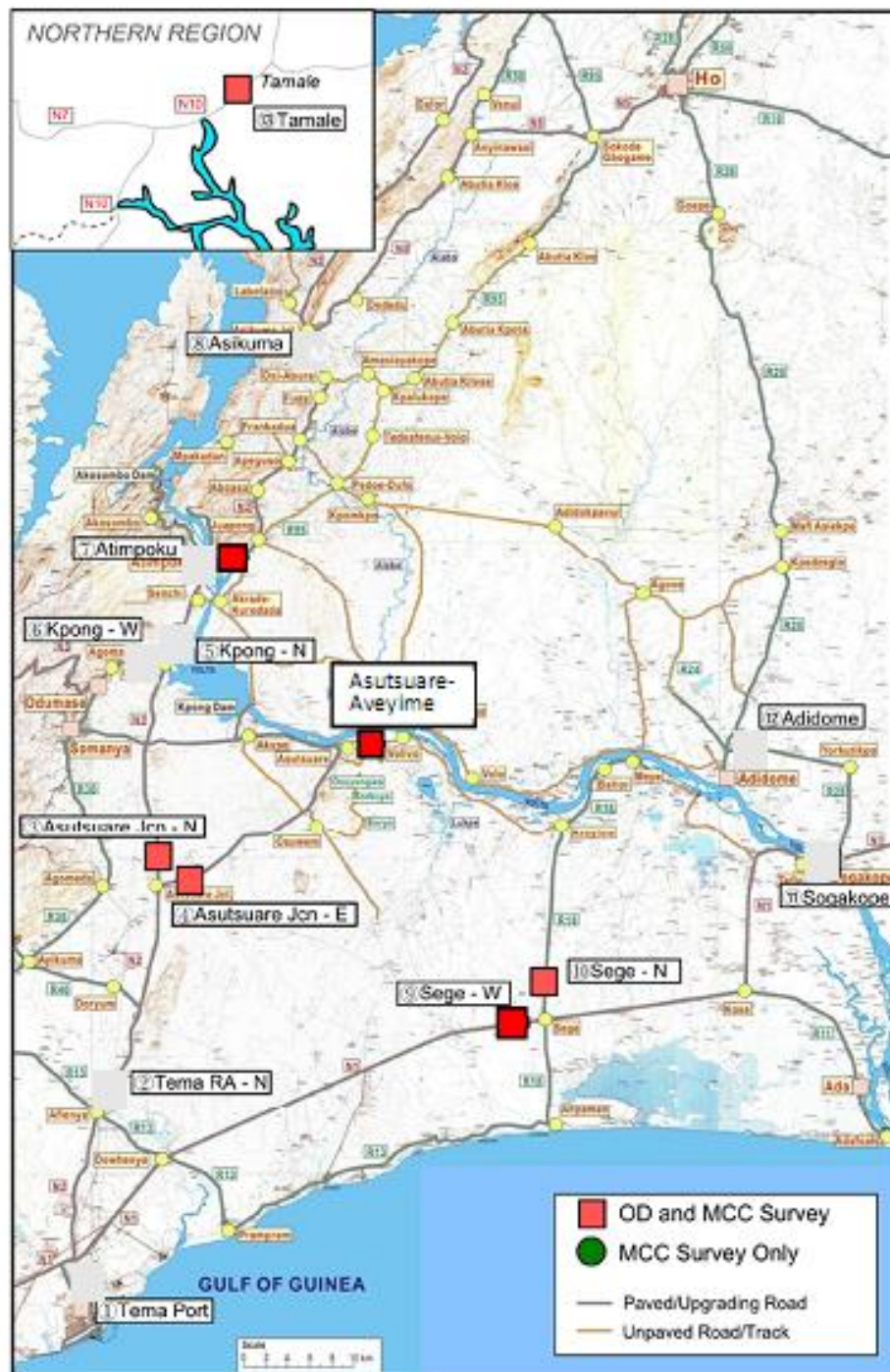


Fig 4 – Classified Manual Counts (MC) and Origin-Destination (OD) Surveys Census Locations

4.3 Project Components

As three (3) sections of the Eastern Corridor International Transit Route form the main components of the Project, there are other sub-project within the overall context of Eastern Corridor Proposal, consisting of the following components (See Table 5.0):

Table 5.0 Project Components

Serial Number	Component Name	Estimated Cost (USD or GHc)	Component Description
1	Road Construction Civil Works	USD 129,786,847.66	(i)Construction Civil Works (Section 1): Asutuare Jn – Volivo Road. (ii)Construction Civil Works (Section 3): Dufor Adidome – Asikuma Jn Road. (iii)Construction Civil Works (Section 2): Asutuare – Aveyime Road. The following are included: (iv)Drainage, traffic studies, geotechnical bridges and interchange, pavement designs.
2	Road Safety	USD 155,744.22	Roads safety awareness and education campaign targeting children. Cyclists, pedestrians, especially women and bus/taxi/okada (motor-cycle taxis) operators.
3	HIV/AIDS/STI/TB/Malaria/Ebola/Cholera Mitigation	USD 129,786.85	HIV/AIDS/STI and others awareness and prevention programs. The program will target construction workers, the communities along the Eastern Corridor and long-haul truck drivers.
4	ESMP Implementation	USD 6,489,342.38	Environmental and social mitigation measures over and above those included in the Bill of Quantities, ie. (i)off-road environmental and social protection activities and (ii)complementary activities such as tree planting, water provision, etc. It is

			estimated that 16ha of trees will be planted under the Project (40.59 acres of bare land will be appropriated under RoW acquisition).
5	Gender Component	USD 804,678.45	Gender sensitization and capacity building of community- based organizations.
6	Compensation and Resettlement of PAPs	GHc 26,292,463.89	Provision of adequate compensation and relocation/resettlement of PAPs identified in the ESIA and FRAP documents.
7	Consulting Services	USD 1,064,252.15	(i)Consulting services for construction supervision of civil works. (ii)Consulting services for Project Technical and Financial Audit.
8	Institutional Support and Capacity Development Component	USD 194,680.27	Consulting services for: (i)Preparation of Bidding Documents and Bid Evaluation assistance, as well as contract management assistance. (ii)Design of a Project Performance Monitoring System (PPMS) for Project impact monitoring. (iii)Enhancing GHA's Project Management capacity (preparation of BDs and procurement (contract management, including cost control) (iv) capacity development at national and district/municipal assemblies levels.

Source: K E & T Data Records

4.4 Project Description

4.4.1 Field Study Findings of Proposed Alignments (Sections 1 and 3)

- Section 1: Asutuare Jn – Volivo Road (28.3km)
- Section 3: Dufor Adidome – Asikuma Jn (38.4km)

4.4.1.1 Hydrological and Drainage Conditions of Sections 1 and 3

There are 2No. Pipe Culverts and 9No. Box Culverts as definite drainage arrangements within the entire Section 1 of the proposed road. On the other hand, there are no pipe culverts nor box culverts adorning Section 3 of the proposed project road. Instead, River Volta, River Alabo and tributaries of River Lomen cross Section 3 of the proposed project road. The existing drainage structures within Section 1 are structurally weak with inadequate hydraulic capacities, therefore, would have to be demolished and replaced. **See Table 6.0.**

Table 6.0 Hydrological/Drainage Findings for Sections 1 and 3 of Project Roads

Serial Number	Number Existing (No.)	Description	Comments
1	2	Pipe Culverts	Demolish and Replace on Section 1 Project Road.
2	9	Box Culverts	Demolish and Replace on Section 1 Project Road.
3	-	River Volta; River Alabo and Tributaries of River Lomen	Main Rivers Crossing Section 3 of the Project Roads.

Source: K E & T Design Document

4.4.1.2 Traffic Studies of Sections 1 and 3 Catchment Zone

The Classified Manual Counts (MC) and Origin-Destination (OD) surveys were conducted on the respective road sections within the Sections 1 and 3 project roads catchment zone and shown in **Table 7.0**. This information was used in pavement design. The census locations are shown in **Figure 4**.

Table 7.0 Traffic Studies and Results for Sections 1 and 3 Project Roads

Serial Number	Road Section	ADT	AADT
1	Asutuare East – Asutuare Junction	550	528
2	Sege West - Battor	1,506	1,446
3	Sege North - Tema	5,612	5,387
4	Asutuare North – Kong	3,508	3,368
5	Juapong - Atimpoku	2,836	2,723
6	Bunso – Osino	8,740	8,827

Source: K E & T Design Documents

4.4.1.3 Geotechnical Investigations Results for Sections 1 and 3 of Project Roads

The subgrade and existing pavement conditions were investigated. The results were as follows:

- Subgrade CBR ranges from 8% to 20%
- A design CBR of 12% was used for pavement design

Black cotton clay was located at the following chainages and recommended to be removed to the stated depths below:

- CH. 10+800 – CH. 28+245 (1.5m deep)
- CH. 28+700 – CH. 48+000 (2.0 m deep)

4.4.1.4 Bridge Site Investigations for Sections 1 and 3 of Project Roads

The allowable bearing capacities and foundation depths are indicated below:

- Allowable Bearing Capacities obtained range from 200kPa to 290kPa
- Recommended Foundation depths range between 3.0m and 3.5m

4.4.1.5 Construction Materials Survey for Sections 1 and 3 of Project Roads

The construction materials survey and findings are shown in **Table 8.0**.

Table 8.0 Construction Materials Surveys and Findings

Serial Number	Construction Materials Type	Location Obtainable	Comments
1	Sand	Volta River at Asutuare; Aveyime and Battor.	For Concrete Works
2	Rock Aggregates	Eastern Quarries; Bigleb Quarry; Rockshell Quarry and Mafi-Kpedzi Outcrop	For Concrete and Road Surfacing
3	Gravels	Afienya and Its Environs.	Quality Gravel.

Source: K E & T Design Documents

4.4.2 Detailed Engineering Designs for Sections 1 and 3 of Project Roads

4.4.2.1 Geometric Design for Sections 1 and 3 Project Roads

The detailed geometric engineering design for sections 1 and 3 of the project roads is shown in **Table 9.0**.

Table 9.0 Geometric Design for Sections 1 and 3 Project Roads

Design Parameters	Roads Classification	Design Speed	Minimum Radius (m)	Minimum Arc Length (m)	Minimum Curve (m)	Minimum K Value (Crest)	Minimum K Value (Sag)
-	National Road	100km/h	-	-	-	-	-

Horizontal Design	National Road	100km/h	694.495	170.0	-	-	-
Vertical Alignment	National Road	100km/h	-	-	85	64	28

Source: K E & T Design Documents

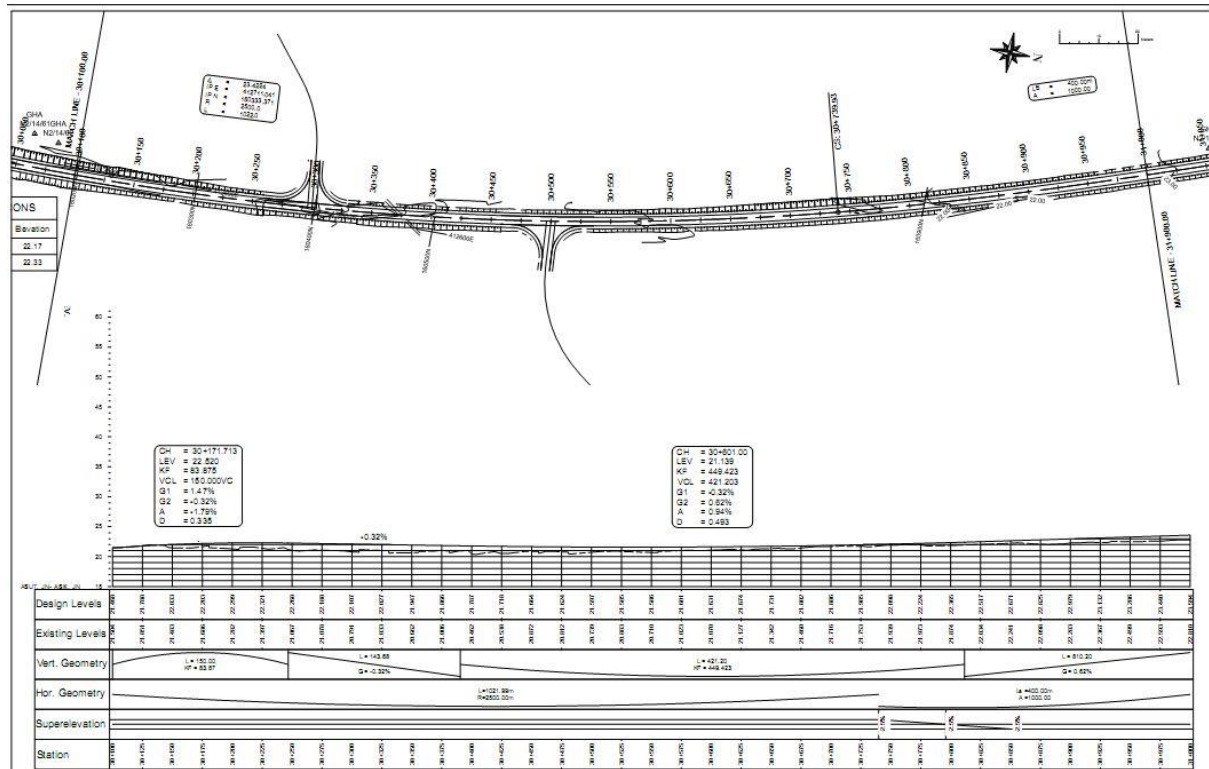


Figure 5 Sample Road Plan and Profile for Sections 1 and 3 Project Roads

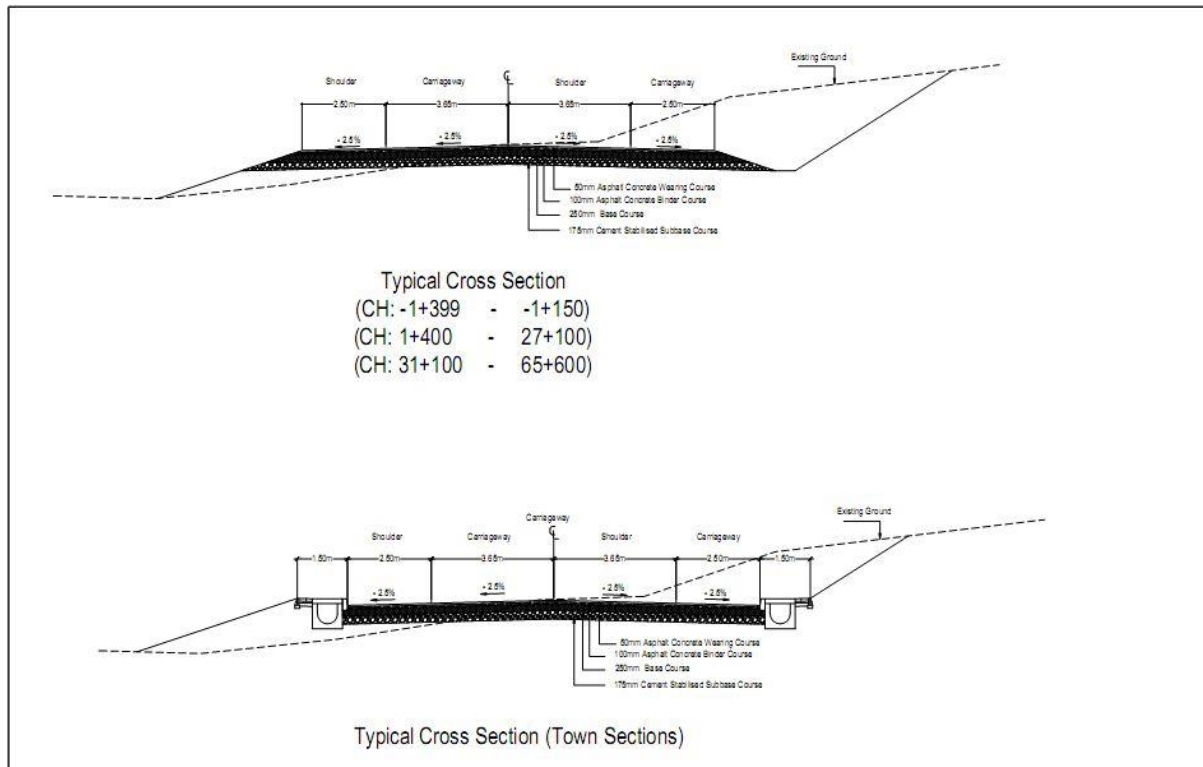


Figure 6 Typical Cross-Sections of Project Roads 1 & 3

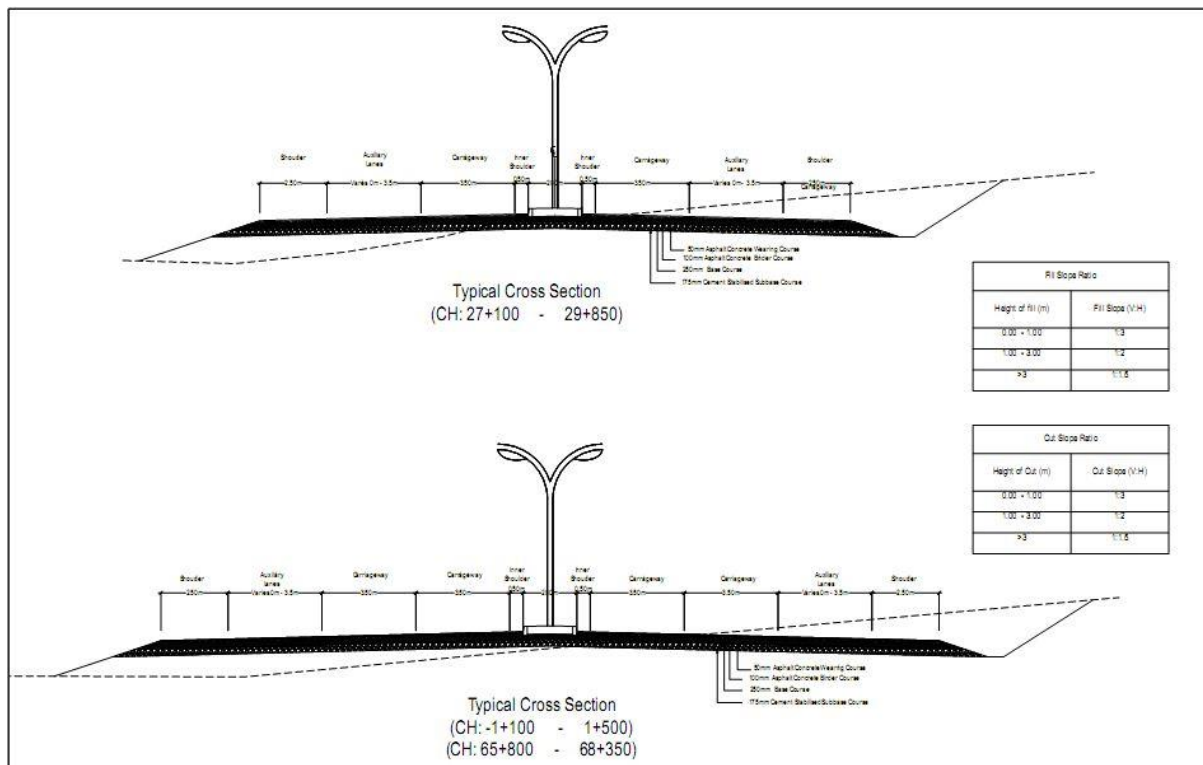


Figure 7 Typical Cross-Sections of Project Roads 1 & 3

4.4.2.2 Pavement Design for Sections 1 and 3 Project Roads

The following data was used for the pavement design of Sections 1 and 3 of the project roads:

- The subgrade strength (CBR) of 8%
- The cumulative number of equivalent standard axles (28,056,869) that will use project roads over the 20-year design life.

Pavement structure design utilized the following recommended data:

- 50mm asphaltic concrete wearing coarse
- 100mm asphaltic concrete binder
- 250mm crushed stone base
- 175mm granular sub-base

4.4.2.3 Drainage Design for Sections 1 and 3 Project Roads

The drainage design for hydrological structures for sections 1 and 3 of the project roads is shown in **Table 10.0**.

Table 10.0 Drainage Design for Sections 1 and 3 of Project Roads

Serial number	Chainage (km)	Structure Type	Span (m)	Comments
1	7 + 200	Bridge	15	Over River Dawhe for Section 1 Project Road
2	23 + 230	Bridge	45	Over Irrigation Canal for Section 1 Project Road
3	33 + 150	Bridge	15	Over Tributary of River Alabo for Section 3 Project Road
4	49 + 850	Bridge	15	Over Tributary of River Alabo for Section 3 Project Road
5	61 + 000	Bridge	60	Over River Alabo for Section 3 Project Road
6	63 + 025	Bridge	90	Over River Alabo for Section 3 Project Road
7	28 No.	Box Culverts	-	Selected locations for Sections 1 and 3 Project Roads
8	9 No.	Pipe Culverts	-	Selected locations for Sections 1 and 3 Project Roads

Source: K E & T Design Documents

4.4.3 Changes to JICA Design by Client

After presentation of the Interim Design Report by Consultant to the Client, the following design changes were made to incorporate the following features and new scope of works:

- Replacement of four (4No.) Rotary Roundabouts in the JICA design.
- Redesign and installation of four (4No.) Grade-Separation Interchanges.
- Design Consultants extra works in redesigning of four (4No.) Rotary Intersections into Interchanges through new topographic surveys, geotechnical investigation, geometric design, bridge design and cost estimation.
- Design Consultants undertook re-alignment of Section 1 of the project road around Golden Exotic Farms to avoid the Paddy Rice Farms and Irrigation Canals and provide a link to the farms.

The New Interchanges Designed are:

- Asutware Junction Interchange at CH. 1 + 425 (Section 1 of Project Road)
- Volivo Interchange at CH. 29 + 095 (Section 1 of Project Road)
- Dufor Adidome Interchange at CH. 30 + 700 (Section 3 of Project Road)
- Asikuma Junction Interchange at CH. 68 + 625 (Section 3 of Project Road)

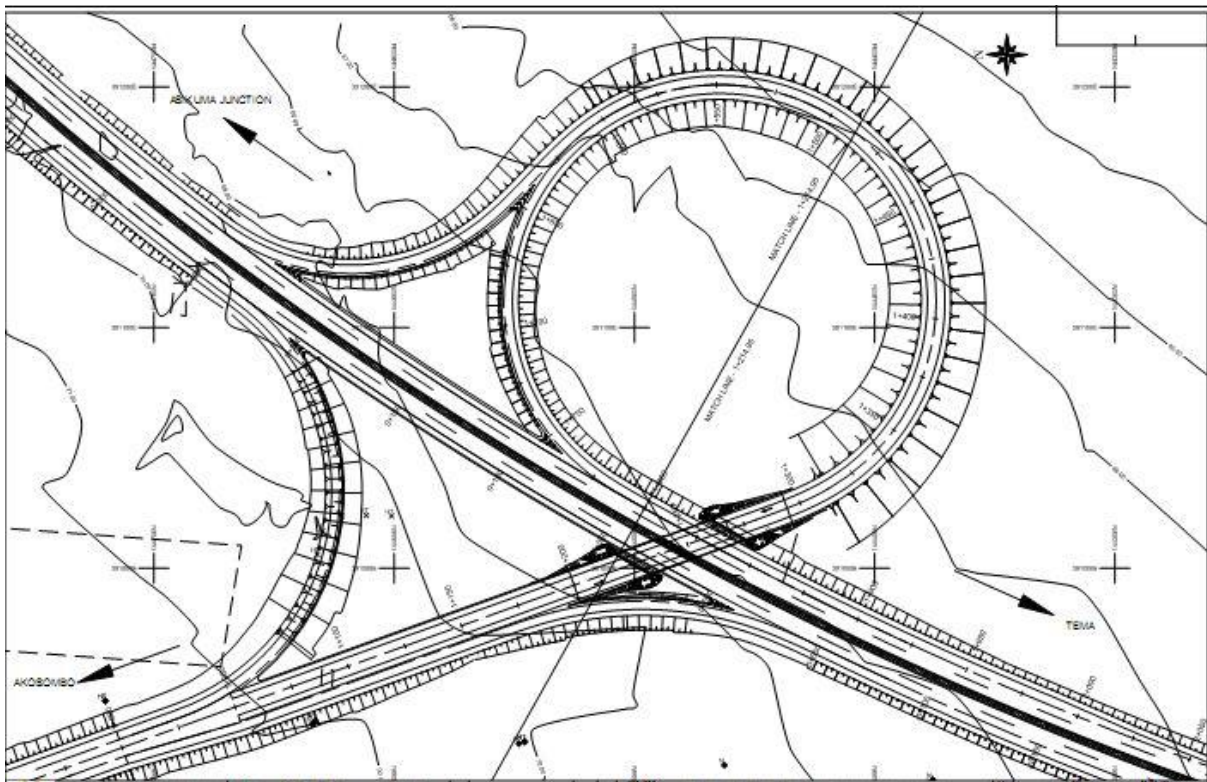


Figure 8 Layout of Asutware Jn Interchange CH. 1+245

APPENDIX - B11 (CH 5+875)

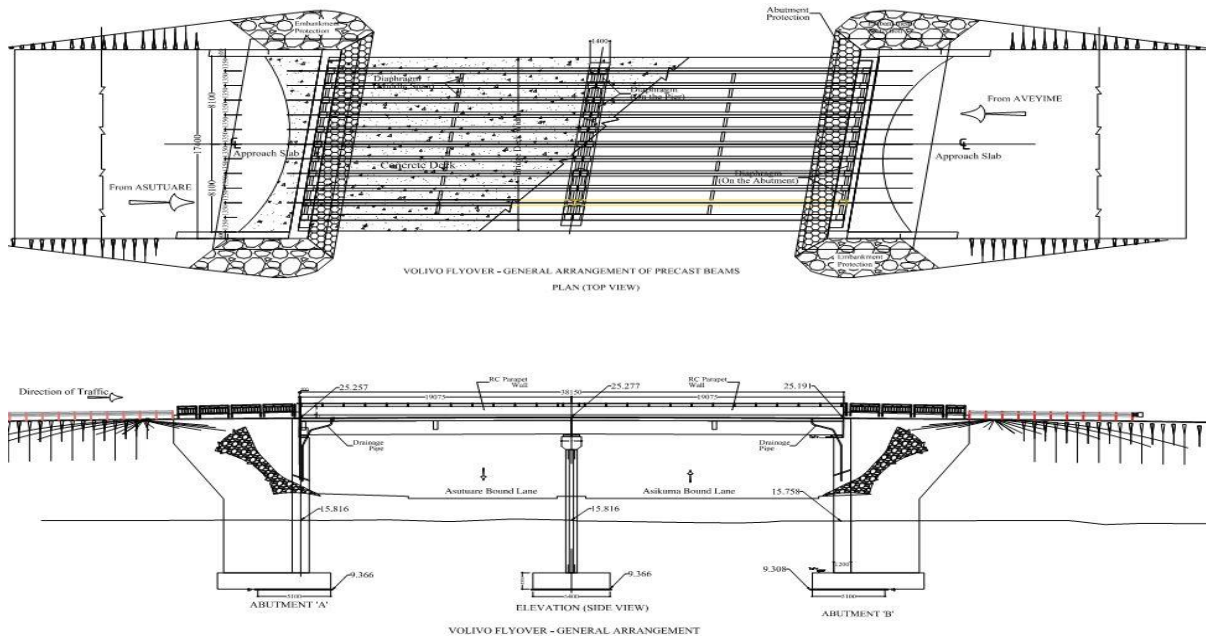


Figure 11 Bridge on Volivo Interchange at CH. 29+350 on Section 1 Project Road

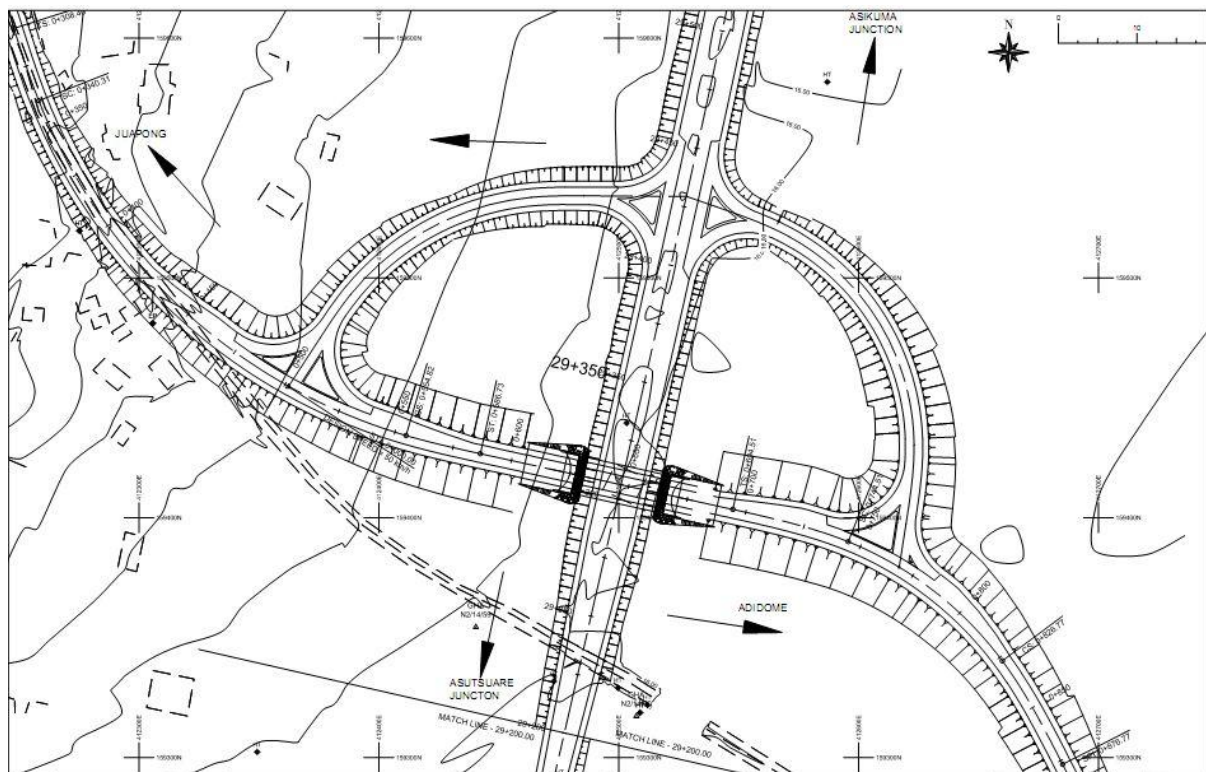


Figure 12 Layout of Dufor Adidome Interchange CH. 29+350 on Section 3 Project Road

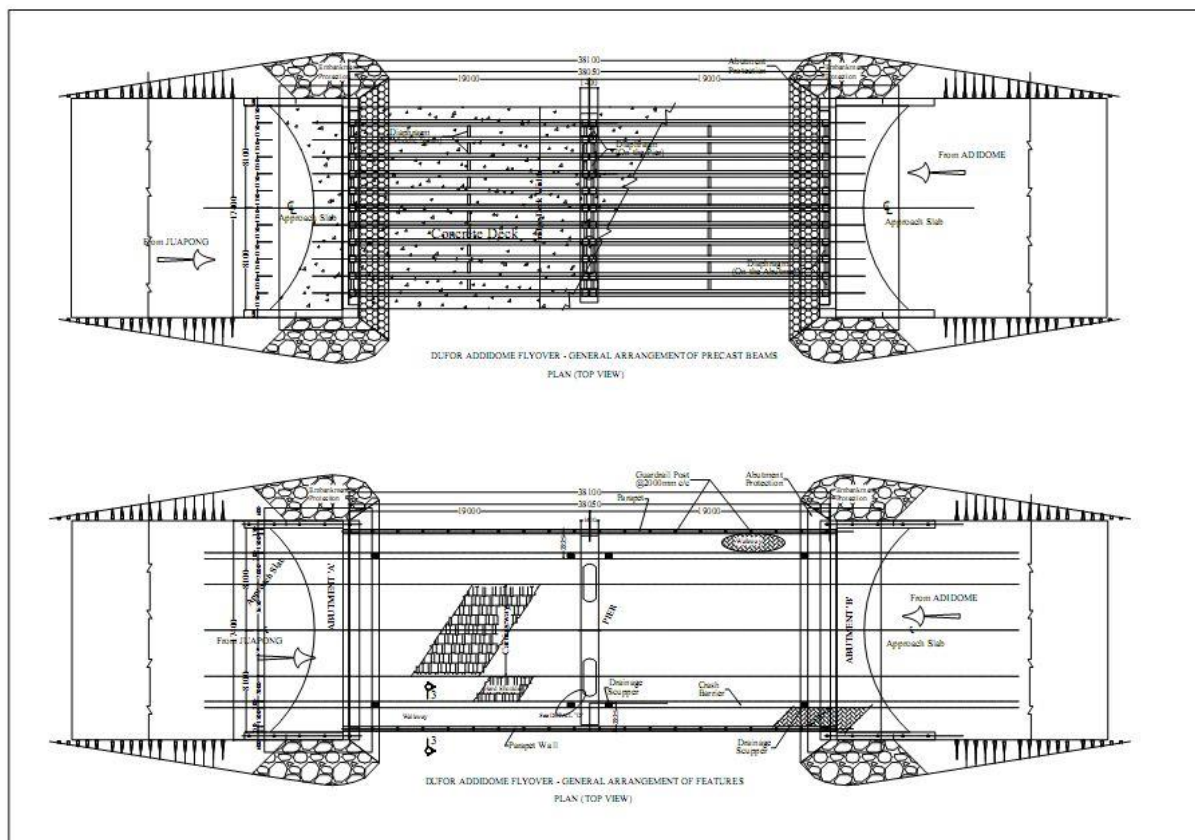


Figure 13 Bridge on Dufor Adidome Interchange CH.29+350 on Section 3 Project Road

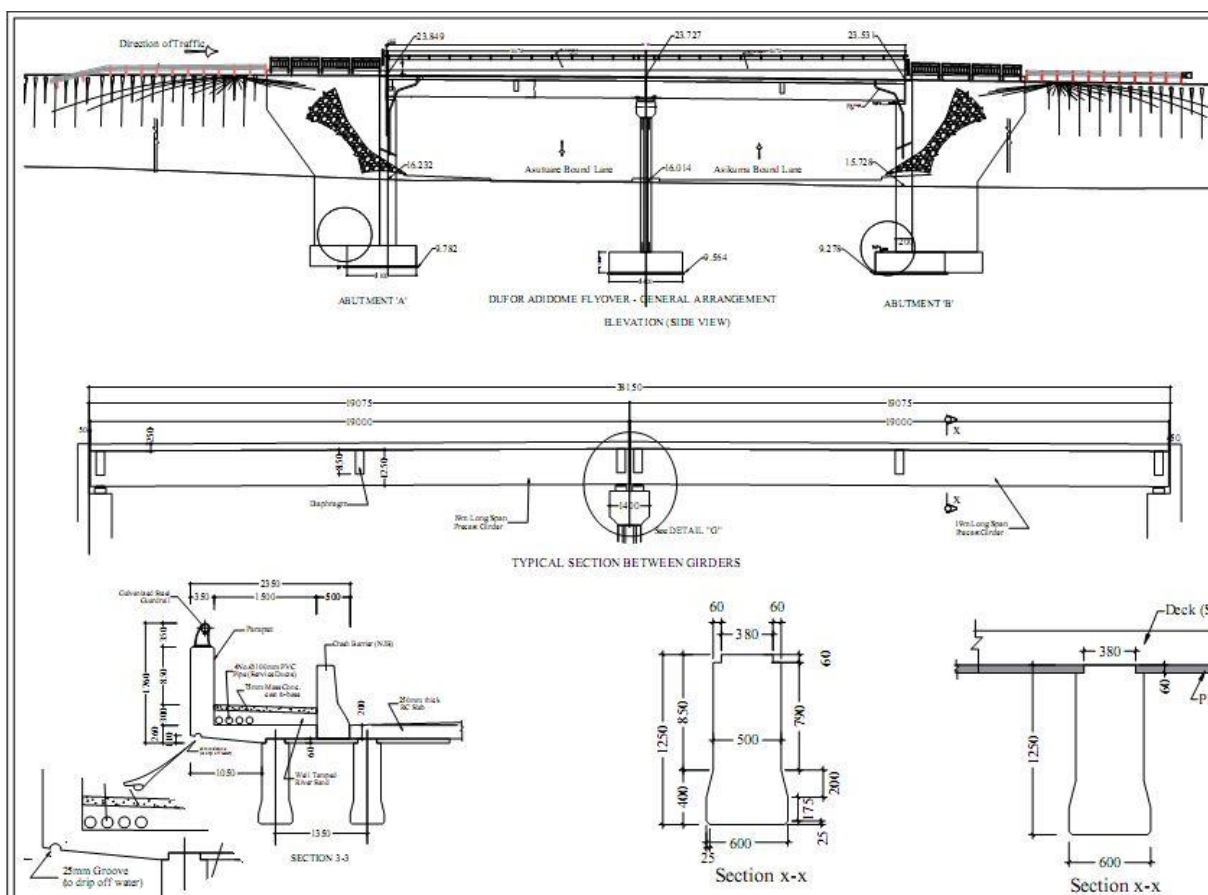


Figure 14 Bridge on Dufor Adidome Interchange CH. 29+350 on Section 3 Project Road

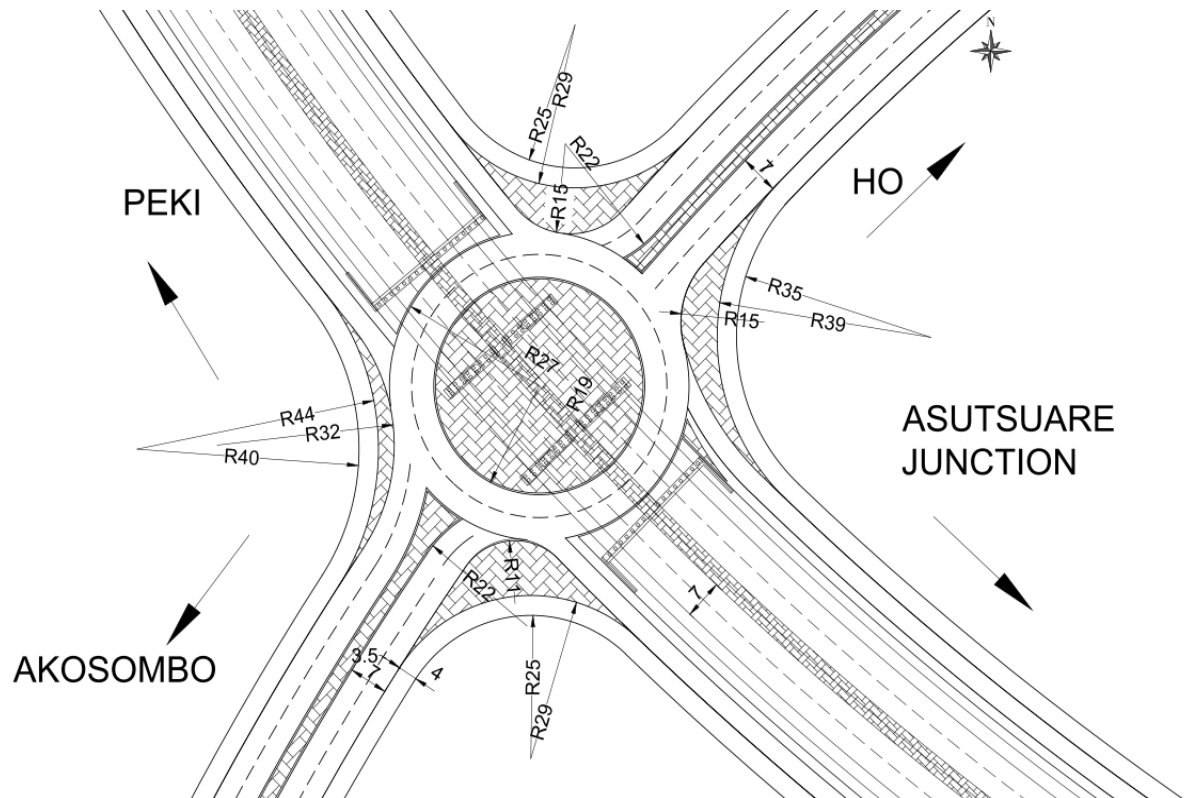


Figure 15 Layout of Asikuma Jn Interchange CH. 67+ 200 of Section 3 Project Road

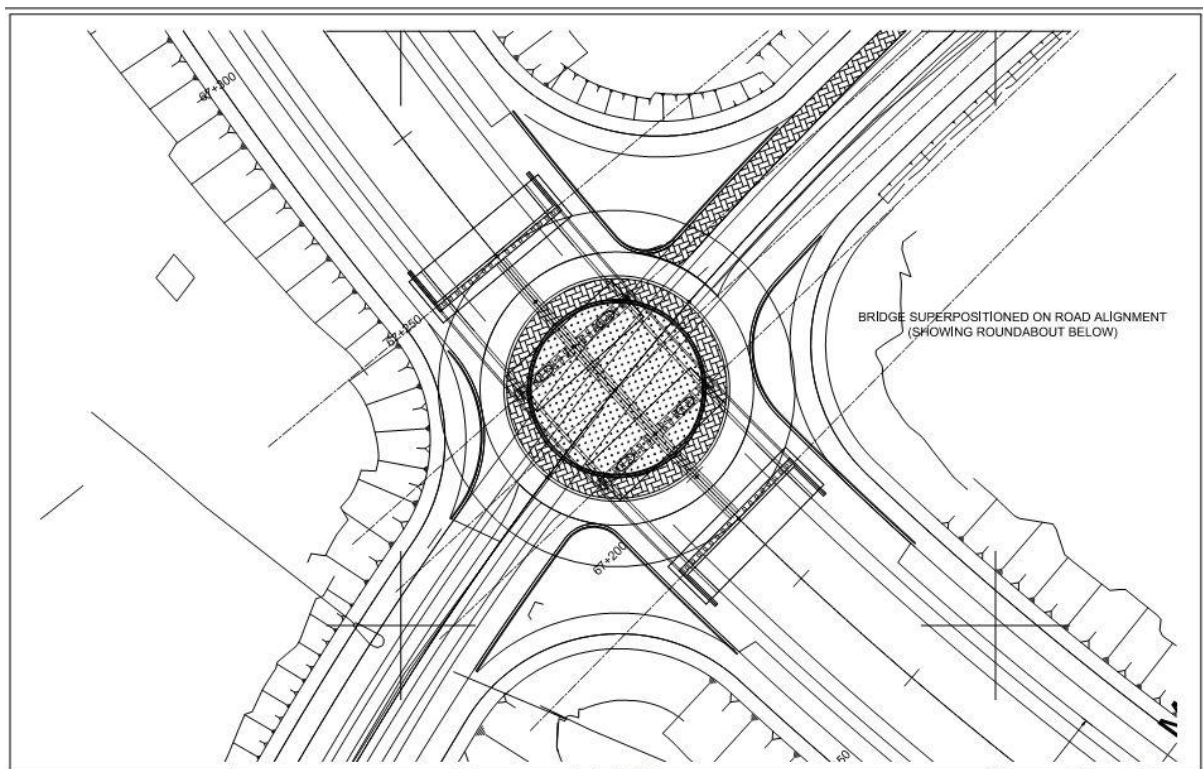


Figure 16 Bridge on Asikuma Jn Interchange CH. 67+ 200 for Section 3 Project Road

4.4.4 Additional Changes to Engineering Design by Client

The client made additional changes to the engineering design after presentation of the final design report with new cost estimates. Details of the new engineering design changes were as follows:

- Section 1 Project Road alignment be revised to avoid the black cotton clay section between CH. 11+700 – CH. 23+000
- The pavement design reviewed from asphaltic to double bituminous surfacing
- Drainage structure types be reviewed to save cost

4.4.4.1 Revised Final Drainage Structures Design for Sections 1 and 3 Project Roads

The revised final drainage structures design for Sections 1 and 3 project roads is shown in **Table 11.0** at selected sections of project roads 1 and 3.

Table 11.0 Revised Final Drainage Structures Design for Sections 1 and 3

Serial number	Quantity	Pipe Culverts	Quantity	Box Culverts
1	7	1/0.9m Diameter	2	2/2.0m x 2.0m
2	3	2/0.9m Diameter	2	3/2.0m x 2.0m
3	9	1/1.2m Diameter	1	3/2.0m x 3.0m
4	3	2/1.2m Diameter	1	4/2.0m x 2.0m
5	8	2/1.8m Diameter	1	4/4.0m x 2.5m

Source: K E & T Design Documents

4.4.4.2 Final Pavement Structures Design for Sections 1 and 3 Project Roads

The following recommendations have been made for Sections 1 and 3 project roads:

- Recommended for Section 1 (Asutware Jn – Volivo Road):
 - ❖ Double Surface Dressing:
 - 150mm Mechanical Stabilized National Gravel Base Course
 - 200mm National Gravel Sub-base
 - 600mm Selected Fill
- Recommended for section 3 (Dufor Adidome – Asikuma Jn Road):
 - ❖ Double Surface Dressing:
 - 150mm Mechanical Stabilized National Gravel Base Course
 - 200mm National Gravel Sub-base
 - 600mm Selected Fill

4.4.4.3 Final Bridges Structure Designs

The final bridges structure designs will be at the following chainages:

- CH. 8+600 – Over River Dawhe on Section 1 project road
- CH. 24+825 – Over Golden Exotic Irrigation Canal and Road on Section 1 project road
- CH. 25+850 – Over Irrigation Canal on Section 1 project road

- CH. 34+550 – Over Tributary of River Alabo on Section 3 project road
- CH. 51+242 – Over Tributary of River Alabo on Section 3 project road
- CH. 62+583 – Over River Alabo on Section 3 project road
- CH. 64+425 – Over River Alabo on Section 3 project road

The revised final design alignment maps are shown below:

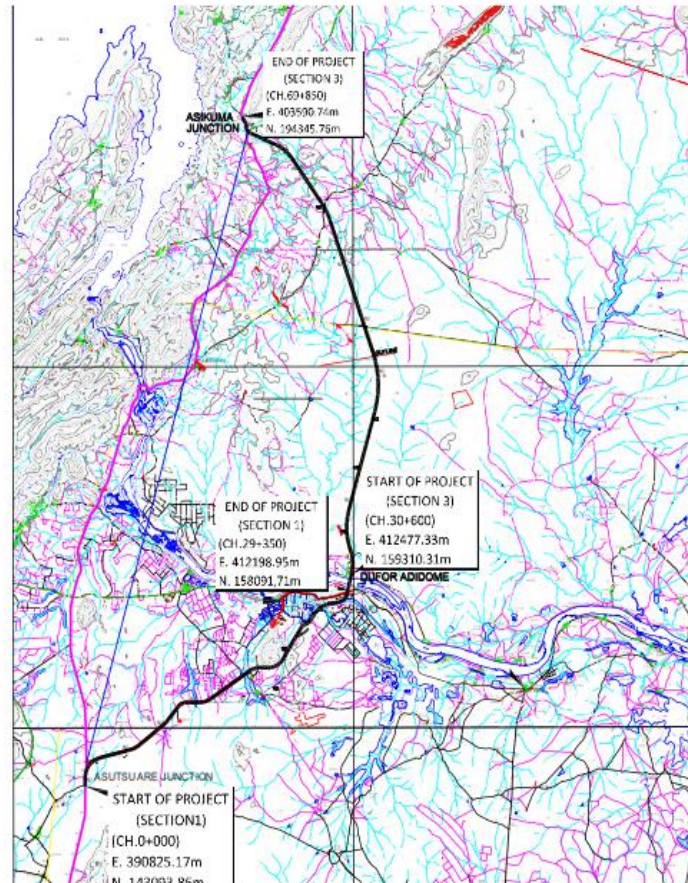


Figure 17 Final Alignments for Sections 1 and 3 Project Roads

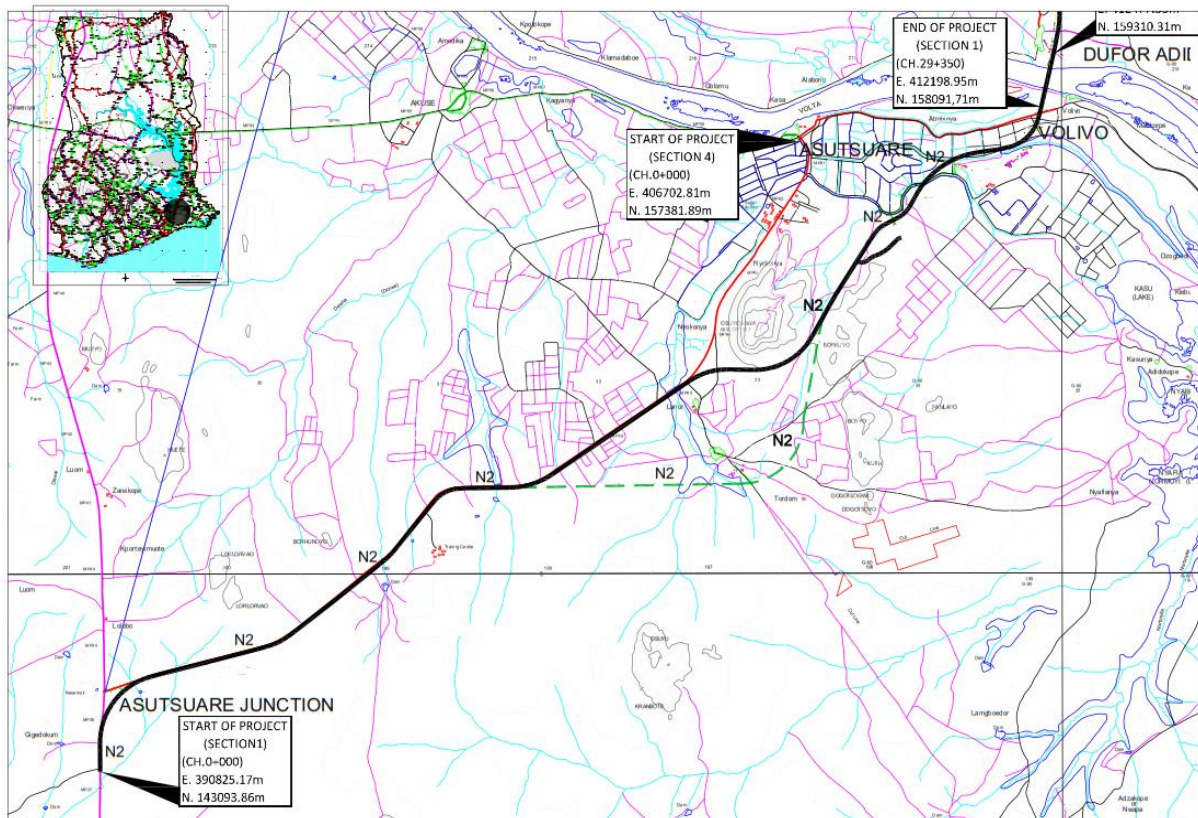


Figure 18 Final Alignment for Section 1 Project Road

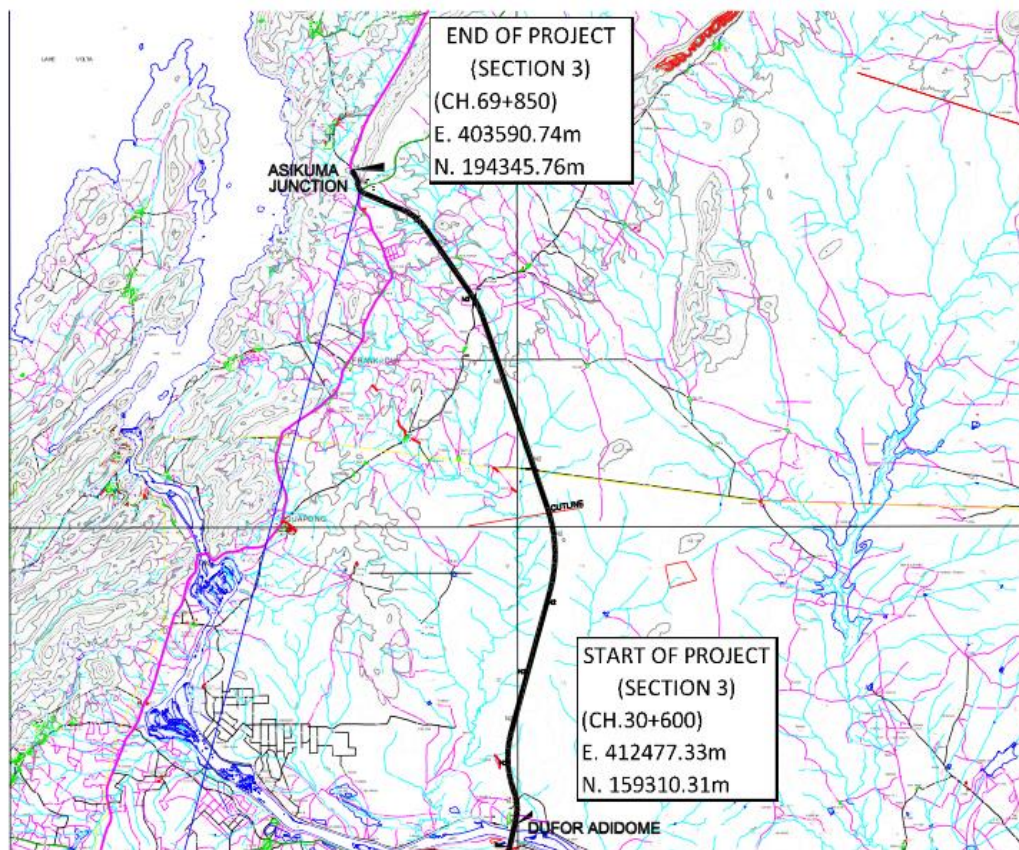


Figure 19 Final Alignment for Section 3 Project Road

4.4.4.4. Revised Final Cost Estimate for Sections 1 and 3 Project Roads

The revised final cost estimate for Sections 1 and 3 project roads is indicated in **Table 12.0**

Table 12.0 Final Cost Estimate for Section 1 and 3 Project Roads

Project Road Section	Original Cost (USD)	Revised Final Cost (USD)	Difference in Cost (USD)
1	135,701,562.37	42,797,472.46	92,904,089.91
3	180,960,800.70	44,682,266.78	136,278,533.92
Total	316,662,363.07	87,479,739.24	229,182,623.83

Source: KE&T Design Documents

4.4.5 Field Study Findings of Proposed Alignment (Section 2 Project Road)

- **Section 2: Asutuare – Aveyime Road (24.0km)**

4.4.5.1 Hydrological/Drainage Structures Findings

The existing drainage structures are structurally weak and of inadequate hydraulic capacities. Moreover, such drainage structures would have to be replaced. See **Table 13.0** for existing drainage structures on Section 2 project road.

Table 13.0 Hydrological/Drainage Structures Field Findings for Section 2 Project Road

Serial Number	Number Existing (No.)	Description	Comments
1	14	Pipe Culverts	Demolish and replace
2	1	U-Culvert	Demolish and Replace
3	17	Box Culverts	Demolish and replace

Source: KE&T Design Documents

4.4.5.2 Traffic and Geotechnical Investigations Results for Section 2 Project Road

The traffic studies and geotechnical investigations findings for Section 2 project road are disclosed below:

- ADT – 392
- AADT – 376
- An estimated Cumulative Equivalent Standard Axles (ESA) of 2,569,596 was obtained
- Sub-grade CBR obtained ranges from 9% to 32%
- A design CBR of 9% was used for pavement design

The same sources of construction materials as listed in Table 5.0 will also apply to the Section 2 project road.

4.4.5.3 Bridge Site Studies, Findings and Recommendations for Section 2 Project Road

The bridge sites field studies findings and recommendations for allowable bearing capacity and depths of foundations are given below with the respective chainages.

- Allowable bearing capacity and depths of foundation are;

- ❖ Bridge at CH. 0+575; 200kPa at depth 3.0m
- ❖ Bridge at CH. 5+875; 200kPa at depth 3.5m

4.4.5.4 Detailed Geometric Design for Section 2 Project Road

The detailed geometric design for Section 2 project road is shown in **Table 14.0**.

Table 14.0 Detailed Geometric Design for Section 2 Project Road

Design Parameters	Roads Classification	Design Speed	Minimum Radius (m)	Minimum Arc Length (m)	Minimum Curve (m)	Minimum K Value (Crest)	Minimum K Value (Sag)
-	Inter-Regional Road	80km/h	-	-	-	-	-
Horizontal Design	Inter-Regional Road	80km/h	424.413	140.0	-	-	-
Vertical Alignment	Inter-Regional Road	80km/h	-	-	70	30	18

Source: K E & T Design Documents

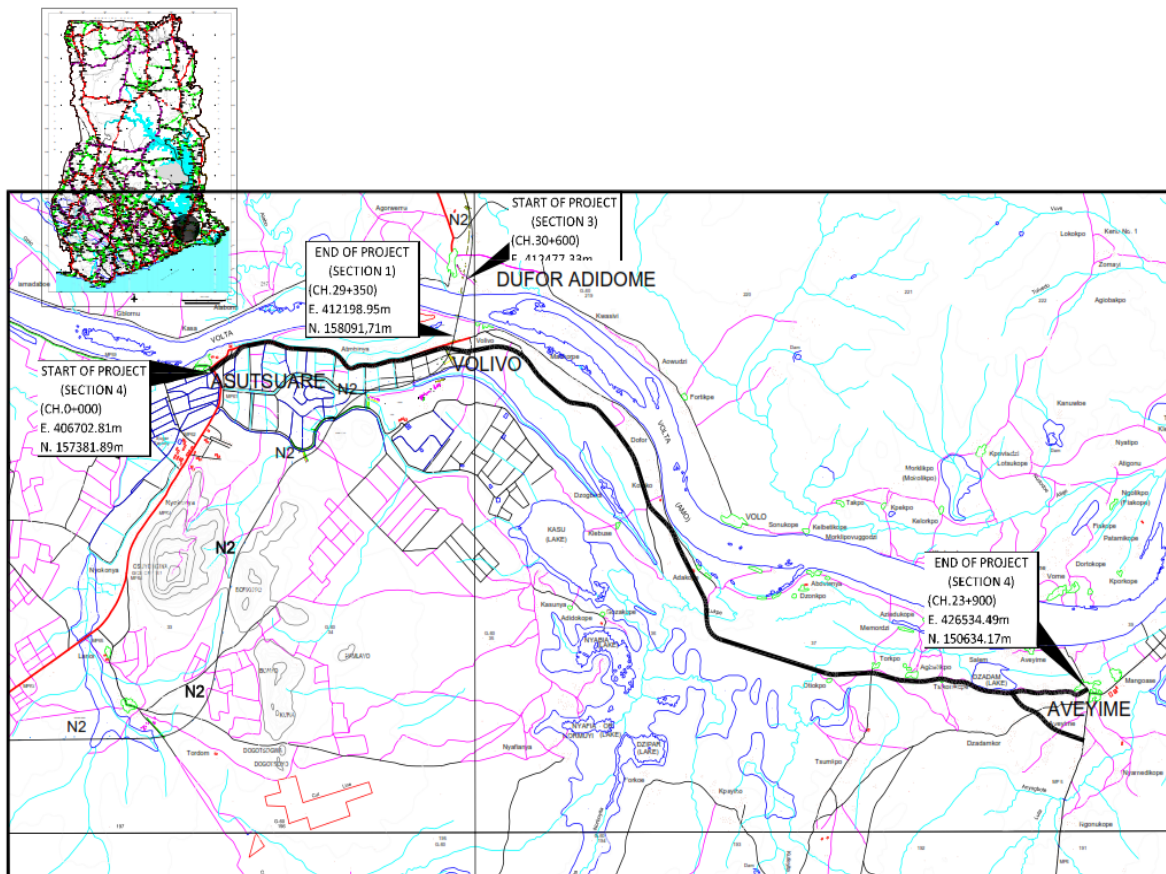


Figure 20 Asutware – Aveyime Road (Section 2 Project Road)

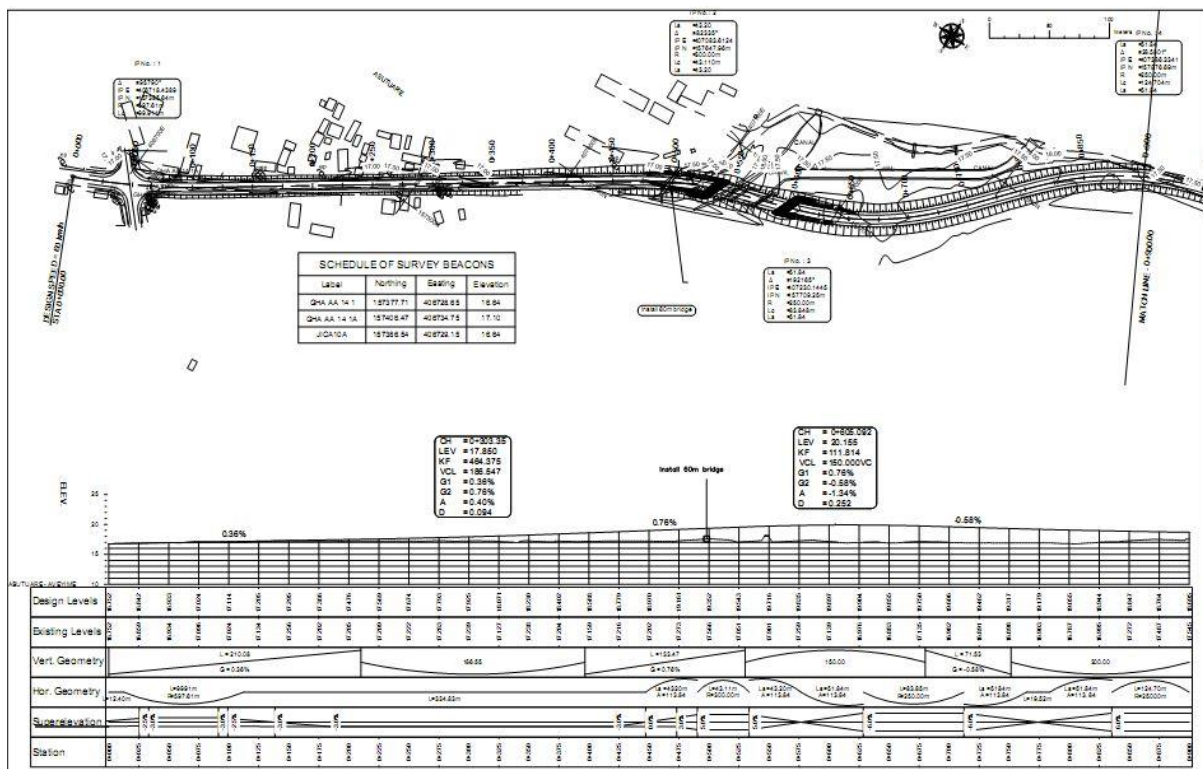


Figure 21 Sample Plan and Profile of Asutware – Aveyime Road (Section 2 Project Road)

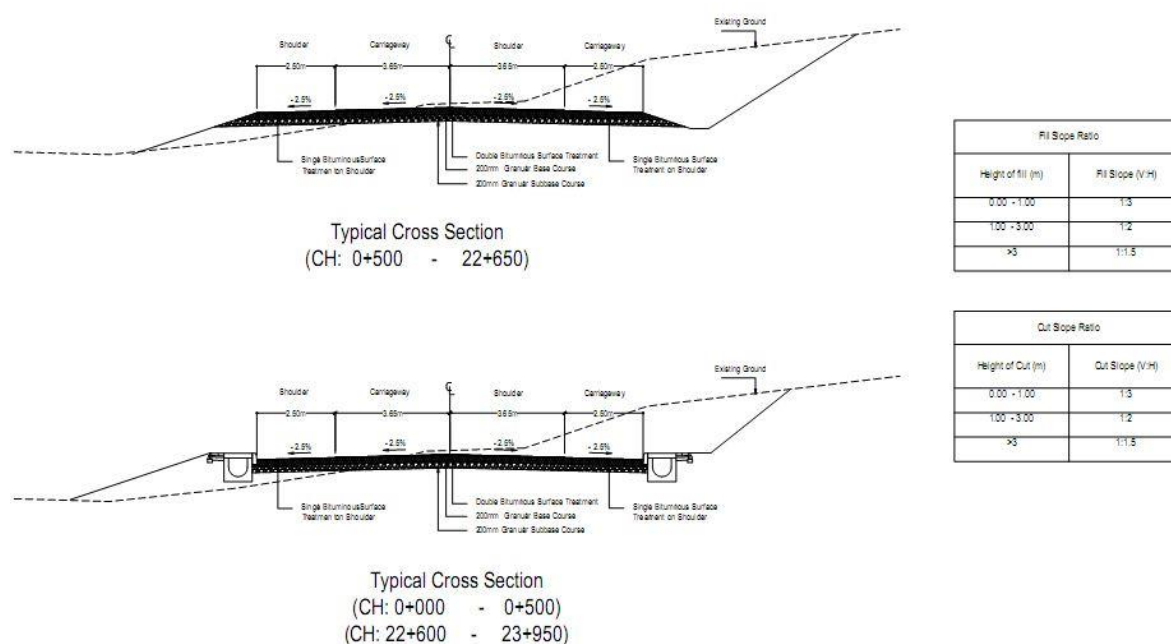


Figure 22 Typical Cross Section of Asutuare – Aveyime Road (Section 2 Project Road)

4.4.5.5 Final Pavement Design for Section 2 Project Road

The final pavement design for Asutuare – Aveyime Road (Section 2 Project Road) is depicted as follows:

- Double Surface Dressing:
 - ❖ 200mm Granular Road Base
 - ❖ 200mm Granular Sub-base

4.4.5.6 Final Drainage Design for Section 2 Project Road

The final drainage design depicts the following:

- 3 No. Box Culverts
- 30 No. Pipe Culverts

4.4.5.7 Final Bridges Design for Section 2 Project Road

The final bridges design depicts the following:

- 25m span at CH. 0+625 over the irrigation canal
- 15m span at CH. 0+800 over the irrigation canal

4.4.5.8 Final Cost Estimate for Section 2 Project Road

The cost estimate for the Asutuare – Aveyime Road (Section 2 Project Road) is
USD 42,307,108.42

4.5 Borrow Areas Materials Extraction Measures

The contractor will adopt these strategic management measures in the operation of borrow areas:

- Borrow areas will be finalized either from the list of locations recommended by District/Municipal Assemblies or new areas identified by the contractor.
- A formal agreement will be established between landowners and contractor.
- The borrow area shall not be located within agricultural field unless unavoidable i.e. barren land is not available.
- The borrow pits shall not be located along any of the proposed project roads.
- The loss of productive and agricultural soil shall be minimized and separately preserved for re-spreading and re-use.
- The loss of vegetation shall be reduced to the barest minimum.
- There is evidence that the required standard of materials is available in plenty.
- Obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing program approved by the Site Engineer, who will ensure that the sub-grade material when compacted to the density requirements shall yield the design CBR value of the sub-grade.
- Fill a reporting format and submit the same for approval by the Site Engineer, after identification of the borrow areas.

Borrow Areas Located in Agricultural Lands

The contractor will adopt these strategic management measures where applicable:

- The preservation of topsoil will be carried out in stockpile.
- A 15cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (vertical: horizontal).
- Borrowing of earth will be carried out up to a depth of 1.5 m from the existing ground level.
- Borrowing of earth will not be done continuously throughout the stretch.
- Ridges of not less than 8m width will be left at intervals not exceeding 300m.
- Small drains will be cut through the ridges, if necessary, to facilitate drainage.
- The slope of the edges will be maintained not steeper than 1:4 (vertical: horizontal).

Borrow Areas Located in Agricultural Land Where Un-Avoidable

The contractor will adopt these strategic management measures where applicable:

- The preservation of topsoil will be carried out in stockpile.
- A 15cm deep topsoil layer will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (vertical: horizontal).
- Borrow area near to any surface water body will be at least at a 1.5m from the toe of the bank or high flood level, whichever is maximum.

Borrow Areas Located in Elevated Lands

The contractor will adopt these strategic management measures where applicable:

- Silt fencing of the top soil stockpile for prevention of erosion and the slopes stabilization through grass turving or coving with mulch of locally available climbers and weeds or their seeds sown at 30cm interval across the slope followed with watering through sprinkler as to get the area covered under vegetation.
- In locations, where, private land owner come forward to allow borrow pits for deepening their property to improve agriculture returns, the top soil of such area should be kept separately and excavated to the depth not exceeding 1.5m in comparison with the level of the adjoining fields be carried out.
- After taking out the materials the top uniformly spread over such property to restore the fertility and environmental balance of the site.

Borrow Areas Near Settlements

The contractor will adopt these strategic management measures where applicable:

- Borrow pits near villages should be at least 100m away from the nearest settlement. If unavoidable, the pit will not be dug to a depth exceeding 30cm and provision should be made for drainage of water from such pits.
- Such locations should not be near any approach road to any dwelling or to any agricultural property.
- Such locations should not be within 15m from any schools and playground.
- All such borrow pits should have to be re-developed immediately after borrowing is completed to restore the physical relief of the area and prevent water logging after spreading the top soil uniformly over the area with provision of drainage to keep it free from stagnant water.

Re-development of Borrow Areas

The contractor will adopt these strategic management measures:

- Objective is the rehabilitation program to return the borrow pits sites to a safe and secure area, which the public should be able to safely enter and enjoy.
- Securing borrow pits in a stable condition is fundamental requirement of the rehabilitation process.
- Achievement is by filling the borrow pit floor to approximately the access road level.

- Re-development Plan will be prepared by the contractor before the start of work in line with the owner's requirement and to the satisfaction of environmental as well as public safety.
- Taking of photographs of various stages i.e., before using materials from the location (pre-project phase), for the period borrowing activities (collection phase) and after rehabilitation (post development phase), to ascertain the pre - and post borrowing status of the area and submit a copy to GHA/District & Municipal Assemblies/Ghana EPA.

4.6 Logistical Requirements and Associated Infrastructure

Construction Camp: To accommodate the necessary material and equipment required for the construction process, excluding lodgings for construction personnel, construction camps are proposed. It is anticipated the camps will be located at areas approved by the District/Municipal Assemblies. The exact locations of such camps will be within the project roads enclave. For high efficiency of construction works, the camps will most likely be located as close to the project roads construction zone as possible. The camps will not comprise accommodation for the local and foreign labor forces. The local labor unit will be housed within the project communities, in rented quarters. However, the foreign labor force will enjoy separate camp with provisions for kitchen, food storage and laundry areas, dry and cold stores and paramedic and first aid facilities. The main operational areas within the project roads catchment zone will house contractor's site offices. A designated storage area will house construction equipment, as well as other material required for the roads project. Due to the rural and peri-urbanized environment all utilities and services required to support foreign worker's accommodation will be purposefully built, including: air conditioners for cooling, water supply and wastewater or sewage storage by septic tanks (dislodged periodically), solid waste management, power supplies (national grid), fire-fighting system, fire tenders and personnel (at Asutuare Township and Asikuma Junction), canteen and link roads with the roads project sites.

Water for the foreign labor force will be sourced from GWCL pipelines. The GWCL potable water will be expected to meet Ghanaian and WHO potable water standards. Septic tanks will be installed for the collection of sewage with periodic dislodgement schedule by third party waste management company at an approved sewage treatment facility by the District/Municipal Assemblies.

Construction Personnel: It is anticipated that the local construction workforce will involve both skilled workers and unskilled workers. Foreign workers will be less in number as compared to the local unit. Given the abundance of skilled and unskilled labor, the unskilled labor will be sourced from the local labor pool, to be employed directly by the contractor. Efforts will be made to use skilled labor, e.g. for office assistant positions. Below is a breakdown of the number of category of labor required for the construction of the roads project: unskilled labor personnel - ground workers; skilled/semi-skilled labor personnel - vehicle operators, equipment operators, masonry.

Construction Workers Fluctuation Scheduling: The general sequencing and duration for construction phase workers fluctuation for the roads project will be developed by the

contractor(s) in the Construction Environmental and Social Management Plan (CESMP). The actual staging and duration of construction activities will be indicated in the CESMP by the construction contractor(s). It should be noted that many of the stages which will be identified in the CESMP can and will be performed concurrently, with staggered starting dates. The overall construction timeframe will also be shown, with the sources of the construction materials being indicated as an important factor in the duration of construction. This timeframe also takes into consideration the likely delays due to adverse weather conditions.

Construction Constraints: The characteristics of the Project sites, including their locations directly adjacent to existing operational sections of the project roads and their exposure to strong stormy weather conditions during the rainy season presents some unique construction challenges that will ultimately influence the construction methodology adopted for the Project. The following construction constraints with greatest bearing on the Project (and which will ultimately inform the construction methodology proposed) are described below:

- Maintaining a fully operational sections of the project roads throughout the duration of the construction period;
- Undertaking construction in adverse weather conditions; and
- Logistics associated with moving and placing large quantities of bulk material for the roads construction works.

Maintaining Fully Operational Sections of Roads Project: One of the mandatory requirements is that some sections of the project roads must remain operational throughout the construction of the Project. All construction activity will therefore have to be managed in such a manner that they do not impinge on the ability of GHA to meet its National and Inter Regional Roads operational requirements.

Construction Hours: Aside from the limitations on heavy vehicle movements to the construction sites, the contractor(s) will operate on a continual basis to complete the Project as efficiently as possible (acknowledge that there will be period of down time due to constraints such as adverse weather conditions). Due to the constraints from existing operations of project roads sections, with regards to the presence of construction machinery or equipment) and the need to maintain scheduled construction works for the duration of the Project, night work will also be required between the hours of 10:00 pm to 5:00 am, where applicable.

A detailed program detailing when and where construction work will be undertaken will be completed prior to the commencement of the construction stage, as part of the CESMP. Construction working days will start from Monday through Saturday, from 8:00 am to 5:00 pm except on holidays, where different schedules will be announced.

Construction Vehicles and Equipment: Earthworks, ground levelling and other construction activities will be required for the project sites by use of the following equipment and machinery: Grader; dozer; track excavator (CAT 225 or similar and CAT 235 or similar);

vibrator roller (Bomag 212 or similar); pedestrian Roller (Bomag BW 90 or similar); water tanker trucks; tipper trucks; backhoe TLB type (CAT 428 or equivalent).

See **Table 15.0** for Construction Machinery and Equipment Schedule for Each Section of the Roads Project.

Table 15.0 Construction Machinery and Equipment Schedule for Project

MAIN HEAVY EQUIPMENT	QTY
BACKHOE TEREX TLB840	4
BACKHOE TEREX TLB890	4
CONCRET MIXER TRUCK IVECO 10M3	3
CONCRET PLANT 40M3/h	1
CONCRET PUMP CONVICTA 1814R	4
CONCRET PUMP PUTZMEISTER TK70B	4
DUMP TRUCK IVECO 18M3	5
DUMP TRUCK IVECO 7M3	5
FORKLIFT MANITOU MI30D	3
FRONT LOADER DUMPER AUSA D250RMS	1
GENERATOR - GENSET CAT SR4 380KVA	1
GENERATOR - GENSET G&J 110KVA	1
GENERATOR - GENSET HIMOINSA 150KVA	4
GENERATOR - GENSET STANFORD 380KVA	1
HIAB TRUCK IVECO 15TON	5
HIAB TRUCK IVECO 24TON	2
LOWBED TRAILER GHEM	2
LUBE TRUCK VOLKSWAGEN 15.180	1
MANLIFT - BOOM LIFT GENIE S125	2
MANLIFT - BOOM LIFT MANITOU 200ATJ	4
MOTORGRADER SHANTUI SG18.3	1
OFF ROAD CRANE TRUCK TEREX RC30	2
OFF ROAD CRANE TRUCK TEREX RT100	2
ROLLER SDLG 14TONS	1
SELF MIXER CONCRET TRUCK FIORI DB460S	2
TELEHANDLE MANITOU MTX1740SLT	1
TRACTOR TRUCK	1
TRUCK FOTON TX5595	5
WATER TRUCK IVECO 20.000L	2
WHEEL LOADER SDLG LG956L	2
ASPHALT PAVER	2
TANDER ROLLER	3
PNEUMATIC ROLLER	3

Site Access and Haulage Routes: Construction fill and waste materials will likely be conveyed to the site via land-based transportation vehicle or equipment. In terms of haulage routes to the construction site it is proposed to use a combination of separate daytime and night time routes, with corresponding different numbers of traffic movement.

Fuel Storage Tanks: Fuel for generators, vehicles and machinery used in construction will be stored in approved metal or plastic containers, placed within a bunded area or double walled tanks. This fuel will be transported to the site via the main airport road and it is anticipated that approximately 10 million liters will be used during construction. The tanks

will be located at a central storage area and will be serviced by a bowser which will transport fuel to where it is needed on the project site.

4.7 Construction Camp Security

The construction camp will be fenced with access control and will be manned by security staff from the local community employed by the contractor(s). The exact details of the security measures that will be implemented will be determined by the construction contractor(s), ensuring security of the works, plant and material in accordance with the tender.

4.8 Construction Water Requirements

It is anticipated that water for the construction works will be purchased from Ghana Water Company Limited (GWCL) or by abstraction from the Volta River through approval by the District/Municipal Assemblies by the contractor(s). Any additional quantity of water will be determined in consultation with the GWCL officials. Water is most likely to be sourced from purchases from GWCL supply points within the project roads catchment zone, and not from groundwater from borehole(s). When supplemental construction water requirements increase, groundwater from borehole will be investigated. The exact location of the borehole for the extraction of groundwater will be identified prior to commencement of construction activities. GHA will ensure that the construction contractor(s) consult with the relevant authorities in the project roads operational areas to obtain the necessary approvals for the siting of the borehole, abstraction of groundwater and surface water use, where applicable.

4.9 Waste Management

All project generated wastes will need to be managed and disposed of in a manner that prevents potential impacts on the environment and risks to human health. Waste streams will be generated during construction activities as well as associated logistical support. The majority of waste will result from the following activities within the discrete project activities: Construction Activities – waste generated from construction activities such as vehicle maintenance, refueling of construction vehicles and equipment; and household waste (including organic biodegradable waste from kitchens/canteen or living quarters, paper and cardboard), and sewage and grey water from operation of the construction camp; and Decommissioning Activities– waste generated from the decommissioning of the construction camp offices.

Categorization of Wastes: Wastes generated from project activities would be categorized as nonhazardous or hazardous according to their types and associated risks. The definitions of waste categories are as follows:

- Non-hazardous wastes are those that do not exhibit any hazardous properties and are relatively low risk to human health and the environment. This category would include a range of materials that may be recycled or can safely be disposed of in a landfill.

- Hazardous wastes exhibit one or more characteristics which mean that the wastes are potentially harmful to human health and/or cause damage to the environment (air, land, and/or water) or natural ecosystems. For example, the waste may be corrosive, reactive, toxic, mutagenic, teratogenic, infectious, carcinogenic, ecotoxic, flammable, or explosive.
- Cut vegetation will be generated from clearance of vegetation. This is not considered to be a waste material and it is envisaged that timber from the trees would be used for example for making local furniture and as wood fuel (firewood and charcoal), and only the minimum debris would be collected and disposed of at approved landfill site.

Solid wastes will be segregated to facilitate alternative management routes. Sewerage, grey water and organic biodegradables will be appropriately disposed of in consultation with the Office of the District/Municipal Assemblies Environment and Health Division. Organic biodegradable wastes from food preparation and leftovers will be disposed of as compost. Small quantities of paper and cardboard packaging will be transported off-site to a suitable recyclable waste regeneration site in Accra. Waste services will be investigated by GHA for third party involvement as part of the project developments.

All hazardous wastes such as spent oil, oil filters, spent batteries; oily rags will be stored separately from non-hazardous wastes and clearly labelled. Spent batteries, drained oil filters, and spent oil will be sent for recycling to an approved recycler. Oily rags and Personal Protective Equipment (PPE) such as masks will be sent for incineration to an approved facility in Accra.

Any medical/clinical waste produced on-site such as swabs or bandages will be stored in dedicated containers and these will be incinerated at approved disposal site in Accra.

Waste Management Plans and Procedures: A Method Statement for waste management will be developed by the contractor(s) and implemented for all stages of the Project. The Method Statement will include a description of the non-hazardous and hazardous waste streams expected from the various construction activities and worker domestic facilities. Information on the practices for minimization, handling, storage and treatment and disposal of all project roads wastes will also be included. The Method Statement will adopt the principles of the 'waste hierarchy' to ensure that waste generation is reduced, and reuse and recycling is maximized to reduce waste load to landfill sites. Waste management activities will be performed in accordance with the following waste hierarchy principles:

- Reduce - the quantity of waste generated by project activities.
- Re-use - materials where possible in engineering structures or return to suppliers where surplus to requirements.
- Recycle and recover– material streams where practicable (e.g. oils, metal, wood, paper, plastics etc.) to reduce the quantity of wastes disposed.
- Responsible treatment and disposal – to landfill or alternative following appropriate treatments to reduce hazards and long-term impacts on the environment.

As part of the development of the Waste Management Plan, GHA will identify suitable local companies and facilities to receive recyclable wastes and treat hazardous wastes. GHA Senior Resident Engineer will conduct site audits at regular intervals to ensure that all waste is being managed in accordance with the Waste Management Plan and procedures.

4.10 Vegetation Clearance

Secondary forest land, farmland and crop fields, fruit trees and land used for livestock grazing and housing are anticipated to be affected within the roads project zone. The total vegetated area that will required for clearance is disclosed in the BOQ. GHA will work with the contractor(s) to develop a forest rehabilitation program, where applicable, for decimated borrow areas with the aim of restoring the floristic species composition and structure of the natural forests, affected by project construction activities. The rehabilitation program will focus on establishing nursery demonstration areas (offsets) in selected locations within potential borrow areas. Naturally moist coastal savanna grassland has natural processes of recovery with many shrub-tree species well-adapted to establish in sites of various degrees of disturbance. The reforestation program aims to follow such natural recovery processes to achieve cost-effective forest rehabilitation with no to minimum planting of trees to assist the rehabilitation process. The rehabilitation approach includes, but is not limited to the following:

- zoning of the areas identified for rehabilitation;
- conversion of potential tree saplings into natural forest. This would require the need to remove all tree saplings on the ground due to their high germination capacity. This presents an opportunity for the development of a small local industry whereby the local community could assist in the removal process of sapling trees; and
- prioritization of areas for conversion to natural forest, such as some remote areas where the presence of saplings may create a constant source for re-invasion, or natural areas around borrow areas to restore the 'natural' environment.

4.11 Location of Animal Crossings

Some portions of the project roads experience movements of animals, such as cattle and goats, at crossing points on Asutuare Jn – Volivo Road (Section 1 Project Road) and Asutuare – Aveyime Road (Section 2 Project Road). To ensure safe passage of animals, animal crossings will be installed at selected locations within the project enclave. Safety fences will be erected at affected locations. Safety fences will be raised over certain lengths before and after the crossing points to prevent animals straying to the project roads.

4.12 Project Activities Description

The project activities to be undertaken have the over-riding consideration that there will be avoidance or preservation of environmentally sensitive areas and limitation of settlement structures demolition. In addition, there will be the minimization of the destruction of trees, crops and arable farmlands, where applicable. And the project activities phasing for consideration are: pre-construction, construction and post-construction (decommissioning, operation and maintenance) phases.

4.12.1 Pre-Construction Phase Activities

The following pre-construction phase activities are required for the project:

- ❖ Feasibility Study.
- ❖ Project Roads Identification and Location
- ❖ Project Roads Survey
- ❖ Identification of Site Offices and Site Camps
- ❖ Acquisition of RoW
- ❖ Consultations
- ❖ Materials Mobilization
- ❖ HIV/AIDS, Ebola and Cholera Awareness Training
- ❖ Road Safety Awareness Education
- ❖ Environmental Protection Training

- **Feasibility Study**

This phase of the project cycle involves project planning and design, through conceptualization, feasibility survey and preparation of feasibility report. Various options consideration and recommendation are highlighted including the preferable option for the project.

- **Project Roads Identification and Location**

The project roads identification and location were established from review of existing mapping. And field inspections were undertaken to confirm and clarify identified project roads and their exact locations.

- **Project Roads Survey**

This activity was carried out by survey teams contracted by K E & T Consult Limited to carry out the survey of project roads, establish land profiles, limit of RoW and limit of construction and select the best alignments from several different options taking several factors into consideration. Some of the factors which were considered included, overall carriageway distances and the avoidance of the potential destruction of settlement structures (where applicable) and other environmentally and socially sensitive areas.

- **Identification of Site Offices and Site Camps**

Principal site offices and camps will be selected with approval by the Site Engineer. This will also be done in direct consultation with the Metropolitan/District Assemblies and project community residents. Generally, the sites selection will involve fairly flat terrain with sparse population densities and devoid of intense traffic and commercial activities.

- **Acquisition of RoW (Right-of-Way)**

Based on the issuance of an environmental permit from EPA Ghana, GHA will go ahead and acquire the RoW in compliance with all laws, regulations, operational directives and guidelines. Basically, the mode of assets valuation will take this dimension. Prior to the construction of the project roads, GHA and Land Valuation Division (LVD) will undertake a survey of all areas of land take, which includes a valuation of settlement properties, business structures, farmland, trees and crops in the RoW, that will have to be compensated. The valuation processes are discussed under compensation scheme.

- **Consultations**

In the courses of the scoping exercise, some traditional authorities' representatives, project community residents, opinion leaders, metropolitan/district assembly's officials and regulatory agencies staff were consulted. This was to enable the survey team gain access to the proposed project roads, since the survey crew had to clear vegetation cover, trees and crops to make way for the survey program.

- **Materials Mobilization**

The haulage of large quantities of construction materials-fine and aggregates-including cement by road to the project sites will take place. There will also be the transportation of heavy construction equipment and machinery to the project sites, under materials, machinery and equipment mobilization work program.

- **HIV/AIDS, Ebola and Cholera Awareness Training**

HIV/AIDS, Ebola and Cholera Awareness Creation and Training Program will be organized for project communities and construction labor units. Moreover, sexually transmitted diseases awareness will be organized along- side the HIV/AIDS, Ebola and Cholera Awareness creation. The program will help explain the pandemic to the workers and the project community residents. The program is to make people aware that AIDS/Ebola and Cholera are real. Condoms and other accessories will be provided in the project catchment zones. There will also be the need to provide condoms at accessible points at the camp for the sexually active ones (ages 20-49) to use when the need arises. People will be encouraged to go for voluntary counseling and test at nearby hospitals or health centers.

- **Road Safety Awareness Education**

Road Safety awareness Campaign through education will be instituted for project communities and construction crew to curb the likelihood of road accidents associated with project implementation. In collaboration with the National Road Safety Campaign of the Ministry of Roads and Highways and the Traffic Police Unit, this activity will review the approach and methodology for the road safety awareness campaign and monitor the effectiveness of proposed mitigation measures. And the target groups will also include school children, street vendors and vehicle operators.

- **Environmental Protection Training**

Environmental Protection Training will be organized for Contractors and other stakeholders. This activity will assist contractors to ensure environmental and social protection measures are adopted to instill good environmental and social management and monitoring practices during construction. Also, the training program will help protect, restore and enhance quality of the environment due to project implementation.

4.12.2 Construction Phase Activities

The following construction phase activities are required for the project:

- Excavations for drainage works.
- Excavations for Volta River suspension bridge anchorages (anchor blocks) foundations.
- Drainage works improvement for flood prone or low-lying areas.
- Construction of the Volta River suspension bridge structure.
- Construction of roads protection structures.
- Improvements of sections of access roads leading into selected project roads.
- Installation of road signs and markings and relevant traffic control devices.
- Construction and/or treatment and sealing of shoulders or pavement works improvements.
- Construction and/or improvement of roads geometric features.
- Construction and/or upgrading the existing project roads to asphaltic surface.

❖ Excavations for Drainage Works

Information on drainage positions from design drawings will lead to excavation works for drains, culverts and storm channels. The drainage works will also lead to the casting of concrete or use of pre-cast concrete products such as U-drains, pipe culverts, box-culverts, etc., where applicable.

❖ Excavations for Volta River Suspension Bridge Anchorages Foundation

The exact positions of the Volta River suspension bridge foundations will be derived from engineering design drawings. Such positions will lead to excavation works to hold anchorages foundations for reinforced concrete seat anchor blocks.

❖ Drainage Works Improvement for Flood Prone or Low-Lying Areas

Flood-prone or low-lying sections of the project catchment zones will be improved through the installation of drainage channels or culverts to drain storm run-off. Such drainage works will involve the use of pre-cast concrete drain products or fresh casting of concrete batch in wooden or metallic molds.

❖ Construction of Volta River Suspension Bridge Structure

It is worth repeating from section 4.9 that the suspension bridge structure over the Volta River will be built of the following basic structural components: **anchorages** (massive concrete

blocks which anchor main cables and act as end products of the suspension bridge); **main towers** (intermediate vertical structures which support main cables and transfer bridge loads to foundations); **main cables** (a group of parallel-wire bundled cables which support stiffening girders/trusses by hanger ropes and transfer loads to towers); **stiffening girders/trusses** (longitudinal structures which support and distribute moving vehicle loads, act as chords for the lateral system and secure the aerodynamic stability of the structure).

❖ **Construction of Roads Protection Structures**

Roads protection structures will be erected at sections with embankments or approach roads to suspension bridge structure. Such structures will take the form of stone pitching, dwarf walls or hydro-seeded surfaces. These structures serve as erosion protection schemes to aid preservation of embankment or landslide zones.

❖ **Improvement of Sections of Access Roads Leading into Selected Project Roads**

Access roads leading to selected project roads will be improved of their geometric features to blend with the proposed project roads. Where applicable, access culverts will be erected to serve as drainage channels to prevent erosion of the project roads foundation.

❖ **Installation of Road Signs and Markings and Relevant Traffic Control Devices**

To minimize traffic confusion and delays, road signs and markings will be installed at the appropriate sections of the project roads. Relevant traffic control devices like signalization will be provided, including traffic management facilities like walkways, crossing and public bus stops or laybys. These devices will aid free flow of vehicles.

❖ **Construction and/or Treatment and Sealing of Shoulders or Pavement Works Improvement**

Pavement improvement and/or construction will be undertaken at pavement sections or shoulders with residual strength and conditions at the end of their design life. These works involve strengthening and/or widening. Where necessary, construction and/or treatment and sealing of shoulders will be carried out.

❖ **Construction and/or Improvement of Roads Geometric Features**

The geometric features of project roads, where feasible, will be constructed and/or improved to meet current design standards. Some of the geometric features include a new carriageway suspension bridge over the Volta River at Volivo to improve the flow of traffic at that corridor and connect Dufor Adidome – Asikuma Junction Road (Section 3 Project Road).

❖ **Construction and/or Upgrading the Existing Project Roads to Bituminous Surface**

Construction and/or surface improvement works of the project roads will lead to double bituminous surfacing of the selected project roads. Such surfacing scheme will prolong the design life of those project roads.

4.12.3 Post – Construction Phase Activities

The following post-construction phase (decommissioning, operation and maintenance) activities are required for the project:

- Decommissioning of Site Offices and Lay-Down Areas.
- Drainage Maintenance.
- Suspension Bridge Inspection and Maintenance Programs.
- Surface Maintenance on Paved Roads.
- Road Side Maintenance.
- Road Side Furniture Maintenance.

❖ Decommissioning of Site Offices and Lay-Down Areas

The decommissioning process will involve the following decommissioning activities:

- Lay down areas materials, equipment and machinery decommissioning.
- Construction sites materials, equipment and machinery decommissioning.
- Decommissioned waste materials collections, stocking, haulage and transportation for reuse or disposal at approved locations.
- Sites restoration schemes involving re-vegetation and reclamation of areas.

During decommissioning phase, all work areas and offices and workshops/garages and other temporary installations will be cleaned up and the site restored. These include removal or reuse of temporary buildings, materials, wood, refuse, surplus materials, embankments or another material that is not in the area before construction of works. All effected natural drainage systems will be restored, and excavated materials will be used to fill excavated areas. The damaged areas will be restored to make it compatible with future use.

❖ Drainage Maintenance

The maintenance scheme for drainage systems will involve the following: ditch clearing by manual labor, ditch clearing by mechanical plant, re-excavation of damaged ditches to install high-capacity channels for storm run-offs, clearing and minor crack repair on drainage structures and erosion and scour repairs.

❖ Suspension Bridge Inspection and Maintenance Program

The suspension bridge inspection program must be undertaken thoroughly as necessary to clearly establish its condition, inspected at the appropriate interval or frequency to insure its continued safe operation. Bridge Condition Assessment Investigations to be performed will include: initial inspections, routine inspections, fracture critical inspections, special inspections, in-depth inspections and damage inspections. However, the suspension bridge maintenance program will cover four (4) schemes: preventive maintenance, minor repairs, deferred maintenance and major repairs depending on the condition of the structures in an inventory.

❖ **Surface Maintenance on Paved Roads**

Paved roads surface maintenance works will involve the following: pothole patching on bituminous surface dressing, pothole patching by pre-mix, pothole patching by hot-mixed asphaltic concrete, repair of depressions, ruts, shoving and corrugations, edge failure repairs on bituminous surface dressed roads and asphaltic concrete roads, crack sealing and resurfacing and re-sealing.

❖ **Road Side Maintenance**

The roadside maintenance schedule will encompass the following scheme: grass cutting by manual labor, grass cutting by mechanical plant, tree/bamboo clearing and bush clearing.

❖ **Road Side Furniture Maintenance**

The maintenance scheme of road side furniture will incorporate the following: road sign cleaning and painting, repair and replacement of traffic signs, repair and replacement of guide posts and guard rails and road line marking.

4.12.4 Project Justification

As already discussed under the introduction section of this report, it is worthy of note that the volume of international cargo, meant for Ghana's neighboring landlocked countries has been increasing in recent times. There are however challenges which the nation would have to deal with in facilitating transit of vehicles from the neighboring countries, such as chronic congestion in and around Accra, the capital city, and Kumasi, the second largest city.

The situation currently hampers fast and efficient movement of cargo to the neighboring landlocked countries necessitating that an alternative route is identified and developed to facilitate transit and trade. A possible alternative international transit route to Burkina Faso is the Eastern Corridor (N2), one of the proposed project roads. The Eastern Corridor which lies to the east of the country, and approximately 695 km in length commences from Tema Roundabout through some important towns in the Greater Accra, Volta, Northern Regions and ends at Kulungugu in the Upper East Region of the country. This corridor is about 200km shorter than the Central Corridor but has a substantial portion unpaved with ageing bridges and experiences washouts and damages during the rainy season making travel difficult.

The Government of Ghana (GoG), in view of the importance of the Eastern Corridor, has put a high priority on its development under the Road Sector Medium-Term Development Plan and is actively promoting the development of this route. The development of the Eastern Corridor is expected to contribute to the economic revitalization and the reduction of poverty in the area along the corridor and the neighboring countries by reducing transport cost and facilitating regional trade.

Chapter 5 Description of Project Environment

5.1 Introduction

The existing baseline conditions include known plans, programs, apparent commitments and/or intentions to the extent they are known, to take them into account in the assessment of cumulative impacts. The existing key baseline data were gathered to depict the Physical, Biological/ Ecological and Human Environments in the project roads corridor key traverse districts of Asuogyaman, Dangbe West and North Tongu. Since June 2012 new district assemblies were carved out of Dangme West District (such as Shai-Osudoku District Assembly and Prampram West District Assembly) and North Tongu District (such as Adaklu-Anyigbe District Assembly).

Due to lack of substantial current information on the newly created district assemblies, key information on the **parent district assemblies (Asuogyaman, Dangme West and North Tongu)** were utilized. The baseline environmental conditions studies conducted under the scoping exercise were evolved from the parent district assemblies.

5.2 Area of Influence

The **Section 1 (Asutua Junction – Volivo Road (28.3km))**, **Section 3 (Dufor Adidome – Asikuma Junction (38.4km))** and **Section 2 (Asutua - Aveyime Road (24.0km))** of the project roads have immediate impact over 5.4 million inhabitants, majority of whom live below the poverty line in the roads project area of influence. The road traverses an area that is noted for its production of cassava, corn, tomatoes as well as cash and food crops for consumption and exports. The current state of two of the roads if not improved shall result in the total deterioration of the road with the resultant prohibitive capital cost for a total rehabilitation and its social effects. The vehicle operating cost is high. Increased travel times on the bad state of the roads become disincentive to business.

5.3 Location

The proposed project roads are sections of the Eastern Corridor International Transit Route. The denoted sections are as follows:

- **Section 1** {Asutua Junction – Volivo Road (28.3km)},
- **Section 3** {Dufor Adidome – Asikuma Junction Road (38.4km)} and
- **Section 2** {Asutua – Aveyime Road (24.0km)},

The roads project traverse one (1) Metropolitan, eight (8) District Assemblies and three (3) Regions. The Metropolitan Assembly is HO (in the Volta Region) while the District Assemblies are: Yilo Krobo, Manya Krobo and Asuogyaman (in the Eastern Region); Dangme West and Dangme East (in the Greater Accra Region) and South Tongu, North Tongu, Adaklu-Ayigbe (in the Volta Region).

Section 1: The Asutua – Aveyime Road (24.0 km) will be upgraded to pass through existing alignment of agricultural and commercial townships and rural villages some of which are in

the Volta Region of Ghana and end up at Aveyime. This is a gravel road with highly deteriorated and distressed surface conditions will be upgraded to asphaltic highway to serve as a major feeder into the Eastern Corridor international transit route (N2).

Section 2: Sections of the Asutwae Junction – Volivo Road (28.3km) connects existing light settlement zone following the existing alignment and diverts through green field of agricultural farmlands and ends at Volivo township. At Volivo township, a JICA Suspension Bridge (1.25km) will be erected over the Volta River to end at Dufor Adidome.

Section 3: Dufor Adidome – Asikuma Junction Road (38.4km) pass through agricultural farmlands and undeveloped fallow fields to end at Asikuma Junction township. The Section1 (Asutwae Junction – Volivo Road (28.3km)) and Section 2 (Dufor Adidome – Asikuma Junction Road (38.4km)) form sections of the Eastern Corridor International transit system (N2). See figures ---- and ----- for project roads locations maps.

5.4 Physical Environment

5.4.1 Climate

- **Asuogyaman District**

The district lies within the Dry Equatorial Climate Zone which experience substantial amount of precipitation. It exhibits double maxima rainy season which reaches its peak period in May– July and the minor season occurs in the period of September–November. Annual rainfall usually starts in April with the peak in June and ends in November. The dry season starts in November–December and ends in March. The annual rainfall is between 67mm and 1130mm.

Temperatures are warm throughout the year with maximum monthly mean of 37.2°C and a minimum of 21°C. Relative humidity is generally high ranging from the highest of 98% in June to 31% in January.

- **Dangbe West District**

The district lies in the Coastal Savannah Zone with double maxima rainy season pattern. The rainfall averages between 762.5mm and 1220mm. The first rainy season is in April and ends in August, while the second rainy season begins in September and ends in November. The coldest months are between July and August.

In November, the mean temperature is 30°C but in March it is about 40°C. The relative humidity is 65% to 98% in the day and night respectively.

- **North Tongu District**

The average annual rainfall varies from 900 mm to 1100 mm with more than 50% of it falling in the major season of April through July. The mean temperature is about 27°C. The maximum and minimum temperatures vary from 22°C to 33°C respectively.

- **Greenhouse Gas Emissions**

Greenhouse Gas Emissions: Greenhouse Gases (GHG) emissions in the atmosphere venting from anthropogenic sources are partly responsible for the global warming and causing global climate change. It is recognized that the average temperature on the Earth has increased by 0.7 degree Celsius since the start of the industrial revolution. The United Nations Framework Convention on Climate Change (UNFCCC) is aimed to disclose country level contribution to the global GHG emissions as well as provide background to analyze emissions by sources. The principal sources of greenhouse gases emission in Ghana are identified to include agriculture, forestry, energy (fuel combustion, mobile combustion & fugitive emission), Industrial Processes and waste (See Table 16.0).

Table 16.0 Baseline Information on Green House Emissions in Ghana

Sources	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total GHG Emissions Excluding Land-Use Change and Forestry (MtCO ₂ e)	20.02	20.80	19.03	22.25	23.19	22.99	22.73	23.77	25.59	27.53	27.34
Total GHG Emissions including Land-Use Change and Forestry (MtCO ₂ e)	51.15	51.98	50.23	53.28	54.25	54.24	53.95	55.00	56.88	58.89	58.84
Total CO ₂ (excluding Land-Use Change and Forestry) (MtCO ₂ e)	7.72	7.45	6.97	7.41	8.74	9.38	8.76	10.09	11.70	12.52	12.81
Total CH ₄ (MtCO ₂)	7.68	8.26	7.86	9.18	8.99	8.69	8.92	8.86	8.99	9.57	9.32
Total N ₂ O (Mt CO ₂ e)	4.54	5.02	4.13	5.60	5.39	4.84	4.96	4.73	4.78	5.32	5.08
Total F-Gas (MtCO ₂ e)	0.08	0.08	0.08	0.07	0.08	0.09	0.09	0.10	0.10	0.11	0.12
Total CO ₂ (including Land-Use Change and Forestry) (MtCO ₂ e)	38.76	38.54	38.12	38.62	39.70	40.41	39.86	41.26	42.94	43.83	44.19
Total CH ₄ (including Land-Use Change and Forestry) (MtCO ₂ e)	7.74	8.31	7.89	9.26	9.06	8.84	9.00	8.90	9.03	9.61	9.41
Total N ₂ O (including Land-Use Change and Forestry) (MtCO ₂ e)	4.56	5.04	4.14	5.63	5.42	4.91	5.00	4.75	4.80	5.33	5.12
Energy (MtCO ₂ e)	9.54	9.32	9.00	9.65	11.02	11.74	11.17	12.54	13.94	14.50	16.30
Industrial Processes (MtCO ₂ e)	1.03	1.03	1.02	0.94	0.98	0.98	0.99	1.00	1.30	1.11	-
Agriculture (MtCO ₂ e)	7.72	8.50	6.93	9.45	8.94	7.89	8.23	7.83	7.91	8.94	8.36

Waste (MtCO _{2e})	1.81	1.94	2.07	2.19	2.24	2.29	2.35	2.40	2.45	2.49	2.54
Land-Use Change and Forestry (MtCO ₂)	31.13	31.17	31.02	31.32	31.06	31.25	31.22	31.23	31.29	31.36	31.51
Bunker Fuels (MtCO _{2e})	0.41	0.41	0.41	0.51	0.50	0.54	0.57	0.64	0.66	0.84	0.98
Electricity, Heat (MtCO _{2e})	1.97	1.76	0.67	1.21	2.42	2.63	1.91	1.71	3.10	2.72	3.18
Manufacturing, Construction (MtCO _{2e})	0.95	0.95	1.03	1.07	1.15	1.18	1.14	1.46	1.42	1.60	1.81
Transportation (MtCO _{2e})	3.36	3.11	3.61	3.57	3.61	3.81	3.70	4.99	5.09	5.66	6.74
Other Fuel Combustion (MtCO _{2e})	2.90	3.23	3.41	3.52	3.57	3.84	4.14	4.11	4.05	4.24	4.29
Fugitive Emissions (MtCO _{2e})	0.27	0.27	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28

Source: Ghana EPA/Energy Commission

Climate is an important consideration, not only for the impacts it may have on pollutants in the air, but also for the impact of human activity on the climate. Greenhouse gases (GHGs) such as water vapor, carbon dioxide (CO₂), methane (CH₄), nitrogen oxide (NO₂), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride are gases that trap radiation and warm the planet's surface. Too many of these gases may overly heat the atmosphere, in effect, changing the climate. GHA has proposed an Action Plan for Climate protection to confront the issue and deal with the possible impacts.

In addition to dust and exhaust from construction, this roads project will result in increase in GHGs emissions. The GHGs that will result from the roads program have not been estimated, due to lack of information from the construction of, the energy demands of, and the transportation demands of this Proposal over the life of the drainage structures and pavements. Besides the GHGs generated from the construction and use of the new side drains, bridges and the new pavements, there will be emissions from vehicular traffic flow that will result from the increased capacity of the terminal building and runway ends extension. The project roads will be able to handle the increase in vehicular movements, passenger numbers and the increase volume resulting from more motor vehicles and therefore more emissions.

5.4.2 Seismicity, Seismic Activities and Geo-hazards

Ghana is far from the world's major earthquake zones but has been known to be seismically active for centuries. Earthquakes of magnitude greater than 6.0 have been recorded; however, current seismic activities have been confined to local tremors of 4.8 or less on the Richter Scale. The earthquakes have mostly occurred west of Accra in the area where the Coastal boundary fault and Akwapim fault zone meet. The Seismic activities of southern Ghana has been linked to the St. Paul's (Axim area earthquakes) and Romanche (Accra area earthquakes) transform-fracture zone systems offshore in the Gulf of Guinea to onshore. The St. Paul's has been inactive for some time but movement along the Romanche Transform fault and Fracture zone is active.

According to Bacon and Quaah (1981), most of the epi-centers are located south of Weija suggesting that there is little activity north-eastward along the Akwapim range and westward along the Coastal boundary fault. It is evident from their results that there is a low level of seismic activity scattered along the Akwapim fault zone that could be due to normal faulting suggested by Burke (1969). In Quaah and Bacon's view, the epicenters of the located earthquakes are related to the level of activity of the faults. They allege that this is to be due to the existence of an old thrust zone, which has been reactivated. Burke (1971) associated the seismic activity of Ghana with the junction of the chain fracture zone and the African continental margin.

Micro-seismic studies in southern Ghana indicated that the seismicity is associated with active faulting (Essel, 1997) between the east west trending Coastal boundary fault and a northeast-southwest trending Akwapim fault zone, defined by number of active faults. A geophysical study by Essel (1997) indicated that the seismic activity is related to deep-seated faults.

It is important that all foundation structures adhere to the "Code for Seismic design for Concrete Structures" (Nov. 1990) as well as the National Building Regulations, 1996, LI 1630. The IEC standard requires a site estimate of the peak ground acceleration (PGA) with a recurrence period of 475 years for the site area. This recurrence level is equivalent to an annual risk of exceedance of 0.2%. There is no explicit IEC limit for PGA, hence the general hazard levels have been adopted in "Low hazard" results in OK, "Moderate hazard" in Caution, and "High" and "Very high hazard" results in Critical, emphasizing the need for further and detailed investigation of seismic loads. Environmental risks like earthquakes and landslides are not considered as major risks and have not been captured. A report by Amponsah (2004) mentions that in 1862, 1906 and 1939 important earthquakes occurred, reaching up to level 6.5 on the Richter scale, but since then, the most important ones only reached rather moderate levels of 4.8 on the Richter scale. In July 2014, a seismic activity was reported in the media, however without details on the magnitude. The expected Peak Ground Acceleration (PGA) of 0.7m/s² is not regarded as critical.

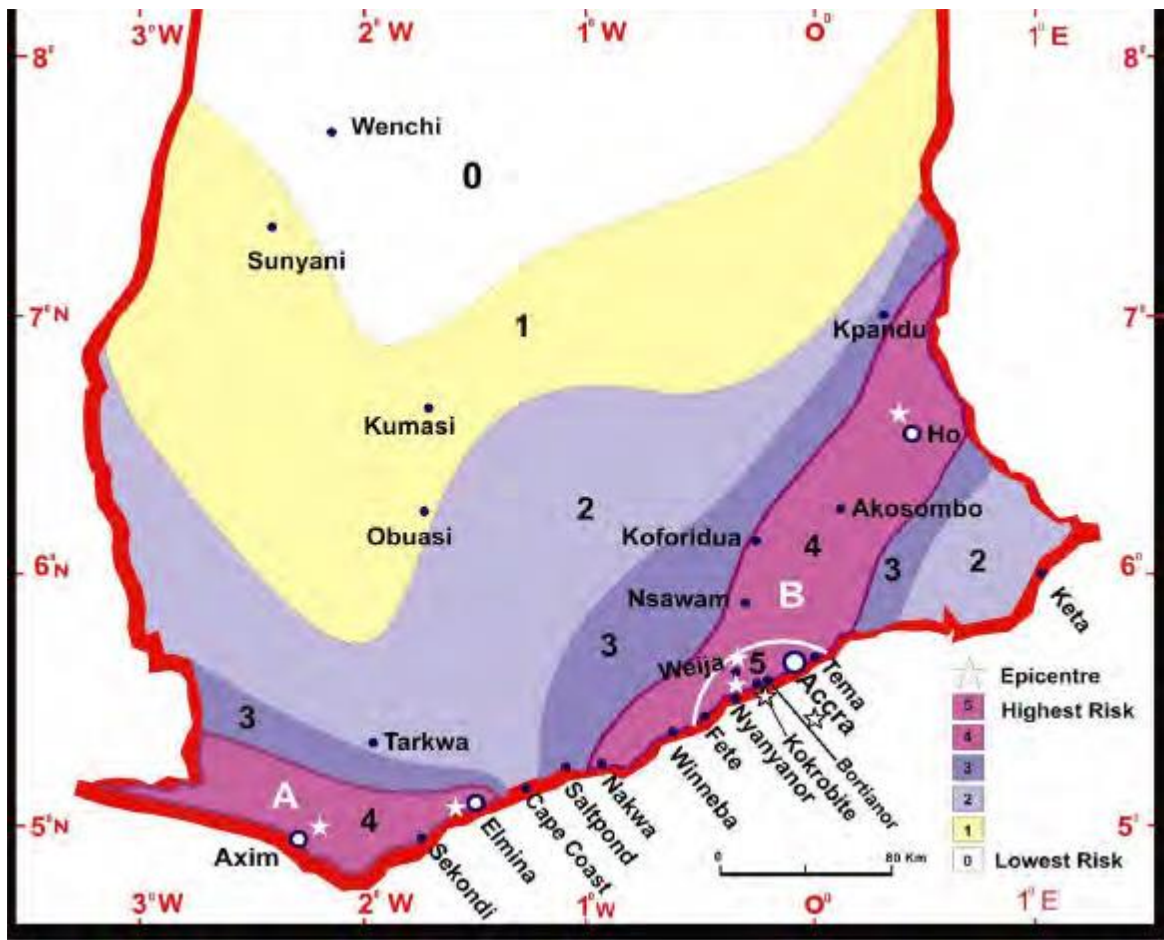


Fig 23.0 Earthquake Risk Zones in Southern Ghana

The project zone is a seismically active area. As a result, reference to seismic activities and geo-hazards, the site and surrounding area is located within a region with highest risk factor of intensity. That is, the project zone does lie within the very heart of seismic zone activities, according to Geo-Hazards Records. The area is considered as a region with highest potential of earthquakes occurrences. Moreover, historically, there have been two earthquakes occurrence over the sites and surrounding areas.

The bridge site of the project zone is located near an active fault which experienced big earthquakes in 1862 and 1939 of about 6.5 and 6.4 magnitude respectively (See Table 16.0). Given the level of non-occurrence of historic seismic activities in the bridge site of the project location since 1939, the risk is still considered significance. A technical note can recommend that a risk/cost analysis is undertaken if it is deemed to be a concern for the proposed project. If a seismic event causes an earthquake large enough to hit the bridge site a significant warning period should be provided. It is therefore recommended within the Emergency Response Plan specific measures are outlined to manage the unlikely event of an earthquake affecting the bridge site of the project enclave. Within this, a framework should be to ensure that the following measures are instituted:

- A Warning System is developed on the proposed bridge site and all on site are aware of its presence and purpose.
- In the event of an alarm evacuation measures should be instituted as far as possible.

- Volivo and Dufor Adidome residents and visitors are evacuated from the bridge site and all buildings.

5.4.3 Topography

- **Asuogyaman District**

The district's relief characteristics are generally undulating with steep slopes in some parts. The district is interspersed with five highlands, which are rocky in nature. On average the highest of the peaks in the district ranges from 70 to 800 m above sea level.

- **Dangbe West District**

The district forms part of the central portions of the Accra plains. The relief of the project zone is generally gentle and undulating, a low plain with height not exceeding 70m. The plains are punctuated in isolated areas by a few prominent inselbergs, isolated hills, outliers and knolls scattered erratically over the area.

- **North Tongu District**

The topography is gentle, ranging from near sea level to about 18m above sea level, with slopes less than 5%. The areas near the Volta River are at higher elevation, falling gradually backwards and rising again into the Adaklu Hills.

5.4.4 Geology and Soils

- **Asuogyaman District**

The project area is underlain by the rocks of the Dahomeyan series of Precambrian age, which form the basement complex of Ghana. They consist of mainly foliated biotite granite gneiss, granite augengneiss and gneiss – Schist with occasional thin beds of quartzite. The major soil groups in the corridor are mainly coastal savanna, ochrosols, lateritic sandy soils, tropical black clay or Akuse soils, and coastal sands. Low-lying areas along the Volta Lake have Savannah Greisol and Aluviosols soil types. Because of their structure, these soils are liable to temporary flooding in times of high water levels. Their nutrient status is moderate but to ensure sustained yield of crops they require the use of fertilizer.

- **Dangme West District**

The geological structure of the district is made up of ancient igneous rocks. These rocks, of Dahomeyan gneiss and schists, comprise large inselbergs (isolated rocky hills) in the north and central parts of areas outside the project zone. The soils underlying the project zone are black and clayey, sandy and poorly drained.

- **North Tongu District**

The geology comprises of few inselbergs, namely Avakpe, Asiekpe and Kluma Hills are composed of granite rocks. The Todze Hill located near New Bakpa is composed of mainly gravel. Soils in the district are dominantly medium to moderately coarse textured alluvial soils along the Volta River. Heavier clay soil, leading to poor surface and sub-surface drainage, make road development very difficult. Moreover, soils are difficult to cultivate because they have low water holding capacity. Areas around Adidome, Anfoe, Kpedzeglo, Mafi Kumase, Sasekpe and Bakpa Avedo consist of moderately coarse or sandy loams which drain easily and are suitable for agricultural purposes.

5.4.5 Hydrography and Water Resources

- **Asuogyaman District**

The critical area of the Volta gorge is situated in this district. The Volta Lake flows through definite channels within the gorge area but spread upstream, after Gyakiti and Boso into the Volta Lake. The Volta Lake is heavily braided at Atimpoku as it flows over the low-lying areas of the district and begins to meander its way into the sea at Ada. The flow of the Volta River through the undulating landscape of the district creates an extensive lakefront good for tourism development.

- **Dangme West District**

The very seasonal nature of most of the streams caused by high temperatures and equally high evaporation levels have encourage the construction of artificial dams and ponds. These water holding systems of varying sizes are used for irrigation and for watering of livestock.

- **North Tongu District**

The district is drained by Alabo, Kolo, Aklakpa, Gblor and Nyifla streams and their numerous tributaries into the Volta River, running north-south through the district. The Todze and its western tributaries drain the eastern part of the district into the Avu Lagoon. During the rainy season, these streams overflow their banks, causing damage to roads and farms. Inland creeks include Kebena, Dear, Dove, Aklamada, Amidoe and Akplordodi. Several ponds and dugouts have been created with major ones located at Atiteti, Adudomu, Mafi Kumase, Adidokpavu and Teleafenu.

Ghana EPA has issued Guidelines for Discharges into Natural Water Bodies as indicated in **Table 17.0**.

Table 17.0 Ghana Sector-Specific Effluent Quality Guidelines for Discharge into Natural Water Bodies

Number	Parameter	Guideline for Maximum Levels
1	PH	6-9
2	Oil and Grease (mg/L)	5-10
3	Temperature Increase (Amount allowable above Ambient)	Less than three degrees centigrade

4	Color (TCU)	150 – 400
5	COD (mg/L)	250
6	BOD (mg/L)	50
7	Total Dissolved Solids (mg/ L)	100
8	Chromium (mg/L)	0.1
9	Sulfide (mg/L)	1.5
10	Phenol (mg/L)	2
11	Total Coliforms (MPN/100ml)	400
12	E. Coli (MPN/ 100ml)	10
13	Turbidity (N.T. U)	75
14	Total Suspended Solids (mg/L)	50
15	Lead (mg/L)	0.1
16	Nitrate (mg/L)	50
17	Total Phosphorus (mg/L)	2
18	Conductivity (uS/cm)	1500
19	Mercury (mg/L)	0.005
20	Ammonia as N(mg/L)	1.0
21	Total Pesticides (mg/L)	0.5
22	Total Arsenic (mg/L)	1.0
23	Soluble Arsenic (mg/L)	0.1
24	Alkalinity	150
25	Fluoride (mg/L)	10
26	Chloride (mg/L)	250

Source: Ghana EPA Records

5.4.6 Air Quality, Dust and Odor

- **Asuogyaman, Dangme West and North Tongu Districts**

The vehicular traffic generated air pollution poses an intermittent threat to create severe pollution in the project corridor because of the absence of trees cape or trees canopy alignment within the road's corridor of the project landscape. Generally, the air ambient quality at the project sites will be punctuated by vehicular exhaust fumes, total suspended particulate and inhalable particulate matter (PM₁₀).

Moreover, the intensity of such emissions will increase with the increasing number of vehicular traffic movement during peak rush hours (6am and 8am in the mornings; 4pm and 6pm in the evenings) on market days. However, periods of reduced vehicular movements

will portray lessened vehicular traffic activities hence minimal number of vehicular traffic movement translates into less exhaust fumes delivery. At such times, the air quality is slightly degraded. But these processes of deterioration are all reversible, resulting in the re-adjustment of air quality to acceptable national standards (field sampling of air quality analysis would have to be carried out and the results will be disclosed for EPA Ghana permitting purposes).

Ghana regulates air pollutant emissions from industrial sources and has established ambient air quality guidelines. Ghana's guidelines standards are, for the most part, as stringent as the World Bank Guidelines for ambient air quality for industrial areas, and more stringent for residential areas. **Table 18.0** indicates the comparison of ambient air quality standards for Ghana EPA and World Bank.

Table 18.0 Comparison of Ambient Air Quality Standards

Pollutant	Ghanaian Ambient Air Quality Guidelines		World Bank Group Ambient Air Quality Guidelines (ug/m ³)
	Industrial (ug/m ³)	Residential (ug/m ³)	
SO ₂ : 24-hours Max	150	100	150
SO ₂ : Annual Average	80	50	80
NO ₂ : 1-hour Average	400	200	N/A
NO ₂ : 24-hour Max	150	60	150
NO ₂ : Annual Average	N/A	N/A	100
PM ₁₀ : 24hour Max	70	70	150
PM ₁₀ : Annual Average	N/A	N/A	50

Source: IFC (World Bank), 2004 and Ghana EPA

5.4.7 Noise Levels

- **Asuogyaman, Dangme West and North Tongu Districts**

The increase number of vehicular traffic at project zone during peak rush hours (6am to 8am in the morning; 4pm to 6pm in the evening) on market days lead to a higher frequency in automobile engine noise pollution and auditory nuisance. Greater intensity of such noise and auditing distortions will increase during rush hour continuous idling of automobile or vehicular engines on market days within marketing centers. But less reduced occurrences in vehicular movement during non-peak rush hours, will originate slightly induced disturbances from noise pollution during non-market days within marketing centers.

Ghana EPA has adopted Ambient Noise Level Guidelines. The permissible ambient noise levels guidelines of the Ghana EPA are presented in **Table 19.0**.

Table 19.0 Ghana EPA's Ambient Noise Level Guidelines

Zone	Description of Area of Noise Reception	Permissible Noise Level d B (A)	
		DAY (0600- 2200)	NIGHT (2200 – 0600)
A	Residential Area with less Transportation	55	48
B1	Educational and Health facilities (school, hospital, clinic)	55	50
B2	Area with same light commercial Or light industry	60	55
C1	Area with same light industry, place of entertainment or public assembly and place of worship (churches/ mosque)	65	60
C 2	Predominantly Commercial Areas	75	65
D	Light Industrial Areas	70	60
E	Predominantly Industrial Areas	70	70

Source: Ghana EPA Data Records

5.5 Biological/Ecological Environment

5.5.1 Flora Species

- **Asuogyaman District**

Predominant vegetation type is of the short grass savannah interspersed with shrub and short trees, a characteristic of the Sub-Saharan type. The vegetation is dense along the Volta River and along the stream basins.

- **Dangme West District**

A large portion of the flora community remains dry for most parts of the year, except for the short rainy season. Along the Dodowa River basin (outside the project roads corridor), higher vegetation cover ranges from thickets to light forest which form vegetative colony around the river basin. But the dry season depreciate the quality of this vegetation cover within the river basin since the Dodowa River then dries up.

- **North Tongu District**

The vegetation type is Tropical Savannah Grassland, which is dense along the Volta River and stream basins. The vegetation consists of mangrove, oil palms, baobab, silk cotton, acacia, etc. Away from rivers/streams the vegetation is sparse, predominantly grassland, interspersed with neem trees and guinea grass, digitaria, decumbent and fan palms, which dot Mafi Kumase and Agohome-Avetakpo areas. Neem and other trees harvested for fuel and charcoal burning (provides revenue but destroy the vegetation cover with subsequent ecological problems). Major affected areas are Alabo, Mafi Kumase, Volo, Dorfor Aklakpa and Dedukope. Shrub and grassland areas which are suitable for cattle grazing make the

district one of the largest cattle producing areas in the country. But uncontrolled grazing and frequent bushfires are gradually, reducing such areas into desert lands.

5.5.2 Wildlife Species

- **Asuogyaman District**

Harvesting of trees for lime and charcoal production in the district including poaching activities have caused wildlife decimation. Wildlife such as antelopes, monkeys, hogs and others have fled for other reserves either close to or away from the project roads corridor to avoid poaching by humans. Partridges are however still common in the area.

- **Dangme West District**

The fauna content home to the vegetation cover includes wildlife species such as antelopes, deer, grasscutter and rodents. The fauna species are hunted for protein food source to improve the nutritional value of the human population within the district.

- **North Tongu District**

The Kolo and Akalakpa Reserves have been destroyed through trees harvesting for lime and charcoal production at Battor, Volo and Darfor. Wildlife poaching activities have reduced the numbers of elephants, antelopes, monkeys and hogs. But partridges are still common.

Wildlife Migration Routes

There are no clearly defined wild animal migration routes, but there is a strong presence of animal breeding outside and inside the project roads catchment zone. There is a consistent presence of commercial cattle keeping and goats and sheep for local consumption and breeding purposes.

5.5.3 Sacred Sites

- **Asuogyaman, Dangme West and North Tongu Districts**

The proposed project roads lie outside three (3) notable, highly sensitive forest reserves. These forest reserves are Shai Hills Resource Reserve, Kalakpa Resource Reserve and Dodowa Forest Reserve. These protected natural biodiversity resources all lies outside the proposed project roads domain of influence. The Shai Hills Resource Reserve is well managed by Ghana Wildlife Division and attracts eco-tourists. However, due to limited access to the Kalakpa Resource Reserve, it has been left with minimal care. But the Dodowa Forest Reserve, because of its historical, cultural and heritage influence enjoys both local and international tourist patronage.

5.6 Human Environment.

5.6.1 Demography and Settlement Pattern

- **Asuogyaman District**

According to the 2010 Population and Housing Census, the district had a population of 98,046 persons of which 52.0% (51,016) were females and 48.0% (47,030) were males. Of the total population, 71% lives in rural areas while 30% lives in the urban centers. The population density is about 65.1 persons per square kilometer.

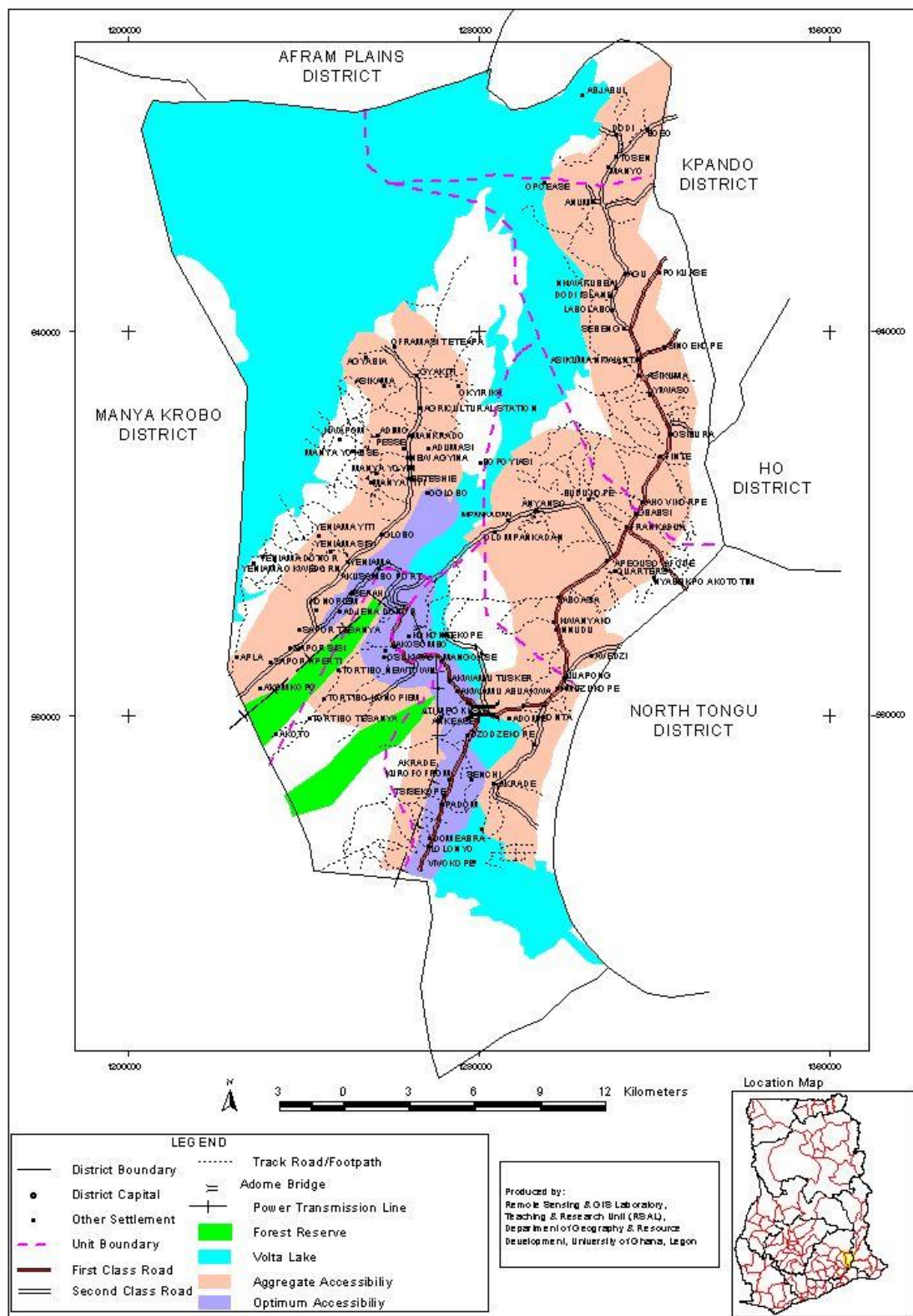
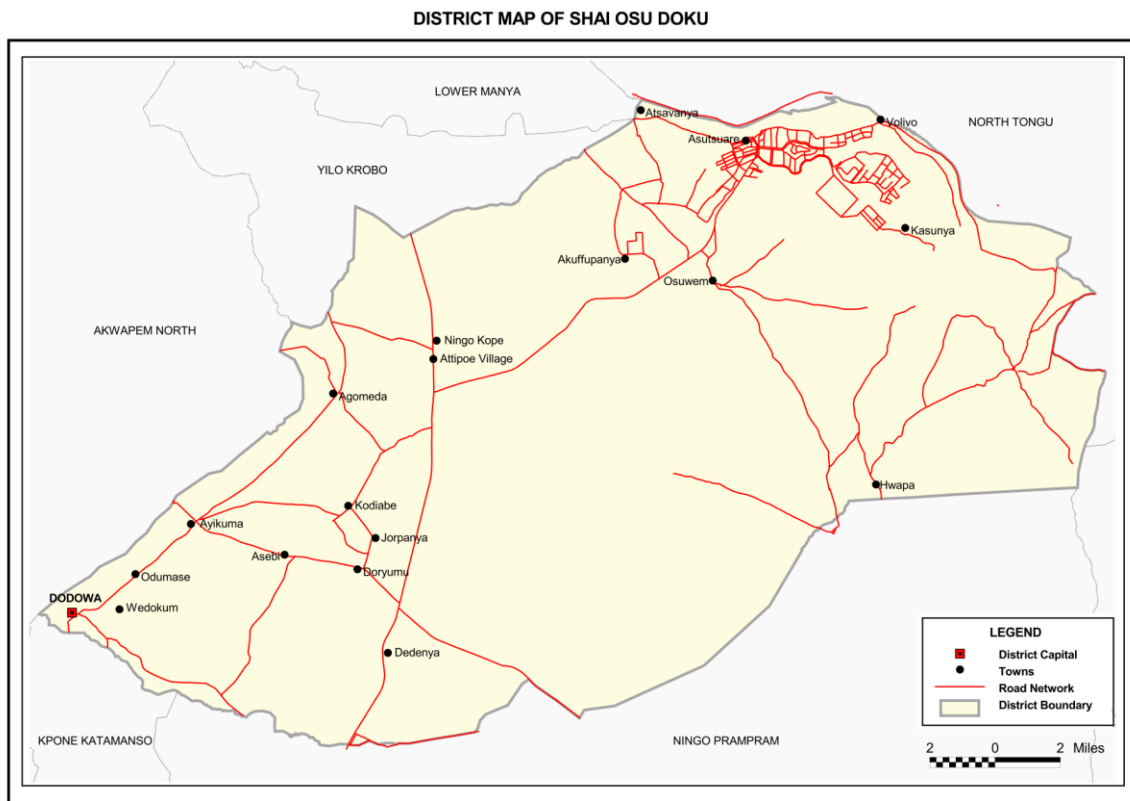


Figure 24: Asuogyaman District Map

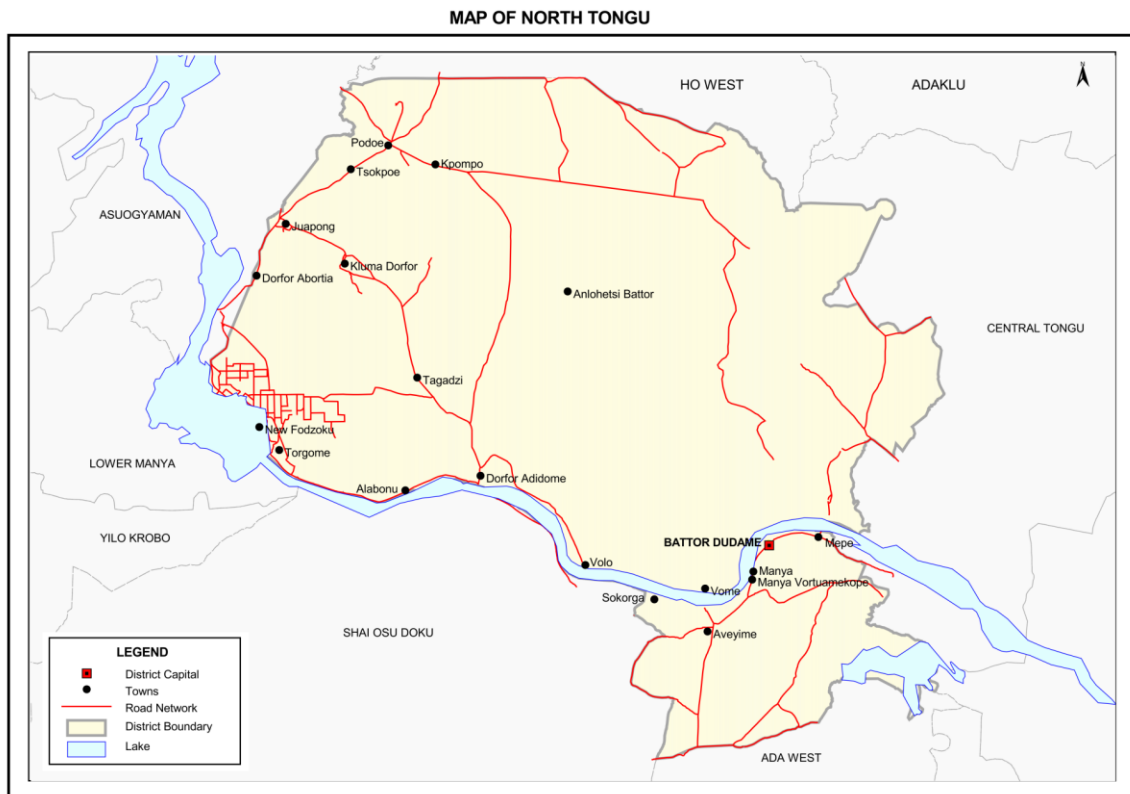
- **Dangme West District**

In 2010, the district had a population of 20,330 persons (2010 Population and Housing Census). Males made up of 48.2% (9,799) and females 51.8% (10,531). The district is mainly rural with about 32% of its population in urban areas. The settlement pattern is about 11.6 persons per square kilometers. Some sections of the project roads pass through the newly created Shai-Osu Duku District.



- **North Tongu District**

The total population of the district in 2010 was 82,152 people (2010 Population and Housing Census). Females made up 51.5% (42,308) and males 48.5% (39,844). The population density of the district is about 128.4 persons per square kilometers. The population is mainly rural, with 94% living in rural areas compared with 6% living in the urban centers.



5.6.2 Culture, Ethnicity and Religion

- **Asuogyaman District**

The district has three (3) traditional councils of Boso, Anum and Akwamu. It has a heterogeneous cultural and ethnicity structure. As at 2010, the ethnic balance was as follows: Akwamus (80% of population), Guans, Ewes, Krobos, Dangme and peoples of Northern, Upper East and Upper West (combined, constitutes 20% of the population). Religious beliefs are profiled in the following categorization: Christians (89.1%), Moslem (3.7%), Traditional (2.4%) and No Religion (4.8%).

- **Dangme West District**

The seat of the traditional council is at Dodowa. The district is dominated by Dangbes (75% of the population), with Ewes and Akans, Gas, Krobos Guans and peoples of Northern, Upper East and West forming the main minority ethnic groups (combined makes up 25% of the population) as at 2010. Christians (74.7%), Islam (4%), and Traditional Religion (21.3%) describe the religious beliefs of the district faith profile.

- **North Tongu District**

Juapong is the seat of the traditional council. The ethnicity profile of the district mirrors most of the other districts within the project roads corridor, with Ewes (85% of the population), Guans, Akans, Krobos, Dangbes, Northern, Upper West and East making up the minority

group (combined, captures 15% of the population). Religious beliefs depict the following statistics: Christians (60%), Moslem (3.9%), Traditional Religion (36.1%).

5.6.3 Economy and Employment

- **Asuogyaman District**

Agriculture is the major economic activity for employment and rural income generation. About 75% of the working population is engaged in this sector, followed by commerce (6%), service (4%) and industry (15%). About 69 percent of the population aged 15 years and older is economically active while 31.2 percent are economically not active. Of the economically active population, 93.0 percent are employed while 7.0 percent are unemployed. The main reason for not being economically active for both sexes is full time education (64.3% of males and 43.1% of females). Of the employed population, majority are engaged as skilled agricultural, forestry and fishery workers (36.4%) and service and sales (21.6%). Agricultural, forestry and fisheries (42.3%) is the main occupation for males while it is service and sales (33.1%) for females.

About 63.2 percent of the population 15 years and older are self-employed without employees and 24.2 are employees. A higher proportion of females (74.2%) are more likely to be self-employed without workers than their male (50.9%) counterparts. The informal private sector is the largest employer of persons in the district (78.3%), followed by the private formal sector (10.8%) and public (government) sector (8.3%).

- **Dangme West District**

The population of the active labor force engaged in various sectors of the local economy is given as follows: agriculture (65%); commerce (25%); service (3%) and industry (7%). The District data shows that 69.2 percent of the population is economically active, with 72.8 percent representing males and 66.0 percent representing females. Again, 93.3 percent of the economically active population is employed with males (94.4%) and females (92.3%). In addition, 6.7 percent of the economically active population is unemployed with males representing 5.6 percent and females 7.7 percent. Additionally, majority of the unemployed population are seeking work for the first time (55.3%).

Agriculture, forestry and fishing industry engages 46.4 percent of the employed population 15 years and older in the district. The agricultural industry is followed by wholesale and retail, and manufacturing industries which employ 15.2 percent and 12.7 percent respectively. With respect to employment status, Self-employed without employees has 59.6 percent and with employees' 24.1 percent. The private In-formal sector employs most of the employed with 80.6 percent. The government sector engages 8.5 percent and the Private Formal sector 10 percent.

- **North Tongu District**

Agriculture employs about 70% of the active labor force followed by commerce (20%), service (9%) and industry (1%). About 66.3 percent of persons aged 15 years and older are

economically active while the economically not active constitute 33.7 percent. The percentage of unemployed in the District is 4.2 percent and the employed constitute 95.8 percent of the economically active population. The District also has 53.3 percent of its population 15 years and older in full time education and therefore not economically active.

The North Tongu District, being an agrarian economy, has more than half (57.2%) of the employed population engaged in skilled agricultural, forestry and fishery whilst 15.3 percent are involved in service and sales. With respect to employment status and sector of employment the 2010 census result indicates that 71.9 percent of the employed in the District are self-employed without employees, 10.5 percent are Employees and 11.4 are contributing family workers. The private informal sector is the largest employer in the District (90.8%) and the Public sector 4.8 percent.

5.6.4 Agriculture

- **Asuogyaman District**

Agriculture is the major economic activity in terms of employment and rural income generation in the District. About 75 per cent of the working population is engaged in this sector which constitutes the main source of household income in the district. There are three (3) prominent types of farming activities in the District. These are livestock farming, food cropping and fishing. The most predominant of these is crop cropping with more than 78 per cent of the farmers in the District taking to this type. The major food Crops produced in the District is maize, cassava, plantain, yam and vegetable. The main farming areas are Tortibo, Domeabra, Mpakadan, Frankadua, Fintey, Gyakiti, Ankyease and Survey line. There is large track of land for commercial farming and other Agro-Business in these areas

The main types of livestock reared in the District are cattle, goats, sheep, poultry and pigs. Also, there are two kraals at Asikuma and Nkwakaben. The main problems affecting farming in the district are low price paid for farmers produce, lack of funds, irregular rainfall, pest and diseases infestation.

Fishing in the Volta Lake which constitutes an important segment of the agriculture sector is done in some communities along the 141km shoreline including parts of the Kpong headwaters. These communities include Dzidzokope, Atimpoku, Abume, Akosombo, Surveyline, Adomi, Dodi Asantekrom, Asikuma, Mpakadan and Senchi Ferry and old Akrade. Volta River Authority and Akosombo Textiles form the major industry employing a major proportion of the population. Major hotels and tourist sites (Volta Hotel, Senchi Royal Hotel, Akosombo Continental Hotel, Afrikiko River Front and Sajuna Beach Park) also contribute to the economy by attracting tourist from all parts of the world.

The service sector serves as the main source of employment for the urban populace, partly due to the presence of major roads; Accra-Akosombo; Accra-Ho and others, which pass through the urban areas where trading and other service activities are very brisk.

Food Security

The major economic sectors and opportunities for private sector discussed in this chapter are the areas of agriculture which is the main stay of the District economy, manufacturing, quarrying and commerce. The informal small-scale businesses, marketing, finance and tourism were also discussed.

Farming Systems

Agriculture is predominantly on small holder basis in the District. About 90% of the farm holdings are less than 3 acres (1.2 ha) although there are some large farms and plantations particularly for mango and banana. The main system of farming is traditional slash and burn, with the hoe and cutlass as the main farming tools.

Farming Activities

There are four (4) prominent types of farming activities in the district: food cropping, cash cropping, livestock farming and aquaculture.

Food Cropping

Seventy-eight per cent (78%) of the farming population is engaged in crop production. The major crops are maize, cassava, vegetables and yam. Large numbers of these farmers have small holdings. The main farming areas are Tortibo, Domeabra, Mpakadan, Frankadua, Gyakiti, Ankyease, South-Senchi, Survey line, Yeniamia and Sapor. **Tables 20.0, 21.0 and 22.0** depict crops grown and major production areas, areas planted to selected crops and crops production.

Table 20.0 Crops Grown and Major Production Areas

Crops	Major Areas of Production
Maize	Frankadua, Asikuma, Mpakadan, Yeniamia, Sapor
Cassava	Apegusu, Mpakadan, Frankadua, South –Senchi, Yeniamia, Sapor
Yam	Frankadua, Fintey, Apenkwa, Adjena,
Plantain	Nnudu, Aboasa, Sapor, Yeniamia.
Pepper	Mpakadan, Old Akraide, South – Senchi
Cocoa	Nnudu, Aboasa, Apegusu, Opokuase – Anum
Oil Palm	Aboasa, Nnudu, Tortibo, Frankadua, Sapor, Apegusu, Asikuma

Source: MOFA, Asuogyaman

Table 21.0 Areas Planted To Selected Crops (Hectares)

Crops	2008	2009	2010	2011	2012
Maize	8,757	9,000	8,800	8935	8,898
Cassava	11,057	11,060	11,100	11,075	10,910.0
Yam	724	800	1,400	1,445	1,430
Cocoyam	450	300	40	38	40
Plantain	1,453	1,550	900	900	906

Source: MOFA, Asuogyaman.

Table 22.0 Crop Production (Metric Tonnes)

Crops	2008	2009	2010	2011	2012
Maize	14,011	13,663	12,902	12,173	16,016
Cassava	147,058	159,511	151,494	148,992	218,200
Yam	12,453	14,539	13,629	12,845	24,024
Cocoyam	3,465	-	-	-	200
Plantain	13,949	9,543	13,305	13,011	7,520

Source: MOFA, Asuogyaman

CASH CROPPING

Cocoa and oil palm are the major cash crops grown on small plantations. Of late, mango production is gaining currency.

Table 23.0 Average Farm Size of Various Crops

Crops	Average Farm Size
1. Maize	2 acres
2. Cassava	2 acres
3. Yam	3 acres
4. Plantain	1 acre
5. Cocoyam	1 acre
6. Citrus	5 acres
7. Cocoa	3 acres
8. Mango	5 acres
9. Pepper	2 acres
10. Okro	1 acre
11. Water Melon	1 acre

Source: MOFA, Asuogyaman

Livestock

The main types of livestock reared in the district are cattle, goats, sheep, pigs and poultry. Most of the livestock farming that goes on in the district is on subsistence levels.

Table 24.0 Livestock/Poultry Population (2001-2013)

Year	Cattle	Sheep	Goat	Pigs	Poultry
2001	2,503	5,450	7,921	2,008	36,142
2002	2,210	6,100	8,210	1,981	39,021
2003	2,423	6,341	8,306	1,720	38,430

2004	2,752	6,446	8,500	1,600	39,741
2005	2,862	6,502	8,729	1,465	39,023
2006	2,901	6,622	8,993	1,233	28,825
2007	2,992	6,843	9,355	1,099	29,913
2008	2,286	6,733	9,531	1,622	31,669
2009	2,377	7,289	10,103	1,740	41,779
2010	2,493	7,312	11,124	1,941	60,225
2011	2,378	8,542	12,221	2,057	67,254
2012	2,562	8,657	12,783	2,465	80,226
2013	2,798	8,924	12,987	2,815	92,547
% change 2012/2013	9.2	3.0	1.6	14.2	15.4

Source: MOFA, Asuogyaman

Fishing

Fishing in the Volta Lake which contributes as an important segment of the agricultural sector is done in some communities along the 141km shore line, including parts of the Kpong head waters. These communities include Dzidzorkope, Atimpoku, Akosombo, Survey Line, Small London, South- Senchi, and Dodi Asantekrom, Kudi Kope, Sedom. Total fish caught on the lake as at the first quarter of 2007 amounted to 434 tons.

There are commercial and small-scale fish farms totaling about ninety in number. Most of these farms have engaged in cage culture. The commercial farms include West Africa Fish Ltd at Asikuma and Tropo Farms at Mpakadan producing table-size fish and Crystal Lake Fish Ltd at Dodi Asantekrom producing mainly fingerlings for supply to farmers.

Non-Traditional Agricultural Crops

The main non-traditional agricultural crops cultivated in the district include banana, mango, pineapple and vegetables. Notable among the farms involved in the production of these non-traditional export crops are listed in **Table 25.0**.

Table 25.0 Cultivation of Non-Traditional Crops (2010)

Name of Farm	Location	Hectarage Cultivated	Crop Produced
Tack's Farm	Old Akrade	200	Mango
		2	Pineapple
Bio- Exotica	Gyakiti	24	Pineapple
Small scale Farms	District wide	4.8	Pineapple
V.R.E.L.	New Akrade	20	Pineapple
Kosh Farms	New Akrade	10	Mango
Dakoba Farms & Indust.	Asikuma	32	Mango
Jachom Farm Ent.	Asikuma	5.2	Mango

Kosh Farms	New Akrade	10.4	Mango
Odjana Farms	Asikuma	7.6	Mango
Otafresh	Anyaaase	12	Mango
Volta Farms	Adjena	32	Mango
Pen Cottage Farms	Asikuma	4	Mango
Azago Farms	Labolabo	4	Mango
V.R.E.L.	New Akrade	184	Banana

Source: MOFA, Asuogyaman

- **Dangme West District**

Agriculture is the predominant source of the district economy. In the agriculture sector, about 90% of the total land area comprises arable land but only about 35% of this is currently under cultivation. About 75% of the active labor force is engaged in agricultural activities such as crop farming, fishing, livestock and forestry. Major crops cultivated are cassava, maize, rice, pepper and legumes. Horticulture crops such as mangoes, pineapple, cashew, water melon, cabbages, lettuce and cucumber are also produced.

Livestock

About 75% of the arable land is mainly savannah grassland, which is very suitable for livestock rearing. Currently, the district has the largest population of cattle in the Greater Accra Region. The Agortor settlement area has been identified as the main location for cattle production in the district.

Non-agriculture

Non-agricultural activities encompass the following: wood processing; mining and quarrying; construction and building; vehicle repair and maintenance; charcoal production; salt mining and beekeeping.

- **North Tongu District**

Agriculture is the leading sector in the District's economy. The sector is dominated by small scale unorganized farmers who depend mainly on simple labor-intensive production techniques.

Though the Agricultural sector is the leading economic sector, it is characterized by low productivity resulting from the continuous usage of indigenous farm implements and adoption of indigenous farming practices. Another feature is the high level of post-harvest losses particularly in maize and vegetable production.

Fishing

River fishing mostly in the Volta River has declined considerably due to the formation of the Volta Lake. The principal traditional fishing communities (Bakpa, Mafi, Mepe, Battor and Volo), which are close to the Volta, have had their economic base eroded. Many of the economically active population have been lost to areas along the Volta Lake in the Kete-Krachi, Nkwanta, Kpando, Atebubu, Gonja – East, Afram Plains and other districts.

Most of the streams and ponds / creeks which used to contain lots of fish have been completely depleted due to the absence of the annual flooding from the Volta that stocks them with fish.

Livestock

The livestock sector forms an integral part of the farming system. More than 30% of the farming families in the District keep some ruminants. The North Tongu District is one of the largest cattle producing areas in the country. Apart from the three major cattle ranches at Aveyime, Amelorkope and Adidokpavu, individual farmers keep Kraals all over the District.

5.6.5 Education Provision

- **Asuogyaman District**

As at 2010, educational facilities in the district are as follows: 98 Primary Schools (68 Public and 30 Private); 49 JHS (36 Public and 13 Private) and 7 SHS (5 Public and 2 Private). About 36,711 persons in the district are attending school. Of those in school 88% are at the basic level (nursery, kindergarten, primary and JHS) and 8.8% at SHS level. Only 2.2% are at the tertiary level. About 2.5% males are benefiting from tertiary education as against 1.8% females.

- **Dangme West District**

In 2010, of the population 11 years and older 70.7 percent are literate, with 45.9 percent being literate in English and Ghanaian language only. Also, 49.8 percent of those currently attending school are in primary school. Educational facilities in the district recorded in 2010 were these: Pre-school 132 (69 Public and 63 Private); Primary 131 (79 Public and 52 Private); JHS 71 (15 Public and 56 Private) and SHS 6 (3 Public and 3 Private).

- **North Tongu District**

Of the Districts population in 2010, 16,615 are 11 years and older and 74 percent are literate with more literate male (51.7%) than female (48.4%). The majority (70%) of the literate population (11 years and older) are literate in English and Ghanaian language only. Also, of the 3 years and older currently in school, 49 percent are in primary school. There were 97 kindergarten, 95 primary, 61 JHS and 4 SHS educational infrastructure in 2010. Moreover, there was 1 special school for rehabilitation of mentally retarded and 1 farm institution at Adidome.

5.6.6 Health Care Delivery

- **Asuogyaman District**

There are two (2) major hospitals in the district as at 2010. They are VRA Hospital and Asuogyaman District Hospital. The district has these medical facilities: six (6) clinics, two (2) private hospitals and seven (7) functional CHPS centers. Health care service delivery is provided by 279 total staff strength, most of them are at the VRA Hospital. Specific HIV/AIDS prevalence information at the district level was not available for documentation in this ESIA. However, being a district within the Eastern Region the HIV/AIDS prevalence among pregnant women attending ANC clinic in 2009 was 4.2 (this was above the national average of 2.9).

- **Dangme West District**

The number of health care facilities in the district in 2009 included the following: 1 (district hospital); 9 (CHPS centers); 3 (health centers); 2 (private clinics); 1 (private medical center); 2 (private maternity homes) and 2 (quasi-government institutions as clinics). The recorded cases of HIV/AIDS in the district in 2008 and 2009 were as follows: 2008 (231 cases) and 2009 (201 cases). In 2008, 231 positive cases consisting of 106 related cases from counseling and testing (CT) and 125 cases from Prevention of Mother to Child Transmission (PMTCT) were recorded. In 2009, 201 positive cases were recorded comprising of 134 CT and 67 PMTCT respectively.

- **North Tongu District**

There are 3 hospitals, 8 health centers, 9 clinics and 1 CHPS center. Distribution of health facilities in the district is skewed in favor of large towns such as, Juapong, Volo, Torgorme, Podoe, Dorffor Adidome, The Catholic Hospital at Battor is the biggest of all the health facilities and is the District Hospital. It receives a lot of referral cases from the other health centres. The Hospital is noted for its specialty in Hernia, Fibroid & goiter treatments. The HIV/AIDS records of the district were not available for inclusion in this report. However, the HIV/AIDS prevalence among pregnant women attending ANC clinics in 2009 in the Volta Region was 2.6 (this was below the national average of 2.9).

5.6.7 Historical, Cultural and Heritage Resources

- **Asuogyaman, Dangme West and North Tongu Districts**

There are some prominent heritage resources within the project zone of influence which will not be affected by the Proposal. These are very symbolic cultural and historic assets which need to be preserved and protected during the project implementation program. Because of the presence of such delicate cultural resources such as sacred grove, shrines and cemeteries which will not be affected by the roads project, a detailed heritage sensitivity assessment will be recommended to be carried out prior to the Proposal implementation.

Section 1: Asutsuare Junction – Volivo Road (28.3Km)

The absence of historical, cultural or archaeological resources within and/or outside the immediate surroundings of this project road eliminates any significant impacts of the project development on heritage sites. This road project implementation program will not have any potential negative impact on any listed historic resources. Where necessary, an archaeological sensitivity assessment should be carried out and all excavation activities should be supervised by experts for the potential discovery of chance find. Moving forward, as more detail on the ground disturbance of construction activities emerges, additional archaeological review should be undertaken, consistent with expert recommendations. This review should include reviewing geotechnical data (i.e. soil boring logs) and underground utility data to identify more precise areas of potentially intact soils where below ground resources may be present.

Section 3: Dufor Adidome – Asikuma Junction Road (38.4km)

At the new Volta River Bridge site at Dufor Adidome, ch (0 + 000) km LHS, there is a sacred grove with two (2) shrines, male and female. The male shrine is called **Tsaduma Shrine** and the female shrine is **Venor Shrine**. The fetish priest who takes care of these shrines and administers traditional rituals and rites to appease the gods is **Fetish Priest Ernest Gakpetor**. Around ch (0 + 800) km LHS, there is a public cemetery. These historical, cultural and heritage assets are not in the RoW and will be avoided to make way for the project road implementation program.

Section 2: Asutsuare – Aveyime Road (24.0km)

At ch (0 + 000) km RHS and ch (1 + 100) km RHS are two (2) cemeteries which will not be affected by the project road development program. These cemeteries are Bosidom Cemeteries 1 and 2. The Adakorkpe Shrine, located at ch (14 + 500) km LHS, will not fall within the RoW of the project redevelopment alignment, therefore, will not require any displacement. An old royal cemetery at ch (24 + 500) km RHS and an old public cemetery at ch (24 + 800) km LHS are not directly within the new road improvement reservation width. A bypass new road will be constructed as part of the section 2 (Asutsuare – Aveyime Road) project road to avoid all the historical and cultural heritage resources located at the tail end of this project road.

5.6.8 Water and Sanitation

- **Asuogyaman District**

Water Supply Access

The Eastern Region of Ghana is reputed to have the least percentage (31%) of potable water coverage according to a survey conducted by GWSC in 1992. This is against a national figure of 49% coverage. In Asuogyaman District apart from Akosombo, Akrade, Atimpoku and a few other settlements, majority of the settlements in the District lack potable water. A field survey conducted in 2012 revealed that the major rural water infrastructure facilities available for the supply of water in the district are boreholes, pipe borne, hand dug wells, streams and the Volta Lake. There are three (3) water treatment plants serving the District. These are the

Kpong, Akosombo and Boso treatment plants. Communities along the main road corridor to Akosombo are either served by the Kpong or Akosombo distribution system. Towns in Anum and Boso Zone are served with water from the treatment plant at Boso. Settlements that are served with pipe-borne water include Akosombo, Atimpoku, Anum, Boso, Akrade, Mangoase and Tusker.

Most settlements with pipe borne water still depend on wells, boreholes, streams and the Volta Lake as supplementary source of water. In Atimpoku for instance in spite of the supply of pipe-borne water about 50% of those interviewed indicated that the Volta River is the main source of water supply.

There are 45 boreholes and 13 wells in the District. Most of the wells are private while on the other hand, majority of the boreholes are public owned. A lot of the boreholes serve as the only source of potable water supply in the communities.

Settlements mainly found in the Gyakiti and Frankadua/Apegueso zones and isolated ones like Tortibo, Sapor, Asikuma centre include communities around Tortibo, Sapor and Asikuma Mpakadan Domeabra Anyansu and Yaniama are without pipe borne water. For most of these settlements their main sources of water supply are boreholes, well and streams. Communities along the Volta River use the Lake as the main source of water supply. The water and sanitation facilities in the district are indicated in **Table 26.0**.

The rural water infrastructural facilities for the supply of water in the District include hand pumps, boreholes and water treatment and distribution systems. There are three water treatment and distribution systems serving the District. These are the Kpong, Akosombo and Boso treatment plants. Communities along the main road corridor to Akosombo are either served by the Kpong or Akosombo distribution systems. Towns in Anum and Boso zone are served from the treatment plant at Boso.

Sanitation Evaluation

Sanitation is of a much bigger problem in the District than water supply. Like at the national level, the sanitation development level is behind that of water systems. Sanitation facilities in the District consist principally of toilet facilities and a few others for ensuring proper hygienic conditions. These include water-close sets (WCs) mainly found in Akosombo, Anum and Boso, KVIPs, ordering Pit latrines and VIP. These WCs are privately owned by certain institutions and individuals.

Waste and Wastewater Evaluation

Properly constructed drainage facilities care is virtually non-existent in the District with domestic waste water running freely from homes on to walk ways. These waste waters get stagnant in little depressions within the settlements and serve as breeding grounds for mosquitoes and other harmful insects. Also absent are proper hygienic methods of human waste as well as solid waste disposal. This results in the indiscriminate disposal of waste.

Refuse is disposed of in heaps near rivers or at places near to food preparation sites. These disposal sites are breeding grounds for disease vectors and bacteria which pose serious health hazards for inhabitants of the settlements. It must also be noted that par latrines lack requisite specialists to empty the pans thus necessitating the phasing out of all these types of toilets.

Currently CWSA is in collaboration with Assembly implementing a DANIDA funded Community Water and Sanitation Project. This project started in 1999 as a pilot phase of the eastern Region Community Water and Sanitation Program. Under the pilot phase of the project four (4) institutional latrines and one hundred and fifty (150) household latrines were constructed throughout the District by the end of January 2000. The construction of additional 50 VIP toilet facilities started in February 2000 and is currently on-going.

Table 26.0 Water and Sanitation Facilities in the Asuogyaman District

Type	No.	No.Functioning	No. Not Functioning	Donor	Community
Bore-hole	59	48	11	JICA/WVI	39
Hand dug wells with pump	4	0	4	Rotary	-
Hand pump without pump	18	13	5	ADA	-
Pipe Connections	1626	1626	0	ADA	21
KVIP	44	44	0	ADA	24
Aqua Privy	9	9	0	Individuals	-
Pan Latrine	12	12	0	ADA/Com	-
VIP	255	255	0	ADA/Com	-
Water Closets	1596	1596	0		-

Source: Socio-Economic Survey, 2012.

Sanitation Evaluation

Sanitation facilities in the district consist principally of toilet facilities and few facilities for ensuring proper hygienic conditions in the Districts. These include Water closet s (WC mainly in Akosombo, Anum and Boso); Kumasi ventilated improved Pits (KVIPs), pit latrines, Pan Latrines and Ventilated Improve Pits (VIP's) the WC's are mainly owned institutions and private individuals.

- **Dangme West District**

Water Supply Access

Access to potable water supply in the project environmental is totally absent. This is due to the complete absence of surface water resources potential for treatment and connection, especially in the dry season. Such defective natural environmental conditions hinder the drilling of boreholes, hand-dug wells and dugouts.

Moreover, potable water supply from Ghana Water Company Limited is also limited to urban centres such as Dodowa, Prampram, Ningo, Afiencya, Asutsuare, Osuwem and Ayikuma. These

areas are served by potable water supply resource from Kong and Osudoku Water Project, which often experience irregular water flow.

In the rainy season, smaller communities within the district depend on dams, streams, rivers hand-dug wells and other dug-outs for sources of water supply for drinking and domestic use. In all, there are 58 boreholes in the districts which are currently functional.

Sanitation Evaluation

Human excreta disposal systems involve the use of three (3) facilities: KVIP, Pit Latrine and Bucket / Pan Latrine. The bucket/pan latrine use has declined due to associated problems such as lack of suitable disposal site and the unhygienic method of disposal. "Free range" also known as indiscriminate defecation in open spaces, is popular and highly common in the district along the coastal and the forest areas.

Sanitation management in the areas of solid and liquid waste disposal within the project environment and the district is ineffective. Refuse and household waste are disposed of indiscriminately, with the resultant creation of solid waste landfill sites. At these landfill sites, disposal of solid waste continues by dumping and burning. As a result, a potential increase in waste generation volumes is imminent. This has direct implications for the waste management needs of the district which is currently characterized by undesirable operational practices, poor and /or entirely absent of operational strategies. Waste disposal by open dumping promotes insanitary environmental conditions with the incidence of communicable diseases.

- **North Tongu District**

Water Supply Access

About 34.2% of households in the District surveyed in 2010 revealed that they use river/stream as their main source of drinking water. However, 44.6% of households in the rural areas use river/stream as their main source of drinking water compared to 19.2% in the urban areas of the District. Also, 16.3% of households in the district use public tap/standpipes as their main source of drinking water whilst 14.7% use pipe borne water outside the dwelling. Only 10.0% of households use pipe borne water inside the dwelling for drinking.

Sanitation Evaluation

There five (5) main toilet facilities in use in the District. The highest reported toilet facilities (or lack of it) used in the District are pit latrines 5,734 (30.9%), toilet facility 5,091 (27.4%), public toilet 4,837 (26.0%), Kumasi Ventilated Improved Pit Latrine (KVIP) 2,301 (10.9%) and water closet 721 (3.9%). Households who practice no facility (bush, beach and field) are more in the rural areas (35.0%). Also, households using WC are more in the urban areas constituting 8.1% whilst only 1.0% use WC in the rural areas.

About 6,419 (34.6%) of households use public dumps (open space) as their main source of refuse disposal. In the rural areas, 30.0% use public dumps (open space) as compared to

41.1% of urban households. Burning as a form of solid waste disposal is carried out by 5,250 (28.3%) households.

With regards to liquid waste disposal, 12, 232 (65.8%) of households dispose liquid waste indiscriminately by throwing onto compounds. About 55.3% of urban households dispose liquid waste on compounds as compared to 73.1% in rural areas. Only 0.9% of households dispose their liquid waste through the sewerage system. About 1.9% households in the urban areas and 0.3% of rural households dispose liquid waste through a sewerage system.

5.6.9 Energy and Power Resource

- **Asuogyaman District**

The main type of energy utilized in the District are electricity, charcoal fuel wood and Liquefied Petroleum Gas (LPG). Due to the government's rural electrification project and the proximity of the District to the Akosombo Hydro-electric Plant the numbers of settlements enjoying electricity have increased. Settlements enjoying electricity in the district includes Akosombo, Mangoase, Tursker, New and Old Akrade, Atimpoku, Senchi. The rest include Nnudu, Aboasa, Apegusu, Anum, Boso, and Adjena. Settlements with on-going electrification projects are Fintey, Osiabura, Yeniamas Surveyline and Frankadua. All the major towns and villages in the district are expected to be connected to the National Grid by the end of 2003. Electricity is used for industrial, commercial and domestic purposes. Domestic use tends to be the most frequent in the district where it is widely used for lighting and to power household appliances. The use of electricity for cooking is uncommon except in Akosombo.

Petrol, diesel and kerosene constitute a very important source of energy in the district. They are mainly used by vehicles and agricultural machinery such as sprayers, tractors and outboard- motors. Kerosene is generally used for lighting in communities which lack electricity and for lighting lamps during periods of power outage. Oil companies at filling stations supply fossil fuels. There are filling stations in four communities. The communities with filling stations are, Akosombo, Atimpoku, New-Akrade, and Asikuma.

Table 27.0 Energy Use in the Asuogyaman District

Type of Energy	Frequency	Percentage
Electricity	45	28
Kerosene	39	24.9
Charcoal/Fuel/Wood	69	43.7
LP GAS	5	3.4
TOTAL	158	100

Source: Asuogyaman District Survey, 2013.

Charcoal and fuel -wood constitutes the predominant energy source for cooking in both the rural and urban areas of the district. Fuel-wood tend to be used more in the rural areas whereas charcoal is frequently use in urban communities. L P gas constitutes just about 3 percent of energy usage in the District. The cost of LP Gas is quite high and thus out of reach of most households in the District. As far as environmental protection is concerned electricity

and LP gas are the safest. The only problem with these sources is that, they are relatively expensive compared to other sources. Facilities for the re-filling of gas cylinders are not available in the District and users go to Kpong for refilling which increase the cost to the consumer.

- **Dangme West District**

Households in the District were asked about their main source of lighting facility in the house during 2010 survey. The response indicated that electricity through main national grid (53.7%) is the major source of lighting for households in the district. A significant percentage (32.0%) of households also uses the kerosene lamp whilst 11.2 percent also use flashlight/torchlight. A relatively low proportion of households 1.2% in the district use private generators; for a rural district, this is quite significant. The use of gas lamp, solar energy, firewood and crop residue for lighting are almost non-existent in the district. Households in both urban and rural areas mostly use electricity through main national grid with higher percentages of urban households 80.9% compared to 44.2% of their rural counterparts using electricity. The use of kerosene lamp is however pronounced in rural areas (38.8%) than urban areas (12.6%).

The source of fuel used for cooking in the District and the distribution by locality were also indicated. The main fuel used for cooking in the district is charcoal (45.7%) while 33.3 percent of households use wood to cook and 16.4 percent also use gas. About 3.8 percent of households do not cook at all. Animal waste as fuel for cooking is the least used by households with an insignificant proportion. In urban households, the major fuel used for cooking is also charcoal (60.0%), 24.7 percent use gas and 10 percent use wood for cooking. The major fuel used in rural communities is wood 41.4% and charcoal 40.7% while significant proportion of households also uses gas 13.5 percent.

The survey data further provides information on cooking space used by households. The data shows that 34.3 percent of the households in the district cook their foods on verandahs followed by 27.8 percent of households that use separate rooms for exclusive use of the households. A significant proportion (20.7%) of households cook their food in open space in compound, while 5.8 percent also use structure with roof, but no walls and 4.9 percent do not have a cooking space at all. In urban households, verandah (47.5%) is main space used for cooking. Another 18.2 percent of the households also use kitchens to cook 19.0 percent cook in open space in compound whilst 3.7 percent do not have a cooking space at all. Rural households however use kitchen (31.2%) mostly in cooking whilst other households also use verandah (29.7%) and open space in compound (21.3%).

- **North Tongu District**

A 2010 survey data depicted the main source of lighting of dwelling unit by type of locality. The main source of lighting for most households (48.9%) is kerosene lamp. A higher proportion of households using kerosene lamp as their main source of light is higher in rural (62.4%) than urban areas (29.3%). Out of the urban households in the District, 57.8 percent use electricity with 19.7 percent in rural areas also using electricity as their main source of lighting.

The main source of cooking space used by households also shows that a higher proportion of the households use a Separate room for exclusive use representing 40.5 percent for domestic activities with urban and rural proportions of 32.9 percent and 45.7 percent respectively. Open space in compounds (23.4%) is the next commonest cooking space used by households with urban and rural proportions of (28.8%) and (19.6%) households respectively.

5.6.10 Transportation

- **Asuogyaman District**

Transport facilities in the district include road, lorry parks and water transport. Road transport is by far, the most important mode of transport in the district. The Tema-Akosombo portion of the road is asphalt. The road network from Atimpoku to Anum and Boso is bitumen surfaced. The rest of the road network in the district is basically feeder roads. Akosombo has an inland water port at Marine managed by the Volta Lake Transport Company. The company has ferries which transport goods and people on the Lake to Afram Plains and Yeji in the North. The lake also provides opportunities for farmers who use canoes to the big market centre at Dzemeni in the South Dayi district of the Volta Region.

- **Dangme West District**

The district has about 252 kilometers of road network; 40 percent is surfaced while the rest are feeder roads. Tracks and footpaths also link villages. The total road network when compared to other districts appears to have a good spatial distribution. Apart from the central portion of the district, which is devoid of roads, the rest of the district is fairly linked up. The road surface condition of the national trunk roads is of an appreciably good condition. However, the local arterials such as the Dodowa-Afiencya road and Doryumu-Agomeda road need urgent improvements. Most of the feeder roads that give access to the more rural centres are unsurfaced and need regular resurfacing especially after the rainy season. Statistics about traffic on those roads such as traffic volume, vehicle fleet, traffic composition, hourly distribution, peak hour traffic, and passenger and freight movement are unavailable for the district. Surveys would have to be conducted to collect such vital data for future planning purposes.

There is a disused 14.8 kilometers railway line from Tema through Afiencya to the Shai Hills used for the construction of the Tema Harbor. This line can be rehabilitated for urban transport.

- **North Tongu District**

The District has a tarred road linking from the main Accra-Aflao road through Sege. Other communities such as Juapong are along the main Accra-to Ho road. There are also some motorable feeder roads within The District. Another form of transportation in the District is by river. The District is divided by a stretch of the Volta lake with communities such as Torgorme, Volo, Vome Battor and Mepe among others lying along the river.

5.6.11 Vulnerable Group

- **Asyougyaman, Dangme West and North Tongu Districts**

Potential vulnerable groups often include children, aged, disabled and women. Potential vulnerable groups often also include “indigenous peoples” as used by donor institutions refer to social groups with a social and cultural identify distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process. The people so described have been traditionally marginalized and exploited. Indigenous or tribal people are commonly known to be among the poorest segments of a population. They traditionally engage in economic activities that range from shifting agriculture in or near forests to wage labor or even small-scale market – oriented activities. The Word Bank (Operational Directive 4.10) lists the following characteristic of the indigenous peoples’ in geographical areas as follows:

- ❖ A close attachment to ancestral territories and to the natural resources in those areas;
- ❖ Self – identification and identification by others as members of a distinct cultural group;
- ❖ An indigenous language, often different from the national language;
- ❖ Presence of customary social and political institutions; and
- ❖ Primarily subsistence – oriented production.

With regards to the potential area, of Project influence given the available data, there are populations subject to resettlement by the project. However, these project populations do not appear to warrant categorization as indigenous people pursuant to World Bank Operational Directive 4.10. This determination should be considered and subjected to verification. However, GHA addresses vulnerability and social exclusion issues through initiatives and interventions for women and gender related issues.

5.6.12 Gender Equity and Mainstreaming

- **Asuogyaman, Dangme West and North Tongu Districts**

GENDER INEQUALITY

Gender equality is a goal that has been accepted by governments and international organizations. It is enshrined in international agreements and commitments. There are many ongoing discussions about what equality means (and does not mean) in practice and how to achieve it. There are global patterns to inequality between women and men. For example, women tend to suffer violence at the hands of their intimate partners more often than men; women’s political participation and their representation in decision-making structures fall behind men’s; women and men have different economic opportunities; women are over-represented among the poor; and women and girls make up majority of people trafficked and involved in the sex trade. These issues – and others – need to be addressed in efforts to promote gender equality. Achieving greater equality between women and men will require changes at many levels, including changes in attitudes and relationships, changes in situations

and legal frameworks, changes in economic institutions, and changes in political decision-making structures.

MARGINALIZATION OF WOMEN

Generally, females are being marginalized resulting in the fact that their views not adequately captured in decision making and therefore making them vulnerable. A larger proportion of female head households exists due to migration of the male counterpart, child neglect etc. Most of the women however have no regular source of remittance. The domestic roles of women include taking care of children. Women are therefore saddled with the responsibility of providing food, clothes and in some cases the payment of school and hospital fees. The low income earned by these women, therefore inadequate to meet the needs of their households hence their disadvantaged positions economically

Social problems faced by women who have some relationships with poverty include the traditional social systems, fertility, conflicts and gender equity in personal and social relations. Also, in traditional legal systems, the perceptions of female roles combine to ensure that allocation of resources favor male authority and interest still exist. Some negative traditional practices, restrictions on pregnant and lactating mothers as well as serving the best and largest parts of the meal to the male members of the household, all conspire in no small measure towards worsening the lot and the general poverty-stricken position of most women in the district. Women generally have lower access to land. When land allocations are made to women, they are normally given smaller acreages no matter their individual capabilities. The District Assemblies ensured that on the basis of gender analysis, gender concerns are addressed in all planning activities when setting priorities, allocating resources and identifying actions and activities.

GENDER MAINSTREAMING

Specific gender mainstreaming activities include the following: provision of adequate sanitary facilities for both male and female at all public places especially schools and health facilities due to the special needs of girls; analysis of development proposals in the light of how it affects both male and female and provide each facility adequately to address their needs; organization of sensitization programs for men and women to encourage cross gender participation in local governance; encourage more female aspirants to take political and public positions; form school clubs for girls to build their confidence and capacity to bridge the gap between boys and girls; supporting women trades groups in the districts in accessing resources for their activities; addressing the issue of women access to land for farming.

Chapter 6 Presentation of the Alternatives Considered

6.1 Project Alternatives

The basic technical study analyzed all the feasible scenarios from the economic, environmental and social standpoints. This technical study facilitated the determination of the best viable alternatives which are: the non-project option; the new routes option and the selected option.

6.2 Conceptual Alternatives

Various conceptual alternatives were evolved by the JICA Feasibility Studies in 2012. And each of the conceptual alternatives was evaluated in terms of project purpose and need, social economic and environmental resources, geometric feature, right-of-way, planning-level costs and public involvement to quantify benefits and impacts to the greatest extent possible.

The results of the conceptual alternatives analysis have been documented and the report coordinated with all the relevant project stakeholders. Based on the alternative's analysis and the inter-agency review, not all the conceptual alternatives were found to be reasonable solution that met the elements of the project purpose and need. Therefore, not all alternatives were carried forward as feasible alternatives to further quantify the benefits and cost of each. The following sections discuss the alternative analysis findings of JICA Feasibility Studies in 2012.

6.2.1 Strategies for Development of the Road Network in the Study Area

❖ Present and Future Road Network Configuration in the Study Area

The trunk roads were reclassified by the MRH based on their functional importance in 1998. The new system reclassified the roads into National, Inter-Regional and Regional Roads, reflecting their national and socio-economic importance and tying in with the present regional and district administrative structures of the country. Beside the trunk road network, there are urban roads managed by the DUR, and feeder roads managed by the DFR both under the MRH.

According to the GHA, the proposed new route of the Eastern Corridor between Asutsuare

Jct. and Asikuma Jct. will be classified as a National Road after construction of the new route. Moreover, the international traffic and major logistic corridor functions of the existing N2 between Asutsuare Jct. and Asikuma Jct. via the existing Adomi Bridge will be expected to shift to a proposed new route with a new bridge crossing the Volta River, when the whole section of N2 between Tema and the border with Burkina Faso will be improved.

❖ **Proposed Future Road Network Configuration in the Study Area**

Figure 25 illustrates the present road hierarchy in the Study Area. There are four national roads (N1, N2, N3 and N5), five regional roads (R18, R23, R24 (only a short length), R28 and R95), and various feeder roads. Considering the functional hierarchy of the road network and regional development trend, the north-south axis and the east-axis on both the left and right sides of the Volta River are weak.

To accelerate the regional development, particularly agricultural development, the Study Team proposes the future road network configuration in the Study Area as shown in Figure 26.

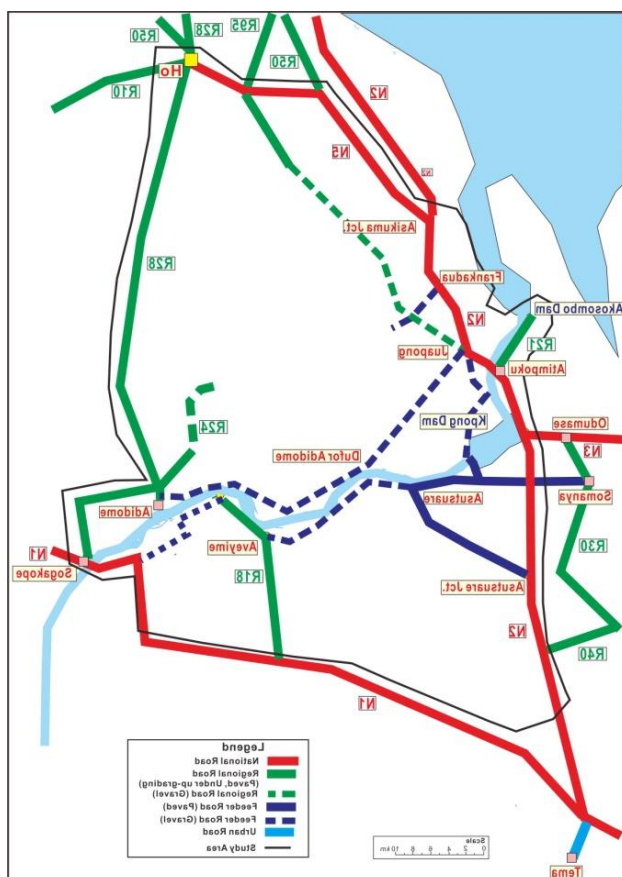
Under this proposed road network configuration, the new proposed route between Asutsuare Jct. and Asikuma Jct. will be classified as a national trunk road with a function as an international corridor between Tema and the border with Burkina Faso, while the road section between Asutsuare and Aveyime will be a part of the inter-regional road connecting N2 and N1 via the green-belt area of Ghana, where major rice production is expected.

6.2.2 Design Standards Applied for the Study Roads and Bridges

❖ **Design Speed**

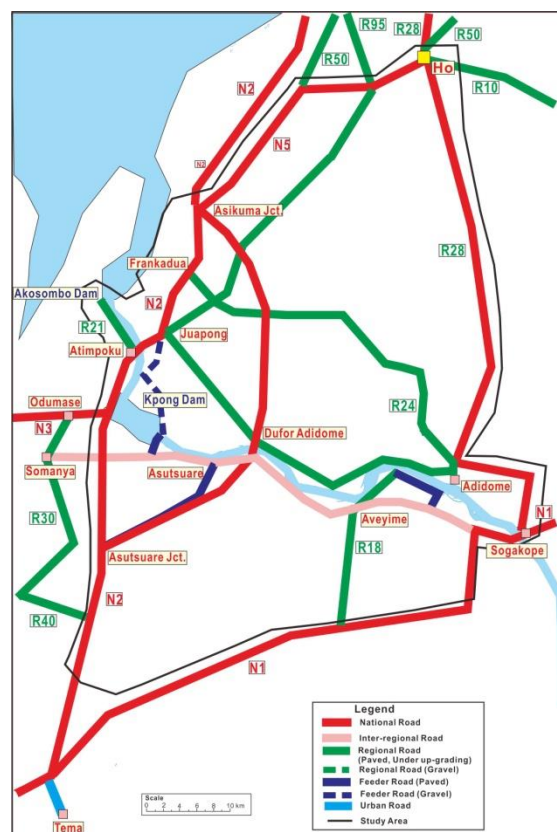
The design speed for the proposed roads is determined by the Road Design Guide of Ghana and the following facts:

- The upgrading works of a part of Lot 2 of N2 between Asikuma Jct. and Have (48 km), just after the section of proposed route (N2) in the Study, has already started with GoG fund. The design speed for the section between Asikuma and the 37 km point from Asikuma Jct. is 100 km/h because of flat terrain.



Source: Study Team

Figure 25 Present Road Hierarchy in the Study Area



Source: Study Team

Figure 26 Proposed Road Network Configuration in the Study Area

To consider uniformity of the design speed on the same type of terrain, design speed for the new road section between Asutsuare Jct. and Asikuma Jct. is proposed 100 km/h based on the Road Design Guide of Ghana.

Table 28.0 Design Speed for National Road

Road Type	Classification	Design Speed (km/h)	Absolute Values (km/h)
National	Flat	100	80
	Hilly	80	60
	Mountainous	60	40

Source: Road Design Guide in Ghana

❖ Design Radius

To accommodate international logistics freight vehicles, mainly large trailers, to secure traffic safety, and to harmonise with the natural and topographical conditions, the radius of curves is designed to be gentle. Although the minimum design radius is 700 m for the design speed

of 100 km/h, it is desirable to use a radius of more than 2,000 m or at least 1,400 m corresponding to two or three times the minimum design standard.

❖ **Typical Cross Section**

▪ **Lane Width**

The main traffic function of the proposed road is to create a national trunk road network to link economic and administrative centers as well as ensure efficient international logistic flows. A lane width of 3.65 m defined in the Road Design Guide of GHA is proposed for the following reasons:

- A lane width of 3.65 m is adopted for the section between Asikuma Jct. and Have on N2 currently being upgraded.
- A lane width of 3.65 m is also adopted for ongoing national road projects such as the N8 upgrading project.
- According to AASHTO Geometric Design of Highways and Streets (2004), the lane width of roads classified as national highways is recommended as 3.65 m (12 feet).

Thus, a lane width of 3.65 m is proposed for the road sections between Asutsuare Jct. and Asikuma Jct., and Asutsuare and Aveyime according to the Road Design Manual of Ghana.

▪ **Shoulder Width**

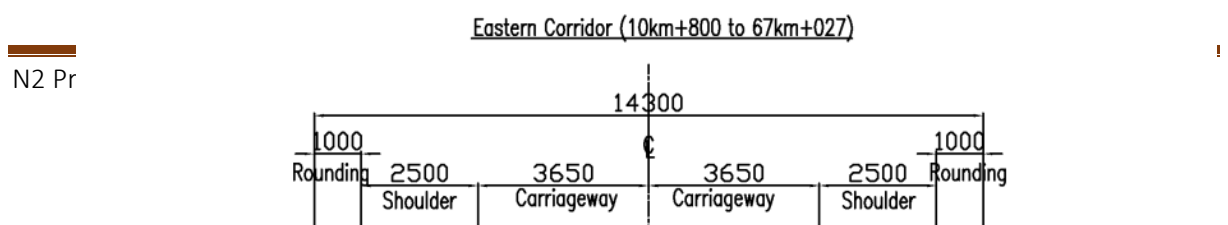
The main function of shoulders on national roads is not only to provide space for stopping vehicles, including broken-down vehicles, but also walking space for pedestrians. A shoulder width of 2.50 m defined in the Road Design Guide of GHA is proposed for the following reasons:

- A shoulder width of 2.50 m is adopted for the section between Asikuma Jct. and have on N2 currently being upgraded.
- A shoulder width of 2.00 m is adopted for the ongoing national trunk road project (N8 upgrading project). In this case, even though a consultant proposed 2.50 m to follow the Road Design Guide of GHA, the existing shoulder width was 2.00 m following the previous guide, and the GHA finally decided to adopt 2.00 m to comply with the existing shoulder width.
- According to the AASHTO standard, heavily travelled, high-speed highways and highways carrying large numbers of trucks should have usable shoulders of at least 3.0 m (10 feet).
- The Japanese standard, defines, a shoulder width of 2.50 m, and 3.25 m is preferable for national expressways.

Thus, a shoulder width of 2.50 m is proposed for the road section between Asutsuare Jct. and Asikuma Jct., while a shoulder width of 2.00 m is proposed for the Asutsuare and Aveyime road which will be changed to an inter-regional road after the completion of upgrading works.

Figures 27 and 28 show typical cross-sections used for the preliminary design of ordinary road

sections and bridges, including new bridge across the Volta River, on the Eastern Corridor. Figures 29 and 30 show typical cross-sections used for the preliminary design of ordinary road sections and roads in townships along the Asutsuare – Aveyime road. Mount-up sidewalks on both sides of the carriageway are proposed to secure the safety of both pedestrians and bicycles for bridges and in township areas. The Study Team proposed several alternative cross sections at the Working Group Meetings (WGM) with GHA officials, and both sides agreed to adopt the cross-sections shown in these figures.



Source: Study Team

Figure 6-3 Typical Cross-section between Asutsuare Jct. and Asikuma Jct.

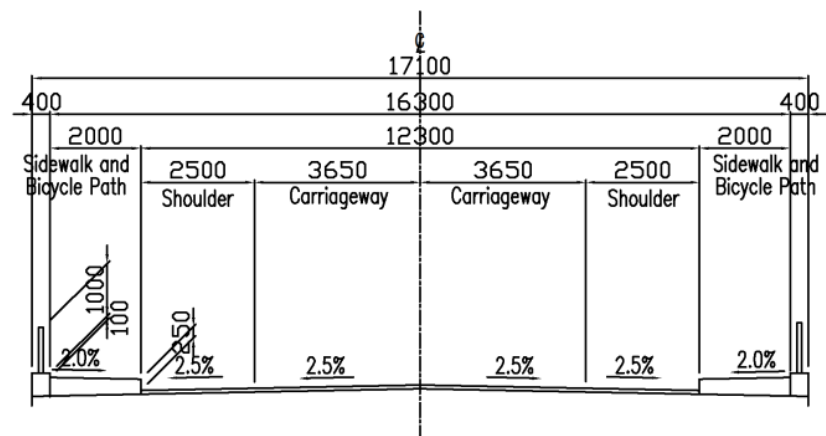
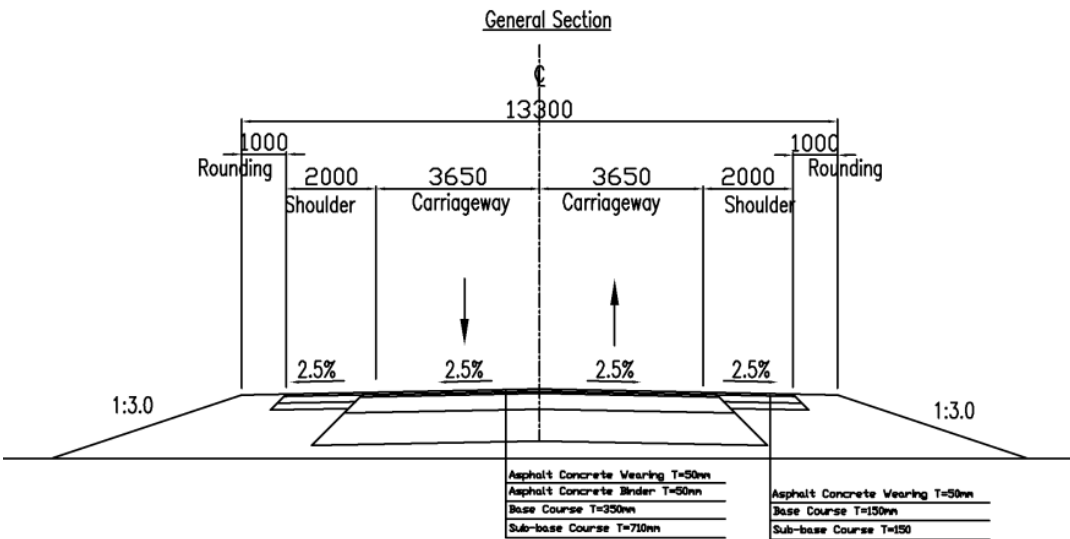
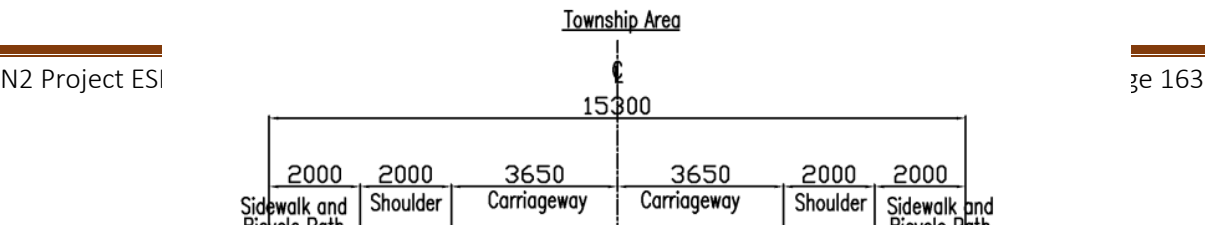


Figure 27 & 28 Typical Cross-section of Bridges



Source: JICA Study Team

Figure 29 Typical Cross-section for Ordinary Section of Asutsuare–Aveyime Road



Source: JICA Study Team

Figure 30 Typical Cross-section in Township Area of Asutsuare–Aveyime Road

❖ Right of Way

According to the GHA, the Right of Way (ROW) for trunk roads and inter-regional roads must be 90 m wide (45 m from the centreline on both sides) and 60 m wide (30 m from the centreline on both sides), respectively. Thus, 90 m ROW is applied for the new road section between Asutsuare Jct. and Asikuma Jct. on the Eastern Corridor, while 60 m ROW is applied for the Asutsuare–Aveyime road.

6.2.3 Road Alignment Study

6.2.3.1 Basic Concept of the Preliminary Design of Road Alignment

❖ Road Classification and Functions

The trunk roads were reclassified based on their functional importance in 1998. The new system reclassified the roads into National, Inter-Regional and Regional Roads, reflecting their national and socio-economic importance and tying in with the present regional and district administrative structures of the country.

According to the GHA, the proposed route of the Eastern Corridor between Asutsuare Jct. and Asikuma Junction will be classified as a National Road after completion of this route. Moreover, the international traffic and major logistics functions of the existing National Road N2 between Asutsuare Jct. and Asikuma Jct. including the Adomi Bridge will be shifted to the proposed route with a new bridge over the Volta River.

❖ Major Policy for Road Alignment Alternatives

▪ Number of Lanes

According to the GHA's Project Profile for Upgrading of Asutsuare Jct. – Asutsuare – Frankadua Road in the Greater Accra and Volta Regions of Ghana, the road will be upgraded to a 2-lane single carriageway with asphalt concrete (flexible pavement) surface. The Study Team has confirmed the required number of lanes for the proposed road based on the future traffic demand forecast with the target year of 2036.

❖ Considerations to Determine Road Alignment

The major considerations when determining alternative road alignments were as follows:

- To minimise the resettlement of homes and other commercial buildings
- To avoid passing through paddy fields or irrigation schemes in view of the importance of rice cultivation, particularly on the southern side of the Volta River which is defined as the Southern Greenbelt of Ghana with large potential for agricultural activities
- To minimise the effects on existing, on-going and planned agricultural development schemes.
- To set the road alignment perpendicular to the Volta River and to select a location where the river is narrow to reduce bridge construction costs.
- To minimise the number of crossings of rivers, watercourses and irrigation canals in view of road conservation and maintenance works. Even if culverts need to be installed at appropriate locations, water flows may change in the future due to the flat terrain in the Study Area.
- To clearly identify locations of possible deposits of black cotton soil, where either soil replacement or soil stabilisation works will be required.
- To consider a gentle longitudinal profile where alternative routes run alongside the mountains near Asutsuare township. If alternative routes have a longitudinal gradient of 4% for more than 700 m, an additional lane (climbing lane) would be considered to secure the smooth flow of traffic without being affected by slow-moving heavy vehicles.

6.2.4 Road Alignment Study between Asutsuare Jct. and the Volta River

❖ Possible Alternative Routes

The Study Team prepared five possible alternative routes between Asutsuare Jct. and the Volta River, as shown in Figure 31, in the southern part of the Study Area (S-1, S-2, S-3, S-4 and S-5), which was presented at the First Working Group Meeting (WGM) held on 18th April 2012 for the first screening of alternative routes.

❖ Comparison of Possible Alternative Routes

Results of the initial comparison of possible alternative routes by the Study Team are summarised in Table 29.0.

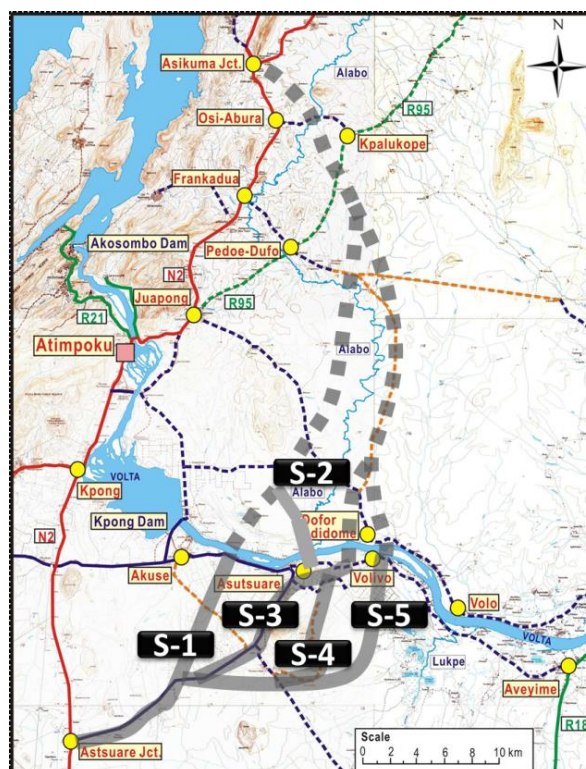
❖ Discussions in the WGM

Comments from GHA officials at the WGM are summarised in Table 30.0.

❖ Screening of Alternative Road Alignments

Based on the results of discussions in the WGM, alternative road alignments S-1, S-2, S-3 and S-4 were selected for the further study. Alternative road alignment S-5 was not selected because it could encroach on the area where Golden Exotic Ltd. plans to expand its banana estate.

- S-1:** Route passing between Asutsuare and Akuse, turning toward the eastern direction after crossing the Volta River at bridge location B-1
- S-2:** Route following the existing road alignment and then crossing the Volta River close to Asutsuare (at bridge location B-2)
- S-3:** Route following the existing road alignment, changing direction towards Volivo and then crossing the Volta River close to Volivo (at bridge location B-3)
- S-4:** Route passing on the eastern side of Osuyongwa Mountain, turning toward the eastern direction, and crossing the Volta River on the western side of Volivo township (at bridge location B-3)
- S-5:** Route passing behind Osuyongwa Mountain and banana estate, shifting toward the western direction, and then crossing the Volta River (at bridge location B-4)



Source: JICA Study Team

Figure 31 Possible Alternative Routes between Asutsuare Jct. and Volta River

**Table 29.0 Comparison of Possible Alternative Routes between Asutsuare Jct.
and the Volta River**

ITEM		Alt. S-1	Alt. S-2	Alt. S-3	Alt. S-4	Alt. S-5
1	Alignment	Gentle (+)	R=700m	R=700m	R=700m	Gentle (+)
2	Travel time saving	Highest (++)	High (+)	Low	Low	Low
3	Bridge construction	Long span bridge	Long span bridge	Long span bridge	Long span bridge	Medium span bridges (+)
3	Contribution to regional development	Medium	Medium	Medium	Medium	Medium
4	Number of resettlements	Few houses (+)	Some houses	Few houses (+)	Few houses (+)	Few houses (+)
5	Disturbance of agricultural activities	Paddy fields and tilapia cultivation	Paddy fields, irrigation scheme	Some paddy fields (+)	Some paddy fields (+)	Some paddy fields (+)
6	Road length requiring investment	19km (+)	23km	29km	30km	32km
	Total Score	High (+++++)	Low (+)	Low (++)	Low (++)	Medium (+++)

Source: JICA Study Team

Table 30.0 Major Comments from GHA

Field	Major Comments from GHA
Agriculture	▪ New trunk road could boost rice productivity and cross some existing

Activities	canals. ■ Alternatives should avoid green belt including banana estate on the southern side of the Volta River, in accordance with government agricultural policy. ■ There are concerns about loss of agricultural land due to the concentration of population along the new trunk road. ■ Irrigation scheme on the northern side of the Volta River by MiDA will encourage rice exports.
Aquaculture Activities	■ There are concerns about the impact on tilapia cultivation and decrease of farmers' incomes.
Communities	■ There are problems about how to access safely the new trunk road with Asutsuare and Akuse.
Road Function	■ The new trunk road should avoid communities because of its importance for linking agricultural land with Tema Port. ■ The new trunk road should secure high-speed travelling, avoiding existing communities.
Road Construction	■ Soil conditions should be investigated.

Source: JICA Study Team

6.2.5 Study of Alternative Bridge Location over the Volta River

❖ Study of Bridge Location

In parallel with the selection of alternative road alignments, the Study Team selected four possible alternative locations for a new bridge over the Volta River. The Study Team considered the following aspects mainly from the results of site investigations, available topographical maps and aerial photos:

- Narrower river width section
- River configuration (to avoid sections with tributaries, curved reaches, and transition points of river bed gradient) and hydrological conditions
- Possible length and configuration of access roads to bridge
- Geological conditions on the river bank and surrounding areas
- Land use and use of river (pumping station, live box for tilapia cultivation, etc.)

❖ Screening of Bridge Locations by the Working Group Meeting

The Study Team considered four possible locations of a bridge over the Volta River between Akuse and Volivo (B-1, B-2, B-3 and B-4) as shown in Figure 32. Selection of alternative road alignments mentioned in Section 5.2.2 was fully coordinated with the selection of possible locations of a bridge. Then, the JICA Study Team presented the possible bridge location at the First Working Group Meeting (WGM) for the first screening of locations. Based on the results of discussions in the WGM, locations B-1, B-2 and B-3 were selected for further study, while B-4 was not selected because alternative road alignment S-5, which connect to B-4, was dropped.

6.2.6 Road Alignment Study between the Volta River and Asikuma Jct.

❖ Possible Alternative Routes

The Study Team prepared three possible alternative routes between the Volta River and Asikuma Jct. on the National Road N2 as shown in Figure 33, in the northern part of the Study Area (N-1, N-2, and N-3), and presented them in the First Working Group Meeting for the first screening of alternative routes.

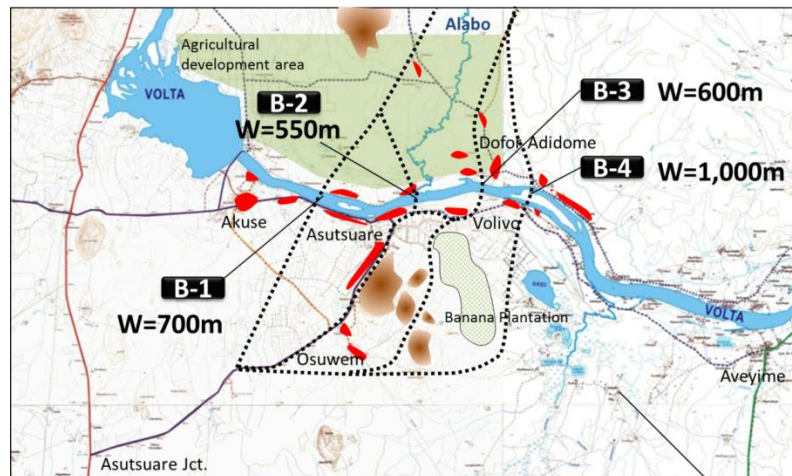
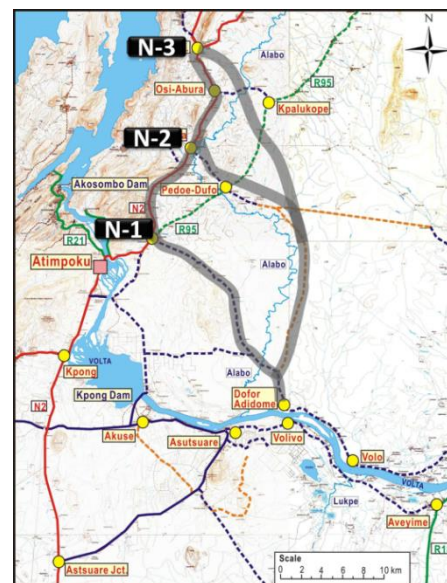


Figure 32 Possible Alternative Bridge Locations

- N1:** Route connects the Volta River and Juapong on N2 with a length of 24 km, mostly follows the alignment of the existing feeder road between Juapong and Dufor Adidome, then follows the existing N2 to Asikuma Jct. with a length of 21km.
- N2:** Route connects the Volta River and Frankadua on N2 with a length of 32 km of mostly new road, then follows the existing N2 to Asikuma Jct. with a length of 11km.
- N3:** Route directly connects the Volta River and Asikuma Jct. with a length of 40 km of mostly new road.

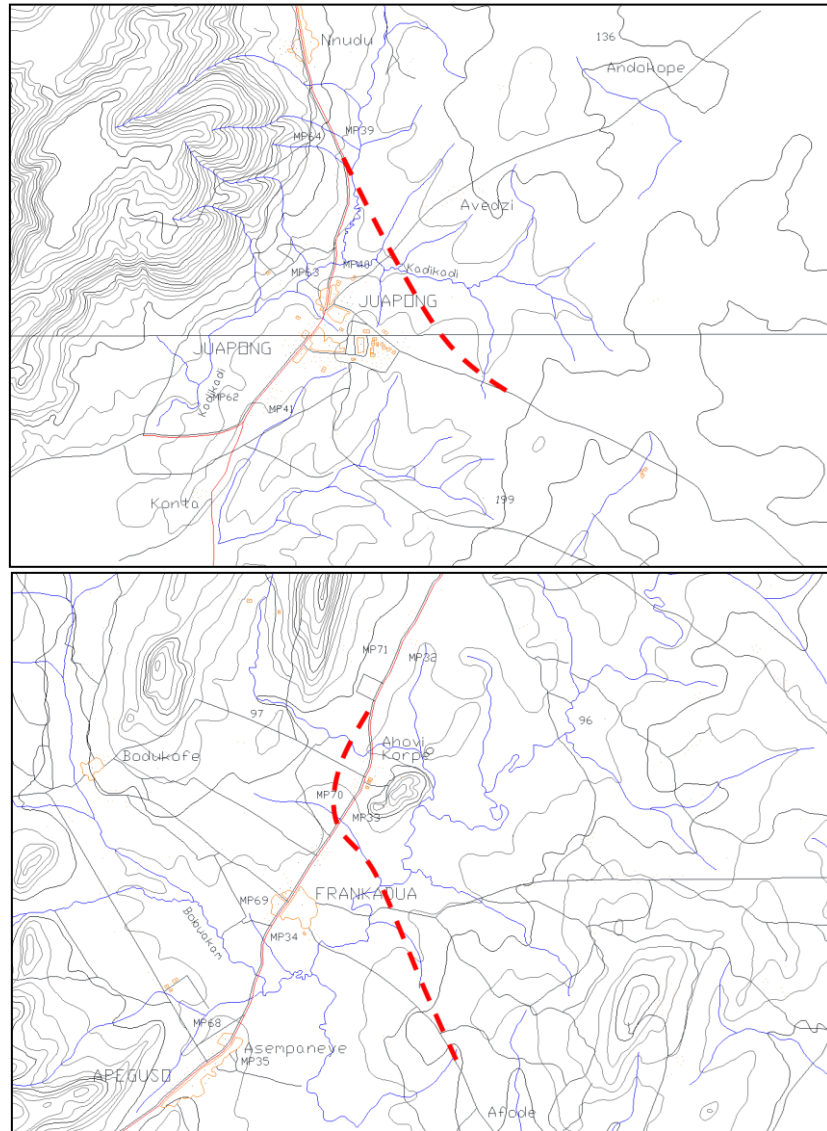


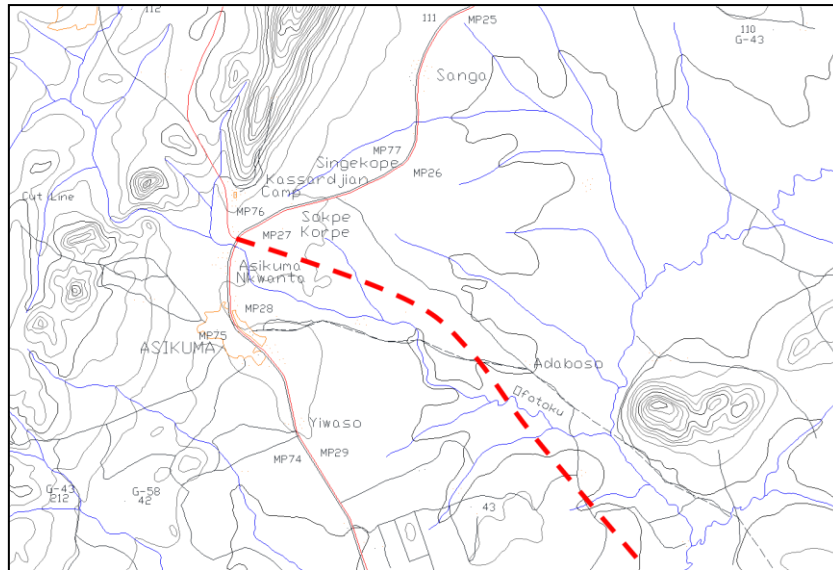
Source: JICA Study Team

Figure 33 Possible Alternative Routes between the Volta River and Asikuma Jct.

The urban areas of Juapong, Frankadua and Asikuma townships have been expanding along existing roads and it is almost impossible to connect the proposed new road at

the existing intersection with N2 without many resettlements. Furthermore, it is necessary to give priority to the intersection approach alignment for the proposed new road when designing the intersection with N2, as the new road will become an international transport corridor. Therefore, the Study Team studied possible concept of the intersection of the proposed road with N2 for alternative roads N-1, N-2 and N-3 at Juapong, Frankadua and Asikuma Jct., respectively, to minimise resettlement as well as to improve the approach alignment for the proposed road, as shown in Figure 34.





Source: JICA Study Team

Figure 34 Concept of Intersection at Juapong, Frankadua and Asikuma

❖ Comparison of Possible Alternative Routes

The results of initial comparison of possible alternative routes by the Study Team are summarised in Table 31.0.

Table 31.0 Comparison of Possible Alternative Routes between the Volta River and Asikuma Jct.

Item	Alt. N-1.	Alt. N-2	Alt. N-3
1 Travel time saving (Dufor Adidome – Asikuma Jct.)	Low	Medium	High (+)
2 Solve problems of existing N2	Not expected	Partially expected (+)	Fully expected (++)
3 Contribute to regional development (agriculture)	Low	Partially expected (+)	Fully expected (++)
4 Number of resettlements	Few houses (+)	Few houses (+)	Few houses, one hotel
5 Disturbance of agricultural activities	Some areas near Juapong	Some areas near Frankadua	Very limited (+)
6 Road length for construction	24 km (+)	32 km	40 km
Total Score	Low (++)	Medium (+++)	High (++++++)

Source: JICA Study Team

❖ Discussions in the WGM

Since both Alt. N-1 and N-2 will require upgrading of the existing N2, which passes through several townships, and this upgrading scheme is not covered by the Study, every participant of the WGM agreed to screen out Alt.N-1 and N-2.

In addition, the GHA requested the Study Team to consider a fly over at Asikuma Jct. if future traffic demand will exceed the capacity of the at-grade intersection.

❖ Screened Road Alignment

Based on the results of discussions in the WGM, an alternative road alignment N-3 was selected for further study.

6.2.7 Further Studies for Selected Alternatives

❖ Alternative Route Alignments

The Study Team conducted the detailed site investigations for the alternative alignments S-1,

S-2, S-3 and S-4 in the south and N-1 in the north after the WGM. As a result, the Study Team identified an additional alternative alignment which passes beside Osuyongwa Mountain, follows the Alt. S-4 alignment, and joins Alt. S-2 to cross the Volta River near Asutsuare (at bridge location B-2) to minimise negative impacts on paddy fields by crossing them by Alt. S-4, and securing smoother horizontal alignment. Therefore, there are five alternative routes for further study: Alt. 1, Alt. 2, Alt 3, Alt. 4 and Alt. 5, as summarised in Table 32.0 and Figure 35.

❖ Horizontal Alignment of Alternative Routes

▪ Common Section

- The road alignments in the south up-to about 9 km from Asutsuare Jct. is the same for all alternatives because they follow the existing feeder road. The curve radius of this section is 1,500 m to 5,000 m.

Table 32.0 Summary of Alternatives for Further Study

Alternative	Description
Alt. 1	Route passing between Asutsuare and Akuse, crossing the Volta River, turning toward the northeast, crossing the Alabo River once, turning north, crossing the Alabo River a second time, and connecting Asikuma Jct.
Alt. 2	Route following the existing Asutsuare Jct. – Asutsuare Road alignment and then crossing the Volta River on the eastern side of Asutsuare, going north and joining Alt. 1.
Alt. 3	Route following the existing Asutsuare Jct. – Asutsuare Road alignment, going toward the eastern direction., crossing the Volta River on the western side of Volivo township, turning north on the eastern side of the Alabo River, and joining Alt. 1 after crossing under the high-voltage transmission line.
Alt. 4	Route passing on the eastern side of Osuyongwa Mountain, turning toward the eastern direction, and joining Alt. 3.
Alt. 5	Route following Alt. 4 until near the banana estate, and directly joining Alt. 2.

- A common section of road alignments for all alternatives in the north starts from adjacent to the high-voltage cable near Kpomkpo, goes north-west, crosses R95 near Dongbe and the Alabo River on western side of Amasiyakope, and reaches Asikuma Jct.

▪ Alternative 1 (Alt. 1)

- The road alignment of Alt. 1 intersects at the common section, goes north, crosses the Lomen River and existing Somanya – Asutsuare road between Akuse and Asutsuare adjacent to the Volta River, and reaches the alternative bridge location B-1 of the new Volta River Bridge.
- After crossing the Volta River, the proposed road crosses two small rivers (Gblo River and Nyifla River), goes north-west, crosses the existing feeder road Juapong –

Adidome and the Alabo River, and joins the common section in the north mentioned above.

▪ **Alternative 2 (Alt. 2)**

- The road alignment of Alt. 2 mainly follows the existing feeder road Asutsuare Jct. – Asutsuare up to 21 km point from Asutsuare Jct. near Asutsuare township, crosses the existing feeder road Asutsuare – Aveyime, and reaches the alternative bridge location B-2 near the pumping station.
- After crossing the Volta River, the proposed road crosses the centre of the agricultural development scheme carried out by PE-AVIV company, and join Alt. 1.

▪ **Alternative 3 (Alt. 3)**

- The road alignment of Alt. 3 intersects from Alt. 2 near Asutsuare, runs along the existing feeder road Asutsuare – Aveyime, and reaches the alternative bridge location B-3 near Volivo township.
- After crossing the Volta River, the proposed road runs north on the eastern side of the Alabo River and joins the common section in the north.

▪ **Alternative 4 (Alt. 4)**

- The road alignment of Alt. 4 intersects Asutsuare Jct. – Asutsuare road at the 11 km point from Asutsuare Jct., runs east until near Asuwem township and changes direction to the north to cross the hilly area on the east of Osuyongwa Mountain, passes the western side of the Golden Exotics banana estate, changes direction to the east to minimise its impact on paddy fields, and joins Alt. 3.

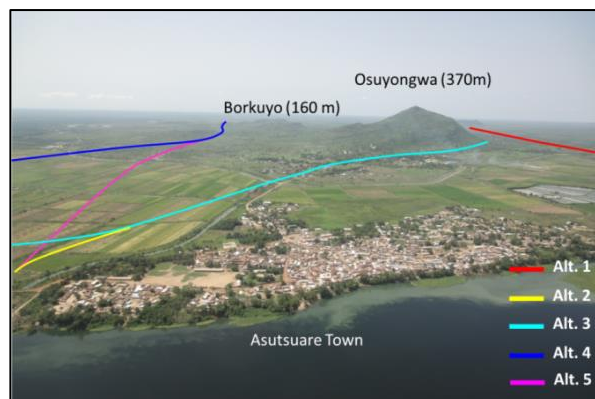
▪ **Alternative 5 (Alt. 5)**

- The road alignment of Alt. 5 follows the alignment of Alt. 4 up to the eastern side of the Golden Exotics banana estate and from the intersection with Alt. 4, goes north to join Alt. 2.

▪ **Planned Horizontal Curve**

The planned horizontal curve of each alternative alignment is as follows.

- Alt. 1: Very gentle continuous curves of 2,000 m to 3,000 m in radius
- Alt. 2: Single curves of 1,000 m in radius
- Alt. 3: Gentle continuous curves of 1,500 m to 1,000 m in radius
- Alt. 4: Very gentle continuous curves of 1,800 m to 2,000 m in radius
- Alt. 5: Same as Alt. 4



Source: Study Team

Figure 35 Alternative Alignment near Asutsuare

■ Longitudinal Profile

There is basically no problem of longitudinal profile because the Study Area is mostly on flat terrain. However, there is an exception where Alt. 4 and Alt. 5 pass on the eastern side of Osuyongwa Mountain. The slope gradient at this section is between 2% and 3.2% (for a 500 m section). Regarding this hilly section, however, the Study Team considers that it is not necessary to construct an additional lane (climbing lane), because the gradient can be reduced to less than 3% by civil works.

❖ Crossing Roads

Section between Asutsuare Jct. and the Volta River:

- Alt. 1 crosses the existing Somanya – Asutsuare road adjacent to the Volta River.
- Alt. 2, Alt. 3, Alt. 4 and Alt. 5 cross the existing feeder road Asutsuare – Aveyime, however, this road is planned to be upgraded to an inter-regional road and an improvement plan will be prepared in the Study.

Section between the Volta River and Asikuma Jct.:

- Alt. 1, Alt. 2, and Alt. 5 cross the existing feeder road Juapong – Adidome on the western side of the Alabo River.
- Alt. 3 and Alt. 4 cross the existing feeder road Juapong – Adidome on the eastern side of the Alabo River.
- The common section of the proposed road crosses R95 between Dangbe village and Kpalukope township,
- The common section of the proposed road is the existing feeder road Osi-Abura – Kpakukope on the western side of Amasiayakope township.

❖ Crossing Rivers other than the Volta River

Section between Asutsuare Jct. and the Volta River:

- Other than the Volta River and an irrigation canal of the KIS, only Alt. 1 crosses the Romen River.

Section between the Volta River and Asikuma Jct.:

- Alt. 1 crosses the Gblo River, Nyifla River, Honi River and Alabo River before joining the common section of the proposed route.
- Alt. 2 and Alt. 5 cross the Honi River and Alabo River after joining Alt. 1.
- Alt. 3 and Alt. 4 do not cross a river other than small streams before joining the common section.
- The common section crosses the Alabo River on the western side of Amasiyakope township.

❖ Soil Condition

▪ Soil Testing

From the initial site survey, the Study Team found that there is a high possibility of black cotton soil¹ deposit based on the FAO Soil Classification Map of the Study Area shown in Figure 36

To identify possible areas of black cotton soil deposit along the proposed alternative road alignments, the Study Team conducted a soil investigation focusing on black cotton soil deposits in May 2012, with cooperation from the Material Division of the GHA by collecting samples and laboratory tests.

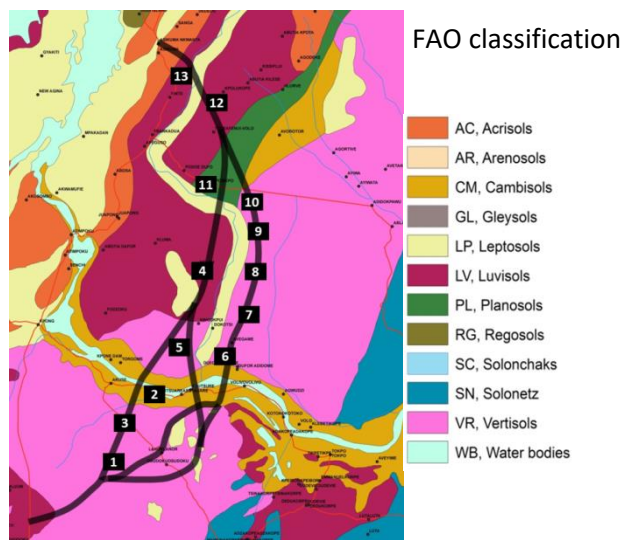
The results of the soil investigation are shown in Table 33.0 and Figures 36 and 37.

Table 33.0 Soil Conditions between Asutsuare Jct. and Asikuma Jct.

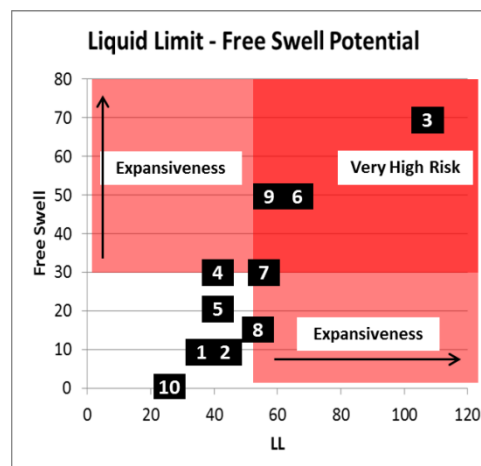
Sample	Atterberg Test			Natural Moisture	Free Swell Potential
Soil samples (Thickness of black soil)	LL %	PL %	PI %	%	%
PIT 1 (0.6 m)	40	20	20	10.81	10.0
PIT 2 (over 1.0 m)	43	23	20	8.67	10.0
PIT 3 (over 1.0 m)	109	38	71	34.77	70.0
PIT 4 (0.6m)	42	22	20	10.14	30.0
PIT 5 (0.8m)	41	20	21	10.04	20.0
PIT 6 (0.8m)	64	22	42	26.3	50.0
PIT 7 (0.65m)	57	31	26	14.7	30.0
PIT 8 (over 1m)	53	25	28	20.9	15.0

PIT 9 (over 1m)	61	25	36	14.6	50.0
PIT 10 (0.4m)	27	16	11	13.6	-
PIT 11	Gravel				
PIT 12	Gravel				
PIT 13	Gravel				

Source: GHA, Material Division



Source: Soil Research Institute
Figure 36 Location of Soil Investigation Testing Pits



Source: JICA Study Team

Figure 37 Relation of Liquid Limit and Free Swell Potential for Soil Samples

As shown in the soil sample from PIT 3 showed the highest values of the Liquid Limited (LL-109%), Plasticity Index (PI-71%) and Free Swell Potential (70%). This means that there is the highest risk of extensive black cotton soil in the area around PIT 3. Other than PIT 3, LL values exceeding 50% were found for samples from PITs 6, 7, 8 and 9, while Free Swell Potential values of more than 30% were found for samples from PITs 6, 7 and 9. These results also means a higher risk of extensive black cotton soils in these areas as well.

❖ Countermeasures

There are several countermeasures for the black cotton layer, such as replacing the black cotton layer or using lime-stone stabilisation, to stabilise the subgrade and prevent shrinking and swelling of black cotton soil, etc. This Study proposes replacements of the black cotton layer because the lime stone stabilisation method would be more expensive in Ghana.

6.2.8 Bridge and Drainage Structure Study

This section describes bridge and drainage structural study other than for the Volta River.

❖ Structure Type to Cross Rivers and Irrigation Canal

Construction of a bridge is proposed for a location where the alternative route crosses the

following rivers. While the Study Team proposes that drainage structures over small streams (less than 30 m of width) and an irrigation canal are planned to be concrete culverts (either box culvert or pipe culvert):

- Alt. 1: Lomen River (100 m), Gblo River (30 m), Alabo River (55 m)
- Alt. 2: Lomen River (50 m), Alabo River (55 m)
- Alt. 3: Lomen River (50 m)
- Alt. 5: Alabo River (55 m)
- Common section in the north: Alabo River (50m)

❖ Bridge Type

▪ Selection of Superstructure Type

With reference to Table 34.0, a continuous T-girder bridge is selected for the following reasons:

- Continuous structures, which are more resistant to earthquakes, are mainly compared.
- Concrete bridges are maintenance-free and economical.
- These types of bridges are commonly used in Ghana.
- As PC continuous composite girder bridge is unfavourable in terms of ease of construction and quality control compared with a PC continuous T-girder bridge and offers no advantage.

▪ Selection of Substructure Type

Table 35.0 compares the applicable bridge substructure type and standard bridge height. Since a substructure height of about 10 m is required for every bridge according to site investigations, the JICA Study Team proposes the reverse T-style abutment for all bridges. In the case of bridge piers, the Study Team proposes column piers for every bridge to minimise negative impacts on the river flow and better workability.







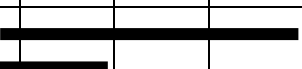
Table 34.0 Comparison of Superstructure Types and Standard Spans of Bridge

Superstructure Type		Standard Span												Possibility of Curves		Girder height
		50 m	30m	100 m	150 m	Main Structure	Bridge Deck	Span ratio								
Steel bridge	Simple composite plate girder													○	○	1/18
	Simple plate girder													○	○	1/17
	Continuous plate girder													○	○	1/18

❖ **Proposed Structure Types and Bridge Lengths for each Alternative Route**

Table 36.0 summarises the proposed structure types and bridge lengths of bridges on each alternative route.

Table 35.0 Comparison of Substructure Types and Applicable Heights of Bridges

Bridge part	Substructure type	Applicable height (m)				Characteristics
		10	20	30		
Abutment	1.Gravity type					With shallow support ground, the gravity type is suitable for direct foundations.
	2.Reverse T-style					Used in many bridges. Suitable for direct foundations and pile foundations.
	3.Buttressed type					Suitable for tall abutments. Few materials are used for this type, but the lead time is long.
	4.Box type					Designed for tall abutments. The lead time is somewhat long.
Pier	1.Column type					Low piers. Suitable for stringent intersection conditions and installation in a river.
	2.Rigidframe type					Relatively tall piers. Suitable for wide bridges, but their installation in a river may hinder water flow during flooding.
	3.Pile bent type					The most cost efficient, but not suitable for bridges with high horizontal force. Their installation in a river may hinder water flow during flooding.
	4.Elliptical type					Tall bridge piers. Suitable for bridges with high external force.

Source: JICA Study Team

Table 36.0 Proposed Structure Types and Bridge Lengths for Alternative Routes

Item	Alabo River (1)	Alabo River (2)	Lomen River	Gblo River
------	-----------------	-----------------	-------------	------------

Super-structure type		PC continuous T girder bridge	PC continuous T girder bridge	PC continuous T girder bridge	PC simple T girder bridge
Sub-structure type		T-style abutment, Column type pier	T-style abutment, Column type pier	T-style abutment, Column type pier	T-style abutment
Foundation type		Direct foundation	Direct foundation	Direct foundation	Direct foundation
Bridge Length	Alt.1	55m	50m	100m	30m
	Alt.2	55m	50m	50m	----
	Alt.3	----	50m	----	----
	Alt.4	----	50m	----	----
	Alt.5	55m	50m	----	----

Source: JICA Study Team

6.3 Study of Bridge across the Volta River

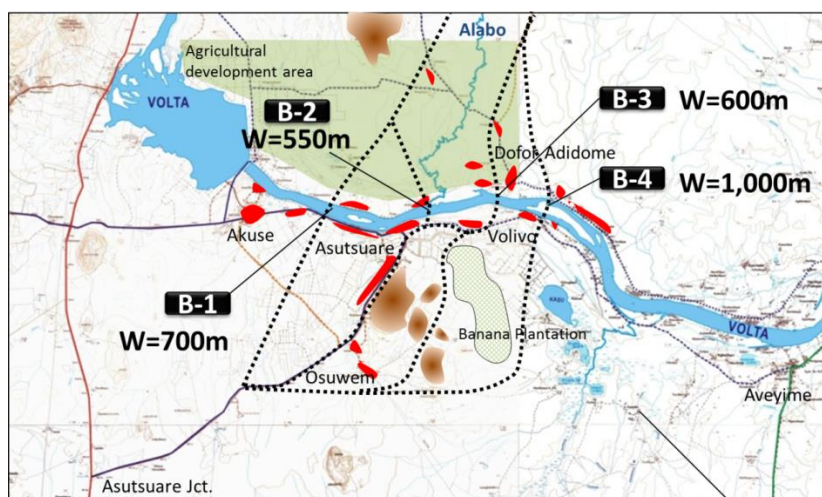
6.3.1 Study of Bridge Location

Recommended bridge locations are decided based on the alignments of new road, which are selected through many control points. The exact location is selected where the river is narrower to reduce the construction cost. The decision on the location also depends on other factors such as:

- The river configuration (to avoid sections with tributaries, curved reaches, and points of changing gradient) and hydrological conditions
- Length and configuration of access road
- Geological conditions at the river and surrounding areas
- The state of usage of the river and surrounding areas (to consider temporary uses for construction)

6.3.2 First Screening of Bridge Locations by the WGM

The JICA Study Team presented the following four possible bridge locations for the Volta River between Akuse and Volivo (B-1, B-2, B-3 and B-4) together with the alternative alignments to the Working Group Meeting. Based on the results of discussions in the WGM, alternative bridge locations B-1, B-2 and B-3 were selected for further studies.



Source: JICA Study Team **Figure 38 Alternative Possible Bridge Locations**

6.3.3 Study of Bridge Type for the Selected Bridge Location

❖ Bridge Length

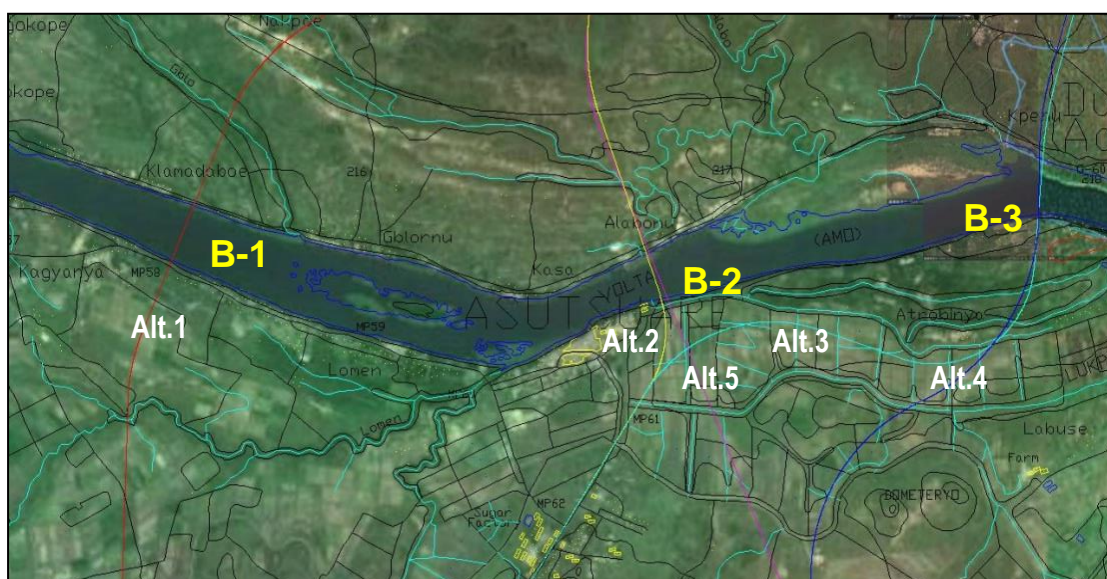
The Study Team conducted detailed site surveys for the selected alternative bridge locations B-1, B-2 and B-3 (see Figure 30-37), mainly considering minimisation of resettlement of houses and shops:

- Bridge length at B-1 for Alt. 1: 620 m
- Bridge length at B-2 for Alt. 2 and Alt. 5: 530 m
- Bridge length at B-3 for Alt. 3 and 4: 580 m

❖ Topographical and Geological Conditions

The bathymetric survey and geotechnical investigation revealed the following natural conditions at the proposed locations of alternative bridge sites:

- The Volta River, with a maximum riverbed depth of 6–8 m.
- The Volta River has a uniform current which is controlled by the Kpong Dam and the velocity is approximately 0.6 m/s.
- The river water is not saline.



Source: JICA Study Team Figure 39 Locations of Selected Alternative Bridges

- The support layer is very near to the river bed, with a minimum depth of 3–6 m from the river bed.
- The support layer is a very hard rock layer with an N-value of more than 300.

❖ Seismic Load

▪ Seismic Resistance Design Standard

The JICA Study Team used the Japanese standard when considering the seismic design of the new bridge for the Volta River because Japan has experienced several big earthquakes and structures have been upgraded to withstand the seismic forces. The Japanese standard considers two types earthquakes. One is the probable earthquake during the service life of the structure and is called the “Level I” earthquake. The other is a rare but very big earthquake called the “level II” earthquake. Each earthquake level requires performance (see Table 35.0). Therefore, the Japanese standard is designed to give bridges seismic resistance against either weak or strong earthquakes.

Table 37.0 Design Seismic Resistance and Required Performance

Earthquake Type	Required Performance
Level I earthquake	After an earthquake, bridge structures will not be broken.
Level II earthquake	After an earthquake, damage will be limited to allow a part and functions of the bridge to be quickly restored.

Source: JICA Study Team

❖ Level I Earthquake

The maximum response acceleration is estimated by considering past earthquakes in and around the Study Area, formula for distance damping and difference between response acceleration and ground level acceleration. The design return period is 75 years as the

probable earthquake during the service life of structures. The size of earthquake in this period is estimated by using the revised epicentre distance (see Table 38.0).

Table 38.0 Past Earthquakes and Level I Maximum Response Acceleration

Year	Magnitude	Epicentre Distance (km)	Historic Return Period (year)		Revise Epicentre Distance (km)	Ground Level Acceleration (gal)	Max Response Acceleration (gal)
1636	5.7	290.0	----	----	----	----	----
1862	6.5	99.4	(2012-1862)/2=	75	121.7	55.2	108
1872	4.9	98.9	(2012-1862)/4=	37.5	85.6	34.7	68
1906	5.0	101.0	(2012-1862)/4=	37.5	87.5	35.8	70
1939	6.4	114.0	(2012-1862)/2=	75	139.6	45.9	90
Design maximum response acceleration = 110 gal							

Source: JICA Study Team

- Revise epicentre distance = epicentre distance \times (historical return period)^{0.5} / (design return period)^{0.5}
- Ground level acceleration = $987.4 \times 10^{0.216} M \times (\Delta + 30)^{-1.218}$
M: Magnitude Δ : Epicentre distance
- Max response acceleration = (ratio between response acceleration and ground level acceleration in Japanese standard = 200/102.24) \times ground level acceleration

❖ Level II Earthquake

The bridge site is located near an active fault which experienced a big earthquake in 1862 and 1939, and the Study Team expects an earthquake to occur at the active fault. The expected magnitude of that earthquake is 6.5, the same as the earthquake in 1862. The epicentre distance is expected to be 10 km in the worst situation. (see Table 39.0 and Figure 40)

Table 39.0 Expected Level II Earthquake

Magnitude	6.5
Epicentre distance (km)	10.0
Ground level acceleration (gal)	280.0
max response acceleration (gal)	712.5

**Design maximum response acceleration =
720 gal**

Source: JICA Study Team



Source: JICA Study Team **Figure 40 Expected Level II Earthquake and Active Fault**

- Ground level acceleration = $987.4 \times 10^{0.216} M \times (\Delta + 30)^{-1.218}$
M: Magnitude Δ: Epicentre distance
- Max response acceleration = (ratio between response acceleration and ground level acceleration in Japanese standard = 2000/786) × ground level acceleration

6.3.4 Preliminary Study of the Bridge across the Volta River

❖ First-Step Comparison of Superstructures

▪ Selection of Alternatives Superstructure Types for the First-Step Comparison

With reference to Table 40.0, possible combinations of bridge types and span allocations for this bridge, were selected and seven alternatives steel bridges and six alternative PC bridges were chosen for the comparison, mainly considering the following points:

- A simple girder type was not selected for the comparison, because this type of bridge could fall off a pier and has less seismic resistance.
- Steel Langer girder, steel Lohse girder and steel arch types were not selected because they are suitable for only short-span bridges.
- The pre-tensioned girder type was not selected because there is no girder manufacturing workshop in Ghana.
- A PC π shaped rigid frame bridge was not selected, because this type is basically used for flyover bridges and there is no example of its use for a river bridge.
- PC Hollow slab, RC Hollow slab and RC continuous spandrel-filled arch types were not selected because their applicable span length was too short for this bridge.

- The steel continuous box girder type was not selected because the production and transportation of the steel girder are expensive, advanced technology and equipment is required for erection of girders, and there is no merit compared with the truss girder type for the same bridge span.
- The PC continuous composite girder type was not selected, because it is unfavorable in terms of ease of construction and quality control compared with the PC T-girder type.
- The PC continuous box girder (push-out or support method) is less economical for a 40 m span length compared with the PC T-girder type and almost the same economical level for a 60 m span length compared with the PC T-girder type using the cantilever method. This type, however, would become one of the longest girder lengths if applied in this bridge. Thus, this type was not selected because of difficulty of construction, because advanced technology would be required for construction with the push-out method.

▪ Selection of Alternatives Superstructure Types for the Second Step Comparison

- For the 13 alternative superstructure types for the first-step comparison, a second-step comparison was made, considering the effects on the river flow, landscape aesthetic value, ease of maintenance and construction cost, as shown in Table 40.0. Based on this comparison, the following three alternative superstructure types were selected for the following reasons:

Table 40.0 Comparison of Superstructure Types and Standard Spans of Bridge

Superstructure Type		Standard Span										Evaluation	Judgment
		50 m		100 m				150 m					
Steel bridge	Simple composite plate girder											Not applicable	No
	Simple plate girder											Less seismic resistance	No
	Continuous plate girder											Applicable	Yes
	Simple box girder											Less seismic resistance	No
	Continuous box girder											Less economical than truss	No
	Simple truss											Less seismic resistance	Yes
	Continuous truss											Applicable	Yes
	Reverse Langer girder											Not applicable	No
	Reverse Lohse											Not	No

	girder																	applicable	
	Arch																	Not applicable	No
	Continuous cable-stayed bridge																	Applicable	Yes
PC bridge	Pre-tensioned girder	—																Not applicable	No
	Hollow slab	—																Applicable span is too short	No
	Simple T girder	—	—															Less seismic resistance	No
	Simple composite girder	—	—															Less seismic resistance	No
	Continuous T girder,	—	—	○														Applicable	Yes
	Continuous composite girder	—	—															Less economical than T-girder	No
	Simple box girder	—	—															Less seismic resistance	No
	Continuous box girder (cantilever method)					○	—	○	—	○	—							Applicable	Yes
	Continuous box girder (Push-out or support method)				—	—												Less economical than T-girder	No
	π shaped rigid frame bridge	—	—															Not applicable	No
RC bridge	Continuous ex-tradosed bridge																	Applicable	Yes
	Hollow slab	—																Applicable span is too short	No
	Continuous spandrel-filled arch	—																Applicable span is too short	No

Source: JICA Study Team

- Alternative 1: Steel-3 – Continuous cable-stayed bridge (Span: 117.5 + 265.0 + 117.5)
- Alternative 2: PC-2 – Continuous box girder bridge (Span: 70 + 3@120 + 70)

- **Alternative 3: PC-3 – Continuous extradosed bridge (Span: 95 + 2@155 + 95)**
 - Even though the Steel-1 Continuous plate girder type is relatively cheaper with a span of 60 m, it is difficult to construct due to many construction-works in the river and it offers no better landscape aesthetic value. Thus, this type was excluded from the second-step comparison.
 - The Steel-2 continuous truss bridge was excluded from the second-step comparison, because it is relatively expensive and offers no merit.
 - The Steel-3 continuous cable-stayed bridge was selected for the second-step comparison, because of its better landscape aesthetic value and comparatively low construction cost. Regarding 3 spans or 4 spans, the 3 spans type is superior in terms of landscape aesthetic value with a monumental and landmark shape for the surrounding area due to the main tower which is more than 50 m in height: this was selected for the second-step comparison, because this advantage is judged to be more superior than the 3% higher construction cost of the 4-span alternative.
 - The PC-1 connected T-girder bridge was not selected because it would have large effects on the river, its landscape aesthetic value is low and construction cost is higher.
 - The PC-2 continuous box girder bridge is a better alternative, because its construction cost is the lowest. The 5-span type was selected for the second-step comparison, because it is easier to construct with relatively few construction- works in the river.
 - The PC-3 continuous extradosed bridge with 4 spans was selected for the second-step comparison because of its relatively high landscape aesthetic value with the striking landscape features of the cable structure.

❖ **First Step Comparison of Substructure**

▪ **Selection of Abutment Type**

The economical reverse T-style abutment was selected in the first-step comparison, and the height of abutment was determined as 12 m, which is the marginal height of a reverse T-shape abutment, to reduce the bridge length. The economical direct foundation was selected for the foundation type, as a sandy gravel layer with an N-value of more than 50 exists at the bottom of the planned footings (the height of abutment and foundation type are revised in the second-step comparison).

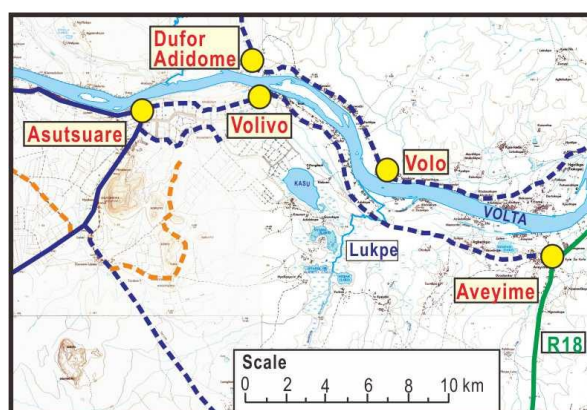
▪ **Selection of Pier Type**

The column type elliptical pier was selected as the pier type, to minimise the obstruction of river flow, as most of the piers will be constructed in the river. The economical direct foundation was adopted for the foundation, because a hard rock layer was found at a shallow level.

6.3.5 Road Alignment Study between Asutsuare and Aveyime

❖ Road Category

According to the GHA, the category of feeder road section between Asutsuare and Aveyime will be changed in part to an inter-regional road connecting Somanya and N1 via Akuse, Asutsuare, and Aveyime after the improvement is completed. The existing feeder between Asutsuare and Aveyime is a gravel road about 6.0 m wide for 25 km. This road passes through the centres of Asutsuare, Volivo and Aveyime townships.



Source: JICA Study Team

Figure 41 Location of Asutsuare and Aveyime Road

❖ Proposed Horizontal Road Alignment

Since the classification of this road will become an inter-regional road, the Study Team proposes that the horizontal alignment of this road section should basically follow the existing road alignment, except at sections on the east of Asutsuare township, where the existing road crosses two irrigation canals: in Volivo township, where the present alignment will not satisfy the minimum curve radius: and in Aveyime township, where some houses are encroaching on the road and there is a T-shape intersection adjacent to the Aveyime roundabout. The preliminary design of this road section will be carried out in the next stage of the Study, when topographical maps will be created based on topographical surveys.

❖ Proposed Longitudinal Profile

Since the topography along this road is totally flat on the Accra Plain along the Volta River, there are no problems of longitudinal profile for the proposed improvement.

❖ Crossing Road

There is no classified cross road other than minor gravel feeder roads.

❖ Crossing Rivers and Streams

There is only one river, the Lupe River, which is located around 15 km from Asutsuare and there is one double box-culvert at present. Since the Norboyita Dam is planned on the upper reaches of the Lupe River, the water discharge volume and current velocity are expected to be controlled by this dam.

Chapter 7 Results of the Comparison of Alternatives

7.1 Introduction

This section mainly describes merits and demerits of alternate options and recommendations for the most suitable option.

7.2 No – Development Option

This addresses the potential adverse environmental and social impacts which when found at the Initial Environmental and Social Examination (IESE) and Scoping Exercise Studies to be severe, will mean that the Eastern Corridor Road Project should not be constructed. Moreover, the no-action alternative would have only been considered not to be easy to mitigate and monitor.

Moreover, the “No –Action” or “No- Project” is included in the analysis of alternatives in environmental and social investigations to assess what is likely to occur if the proposed actions are not taken. The “No-Action” Alternative is defined as a decision not to undertake the proposed Eastern Corridor N2 Project by use of African Development Fund of the AfDB. In the absence of adequate local funds and/or other international funding sources to

undertake the Planned Project, the “No Action” would result in the continued diseconomies in the Government of Ghana financial management systems for planned development project under the Road Sector Medium-Term Development Plan.

All positive benefits would be foregone. In the long-run, however, failure to undertake the Eastern Corridor N2 Project Initiative would severely cripple Ghana development efforts. Therefore, the “No–Action” Alternative is imprudent in the best interest of Ghana economic sustainability effort and road sector development and expansion.

More importantly, the volume of international cargo for neighboring landlocked countries will continue to increase in the future, while chronic congestion in and around Accra and Kumasi will continue to persist. The hampering of fast and efficient movement of cargo to neighboring landlocked countries will not require the necessity of an alternate route identification and development to facilitate transit and trade. A possible alternate international transit route to Burkina Faso will not be the Eastern Corridor N2 project under the Road Sector Medium-Term Development Plan. No development of the Eastern Corridor N2 project is expected without contribution to the economic revitalization and the reduction of poverty within the corridor and the neighboring countries by reducing transport cost and regional trade facilitation.

7.3 Development Options Considered and Dismissed.

Originally, several alternative options were developed to address the issues of proposed alternative routes and alternative new bridge locations. These alternatives routes and new bridge locations and the rationale for either dismissing or carrying each are presented in the following sections with reference to Sections 5.2 through 5.3.

- **Proposed Alternative Routes and Bridge Locations**

Five (5) possible alternative routes S-1, S-2, S-3, S-4 and S-5 between Asutsuare Junction and the Volta River were considered. S-1, S-2, S-3 and S-4 were selected for further study while S-5 was dismissed because it could encroach on the area where Golden Exotic Limited plans to expand its banana estate. However, four (4) possible alternative locations for a new bridge over the Volta River B-1, B-2, B-3 and B-4 were similarly considered. But the selection of alternative road alignment was carefully coordinated with the selection of possible locations of a bridge. B-4 was dismissed from consideration because alternative alignment S-5, which connects to B-4 was dropped.

Moreover, between Volta River and Asikuma Junction on the N2, three (3) possible alternative routes were examined. These were N-1, N-2 and N-3. But alternative routes N-1 and N-2 were screened out because they require upgrading of the existing N2, which passes through several townships and this upgrading scheme is not covered by the Program of Study. Also, consideration was given to a fly-over at Asikuma Junction if demand exceed the capacity of the at grade intersection. Therefore, alternative N-3 was selected for further study.

Additional alternative alignments were evolved which passes beside Osuyougwa Mountain. These were Alt 1, Alt 2, Alt 3, Alt 4 and Alt 5.

7.4 Selected Development Option.

In terms of sustainability and the optimization of goods and passenger traffic, the options retained are the best “cost/benefit” compromise of all the options proposed. Even though some dissenting voices were raised against some selected sectional alignment away from the paddy rice fields (**ch (23 + 250) km LHS/RHS on Asutsuare – Volivo Road**) during the scoping exercise undertaken, the best selected options were sound from the technical, economic, environmental and social standpoint. Moreover, there are entanglement of all the project roads with involuntary resettlement issues, namely, **Dufor Adidome – Asikuma Junction Road, Dufor Adidome – Asikuma Junction and Asutsuare – Aveyime Road.**

The **Asutsuare – Aveyime Road** option will mean maintaining the existing road alignment as much as possible within the entire road corridor. There will also be surface condition improvement and drainage systems enhancement. Details of this option involves: strengthening of existing pavement, double bituminous wearing course, bituminous and granular base course, granular sub-base and rip and recompact in-situ existing material; construction of roadside drains and improvement of some existing structures; provision of toll-booths, laybys-busbays, pedestrian crossings and walkways on both sides of the road. Similarly, the new alignments for Asutsuare – Volivo and Dufor Adidome Roads will experience engineering designs suitable for the geotechnical survey information depicted by the geological profile of the projects zone.

All the selected options come with potential negative impacts from construction and operation of the project roads along all the selected alignments which will be minimized and /or reduced to an acceptable level. Prescribed mitigation measures, protective works and planting programs will be conducted. Moreover, to enhance the prospect of compliance with the impact mitigation requirements, monitoring will be undertaken throughout and immediately after construction period.

Chapter 8 Potential Environmental and Social Impacts

The planning of proposed project intervention points towards the impacts in the pre-construction, the construction and the post – construction phases. The prediction of impacts due to the Proposals on the natural, biological and human environments will be discussed in this section.

8.1 Impact Analysis

Impact Identification and Characterization: For each environmental and social topic, impacts will be identified and characterized. Impacts can be defined as a physical or measurable change in the environment which results from the Project. Impacts for the purposes of the ESIA are defined as set out in **Table 41.0**.

Table 41.0 Definition of Potential Impact Types

Item number	Term	Definition
1	Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
2	Adverse / Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
3	Direct	Impacts that arise directly from activities that form an integral

		part of the Project (e.g. new infrastructure).
4	Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road traffic resulting from the operation of Project).
5	Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
6	Cumulative	Impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.
7	Transboundary	Impacts that extend to multiple countries but are not global in nature (e.g. air pollution extending to neighbor countries and use or pollution of international waterways).
8	Global	Impacts that, when taken together with impacts created by other human activities, can become nationally, regionally or globally significant.

Source: Impact Assessment Data Records

Further information on some of these definitions is given below. Potential effects identified as arising from the Project are likely to cut across the topic areas identified, either intrinsically or in terms of secondary or indirect impacts.

Cumulative Impacts: Cumulative impacts are defined as “the combination of multiple impacts from existing projects, the Project, and/or anticipated future projects may result in significant adverse and/or beneficial impacts that would not be expected in case of a stand-alone project”. This guidance will be applied during the assessment of cumulative impacts. The Equator Principles Exhibit II also states that the Social and Environmental Assessment need to address cumulative impacts of existing projects, the Project and future projects. The ESIA considers cumulative impacts of the Project from existing and proposed developments.

Transboundary Impacts: Transboundary impacts are impacts that extend to multiple countries but are not global in nature. It is not anticipated that the Project will give rise to any transboundary impacts.

Global Impacts: The individual project impacts on climate change, ozone layer, biodiversity or similar environmental issues may not be significant, when taken together with impacts created by other human activities, they can become nationally, regionally or globally significant. An assessment of the global warming potential of the Project is included in this document. No other potential impact from the Project is considered to represent a ‘global impact’.

Assessment of Impacts and Identification of Significant Effects: For each of the baseline topics covered, the significance of potential impacts will be assessed. The determination and assessment of impacts will be based on the following criteria:

- **Magnitude:** to what extent environmental resources are going to be affected;
- **Extent:** how much area will be adversely or positively affected by the project;
- **Significance:** what value in terms of costs and benefits does society place on the resources and the different impacts affecting the resource(s); and
- **Special sensitivity:** which impacts are significant in the specific local economic, social and ecological setting.
- **Residual:** following the adoption of mitigation measures, post-mitigation impacts significance affecting the resources.

Following international best practice, significant effects will be determined by consideration of the following:

- **Sensitivity of the resource or receptor** (rated as high, medium and low) by considering the importance of the receiving environment (international, national, regional, district and local), rarity of the receiving environment, benefits or services provided by the environmental resources and perception of the resource or receptor); and
- **Severity of the impact**, measured by the importance of the consequences of change (high, medium, low, negligible) by considering inter alia magnitude, duration, intensity, likelihood, frequency and reversibility of the change.

The following criteria are used to determine the sensitivity of the receptor/resource and severity of the impact. It should be noted that the definitions given are for guidance only, and not all the definitions will apply to all environmental/social receptors and resources being assessed. Therefore, the assessment will be further justified within each topic, referring to those in **Tables 42.0, 43.0 and 44.0** where definitions are applicable.

Table 42.0 Determination of Receptor Sensitivity

Rule	High	Medium	Low
Guideline Definitions	Receptor is rare, legally protected, of international or national designation.	Receptor is of regional importance. Resource may benefit the local population, but they do not rely on it for health, subsistence or livelihood. Receptor is of some cultural value.	Receptor is common or of local importance. Resource is not used or is of no value to the population.

Source: Impact Assessment Data Records

Table 43.0 Determination of Impact Severity

Rule	High	Medium	Low	Very Low
------	------	--------	-----	----------

Guideline Definition	Effect is transboundary or national. Effect exceeds a national or international standard. Greater than 75% of receptor or resource is affected. Effect is long-term (greater than 10 yrs.) permanent and irreversible.	Effect is regional, 25-75% of a receptor or resource is affected. Effect is medium term (2-10 yrs) and reversible.	Effect is local, 10-25% of a receptor or resource is affected. Effect is short term (less than 2 yrs) and reversible.	Effect is too small to be measured. Less than 10% of a receptor or resource is affected. Effect is confined to construction period or is intermittent.
----------------------	--	--	---	--

Source: Impact Assessment Data Records

Table 44.0 Determination of Significance Criteria

Effect	Receptor/Resource Sensitivity	Receptor/Resource Sensitivity	Receptor/Resource Sensitivity
Impact Severity	High	Medium	Low
High	Major	Major	Moderate
Medium	Major	Moderate	Minor
Low	Moderate	Minor	Minor
Very Low	Minor	Insignificant	Insignificant
No Change	None	None	None

Source: Impact Assessment Data Records

Likelihood or Consequence: Once a rating is determined for magnitude and likelihood, significance rating matrix for positive and negative impacts can be used to determine the impact significance. See Table 45.0 for likelihood or consequence.

Table 45.0 Significance Rating Matrix Positive and Negative Impacts

LIKELIHOOD	Unlikely	Likely	Definite
Negligible	Negligible	Negligible	Minor
Low	Negligible	Minor	Minor
Medium	Minor	Moderate	Moderate
High	Moderate	Major	Major

Source: Impact Assessment Data Records

Cumulative Effects: The Proposal is being developed in the influence areas of the project roads boundary areas, so there is potential for cumulative effects for both construction and operation stages of the program. Although some limited information has been obtained for other projects outside the proposed project sphere of influence, in most cases, there is currently no ESIA information on which to base cumulative effects. Therefore, the following assumptions have been made:

- Impacts on receptors and their magnitude will be same for those predicted for Project.
- It assumed that similar mitigation and compensation will be required through Ghanaian National Legislation and AfDB operational safeguards requirements.

- The program for development of other projects has been set out to the best available knowledge at the time of writing. In some cases, a precautionary principal has been applied, e.g. overlap of construction periods so that a worst-case scenario can be assessed.

The impacts assessed are also largely qualitative in nature rather than quantitative, due to the lack of raw data from other developments at this stage. It is acknowledged that there is some uncertainty associated with cumulative effects assessment. Therefore, it does ensure that cumulative effects are captured as part of the ESIA process. A cumulative impact assessment has been undertaken and covers two aspects:

- **Total effects** – this is the total effect of the Project with all the other on-going developments. This approach ensures that the total impact of the development of all the projects is accounted for.
- **Additional effects** – this is the contribution the Project alone will make to the total effects above.

Mitigation and Enhancement Measures: For any significant negative impacts identified from the Project, mitigation measures are proposed to ensure compliance with applicable Ghanaian acts and regulations, and meet the requirements of international standards, including the AfDB operational safeguards.

Mitigation is considered under the following classifications:

- **Avoidance** – avoiding environmental damage at source through design;
- **Minimize** – lessening the severity of an impact which cannot be avoided entirely;
- **Mitigation and compensation** – acknowledge that some negative consequences will stem from development, but provides means by which the conditions can be compensated for or improved; and
- **Enhancement** – increasing the effects of positive impacts.

The potential project impacts have also been assessed and classified using specific significance criteria: These are detailed in **Table 46.0**.

- **Positive:** Impact is considered to have a positive benefit on the environment either through an improvement in the resource base or by increasing the resource base. Positive benefits should be offset against negative impacts.
- **Unknown:** Not enough data to assess the extents and nature of the impact in any meaningful way. Recommended course of action would be to monitor unless the resource is of a critical nature (habitat or species) in which case additional studies would be required.
- **Negative:** Impact is considered to have a negative effect on the environment through deterioration of the resource base or by reduction in the resource base.

Table 46.0 ESIA Impact Assessment Criteria

No.	Significance	Examples of Significance Criteria
-----	--------------	-----------------------------------

1	Negligible (no impact) No mitigation is required.	No detectable impact; i.e. impacts are within the normal range of natural variations.
2	Low/Minor (not significant) No mitigation is required.	Short- time scale of the impact: <ul style="list-style-type: none"> • Less than 5% of the regeneration time of the resource of concern. • Less than 5% of a critical sensitive period. • Less than 5% of project duration. • Less than 5% of the area occupied by the resource of concern.
3	Medium/Moderate (not significant). Some mitigation may be necessary to minimize the impacts.	<ul style="list-style-type: none"> • Time scale of the impact is between 5-10% of the regeneration time of the resource of concern. • Critical sensitive period of event occurs between 5-10% of total project duration.
4	High/Significant (Significant) Mitigation is required – Project cannot proceed without it.	<ul style="list-style-type: none"> • Time scale of the impact is greater than 10% but less than 50% of the regeneration time of the resource of concern or a critical sensitive period or even occurs between 10% and 50% of the total project duration.
5	Critical (Significant) Changes to project design will be needed to allow mitigation or project may need to be abandoned.	<ul style="list-style-type: none"> • Time scale of the impact is greater than 50% of the regeneration time of the resource of concern or a critical sensitive period or event occurs more than 50% of the total project duration.

Source: Impact Assessment Data Records

8.2 Direct Negative Impacts

The roads project impacts and issues of concern have been assessed based on the information collected from the screening and scoping of environmental attributes at the feasibility stage. Moreover, the planning of the proposed projects intervention points towards the impacts in the pre-construction, construction and operation phases. The subsequent sections deal with prediction of impacts due to the proposals on the physical, biological/ecological and human conditions within the roads project catchment zone.

8.2.1 Roads Project Site Preparation Phase Impacts

The environmental and social effects before construction will cover the following:

8.2.1.1 Impact of Survey Works

Professional surveyors will be engaged to survey the proposed roads alignment sites for the sitting of bridges and drainage systems, borrow areas, camp sites and offices, removal of structures, foundations and pavements. During the survey process, coordinates of the terrain to create profiles of the project roads alignments and other relevant sites/areas will be taken. The profile lines will be approved by the Project Engineers. The completion of the surveying and designing leads to the pillaring of the sites for roads alignment setting, borrow areas markings and excavation works to begin. Such works involve the digging of the site camps/offices foundations and trenching using excavation equipment or manual labor. In all cases, the accompanying environmental impacts will be insignificant or minimal. No mitigation measures will be required. Therefore, no residual impact significance is expected.

8.2.1.2 Impact of Work Camps/Site Offices Organization

The creation of work camps/site offices, mobilization of machinery and equipment as well as aggregate materials handling is very likely to serve as channels for the transmission of occupational health and safety hazards. These hazards will result in injuries from handling, lifting and carrying, contact with mobile machinery, impacts from moving or falling from height, exposure to fire, explosion and harmful substances. The construction labor unit will be exposed to these hazards. The extent of injury will depend upon the severity of the hazards. The impact will be significant and moderate. Mitigation measures will be required, including expectation for residual impact significance.

8.2.1.3 Impact of Materials Mobilization and Transportation

The transfer of large quantities of construction materials – fine aggregates, gravels, stones – by construction access roads to the project sites will disturb the normal flow of traffic on the proposed project roads. These main townships are likely to experience construction haulage material traffic interference: Asutsuare, Osuwem and Volivo (**Asutsuare Junction – Volivo**); Dofor Adidome and Asikuma Junction (**Dofor Adidome – Asikuma Junction**) and Asutsuare, Volivo and Aveyime (**Asutsuare – Aveyime**). But this impact will be short, negligible and localized between peak periods of traffic flow (morning peak period: 6:00 am to 8:00am; evening peak period: 4:00pm – 6:00pm). In all cases, the materials and equipment will be transported to the sites during the minimum peak vehicular periods. The impacts will be insignificant or negligible, without any trigger for residual impact significance.

8.2.1.4 Impact on Flora

The setting of roads project alignments and creation of borrow areas will lead to the cutting of trees, removal of shrubbery and vegetation cover. Trees within the ROW and borrow areas boundaries will be felled. Case by case basis felling of trees will be considered for those trees, which are found at the very fringes of the borrow site boundaries. The clearing of vegetation at the borrow sites will de-vegetate the borrow environment within the borrow boundaries. At the borrow areas, there will be loss of flora species, loss of nesting and foraging habitat, habitats fragmentation on fauna, bird's mortality from loss of eggs and young in nest during habitat clearance which will result in the loss of fauna habitat and natural resources on a very high scale. The very removal of top soil will give rise to soil disturbance and instability episodes. Moreover, such episodes will easily lead to soil erosion of uphill areas and sedimentation of low-lying areas including the canals during the rainy season. The impact will be significant and moderate. Mitigation measures will be required, including the expectation for residual impacts significance.

8.2.1.5 Impact of Demolition of Structures and Removal of Foundations

The implementation of the project roads will lead to the demolition of buildings and structures. The project roads, locations and type of structures to be demolished are the following: **Asutsuare Jn – Volivo Road** at ch (1 + 425) km LHS/RHS; **Asutsuare – Aveyime Road** from ch (22 + 650) km LHS/RHS to ch (23 + 964) km LHS/RHS involving electric poles,

residential houses and shops; **Dofor Adidome – Asikuma Junction** at ch (1 + 000) km LHS an uncompleted sandcrete building foundation and at ch (68 + 625) km LHS/RHS.

To limit displacement and resettlement impacts, property losses on the **Asutuare – Aveyime Road** will be avoided through the construction of bypass road at location ch (19 + 500) km. Generally, all salvageable materials will be saved from destruction for reuse and recycle to divert demolition waste from landfill sites, in situations where demolition take place. Potential demolition of structures could potentially result in exposure and mobilization of asbestos-containing material and/or lead-based paint contaminants. Strategies will be adopted to reuse sandcrete blocks, concrete materials, wooden products, roofing-tiles and zinc roofing sheets so that impact of disposal of these materials could be minimized. Hazardous materials management will be undertaken to mitigate their negative impacts on the environment. Impact from demolition of structures and removal of foundations are considered moderately to minimally significant. Mitigation measures are required, including the expectation for residual impacts significance.

8.2.1.6 Impacts on Human Health and Safety

All the processes involved in effecting the pre-construction phase activities are characterized by some degree of occupational health and safety implications. The extent, measure and duration of those implications will depend on the levels of severity and the cumulative effects, imposed by those hazards. Institution of maximum precautionary measures will offset any perceived impact at this phase of the program. Impacts will be negligible and insignificant. There will be no need for the expectation of residual impacts significance.

8.2.1.7 Impact on Air Quality

The pre-construction stage activities will include sites clearance, shifting of utilities (where applicable), removal of trees present in the corridor of impact, transportation of construction workforce and material, construction of work camps/site offices, construction of stock yards/staging areas, installation of concrete batch plants and construction of bituminous hot mix plants. Dust generation during such activities will be the predominant polluting activity during pre-construction stage. Most especially when pre-construction tasks are performed in the dry season. The impacts due to the pre-construction activities are temporary and location specific with limited impacts. Therefore, the impacts at the pre-construction phase are temporary, localized and fugitive in nature. No need for the relevant evaluation of residual impacts significance.

8.2.2 Roads Project Construction Work Phase Impacts

The environmental effects during construction will encompass the following parameters:

8.2.2.1 Impact on Air Quality

Short term air quality impacts from fugitive dust may be expected during excavation, demolition and the early phases of construction of the Projects. Major sources of dust

emissions from construction activities have been identified as a potential cause of air pollution. These include:

- ❖ Delivery, unloading, storage and use of construction materials, notably, aggregates and earth.
- ❖ Movement of construction vehicles on untarred internal site roads.
- ❖ Dust generation from the access roads to the soil borrow-areas, aggregate quarries construction plants and construction camp sites.
- ❖ Operation of the construction plants such as hot mix plants and concrete batching plants.
- ❖ Asphalt/ bitumen odor during paving of asphalt / bitumen layers.
- ❖ Exhaust emissions from construction vehicles, machinery and equipment containing concentrations of carbon monoxide, nitrogen oxide, hydrocarbons, specific particulate matter and lead.
- ❖ Deep to moderate excavations, filling and compaction of foundations, movement of heavy-duty construction truck to and from the project site.

The untarred nature of the **Asutsuare – Aveyime Road** will cause construction vehicular traffic to generate large quantity of dust. Dust nuisance will intensify, most especially, in the dry season. For this and other exposed roads resulting from construction activities, dust is the largest air pollutant. This is particularly true on the laterite road surfaces which are more easily subject to pulverization of the wearing course than the stone-based gravel wearing course. Other sources of dust includes the earthworks, wind induced emissions from exposed surfaces and stockpile of construction material and surfacing cleaning before the application of bitumen.

Settlements, commercial areas very close to the project roads, project community residents' walking/working within the project zone will be exposed to degenerated air quality which could be life threatening. Respiratory and bronchial infections or disease will be common in the project communities. And residents who already have respiratory and bronchial problems are particularly vulnerable. It is worthy of note that, high levels of pollutant emissions will give rise to the following concerns:

- ❖ Eye irritation, coughing and sneezing by the project residents close to the project sites.
- ❖ Defoliation of flora species through the plugging of flora leaves.
- ❖ Defacing and tainting of aesthetic forms of building structures within the projects corridor of impactation.

Generally, the shortness, in terms of duration, of the degradation of the air quality will not cause any significant forms of human health hazards. In the dry season, however, dust nuisance will be pronounced but will subside in the rainy season. The construction period dust impacts will be non-beneficial and minor in significance. Mitigation measures are required, including assessment for residual impacts significance.

8.2.2.2 Impact on Soundscape and Vibration Effects

Noise and vibration nuisance will occur from vehicular movement, drilling and concrete mixing. Moreover, there will be noise and vibration pollution from loading of construction spoil, tipping of raw materials (gravel, sand and aggregate) and soil compacting machines. Noise pollution levels will depend on the intensity of these noises coming from all the sources. Noise levels of excessive intensity will become a nuisance and pose serious health hazards to project population and visitors within the project's impact zone. Moreover, noise pollution will impact construction workers, buildings, fauna, burrowing wildlife (e.g. snake), other nocturnal fauna and break the synchrony of natural ecosystem in the borrow material zones.

Developments of sensitive nature will be exposed to high levels of noise nuisance within noise reception zones. These sensitive developments include clinics, churches, schools, mosques, chief's palace and project settlement areas. Schools, health centers and mosques will be exposed to high forms of noise pollution during school, clinical and worship hours only. Therefore, effects of noise pollution from all general sources to reception zones are directly negative, significant, temporary and of short duration. Noise generation from the construction period will also be intermittent.

Added to the noise generating, will be the effects of vibration from heavy construction machinery traffic. Some of the old antiquated buildings within the project endive will be subjected to vibration effects. These effects from vibration will further weaken the already weak, old and aged colonial structures. Moreover, the heavy-duty construction machinery drivers or operators will be exposed to vibration effects of such machinery. Eminent health hazards inflictions are expected on the construction machinery drivers or operators. The direct negative impact from vibration effects will be qualified as minor and temporary. Mitigation measures will still be required, including assessment for residual impacts significance trigger.

8.2.2.3 Impacts of Borrow Pits Generation

Generally, the generation and development of borrow pits will start with the removal of vegetation cover. This activity will lead to the loss of production land, loss of vegetation cover, soil erosion induction, water courses siltation and loss of aesthetic value (visual impairment of landscape quality). Use of heavy construction machinery at borrow areas during the proposed project works, will lead to entrenched soil disturbance. When these activities are poorly supervised and uncontrolled, the extent soil disturbance and vegetation cover removal will be very devastating. Furthermore, any precipitation event will initiate soil erosion with destructive dimension. Such destruction will affect surface water resources adversely. Moreover, all borrow pits remaining open and operational, during such rainy season, will all collect water. Such waterlogged receptacles of borrow pits, may become breeding grounds for mosquitoes and other waterborne disease vectors. Also, the potential for land acquisition conflicts for selected borrow areas could result in social upheaval or disturbance of the construction phase. The Contractor(s) will locate borrow areas which will be approved by the Resident Engineer before material mining takes place. Impacts from borrow pits generation are significant and moderate to major. Mitigation measures are required.

8.2.2.4 Impact of Soil Erosion and Sedimentation

One of the most important issues of socio-environmental impacts in roads project is soil erosion. Erosion is a function of the stage of construction and the physical environmental condition (geology, climate, soil, topography). Erosion with roads construction is often associated with unstable geologic conditions.

Disruption of Natural Ecosystem

Generally, the basic construction activities will involve these logical steps: vegetation cover removal for soil materials; excavation of soil materials and transportation of soil materials. Large amounts of excavation, earth movement and clearing of vegetation cover, during the construction phase are necessary. Within the project locations, soil erosion and gulling may occur, particularly where there is rugged, slopping topography. These will also result in the loss of topsoil, diminishing soil fertility and ultimately, siltation of waterways (especially the canal irrigation system channels at Asutsuare and the Volta River crossing at Volivo and Dofor Adidome) and wetlands in the rainy season. This will be a problem, especially, along steeper slopes where landslides could occur and when the proposed works take place along water course where flooding could ensue.

De-vegetation events at the project sites will introduce removal of top soil and destabilization of soil stability structures. The exposed soil character becomes disturbed by both actions of wind and rain. These incidents will lead to soil erosion and sedimentation of low-lying zones of the project sites. Moreover, excavation works will let loose, the surface soils at the sites. Without any protective cover of vegetation, the loosened soils will be exposed to severe storm run-offs from precipitation events.

Excavation works with its resultant erosion effects will disrupt the integrity of existing ecology and natural ecosystem and biodiversity. Vegetation clearing will impact shelter, feeding and/or breeding and / or physical destruction and severing of habitat zones within the site, where applicable.

Surface and Groundwater Pollution

In draining the cambered surface of the project roads, water channelizing off (run-off) into and along roadside ditches can gain force and cause erosion in-situ or lead to adverse off-site consequences on neighboring lands. These consequences could be significant if settlements are adjacent to the project roads or if the lands are arable farmlands for growing crops. Moreover, discharging culverts or crosses drains into filled-based slopes without protection will quickly erode the side hill. Even in the flatter areas, loosen or disturbed soil can be washed into the roads ditches or drainage ways, adding to maintenance of these structures.

Eroded sediments into surface water facilities or resources will deteriorate surface water quality, including domestic waste from construction camps and site offices. Erosion effects will transform groundcover and topography, which will result in changes in surfaces water drainage patterns, including infiltration and storage of storm water. Runoff from material stockpiles will also increase sediment delivery and contaminant loading of surface water systems. The direct impact from soil erosion and siltation are moderate to major, significant

and negative. Mitigation measures are required including residual impacts significance assessment.

8.2.2.5 Waste Generation and Disposal

The construction process will generate heaps of construction waste (spoil) from borrow areas and realignment cuts. Improper handling and disposal of these spoils will have a negative impact on the project roads environment. Moreover, additional construction spoil or waste will be produced in the form of excavated soils, pieces of discarded wood and sandcrete blocks, paper, nails, glass or other used building materials. Construction workers will also produce solid and liquid wastes. Waste or spoil generation will also be in the form of spilled or discarded oil or lubricants. In all cases, the direct impact on the aesthetic values of the projects landscape will be negative, moderate to major, significant and non-beneficial, with human hazard implications in the long-term through disease spread and infections. Mitigation measures are required, including the determination of residual significance.

8.2.2.6 Impacts on Water Quantity and Supplies

Water availability within the project zone is not tight therefore the construction phase activities involving water usage and its supplies will not result in reduced water availability to affected project roads communities. It is noteworthy that the affected roads project communities rely on water supply from Ghana Water Company Limited (GWCL), Volta River and borehole abstraction sources located at strategic aquifer points within the project's catchment zones. The construction phase water supply requirements is expected to be high, with no undue negative impact on the projects communities ground and surface water resources quality and availability to existing users if construction water supplies tap into the Volta River water resources, by permission and approval from Water Resources Commission. If water supplies are emanating from the Volta River water resources, the impact will be minor, insignificant and negligible. No residual impacts significance assessment required.

8.2.2.7 Impacts of Concrete Batch Plant Waste

The construction of culverts, anchorages or anchor blocks for the Volta River Bridge, erection of foundations for site camps/offices will lead to the development of concrete products. The strength of the concrete products will depend on the quality of concrete mix. And the actual composition of the concrete will also depend on the sizes of aggregates (gravel, sand, cement and additives). The project sites will incorporate concrete batching plants areas, where necessary. Any leftovers of contaminated cement materials will have to be disposed of. The impact from waste disposal will be negative, minor and insignificant. No residual impacts significance determination needed.

8.2.2.8 Impacts of Construction Camps and Site Offices Creation

From the social standpoint, location of construction camps and site offices within the project communities will pose social problems as construction workers and project roads residents interact. Entrenched social values in culture and religion will most likely lead to social friction.

Transmission of communicable diseases such HIV/AIDS, STDs/STIs and Ebola due to workers–roads project residents’ interaction, will be a major social impact.

Setting up of construction camps and site offices will generate dust and soil erosion. Also, improper disposal of both solid and liquid waste will affect air and surface water quality and pollute groundwater resources. The impacts are moderate and significant. Mitigation measures are necessary, including residual impacts significance assessment.

8.2.2.9 Impacts on Loss of Fauna and Flora

The selective and extensive removal of vegetation cover of young trees, shrubs, brush-land and thicketed foliage at locations for utility pipelines location will devastate existing ecological integrity, natural ecosystem and biodiversity disintegration, where applicable. The major role of vegetative cover is preservation of soil composition nutrients, organic matter, biota and productivity using intercepted rainwater. This phenomenon aids soil porosity and water infiltration.

Continuous removal of large quantities of vegetation cover will occur during the construction phase. Extensive vegetation community removal is anticipated at the following locations: construction camp sites and site offices; borrow areas operational activities and realignment of sections of the project roads through vertical and horizontal cuts. Moreover, vegetation cover removal will lead to the destruction of fauna habitat including their source of food. Rural stretches within the project enclaves will be hardest hit. Vegetation cover clearing will impact flora species, including medicinal plants. However, major potential impacts on fauna and flora species will occur at selected borrow areas.

Forested Habitat Impacts: The operation of borrow pits for the Project are supposed to be non-permanent feature resulting in non-permanent loss of forest habitat unless the accompanying Borrow Pits Reinstatement Plan to be executed by the contractor is not effectively implemented as documented. There are vegetated forest areas within mapped out borrow zones which will experience significant impact on habitats. The forest covers provide habitats for flora and fauna species which are not endemic or not threatened. Taxonomically, many of the species ecological sensitivity are not known; **Habitats Fragmentation Impacts:** The loss of habitat will lead to fragmentation and such impacts will offer severe effects on the already developed forested environment; **Loss of Non-Endemic and Non-Threatened Plant Species:** The borrow areas are hosts to diversity of non-endemic and non-threatened plant species whose population sizes will be affected in a limited way by materials extraction within the borrow zones; **Terrestrial Fauna Impacts (excluding birds):** The community of faunal species at the borrow areas will face habitat loss. The assemblage of unique faunal species will lose considerably patch of forested colony of vegetation, which in the context of habitat loss will be permanent unless mitigation measures are undertaken; **Avifauna (Birds) Impacts:** Vegetation clearance at the borrow areas will result in loss of bird nesting and foraging habitat. There will also be bird mortality from loss of eggs and young in nests during habitat clearance; **Human Disturbance on Fauna:** Borrow material winning activities will introduce increased human presence in the borrow zones, which will affect fauna sensory negatively and decimate habitat suitability in immediate vicinity of borrow pits areas. These disturbances

will interfere with sensitive life profile or directly undermine fauna breeding through hunting and poaching.

Adversely, aquatic fauna habitat (rivers, stream, ponds and pools) will also be affected by the project roads implementation program. Construction camps/site offices indiscriminate waste disposal will pollute some of the water resources within the project areas. Notable waste products to be discharged into water bodies include: human waste; sewage and garbage. Additional pollution will emerge from deliberate and accidental spillage of petroleum products like grease, fuel and lubricants. In all cases, the removal of vegetation colony is non-beneficial, negative. But the direct impact will be significantly moderate. Mitigation measures will be required, including residual impacts significance assessment.

8.2.2.10 Impacts of Traffic and Transportation

The conveyance of large quantities of construction materials to the proposed projects sites will create traffic blockage, congestion and nuisance on accessible project roads. Such traffic nuisance will occur even during peak period traffic flows in the mornings and evenings. Resultant traffic hazards and accidents at such times will be eminent.

Moreover, more pedestrian – vehicular conflicts, vehicular – vehicular conflicts with greater and dangerous consequences will also occur at sensitive areas as crosswalks within the urban project's catchment zones. Admittedly, Okada riders (operators of motorcycles as taxis) within the project's areas, face the risks of accidents. Furthermore, any mechanical breakdown of construction trucks or vehicles in the construction fleet will pose as a potential for serious accident hazard, on any of the project's roadways. Lastly, public safety will be compromised if open trenches are left unprotected within the project's areas.

Therefore, the sequencing of construction will be programed to minimize traffic delays and reduce risk of accidents throughout the project's corridor. However, the projects will involve the partial or total closure of some project roads, especially, at the **Asutsuare – Volivo Road** intersection with the **Asutsuare – Aveyime Road (ch (27 + 500) km to ch (27 + 550))**. The effect of the closure will spill over onto other roads within the project's corridor. There will be delays at culverts improvement sections of the projects enclave. These will increase travel times within these corridors.

A Traffic Management Plan (TMP) will be developed and implemented during the engineering phases to ensure reasonable access to settlements, residences, businesses, public facilities, community services and local roads during the construction. Traffic flow and directional signs will be posted at selected locations and local newspaper notified, including FM Radio stations, to provide ample notice of detours, closing and other construction-related activities to plan alternate travel routes and accommodate time delays in advance. Traffic congestion and delays will be controlled where many construction operations are in progress at the same time. Within construction areas, traffic control measures using standard practices will be used. Access to residences and businesses impacted by the construction will be maintained through construction scheduling, temporary driveway construction and temporary connections.

A Work Zone Analysis Report will be developed to address maintenance of traffic issues for the Proposals. Based on the work zone analysis, the best alternatives relative to maintaining traffic during construction will be evolved. In addition, collector-distributor roads will be used for temporary access during construction. Admittedly, the ability to maintain accesses into and out of the projects corridor, are key issues of the work zone policy criteria consideration. And all the best access maintenance opportunities will be utilized. Acceptably, in all cases traffic nuisance impact will be negative, significant and moderate in the construction phase. Mitigation measures will be required including residual impacts significance.

8.2.2.11 Impacts on Human Health and Safety

Construction workers, project roads resident's project roads users and visitors to the projects zone will be exposed to noise, dust and construction vehicular movement's hazards. These impacts will lead to work related accidents and hazards resulting in severe injuries and death in extreme cases. Moreover, public safety will be compromised in the inter-locking incidence of construction workers and other pedestrian vehicular conflicts within the projects enclave. Construction activities have the potential to transmit disease like malaria, diarrhoea and dysentery exacerbated by inadequate health and safety practices. The populations in the proximity of the construction areas will be exposed to biophysical health risk factors (chemicals, construction materials, solid waste, wastewater, vector transmitted diseases, etc.). Other risk factors will result from negative human behavior (STDs, HIV/ AID). Lack of first aid and health care facilities, water and sanitation facilities will affect construction workers personal health and hygiene delivery. Also, other key sources of disease transmission and their vectors include: stagnant ponds at deserted borrow pits; contaminated streams and rivers and influx of migrant labor units who practice unsafe sex. The impacts are major, significant and negative. Mitigation measures are required, including residual impacts significance.

8.2.2.12 Impacts on Visual Quality and Amenities

The proposal will effect a visual change to the existing landscape character. Construction material pile up within the project zone of influence as well as broken down construction machinery, vehicles and equipment including dust pollution, will reduce the aesthetic conditions of the project environment.

Moreover, the erection of the project bridge structure (**New Volta River Bridge between Volivo and Dofor Adidome**) will pose an obtrusive hindrance to the visual quality of the project landscape. Sight distance will be impaired by the imposition of the project structure in the line of vision. The impact will be moderate and significant. Mitigation measures are necessary, including residual impacts significance.

8.2.2.13 Impacts on History, Archaeology and Heritage Resource

Based on scoping stage historical, cultural and heritage resources survey of the project roads catchment areas, the following findings were made. There are some prominent heritage resources within the project zone of influence which will be affected by the Proposal at the construction phase. These are very symbolic cultural and historic assets which need to be

preserved and protected during the project implementation program. Because of the presence of such delicate cultural resources such as sacred grove, shrines and cemeteries which will be affected by the roads project, a detailed heritage sensitivity assessment will be further undertaken before the commencement of the construction processes.

Section 1: Asutsuare Junction – Volivo Road (28.3Km)

The absence of historical, cultural or archaeological resources within and /or outside the immediate surroundings of this project road eliminates any significant impacts of the project development on heritage sites. This road project implementation program will not have any potential negative impact on any listed historic resources. Where necessary, an archaeological sensitivity assessment will be carried out and all excavation activities will be supervised by experts for the potential discovery of chance find. Moving forward, as more detail on the ground disturbance of construction activities emerges, additional archaeological review will be undertaken, consistent with expert recommendations. This review will include reviewing geotechnical data (i.e. soil boring logs) and underground utility data to identify more precise areas of potentially intact soils where below ground resources may be present.

Section 3: Dufor Adidome – Asikuma Junction Road (38.4km)

At the new Volta River Bridge site at Dufor Adidome, ch (0 + 000) km LHS there is a sacred grove with two (2) shrines, male and female. The male shrine is called **Tsaduma Shrine** and the female shrine is **Venor Shrine**. The fetish priest who takes care of these shrines and administers traditional rituals and rites to appease the gods is **Fetish Priest Ernest Gakpetor**. Around ch (0 + 800) km LHS, there is a public cemetery. These historical, cultural and heritage assets will not be displaced either partially or totally to make way for the project roads implementation program at the construction stage.

Section 2: Asutsuare – Aveyime Road (24.0km)

At ch (0 + 000) km RHS and ch (1 + 100) km RHS are two (2) cemeteries which will be not be affected by the project road development program during the construction period. These cemeteries are Bosidom Cemeteries 1 and 2. The Adakorkpe Shrine, located at ch (14 + 500) km LHS, will not fall within the RoW of the project redevelopment alignment width, therefore, will not require displacement and relocation. An old royal cemetery at ch (24 + 500) km RHS and an old public cemetery at ch (24 + 800) km LHS are directly within the new road improvement reservation width. These cultural assets not will have to be relocated. A bypass project road will be constructed at ch (18+275) as part of section 2 to avoid the historical, cultural and heritage resources corridor between ch (22+650) and ch(23+965).

The GHA recognizes the value of historic preservation on the roads project enclave. The GHA accepts responsibility for the preservation of all historically significant resources and is committed to a comprehensive understanding of their place in the broader cultural /historical fabric of the project zones. Therefore, during the construction phase recommendation will be made for Professor Benjamin W. Kankpeyeng and his team at the Department of Archaeology and Heritage studies at the University of Ghana Legon campus to be present during excavation works to identify, document and assess any historic/cultural resource find. The

impact will be negative, minor and insignificant. Mitigation measures will be required during earthworks, including residual impacts significance.

8.2.2.14 Impacts of Pedestrian-Vehicular Conflicts

Pedestrian-vehicular conflicts will occur in all phases of the project roads program. Notable occurrences at the construction sites will be construction crew, vehicular trucks and machinery of the contractors. Furthermore, passing traffic, pedestrians and the activities of the commercial settlement areas will give rise to added conflicts.

Greater conflict with dangerous implications will be prominent at sensitive developments like schools. School children use the **Asutsuare-Aveyime Road** to and from school by walking or riding bicycles. Risks of accidents near schools will be high. In all cases, the impacts are considered significant, negative but moderate. Mitigation measures will be required, including residual impacts significance.

8.2.2.15 Impacts on Public Utilities and Services

No utility facilities such as electric poles, boreholes and standpipes, are located within the RoW, and will not be relocated during the construction phase. These utility facilities will not be affected by **Asutsuare-Aveyime Road** construction process. These service lines fall outside the project road RoW. Any interruption of these services, at the construction phase, will result in the temporary disruption of both water and electricity supplies to the project road community residents. The impact on public utilities and services in the construction phase is insignificant, negligible and not negative. Mitigation measures are not required, including residual impacts significance.

8.2.2.16 Impacts on Loss of Assets and Compensation Payment

Significant number of sandcrete buildings of residential and commercial properties, crops/farms and bare farmlands will be affected by the construction process on all the project roads (**Section 1: Asutsuare Jn-Volivo Road; Section 3: Dufor Adidome- Asikuma Jn Road and Section 2: Asutsuare-Aveyime Road**). The typical sections of all the project roads with resettlement issues have captured in the Resettlement Action Plan documentation. During the construction, the any affected temporary structures like wooden kiosks in the RoW will be moved further away from the roads or relocated further down the roads, if possible.

The displacement of bare fallow lands, farmlands, crops and non-economic shrubbery trees will occur predominantly at several sections on the **Section 1: Asutsuare-Volivo Road** and **Section 3: Dufor Adidome – Asikuma Jn Road**. Generally, the impact of scenarios involving temporary structures relocation, permanent structures demolition, and trees, crops, bare fallow lands and farmlands take will be highly significant and negative. Mitigation measures are required, including residual impacts significance.

❖ Compensation Payments for Affected Assets and Properties

Buildings and structures, crops and farms, bare farmlands are the assets which will be acquired through involuntary resettlement and displacement by the project roads implementation program. Summary of interim values for compensation payment are indicated in Tables 46.0, 47.0, 48.0 and 49.0.

Table 46.0 Summary of Interim Values for Compensation for Section 1: Asutuare Jn-Volivo Road (28.7km)

Serial Number	Description	Number of PAPs	Land Value (GHc)	Building, Structures Value (GHc)	Crops, Farms Value (GHc)	Compensation Sum (GHc)
1	Buildings, Structures	134	1,498,471.88	6,034,690.32	-	7,533,162.19
2	Crops, Farms	278	-	-	718,539.98	718,539.98
3	Bare Land (427.67 acres)	295	1,451,389.00	-	-	1,451,389.00
4	Sub-Total	707	2,949,860.88	6,034,690.32	718,539.98	9,703,091.17

Source: GHA Data Records

Table 47.0 Summary of Interim Values for Compensation for Section 3: Dufor Adidome-Asikuma Jn Road (38.4km)

Serial Number	Description	Number of PAPs	Land Value (GHc)	Building, Structures Value (GHc)	Crops, Farms Value (GHc)	Compensation Sum (GHc)
1	Buildings, Structures	60	320,553.78	3,339,160.26	-	3,659,714.03
2	Crops, Farms	120	-	-	547,318.58	547,318.58
3	Bare Land (427.67 acres)	134	1,596,390.00	-	-	1,596,390.00
4	Sub-Total	314	1,916,943.78	3,339,160.26	547,318.58	5,803,422.61

Source: GHA Data Records

Table 48.0 Summary of Interim Values for Compensation for Section 2: Asutuare-Aveyime Road (24.0km)

Serial Number	Description	Number of PAPs	Land Value (GHc)	Building, Structures Value (GHc)	Crops, Farms Value (GHc)	Compensation Sum (GHc)
1	Buildings, Structures	204	399,835.82	5,222,336.46	-	5,622,172.28
2	Crops, Farms	215	-	-	105,573.63	105,573.63
3	Bare Land (427.67 acres)	35	92,150.00	-	-	92,150.00
4	Sub-Total	454	491,985.82	5,222,336.46	105,573.63	5,819,895.91

Source: GHA Data Records

Table 49.0 Summary of Total Interim Values for Compensation for Sections 1,3 and 2: (Asutuare Jn-Volivo Road (28.7km); Dufor Adidome-Asikuma Jn Road (38.4 km); Asutuare-Aveyime Road (24.0 km))

Serial Number	Description	Number of PAPs	Land Value (GHc)	Building, Structures Value (GHc)	Crops, Farms Value (GHc)	Compensation Sum (GHc)
---------------	-------------	----------------	------------------	----------------------------------	--------------------------	------------------------

1	Buildings, Structures; Crops, Farms, Bare Land (Total Acreage – 1,045.39)	1,475	5,358,790.47	14,596,187.04	1,371,432.19	21,326,409.69
2	GHA Operation Expenses	-	-	-	-	306,000.00
3	Grand Total	1,475	5,358,790.47	14,596,187.04	1,371,432.19	21,632,409.69

Source: GHA Data Records

8.2.2.17 Impacts of Influx Population Surge

The influx of imported labor into the projects zone for the program's implementation, most especially at the construction stage, will cause an increase in population change within the project's corridor. Moreover, effective demand on the provision of non-farm service will usher in higher numbers of itinerant service providers, businessmen and women, traders, sex workers and other service providers into the peri-urban centers within the projects enclave. This addition will swell the local populations within the larger project's catchment areas outside the immediate periphery of the Projects zone. The sociological implication of such population changes will upset the prevailing social harmony, causing adverse social disequilibrium and disharmony among the foreign and local-residents. Other social issues of concern requiring mitigation include the following:

❖ Disruption and Change of Local Livelihoods

The Proposal is expected to lead to some disruption and change of livelihoods of the local people during construction stage. The locals in peri-urban and rural centers such as Asutuare Junction, Asutuare, Volivo, Aveyime, Dufor Adidome and Asikuma Junction will have to interact with influx of foreign labor force that will be engaged for construction works. This will lead to changes in behavior and livelihoods (increase in crime rates, substance abuse, prostitution, teenage pregnancies, increase in abortion rates and other social deviations).

❖ Interference with Cultural Set-Up of Project Communities

Increased immigration into the project areas will lead to increase in population in rural towns, peri-urban and urban centers. The swelling of population numbers, though temporal, will result in strained relationships which sometimes degenerate into open conflicts between the residents and the foreign labor units. The increased population will exert additional demand on the existing social amenities and facilities.

❖ Increased Crime Rates and Cultural Erosion

Social crime rates in the project zones of influence is expected to rise with increase influx of job seekers thronging the project roads enclave looking for employment opportunities. This will be interaction with other cultures leading to cultural erosion in areas such as Asutuare junction, Asutuare, Volivo, Aveyime, Dufor Adidome and Asikuma Junction.

Such social conflicts and deviations will be negative, significant, minor to moderate and non-beneficial. Mitigation measures will be required, including residual impacts significance.

The roads project implementation program could result in more employment opportunities for the project areas and stimulate growth of cottage industries including the following:

Local Employment, Procurement and Income Generation

Employment: All employment procedures and practices will be undertaken in accordance with national legislation and aligned with GHA's policies and the ILO conventions as ratified by Ghana Government. The contractor will establish a Recruitment Policy which prioritizes the employment of people from project areas over outsiders by setting a clear criterion. Where possible, residents of the local communities will be prioritized for employment. With respect to unskilled labor, after preference has been given to people directly affected by the project, these opportunities will be evenly distributed between the affected communities.

Employment targets will aim to reflect an even distribution of demographic characteristics of the local communities. The contractor will be required to recruit in terms of GHA recruitment policy, where possible. A Recruitment Committee will be established consisting of representatives from Local Communities, GHA, District/Municipal Assemblies and NGOs with the aim of identifying and employing locals for available employment opportunities. The criteria (skills and experience) for available jobs will be documented and made available to the Recruitment Committee and through local and national media, where applicable. No employment will take place at the entrance to the site (to avoid people congregating at the work site). Only formal channels for employment will be used.

Procurement: Opportunities for local procurement will be identified and procurement targets, focusing on suppliers, will be incorporated into the key performance indicators of the project team and specified in the contractor's contract. GHA will build the capacity of local people, where possible, in order that they can assess more of the semi-skilled jobs and meet the employment and procurement need associated with future GHA development activities.

Increased Government Revenue: The national revenue will slightly increase due to the contractor's procurement of certain licenses needed for the extraction of materials in the borrow pits sites, port taxes and duty fees, and other fees and taxes. Even though the amounts will not be significant, they will contribute to local government revenues.

Income Generation: Construction workforce will increase local expenditure and provide a boost to local revenue generation for purchase of food and drink, supplies and other necessities and social services. Impact on vendors households are positive and able to support service these needs. Project roads operation will create limited additional employment at the local level, although the number of jobs that will be created cannot be known figuratively. But the increased use of the project roads for the tourism market is expected to change the supply and demand for goods and services, such as accommodation, eateries and public transport thereby creating opportunities for local suppliers able to supply

food and services. The local economy will be simulated on a growth path trajectory due to improved access routes and project enclave economic expansion.

8.2.2.18 Impacts of Greenhouse Gas (GHG) Emissions

At the construction phase, the combustion of transportation fuels (petrol and diesel) will release several contaminants into the atmosphere, including carbon monoxide, hydrogen, oxides of nitrogen, lead, particulate matter and other volatile organic compounds. Hydrocarbons in exhaust emissions are the result of incomplete combustion of fuel. Particulates are minute solid or liquid particles that are suspended in the atmosphere. They include aerosols, smoke and dust particles. Once emitted into the atmosphere, air pollutants undergo mixing or diffusion, degree of which depends on topographic, climatic and meteorological conditions. These including wind speed and direction and atmospheric stability. Generally, construction fleet of trucks as key form of transportation is a major source of GHG emissions and other pollutants that contribute to health problems. Due to disproportionate exposures, these health impacts will be frequently more pronounced in projects population occupying facilities proximate to major transportation routes or corridors within the projects enclave. GHG emission levels will have to be captured and computed to indicate the GHG accounting footprint at the construction stage to serve as a guide towards the development of a comprehensive Carbon Management Plan, so that there will be a consistent and measurable effort to reduce carbon footprint over the long term. Impact is unknown.

8.2.2.19 Impacts of Quarry and Bituminous Hot-Mix Plants Pollution

The contractor(s) will establish a **new quarry** only with the prior approval by Minerals Commission, Ghana EPA, GHA and the district/metropolitan assemblies' only with cases where materials from the leading existing quarries is uneconomical and alternative material sources are not available. The contractor(s) will prepare a Redevelopment Plan for the quarry site and get approval from the same authorized institutions. The construction schedule and operations plan will contain a detailed work plan for procuring materials that includes procurement, transportation and storage of quarry materials. Moreover, the Operation and Redevelopment Plan of the new quarry will include, at a minimum, the following information: photograph of the quarry site prior to commencement; quarry boundaries, location of materials deposits, working equipment, stockpiling, access roads and final shape of the pit; drainage and erosion control measures at site; safety measures during quarry operation; design for redevelopment of exhaust site.

The contractor (s) will install a **new bituminous hot-mix plant** only with the prior approval by Ghana EPA and GHA. A decommissioning plan will be developed for the new bituminous hot-mix plant in accordance with national regulatory compliance regime. Moreover, the new quarry and bituminous hot-mix plants will be located sufficiently away from habitation, agricultural farmlands, forestlands, water bodies, open haulage roads and settlement localities.

The operations of the quarry plants will produce possible dynamic environmental impacts such as high levels of noise, vibration, heat, and dust emissions. Erosion of excavated

materials will ensue at the quarry sites and inadequate drainage systems will give rise to flooding due to runoff. The down-wind direction enhances adverse impacts of dust and noise. Noise nuisance becomes pronounced when crushers are not regularly maintained. Where slopes are not flatter than 20 degrees, sliding occurs during excavations. Non-compliance of all workers related safety measures can lead to accidents, even deaths. Blasting materials storage violations can lead to accidental explosions, while overburden non-support or removal can initiate falling rocks episodes.

The bituminous hot-mix plant operations on the other hand will generate dynamic environmental impacts like dust, noise, heat, noxious gas and toxic effluent. Bitumen material discharge into side drains will lead to waterbodies pollution. Moreover, bitumen heaters non-maintenance will create smoke, soot and noxious gas emissions emanating from incomplete combustion of kerosene, diesel or LPG as fuel feed for the plant. Ineffective control of odor, heat and dust can lead health and safety inflictions on the plant operators. Potential damage to the top soil, spill over, hazards of carriages, storage, erosion, air and soil pollution is eminent. The impacts will be high, significant and negative. Mitigation measures will be required, including residual impacts significance.

8.2.2.20 Impacts of New Volta River Suspension Bridge Project

The major environmental concerns within the selected **New Volta River suspension bridge sites at Volivo and Dufor Adidome** will be addressed to meet the basic Ghana EPA and AfDB Environmental Guidelines and Safeguards Compliance. Pollution from human-centered activities emanating from settlement zones along the banks of the Volta River is one of the most serious environmental red flag issues.

New Volta River Suspension Bridge Sites Pollution by Human Activities

The Volta River selected sites for the new suspension bridge at Volivo and Dufor Adidome have been experiencing water pollution through human-centered activities at the river banks. The river is the dominant aquatic feature in the study area. Within the study area, the sections accessible to the bridge section communities have very poor biological conditions at the river banks. Such poor conditions emanate from washing, bathing, siltation, point discharge of household wastewater as effluent and recreational sport activities in the river.

Consequently, the aquatic biological utilization, naturally, as supporting resource of maintaining a balanced, integrated, adaptive community of aquatic organisms having a species composition, diversity and functional organization is lost in the hot, dry season. But the reversal of this deteriorating condition occurs in the wet, rainy season. But for the purposes of this project, no quantitative sampling for macroinvertebrate communities or fish was performed.

Heavy machinery operations at the bridge site during construction will leave soil and substrate to sediment transport and alteration of river hydrology. During the construction phase, these operations are very likely to take place. They include: aquatic life disruption and pollution of water quality through hazardous hydrocarbon chemical spillage and sediment delivery into the river system; river channel enlargement by the construction process and

possible reduction through sediment delivery restriction of internal circulation of air and eddy current movement.

The construction process will impact negatively on the channel, resulting in channel regime changes. Moreover, various characteristics of the available aquatic habitats based on their ability to support viable, diverse aquatic fauna will be temporarily decimated. Increasingly, the type of quality of channel substrate composition which will be artificial (concrete and brick) and silt, amount of in-river cover, channel morphology, extent of riparian canopy, maximum pool depth and river bank width development and quality, and the site-specific river gradient are some of significant parameters that will be impacted adversely. These temporary setbacks will provide poor habitat for macroinvertebrates, amphibians and fish within the new suspension bridge provision sites.

Finally, creation of imbalances in fisheries and aquatic living organisms who eat, hibernate and interacts within the river basin leading to loss of aquatic biodiversity – species richness and composition, trophic composition and abundance and composition – will ensue. That, aquatic organism's tolerance level to wide range of stress including chemical and physical degradation, will be compromised, thus, the Volta River would be severely impacted by habitat alternation and pollution. The turbidity will be elevated therefore, little light will penetrate the water and few aquatic macrophytes will be able to grow. Limited macrophytes population, slow flow rate (due to deliberate restriction of river flow), and a lack of riffles will all result in lowered oxygen levels in the Volta River. Mitigation measures will be necessary for these high, significant negative impacts, including residual impacts significance.

8.3 Roads Project Operation Phase

8.3.1 Impact on Air Quality

The intense dust nuisance during the construction period will abate during the operational phase. Traffic volume and vehicular waiting periods at traffic intersection points will cause subdued forms of air deterioration through low levels of vehicular exhaust emissions. These emissions from vehicular traffic exhaust include carbon monoxide, hydrocarbons, nitrogen oxide and lead, which are not harmful at subdued lower levels in the atmosphere. And as the volume of traffic increases within the projects enclave, so will their exhaust emission into the atmosphere. These emissions are not expected to cause air quality in the ambient air to exceed the applicable Ghana EPA standards, following dilution and dispersion. Moreover, this impact to air quality will be minor at this stage as the traffic management improvements or interventions will ensure free and smooth traffic flow.

8.3.2 Impact on Soundscape and Vibration Effects

Expected increase in traffic volumes around the project sites with high population densities will still be exposed to noise pollution in the operational phase. Such traffic generated background noise may exceed the Ghana EPA acceptable ambient noise levels. To ensure that noise sensitive receptors located within the projects enclave do not experience over the permissible limits of Ghana EPA baseline day time noise levels, noise survey should be carried out by use of noise integrator both inside and outside the sensitive receptors. However, in

all cases, noise impact at the projects sphere of influence and from vehicular operational activities, are expected to be low because of construction activities stoppage at the operation stage. But the creation of super highway conditions will lead to the generation of highway speeding noise nuisance on the **Asutsuare – Volivo Road** and **Dofor Adidome – Asikuma Junction Road**. Such noise intensity levels will be significantly high but temporary and for a short time.

8.3.3 Impact of Borrow Pits Generation

Failures to rehabilitate all borrow areas aligning project roads by the Contractor(s), especially in the rural areas, will lead to land degradation. Other events which are very likely to ensue are:

- ❖ Land sterilization.
- ❖ Loss of arable agricultural farmland;
- ❖ Loss of economic trees; and
- ❖ Creation of stagnant ponds or pools for the breeding of mosquitoes and other disease vectors.

Mitigation measures will be required since the direct negative impacts are non-beneficial, moderate to major and significant, including residual impacts significance. Borrow areas are often regarded as very sensitive landscape systems.

8.3.4 Impacts of Soil Erosion and Sedimentation

During the operational phase, drainage channels along the improved project roads will be filled up to capacity with solid waste disposed from both rural and urban settlements within the projects landscape. These blocked drainage channels including run-offs from projects roadway surfaces within the project catchment zones, will give rise to stagnant ponds or pools, during rainy regimes. Undoubtedly, flood prone enclaves will evolve.

The twin combination of run-offs from project roads and turnouts from roadsides drainage channels will lead to the siltation of surface water bodies or resources. Aquatic life support mechanisms will be over-stretched and disrupted in such water systems. In all cases, the direct impact is negative, significant, non-beneficial and moderate to major. Mitigation measures are needed, including residual impacts significance.

8.3.5 Impacts of Waste Generation and Disposal

During the operational phase, any towering heaps of neglected construction wastes within the project environment will affect the aesthetic values or amenities of the projects landscape. The right-of-way approach to motorists will be interrupted or completely blocked. Visual amenities of projects community residents will be punctuated by negative visual effects from towering heaps of discarded construction spoils, visible at numerous key vantage points close to or away from the project sites. The direct impact is negative, moderate, significant and non-beneficial. Mitigation measures will be necessary to correct the impact, including residual impacts significance.

8.3.6 Impacts on Water Quality and Supplies

Operation phase water supply demands by the project communities' inhabitants will be met by water supply expansion provisions to be carried out through the erection of water storage reservoirs, boreholes and hand dug wells by the district assemblies, where feasible. The water storage systems will be required to store potable water from GWCL and borehole waterlines extractions for use by the roads project residents, when the project roads are operational. No direct impacts are expected, including no residual impacts significance.

8.3.7 Impacts of Concrete Batch Plant Waste

Soil contamination may take place, from discarded concrete products strewn all over the construction zones, especially into the Asutsuare irrigation canals and Volta River crossing points at Volivo and Dofor Adidome. Exposed, rejected concrete materials at precipitation events will be washed into the groundwater by infiltration processes. Contamination of groundwater will ensue from the presence of huge debris of concretized products generated from the concrete batch plants and from the dismantling of the lavatories at the project sites (if mobile toilet facilities are not used). Impacts from contamination will be low and insignificant. No mitigation measures required, including residual impacts significance.

8.3.8 Impacts of Camps and Site Offices Creation

Any abandoned construction camps and site offices structures will facilitate the following: habitat for social miscreants such as drug pushers and dealers, thieves and armed gangs; habitat for reptilian species like snakes, lizards; dump site for domestic waste generation (environmental degeneration); fire hazard designation, which will lead to bush fire start-ups. The impacts are minor and insignificant. No mitigation measures required, including residual impacts significance.

8.3.9 Impacts on Biodiversity Loss (Fauna and Flora)

Chocked drainage channels will lead to flooding of low-lying vegetated landforms within the projects zone, such as the areas closest to the proposed projects sites. Any ponded water systems will serve as breeding sites for vectors of waterborne diseases. These will pose serious health risk to the project's residents. Moreover, improved urban-rural roads network within the project's catchment areas will increase commercial activities in bush meat, fuel wood and charcoal. Such activities will be pronounced in the rural catchment areas, leading to the destruction of some fauna species. No endangered species were recorded in the project roads enclave. Hence, the impacts are considered negative but significantly moderate. Mitigation measures will be required, including residual impacts significance.

8.3.10 Impacts of Traffic and Transportation

During the operational phase, improved traffic management systems in place will help control any increase in vehicular traffic numbers and the likelihood of any eminent accidents. Signs for speed limit, no parking and stop will help regulate traffic flow. Motorists will be compelled

to obey all traffic signs and road markings. Additionally, the provision of pedestrian and traffic management facilities like walkways, crossing and public bus stops or laybys will ensure the free flow of vehicles. Vehicle operating cost as well as accident rates will reduce. The impact is considered minor, insignificant and negative. No mitigation measures required, including residual impacts significance.

8.3.11 Impacts on Human Health and Safety

The project roads community's exposure to air and noise pollution will cease at this stage. Threats to public, occupational health and safety of projects community will be removed except for the exposure to vehicular exhaust fumes or emissions, which will be insignificant and less negative because of diffusion and dilution. Accessibility to social services including health facilities will be enhanced. Impacts will be moderate and significant. Mitigation measures will not be required, including residual impacts significance.

8.3.12 Impacts on Visual Quality and Amenities

The project roads community's exposure to air and noise pollution will cease at this stage. Threats to public, occupational health and safety of projects community will be removed except for the exposure to vehicular exhaust fumes or emissions, which will be insignificant and less negative because of diffusion and dilution. Accessibility to social services including health facilities will be enhanced. Impacts will be moderate and significant. Mitigation measures will not be required, including residual impacts significance.

8.3.13 Impacts on History, Archaeology and Heritage Resources

The potential for future historic, archaeological and heritage resources find could exist for future expansion works on the roads project. Any developed future Heritage and Preservation Guidelines and Management Procedures will be referenced to. This will help to address the GHA emphasis on the propose project roads future redevelopment by articulating the historic resources component of the Cultural Heritage Management Plan. The GHA is committed to the continuous pursuit of historic assets conservation and redevelopment in relation to heritage protection and enhancement. Any project roads heritage and historic resources find in the operation phase expansion works will be documented and reported to the Ghana Museum and Monument Board, through the Department of Archaeology and Heritage Studies at the University of Ghana, Legon.

8.3.14 Impacts of Pedestrian-Vehicular Conflicts

During the operation phase, accident rates will increase due to improved project roads conditions. Motorists will be inclined to increase vehicular speed leading to high incidence of roads kill. The impact is considered moderate and negative. Mitigation measures are required, including residual impacts significance.

8.3.15 Impacts on Public Utilities and Services

Increase in the provision of additional utility services in deprived project communities is expected at the operational phase. The project roads corridor will then become more accessible to the reception of more public services. By so doing, the utility facilities will be overloaded due to possible emergence of urban sprawl in large settlement areas like **Asutsuare, Volivo, Dofor Adidome and Aveyime**. The impact on public facilities will be significant, negative and high. Mitigation measures are required, including residual impacts significance.

8.3.16 Impacts on Loss of Assets and Compensation Payment

Unpaid compensation monies to project affected persons (PAPs) for resettlement, displacement or dislocation issues will lead to social upheaval. Prompt compensation monies payment and livelihood restoration through income generation programs implementation will forestall any grievance agitations. Enhancement of peace and harmony will prevail within the project roads enclave.

8.3.17 Impacts of Influx Population Surge

At the operation phase, construction activities will come to a stop. All imported labor units will leave the project catchment zone. Hawking activities and other service provisions will cease. Depopulation of the project's catchment areas will ensue, thus depleting the temporary increase or surge in population change during the construction phase. The disruption and change of local livelihood, interference with cultural setup of communities and increased crime rates and cultural erosion will diminish and invariably cease.

However, the original figures in the local population before the commencement of the program will indirectly be increased, not quite substantially, by the presence of illegitimate children left behind by the imported labor crew. This scenario will cause insignificant changes in the population, but will, however, raise a social issue of tremendous social intervention concerns. Impact will be minor and insignificant. No mitigation measures required, including residual impacts significance.

8.3.18 Impacts of Greenhouse Gas (GHG) Emissions

At the operation phase, activities of the construction truck fleet will cease. The concomitant increase in exhaust fumes and emissions from construction traffic will abate. Levels of GHG emissions from construction traffic will abate. Levels of GHG emissions will be expected to decrease with significant decrease in associated construction traffic abatement. However, operational traffic flow will also increase due to increase in population numbers within the projects corridor who will swell transportation vehicular movement patronage. The expected GHG emissions at the operation phase will have to be determined scientifically by field monitoring to establish GHG footprint record at the operation on stage.

8.3.19 Impacts of Quarry and Bituminous Hot-Mix Plants

Decommissioning of both quarry and bituminous hot-mix plants will ensue at the operation phase, since construction phase activities cease. Dismantled component parts of the plants

will be either scrapped or reused on another project. The contractor(s) will be fully responsible for any claims for damages caused to the owners of property, fields and residents of settlements affected by the operations. Operation and Redevelopment Plan of the quarry will be implemented. Reclamation measures designed for the bituminous hot-mix plant sites will be carried out.

8.3.20 Impacts of New Volta River Suspension Bridge Project

At the operation phase, these events are likely to prevail. They are:

- ❖ Surface runoffs and storm waters discharge into the Volta River basin. The river will be polluted. Such events will occur during stormy precipitation events.
- ❖ Termination of aquatic life support systems, through oxygen depletion and eutrophication effects. These chemical reactions will be facilitated by the presence of dissolved organic and inorganic matter in the river.
- ❖ Plastic waste discharge from moving vehicles over the suspension bridge and the surrounding communities' solid and liquid waste discharge into the river are also expected. This sensitive ecological system will be polluted. Most of the plastic waste products will also originate from the river bank communities (especially Volivo and Dofor Adidome) which are very close to the Volta River proposed suspension bridge sites.

8.4 Climate Change Impacts

Introduction

A national strategy on Climate Change has been developed. Nevertheless, Project design has taken into consideration climate change resilience measures of project roads reinforcement to protect the infrastructure from unforeseen heavy rainfalls, including drainage facilities and pavement surfacing type.

Challenges and Risks

The major challenges identified are: (i) a significant drop in annual rainfall pattern (ii) increased frequency of extreme events such as floods, and (iii) generation of greenhouse gas (GHG) emissions.

The project is classified as category 1 in terms of climate change. Climate risks mainly relate to flooding especially on the Section 1 (Asutuaire Jn-Volivo Road) and Section 3 (Dufor Adidome-Asikuma Jn Road) at the following locations:

- Section 1: Asutuaire Jn-Volivo Road - ch (7+200) km of River Dawhe floodplain.
- Section 3: Dufor Adidome-Asikuma Jn - ch (33+150) km of River Alabo tributary floodplain; ch (49+850) km of River Alabo tributary floodplain; ch (61+000) km River Alabo floodplain and ch (63+025) km River Alabo floodplain.

Indeed, almost all the rivers at these sections suffer from overflows caused by heavy rains. Within these sections of the project terrain, large areas of wetlands and other low points along the project roads RoW, there are vast stretches of stagnant waters in the rainy season at varying depths. Two major problems emerge.

Regarding the first major problem, River Dawhe on Section 1 project road flows through inadequate and limited capacity box culvert which has been subjected to continuous risks of flooding, major temperature variations between day and night leading to cracks from tension/compression in materials especially from hydraulic binder treatment.

Regarding the second problem, the Alabo River tributaries cross the Section 3 project road at three (3) locations, while the Alabo River itself crosses the same Section3 project road at only one (1) location. At these locations, there are no civil engineered drainage systems to channel the river flows during wet precipitation events. Therefore, such locations have become wetlands, experiencing floodplain conditions leading to the river basins becoming very sensitive surface water body areas.

Adaptation Measures

The adaptive measures were identified through review and evaluation procedures for adaptation (AREP) of the AfDB. The adaption measures adopted are the following:

Regarding the first risk, it will be considered as part of the solution for the pavement structure and especially during implementation, consideration will be given to the time needed for materials to develop resistance leading to cracks from tension/compression in materials especially from hydraulic binder treatment. On the other hand, with respect to the second risk, it is planned to raise the landforms of the project roads at these natural wetlands and low-lying sections for the installation of hydraulic structures of designed culverts with adequate, appropriate and sufficiently dimensioning of hydraulic structures, taking into account rainfall and the return-period of peak flows capacities to restore water courses, the discharge rates and low points drainage facilities.

Regarding crossing facilities such as bridges or box culverts over the Rivers Dawhe and Alabo and their tributaries the sizing will consist of sufficiently designed and adequate hydraulic outlets to properly dispose of a hundred-year flood. To attain this, after implementation of the facilities, a minimum vertical clearance of about 1.20 meters against the slope of the Highest Water Point (HWP) will be spared to facilitate the discharge of floating objects, debris including sticks and tree trunks. These measures will help increase climate resilience of the project roads infrastructure.

The rough nature of the Asutuare-Aveyime Road as it is now lead to longer travel time, increased wear and tear of vehicular parts and increased emissions, especially greenhouse gases. This episode impact climate change.

8.5 Positive Direct and Indirect Impacts

Much of the potential positive impacts of the proposal will be experienced on a long-term basis through induced characteristics. These induced transformation events are more socio-economic and cultural in perspective. The potential key expected positive impacts of the proposals include the following: (i) the contribution to improvement of trade among project influence populations (ii) improved transport conditions of goods and populations in the relevant project roads sections (iii) the internal opening up and improved access to basic socio-economic infrastructure for the populations within the project roads enclave (iv) the creation of direct and indirect jobs and employment during the construction, operation and maintenance phases of the project roads implementation program (v) development of tourism potential (vi) improved and enhanced living conditions and social facilities for vulnerable populations served by the project roads (vii) reduced risks of landslides and erosion by strengthening and monitoring of slopes (viii) improved safety around schools, health centers, churches, mosques and other social amenities along the project roads catchment zones (xi) suppression of dust through bituminous surfacing of the project roads pavements (x) reduction in greenhouse gas (GHG) emissions (xi) reduction in travel time and costs (xii) reduced traffic congestion resulting from flooded road section conditions on the **Asutware-Aveyime Road** during heavy precipitation conditions (xiii) improved travel safety and comfort (xiv) increased land values within the roads project enclave (xv) enhanced economy and gender development (xvi) improvement in agriculture, especially in rice, maize, cassava and vegetables cultivation using latest technology. Some key expected positive impacts have been discussed below:

8.5.1 Rural-Urban Income Level Enhancement

Employment Opportunity: The contractor(s) will be expected to create job opening and employ a sizeable number of the project's population on the periphery of the projects zone for various aspects of construction activities. Both skilled and unskilled job or will be involved in the construction activities. Most of the unemployed and under-employed youth, in the project's neighborhood communities, will be gainfully employed during the construction period.

Improvement in Rural-Urban Economy: Monthly earnings of laborers and artisans including engineers and technicians will be expected to be pumped into the rural-urban economics in the form of payments for workers' salaries. Other building and construction materials like gravels, sand, steel reinforcement and cement for the Projects will be obtained locally. The purchasing power of both construction workers and construction materials vendors will go up through enhanced rural-urban income levels, the net effect will be positive impact on the project's neighborhood communities' lifestyle and rural-urban economies.

8.5.2 Gender Issues

Introduction: Women are traditionally most active in the day-to-day upkeep of rural life. Studies carried out by district/municipal assemblies in the target project influence areas show that women account for 76% of time spent on transport and 85% of load carried while men account for 21% of the time and 11% of the load carried. As a result, it was found common that women move about 50kg per day over distance of 4km, spend 75% of total transport time walking along distances to and from farms and other production units, and largely

contribute to the tonne-km of the households on head or back loading. However, the amount produced is small due to time wasted, as walking constitutes the major transport means. The situation becomes more difficult for pregnant women and lactating mothers, aged vulnerable people and small children who also walk long distances to access basic social services. This is partly due to inadequate and poor transport service caused by poor rural transport infrastructure like the Asutuare-Aveyime Road. The improvement of the roads project in project zone is expected to reduce this physical and emotional burden on women while increasing their productivity and overall wellbeing.

Predominantly, women make up almost 52% of the total population of the project roads catchment area. Their contribution to the economy, both in rural, peri-urban and urban areas, is recognized at all levels. They play a major role in the informal sector where they carry out more than 60% of production activities in various domains (agriculture – rice, maize, vegetable farming, livestock breeding, petty trading, processing of agro-based products, etc.,). Despite this predominant role, women still encounter difficulties in accessing, using and controlling resources and the benefits of their socio-economic activities compared to men. The major constraints to women economic advancement in the project impact area include:

- ❖ Persistent socio-cultural obstacles
- ❖ Difficulties associated with business development procedures
- ❖ Limited access to financing
- ❖ Limited access to information about economic opportunities
- ❖ Difficulties in accessing markets and selling produce
- ❖ Limited access to effective production factors and technologies.

During the needs' assessment meetings with project roads community residents, AfDB officials and Consultant team, the representatives of women's associations and groups expressed specific needs concerning the difficulties they face in their areas. These needs have been considered in the choice of related facilities to be provided under this Proposal. The Proposal foresees having both positive and negative impacts on gender.

Positive Impacts on Gender: Gender sensitization programs will take place in the project communities. These sensitization programs while targeting at the civil works components will have consequences beyond the project roads enclave in influencing people's attitudes to gender. An experienced and well qualified service provider such as an NGO will be sub-contracted by the civil works contractor(s) for this purpose.

Increase in income levels for men and women through employment opportunities to be generated during construction, operation and maintenance phases. It has been estimated, that a total of more than 1,500 skilled and unskilled laborers will be employed during construction while at least 500 permanent employment opportunities will be created during the maintenance of the roads. The income generated from employment will improve the livelihood of the local populations. GHA will include in the Special Conditions of the Bidding Documents (BDs) for civil works an obligation for contractors to ensure that (i) 20% of the unskilled labor force during construction are women (ii) 10% of the unskilled labor force during implementation are women (iii) additional sources of income for women will be through sales of food items to construction workers.

Admittedly, the proposal will create new business avenues at the **construction phase**, for rural-urban women food sellers/ vendors. These new business openings will offer these rural-urban women financial opportunities to cash in and improve their lot and that of their families. These rural-urban women will also benefit from increasing demand for goods and services. Such demand will translate into improved profits for the rural-urban women service providers. The impacts on rural-urban women livelihood will be positive and significant.

Additional projects corridor infrastructure and growth in projects populations will enhance the free movement of projects resident population, goods and services and visitors into the projects enclave during the **operation phase**. Trading activities, such as food vending, sales of sachet water and bush meat vending are expected to increase within the projects enclave. Provision of goods and services will enhance trading, leading to raised profit margins which in turn will contribute to poverty reduction of the projects zone and neighboring projects communities. Beneficial impact on the projects zone local economies will be positive and significant.

Negative Impacts on Gender: The negative gender impacts likely to emerge from the roads project include:

- ❖ Increased vulnerability from both men and women at the roads project sites. During the road's construction, the skilled work force (mostly men) will come from outside the project communities being away from their families and spouses for considerable time. Construction workers are usually male with high disposal incomes will lead to life-style changes that could spread sexually transmitted diseases and unwanted pregnancies in relatively poor environments with large number of disadvantaged women. This may result in casual and multiple sexual relationships or the practice of "Multiple Concurrent Partnership" (MCPS) by many local women, whereby these relationships tend to involve truck drivers and are practiced in exchange for cash. Girls, mostly teenagers, are particularly vulnerable to this risk.
- ❖ The risk that increased household incomes may result in men taking new wives. The proposed HIV/AIDS and gender sensitization programs will be designed to seek to mitigate risks through prevention campaigns and capacity building of Community Based Organizations (CBOs) and peer educators. The gender sensitization programs will complement these HIV/AIDS initiatives.

8.5.3 Traffic Safety, Accident and Comfort

Existing conditions of the **Asutsuare – Aveyime Road**, raise major issues of traffic congestion (**at ch(22 + 650) km LHS/RHS to ch(23 + 964) km LHS/RHS**), accidents and safety within the project road environment. **Construction stage** activities will pronounce or entrench the concerns of traffic congestion, safety and accidents. Moreover, additional issue of undulating and rough surface of the project road will provide riding discomfort to the project road users at the construction phase. During storm events, the project road will become slippery and dangerous to both pedestrians and motorists. The expected impacts will be moderate. Mitigation measures will be required, including residual impacts significance.

Horizontal and vertical realignments including bituminous overlay of the project roads will significantly improve roads safety and comfort for roads users during the **operation stage**. Riding comfort of motorists will improve over the long term. Institution of traffic safety measures, including the use of roads furniture and the improved conditions of the tarred project roads will reduce the number of the road's accidents. Similarly, reduction in the number of conflicts between pedestrians, cyclists and vehicles will be expected. The operation phase impact on roads safety and travelling comfort on the tarred project roads will be positive and significant.

8.5.4 Traffic Congestion Dissipation

Currently, traffic movement and safety are primarily hindered by present and projected increases in congestion within the system flow, most especially on **Asutsuare – Aveyime Road, at ch (22 + 650) km LHS/RHS to ch (23 + 964) km LHS/RHS**. Geometric design deficiencies also hamper traffic movements and compromise safety within the study areas. Elements such as inadequate laybys, the intermixing of vehicular traffic flow with local pedestrian activities, partial or total inadequacy and insufficiency of intersection traffic management devices provision, road alignments that do not meet current design standards, and non-existence of road markings create safety concerns in and around the study areas. At the **construction phase**, traffic congestion dissipation and /or reduction cannot be met. Rather, intensification of traffic congestion will ensue leading to extreme forms of traffic interference between construction vehicles, pedestrians and local traffic vehicular flow. The heightened frequency of occurrence of traffic congestion at the construction phase calls for effective mitigation measures, including residual impacts significance.

At the **operation phase**, the geometric deficiencies which contribute to levels of service that is at or below acceptable thresholds and are projected to degrade in the future, will be dissipated or reduced considerably. In addition, the project roads will be functioning as intended to move people and goods through the project's community corridors. Tremendous relieve in traffic congestion choke-hold will be experienced at the operation phase. Therefore, the beneficial impacts from traffic congestion dissipation/reduction will be positive and significant.

8.5.5 Vehicle Operation and Transportation Costs

General interruption of commercial activities within the **Asutsuare – Aveyime Road** corridor, during the **construction phase**, will result in great loss in vehicle availability plying that project road. Road users within the project enclave will be subjected to the following:

- ❖ Long waiting times;
- ❖ Long travelling times; and
- ❖ High transport costs.

Improvement of the roads surface conditions will offer the following benefits in the **operation phase**. These are:

- ❖ Enhanced vehicle availability;

- ❖ Reduced waiting times;
- ❖ Reduced travelling times;
- ❖ Low transport costs;
- ❖ Reduced maintenance cost;
- ❖ Reduced wear and tear of vehicles; and
- ❖ Reduced fuel consumption.

The operation phase effect on overall vehicle operational cost is positive and significant. No mitigation measures are required.

8.6 Cumulative Impacts and Strategic Considerations.

Cumulative impacts are impacts on the environment that result within the effects of implementing the projects activities are added to analogous effects of other past, present and reasonably foreseeable future actions. Cumulative impacts are important because impacts of individual projects may be minor when considered in isolation, but significant when the projects are viewed collectively. Cumulative effects can be: **additive** (the simple sum of all the effects); **neutralizing** (where effects counteract each other to reduce the overall effect); **synergistic** (where the effects interact to produce a total effect greater than the sum of the individual effects).

Negative Impacts: There are considerable socio-economic activities or cottage industrial complexes such as rice and gari processing in the project roads catchment area which suffer from patronage due to difficult access. However, revitalization of the project impact zone through the roads project will entail during the construction and operation phases the displacement of populations in search of jobs or any other economic activity and increased movement of raw materials. Human pressure on natural resources and profound change in the project environment will increase. Threats to wildlife populations will be on the ascendancy due to the influence from human population surge within the project roads enclave. These impacts will be negative.

Positive Impacts: The project roads program will revitalize and redeploy socio-economic activities, especially in the processing of rice and gari, transportation and distribution, services and ecotourism. Given the expected potential in increased trading volumes due to the roads program, rural and peri-urban populations will have improved access to a greater variety of farm and non-farm products. Overall living conditions of the project populations within and outside the project catchment areas will be improved. The roads project will enhance and promote development of new traditional and administrative zones in the areas of direct and indirect influential enclaves, previously considered as inaccessible, undeveloped or under-developed. The ease of procurement of construction materials due to the good surface conditions of the project roads could inspire the project roads residents to improve their housing and community socio-economic amenities. These impacts will be positive. Examples of cumulative effects are given in **Table 50.0**.

Table 50.0 Examples of Cumulative Effects

No.	ESIA Topic	Cumulative Effects (can be positive as well as negative)
-----	------------	--

1	Project Population	<ul style="list-style-type: none"> • Project Community Severance. • Sections of Project Population Cumulatively affected by the Projects Development and Associated Traffic. • Inequalities in Access to Project Utility services, where applicable.
2	Human Health	<ul style="list-style-type: none"> • Incidences of Malaria, HIV/ AIDS/ STDs/TB. • Changes in Crime Levels. • Changes in Accident Levels.
3	Biodiversity (Fauna & Flora)	<ul style="list-style-type: none"> • Fragmentation of habitats. • Changes in biodiversity. • Species extinction. • Loss of High-Quality Landscape. • Soil Erosion, Flooding and Landslides.
4	Climatic Factors	<ul style="list-style-type: none"> • Effects of Climate Change (high winds, temperatures extremes, etc.).
5	Material Assets	<ul style="list-style-type: none"> • Peri – Urban Diversification. • Changes in Services Provision.
6	Landscape	<ul style="list-style-type: none"> • Changes in Land Use. • Changes in Landscape character.
7	Water	<ul style="list-style-type: none"> • Pollution. • Eutrophication, Acidification.
8	Interrelation between factors	<ul style="list-style-type: none"> • Loss of Tranquility. • Social stratification enhancement.

Source: K E & T Data Records

Chapter 9 Mitigation/Enhancement Measures and Complementary Initiatives

9.1 Overview

Following the successful identification of the potentially significant impacts of the roads project, appropriate mitigation measures are outlined in this chapter. The environmental and social criteria for the prescription of mitigation and enhancement measures will follow the same order and enumeration pattern as the Potential Environmental and Social Impacts (**See Chapter 8**). In some cases, additional socio-environmental value-components have been mentioned to buttress the importance GHA/AfDB attaches to them and their potential effects to the Proposals.

9.2 Roads Project Pre-Construction Phase Mitigation Measures

9.2.1 Impacts of Work Camps/Site Offices Creation

The selection of work camps/site offices location will be approved by the Project Engineer or Resident Engineer. The Contractor(s) will follow these mitigate strategic measures:

- Camp sites/ site offices location selection to involve fairly-flat terrain.
- Storage and nurturing of removed vegetation cover for future use.
- Provision of mobile toilet and other sanitary facilities. The toilet facilities will be emptied at approved district/ metropolitan assemblies' sites.
- Daily collection of generated solid waste.
- Equipment and machinery will be handled with maximum maintenance care

9.2.2 Impacts on Flora

Terrestrial impacts are also another danger to development activities. They include potential impacts to soil arising from three (3) basic sources: (i) physical disturbance from construction; (ii) contamination resulting from spillage and leakage of solid waste; and (iii) indirect impact arising from open access roads and social change. Potential impacts may result from poor designs and construction induced soil erosion due to soil structure, slope or rainfall. Left undisturbed and vegetated, soils will maintain their integrity, but, once vegetation is removed and soil is exposed, soil erosion may result.

Notable, woodlands and bushlands – lowland woodland, bushland, shrubland and wooded grassland represent a variety of woody vegetation types that will be affected by the projects, where borrow materials will have to be mined. The Contractor(s) will have clear guidelines for vegetation management and trees protection. These guidelines will include:

- Fully abide by and comply with the formal landscaping plan that have been developed by GHA/Ghana EPA in consultation with projects residents, which includes provisions mandating the replacement with three (3) new saplings for each tree cut (provision mandated by Ghana EPA and Forestry Commission), retention and maintenance of all existing trees along all portions of the projects zone perimeter.
- Implement all aspects of the landscaping designs set forth in the Grounds, Parks and Gardens Operational Guidelines, as supplemented by GHA Aesthetics and Landscape Guidelines, including the planting of indigenous and drought resistant trees, shrubs and plants.
- New trees will be promptly planted to fill any gaps on the proposed projects sites and along the perimeter of the projects zone.
- New trees and landscaping will comply with the GHA Aesthetics and Landscape Guidelines. Landforms and landscapes will be promptly installed on the proposed sites and in consultation with projects residents.
- Trees not to be cut will be identified and such information packaged to the contractor(s).
- Preferred methods for tree felling will be specific and indicative; in consonance with Ghana Forestry Commission Tree Cutting Guidelines.
- Working methods for tree felling will be indicated or specified to reduce the degree of damage to surrounding vegetation.
- No burring of vegetation for the purposes of site clearance will be allowed, especially in areas prone to bush fires (especially in the dry season).
- Establishment of vegetation covers immediately after construction on embankments slopes and borrow areas.
- Removal and stockpiling of vegetation cover topsoil to re-contour sites to blend with surrounding areas will be instituted. Use of local plant species will be advisable and recommended.
- Measures will be instituted to ensure that natural processes of vegetation cover restoration or regeneration through biochemical/ecological reactions within the ecosystem take place unrestrained.
- The removal of trees and vegetation will be kept to the minimum necessary to accommodate the permanent works as indicated by design drawings. The Contractor(s) will be responsible for ensuring that any exposed surfaces are re-vegetated as construction progresses in accordance with design drawings.

9.2.3 Impacts of Demolition of Structures and Removal of Foundations

Prior to the demolition activities at the proposed sites, where applicable, for the permanent structures of sandcrete buildings for shops, residences and other sandcrete facilities all related, asbestos-survey and lead-based paints abatement documents will be reviewed and, if necessary, complete asbestos-containing materials and lead-based paint will be removed in accordance with all applicable Ghana EPA/GHA and District/Metropolitan Assemblies Bye-Laws.

Added to the asbestos containing material and lead-based paint surveys, all water and electrical systems will be disconnected. These activities will be followed by the removal of all salvageable materials for reuse or recycle. The following recyclable materials will be reused: sandcrete blocks, and concrete materials, woody products, electrical fittings, roofing tiles, roofing sheets, etc.

9.3 Roads Project Construction Phase Mitigation Measures

9.3.1 Impacts on Air Quality

Every effort will be made by the Contractor(s) to observe Ghana EPA guidelines for ambient air quality for the project catchment areas. Any conscious effort will be made to maintain the ambient projects sites air quality levels. These strategic measures will be adopted by the Contractor(s):

- Work sites and access roads to borrow areas will undergo watering on continuous basis. This will be done three (3) times a day- morning, afternoon and evening - to keep them moist for dust control.
- Bituminous/asphalt plants will be maintained to reduce hydrocarbon and particulate matter emissions.
- Construction vehicles will also be maintained regularly to minimize diesel particulate emissions.
- Earthmoving trucks with loads of sand, stones and spoil will be covered during haulage.
- Using wetting agents on areas of exposed soil on a scheduled basis.
- Covering soil and material stockpiles on sites.
- Minimizing spoils on the construction sites.
- Monitoring of actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized.
- Minimizing storage of debris on the sites.
- Providing a wheel wash for vehicles leaving the project sites.
- Limitations of vegetation cover removal to demarcated areas only.
- Reduce speed and limit movement of vehicles.
- Minimize the height of fall of materials.
- Create sensitive zones, as appropriate, where activities are limited.

- Restrict dust generated activities to sheltered areas or use windbreaks, netting screens, semi-permeable fences, if these devices are considered practicable for the sites.
- Re-vegetate exposed surfaces progressively such as overburden mounds, to minimize dust emissions.
- To the extent feasible minimize construction trucks idling on sites and locate staging-areas away from location where projects residents congregate.
- Potential significant adverse impacts to adjacent projects settlements during construction will be mitigated by either discontinuing until favorable conditions are restored, or if warranted, sites may be watered to prevent dust generation, particularly at concrete batch plants areas.
- Operators will be required to install emission controls.
- Machinery and equipment will be fitted with pollution control devices, which will be checked at regular intervals to ensure that they are in working order. Best available pollution control technologies will be required.
- Refrigerant and fire extinguishing substances shall be in accordance with Montreal Protocol adopted by the United Nations to control the use and disposal of these substances.
- Open burning will be prohibited and requirements for spraying and related dust control measures and the proper use of solvents and volatile materials will be incorporated in the contract provisions.

The GHA will require the contractor(s) meet all Ghana EPA emission standards at ambient conditions for non-road construction. If specific equipment does not meet those standards, the contractor(s) will be required to retrofit the equipment using after-engine emission controls such as oxidation catalysts or diesel particulate filters to meet the standard. Contractor(s) will be required to submit to GHA a certified list of the non-road diesel-powered construction equipment that will be retrofitted with emission control devices.

9.3.2 Impacts of Soundscape and Vibration Effects

All construction activities will be undertaken in such a manner as to not cause undue or unnecessary disruptions to or interference with, the Projects residents or the surrounding project communities. The term “Construction activities” will be interpreted in broadest possible sense, and will include, without limitation, construction, grading or landscaping work, construction-related maintenance activities, the delivery of construction materials to the Projects sites, and the hauling of soil or construction debris away from the Projects. To that end, all appropriate reasonable steps will be taken by the contractor(s) to minimize the amount of any noise pollution generated by construction activities and all feasible mitigation measures will be implemented to protect the Projects and neighboring communities against any potentially harmful effects of such pollution. Without limiting the generality of the foregoing, the contractor(s) will adopt these strategic measures:

- Employ noise-reducing construction practices to comply with Ghana EPA ambient noise standards as well as existing applicable Local Bye –Laws on noise standards.
- Construction activity, at or near the project zone, will be limited to the hours of 8:00am to 5:00pm weekdays and 7:30am of 5:00pm on Saturday with construction

prohibition on Sunday. The Contractor(s) may engage in reasonable construction activities at other times to the extent those activities are necessary to address unexpected and unplanned emergencies that threaten life or property.

- All equipment will have sound control devices on less effective than those provided on the original equipment. No equipment will have an un-muffled exhaust.
- Appropriate mitigation measures will be implemented relating to changing the location of stationary construction equipment, shutting off idling equipment, rescheduling construction activity or installing acoustic barriers around stationary construction noise sources or construction sites.
- No construction equipment or vehicles operating or traveling on or near the Projects will utilize a system that sounds warning beeps when the vehicle backs up, rather GHA will require that the use of additional personnel or other means to assure backup safety.
- Noise monitors will be installed at a minimum of two (2) locations on each site. Said monitors will be operated continuously throughout the construction phase (and subsequent operation phase). The data from these monitors (showing sound levels at 15 seconds intervals throughout the day and night) will be provided online and will be made available to the Projects and neighborhood populations. Should such data indicate that Projects noise creates a noise environment at the stations above applicable Ghana EPA standards, noise mitigation measures will be increased until such standards are met.
- All construction activities will be undertaken in total and complete conformity with all laws, rules and regulations imposed by Ghana EPA on construction activities taking place within the Projects boundaries.
- No construction vehicles (which will include all vehicles participating in any construction work in Projects and all vehicles hauling materials, debris or other items relating to the construction projects to or from the Projects) will be permitted in the construction zone until 8:00am Monday through Friday and 7:30am on Saturday. And no construction vehicles will be permitted, at any time, to stand, park or stage at any location other than the construction staging and parking areas.
- GHA will prepare in consultation with relevant stakeholders, Construction Mitigation Plan for the projects containing legally binding construction mitigation requirements for noise and vibration that GHA will follow during the implementation of the Projects. The GHA will ensure that the Construction Mitigation Plan will be regularly updated so that all information contained therein is correct. Copies of the Construction Mitigation Plan, and any revisions or updates thereto will promptly, and at no charge, will be distributed to the Contractor(s) and Sub-Contractors(s). At a minimum, the Construction Mitigation Plan will address each and all matters set forth in the addressal of Noise and Vibration Effects, Air Pollution and all other potential adverse impacts emanating from the construction activities.
- GHA will appoint an employee or authorized agent to serve as an Ombudsperson during the period of construction of the projects to respond to questions and concerns from the surrounding projects and Projects communities on noise and vibration impacts, to ensure that all mitigation measures adopted by the contractor(s) and sub-contractor(s) are fully complied with and to facilitate, to the extent feasible, the prompt resolution of any other construction activities issues that may arise relating to the construction or the mitigation measures. The name, title and mobile telephone

number of the Ombudsperson will be distributed twice per year to the Projects and neighborhood communities and to representatives of associations, NGOs and will be prominently displayed on the GHA website. The Ombudsperson will be available on a 24 hour a day basis, 365 days a year, to respond to Projects residents within 30 minutes of an initial call. The Ombudsperson will have authority to intimate a response on behalf of the GHA in all foreseeable matters and will use reasonable efforts to promptly answer questions and resolve concerns in a manner acceptable to the Projects/neighborhood communities. The Ombudsperson will be appointed and will operate in accordance with all provisions of the Ghana Bar Association Standards.

The IFC Noise Level Guidelines indicated in **Table 51.0** will be adhered to by the Contractor(s) in addition to Ghana EPA Ambient Noise Guidelines.

Table 51.0 IFC Noise Level Guidelines

Receptor	One Hour Leq dBA Day Time (07:00 to 22:00)	One Hour Leq dBA Night Time (22:00 to 7:00)
Residential, Industrial, Educational	55 (free-field)	45 (façade)
Industrial, Commercial	70 (free-field)	70 (free-field)

Source: IFC Data Records

Moreover, the Contractor(s) will adopt these strategic generic measures to control noise and vibration pollution:

- Minimize height at which materials drops from trucks or plant.
- Minimize distance between loading and emptying operations.
- Use rubber linings in chute, dumpers, trucks and transfer points.
- Switch off equipment when not in use.
- Reduce propagation of noise by use of temporary bunds and portable screens if the noise may be a nuisance to Projects residents.
- Maintenance of all vehicles and machines to minimize noise pollution.
- Provision of earmuffs to construction workers to suppress noise pollution from constructions machinery and trucks.
- Provision of padded, comfortable seats and gloves on construction plant and machinery to control vibration effects.

Typical noise levels of principal construction equipment and machinery are indicated in **Table 52.0**. **Table 52.0** provides a general indication of the noise impacts that can be anticipated. In assessing potential noise impacts, one must be mindful of the fact that, in addition to being dependent on the type of equipment used construction noise is generally intermittent and

attenuates quickly with distance. Potential construction related noise levels of 85-90dBA at 18 meters from the source would be reduced to less than 62 dBA at 67 meters from the source. Excavation noise levels, for example, assuming bulldozer and dump truck activity only, would yield a Leq of approximately 85 dBA at 18 meters. These noise levels would decrease by about three to four dBA with every doubling of distance.

Table 52.0 Typical Noise Levels of Principal Construction Equipment
(Noise Level in dBA at +/- 18 meters)

Clearing	Noise Level (dBA)	Structure Construction	Noise Level (dBA)
Bulldozer	80	Crane	75-77
Front End Loader	72-84	Welding Generator	71-82
Jack Hammer	81-98	Concrete Mixer	74-88
Crane with Ball	75-87	Concrete Pump	81-84
Excavation & Earth Moving	Noise Level (dBA)	Concrete Vibrator	76
Bulldozer	80	Air Compressor	74-87
Front End Loader	72-84	Pneumatic Tools	81-98
Dump Truck	83-94	Bulldozer	80
Jack Hammer	81-98	Cement and Dump Trucks	83-94
Scraper	80-93	Front End Loader	72-84
Grading and Compacting	Noise Level (dBA)	Dump Truck	83-94
Grader	80-93	Paver	86-88
Roller	73-75	Landscaping and Clean-Up	Noise Level (dBA)
Paving	Noise Level (dBA)	Bulldozer	80
Paver	86-88	Backhoe	72-93
Truck	83-94	Truck	83-94
Tamper	74-77	Front End Loader	72-84
		Dump Truck	83-94
		Paver	86-88
		Dump Truck	83-94

Source: U.S. EPA, Noise Form Construction Equipment and Operations, Building Equipment and Home Appliances, NJID, 300.1, December 31, 1971.

9.3.3 Impacts on Borrow Pits Generation

All borrow areas and their access roads will be considered as one site. This will allow the Resident Engineer/Project Engineer to exercise his authority on environmental and social protection measures. The contractor(s) will give the Resident Engineer/Project Engineer details of any borrow pit operational plan for approval. The submission shall show the following:

- Exact location (markers to be placed in the field);
- Plan of the area showing type and size of trees (if any);
- Excavation plan (management of vegetation and top soil, volume and depth of excavation); and
- Rehabilitation plan for the pit and access roads.

The Contractor(s) will follow these strategic guidelines:

- Access roads to projects sites will avoid farms and settlements;
- Stock piles of topsoil will be protected by regular watering for re-vegetation; and
- Creation of stagnant water bodies will be avoided through improved landscaping of the site.

9.3.4 Impacts of Soil Erosion and Sedimentation

Soil erosion and associated sediment transport may adversely impact adjacent vegetation, water quality in water courses and aquatic flora and fauna. Moreover, failure to prevent erosion may result in a loss of surface soil thus reducing rehabilitation prospects. These guidelines will be strictly undertaken by the contractor(s) to minimize erosion and sedimentation issues at the construction phase. Most of the measures will curb excessive removal of vegetation cover. The contractor(s) will follow these strategic measures:

- Execution of earthworks will be done with due diligence and skills to control soil erosion and sedimentation
- Operations involving extensive earth movement will be done, preferably, in the dry season to control erosion and sedimentation.
- Clearing will be kept to the minimum necessary for construction works.
- Clearing will be conducted in such a manner that minimizes the potential for erosion or harm to flora and fauna and maximizes potential for successful rehabilitation post construction.
- All clearing activities will have approval to commencement of the activity.
- All illegal clearing to be documented.
- Preservation of ecological biodiversity will be maximized.
- Development of a detailed management manual that will include preservation of Biodiversity.
- Placement of sandbags around basins, the use of proper grading techniques, appropriate sloping, shoring and bracing of the construction site and covering or stabilizing topsoil stockpiles.
- All excavations and shoring systems will meet the minimum requirement of Ghana EPA Occupational Safety and Health Standards.
- Temporary sediment control by use of hydraulic mulch, hydroseeding and geotextiles.
- Temporary soil stabilization by use of straw barriers, straw bale barriers, sediment traps and fiber-rolls.
- Wind erosion control by use of portable water and straw mulch.
- Tracking control by use of street sweeping and entrance and outlet tire washing.
- Comply with GHA guidelines on Standard Urban Storm Water Mitigation Plan (SUSMP) requirements that meet Ghana EPA standards.

9.3.5 Impacts of Waste Generation and Disposal

Construction waste will be generated from heaps of cuts that result from vertical and horizontal re-alignments of right-of-way. Moreover, other different forms of solid and liquid waste such as asphalt waste, sewage, garbage and oil spills from construction equipment will be generated. Intense trading activities at the construction sites will evolve serious sanitation

problems. Other potential issues will arise from inappropriate management of domestic and industrial wastes such as tires, used oils, chemical containers, scrap-metal and used spares, used office supplies, cleaning supplies, sewage, hazardous materials and domestic waste (food, bottles, plastic, paper, etc.). Moreover, potential for the production, transport, recovery and disposal of waste will cause pollution of the environment or become detrimental to Projects and neighboring communities' health and safety.

The Contractor(s) will adopt these strategic measures:

- Minimize wastes generation.
- Separation of waste into what may be re-used/recycled and those requiring disposal by appropriately approved disposal channels.
- Storage, handling, transport and disposal in accordance with relevant legislation.
- No legitimate unresolved complains due to inappropriate waste management.
- Implementation and documentation of waste reduction practices.
- Temporary waste storage areas are established that ensure appropriate sorting of waste e.g. re-usable, recyclable and hazardous.
- Establishment of a possible resource exchange and reuse with the Projects and neighborhood communities.
- Provision of waste bins to be used by the workforce.
- Toilet /portable toilet facilities will be provided as required.
- Consult with the district/metropolitan assemblies about possible sites for waste disposal.
- Protect all surface water bodies and no excavated materials will be dumped at 500m on either side of these resources.

9.3.6 Impacts on Water Quality and Supplies

The contractor(s) will adopt these strategic measures:

- Responsibility to Contractor(s) to make their own arrangement for water supply usage for construction works.
- Contractor(s) arrangements for water supply usage must not affect the quality or availability of groundwater or surface water resources to existing Projects community users.
- In the event of ensuing valid disputes regarding the effect of contractor(s) arrangement have had on the water supply of the projects zones, the Contractor(s) would be responsible, at their own expense, for providing an alternative supply of the same quality as previously enjoyed by the Projects community users.

9.3.7 Impacts of Concrete Batch Plant Waste

The contractor(s) will adopt these strategic measures:

- Incorporate a concrete batching plant area into the work zone.
- Locate concrete batching plants at least 100 m away from any sensitive development.

- Detailed design of the concrete batching plants areas to be segregated into “clean” and dirty areas
- Dirty areas to contain contaminated cement materials collected for reuse
- Clean area as remainder of the site without contaminated cement materials.
- Recycle for reuse all cement materials classified as contaminated or waste or spoil.
- Prevent dumping of concrete waste, indiscriminately at the project sites.

9.3.8 Impacts of Construction Camps and Offices Creation

Selection and establishment of campsites/offices will be undertaken in an environmentally and socially responsible and sensitive manner to minimize their impacts. All plans for the Projects will be done in consultation with the Projects residents and project neighborhood community populations and GHA. The Contractor(s) will adopt these strategic measures:

- Health and safety of all construction workforces will be managed through contractor(s) own Workplace Health and Safety Management Plan.
- Erosion and dust will be regularly controlled and managed within the facilities.
- Select fairly- flat terrain for campsite.
- Ensure that entrance to camp sites will have a minimum clearance of 500m on both sides of the construction routes to allow construction vehicles to enter and exit safety.
- Provide mobile toilet and other sanitary facilities for the construction labor unit. The toilet facilities will be emptied at approved locations by the District/Metropolitan Assemblies.
- Collect all solid waste daily.
- Dispose of petroleum products (waste oil) with the consent of the Project Engineer)/ Resident Engineer.
- Mount oil traps around oil storage tanks to control any accidental spillage.
- Avoid the disposal of construction materials (remnants) into water resources.
- Avoid encouraging pests (rats, mice and mosquitoes) through appropriate waste disposal facilities and directing storm water away from sites avoiding areas where storm water can pond.

9.3.9 Impacts on Loss of Fauna and Flora

The Contractor(s) will adopt these strategic measures:

- Control all clearing activities.
- Minimize number of trees to be felled.
- Reduce potential impacts on flora and fauna habitats.
- No ground disturbance, site clearing, or removal of any potential nesting habitat will be conducted within the typical breeding/nesting season for birds (November – March); or within 15 days and again within 72 hours prior to any ground disturbing activities, a qualified biologist will conduct surveys for nesting birds at the borrow material sites, where applicable. The surveys will occur prior to the clearing, removal or trimming of any vegetation. Surveys will include areas within 100m of construction

site boundaries. The biologist must be qualified to determine the status and stage of nesting efforts by all local breeding birds without causing intrusive disturbance.

- If an active nesting effort is confirmed or considered very likely by the biologist, a fence barrier will be erected around the nest site to provide a minimum – 50m barrier between the nest and construction activities. A 200m buffer will be required for any maximum barrier allowable. No habitat removal or any other work will be allowed to occur within the fenced nest zone until a qualified biologist confirms that the young have fledged and have left the nest.
- An on-site biologist will be present to monitor construction activities, flag sensitive habitats and educate the construction crew about biological concerns.

9.3.10 Impacts of Traffic and Transportation

The Contractor(s) will adopt these strategic measures:

- Conduction of contractor(s) operations in such a manner as to maintain the existing flow of Projects and neighborhood traffic flows.
- Deployment of warning and directional sign at vantage points and approaches to the sites.
- Provide busing, rideshare and transit incentives to construction personnel.
- Configure construction parking to minimize traffic interferences.
- Provide a flag person with radio communication to guide traffic properly when and if necessary.
- Parking for construction vehicles (i.e. construction trucks and construction staff vehicles) will be restricted to the designated construction staging and parking sites. No construction vehicles will be permitted to stand, park, or stage in the Projects other than at construction staging and parking areas. No construction vehicles will be permitted to stand, park, or stage on the streets surrounding the Projects. All vehicles carrying workers or other people, who are involved in the Proposals, must park in Projects parking lots (or in designated construction staging and parking sites) and will be absolutely prohibited from parking on major roads, or on neighborhood streets.
- The GHA will ensure that there will always be adequate Projects parking for Projects populations (as well as for GHA staff, construction workers, and other invitees and visitors) to minimize and dissuade Projects community from parking on the major roads. The GHA will prepare a schedule of parking, which estimates the number of onsite parking spaces for each quarter during the Project period, and a construction schedule showing the order in which each of the proposed projects will be constructed, demonstrating that at all times there will be an adequate supply of parking space in Projects areas to handle all projected Projects populations, staff, construction personnel and invitees of the GHA. The contractor(s) will not deviate from the order shown in the construction schedule in any way that could delay the commencement or completion of construction of the projects unless the contractor(s) notifies GHA of any intended deviation from the order shown in the schedules and demonstrates that there will at all times be an adequate supply of parking in Projects areas to handle the needs of the Projects construction personnel and guests.
- Roads users will be accommodated through and around the construction zones safely with a minimum of delay.

- Traffic control and construction activities will be coordinated to provide for safe and efficient flow of traffic together with efficient, safe and rapid progress of construction activities.
- Where construction activities take place at multiple sites along the same or on parallel roads, construction activity and the movement of roads users will be coordinated to ensure that the total delay along the routes or on the signed alternative routes is within acceptable limits.
- Driver behavior will be influenced so that speeds are reduced to the desired level on the approaches to and within the construction zones and urban areas.
- Works requiring partial road closure on alternative routes will be phased, where possible, so that they are not undertaken at the same time.

TRAFFIC CONTROL DEVICES, EQUIPMENT AND INSTALLATIONS

Road signs, delineators, drums, barricades and flagmen will be used for the following purposes: warn the roads users; inform the roads users; guide the roads users; modify roads users' behavior; protect the roads users and the vehicles; ensure safe passage to the roads users and provide safe working areas.

9.3.11 Impacts on Human Health and Safety

The contractor(s) will adopt these strategic measures:

- Provision of protective clothing, helmets goggles, earplugs wellington boots and other Personnel Protective Equipment (PPE) and safety devices to construction workers.
- Ensure adequate provision and stocking of appropriate PPE always by the Project Engineer/Resident Engineer.
- Use directional and reflectorized warning signs and diversion, speed ramps, etc., will be adequately provided and established where work is in progress to avoid any form of accidents and delay to motorists.
- Use of public education campaign through press and radio to brief the public, projects residents and visitors on the dangers of works being carried out.
- Provision of temporary pedestrian ways and where crossings are provided, new drains will be covered.
- Construction vehicles will move only during the off-peak periods.

9.3.12 Impacts on Visual Quality and Amenities

The contractor(s) will adopt these strategic measures:

- Fence in of projects sites offices/camps and open spaces within them to prevent visual impairment and intrusion on the project's residents and project neighborhood populations.
- Water all exposed areas to prevent air quality degradation.
- Control the tipping of sand, stone/gravel aggregates to minimize dust intrusion of the project's areas ambient air.

- Control the loading and unloading of cement bags to reduce/ minimized fugitive cement dust pollution of the project ambient air.

9.3.13 Impacts on History, Archaeology and Heritage Resources

The contractor(s) will follow these strategic measures:

- In those areas that are not monitored by an archaeologist and a certified culturally affiliated expert in heritage resources, if buried cultural resources are uncovered during construction, all work will be halted in the location of the archaeological discovery until a qualified archaeologist can visit the site of discovery and assess the significance and of the archaeological resource
- Follow guidelines in the determination of damage avoidance and preservation principles outlined in Ghana Museums and Monuments/Ghana EPA Historical, Archaeological and Culture Property Management Plan.

9.3.14 Impacts of Pedestrian-Vehicular Conflicts

The contractor(s) will adopt these strategic measures:

- Posting of safety barriers and signage at pre-determined locations to give early warnings.
- Provision of road signs and speed limits will be posted clearly at these sensitive areas:
 - ❖ School areas –warning signs of children crossing.
 - ❖ Market areas signs.
 - ❖ Water post areas-warning signs of projects residents crossing.
 - ❖ Provision of laybys to allow vehicles to stop.
 - ❖ Provision of parking lands at busy market areas.

9.3.15 Impacts on Public Utilities and Service

The contractor(s) will adopt these strategic measures:

- Ensure that all utility services disruption is reconnected or restored.
- Affected utility service lines are relocated prior to project implementation.
- Consultations with utility service providers to either relocate or restore affected service lines.

9.3.16 Impacts on Hydrology and Drainage Systems

The contractor(s) will adopt these strategic measures:

- Diligent and professional execution of earthworks to control soil erosion and landslides.
- Create settlement basins or vegetated runoffs for drainage channels discharge into surface water reservoirs.

- Provide sanitary facilities at construction campsites for labor units.
- Provide proper storage facilities for fuel, oil lubricants and waste oil.
- Stone pitching of approach roads embankments to avoid erosion and siltation of the rivers and streams.
- Provide effectively designed oil traps, to prevent leaks and spillages.
- Provide detection systems or inventory control to regularly test storage tanks.
- Regular painting of rusty storage tank surfaces (using rust proof oil paint) to avoid rusts being washed into surface water systems.
- Provide earth bunds around storage tanks to contain leakages.
- Avoid the storage of construction materials (for bridges) close to streams and rivers.
- Limit the removal of vegetation cover around proposed bridge sites to areas for concrete mixing and storage or non-polluting materials.
- Educate construction labor force not to dispose of construction materials into rivers and streams.
- Prohibit washing in the streams and rivers.
- Restore rivers and streams beds into original characteristics through desilting when deposition of construction materials into them takes place.

9.3.17 Impacts on Project Communities Access

The contractor(s) will adopt these strategic measures:

- Meet the social concerns of the Projects community, recognizing health and safety issues and the needs of vulnerable groups for example those with mobility disabilities.
- Pedestrians, cyclists and motorists will be accommodated through and around the construction zones safely with a minimum of delay.
- Traffic control and construction activities will be coordinated to provide for safe and efficient flow of traffic together with efficient safe and rapid progress of construction activities.
- Driver behavior will be influenced so that speeds are reduced to the desired level on the approaches to and within the construction zones.
- Work requiring partial road closure on alternative routes will be phased, where possible, so that they are not undertaken at the same time.

9.3.18 Impacts on Loss of Assets and Compensation Payment

Any person, who will suffer loss or damage to his/her property or asset from the design of the roads project, will receive compensation. This provision is by the State Land Acts 186 of 1963. Structures, farmlands and crops have been identified for displacement through involuntary resettlement emanating from the project's implementation program. The list of affected properties and their owners has been attached to this report as an appendix.

Most of the property owners affected by the roads project have been fully identified. As a result, the List of Identification of Property Owners and Types of Property at this draft final report stage are incomplete. However, all attempts will be made to identify all property owners whose assets will be affected through involuntary resettlement exercise to be

triggered by the project's implementation schedule. The List of Identification of Property Owners and Types of Property will be subsequently revised to reflect the new changes that are likely to evolve.

For the purposes of compensation, all affected properties will be valued and the compensation payment procedure to be adopted will follow this procedure. The GHA with support from the Land Valuation Division will be responsible for all compensation payment schemes and all related issues arising including:

- Identification of all properties within the RoW very likely to be affected during the projects phasing periods.
- Identification of individuals or group of owners of property and users liaising with GHA and District/Metropolitan Assemblies (especially Planning Department) for the following purposes:
 - ❖ Facilitation of negotiation and consultation processes on compensation packaging and organization.
 - ❖ Finalization and affirmation of roads reservation boundaries.
 - ❖ Determination of exact areas with properties affected by the demolition or displacement and resultant compensation measures.
 - ❖ Revision of portions of land use zones affected by the need improvement scheme and other areas of projects impaction zone of interest in relation of compensation and property or amenity loss.
- Holding consultation meetings with property owners and users, prior to serving of the necessary notices. Invitation of GHA Officials and other relevant statutory stakeholders including Ghana EPA Regional Officials, to observe and advice or guide the compensation processes.

Preparation of a compensation report (Resettlement Action Plan (RAP)) will be prepared to depict the various project roads and project periods, including the following:

- Maps/diagrams showing the plotted properties affected.
- Property owners and users and their respective interests.
- Meetings held and general outcome.
- Agreed compensation packages (including formula for calculating compensation).
- Modalities for payment and timing of payment.
- Support in managing the compensation paid.
- Roads reservation corridor well marked out.

The agreed compensation packages and payment arrangement and modalities will be submitted to the GHA, LVD and the Ministry of Transport for acceptance prior to commencement of the projects. Moreover, copies of the report will be forwarded to the respective District/Metropolitan Assemblies.

9.3.19 Impacts of Influx Population Surge

The contractor(s) will adopt these strategic measures:

- Education contraction labor crew on the need to preserve prevailing social harmony and peace within the project neighboring communities where most of the workforce will reside upon employment.
- Establish effective interactions and integration of foreign/ imported labor crew and local hiring's on the Projects.

9.3.20 Impacts of Greenhouse Gas (GHG) Emissions

Contractor(s) will adopt these strategic measures:

- Service equipment, machinery and plant, vehicles regularly according to manufacturer recommendations, control release of contaminants into atmosphere such as carbon monoxide, hydrogen, oxides of nitrogen, lead, particulate matter and other volatile organic compounds to check excessive GHG emissions.
- Capture GHG emissions before the start of construction activities and during the peak of construction activities to check the GHG accounting footprint from construction vehicular activities to guide the construction process in carbon accounting principles.

9.4 Roads Project Operation Phase Mitigation Measures

9.4.1 Impact on Air Quality

Dust emissions from construction activities will end at the operational phase. Moreover, construction vehicular traffic emission will cease. Increase in traffic volume within and around the proposed projects sites will lead to corresponding increase in vehicular exhaust emissions, which could exceed Ghana EPA ambient air quality standards significance thresholds. However, atmospheric dilution and dispersion including traffic management improvements and interventions will ensure free flow of traffic; leading to reductions in carbon monoxides, hydrocarbons, nitrogen oxide and lead levels in the atmosphere. Operational phase air pollution monitoring will underscore the extent of reductions in baseline ambient air quality levels and magnitude of the impacts so determined.

9.4.2 Impact on Soundscape and Vibration Effects

The GHA will ensure the minimization of noise pollution to Ghana EPA approved guidelines on ambient noise levels through these measures:

- Erection of no horn signs postings at very sensitive receptor zones within the projects catchment areas.
- Encouragement of trees and shrubs planting within the projects enclave to serve as noise control barriers.
- Compliance with relevant legislations associated with noise and vibrations including any health impacts.
- Conduction of noise and vibration surveys both inside and outside of sensitive receptors to check on noise sensitive receptors sensitivity to noise and vibration nuisance permissible limits to Ghana EPA baseline day time noise and vibration levels.

9.4.3 Impacts on Borrow Pits Generation

Strict reclamation measures will be followed by the contractor(s) at the operational phase. Generally, borrow areas are considered as very sensitive landscape systems. The contractor(s) will carry out these reclamation measures:

- All stagnant pools and ponds will be filled up with spoils. These spoils will come from cuts, re-alignments and vegetation removal operations.
- Backfilling of all excavations will be undertaken.
- Stocked up topsoil will be utilized to re-contour the borrow areas.

9.4.4 Impacts of Soil Erosion and Sedimentation

More mitigation measures will be necessary at the operational phase. Effective controls will be instituted. After the improved surface conditions of the projects zones the contractor(s) will carry out the following to minimize erosion and sedimentation events. These strategic measures are:

- Use of vegetation cover on exposed surfaces around the project's sites.
- Use of improved drainage and storm-water structures to minimize runoff during precipitation events.
- Direct turnouts from drains into approved water systems by use of silt traps.
- Educate the project populations to continuously de-silt drains and other drainage structures from choking.

9.4.5 Impacts of Waste Generation and Disposal

Conscientious disposal of construction waste at operational phase will enhance the aesthetic amenities of the project corridor. However, the deliberate refusal to dispose of towering construction spoil will intrude on the visual quality/aesthetic amenities of the project environment. The contractor(s) will implement these strategic measures:

- Completion and development of an Anti-Litter Program Projects wide.
- Treated leachate and other liquid effluents from the projects enclave will meet sound Best Industrial Practice Guidelines requirements.
- Develop a Waste Disposal Policy for the projects sites and ongoing monitoring of compliance. The policy will detail the schedule collection, minimize waste handling, and maximize waste containment, control odors and loss of waste, include recovery facilities and proper maintenance of collection vehicles to ensure safe collection and transportation of waste.
- Chemicals and oils to be delivered in bulk where possible to reduce the number of containers requiring disposal.
- Establish appropriate temporary areas and facilities that are clearly signed and comply with relevant legislation (including environmental licenses), codes and standards, including:

- ❖ A designated disposal site for soil contaminated by spills of hazardous substances.
 - ❖ Separated bins/areas for recyclables (e.g. bottles, aluminium cans, tires, paper, etc.) and usable wastes.
 - ❖ Separated bins/areas for dangerous hazardous liquids and solid wastes.
 - ❖ Separate areas for vegetation waste as necessary; these will be composted whenever possible.
- Establish a recycle program use standard colors and signs for recycling bins and training of the system.
 - Review the impact of litter on sites and establish recycling points as “hot spots”
 - Investigate market for surplus and used solid waste. Stockpile, salvage and arrange for collection reusable and recyclable wastes, such as timber skids and scrap metal
 - Waste oil to be recycled if practicable.
 - Materials that cannot be recycled, and that do not pose a potential leachate problem are to be disposed of to a suitable landfill.
 - All human waste will be treated by an engineered central sewage and wastewater treatment plant outside of the Projects zone, where necessary, operating to sound Best Industrial Practice Standards.
 - Health and hygiene issues will be considered for disposal of food and other putrescible wastes.
 - All Projects populations, residents and GHA staff will be instructed in projects waste management as a component of the Environmental and Social Responsibility Program.

9.4.6 Impacts on Water Quality and Supplies

At the operation phase, potable water supply needs for drinking by construction crew and GHA supporting staff will be provided by the contractor(s). Intermittently, the quality of drinking water will be tested to ensure International Standards compliance such as Ghana EPA/ WHO and other regulatory compliance requirements.

9.4.7 Impacts of Concrete Batch Plant Waste

Contaminated run-off from the concrete batching plant which has not been properly decommissioned at the operation phase has the potential to adversely affect receiving waters. The contaminants in the runoff will contribute sediment to any runoff from the sites which should be collected and treated prior to discharge. The Contractor(s) will adopt these strategic measures:

- Remove all damaged top soil from the concrete batch plant sites and dispose of according Ghana EPA regulations and district/metropolitan Bye-Laws.
- Re-contour sites to its original states and landscape where applicable.
- Implement Concrete Waste Management and Contaminated Soil Management Plans where applicable.

9.4.8 Impacts of Construction Camps and Site Offices Creation

The Contractor(s) will adopt these strategic measures:

- Complete dismantling and removal of construction camps/offices through decommissioning activities.
- Dismantled or removed construction camps/office recyclable materials will be recycled for reuse to deviate or direct waste materials disposal at landfill sites.
- No waste, toxic materials or deteriorating structures remaining at camp sites after construction.

9.4.9 Impacts on Loss of Fauna and Flora

The contractor(s) will adopt these strategic measures:

- Re-vegetated areas monitored and maintained until there is evidence of stable cover by self-sustaining vegetation community.
- Weed Management Plan implementation and no new weeds or increase in weed cover during monitoring period.
- Ensure stable landform without significant soil erosion.
- Develop and implement Re-vegetation Plans.

9.4.10 Impacts of Traffic and Transportation

The contractor(s) will adopt these strategic measures:

- Construct and monitor projects roads to a safe and stable flow standard.
- Minimize the erosion caused by the operation of the project's roads.
- Minimize the impact on flora and fauna during maintenance of projects roads and water course crossings.

9.4.11 Impacts on Human Health and Safety

The contractor(s) will adopt these strategic measures:

- Use of adequate projects roads improvement measures to reduce accident rates.
- Minimize risks/ hazards to project roads users.
- Strengthen roads safety campaigns programs to be run in collaboration with National Road Safety Commission (NRSC).

9.4.12 Impacts on Visual Quality and Amenities

The Contractor(s) will adopt these strategic measures:

- Ensure compatibility and cohesion in terms of engineering designs, scale, massing and sitting of the new road's alignments and site camps/office buildings.
- Ensure that all the proposed projects roads trees plantings will comply with the GHA Projects Aesthetic and Landscape Guidelines.

- Follow a Lighting Plan developed by GHA (in consultation with stakeholders) for the Projects site camps/offices prior to the installation or replacement of any light standards on and around the Projects.
- Ensure that all modifications to projects roads within and surrounding the Projects neighborhood that are located near residential areas will be designed to minimize the impact from lights on them.

9.4.13 Impacts on History, Archaeology and Heritage Resources

The contractor(s) will adopt these guidelines as strategic measures:

- Any Projects road heritage and historic resource find in the operation phase expansion works will be documented and reported to the Ghana Museums and Monument Board, through the Department of Archaeology and Heritage Studies of the University of Ghana, Legon.
- All archaeological features will be given, where necessary, a predictable low probability of impact and occurrence at the operation stage.

9.4.14 Impacts of Pedestrian-Vehicular Conflicts

The following induced socio-economic activities will give rise to new vehicular-pedestrian conflicts and accidents:

- Improved roads conditions will introduce roads side commercial, industrial and settlement developments.
- Schools, health centers, churches and mosques, entertainment centers development.
- Motorists enticed to increase vehicular speed because of improved projects roads conditions leading to accident rates shoot up.

9.4.15 Impacts on Public Utilities and Services

The following developments will emerge:

- Opening-up of new settlement communities due to completed project roads.
- New commercial businesses, residential outlets, schools, health posts, etc. development.
- Urban sprawl emergence due to in-out migration patterns.
- New developments exacting a devastating toll on the provision of utility services.
- Utility service companies will have to increase their capacity to meet induced demand for more service provision.

9.4.16 Impacts on Hydrology and Drainage Systems

The contractor(s) will adopt these strategic measures:

- Runoff from projects roads will be directed into drainage channels and discharged into approved waterbodies located further away from settlement areas.

- Runoff from project roads will be channeled away from fertile agricultural farmlands to avoid damage to food crops and economic trees.
- Erosion protection works like grassed or stabilized slopes will be maintained constantly and inspected frequently to ensure effective operation.

9.4.17 Impacts on Project Communities Access

The Contractor(s) will adopt these strategic measures:

- Deploy traffic control devices, equipment and installations to warn motorists, pedestrians, cyclists, inform road users, guide road users, modify road user's behavior, protect road users and their vehicles, bicycles, motorbikes, ensure safe passage to road users and provide a safe Projects working zones.

9.4.18 Impacts on Loss of Assets and Compensation Payment

The GHA will adopt the following strategies in dealing with the loss of assets and payment of compensation:

- Ensure the provision of detail guidelines for easy implementation of the RAP program.
- Deliver the entitlement to the PAPs and support the restoration of their livelihood in accordance with 2010 Resettlement Policy Framework of the Ministry of Transport (MoT).
- Ensure timely compensation payment to PAPs to avert any social uproar and unrest from the PAPs.
- Identify strategies for effective public information dissemination, public consultation and participation of the PAPs to ensure success of the RAP program.
- Ensure that the standard of living of PAPs is improved or at least restored.
- Maximize the involvement of the PAPs in all stages of the implementation of the RAP program.
- Assign identification numbers to each PAP to help identify themselves in relation to their claim. This number will be presented during payment of their claim.
- Compensation payments will be made to 1,475 PAPs whose affected properties range from building/structures, crops and bare farmlands. The total interim compensation payment sum is about GHc 26,292,463.89 (including GHc 4,563,154.89 for implementation and monitoring cost).

9.4.19 Impacts of Influx Population Surge

The GHA will adopt these strategic measures:

- The GHA will develop and operate Influx Management Plan (IMP) to address projects induced migration incidence.
- Discourage the in-migration of prospective job seekers into the Projects enclave by enforcing "No Employment" signs at the Projects as a policy to prevent them from camping outside the Projects boundaries.

9.4.20 Impacts of Greenhouse Gas (GHG) Emissions

The GHA will adopt the following these strategic measures:

- Meet GHG requirements by completing GHG analysis and a discussion of the energy improvement related to the Projects.
- Include an assessment of GHG emissions generated by both stationary and mobile sources using standard methods and modeling assumptions.
- Motorized transport is by far the most dominant and is a major source of pollution and emitter of GHG, especially in the rural, peri-urban and urban areas. Emission of GHG by vehicles is due to traffic congestion, poor servicing and large number of old second-hand vehicles, poor infrastructure and poor roads conditions. The preferred or selected alternative option for the proposed roads project will result in the least quantities of GHG emissions since it will drastically reduce traffic congestion and reduce residence time of vehicles along the project roads corridor, especially on the Asutuare-Aveyime Road from 2 to 3 hours to about 10 minutes.

9.4.21 Climate Change

The proposed roads design incorporates various considerations aimed at adapting to climate change especially to extreme events such as droughts and floods in the project influence areas. The following measures will be implemented:

- Selection of appropriate and adequate type of pavement.
- Proper design of drainage facilities or structures.
- Proper levels of roads embankments.
- Provision of dugouts and boreholes where appropriate.

Although there is no baseline data on CO₂ emissions in the project areas, it is expected that in the long run, CO₂ emissions into the atmosphere increases due to an increase in traffic on the project roads. However, the net contribution of this segment, remains negligible. Moreover, the fluidity of traffic at the project roads implementation stage compared to the current situation on the Asutuare-Aveyime Road, planting trees of over 10,000 roadside trees and groves will help mitigate the impacts of such emissions. Finally, the installation of solar public lighting systems at the four (4) Grade-Separated Interchanges and other selected locations will prevent additional emissions during project roads implementation program. These strategic measures will be tailored to mitigate climate change:

- The Proposal has made provisions for financing an elaborate program of planting of about 20,000 trees made of various indigenous species in villages along the perimeter of the roads reserve to act as a carbon sink. Moreover, as part of planned reforestation activities the trees planting program will contribute to increasing carbon sequestration capacity, albeit locally. This program will be implemented in collaboration with the Forestry Commission, which has a substantial presence at district and municipal levels and has an Agro-Forestry and Woodlot establishment Program. Through its offices, local NGO partners and Village/Town Development Committees will carry out community sensitization to protect the proposed catchment and facilitate the proposed tree planting of approximately 20 hectares.

- Proper reinstatement of borrow pits.
- Enforcing good maintenance of site equipment, machines and vehicles to curb CO₂ emissions.
- Minimizing of bush clearing during the construction works.
- Sensitization of project communities, including the youth, on climate change related topics such as bush fires, conservation agriculture, popularization of resilient rice seeds and improved irrigation techniques. Carbon emissions from irrigation activities within the paddy rice field will be minimized by adopting eco-friendly farming techniques.

9.5 Complementary Initiatives

Several complementary initiatives will be implemented as part of the project. These include:

Road Safety Campaign and Children's Traffic Education: One of the major issues raised by stakeholders is that of potential increased road accidents during project implementation. In addition to providing funds for conducting road safety campaigns, the project will therefore, finance (i) construction of foot bridges at designated crossings (ii) conduct, in collaboration with National Road Safety Commission (NRSC), road safety campaigns for communities and schools in the project areas both during construction and implementation; and (iii) finance production of propaganda materials for inclusion as extra-curricular activities in schools and introduction of Safety Wardens to assist children cross project roads.

Disruption to Utilities (Water Provision, Power Lines and Communication): During public consultations and engagements, concerns were raised about the possible disruption of services and utilities and the duration it takes for utilities to be reinstalled during construction. GHA, ECG and GWCL will set out service standards guiding the maximum period which each of the utilities can be disrupted before being reinstalled. Critical paths of importance are water supply systems and power lines.

HIV/AIDS and Communicable Diseases: The project will incorporate HIV/AIDS and Communicable Diseases Awareness and Education Campaigns as an effective way of dealing with a variety of HIV/AIDS or Health issues without stigmatization. Wellness Centers will be attached to Hospitals, Clinics and CHPS Compounds within the project enclave to become a one-stop-shop for HIV testing and counselling, blood group matching, malaria testing, diabetic checks, STI testing and others.

Gender Mainstreaming Plan of Action: in line with the AfDB's policy on Gender, the project plans to mainstream gender and ensure equal opportunities between men and women in project planning, implementation and benefits. Women together with men have fully participated in the consulting and engagement processes and views of both genders have been incorporated in the project design. As part of women's economic empowerment, the project will apply the national practice of allocating a quota of at least 30% of jobs to women at the construction sites.

Moreover, the project will develop a Project Specific Gender Plan of Action. This will include, but not limited to: (i) provision of ablution corners (ii) adequate and secure accommodation

for women (iii) resting space dedicated for women (iv) code of conduct to prevent abusive language and unwanted approaches at work place (v) consideration of particular needs of both men and women especially during resettlement and compensation and (vi) in the design and determination of activities aimed at the control of the spread of HIV/AIDS and STI. The project will also construct market stalls at designated locations for the women trading in rice, maize, fresh foods (fruits and vegetables).

Youth Involvement Program: The project will ensure that youth are involved in various aspects of the project. The youth will be given apprenticeship training program at local garages along the project corridor that will be affected. Youth will be sensitized to register their skills into database. GHA/District and Municipal Assemblies/Association of Auto-Mechanical Garages will establish a mechanism to identify the youth who qualify for training to attend artisan courses at the Ho Technical University or Accra Training Institute. The trained youth will then be given opportunities during construction to gain experience. The District and Municipal Assemblies/National AIDS Commission has a database on orphaned and vulnerable youth in the project areas that are qualified to work on the construction sites or be employed in the Wellness Centers. GHA/District and Municipal Assemblies will ensure that the said youth and orphans are employed on the project.

Landscaping and Trees Planting Program: The project will support the efforts of Forestry Commission, Identified NGO's and the District and Municipal Assemblies to beautify the roads project corridor through planting of trees and shrubs. The following activities will be supported by the project: (i) replacing trees that may be cut down during construction (ii) protection of the roads reservation (iii) planting trees that will contribute towards sequestration carbon emissions. The GHA will engage a Landscape Architect to develop a suitable design and specifications for the roads project setting.

Resettlement/Compensation (RAP): The details and estimates for Resettlement and Compensation are included in Appendices of this report. During consultations and engagement with the PAPs, the impacts of the project and proposed mitigation measures were explained to them and they individually gave assurances that they will cooperate to ensure smooth implementation of the project. Further consultations and engagements will be held prior to the payment of compensations to the individual PAPs. They will be notified about compensations due them and where to collect the compensation. They will also be notified of the start date of civil works.

9.6 New Suspension Bridge Project Over Volta River Mitigation Measures

The proposed mitigation measures to be implemented at the new Volta River Suspension Bridge construction sites will be basically, the same for the essential valued ecosystem components described for the roads project. These components are: water pollution; noise and vibration; waste generation and disposal and traffic management and safety. However, specific attention will be drawn to the issues of mitigation for water quality and aquatic resources preservation and soil erosion/siltation control.

Reducing impacts to new suspension bridge sites river water quality is to avoid and minimize them to the greatest extent possible. Unavoidable environmental impacts, however, will be

mitigated, in accordance with Ghana EPA and Water Resources Commission regulations. The suspension bridge sites mitigation plan will focus on on-site river restoration and preservation at sites adjacent to the impact areas, including these key issues:

Impacts on Threshold Condition Attainment

These parameters will help to establish the threshold condition attainment within the selected bridge sites. They will cover the following areas: sediment and erosion controls; control of construction activities that may impact water quality; construction methods that are appropriate and environmentally/socially sound and practicable; migratory waterfowl habitat identification and preservation; tilapia fish habitats identification and conservation; habitat for birds of prey identification and preservation; wetland and riparian habitats protection; migratory corridors identification and protection; wintering areas and other critical feeding sites identification and preservation; public water supplies protection, including important aquifers; hazardous waste sites establishment and protection; regulatory flood ways and other floodplain areas conservation; commercial fish and shrimps production areas protection; important sport fishing areas identification and protection; highly erodible soils protection; listed and proposed wild and scenic river tributary conservation; navigable waterway or canoe traffic corridor safety and security; significant historic, cultural and heritage resources preservation.

Impacts from Riverbed Disturbing Activities

One of such activities is dredging in channels and the placement of rip rap within 61 meters of the embankment, but only to restore the waterway in the immediate vicinity of the embankment to the approximate dimensions that exist. Dredging poses direct threat to the areas in which it occurs. It introduces sediment into the adjacent water column, which is then re-deposited on the bottom. This has a variety of usually short-term effects on pelagic fish and the benthic community. The suspended sediment increases turbidity, decreasing light penetration and photosynthetic activity. Changes in water circulation patterns from dredging activities can also alter sediment accumulation, thus affecting all ecosystems in the immediate areas. Dredged material disposal poses serious environmental problems. An estimated 10% of dredge silt is contaminated with oil, heavy metals, nutrients and organochlorine compounds.

Impacts on River Bank Stabilization

The river bank stabilization activities necessary for erosion prevention will be undertaken provided the activities meet all of the following criteria: no material is placed in excess of the minimum needed for erosion protection; the bank stabilization activity is less than 152 meters in length; the activity will not exceed an average of 0.76 m³ per running meter placed along the bank below the plane of the ordinary high water mark or the high tide line; no material is placed in any special aquatic site, including wetlands; no material is of the type, or is placed in any location, or in any manner, so as to impair surface water flow into or out of any wetland area; no material is placed in a manner that will be eroded by normal or expected high flows.

Impacts on Water Quality

These activities will undermine the water quality of the Volta River at the bridge sites: any discharge of a hazardous substance to the river, which is in excess of the reportable quantity (RQ) established for that substances be reported to the Ghana EPA; sediment and erosion can occur as a result of bridge construction such as removing vegetative cover or construction associated with earthworks; quality of water in the river, including increased turbidity can be a result of construction activities such as placing fill at settled bridge approaches; Sediment and Erosion Control Plan (SECP) is required if it is anticipated that soil will be disturbed during construction activities; Ghana EPA must certify that the SECP minimizes the impact to water quality and aquatic environments; construction activities will be designed to minimize effluents from the construction procedures; by utilizing water-tight cofferdams, water pollution can be minimized; cofferdams themselves will be designed materials that will be environmentally sound, non-toxic and clean, especially if applied under wet conditions.

Impacts on River Classifications

There are environmental classifications that may impact suspension bridge construction activities. Some may include the following: construction activities disturbing fish habitats will be coordinated with Ministry of Fisheries or Fisheries Commission; construction activities will be required during certain times of the year to avoid spawning activity in the river.

Impacts from Hazardous Wastes

Other issues impacting construction activities are the following: disposal of incidental waste associated with bridge construction; oil, gasoline, diesel, hydraulic fluid and various cleaners will be disposed of properly, in accordance with Ghana EPA Environmental Safeguards and District Assemblies Bye-Laws; bridge construction will involve excavation and have the potential to come into contact with spills, dumps, containing hazardous materials; hazardous waste spills will occur through the actual maintenance activity, through faulty equipment or accidental spills; an attempt will be made to confine construction activities to areas where spills can be easily intercepted prior to penetrating the soil or entering the river.

These strategic measures will be adopted as well by the contractor(s):

- Impacts to Volta River basin and adjoining wetlands will be minimized during design and construction.
- Alterations or disturbances to river banks and bank vegetation community will be limited to that necessary to construct the project.
- Use of shredded mulch to absorb accidental spillages.
- Proper disposal of earth-piles and spoil heaps to avoid being wash into the river.
- Continuous maintenance of internal traffic flow within the suspension bridge sites.
- Use of reflectorized traffic signs and control signals for direction and control of traffic.
- Provision of temporary safe crossing for pedestrians.
- Implementation of an erosion and sediment control plan.
- Construction of storm water detention/treatment facilities to minimize impact of highway contaminants on Volta River water quality.

- Properly sized and engineered suspension bridge for carriageway-river crossing to minimize impacts attributable to flood height and flood duration.
- Suspension bridge river-crossing which is properly sized and engineered to provide unobstructed, continuous flow for fish and macroinvertebrates.

The potential environmental and social impacts matrix for project roads with mitigation measures for expected impacts, magnitude of extent, likelihood, phase and duration, and overall significance are shown in Table 53.0.

Table 53.0 Potential Environmental and Social Impacts and Mitigation Measures Matrix for Project Roads

Project Activities	Mitigation Measures for Expected Impacts	Magnitude of Extent	Likelihood	Phase and Duration	Overall Significance	Estimated Total Cost (USD)
Survey Works	Limited, localized opening of de-bush line. Limited vegetation cover removal.	Definite	Short Term	Pre-Construction Period. Local level.	Minor	See ESMP Cost Budget
Work Camp & Site Offices	Provision of mobile toilet and sanitary facilities. Daily collection of solid waste. Selection of flat location. Removal of vegetation cover.	Definite.	Medium Term	Pre-Construction Period. Local level.	Moderate	See ESMP Cost Budget
Removal of Trees (Flora Content)	Cutting and removal of limited number of trees. Removal and stockpiling of vegetation cover topsoil. New trees saplings to be promptly planted.	Definite	Long Term	Pre-Construction Period. Local level.	Moderate	See ESMP Cost Budget
Demolition of Structures	Reuse salvageable materials. Conduct asbestos and lead-based paint survey. Use health and safety controls.	Definite.	Long Term	Pre-Construction Period. Local level	Moderate-Minor	See ESMP Cost Budget
Air Quality	Fugitive emissions localized. Limited dust generation. Limited site clearance.	Definite	Short Term	Pre-Construction Period. Local level.	Minor	See ESMP Budget
Human Health and Safety	Use of PPE by workforce. Setup health education programs. Prevent accidents.	Definite	Short Term	Pre-Construction Period. Local level.	Minor	See ESMP Cost Budget
Air Quality	Construction vehicles maintenance.	Definite	Short Term	Construction Period. Local level	Minor	See ESMP Cost

	Watering of exposed surfaces. Cover vehicles carrying spoil. Install and maintain equipment mufflers.					Budget
Soundscape & Vibration	Install sound control devices. Switch-off idling machines. Provide ear plugs to workers. Provide padded seats for equipment operators.	Definite	Short Term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Borrow Pits Generation	Access vector ecology in work areas. Employ adequate drainage. Fill methodology to avoid creating mosquito habitats.	Definite	Short term	Construction Period. Local level	Moderate-Major	See ESMP Cost Budget
Soil Erosion and Sedimentation	No major earthworks during the rainy season. Limited vegetation cover removal. Use adequate drainage structures.	Definite	Short Term	Construction Period. Local level.	Moderate-Major	See ESMP Cost Budget
Waste Generation and Removal	Minimize waste generation. Segregate waste for reuse. Provide waste bins. Develop disposal policy.	Definite.	Short Term	Construction Period. Local level.	Moderate-Major	See ESMP Cost Budget
Water Quantity and Supplies	Provision of water supplies by contractor. Avoid using project communities water sources.	Probable	Short Term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Concrete Batch Plant Waste	Reuse concrete products. Prevent dumping of concrete waste. Segregate areas into "clean" and "dirty" sections.	Definite	Short Term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Construction Camps and Site Offices	Carefully site, construct and manage construction camps. Control erosion and dust. Plan and carry out post-construction site clean-up.	Definite	Short Term	Construction Period. Local level.	Moderate	See ESMP Cost Budget
Loss of Flora and Fauna	Control all clearing activities. Minimize number of trees to be felled. Reduce potential impact of flora and fauna.	Definite	Long Term	Construction Period. Local level.	Moderate	See ESMP Cost Budget
Traffic and Transportation	Set and enforce speed limits.	Definite	Short Term	Construction Period. Local level.	Moderate	See ESMP

	Regulate transport of toxic materials. Reduce accident risks by safe driving speeds.					Cost Budget
Human Health and Safety	Use of PPE by workforce. Collect and recycle lubricants. Take precaution to avoid accidental spills. Setup health education, HIV/AIDS/STDs/Malaria/Ebola.	Definite	Short Term	Construction Period. Local level.	Major	See ESMP Cost Budget
Visual Quality and Amenities	Fence in project sites and open spaces to prevent visual intrusion. Water all exposed areas. Ensure that new developments are culturally sound, environmentally and socially appropriate and aesthetically acceptable.	Definite	Short Term	Construction Period. Local level	Moderate.	See ESMP Cost Budget
History, Archaeology, Heritage Resources	Assess heritage value of planned sites. Alert Department of Archaeology Heritage Studies (University of Ghana, Legon) on discovery of any object of possible archaeological significance.	Possible	Long Term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Pedestrian-Vehicular Conflicts	Provision of pedestrian access and walkways. Potential conflict spots will be marked with appropriate road signs. Provision of road signs warning motorists.	Probable	Short Term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Public Utilities and Services	Locate all public utility lines in the RoW. Relocate all public utility lines outside roads project RoW. Engage and consult all public utility line agencies for relocation plans implementation approval.	Possible	Short Term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Hydrology and Drainage Systems	Diligent execution of earthworks. Create settlement basins or vegetated runoff catchments. Provide oil traps to control leaks and spillage.	Possible	Long Term	Construction Period. Local level.	Moderate	See ESMP Cost Budget

Project Communities Access	Meet social concerns of project communities. Provide access for pedestrians, cyclists, motorist and project residents. Provide warning signs for motorists.	Probable	Short term	Construction Period. Local level.	Minor	See ESMP Cost Budget
Loss of Assets and Compensation Payment	Identify all affected properties in the RoW. Hold consultation and engagement meetings with PAPs. Mark out roads reservation corridor. Payment of compensation monies to PAPs.	Definite	Long Term	Construction Period. Local level.	Major	See ESMP Cost Budget
Influx Population Surge	Educate workforce on social harmony. Establish positive relation between workers and project residents.	Definite	Short Term	Construction Period. Local level.	Minor-Moderate	See ESMP Cost Budget
Greenhouse Gas (GHG) Emissions	Service construction machinery and equipment regularly. Capture GHG emissions for mobile construction vehicles and stationary equipment.	Probable	Long Term	Construction Period. Local level.	Unknown	See ESMP Cost Budget
Air and Soundscape Quality	Monitor periodically ambient air and noise quality at designated areas. Provide barriers in front of sensitive receptors. Enforce Ghana EPA guidelines for air and noise emissions.	Definite	Long Term	Operation Period. Local level.	Minor	See ESMP Cost Budget
Borrow Pits generation	Fill up all stagnant pools and ponds. Backfill all excavations. Re-contour areas with stocked up topsoil.	Possible	Medium Term	Operation Period. Local level.	Major	See ESMP Cost Budget
Soil Erosion and Sedimentation	Revegetate exposed surfaces. De-silt drains of choked materials. Use silt traps to restrain turn-outs.	Possible	Medium Term	Operation Period. Local level.	Moderate	See ESMP Cost Budget
Waste Generation and Disposal	Prevent littering of project sites. Prevent unapproved landfill creation. Reduce, reuse and recycle waste materials.	Probable	Medium Term	Operation Period. Local level.	Moderate	See ESMP Cost Budget

Water Quality and Supplies	Test quality of drinking water. Ensure Ghana EPA/WHO regulatory standards.	Probable	Short Term	Operation Period. Local level.	Minor	See ESMP Cost Budget
Concrete Batch Plant Waste	Remove all damaged top soil. Dispose of concrete waste according to approved standards. Re-contour sites to original states.	Possible	Short Term	Operation Period. Local level.	Minor	See ESMP Cost Budget
Construction Camps and Site Offices Creation	Complete dismantling and removal camps and offices. Recycle all recyclable materials to deviate waste materials to landfill sites.	Probable	Long Term	Operation Period. Local level.	Moderate	See ESMP Cost Budget
Loss of Flora and Fauna	Re-vegetate areas monitored to sustain vegetation community growth.	Possible	Long Term	Operation Period. Local level.	Major	See ESMP Cost Budget
Traffic and Transportation	Minimize impact on flora and fauna during maintenance stage. Monitor traffic flow safety and hazards.	Probable	Long Term	Operation Period. Local level	Moderate	See ESMP Cost Budget
Human Health and Safety	Reduce accident rates through improved measures. Minimize risks to project road users.	Definite	Long term	Operation Period. Local level.	Major	See ESMP Cost Budget
Visual Quality and Amenities	Trees planting program should be carried out. Remove visually offensive structures and heaps of waste materials.	Probable	Medium Term	Operation Period. Long level	Minor	See ESMP Cost Budget
History, Archaeology, Heritage Resources	Any 'chance find' from roads expansion program will be documented. Report 'chance find' to Ghana Museums and Monument Board.	Probable	Long Term	Operation Period. Local level.	Minor	See ESMP Cost Budget
Pedestrian-Vehicle Conflicts	Remove improved roads condition leading to roads side commercial, industrial and settlement developments creating conflicts. Prevent development of social amenities (schools, health centers, churches, mosques, etc.) close to project roads leading to conflicts.	Definite	Long Term	Operation Period. Local level.	Major	See ESMP Cost Budget

Public Utilities and Services	Control new developments exacting devastating toll on provision of public utility services. Control urban sprawl emergence due to in-out migration.	Definite	Long Term	Operation Period. Local level.	Minor	See ESMP Cost Budget
Hydrology and Drainage System	Maintenance of grassed or stabilized slopes. Direction of runoffs from roads project away from fertile agricultural lands.	Possible	Long Term	Operation Period. Local level.	Moderate	See ESMP Cost Budget
Project Communities Access	Warn motorists, pedestrians, road user's behavior with traffic control devices. Ensure safe passage to project residents by provision of walkways or sidewalks facilities.	Definite	Long term	Operation Period. Local level.	Moderate	See ESMP Cost Budget
Loss of Assets and Compensation Payment	Ensure success of RAP program. Maximize involvement of PAPs during implementation of RAP program. Provide adequate and acceptable compensation payment monies to all PAPs.	Definite.	Long Term	Operation Period. Local level.	Major	See ESMP Cost Budget
Influx Population Surge	Control induced migration incidence. Discourage in-migration of job seekers into project corridor by use of "No Employment" signs – prevent them from camping outside project boundaries.	Definite	Long term	Operation Period. Local level.	Major	See ESMP Cost Budget
Greenhouse Gas (GHG) Emissions	Monitor GHG emissions sources within project corridor.	Probable	Long Term	Operation Period. Local & Regional levels.	Unknown	See ESMP Cost Budget
Climate Change and Complimentary Initiatives	Selection of appropriate and adequate type of pavement design. Proper design of drainage structures. Proper levels of roads embankment. Provision of dugout and boreholes where appropriate.	Possible	Long Term	Operation Period. Local level.	Major	See ESMP Cost Budget

	Roads safety campaign and children's traffic education. Disruption to utilities. HIV/AIDS and Communicable Diseases Awareness and Education. Gender Mainstreaming Plan of Action. Youth Involvement Program. Landscaping and Trees Planting Program. Resettlement/Compensation (RAP) Payments.					
Gender Issues	Ensure equal opportunities for men and women in line with AfDB Policy on Gender. Provision of ablution corners. Resting place dedicated to women. Consideration of needs of men and women during RAP implementation. Construction of market stalls for women.	Definite	Long Term	Operation Phase. Local level.	Major	See ESMP Cost Budget

Sources: KE&T Data Records

Chapter 10 Expected Residual Effects and Environmental Hazard Management

10.1 Introduction

Residual effects are those environmental and social effects predicted to remain after the application of mitigation measures outlined in this ESIA Report **(See Chapter 9)**. The project activities have the potential of generating environmental and social risk association for the Proposal at the construction, post-construction (operation) and decommissioning Phases. This section covers all environmental and social risks except those relating to climate change. A section dedicated to climate risk is provided at **Chapter 9 (Section 9.4.21)**.

10.2 Construction Phase Risk

10.2.1 Location of Fueling Operations

The location of fueling tanks and their operations will result in the potential contamination of soil, water bodies and ground water resources with resultant water borne diseases, fire hazard presence and fugitive hydrocarbon fumes emissions. Generally, during the construction phase, environmental risk for road sections is mainly related to accidental spillage of hydrocarbons, oil products, explosives and other substances that form part of the construction of the roads project. These risks are important as the affected areas are drained by major rivers. The fire also remains a major risk likely to cause enormous damage. Also, bush fires are a risk which may degrade the plant colony or cover (timber and non-timber species) and pasture in the project areas. Given the context, the risk of contamination and spread of Ebola should not be discounted or excluded.

Mitigation of Risk Measures: Location of fueling of tanks operation away from water resources with bunded facilities to contain any spillages and leakages. Fire extinguishers will be provided to control fire outbreaks. Poaching of wildlife for game and consumption will be discouraged with strict punitive controls.

10.2.2 Location of Wheel Washing Facilities

The location of wheel washing facilities will give rise to potential contamination of water resources, groundwater quality with resultant water contagious diseases prevalence.

Mitigation of Risk Measures: Location of wheel washing facilities away from water bodies with provision for oil-water separator device to separate water and oil for recycle.

10.2.3 Location of Sand and Aggregate Storage Provisions

Sand and aggregate storage provisions, with respect to their location, can introduce potential damage to top soil, spill over, air and soil pollution and problem of flooding at lower landscape sections.

Mitigation of Risk Measures: Fencing of sand and aggregate storage areas with polystyrene material to prevent erosion. Provision of construction workers with nose masks to control dust inhalation. Establishing safety and inspection procedures in materials handling and operating heavy equipment.

10.2.4 Air Quality

Ambient air quality impingement by the Proposal will result in potential deterioration of ambient air by fugitive emissions of dust, hydrocarbon fumes with resultant affection on plants, animals and humans. Construction workforce and project roads residents living closer to the project roads sections will be exposed to excessive dust particles or toxic fumes from bitumen and other chemicals used in road works.

Mitigation of Risk Measures: Continuous watering of the roads project zone three (3) to four (4) a day with water bowser to control dust pollution. Construction workers will wear nose masks to control dust inhalation. Asphalt and concrete batching plants will be located away from settlement areas to protect residents from particulate emissions and toxic fumes. Limiting time of exposure to dust particles and chemicals.

10.2.5 Water Quality

The quality of water resources within the project catchment zone will suffer deterioration from potential contamination from discharge of sediments, hydrocarbons oils, grease and fuel, into surface water basins decimating aquatic resources and adversely affecting the food chain.

Mitigation of Risk Measures: Water conservation measures will be used to control quality of water resources. Control measures will include implementation of Water Resources Quality Management Plan and monitoring of containment procedures for hydrocarbons oils. Grease and fuel.

10.2.6 Noise and Vibration Effects

Construction stage noise and vibration effects will introduce potential creation of noise nuisances and pollution through construction machinery and equipment operations. Temporary forms of noise and vibration disturbance will affect construction workers, projects neighborhood residents, birds and animals.

Mitigation of Risk Measures: Provision of ear plugs for workers to subdue noise nuisance and padded seats in equipment and machinery for operators use to control vibration effects. Limiting the time of exposure to noise levels

10.2.7 Location of Liquid and Toxic Material Storage

Location of liquid and toxic material storage could experience potential spillage of liquid and toxic materials. The resultant spillage of liquid and exotic materials will lead to fouling of the project environment (land, water and air), incidence of infectious air and water borne disease likelihood.

Mitigation of Risk Measures: Liquid and toxic material storage areas will be sited away from water bodies and provided with bunded facility to control leakages and spillages. Hooded and full-length PPE will be provided to workers working at such facilities. Periodic monitoring of these workers health will be undertaken to ensure their state of wellness and safety. Safe handling of toxic materials, explosives and other hazardous substances.

10.2.8 Waste or Spoil Storage and Disposal

Potential improper storage and disposal of construction waste or spoil will give rise to unhygienic and unsanitary conditions at the project areas. The resultant negative health impacts will give rise to contagious air and water borne disease and skin infections.

Mitigation of Risk Measures: Implementation of Waste Management Plan to ensure proper segregation of the various types of waste (including hazardous and non-hazardous), including approved disposal methods and sites and roles of the EPA/District/Municipal Assemblies in monitoring. Use of third-party waste management companies will ensure scheduled disposal periods to prevent environmental degradation.

10.2.9 Operation of Excavators, Trucks and Dumpers

Potential accident hazards will result from inexperience operators or operators under the influence of drugs and alcohol usage. The operators themselves, construction workers, projects residents and projects neighborhood inhabitants are all at risk of accident hazards. The operation of heavy machinery close to passing traffic (risks of accidents), trenches and slopes (resultant collapse), watercourses and risk of rock falls during blasting involves occupational health and safety risks to road workers.

Mitigation of Risk Measures: Proper training of plant and machinery operators in risks of accidents, toppling over of equipment/machinery and preventive techniques in occupational, health and safety practices. Establishing safety and inspection procedures in constructing trenches and slopes.

10.2.10 Gas and Electrical Welding Operations

The welders and welding units will experience potential hazards/risks from inhaling the noxious fumes and gases from burning electrodes, sparks, splinters, sharp edges of metal and hot welded strips, welding rods, exposed electric cables, leaking gases. The resultant accidents potential will be injuries to eyes, hands, arms, hair, head, legs, and other parts of the body, even electrocution.

Mitigation of Risk Measures: Training of gas and electrical welders in Guidelines for Gas and Electrical Welding Operations and provision of adequate and appropriate PPE for such task assignments. Strict monitoring of welders and welding units will be undertaken by assigned supervisors.

10.2.11 Unpredictable Escalation of Construction Cost

The risk of significant increases in construction cost will result if the project costs though based on detailed design includes insubstantial contingency provisions.

Mitigation of Risk Measures: Substantial contingency provisions will be made while basing estimated project cost on detailed design.

10.2.12 Emergency Response Plan (ERP)

The emergency response plan specifies the procedures to handle unforeseen and sudden circumstances. It aims to limit the possible consequences of an emergency and, to this end, to prevent accidents and injuries, reduce damage caused, to the site equipment and machinery, and accelerate the return to normal operations.

Mitigation of Risk Measures: The emergency plan will include measures to be taken in case of detection of the Ebola virus in one of the personnel on site. The definition of this component of the PIU will be done in conjunction with the relevant services in the project areas.

The PIU will take into account, among others the following: (i) the formal commitment by the Construction Manager to the safety of employees (ii) the constitution and the formation of a security team ready to respond at all times (iii) equipping construction products and safety devices (first-aid boxes, fire extinguishers, etc.) (iv) making available to all workers a health emergency telephone numbers (vii) the regular performance of exercises/stimulations of implementation of the response plan to ensure proper management of the emergency situations (viii) method statements covering the procedures for the main activities which could generate emergency situations through accidents or neglect of responsibilities, including accidents at work place accidental fires, accidental leaks and spillages, vehicle and plant accidents and traffic accidents and security of plant and equipment (ix) the contractor will submit a Traffic Management Plan for approval before implementation (x) monitoring environmental and social actions and responsibilities and making provision for remedial actions (xi) planning for remedial measures in case initial planned actions are not successful.

10.3 Operation Phase Risk

10.3.1 Air Pollution

Potential health effects from hydrocarbon emission from vehicular traffic are feasible with the following afflictions: respiratory and cardiovascular, eye, nose and throat infections; headaches; asthma; bronchitis; nervous disorders.

Mitigation of Risk Measures: Severity of potential effects will be minimal except projects residents using facilities very close to the project roads network of the proposed projects.

10.3.2 Noise Pollution

The potential health effects from noise nuisance and disturbances will lead to temporary forms of hearing impairment.

Mitigation of Risk Measures: The resultant effects will be minimal except projects residents using facilities very close to the project roads networks of the proposed projects.

10.3.3 Drainage Channels Siltation

The lack of maintenance of drainage channels will lead to siltation and sedimentation of temporary wetlands and waterways. The resultant effects will lead to flooding events at low-lying sections of the project zone of influence. Potential incidence of water borne infections is very likely.

Mitigation of Risk Measures: Continuous maintenance of drainage channels through desilting at scheduled periods and in emergency situations.

10.3.4 Fire Hazards

Lack of fire safety precautions at the restaurant kitchens at rest stops will lead to spontaneous fire combustion from leaking gas emissions from rubberized/plastic gas lines. The resultant hazards/ risks from fire incidences at the restaurants and food courts will be explosions and death to human beings.

Mitigation of Risk Measures: Certification and monitoring of restaurants kitchens and food courts by Ghana National Fire Service. Provision of fire hydrants at selected locations for fire-fighting and fire rescue missions.

10.4 Decommissioning Phase Risk

The decommissioning period activities will involve the following: work areas and site offices dismantling; hot-mix/bitumen plants, concrete batch plants, workshops and garages dismantling; temporary installations and erections dismantling; restoring or reclaiming of borrow sites through landscaping or re-contouring of sites to original states; natural drainage systems restoration. These activities will lead to potential accidents such as fall from heights

and electrocution by exposed live electrical wires, exposed nails injuries to under- foot, fall into partially covered excavations etc.

Mitigation of Risk Measures: (i) provision of safety harnesses for works at height (ii) disconnection of power source for electricity supply and water supply lines disconnection (ii) removal of all spikes to prevent trip and fall hazards (ii) filling of excavated areas with fill materials to prevent fall into the deep (iii) all district/municipal assemblies to prepare, update their planning schemes to enable the respond to new developmental projects (iv) in collaboration with the EPA /GHA/District and Municipal Assemblies will ensure that all future applications for developmental projects meet Environmental and Social Assessment (ESA) requirements and do not contribute to cumulative landscape impacts.

Chapter 11 Environmental and Social Monitoring Program

11.1 Overview

The purpose of environmental and social monitoring is to quantitatively measure the compliance of the contractor on the implementation of the proposed environmental and social mitigation measures as well as the effectiveness of the mitigation measures. The environmental monitoring program will operate through the pre-construction, construction and operation phases. It will consist of activities, each with a specific purpose, key indicators and significance criteria. The monitoring program will capture the following parameters:

- Proposed mitigation measures effectiveness.
- Requirements specified in the various laws and regulations.
- Commitments of GHA and contractors to effectively implement and follow up these measures; and
- Requirements of the other laws and regulations related to public health, improvement of living conditions of the PAPs, environmental and social protection, water quality management and sensitive areas protection and conservation.
- GHA and AfDB will ensure close monitoring throughout project implementation.
- Joint supervision, monitoring and mid-term review missions will be conducted by the AfDB during the implementation.
- Monitoring and evaluation manual will be prepared at start-up identifying relevant monitoring indicators as well as monitoring procedures to be implemented.
- The project will provide for two types of monitoring: internal and external. Internal monitoring will be carried out by the PIU using trend charts prepared for the purpose. Quarterly and annual progress reports will be prepared. External monitoring will focus on project outcomes and impacts for achieving project objectives.

11.2 Monitoring of Various Components

The monitoring parameters will include (i) air quality and dust emissions - with focus on PM₁₀, TSP, SO₂ and NO₂ in the construction and operation phases (ii) noise and vibration and the provision and use of PPE (iii) restoration of borrow sites and quarries (iv) vegetation and wildlife protection (v) disturbance of cultural, heritage and archaeological sites and associated conflicts (vi) occupational health and safety measures – induction, toolbox meetings and the use of PPEs (vii) effectiveness of the drainage system – culverts and drains functionality effectiveness and erosion prevention and control measures (viii) prevention of pollution of surface water (v) disruption of public utilities (domestic water supply, sewerage, power lines) (ix) disposal of wastes strategies and sanitary facilities for workers (x) reduction in travelling times through surveys (xi) employment opportunities for the local community residents (xii) visual intrusion (xiii) disruption of local economy (xiv) compensation of affected assets and properties (xv) road safety measures - adherence to road signs, markings, accidents and traffic diversions (ix) frequency of HIV/AIDS and STIs awareness and prevalence rates programs.

The environmental and social parameters will be monitored as per the details presented in **Table 54.0**

Table 54.0 Environmental and Social Monitoring Program with Cost Component

Impact Receiver	Monitoring Elements	Measuring Indicators (Indicative)	Follow-up Period (Phases)	Monitoring Frequency and Cost (USD)	Responsibility
Air	Pollution with respect to TSP, SPM, RMP, NO _x , SO ₂ , CO.	Importance of dust and exhaust fumes take-off: Dust levels from construction activities. Exhaust fumes levels from construction vehicles, equipment and machinery.	During pre-construction, construction and operation	Monthly. USD 10,902.10	Contractor, GHA, EPA, Supervision Consultant
Noise	Pollution with respect to L ₁₀ , L ₉₀ and L _{eq}	Importance of effect levels from construction activities. Nuisance to sensitive receptors (schools, health centers, project residents). Nuisance to workers.	During pre-construction, construction and operation	Monthly. USD 5,451.05	Contractor, GHA, EPA, Supervision Consultant
Soil	Erosion and sedimentation of surface water bodies. Pollution and contamination of groundwater.	Gully from borrow sites and quarries. Scour the right of works in the operation phase. Soil contamination and ground water pollution.	During pre-construction, construction and operation.	Monthly pre-construction and construction phases. Bi-annually operation phase. Monthly. USD16,353.14	Contractor, GHA, EPA,
Waters	Pollution and contamination of surface and ground water resources due changes in hydrology, drainage and use of water and	Physiochemical for surface waters. Physiochemical and bacteriology for drilling and excavation for drainage structures.	During pre-construction, construction and operation.	Quarterly. USD 21,804.19	Contractor, GHA, EPA, Water Resources Commission, Supervision Consultant.

	ground water resources. Pollution with respect to BOD, COD, conductivity, fecal matter, oil and grease, arsenic.				
Vegetation and Fauna	Revegetation for borrow sites, quarries and roads sides landscaping. Wildlife disturbance. Destruction of wildlife habitats.	Plantation success rates. Number of accidents involving animals. Number of destroyed habitats.	During construction and operation.	Quarterly in the construction phase. Annual operation phase. USD 27,255.24	Contractor, GHA, EPA, Forestry Commission, Supervision Consultant.
Waste Generation and Disposal	Poor waste disposal leading to disease spread. Wildlife deaths linked to poor waste disposal. Poor sanitation effects.	Frequency of waste disposal success rate. Waste Management Plan implementation success rate. Effectiveness of Environmental Audit.	During pre-construction and construction.	Monthly. USD 32,706.29	Contractor, GHA, EPA, District and Municipal Assemblies, Supervision Consultant.
Historical, Cultural and Archaeological Resources (Sacred Sites)	Protection, preservation and conservation.	Number of protected, preserved and conserved sites.	During pre-construction, construction and operation.	Monthly. USD 38,157.33	Contractor, GHA, EPA, District and Municipal Assemblies, Museums and Monuments Board, Supervision Consultant.
Land	Changes due to disappearance of public areas. Disappearance of vital and critical biodiversity.	Land use and re-zoning plans.	During pre-construction, construction and operation.	Monthly during pre-construction and construction phases. Bi-annually operation. USD 43,608.38	Contractor, GHA, EPA, Lands Commission, District and Municipal Assemblies, Town & Country Planning, Supervision Consultant.

Public, Occupational Health and Safety	Disease spread from HIV/AIDS/STDs.	Prevalence rate. Effectiveness of awareness creation Programs. medical records and statistics.	During construction and operation.	Monthly during construction phase. Annual operation. USD 49,059.43	Contractor, GHA, EPA, MoH, GHS, District & Municipal Assemblies, Supervision Consultant.
Road Safety	Traffic accidents records. Police records and reports.	Number of accidents in pre-construction and construction phases. Total number of accidents in operation phase.	During pre-construction, construction and operation.	Monthly. USD 54,510.45	Contractor, GHA, EPA, National Roads Safety Commission, District & Municipal Assemblies, Supervision Consultant.
Indemnification and compensation for loss of assets.	Destruction of crops, farms, buildings & structures, bare lands.	Status of compensation for assets affected by project works.	During pre-construction, construction and operation.	Monthly during construction phase. Annual during operation. GHc 4,563,154.89	Contractor, GHA, EPA, Land Commission (Land Valuation Division), District & Municipal Assemblies, Supervision Consultant.
Socio-Economic	Employment, job creation and improved income.	Number of jobs created through employment. Average income in districts and municipalities affected by the project.	During pre-construction, construction and operation.	Monthly employment. Annual average income. USD 49.059.43	Contractor, GHA, EPA, Labor Commission, District & Municipal Assemblies, Supervision Consultants.
Gender	Employment of women. Complaints of gender bias. Reported cases of women rape victims.	Number of jobs created for women. Average income of women workers in districts and municipalities affected by the project.	During pre-construction, construction and operation.	Monthly employment. Annual average income. USD 5,451.05	Contractor, GHA, EPA, Labor Commission, Women & Children Ministry, District & Municipal Assemblies, Supervision Consultants.

Source: KE&T Data Records

11.3 Sites Monitoring Roles and Responsibilities

The relevant stakeholders to be involved in the ESIA monitoring program during project execution will most likely be: Client (GHA); Financiers; Project Consultants; Ghana Water Company Limited (GWCL); Electricity Company of Ghana (ECG); Ghana Health Services (GHS); Ghana Environmental Protection Agency (EPA); Forestry Commission (FC); District/Metropolitan Assembly; Ministry of Transport; Ministry of Energy; Projects Organizations and Non-Governmental Organizations (NGO's).

Depending on the implementation status of environmentally sensitive project activities, the regulatory agencies and GHA will perform annual or bi-annual environmental and social reviews in which environmental and social concerns raised by the project will be reviewed alongside project implementation. The implementation of environmental and social measures or components will be concurrent with that of the work and incorporated upon delivery of work.

The organizational and staffing structure identifying the personnel (by job title and name) and relevant institutions to be assigned for ESIA monitoring issues to be addressed with responsibility assignment to the Project is shown in **Table 55.0**.

Table 55.0 Organization and Staffing Structure with Site Management Roles and Responsibilities

Number	Designation	Roles and Responsibilities
1.	Project Environmental and Social Coordinator	<ul style="list-style-type: none">• Responsible for day-to-day environmental and social management of project sites• Organize activities to motivate and maintain the interest of project staff in environmental and social issues.• Create awareness of environmental and social issues through training programs and review meetings.• Coordinate investigations on all types of accidents.• Conduct environmental and social audit in line with project monitoring guidelines.• Produce environmental and social reports on the project.• Coordinate with EPA and other relevant institutions.• Develop work plan for the implementation of the ESMP• Meet twice per month with consultant and contractor to discuss work requirements, compliance issues, environmental and social matters.• Inspect various aspects of the work areas and equipment for general housekeeping, dust, fumes, noise and compliance with spill prevention plan• Monitor environmental and social parameters for comparison with available or proposed standards.• Provide reports on environmental and social compliance during implementation as part of their monthly, quarterly progress reports and annual

		environmental and social monitoring reports to GHA, AfDB and EPA.
2.	Project Manager (Contractor)	<ul style="list-style-type: none"> • Construction methods and standardized materials under contract usage. • Overall supervision of project implementation work program, contract specifications and conditionalities attainment. • Liaison with Client on project implementation challenges, and timeliness of project execution.
3.	Project Manager (Consultant)	<ul style="list-style-type: none"> • Ensures that Contractor(s) meets its environmental, social, health and safety obligations to the project implementation work program.
4.	Client, GHA Representative	<ul style="list-style-type: none"> • Ensures that project execution meets specified environmental, social, health and safety guidelines contained in the contract documents and ESMP. • Responsible for negotiation procedures and compensation calculations. • Responsible for reporting on resettlement issues and restoration of livelihoods by the RMC. • Responsible for grievance redress procedure and its functioning and effectiveness of other litigation avoidance measures. • Oversee road safety, erosion, drainage and HIV/AIDS awareness program. • GHA will engage the services of a consultant to assist in GHA's monitoring role to ensure that livelihoods are maintained or restored. • Monitor displaced persons, locate all PAPs, organize follow-up visits and meetings. • Monitor PAPs at half yearly intervals till project closure.
5.	Ghana Health Service	<ul style="list-style-type: none"> • Change of frequency of diseases.

		<ul style="list-style-type: none"> • Occurrences of new diseases in the project catchment areas. • Seminar/lectures on HIV/AIDS, STDS and health care and diseases prevention.
6.	ECG	<ul style="list-style-type: none"> • Public Education and Awareness on power consumption and conservation. • Monitoring of transmission lines and structures (poles) failure • Ensure safety system deployment during project implementation. • Ensure use of standard wiring cables, materials/ components by Contractors.
7.	EPA	<ul style="list-style-type: none"> • Overall supervision of environmental and social performance of ESMP and Project. • Implementation and monitoring of air quality, noise, waste
8.	Forestry Commission / Ghana Wildlife Society	<ul style="list-style-type: none"> • Supervision of cutting of trees within and outside the right-of-way for the project • Maintenance of fauna habitat to prevent degradation and decimation of fauna biodiversity.
9.	Projects Organizations Project Community Opinion Leaders/NGOs	<ul style="list-style-type: none"> • Expression of concerns/issues on environmental protection and sustainability measures enshrined in the PEMP and by the Contractor(s) own PEMP documentation.
10.	GHA Environmental and Social Assessment Unit	<ul style="list-style-type: none"> • Lead the internal monitoring day-to-day and periodically of ESMP implementation
11.	Policy Planning and Monitoring and Evaluation Units of GHA	<ul style="list-style-type: none"> • Coordination of internal and external monitoring of ESMP implementation. • Periodic monitoring of the ESMP implementation and its impact
12.	External Consultants or NGOs	<ul style="list-style-type: none"> • Periodic monitoring, evaluation and auditing of ESMP implementation.
13.	Resettlement Monitoring Committee (RMC)	<ul style="list-style-type: none"> • Consist of GHA, LVB, EPA and PAPs representatives. • Meet monthly to monitor the effects of resettlement of PAPs. • Responsible for monitoring of resettlement program, including number of PAPs successfully compensated.

Source: KE&T Data Records

The overall monitoring cost for the three (3) monitoring phases is summarized as follows: (i) mitigation measures follow-up (ii) sensitization campaigns and awareness programs (iii) capacity building of the GHA project staff, etc. The estimated cost of monitoring the ESMP is **USD 545,104.76**.

Chapter 12.0 Public Consultation and Community Participation

12.1 Introduction

Relevant stakeholder consultations and engagements for the proposed roads project were conducted to capture the significant concerns associated with the project from all concerned and interested parties. The process ensured that these groups were given the platform to voice their opinions and views. The process also gave prior disclosure of relevant and adequate project information to stakeholders. The KE&T ESIA/RAP Study Teams held six (6) public meetings on 18/10/2014, 05/12/2014, 06/12/2014, 26/06/2015, 27/06/2015 and 13/11/2015 along the roads project enclave during the development of the ESIA and RAP Reports. Moreover, the KE&T ESIA Study Team, GHA and AfDB Project Design Teams held Stakeholders Community Needs Assessment public meetings on 18/04/2018 at Asutuare Junction, Asutuare, Volivo, Aveyime and Dofor Adidome along the project roads corridor. Finally, KE&T ESIA/RAP Study Teams, GHA RAP and AfDB ESIA/RAP Teams held Stakeholders ESIA/RAP Awareness Education public meetings on 20/04/2018 at Asutuare Junction, Asutuare, Volivo and Aveyime. The same program was slated to have been held the following day (21/04/2018) at Dofor Adidome but due to funeral celebration, this program could not come on since the project community residents attended the funeral celebration.

The participants of the various public meetings included representatives of community-based associations such as the Ghana Private Road Transport Union (GPRTU), Drivers, Taxi Owners, Market Women, Rice Traders, Teachers, Parents, Home Owners, Property Developers, Nurses, Assembly Men and Women, Elders, Rice Farmers, Fruits and Vegetable Farmers, Project-Affected-Persons (PAPs) and Project Community Residents. The stakeholder consultative and engagement meetings provided views, opinions and suggestions on the most appropriate considerations on the construction and use of the proposed roads project. The sessions also laid out fears and concerns to be addressed during construction. To ensure that both women's and men's views were taken on board in the project design, the public consultations were carried out in an all-inclusive manner. The consultations sought community participation and instant feedback into the project design especially related to matters of road alignment, RoW and shoulders design, resettlement and compensation payment. The consultations created awareness and identified positive and negative socio-economic impacts of the roads project, proposed mitigation measures to address the potential impacts during pre-construction, construction and operation phases programs,

The following are some of the issues and concerns raised at the which were responded to and as much as possible recommendations have been made incorporated in project design: (i) road safety measures for school children (ii) public appreciation and concerns of the roads project due to their importance (iii) high expectations (direct and indirect jobs creation and employment generation from the project, development and improvement of businesses, provision and enhancement of access to social amenities, reduction of travel time) (iv) fears and concerns associated with the roads project including increased road accidents and increased HIV/AIDS/STDs (v) timely and fair compensation payments (vi) road drainage and flooding

especially on Asutuare-Aveyime Road and Dofor Adidome-Asikuma Junction low-lying wet land sections (vii) establishment of toll plaza (viii) waste generation and disposal along the project roads corridor (ix) traffic management and security provisions for road users during construction (x) establishment of a Grievance Redress Mechanism for PAPs and all road users and the need for continuous information sharing (xi) noise and excessive vibrations during construction (xii) public infrastructure and utilities disturbance or destruction repairs during construction works.

12.2 Summary of Stakeholder Community Needs Assessment

The AfDB Project Design Team mission was to visit the project roads corridor consult and interact with the affected project populations and assess the community needs. Such needs will be prioritized and factored into the project budgetary provisions for approval by the board. Moreover, the AfDB Project Design Team wanted to know and assess how the project will affect the communities, livelihoods and future planned programs. The summary of stakeholder community needs assessment is detailed in Table 56.0.

Table 56.0 Summary of Stakeholder Community Needs Assessment

Serial Number	Project Location	Community Needs	Commentary
1	Asutuare Junction	CHPS compound facility, community center, JHS/SHS School, Borehole, pipe borne water supply, public toilet, market, timely PAPs compensation payment, employment priority for youth.	Public meeting held on 18/04/2018. Attendance by KE&T ESIA/RAP/Project Design Team, GHA and AfDB Project Design Teams and Community Residents.
2	Asautuare	New Market, pipe borne water, public toilet, employment priority for youth, upgrade lorry park, timely PAPs compensation payment.	Public meeting held on 18/04/2018. Attendance by KE&T ESIA/RAP/Project Design Team, GHA and AfDB Project Design Teams and Community Residents.
3	Volivo	Completion of CHPS compound facility, pipe borne water, public toilet. Jobs and employment for youth, market, business assistance loans for traders, community center.	Public meeting held on 18/04/2018. Attendance by KE&T ESIA/RAP/Project Design Team, GHA and AfDB Project Design Teams and Community Residents.
4	Aveyime	Clinic, pipe borne water, ICT center (present in dilapidated building), community center, jobs and employment for youth, gari processing factory.	Public meeting held on 18/04/2018. Attendance by KE&T ESIA/RAP/Project Design Team, GHA and AfDB Project Design Teams and Community Residents.

5	Dofor Adidome	Pipe borne water, dams for animals and people, hospital, market, technical-vocational school, ICT laboratory, public toilet, teacher's bungalow and nurse's accommodation, employment for youth, nursery school, PAPs compensation prompt payment, police quarters for project personnel protection.	Public meeting held on 18/04/2018. Attendance by KE&T ESIA/RAP/Project Design Team, GHA and AfDB Project Design Teams and Community Residents.
6	Asikuma Junction	Pipe borne water, market, public toilet JHS/SHS, technical and vocational school, clinic, PAPs compensation payment, jobs and employment for youth.	Public meeting held on 18/04/2018. Attendance by KE&T ESIA/RAP/Project Design Team, GHA and AfDB Project Design Teams and Community Residents.

Source: KE&T Data Records

12.3 Stakeholder Community ESIA/RAP Reports Awareness Education

The AfDB ESIA/RAP Team mission was to visit the project roads corridor consult and interact with the affected project populations and educate the community on the provisions of the ESIA and RAP Reports. Such provisions dealt with project pollution concerns and controls which have been factored into the project budgetary provisions for approval by the board. The AfDB ESIA/RAP Team wanted to know and assess how the PAPs are dealing with the project displacement of assets and properties impinged upon by the roads project alignments. Moreover, the team wanted to assess the effects of the project roads on the communities, livelihoods and future planned programs. The summary of stakeholder community ESIA/RAP Reports Awareness Education is shown in Table 57.0.

Table 57.0 Summary of Stakeholder Community ESIA/RAP Reports Awareness Education

Serial Number	Project Location	ESIA/RAP Reports Awareness Education	Commentary
1	Asutuare Junction	<p>Appreciation: improved roads condition; improved transportation; increased social and economic interaction; increased commercial activities.</p> <p>Concerns: air pollution; noise pollution; pollution of water resources; destruction of natural vegetation; disturbance</p>	Public meeting held on 20/04/2018. Attendance by KE&T ESIA/RAP Team, GHA and AfDB ESIA/RAP Teams and Community Residents.

		of natural habitat of wildlife; Location of borrow pits; pedestrian consideration; project compatibility with general planning schemes and adjoining land uses.	
2	Asautuare	<p>Appreciation: improved roads condition; improved accessibility to natural resources; enhanced socio-economic development.</p> <p>Concerns: adequate consultation with relevant stakeholders; proper location of borrow areas and their reinstatement; water pollution; construction traffic and safety; noise and air pollution; inadequate; compensation for PAPs.</p>	Public meeting held on 20/04/2018. Attendance by KE&T ESIA/RAP Team, GHA and AfDB ESIA/RAP Teams and Community Residents.
3	Volivo	<p>Appreciation: development of their respective communities; creation of employment opportunities; increase commercial activities; improved roads condition.</p> <p>Concerns: development of their respective communities; creation of employment opportunities; increase commercial activities. Improved roads condition.</p>	Public meeting held on 20/04/2018. Attendance by KE&T ESIA/RAP Team, GHA and AfDB ESIA/RAP Teams and Community Residents.

4	Aveyime	<p>Appreciation: Road Sector Development Program attainment; socio-economic development opportunities; traffic congestion removal; improved traffic flow; enhanced vehicular availability.</p> <p>Concerns: construction site camps/offices location; Settlement farmlands destruction; water resources pollution; noise and dust pollution; relocation of affected utilities; envisaged changes in project roads alignments effect on land uses.</p>	Public meeting held on 20/04/2018. Attendance by KE&T ESIA/RAP Team, GHA and AfDB ESIA/RAP Teams and Community Residents.
5	Dofor Adidome	<p>Appreciation: Easy transportation; cheaply acquired goods accessibility; development of towns and villages along the roads; population increase along project roads; increase and access to social amenities provision.</p> <p>Concerns: Increase in HIV/AIDS/STDs infections; loss of family values; properties destruction; destruction of wildlife habitats; accidents from speeding vehicles.</p>	Public meeting held on 20/04/2018. Attendance by KE&T ESIA/RAP Team, GHA and AfDB ESIA/RAP Teams and Community Residents.

Source: KE&T Data Records

Chapter 13.0 Environmental and Social Management Plan (ESMP)

13.1 Introduction

The Environmental and Social Management Plan (ESMP) presents the implementation schedule of the proposed mitigation measures to both environmental and social impacts as well as planning for long-term monitoring activities. The ESMP also includes the associated environmental and social costs needed to implement the recommended mitigation measures. The engineering designs have already included some of the mitigation measures recommended in this report. Additional recommendations are provided in the ESMP to enable the proposed roads project to be environmentally and socially friendly. The implementation steps will involve the Contractor, the Resident Engineer, Project Financier, GHA, road users and the local communities within the project corridor.

13.2 Implementation of ESMP

The environmental and social mitigation and enhancement measures incorporated in the detailed engineering design will be attached to the Contract Documents. The Contractor will take stock of the contents of the ESIA Report of the Project. The Contractor will have an Environmental Expert with at least ten (10) years' experience in projects of similar nature. The expert will be familiar with the scientific measurement of environmental and social impacts and remedies and enhancement.

The Contractor(s) will be supervised by a selected consulting firm (Engineer). One of the team members of the supervision team will be an Environmental Specialist who is an expert in Environmental Management issues especially of construction projects (with at least 10 years' experience in projects of similar nature). One of his tasks will be to oversee contractor implementing the mitigation measures proposed by the ESMP during pre-construction, construction and operation phases. His other duties will be to assist the contractor(s) in the implementation of the Environmental Monitoring Plan during pre-construction, construction and operation stages.

13.3 Construction Specific ESMP

The project specific environmental and social construction guidelines (also known as contractor's specific construction environmental and social management plan (CESMP)) will be developed by the contractor's Environmental Expert. These guidelines will specify precautions and mitigation measures for pre-construction, construction and operation activities inclusion in the CESMP. The ESMP developed in the project ESIA will serve as a reference material to comprehend the scope of the CESMP.

13.4 Institutional Arrangement for Monitoring

The institutional arrangement for monitoring the performance and compliance at national and district/municipal assemblies is summarized in Table 58.0. The following institutions will play key roles in the project monitoring program:

- **National Level** – Ghana Highway Authority (GHA), Environmental Protection Agency (EPA), Electricity Company of Ghana (ECG), Ghana Water Company Limited (GWCL), Forestry Commission (FC), Land Valuation Division (LVD) of Land Commission (LC), Water Resources Commission (WRC), Ministry of Health (MoH), Ghana Health Services (GHS).
- **District/Municipal Assemblies** – Environment and Health Division, Waste and Sanitation Division, Roads Division, Town and Country Planning Division, Community-Based Organizations (CBOs).

Table 58.0 Institutional Monitoring Arrangements

Report	Main Themes Objectives	Responsibility	Frequency	Method of Communications
Stakeholder Engagement and Consultation Report	To get better understanding and validation of the potential environmental and social issues that have been identified in ESMP and /or for new sites to solicit stakeholders' views and narrowing-down potential and significant environmental and social impacts of project of significance.	GHA (PIU)	During pre-construction, construction and operation phases.	Applicable means of consultation (including focused group, seminar, local meeting with chiefs and elders) and to be approved by GHA, District and Municipal Assemblies, NGOs.
Monitoring Reports	Measuring project indicators and mitigation measures.	GHA (PIU)	Annually	Wide dissemination to relevant parties.
Baseline Survey Report	Collecting information/data on existing social and physical conditions	GHA (PIU)	Once during operation of the project.	Consultation and participatory workshop and dissemination to relevant parties.

Source: KE&T Data Records

13.5 Capacity Development

Various gaps and opportunities have been identified to develop and strengthen existing capacities to ensure effective implementation of the ESMP at both national and district/municipal assemblies' levels. Such capacity development is summarized in Table 59.0.

Table 59.0 Capacity Development Training Plan

Training Topic	District/Municipal Assemblies Approval Authorities	District/Municipal Assemblies Staff	NGOs/CBOs	Community Leaders & Contractors
Environmental and Social Assessment	Awareness-raising	Detailed Training	Sensitization to the Issues	Awareness-raising
Environmental Assessment legislation and relevant Environmental and Social Policies	Awareness-raising	Detailed Training	Sensitization to the Issues	Awareness-raising
Potential Impacts of Projects and Mitigation	Awareness-raising	Detailed Training	Detailed Training	Sensitization to the Issues
Use of the Environmental Guidelines & AfDB Safeguard Policies	Awareness-raising	Detailed Training	Detailed Training	Awareness-raising
Monitoring and Evaluation	Awareness-raising	Detailed Training	Awareness-raising	Awareness-raising
Supervision	Awareness-raising	Detailed Training	Detailed Training	Awareness-raising

Source: KE&T Data Records

13.6 Estimated Cost of ESMP

The breakdown of estimated costs for putting the ESMP into operation is provided in Table 60.0. The total estimated costs for facilitating the use of the ESMP (excluding RAP implementation costs) during project period is at **USD 6,489,342.38**. About 40.0% of this cost is related to the required mitigation measures for some activities which will be assessed and incurred as part of the contract's cost.

Table 60.0 Estimated Environmental and Social Management Plan (ESMP) Budget

Potential Impacts	Mitigation Measures	Specific Objectives	Monitoring Indicators	Implementation Period (Timing)	Responsible Party	Estimated Total Cost (USD)
Survey Works	Limited, localized opening of de-bush line. Limited vegetation cover removal.	Minimization of de-vegetation.	Surveyed line with marked boundaries.	Pre-Construction Period	Contractor	22,712.70
Work Camp & Site Offices	Provision of mobile toilet and sanitary facilities. Daily collection of solid waste. Selection of flat location. Removal of vegetation cover.	Approval from GHA & District/Municipal Assemblies.	Involvement of GHA & District/Municipal Assemblies.	Pre-Construction Period	Contractor	45,425.40
Removal of Trees (Flora Content)	Cutting and removal of limited number of trees. Removal and stockpiling of vegetation cover topsoil. New trees saplings to be promptly planted.	Minimization of de-vegetation	Surveyed area with marked boundaries.	Pre-Construction Period	Contractor	68,138.10
Demolition of Structures	Reuse salvageable materials. Conduct asbestos and lead-based paint survey. Use health and safety controls.	Reduce, recycle, reuse waste materials to minimize landfill load from demolition activities.	Implement Demolition Management Plan.	Pre-Construction Period	Contractor	81,765.71
Air Quality	Fugitive emissions localized. Limited dust generation. Limited site clearance.	De-vegetation limitation.	Implement Vegetation Removal Management Plan.	Pre-Construction Period	Contractor	90,850.79
Human Health and Safety	Use of PPE by workforce. Setup health education programs. Prevent accidents.	Public, Occupational Health and Safety Practice.	Implement Health and Safety Plan (HSP).	Pre-Construction Period	Contractor	145,361.27
Air Quality	Construction vehicles maintenance. Watering of exposed surfaces. Cover vehicles carrying spoil. Install and maintain equipment mufflers.	Dust, fumes and odor nuisance control.	Implement Health and Safety Plan (HSP).	Construction Period	GHA, Contractor, EPA	58,404.08
Soundscape & Vibration	Install sound control devices. Switch-off idling machines. Provide ear plugs to workers. Provide padded seats for equipment operators.	Noise nuisance & vibration effects control.	Implement Health and Safety Plan (HSP).	Construction Period	Contractor, GHA, EPA	116,808.16
Borrow Pits Generation	Access vector ecology in work areas. Employ adequate drainage. Fill methodology to avoid creating mosquito habitats.	Prevent stagnant pool or depressions suited to mosquito breeding.	Implement Construction Environmental & Social Management Plan (CSMP)	Construction Period	Contractor, GHA, EPA, Forestry Commission	175,212.24
Soil Erosion and Sedimentation	No major earthworks during the rainy season. Limited vegetation cover removal. Use adequate drainage structures.	Erosion, siltation and land slip from cuts slopes, grubbing and vegetation removal.	Implement CESMP	Construction Period	Contractor, GHA, EPA	233,616.33

Waste Generation and Removal	Minimize waste generation. Segregate waste for reuse. Provide waste bins. Develop disposal policy.	Excavated spoil, building materials, oil, lubricants and domestic waste removal.	Implement CESMP	Construction Period	Contractor, GHSA, EPA, District & Municipal Assemblies.	292,020.41
Water Quantity and Supplies	Provision of water supplies by contractor. Avoid using project communities water sources.	Water shortage, scarcity shortfall.	Implement CESMP	Construction Period	Contractor, GHSA, EPA, GWCL, Water Resources Commission.	350,424.49
Concrete Batch Plant Waste	Reuse concrete products. Prevent dumping of concrete waste. Segregate areas into "clean" and "dirty" sections.	Concrete mixing and resultant contamination.	Implement CESMP	Construction Period	Contractor, GHSA, EPA	408,828.57
Construction Camps and Site Offices	Carefully site, construct and manage construction camps. Control erosion and dust. Plan and carry out post-construction site clean-up.	Environmental and social disruption caused by construction camps.	Implement CESMP	Construction Period	Contractor, GHSA, EPA, District and Municipal Assemblies.	467,232.65
Loss of Flora and Fauna	Control all clearing activities. Minimize number of trees to be felled. Reduce potential impact of flora and fauna.	Clearing, destruction and decimation of fauna habitat and food resources.	Implement Biodiversity Management Plan in CESMP document.	Construction Period	Contractor, GHSA, EPA, Forestry Commission.	525,636.73
Traffic and Transportation	Set and enforce speed limits. Regulate transport of toxic materials. Reduce accident risks by safe driving speeds.	Accidents risks associated with vehicular traffic nuisance.	Implement Traffic Management Plan (TMP).	Construction Period	Contractor, GHSA, EPA, Motor Traffic Transport Unit (MTTU of Ghana Police Service).	584,040.81
Human Health and Safety	Use of PPE by workforce. Collect and recycle lubricants. Take precaution to avoid accidental spills. Setup health education, HIV/AIDS/STDs/Malaria/Ebola.	Creation of diseases vectors affecting humans, plants and animal's avoidance.	Implement HSP	Construction Period	Contractor, GHSA, EPA, MoH, GHS.	642,444.90
Visual Quality and Amenities	Fence in project sites and open spaces to prevent visual intrusion. Water all exposed areas. Ensure that new developments are culturally sound, environmentally and socially appropriate and aesthetically acceptable.	Aesthetic impact of areas development and visually offensive structures removal.	Implement Visual Quality and Amenities Management Plan in CESMP document.	Construction Period.	Contractor, GHSA, EPA.	700,848.98
History, Archaeology, Heritage Resources	Assess heritage value of planned sites. Alert Department of Archaeology Heritage Studies (University of Ghana, Legon) on discovery of any object of possible archaeological significance.	Encroachment on previously unidentified cultural heritage sites.	Implement Cultural Heritage Resources Management Plan in CESMP document.	Construction Period.	Contractor, GHSA, EPA.	759,253.06
Pedestrian-Vehicular Conflicts	Provision of pedestrian access and walkways. Potential conflict spots will be marked with appropriate road signs.	Enhance the safety of project residents.	Implement TMP in CESMP document.	Construction Period.	Contractor, GHSA, EPA, MTTU.	58,404.08

	Provision of road signs warning motorists.					
Public Utilities and Services	Locate all public utility lines in the RoW. Relocate all public utility lines outside roads project RoW. Engage and consult all public utility line agencies for relocation plans implementation approval.	Impacted public utility lines within RoW relocation.	Implement Public Utility Lines Relocation Management Plan in CESMP document.	Construction Period.	Contractor, GHA, ECG, GWCL, Mobile Communication Service Providers.	116,808.16
Hydrology and Drainage Systems	Diligent execution of earthworks. Create settlement basins or vegetated runoff catchments. Provide oil traps to control leaks and spillage.	Prevention of hydrological and drainage systems from fouling and contamination events.	Implement Hydrology and Drainage System Management Plan in CESMP document.	Construction Period.	Contractor, GHA, EPA, Hydrological Services Department.	58,404.08
Project Communities Access	Meet social concerns of project communities. Provide access for pedestrians, cyclists, motorist and project residents. Provide warning signs for motorists.	Easy facilitation of project resident's access within project corridor.	Implement Project Communities Access Management plan in CESMP document.	Construction Period.	Contractor, GHA, EPA, District and Municipal Assemblies.	116,808.16
Loss of Assets and Compensation Payment	Identify all affected properties in the RoW. Hold consultation and engagement meetings with PAPs. Mark out roads reservation corridor. Payment of compensation monies to PAPs.	Reduction of livelihood and restoration challenges to be faced by PAPs.	Implement Resettlement Action Plan (RAP) Report.	Construction Period.	Contractor, GHA, EPA, LVD, District and Municipal Assemblies.	See RAP Report
Influx Population Surge	Educate workforce on social harmony. Establish positive relation between workers and project residents.	Creation of social disharmony between project residents and imported workforce removal.	Implement Influx Population Surge Management Plan in CESMP document.	Construction Period.	Contractor, GHA, EPA, District and Municipal Assemblies.	116,808.16
Greenhouse Gas (GHG) Emissions	Service construction machinery and equipment regularly. Capture GHG emissions for mobile construction vehicles and stationary equipment.	Reduction in contribution to climate change sources.	Implement GHG Emissions Control Management Plan in CESMP document.	Construction Period.	Contractor, GHA, EPA.	58,404.08
Air and Soundscape Quality	Monitor periodically ambient air and noise quality at designated areas. Provide barriers in front of sensitive receptors. Enforce Ghana EPA guidelines for air and noise emissions.	Traffic flow noise and air pollution monitoring.	Implement CESMP document	Operation Period	GHA, EPA	1,946.80
Borrow Pits generation	Fill up all stagnant pools and ponds. Backfill all excavations. Re-contour areas with stocked up topsoil.	Stagnant pool or depressions suited to mosquito breeding avoidance.	Implement Borrow Pits Reclamation Management Plan in CSMP document.	Operation Period	Contractor, GHA, EPA, District and Municipal Assemblies, Minerals Commission.	25,308.44

Soil Erosion and Sedimentation	Revegetate exposed surfaces. De-silt drains of choked materials. Use silt traps to restrain turn-outs.	Prevent flooding from choked drainage systems.	Implement Storm and Runoff Management Plan in CESMP document.	Operation Period	Contractor, GHA, EPA	3,893.61
Waste Generation and Disposal	Prevent littering of project sites. Prevent unapproved landfill creation. Reduce, reuse and recycle waste materials.	Prevent waste materials build-up leading to disease spread.	Implement Anti-Litter Program and Waste Disposal Plan in CESMP document.	Operation Period	Contractor, GHA, EPA, District and Municipal Assemblies.	5,840.41
Water Quality and Supplies	Test quality of drinking water. Ensure Ghana EPA/WHO regulatory standards.	Prevent contamination of groundwater resources.	Implement Groundwater Resources Management Plan in CESMP document.	Operation Period	Contractor, GHA, EPA, Water Resources Commission.	7,787.21
Concrete Batch Plant Waste	Remove all damaged top soil. Dispose of concrete waste according to approved standards. Re-contour sites to original states.	Prevent concrete mixing resultant contamination of groundwater.	Implement Concrete Waste Management Plan in CESMP document.	Operation Period	Contractor, GHA, EPA	9,734.01
Construction Camps and Site Offices Creation	Complete dismantling and removal camps and offices. Recycle all recyclable materials to deviate waste materials to landfill sites.	Prevent littering of project corridor with camp and site offices abandoned structures.	Implement Construction Camps and Site Offices Decommissioning Plan in CESMP document.	Operation Period	Contractor, GHA, EPA, District and Municipal Assemblies.	13,627.62
Loss of Flora and Fauna	Re-vegetate areas monitored to sustain vegetation community growth.	Prevent destruction and decimation of fauna habitat and food resources.	Implement Weed and Revegetation Management Plan in CESMP document.	Operation Period	Contractor, GHA, EPA, Forestry Commission.	21,414.83
Traffic and Transportation	Minimize impact on flora and fauna during maintenance stage. Monitor traffic flow safety and hazards.	Prevent accidents risks associated with vehicular traffic.	Implement Traffic Flow Monitoring Plan and Roads Safety Campaign Programs.	Operation Period	Contractor, GHA, EPA, National Roads Safety Commission.	9,734.01
Human Health and Safety	Reduce accident rates through improved measures. Minimize risks to project road users.	Prevent creation of diseases vectors affection humans, plants and animals.	Implement Disease Spread Control Surveillance in project communities.	Operation Period	Contractor, GHA, EPA, MoH, GHS.	23,361.63
Visual Quality and Amenities	Trees planting program should be carried out. Remove visually offensive structures and heaps of waste materials.	Prevent aesthetic degradation of roads project corridor.	Implement Trees Replanting Program in CESMP document.	Operation Period	Contractor, EPA, Forestry Commission, NGOs.	9,734.01
History, Archaeology, Heritage Resources	Any 'chance find' from roads expansion program will be documented. Report 'chance find' to Ghana Museums and Monument Board.	Prevent encroachment of previously unidentified cultural heritage sites.	Implement 'Chance Find' Management Plan in CESMP document.	Operation Period	Contractor, EPA, Ghana Museums & Monument Board.	13,627.62
Pedestrian-Vehicle Conflicts	Remove improved roads condition leading to roads side commercial, industrial and settlement	Prevent vehicular-pedestrian conflicts.	Implement Pedestrian-Vehicle Conflicts management	Operation Period	Contractor, GHA, EPA, District &	9,734.01

	developments creating conflicts. Prevent development of social amenities (schools, health centers, churches, mosques, etc.) close to project roads leading to conflicts.		Plan in CESMP documents.		Municipal Assemblies.	
Public Utilities and Services	Control new developments exacting devastating toll on provision of public utility services. Control urban sprawl emergence due to in-out migration.	Prevent urban sprawl development.	Implement Urban Sprawl Management Plan in CESMP document.	Operation Period	Contractor, GHA, EPA, District & Municipal Assemblies.	3,893.61
Hydrology and Drainage System	Maintenance of grassed or stabilized slopes. Direction of runoffs from roads project away from fertile agricultural lands.	Prevent flooding of low-lying areas and erosion effects.	Implement Hydrology and Drainage Systems Management Plan in CESMP document.	Operation Period	Contractor, EPA, GHA	5,840.41
Project Communities Access	Warn motorists, pedestrians, road user's behavior with traffic control devices. Ensure safe passage to project residents by provision of walkways or sidewalks facilities.	Meet health and safety issues of vulnerable groups (mobility disability).	Implement Vulnerable Groups Access Management Plan in CESMP document.	Operation Period	Contractor, EPA, GHA, NGOs.	9,734.01
Loss of Assets and Compensation Payment	Ensure success of RAP program. Maximize involvement of PAPs during implementation of RAP program. Provide adequate and acceptable compensation payment monies to all PAPs.	Prevent social discontent and upheavals.	Implement RAP Report effectively.	Operation Period	GHA, EPA, RAP Committees, District & Municipal Assemblies.	See RAP Report
Influx Population Surge	Control induced migration incidence. Discourage in-migration of job seekers into project corridor by use of "No Employment" signs – prevent them from camping outside project boundaries.	Prevent temporary camps setup from job seekers within project enclave.	Implement Influx Population Surge Management Plan in CESMP document.	Operation Period	Contractor, GHA, EPA, District & Municipal Assemblies, NGOs.	7,787.21
Greenhouse Gas (GHG) Emissions	Monitor GHG emissions sources within project corridor.	Control GHG emission sources within project enclave.	Implement GHG Management Plan in CESMP document.	Operation Period	GHA, EPA.	5,840.41
Climate Change and Complimentary Initiatives	Selection of appropriate and adequate type of pavement design. Proper design of drainage structures. Proper levels of roads embankment. Provision of dugout and boreholes where appropriate. Roads safety campaign and children's traffic education. Disruption to utilities.	Climate Change Adaptation and Mitigation Measures. Inclusion of Complimentary Initiatives to enhance the project benefits and participation of local communities.	Implement Climate Change and Complementary Initiatives Plan.	Operation Period	GHA, EPA, District & Municipal Assemblies.	3,893.61

	HIV/AIDS and Communicable Diseases Awareness and Education. Gender Mainstreaming Plan of Action. Youth Involvement Program. Landscaping and Trees Planting Program. Resettlement/Compensation (RAP) Payments.					
Gender Issues	Ensure equal opportunities for men and women in line with AfDB Policy on Gender. Provision of ablution corners. Resting place dedicated to women. Consideration of needs of men and women during RAP implementation. Construction of market stalls for women.	Gender sensitization. Increase income levels for men and women through employment during maintenance phases.	Implement Gender Mainstreaming Plan in CESMP document.	Operation Phase	Contractor, GHA, EPA, NGOs, District & Municipal Assemblies.	1,946.80

Sources: KE&T Data Records

Chapter 14 Institutional Capacities and Strengthening Plan

14.1 Introduction

The successful implementation of the ESMP and RAP depends on the commitment of GHA and related institutions and the capacity within the institutions to apply or use the ESMP and RAP effectively and the appropriate functional institutional arrangements, among others. It is anticipated that actions to strengthen the ability of institutions for the implementation of the ESMP will be initially focused on the needs of GHA to administer construction contract and the development of working relationships with district/metropolitan-level institutions, NGO's, EPA Ghana for these purposes. The strengthening activities for environmental and social monitoring purposes will build upon the existing GHA M&E Unit. The following sections address the key ESMP areas relevant to its successful implementation:

- Program-Wide Strategies in the Construction Phase.
- Guidelines for Environmental and Social Monitoring of Construction Phase.
- Institutional Strengthening.
- Operational Environmental and Social Management.

14.2 Program-Wide Strategies in the Construction Phase

To ensure that overall impacts are adequately mitigated three (3) aspects of environmental and social management strategies are of prime importance in the development of the Project:

- **Impacts Avoidance Rather than Amelioration**

Avoidance of impacts strategy is preferable form of mitigation rather than amelioration of impacts after the fact is recommended. Avoidance of impacts is of primary importance at the design stage.

- **Enforceable Construction Contract Provisions**

As a matter of environmental and social management strategy, the Project will have to draft and incorporate enforceable contract provisions to ensure good environmental and social management. The environmental and social provisions and standards to which construction and Contractor(s) will be held should be part of the bid solicitation process and incorporated in the solicited bids.

- **Compliance Assurance Through Adequately Staffed, Supported and Empowered Accountable Entity**

The GHA will have to be supported with consulting services and assistance when necessary to ensure that designs are sound, environmental and social standards are met, construction contract provisions are enforced and there is full compliance with operational standards.

14.3 Guidelines for Environmental and Social Monitoring of Construction Phase

Monitoring the Project will generally include observational monitoring to enforce contract provisions to avoid adverse impacts. Observational monitoring includes the activities of Consultants and the implementing agency (GHA) to ensure compliance with all contractual mitigation requirements.

14.4 Institutional Strengthening

It is expected that GHA with assistance from Consultants as deemed necessary will take responsibility for all aspects of the Project, including environmental and social oversight. It is expected that this will include the assistance of Consultants and that GHA will be adequately staffed to take oversight responsibilities for contract management, including supervision of environmental and social monitoring contracts. It is envisaged that capacity development and training will follow these arrangements:

14.4.1 Capacity Development

The capacity to implement environmental and social strategies will require the development of abilities within GHA to:

- Review project designs and specifications during preparation to ensure their adequate and suitability with respect to the established environmental and social standards.
- Coordinate with district/metropolitan assembly officials, community groups, government agencies and departments on environmental and social issues and obtaining the necessary clearances from the regulatory authorities.
- Monitor environmental and social aspects of the Project during construction to ensure that the environmental and social requirements of the contract and the mitigation measures proposed in the ESMP are implemented.
- Supervise Contractor(s) and prepare environmental and social inputs to quarterly progress reports.
- Develop guidelines and a code of good practice describing low-cost environmental and social measures that can be implemented in the context of the Project.
- Develop environmental and social training activities for Contractor(s) in consultation with Ghana EPA.

14.4.2 Training of GHA Staff

Training for the staff of GHA will be more fully determined in the future stages of the Project. On a preliminary basis, it is expected that the training needs will include the provision of two-week of training by local consultants with specific environmental and social management expertise in the execution of the Project. Environmental and social training materials are to consist of environmental and social guidelines to be developed in consonance with Ghana EPA for use in the construction supervision activities and other reference materials.

All training will be targeted to ensure that the GHA staff is properly equipped to oversee the environmental and social monitoring activities by third parties and to assess the implications of findings and determine corrective actions when necessary. Training will also include familiarization of staff with inspecting and reporting procedures to ensure that construction staging areas and site offices are properly sited and maintained and that waste disposal, noise provisions and other provisions stipulated by the contract specifications are properly enforced.

14.5 Operational Environmental and Social Management

It is very likely that GHA during the implementation of the Project will include additional number of relevant district/metropolitan assembly agencies in the Project implementation, including environmental and social management in the operation stage of the Project. Some models for environmental and social compliance for consideration include:

- **Environmental Monitoring Compliance by GHA as Implementing Agency**

The GHA will require an environmental and social unit to conduct monitoring and enforcement activities interact with other government agencies with regards to regulating issues.

- **Compliance Monitoring with Support from Ghana EPA and NGOs**

The Ghana EPA retains authority for the enforcement of environmental and social standards within their jurisdiction. The Ghana EPA has strong field offices to coordinate with the district/metropolitan assemblies and the NGOs.

Chapter 15 Conclusions

15.1 Overview

The nature of civil works proposed under the Proposal is likely to cause significant and/or irreversible adverse environmental and social impacts. Most of the Project impacts will be localized due to the relatively major to moderate activities. However, there are some issues of concern that cut across the range of proposed interventions.

15.2 Lessons from Similar Projects

Field studies and lessons learned from similar Programs show that issues such as good roads infrastructure design, disability consideration, climate effect on designs, camp sites/offices location and layout issues, maintenance of facilities, consideration of environment and climate change factors are some of the key concerns that influence Projects success and sustainability.

15.3 Operationalization of ESMP

To ensure compliance with ESMP requirements during the construction and operation periods, an adequate monitoring and evaluation systems have been developed for implementation under the strict supervision of GHA and Ghana EPA in liaison with local NGOs concerned. The Projects will also include special programs for HIV/AIDS Awareness Training and Environmental and Social Protection Training.

15.4 Beneficial and Non-Beneficial Environmental and Social Requirements

Admittedly, all the non-beneficial environmental and social requirements are negative, significant but controllable. They include: removal of trees/vegetation; air pollution, noise and vibration nuisance; demolition of structures, borrow pits generation; erosion and sedimentation; waste generation; water supplies; concrete batch plant and hot mix asphalt/bitumen; construction camps/site offices; biodiversity loss; traffic control nuisance; public, occupational health and safety; visual impairment; history, archaeology, heritage resource defacement; resettlement issues; projects community access; pedestrian-vehicular conflicts; influx population surge and greenhouse gas (GHG) emission. The expectation is that, all the prescribed implementable mitigation and management measures which have been detailed enough under discussion will reduce, eliminate or reverse the negative, non-beneficial impacts.

However, most of the beneficial issues of the Proposal are positive and significant. They include: human resource development; expansion of GHA roads infrastructure; rural-urban income levels enhancement; improvement in rural-urban economy; rural-urban women livelihood improvement; traffic safety and riding comfort improvement; traffic congestion dissipation; vehicle operation and transport cost reduction. These beneficial impacts will ensure that the Programs with the accompanying ESMP will be friendly, environmentally and socially acceptable. The implementation of the Projects is highly recommended. The Projects residents, project

neighboring populations and future generations will need the Project to boost their socio-economic development.

Chapter 16 Recommendations

16.1 Overview

Based on results of field study findings, lessons learned from similar programs and the Environmental Consultant's professional opinion, the following recommendations are made to GHA:

Ensure Roads Infrastructure Sustainability Plan Implementation: (i) to develop principles of roads facilities sustainability that support the GHA's goal and strategies (ii) to foster understanding of and commitment to the principles of sustainability in roads infrastructure development (iii) to achieve a profile of excellence in world class roads built-environment relevant to sustainability (iv) to contribute to a robust, equitable and environmentally and socially sustainable society by fostering partnerships and engagement opportunities focused on sustainability in roads infrastructure provision (v) to strive for best practice in the management of biodiversity, greenhouse gas (GHG) emissions and energy, water, recycling and waste, planning and development, procurement and transport.

Ensure Good Roads Infrastructure Design: (i) to adopt roads designs which respond to the local climate, topography and any potential hazards (ii) materials of construction which reduce costs of construction and provide better quality roads facilities; disability considerations in the design; climate effect on designs.

Maintenance Regime of Roads Facilities: (i) to engage GHA Maintenance Unit to draw-up a strict program of maintenance regime for the new roads facilities as is the case with all existing roads structure (ii) to ensure new roads sustainability in the long-term.

HIV/AIDS Awareness Training Program: (i) to conduct HIV/AIDS/STDs/Malaria Awareness campaign for projects neighborhood communities, projects populations and construction labor units to explain the pandemic (ii) similar programs could be conducted for Ebola awareness and Cholera infections.

Environmental and Social Protection Training: (i) to organize Environmental and Social Protection Training for Contractor(s) and other stakeholders to instill good environmental and social management and monitoring practices during construction and operation phases.

Demolition of Structures, Displacement/Resettlement and Compensation Issues Management: (i) to avoid resettlement issues or minimization of resettlement/displacement concerns develop RAP document for compensation payment (ii) develop Structures Demolition and Demolition Debris Disposal Plan (ii) provide comprehensive community participation in planning, construction and management of projects activities.

Records Keeping and Documentation: (i) every GHA unit within the projects zone will be required to maintain records of these project roads maintenance management and monitoring programs (ii) in addition to stores and logistics management records regarding the type of waste generated along the roads alignments, where it is generated, when separated, by whom and every other subsequent action until final disposal or handing over to a waste disposal company, all these intermediates and final steps will need to be recorded and documented comprehensively (iii) information on waste types and handling processes should reflect these parameters: data; type and volume/weight of waste; means of transportation, type, volume transported (iv) final disposal method and quantities (v) records of environmental and social performance for hazardous waste management should be disclosed to Ghana EPA.

Awareness Creation: (i) periodic general awareness creation or raising activities on health care and wellness and hazardous and non-hazardous waste management practices should be undertaken through education programs, such as seminars, workshops, lectures, etc. (ii) healthcare Professional Bodies should be engaged in enhancing and understanding and promoting good healthcare practices through effective hazardous and non-hazardous waste management by recycle, reuse and reduce along the Volta River catchment areas within the projects corridor.

Training and Capacity Building: (i) training and capacity building is very necessary in the safe and correct management of hazardous waste generation within and along the Volta River settlement zones to all residents including Environmental Health and Safety Managers of GHA units (ii) pre-service and post-service training of waste handlers should include healthcare waste management (ii) review of health training curricula to incorporate waste management (iii) EHS Managers should ensure that their staff undergoes in-service training in healthcare waste management (iv) training modules should include train-the-trainer and regular on-going training for project roads maintenance management.

Information, Education and Communication: Strategies on information, education and communication should take these dimensions: (i) education of construction workers on the classification of waste, the need for waste minimization and separation using Ghana EPA/Ministry of Health color codes for different containers and bags in the site camps/offices (ii) information dissemination by use of mass media to educate the Projects populations and neighborhood communities on the importance of hazardous and no-hazardous waste management, coding system, container usage type.

Roads Safety Awareness Campaign: The prevailing public consultations clearly indicated the concern over high rates of road accidents which they feel would increase with the improved projects roads. In order to mitigate the negative outcomes, the proposals, in addition to the elaborate engineering design measures, should incorporate road safety awareness campaigns which will help to re-invigorate the activities of the National Road Safety Commission through the Ministry of Transport.

In collaboration with the Traffic Police Unit, this activity will review the approach and methodology for the road safety awareness campaign and monitor the effectiveness of the proposed mitigation measures. The activity will take place during construction and operation periods, and will recommend new mitigation measures where those proposed are not effective. Baseline data will be collected which will augment the road safety audits undertaken by the Ministry. This activity will target school children, street vendors and vehicle operators.

References

1. African Development Bank Group, Environmental Mainstreaming, Safeguards and Results: Bank Road Projects and their Enabling Policy Environment, 1999-2010(2013)
2. Asuogyaman District Assembly, Medium Term Development Plan (20014-2017)
3. Dangme West District Assembly, Medium Term Development Plan (2007-2010)
4. North Tongu District Assembly, Medium Term Development Plan (2007-2010)
5. Olsen & Olsen. Environmental Impact Assessment Using the Rapid Impact Assessment Matrix (RIAM). Ed. Kurt Jensen. 1998.
6. Canadian International Development Agency (CIDA). Policy and Resources on Gender Equality. www.acdi-cida.gc.ca/CIDAWEB/acdicida.nsf/En/EMA-218123616-NN9
7. CDA Collaborative Learning Projects. Stakeholder Consultation Issue Paper. November 2004. www.cdainc.com
8. Constitution of the Republic of Ghana. 1992.
9. Department for International Development (DFID). Tools for Development: A Handbook for Those Engaged in Development Activity. 2002. www.dfid.gov.uk/pubs/files/toolsfordevelopment.pdf
10. Equator Principles. www.equator-principles.com
11. Ethiopia: Second Urban Local Government Development Program: Environmental and Social Systems Assessment (ESSA). January 9, 2014.
12. Ghana Health Services (GHS). Report of Study on Health Care Waste Management in Ghana Health Service Facilities. 2002.
13. Global Reporting Initiative. www.globalreporting.org

Appendix A – Terms of Reference for Engineering Design

Transport Sector Study Objectives

The overall sector goal is to establish an efficient and modally complementary and integrated transport network for the movement of people and goods at least cost throughout the country. The project roads, when constructed and improved, will enhance national economic activities, movement of goods and people to markets, and facilitate regional trade and economic integration.

Engineering Design Study Objectives

The objective(s) of the assignment are as follows:

To prepare detailed engineering designs, cost estimates and Tender Documents for the Development of sections of the Eastern Corridor N2:

- **Section 1: Asutuare Junction– Volivo Road (28.3km).**
- **Section 3: Dufor Adidome – Asikuma Junction (38.4km).**
- **Section 2: Asutuare – Aveyime Road (24.0km).**

Scope of the Engineering Design Assignment

The assignment will cover the following:

- Preparation of Detailed Engineering Designs, Cost Estimates and Preparation of Tender Documents.
- Review and update existing reports, preliminary designs and any related works which will offer an in-depth understanding of the physical and sociological conditions within the vicinity of the corridor with due care and diligence to attain the objectives of the project.
- Undertake any additional surveys required to update the preliminary design concepts for construction.
- Consult, coordinate and collaborate with all stakeholders such as the Ministry of

Roads and Highways, Ministry of Transport, Ministry of Finance and Economic Planning, Ghana Highway Authority, Ministry of Agriculture and all other Government Departments and Agencies related to the assignment to ensure successful implementation of the assignment.

- Be responsible for the analysis, interpretation, conclusion and recommendations derived from data that will be supplied by the Government.
- Liaise closely with the Coordinator and Counterpart staff appointed by the Client for the smooth implementation of the assignment.

Topographical Surveys

The assignment will cover the following:

- Carry out the necessary surveys for the road where there is the need for earthworks. The center line shall be set out, cross-sectioned, with vertical controls established where this has not already been done. The Coordinates of all intersection points shall be tied to the National Survey Grid and all levels related to the National Bench Marks. The reliability of the referenced National Survey beacons must be ascertained in the field before they are used.
- Carry out all the works necessary for the detailed design of the proposed works, for the estimation of quantities to an accuracy of +/- 10% of final quantities as measured on completion of the works; excluding any approved variations of the contract, and for preparation of bidding documents suitable for international bidding.

Engineering Investigations

The following engineering investigations shall be carried out:

- Ground reconnaissance survey to locate the position of the road and to indicate it on a plan;
- Concrete beacons firmly sited as agreed by the Client;
- Geometric characteristics of the centerline of the road, defined and computed and taking data for points at regular interval along the curves and the longer tangent alignments; and detailed site investigations and hydrological surveys at the bridge site, including adequate length upstream and downstream to enable the hydraulic design of the structures to be effected. Any topographical surveys that may be undertaken by the Consultant shall be done to generally accepted international standards and shall be recorded in standard survey format which shall become the property of the government at the completion of the assignment.

Soils and Materials Investigation

A review shall be made of all existing relevant data followed by a general study of the soils and materials along the route. The consultant shall make a detailed soil investigation over the road alignment to identify the various soil types. Disturbed samples shall be taken at intervals of about 500 meters and at other intervals where changes in soil type occur. The soil testing program shall be presented by the Consultant and agreed with the Client.

Boring and penetration tests shall be carried out along the alignment to determine rock surface levels. Investigation for sources of construction materials for pavement structures shall also be carried out and the sources of suitable materials surveyed shown on the engineering plans. Analysis and testing shall be carried out as required on the construction materials in accordance with standard practice adopted by the Government. Tests are to include soil/moisture/density relationships and CBR values of proposed sub-grade soils and any special methods of soil stabilization. The Consultant shall make adequate tests to prepare alternative designs for sub-base, base, and wearing courses with different materials, such as naturally occurring gravel, gravel stabilized with lime/cement/crushed stone and crushed stone.

Construction materials samples shall be tested where necessary for grain-size distribution, plasticity characteristics, maximum dry density and optimum moisture content, aggregate crushing value, bitumen absorption, and chemical water analysis. Other tests which may be necessary shall be carried out and explanation given. Soil and material plans shall be prepared showing exact locations of all construction materials available with an indication of their quantities.

Drainage and Bridge Site Investigation

The Consultant shall carry out hydrological studies on drainage structures which seem inadequate with careful analysis of stereoscopic examination of aerial photographs, study of available maps, and field investigations. The catchment area, run-off coefficient, hydraulic slope, design flood discharge and water elevation for the appropriate return period shall be determined for each drainage structure. Cross-sections and gradients of watercourses shall be surveyed to determine the proper drainage. Erosion protection of the structure and slopes must be checked for adequacy and determined for any additional culvert that may be proposed.

Geometric Design Requirements

The Consultant shall be fully defined the horizontal alignment of the road centerline, tangent points and other critical points relative to stations on the baseline by coordinates and offsets suitable for setting out the centerline where necessary. All points shall be coordinated to the National Survey Grid. Cross-sections shall be taken along the length of the road centerline at 25-meter intervals and at any changes in the topography.

The vertical alignment shall consider the design standard adopted while minimizing the earthworks required. There shall be coordination between horizontal and vertical alignment to the extent possible. Consideration shall be given to road safety standards. The design shall incorporate all the environmental aspects identified in the preliminary engineering report. The

Consultant shall investigate whether there will be any other possible impacts on the environment and make proposals for remedial measures.

Earthworks and Pavements

The Consultant shall:

- Undertake Engineering Analysis using the results of the soils and materials tests to determine the gradients of the slopes, compaction requirements, pavement design, and other engineering factors dictated by available natural materials. The design of the pavement shall conform to the GHA standards.
- Assess all existing geotechnical data and collect additional data adequate to enable the design of the road pavement layers to be proposed. Additional pavement layer data shall include DCP tests at 100m intervals, staggered at 50m in both directions. Engineering analysis shall be undertaken using the results of the axle load survey, Falling Weight Deflectometer results and/or subgrade Resilient Modulus tests, soils and materials tests to determine adequacy of the existing pavement and the design of any improvement proposed. The gradients of the cuts and fills slopes shall be assessed to determine their possible impacts on the defects in the existing pavement. The Pavement Design methodology shall be based on the GHA Pavement Design Manual and any other standards. The design life of the road shall be 20years.

Drainage Structures Design

All existing data and the results of the field investigations for soils, foundations and hydrology shall be used to assess the adequacy of the existing drainage and bridge structures. Detailed hydraulic and structural designs shall be fully documented for any new drainage structure. Detailed designs, where need be, shall be prepared for all drainage structures. The Consultant's design criteria shall take all the relevant site conditions into account, such as soil condition, hydrology, seismic effect, etc. The design data and loadings shall be in accordance with the MRH requirements (BS 5400, BD 37/88) and any other Standards, as may be decided by the Consultant in agreement with the Client.

Toll Plaza Design

The Consultant shall propose toll plaza locations (if required) and discuss with the client. These locations when agreed shall be designed to take into consideration road safety, the effect of static loading and anticipated traffic volume.

Intersection Designs and Traffic Management

The Consultant shall carry out detailed traffic engineering analysis and specify the design of necessary traffic control features. This analysis shall include, where appropriate, design traffic forecasts for major intersections. Based on the traffic simulation and related traffic studies, the

Consultant shall also conduct intersection capacity analyses to determine the location of signs, signals as necessary, pavement markings, and other control features.

Construction Traffic Management Plan

The Consultant shall develop a detailed scheme for maintenance of traffic flow to ensure that vehicular and pedestrian traffic flow is properly maintained during the construction period. The plan shall include details of the location and design of temporary diversions, temporary structures, barriers, signing, and other physical features necessary to accommodate traffic flow during construction. In addition to the design plan, the Consultant shall prepare a traffic operations plan detailing the construction sequencing, public information announcements, and other activities designed to minimize traffic disruption.

Engineering Drawings and Plans

The Consultant shall prepare the following engineering drawings and plans using format and title sheets as required by the Client, the original becoming the property of the Client:

- **Plan and Profile, Scale 1:2,500 and 1:250**

Showing: natural ground levels; horizontal and vertical curve details, running chainages, cross-section chainages, side drain location description and references to all drainage and bridge works, locations of bench marks, locations of road furniture, contour lines superimposed on plans, any other relevant information on the format approved by the Client:

- **Typical Cross-Sections, Scale 1:50**

Showing: all details of road cross-sections in cuts and fills, side drains, pavement thickness, camber, super-elevation, and pavement widening;

- **Cross-section, Scale 1:200**

Showing: natural ground level and superimposed road prism;

- **Typical Culverts**

Showing: details of all types of culverts and other drainage structures with less than 10 meters spans, their inlets and outlets, and any necessary protection work.

- **Soils Plan**

A soils plan shall be produced showing the characteristics of soils for various sections of the route. Plans showing the locations of borrow and quarry sites

shall also be produced;

- **Ancillary Works**

A plan for all other ancillary works shall be prepared.

Construction Quantities

The Consultant shall derive all quantities in accordance with Civil Engineering Standard Method of Measurement (CESMM). The calculated quantities for the works shall be based on the final design drawings. The earthworks quantities shall be derived from calculations based on the field cross-sections taken along the road centerline in accordance with accepted methods of measurement, which shall be agreed with the Client. A detailed bill of quantities shall be prepared generally under the following headings: preliminary and general, clearing and earthworks including sub-grade preparation, drainage, culverts and protection works, sub-base and base; and surfacing, road furniture, ancillary works, contingencies.

Cost Estimates

To make a fair and reasonable estimate of the cost of the project, the Consultant shall prepare a unit price analysis of each item using basic cost elements (labor, materials, equipment, tools, overheads, on-site costs, profit, etc.) He shall show separately the cost of all taxation (direct or indirect). In addition, the cost of supervision of construction by the Consultant shall be analyzed on a unit price basis and included in the overall cost estimates.

The estimated financial cost resulting from this analysis shall be accurate to within +/- 10%, and shall be compared with costs of previous projects or similar works executed in the area or the Sub-Region. Should any differences be found, the causes shall be identified and necessary reviews undertaken to arrive at comparable market prices. The estimates for the right-of-way/borrow areas acquisition shall be made on the basis of the unit prices to be furnished by the Client for each type of land and property utilization.

The Consultant shall provide cost estimates of work items in both foreign and local currency components according to the details previously discussed. In addition, the Consultant shall present separately the taxes and duties element of these two components.

To assist in budgeting for the required construction period, the Consultant shall prepare a construction schedule for the proposed construction contract showing the anticipated annual expenditure. Due account shall be taken of the climatic and any other conditions of the area which may influence the construction schedule.

Pre-qualification and Bidding Documents

The Consultant shall prepare the following:

- Pre-qualification dossier and notice according to a format provided by the Client;
- Bidding documents which includes:
 - ❖ instructions to tenderer, form of tender, tender guarantee and form of agreement;
 - ❖ general information;
 - ❖ form of equipment schedule;
 - ❖ general and special conditions of contract;
 - ❖ construction drawings;
 - ❖ technical specifications for the execution of the work; and
 - ❖ bills of quantities.

The Engineering drawings for tender shall be submitted in A3 size (reduced from the original A1 size). All other documents shall be submitted in A4 size.

Liaison with the Client

The Consultant shall submit his detailed work program for review and approval prior to commencement of services not later than 30 calendar days after the signature date of the contract. As the design progress, the Consultant's project manager shall maintain close liaison with the Client and shall submit for approval from time to time, according to the work program, draft design proposals for earthworks, pavement, structures and other technical aspects of the design prior to proceeding with the detailed design drawings.

Appendix B – Photographs



Stakeholders Consultative Meeting at Dufor Adidome (Meeting of Fetish Priest)



Asikuma Junction Township on the Dufor Adidome-Asikuma Junction Road (Section 3)



Consultations with Elders and Opinion Leaders at Dufor Osudoku



Consultation with Opinion Leader at Volivo



Consultation with Leadership in Volivo Laamo



Community Shrine at Dufor Adidome



Tree Shrine Outside RoW at Dufor Adidome



Avoided Grave at Aveyime Township



Avoided Cemetary at Aveyime Township



Fetish Priest at the Sacred Grove at Dufor Adidome



Avoided Borehole at Aveyime Township



Avoided Constricting Corridor at Aveyime