VOLTA RIVER AUTHORITY

R2004-004
11130154

154

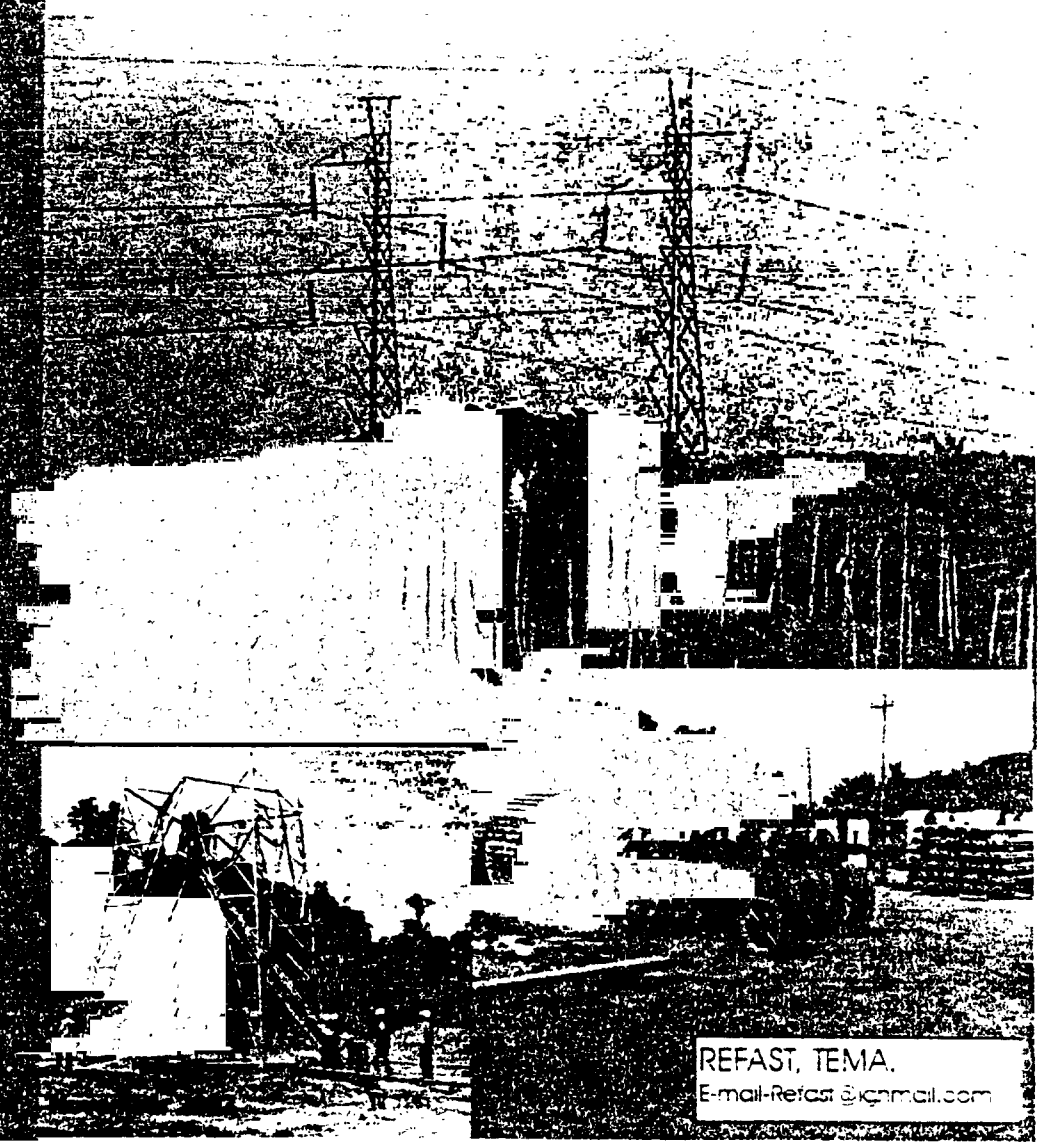
E1105
Volume 1

P075994

PROPOSED 330 KV ABOADZE-VOLTA TRANSMISSION LINE PROJECT

ENVIRONMENTAL IMPACT STATEMENT

R E F A S T



REFAST, TEMA.
E-mail-Refast@ighmail.com

REFAST QUALITY ASSURANCE

Project Title: EIA for PROPOSED 330 KV COASTLINE TRANSMISSION LINE PROJECT

Project No.: RF/EIA/04/02

Document Title: ENVIRONMENTAL IMPACT STATEMENT

Issue	Status	Prepared by	Date	Checked by	Date	Approved & Authorised for Issue by	Date
1	I - Draft	A. O-A	2/12/03	A.A-A	2/12/03	E. D-M	3/12/03

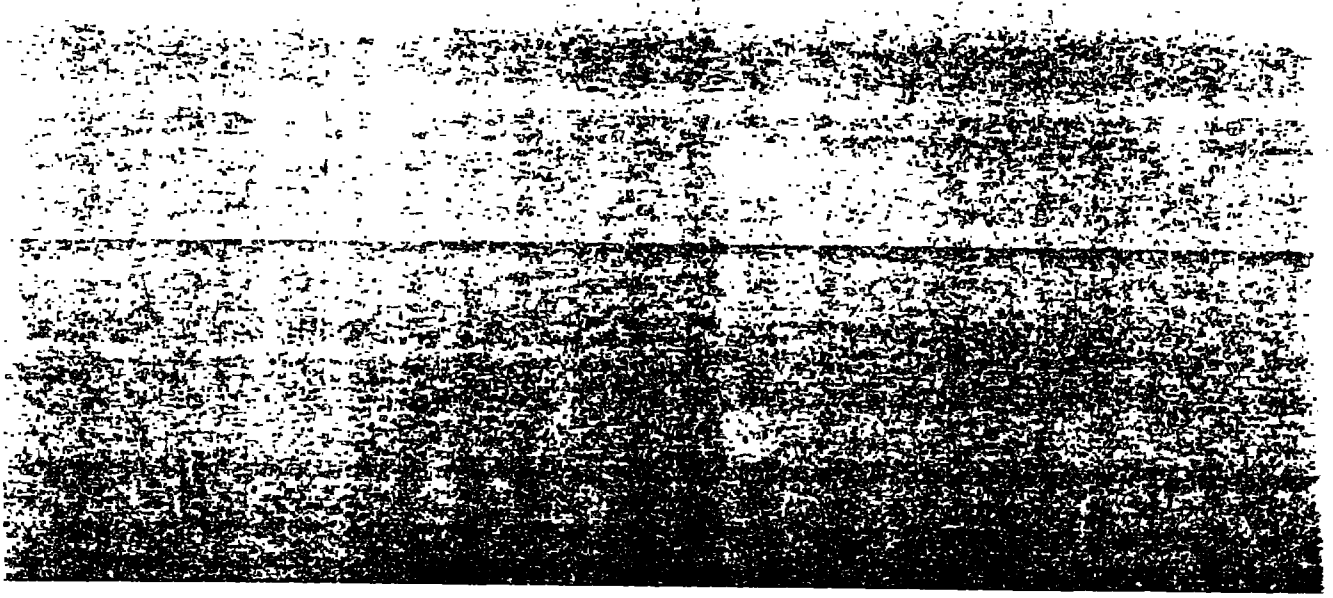
Distribution

Document No.	Issued to	Date
Original	VRA	3/12/03
Copies 1-19	VRA	3/12/03
Copies 21,22	File Copy	3/12/03

ICAO	-	INTERNATIONAL CIVIL AVIATION ORGANISATION
IPP	-	INDEPENDENT POWER PROVIDERS
IUCN	-	INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE
JSS	-	JUNIOR SECONDARY SCHOOL
KEEA	-	KOMENDA EDINA EGUAFO ABIREM DISTRICT
KV	-	KILO VOLT (1,000 VOLTS)
LI	-	LEGISLATIVE INSTRUMENT
LR	-	LOWER RISK
MOU	-	MEMORANDUM OF UNDERSTANDING
NED	-	NORTHERN ELECTRICITY DEPARTMENT
NGO	-	NON-GOVERNMENTAL ORGANISATION
NPLD	-	NON PIONEER LIGHT DEMANDER
PET	-	PROJECT ENVIRONMENTAL TEAM
PHC	-	POPULATION AND HOUSING CENSUS
PIU	-	PROJECT IMPLEMENTATION UNIT
POTP	-	PRESTEA – OBUASI TRANSMISSION LINE PROJECT
R	-	RARE
RoW	-	RIGHT-OF-WAY
SAEMA	-	SHAMA AHANTA EAST MUNICIPAL ASSEMBLY
SB	-	SHADE BEARER
SHEP	-	SELF-HELP ELECTRIFICATION PROJECT
SM	-	SOUTHERN MARGINAL
SSS	-	SENIOR SECONDARY SCHOOL

TAPCO	-	TAKORADI POWER COMPANY
TBA	-	TRADITIONAL BIRTH ATTENDANT
TEPZ	-	TEMA EXPORT PROCESSING ZONE
TICO	-	TAKORADI INTERNATIONAL COMPANY LIMITED
TMA	-	TEMA METROPOLITAN AREA
VALCO	-	VOLTA ALUMINIUM COMPANY
VRA	-	VOLTA RIVER AUTHORITY
VU	-	VULNERABLE

Executive Summary



Executive Summary

The Volta River Authority (VRA) proposes to construct a new Power Transmission Line from Aboadze in the Western Region to Tema in the Greater Accra Region. The project, which is known as the 330 KV Aboadze – Volta Transmission Line Project (AVTP), is required primarily to evacuate power from the Aboadze Thermal Plant to the Volta Switching station at Tema to be fed into the National grid.

Under the provisions of the Environmental Protection Agency (EPA) Act, 1994 Act 490, and in furtherance to its Corporate Policy on Environment, VRA is carrying out an Environmental Impact Assessment (EIA) for the proposed project. Furthermore, in compliance with the provisions of the Ghana Environmental Assessment Regulations, 1999 (LI 1652), erection of Power Transmission Lines falls under the category of Environmentally Critical Projects for which EIA is mandatory; the proposed project has therefore been duly registered with the EPA. Scoping for the EIA has already been carried out and the Terms of Reference for the EIA study have been agreed upon with the EPA.

This chapter is a non-technical summary of the main components of the Environmental Impact Statement, with emphasis on the main significant impacts and proposed mitigation recommendations

- **Background - Volta River Authority (VRA)**

VRA was established in 1961 as a public owned utility by the Volta River Development Act, 1961 (Act 46). VRA is engaged in the business of generation, transmission and distribution of electricity in Ghana. The Authority also supplies power to neighbouring utilities in La Cote d'Ivoire, Benin and Togo.

The Authority owns and operates a countrywide transmission system for the distribution of bulk electric power in Ghana (see Fig.1.1). This transmission network is made up of 35 substations with about 4,000 circuit-km of transmission lines. The transmission grid is also interconnected with Togo and Benin (since 1972) and La Cote d'Ivoire (since 1983).

The Authority supplies all the bulk electric power to the major consumers of electrical power in Ghana. These include the Electricity Company of Ghana (ECG), the Volta Aluminium Company (VALCO), mining companies and some heavy industries in Tema.

Since 1987, VRA, through its Northern Electricity Department (NED), has also been responsible for the distribution of electricity to domestic and industrial consumers over the Northern sector of Ghana covering Brong Ahafo, Northern, Upper West and Upper East Regions.

- **Proposed Aboadze - Volta Transmission Project (AVTP).**

The growths in the national economy, population and modernization have combined to create a demand for more energy. In order to meet this increasing demand, power generation from Aboadze is to be increased by a further 110 MW. In addition, the Ministry of Energy has confirmed plans to generate additional 125 MW from a barge-mounted gas turbine to be installed at Effasu also in the Western Region by 2003.

The proposed line is therefore necessary to provide transmission capacity required for the evacuation of the additional power expected from Aboadze and Effasu.

System planning studies have been carried out on the transmission network covering the various proposed developments up to the year 2020. These are as captured in the in VRA's "Transmission System Master Plan, 2000". These studies confirm that an additional 'coastal' line is required to reliably evacuate the higher power flows from the generating sources in the West to the large load centres in the East. The Western segment is also key to facilitating power transfers between Ghana and the neighbouring countries of La Cote d'Ivoire, Togo and Benin, and a high level of reliability at this section must be ensured.

The 330 KV line will also facilitate future interconnection with Nigeria through Communaute Electrique du Benin (CEB) and the development of the proposed West African Grid System.

- **Legal, Regulatory and Institutional Considerations**

The relevant policies and the regulatory conditions that must be considered for the successful implementation of the project have been assembled and reviewed as part of the Scoping process and consultations with some of the relevant agencies have been initiated.

Those considered include:

- Environmental Assessment Regulations, 1999 (LI 1652).
- The Land Policy, 1999
- Energy Commission Act, 1997 (Act 541),
- Environmental Protection Agency, Act 1994 (Act 490),
- National Museum Decree, 1969, NLCD 387,
- Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542),
- Lands (Statutory Wayleaves) Regulations, 1964 (L.I. 334)
- Lands (Statutory Wayleaves) (Amendment) Regulations, 1964 (L.I. 346)
- Lands (Statutory Wayleaves) Act, 1963 (Act 186)
- Volta River Development Act, 1961 (Act 46),
- Forestry Commission Act, 1993, (Act 453)
- Factories, Offices and Shops Act, 1970, (Act 328)

The Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542) defines "*transmission line right-of-way*" to include the area extending for a distance of fifty feet (50 ft. or approx. 16 m) on either side from the centre line of the transmission towers. Hitherto, this has been applied to the existing transmission lines of up to 161 KV and below. However, for the 330 KV AVTP line, the RoW is expected to be 40m. The legislation will therefore need to be amended appropriately to cover the increased width of the RoW. VRA is taking steps to ensure that this is done to provide for the protection of the RoW in the project area for the smooth implementation and operation of the AVTP.

- **Description of Proposed Developments**

A description of the proposed development activities is given in sufficient detail as is consistent with environmental assessment in Chapter 2, highlighting those aspects that point to potential environmental significance.

The project will involve the erection of steel transmission towers along the route that will span approximately 215 km. The line will be insulated to carry 330 KV. Initially, however, it will carry 161 KV until about the year 2010. All design conditions, including RoW, clearances, tower parts, etc. will be suited to 330 KV. The height of the towers will be such as to provide a minimum clearance of 8.0 to 8.5 metres between the lines and the ground (i.e. at the lowest point). The towers will be about 40 metres high.

The description covers the various pre-construction, construction, operation and maintenance activities. The pre-construction activities include route survey, tower spotting and acquisition of the necessary RoW.

The construction activities include various levels of vegetation clearance to standards prescribed by the VRA. Other activities include excavation of tower foundations, erection of towers and stringing of lines. Expansion works at the proximal and distal switching stations are also included.

- **The Existing Environment**

The proposed 330 KV Aboadze - Volta Transmission Line project (AVTP) is a "linear" project within a relatively wide corridor (up to 120 ft or 40 m), traversing a wide area of influence with diverse characteristics. The proposed line is estimated to extend over a total distance of about 215 km, and lies roughly between longitude 1° 40"W and 0° 00" and latitude 4° 75" N and 5° 45" N.

The existing environment within the project area is discussed under 2 main headings covering the biophysical environment and the socio-economic/cultural environment.

The section on the biophysical environment gives an account of the climate and the natural resources occurring in the project area. It records the general baseline conditions and assesses the significance and value of the natural resources of the area. The major natural resources are the Flora, Fauna, Forest resources, Water resources and Soils.

- **Flora and Forest resources:** The floral survey identified three (3) main vegetation zones as follows:
  i. Maritime Vegetation
  ii. Dry Semi deciduous Inner Zone forest sub-type/ Southern Marginal Forest and their intergrades
  iii. Coastal Grassland and Thicket

  These zones are described in detail in the report. Of particular interest are the scared groves and shrines found along the route. Of these, the Guako Grove at Pokuase is most significant and appropriate details of the flora found there are given accordingly.

  The proposed route also passes through the Yenku Block 'B' Forest reserve and the proposed Apra Hills forest reserve. These issues are considered in sufficient detail in the report. A detailed list of the flora in the project area and their conservation status is given in Chapter 3 – (section 3.1.2).

- **Fauna:** The faunal species in the project areas are typical of coastal scrub and grassland species. They include molluscs, arthropods (millipedes, butterflies and grasshoppers), amphibians (frogs and toads), reptiles (lizards, tortoises, and snakes) birds (kites, vultures, and doves) and mammals (bats, mice, monkeys, rats and duikers). A detailed faunal list including their conservation status is presented in Chapter 3 - (section 3.1.3).

- **Water resources:** The water resources include available surface and ground water resources. In addition, riverine water is available from both perennial and seasonal water bodies. Some of the inhabitants in the communities were noted to be using both surface and ground water for drinking and other domestic purposes.

  The surface water resources along the RoW, from West to East, include major ones as *Pra* River, *Ante* River and River B*onka*. Details of the surface water crossings along the proposed route are presented in the report.

  Ground water resources are appreciably adequate. Most of the boreholes within the project area yield 1,000–1,500 gallons/hour. The swampy coastal strands tend to have a high aquifer recharge, with yields exceeding 1,500 gallons/hour. This water is, however, generally hard and saline.

- **Geology and Soils:** A detailed discussion of the geology and soils in the area is given. The 330 KV line traverses mainly Ochrosols (Forest Ochrosols and Coastal Savannah Ochrosols) from the western end up to around Winneba. The terminal stages of the line have tropical black earths in the inner farmland areas and Lateritic Sandy soils and Granite deposits from Pokuase through to Tema.

- **Socio-economic/cultural environment**

  The section on the socio-economic/cultural environment describes the conditions within the settlements found along the proposed route. About thirty-eight (38) communities have been identified as falling within the area of influence to be affected by the project. These communities are located in eight Districts and three Regions.

  The socio-economic profiles of the affected districts, derived from information provided by the respective District Assemblies, are presented under the following headings:

- Demographic characteristics – Population, Ethnicity and Religion
- Social development – Education, Health and Water resources

- Economic Development – Agriculture, Commerce, Fishing, etc.,

  Generally, it was found that agriculture, commerce and fishing are the main sources of income in all the districts. Many of the people have moved into the urban areas in search of jobs in commerce and related activities.

Agriculture in the area is mainly subsistent, except for the farm plantations of coconut, oil palm, citrus and cashew. Popular local foodstuff like plantain, cassava and maize are also very common.

During the study, 415 whose lands, farms or structures fall within the general route and RoW were identified as being directly affected by the project. They were interviewed using three (3) sets of questionnaire and their responses were collated. The detailed lists of the affected persons and the results of the socio-economic study are presented in Chapter 3, while the questionnaires and analysis of the findings which form part of the baseline, are presented in Annex 3.

- **Significant Impacts and Proposed Mitigation**

The potential environmental effects that would occur from the implementation of the AVTP project are discussed in 3 parts in Chapter 4. Part 1 describes the pre-construction and construction activities and the potential impacts arising from them, mainly on the bio-physical environment, and recommends mitigation measures that should be adopted to minimise or eliminate the impacts where possible. The impacts from operation and maintenance activities are also covered.

The identified impacts from construction include loss of land use, loss of crops, felling of trees, pollution of surface and ground water sources and soil erosion. Mitigation for loss of land use and crops will be by payment of adequate and fair compensation. Felling of trees cannot be avoided but will be kept to the barest minimum. A Memorandum of Understanding (MOU) has been signed between VRA and the Forestry Services Division concerning trees that will have to be harvested in forest reserves. Pollution of water resources will be checked with recommended

controls. Erosion of exposed soil surfaces may be difficult to control in the initial stages but re-growth of graded areas with adequate cover will be encouraged once construction is completed in any area. Faunal dispersion will be limited, as not many were found within the area.

Operation and maintenance impacts are mainly related to safety hazards associated with transferring power along overhead lines. People who carry out the maintenance and others who find themselves close to the lines may be exposed to danger when faults occur.
Enforcing RoW restrictions best mitigates public/occupational health and safety. Compliance with all recommended safety procedures during maintenance is also essential.

Being a "linear" project, the AVTP is expected to have diverse socio-economic/cultural impacts as it traverses many settlements. Part 2 discusses the expected impacts on the socio-economic/cultural environment and appropriate mitigation where feasible.

The population sizes, ethnic and gender distribution within the communities are not expected to be altered by the project as the total number of workers required will be only about 200 of which 120-140 are expected to be employed locally from within the communities. Some workers will come from other parts of Ghana.

The main impacts on the social environment are expected to be loss of land use and its consequential loss of income, which is unavoidable as the RoW (and its protection) is required for safety of both the lines and the people. Mitigation shall be by prompt payment of adequate and fair (market rates) compensation. The impacts on community properties such as cemeteries and shrines shall be avoided by alternative tower spotting/diversions in those specific areas.

Finally, special issues of concern related to implementation of the project, such as EMF effects and concerns about the payment of compensation which require more clarification are discussed in Part 3 under "Special Issues of Concern".

EMF and its effect on human health are discussed in detail. Available research evidence worldwide is inconclusive as to EMF causing diseases such as cancer. The affected public have been educated generally on safety and EMF effects during the field studies.

VRA's mode of payment of compensation (similar to other government agencies) raises major concerns among the people. For the AVTP, a more participatory approach shall be used and payments made promptly to minimise the effects on the rural folks who are mostly poor.

- **Monitoring**

An outline monitoring programme is provided to enable verification of the levels of the predicted impacts and also to adjust mitigation measures where found necessary. The criteria to be monitored are presented in a comprehensive list covering the following:

- Construction phase - transportation, civil works, vegetation clearing etc.
- Waste management – bush burning, handling of chemical wastes etc.
- Operation and maintenance phase – use of herbicides, accident records etc
- Socio-economic and cultural issues – assessment and payment of compensation, loss of land etc.

- **Consideration of Alternatives**

Detailed discussions on the various project alternatives are presented under the following headings:

- "No-development Scenario"
- Upgrading existing facilities
- Alternative modes of transmission – using underground cables
- Alterative tower designs and alternative materials – using wood or concrete
- Alternative routes

These options are all evaluated in the discussions.

Table of Contents

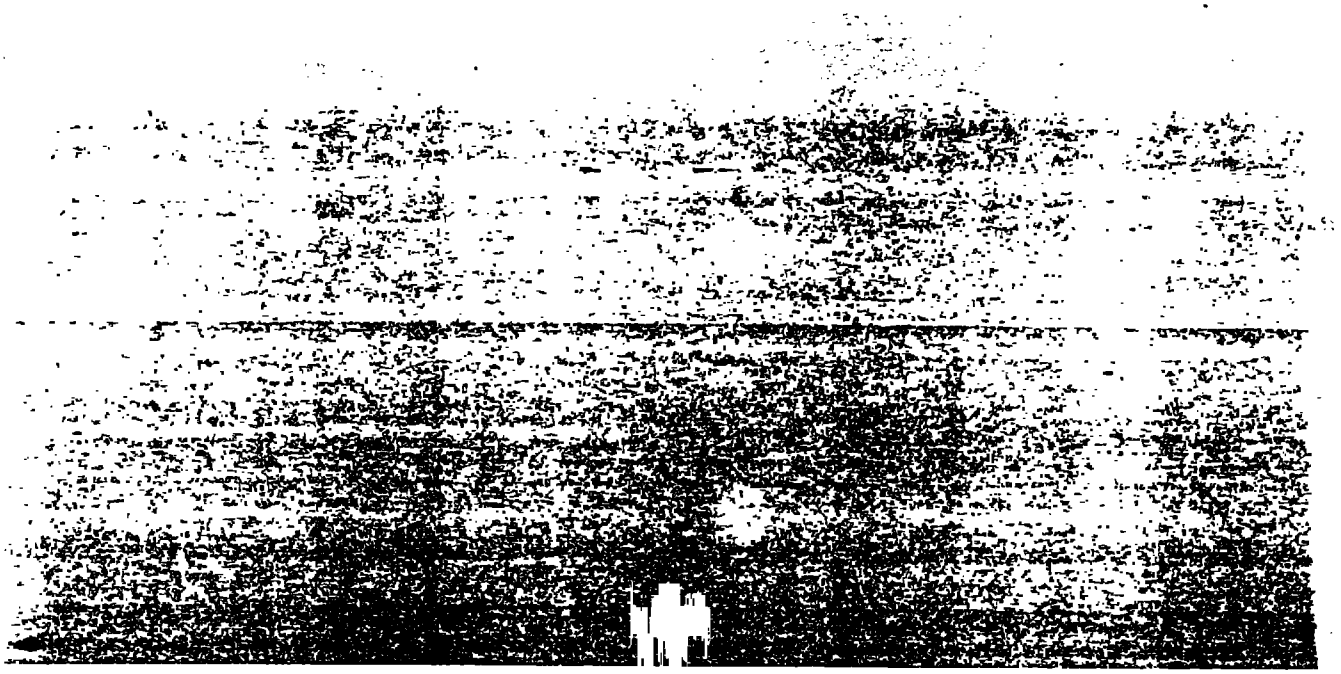


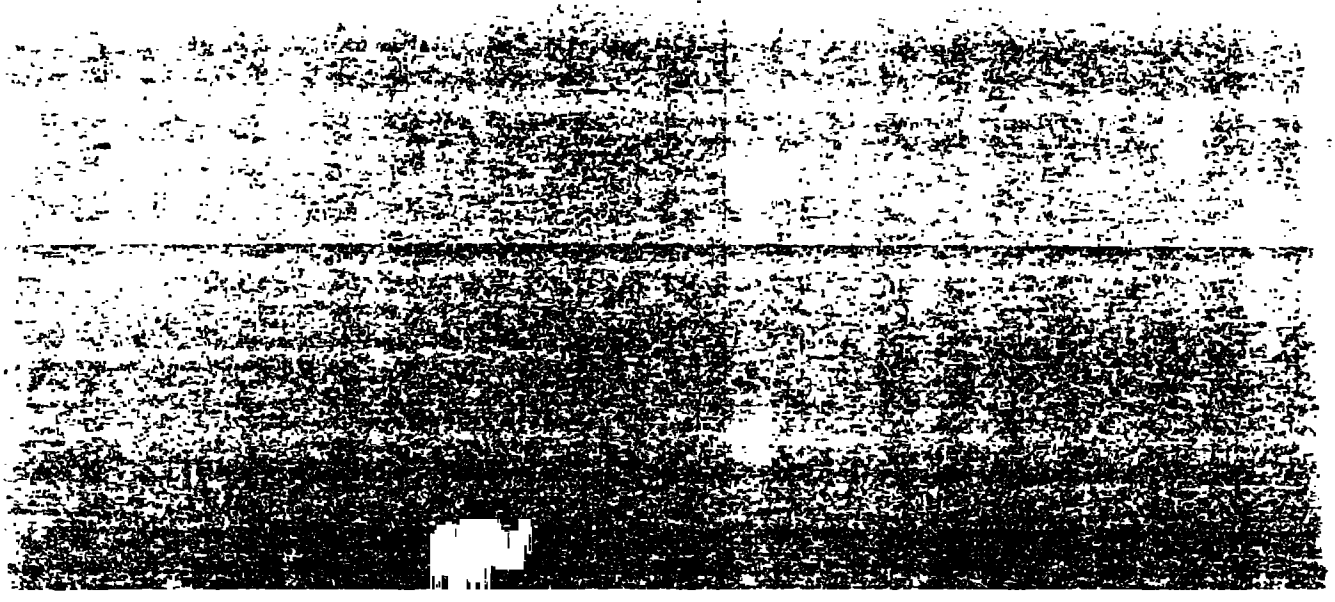
Table of Contents

List of Figures

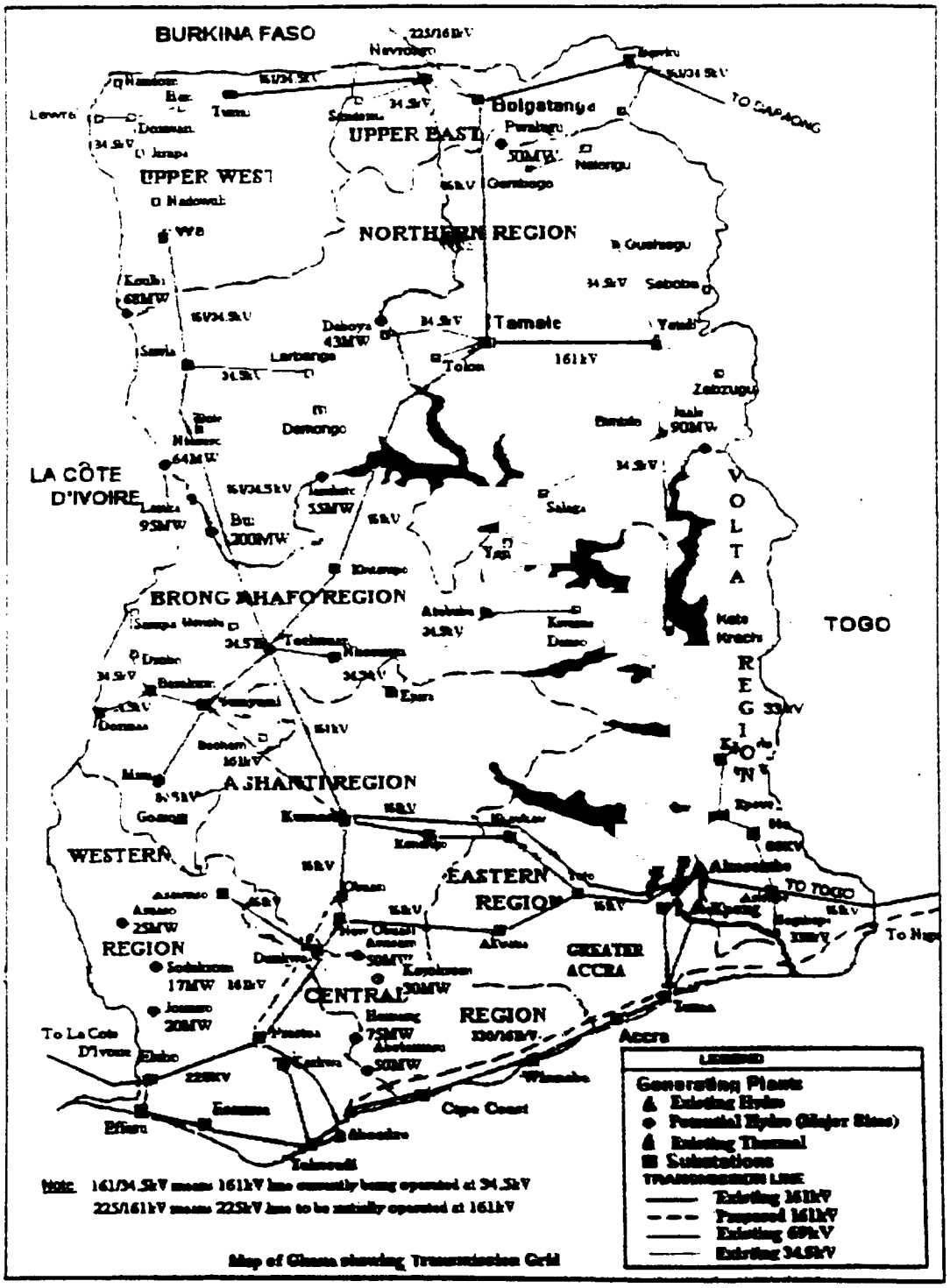
List of Tables

Chapter 1

Introduction



Map of the VRA's
Transmission Network in Ghana *(As at the end of 2000)*



Map of Ghana showing Transmission Grid

REFAST/VRA/330KV | FIG. 1.1

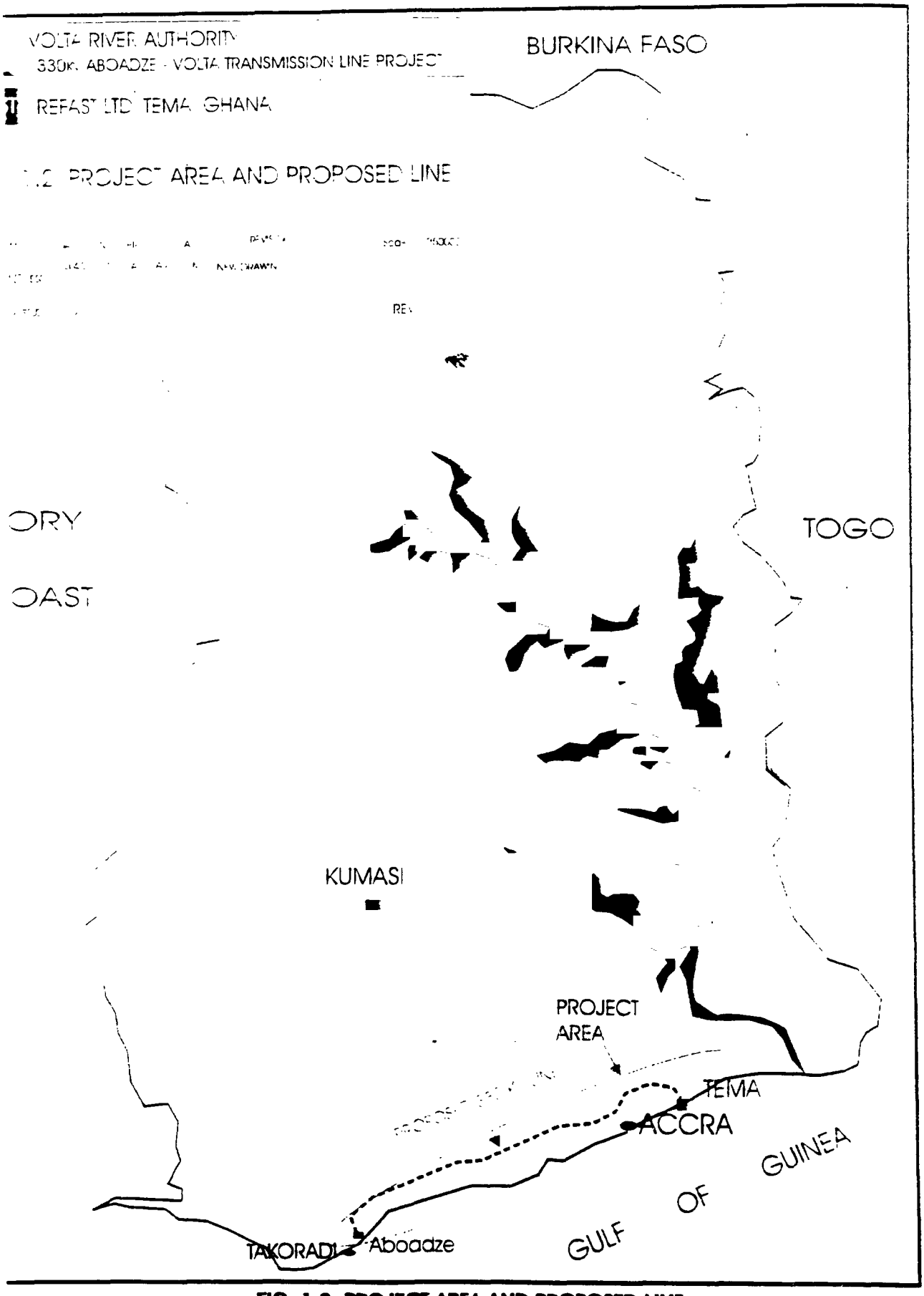
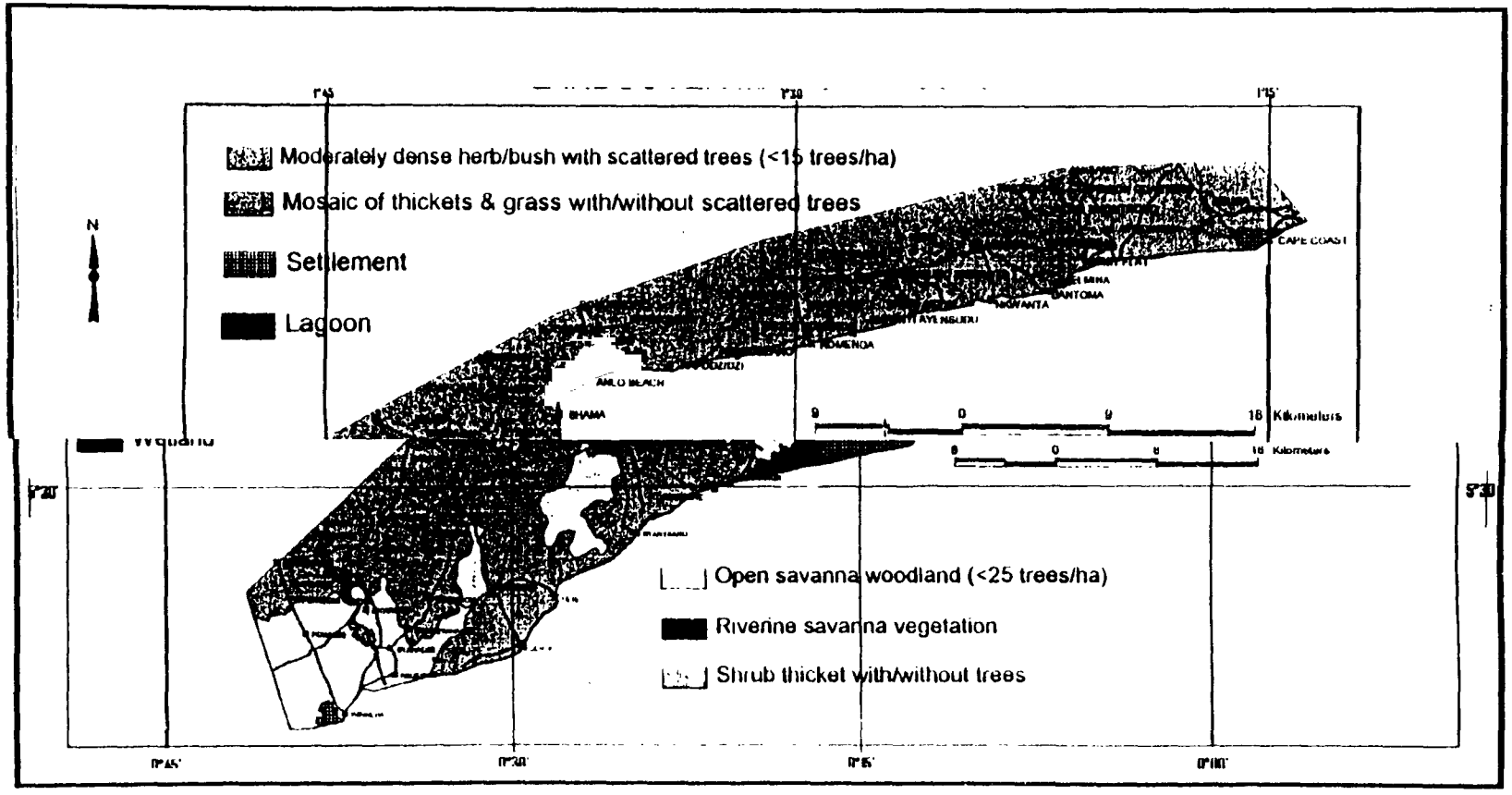


FIG. 1.2 PROJECT AREA AND PROPOSED LINE

PROPOSED 330 KV ABOADZE-VOLTA TRANSMISSION LINE PROJECT



SOURCE: CERSGIS, LEGON FIG. 3.4 LAND COVER MAP OF PROJECT AREA

1 INTRODUCTION

The Volta River Authority (VRA) proposes to construct a new Power Transmission Line from Aboadze in the Western Region to Tema in the Greater Accra Region. The project, which is known as the 330 KV Aboadze - Volta Transmission Line Project (hereafter referred to as AVTP), is required primarily to evacuate power from the Aboadze Thermal Plant to the Volta Switching station at Tema to be fed into the National grid.

In compliance with the Environmental Protection Agency (EPA) Act, 1994 (Act 490), and in furtherance of its Corporate Policy on Environment, which seeks to ensure the welfare of people adversely affected by its operations as well as to assist in sustainable development within the environment in which it operates. VRA is carrying out an Environmental Impact Assessment (EIA) for the proposed project.

Under the provisions of the Ghana Environmental Assessment Regulations, 1999 (LI 1652), erection of Power Transmission Lines falls under the category of Environmentally Critical Projects for which EIA is mandatory; the proposed project has therefore been duly registered with the EPA and Scoping has already been duly carried out.

1.1 Scope of Study

Kefast Ltd. (Marine, Environmental and Quality Consultants) has been engaged by VRA to undertake the EIA assignment.

From the Scoping carried out, the proposed Terms of Reference (see Annex1) for the EIA was submitted to the EPA and this was duly accepted with additions (see Annex 1), and forms the basis of this Environmental Impact Statement (EIS).

The EIS is presented in the format prescribed by the Ghana EIA Procedures and generally follows the pattern recommended by the World Bank.

This Chapter presents a brief background to the project and establishes the need for the project.

Following from this are discussions on the various Legal, Administrative and Policy issues that affect the implementation of the project. Future planned and related developments by VRA are also discussed.

Chapter 2 presents a description of the various components of the project implementation activities that are to be carried out with sufficient details (including photographs) on those aspects that have potential environmental impact.

Chapter 3 describes the baseline environmental conditions and this covers both the bio-physical and socio-economic/cultural components. The significant environmental impacts arising from the various project activities are discussed in Chapter 4 and include appropriate mitigation measures for the identified impacts. Chapter 5 outlines the monitoring plan to be used to verify the predicted impacts and to ensure compliance with recommended mitigation procedures.

Chapter 6 presents a discussion of the consideration of the various project alternatives. The provisional Environmental Management Plan is covered in Chapter 7.

The EIA has involved extensive consultations with various stakeholders including the public; affected persons, NGOs as well as Government agencies. Their inputs have been incorporated in all the Chapters and summarised in Chapter 8. Chapter 9 concludes the report with recommendations

1.2 Background - Volta River Authority (VRA)

The Volta River Authority (VRA) was established in 1961, as a public owned utility by the Volta River Development Act, 1961 (Act 46). VRA is engaged in the **generation, transmission and distribution** of electricity in Ghana.

Currently, VRA's generating capacity is made up of the following units:

- Akosombo Generating Station - Hydro - 912 MW
- Kpong Generating Station - Hydro - 160 MW

- Tema Generating Station - Diesel - 30 MW
- Aboadze Power Station - Thermal - 550 MW

The Aboadze facility is now operated by two separate entities:

- TAPCO – Takoradi Power Company, 100% owned by VRA, generates 330MW from 2 x 110 MW Gas Turbines coupled to 2 x 55MW Steam Turbines.
- TICO – Takoradi International Company Limited; owned 10% by VRA and 90% by CMS (USA), generates 220 MW from 2 x 110 MW Gas Turbines.

VRA owns and operates a countrywide transmission system for the distribution of bulk electric power in Ghana. This transmission network is made up of 35 substations with about 4,000-circuit km of transmission lines (see Fig. 1-1). The transmission grid is also interconnected to Togo and Benin (since 1972) and to La Cote d'Ivoire (in 1983).

The Authority supplies all the bulk electric power to the major consumers of electricity in Ghana. These include the Electricity Company of Ghana (ECG), the Volta Aluminium Company (VALCO), mining companies and some heavy industries (e.g. ALUWORKS, Steel companies) in Tema.

VRA, through its Northern Electricity Department (NED), has also been responsible for the distribution of electricity to domestic and industrial consumers over the Northern sector of Ghana covering Brong Ahafo, Northern, Upper West and Upper East Region since 1987.

1.3 Proposed Aboadze – Volta Transmission Line Project (AVTP).

The growths in the national economy and population, as well as modernisation, have combined to create demand for more energy. In order to meet the increasing demand for power in Ghana, the power generation from Aboadze is to be increased by a further 110 MW. In addition, the Ministry of Energy (through GNPC), has taken delivery (in October 2002) of a barge-mounted gas turbine to be installed at Effasu in the Western region. This is expected to generate an additional 125 MW in the very near future (i.e. 2003).

There is therefore the need to provide adequate transmission capacity for the evacuation of the additional power expected from these sources in the West i.e. Aboadze and Effasu.

System planning studies have been carried out on the transmission network covering the various proposed developments up to the year 2020. These are as captured in the "Transmission System Master Plan, 2000". These studies confirm that an additional 'coastal' line is required to reliably evacuate the higher power flows from the generating sources in the West to the large load centres in the East. The Western segment is also key to facilitating power transfers between Ghana and the neighbouring countries of La Cote d'Ivoire, Togo and Benin and a high level of reliability at this section must be ensured.

The proposed line will be constructed to transmit power at 330KV but will be commissioned initially with 161 KV and later increased to 330 KV (by 2010). The choice of transmitting at 330 KV instead of the usual 161 KV is the result of various studies carried out by VRA, the main advantages being the higher transfer capability and improvement in system reliability. Other benefits of the 330 KV transmission are:

- Improvement in system angular and voltage stability.
- Reduction in the outage rate of the system as the operational failure rate of 330 KV lines is about 50% that of the 161 KV lines.
- Reduction in system losses: higher voltages are transmitted with less current and losses are proportional to the current squared ($P = I^2R$)
- Reduction in overall transmission line Right-of-Way as the 330 KV lines have a larger capacity and will therefore require fewer lines.

A further benefit is that the 330 KV lines will also facilitate future interconnection with Nigeria through Communaute Electrique du Benin (CEB) and the development of the proposed West African Grid System.

1.4 Legal, Regulatory and Policy Considerations

The relevant policies and the regulatory conditions that must be considered for the successful implementation of the project have been assembled and reviewed as part of the EIA process and appropriate consultations with the relevant agencies have been undertaken.

The significant legislation considered include:

- Environmental Assessment Regulations, 1999 (LI 1652).
- The Land Policy, 1996
- Energy Commission Act, 1997 (Act 541).
- Environmental Protection Agency, Act 1994 (Act 490).
- National Museum Decree, 1969, (NLCD 387)
- Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542).
- Lands (Statutory Wayleaves) Regulations, 1964 (L.I. 334)
- Lands (Statutory Wayleaves) (Amendment) Regulations, 1964 (L.I. 346)
- Lands (Statutory Wayleaves) Act, 1963 (Act 186)
- Volta River Development Act, 1961 (Act 46).
- The Forestry Commission Act, Act 453, 1993
- Factories, Offices and Shops Act, 1970, Act 328

Consultations with the Energy Commission (EC) revealed that the provisions of the Commission's PUBLIC NOTICES EC. N. 001 and 003, require VRA to register the proposed project with the Commission prior to commencement of the project as part of the licensing process.

Further, the VRA and the Forest Services Division (FSD) have concluded a Memorandum of Understanding (MOU). This is to provide guidelines for the two institutions to collaborate effectively for the efficient management of electric power-related activities in national forest reserves.

Unlike those projects that are "site-specific" with impacts generally confined to a limited area of influence, the AVTP is a ***"linear"*** project spanning approximately 215 km. The impacts arising

In this respect, consultations with the local communities, including the relevant District Assemblies, have been undertaken as part of the EIA process to ensure that their concerns are taken into account. The details of the consultations are discussed in Chapter 8. However, the concerns and suggestions expressed by the various stakeholders have been duly incorporated throughout the report especially in the discussions on Impacts and Mitigation as well as in the Monitoring and Provisional EMP.

In case of the chance finding of any archaeological artefacts in the course of vegetation clearing or excavation for the erection of the transmission towers, the National Museum Decree, 1969, (NLCD 387) was consulted. This is the law governing the activities and operations of the National Museums and Monuments Board. Procedures to be followed on the discovery of any such artefacts are outlined in NLCD 387

The proponent (VRA) is responsible for addressing all matters relating to compensation and this has been duly addressed in the EIA study. The VRA is preparing a Property Impact Report, identifying all affected properties and their owners and estimating values of compensation to be paid

Consultations with the Energy Commission and the Ministry of Energy on issues relating to government policies and the ongoing Power Sector Reforms have also been undertaken. The thrust of Government policy is still to encourage private sector participation in the generation, transmission and distribution of electric power in Ghana.

The Government continues to receive proposals from various local and international investors interested to set up as Independent Power Producers (IPP). VRA is also continuing with plans to increase the generation and transmission capacity through new additions in the future (see 1.5 below).

From the standpoint of the Electricity Company of Ghana (ECG), the additional power from Aboadze and Effasu into the national distribution pool will go to enhance the system stability and supply reliability of the ECG. The three main performance indicators, which are frequency

of outages, duration of outages and availability of supply to new development areas, will all be enhanced. Particularly, a number of communities close to the RoW would be hooked to the national grid through the Self-Help Electrification Project (SHEP).

1.5 Future Developments by VRA

It is important that the proposed AVTP is seen within the wider context of the overall development objectives of VRA. Apart from additions from the Western Generators discussed earlier, VRA has initiated plans to improve the overall national power generation, transmission and distribution network in the near future and these include the ff:

i. **Proposed Kumasi – Sunyani 161 KV Transmission line** – this will be a 161 KV Transmission line from Kumasi (Ashanti Region) to Sunyani (Brong- Ahafo Region) covering a distance of about 115 km. This line is intended to assure security and reliability in the supply and delivery of power to the increasing load in the Northern parts of Ghana.

ii. **Tumu-Han-Wa 161 KV Transmission line** - this will also be a 161 KV Transmission line. This line is intended to close the Northern loop of the existing transmission network and further assure system performance while providing a means to export power to Burkina Faso.

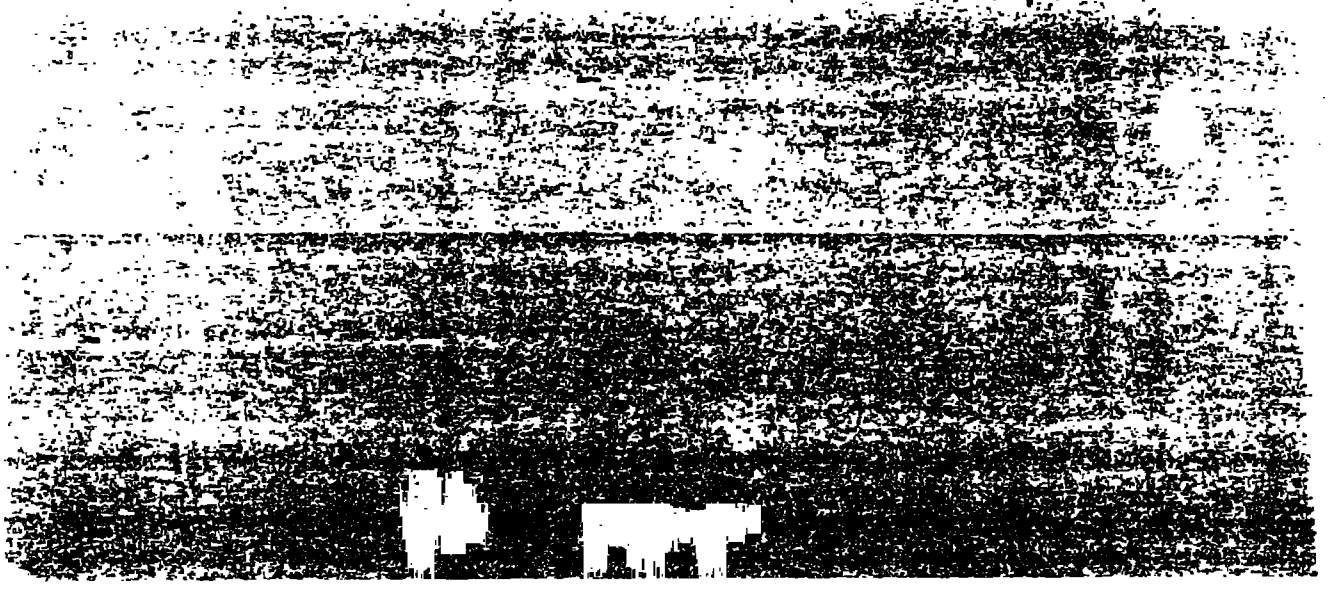
iii. **Tema Thermal Power Plant** – this project will involve the establishment a 300 MW Combined Cycle Thermal Plant operating on natural gas to be obtained from the West African Gas Pipeline project which is currently under development. The additional power is required to meet the growing domestic demand as well as the requirements of the Tema Export Processing Zone (TEPZ).

iv. **Kumasi Second Bulk Supply Substation (K2BSP)** – similar to other BSPs, this project will consist of a 161 KV substation for VRA with an adjacent 34.5 KV switching station for ECG. The main objective is to provide for the growing power requirements of Kumasi, which is Ghana's second largest city and its environs (including the proposed Inland Port at Boankra).

The proposed AVTP and all the projects listed above are expected to be operational by 2005 and this would greatly enhance reliability of power supply in the country and support the socio-economic development aspirations of the nation.

Chapter 2

Description of Proposed Development



2 DESCRIPTION OF PROPOSED DEVELOPMENT

In general, an electrical power transmission system consists of the transmission line itself (including the towers, conductors and their supports), its associated right-of-way (RoW), switchyards and substations as well as access roads and maintenance tracks. The proposal is to construct and operate such a system from Aboadze to Tema over a distance of about 215 km.

This chapter presents a description of the various phases of implementation of the proposed 330 KV Aboadze-Volta Transmission Line Project (AVTP), in sufficient detail in order to highlight those aspects and activities that have a bearing on the environment. In addition to Refast's sources, the information used for this section has been largely obtained from consultations with VRA as well as from project documents.

Along with site preparation activities, the proposed AVTP project will also comprise of the design, manufacture, testing, and delivery to site, erection, testing and commissioning of the 330 KV transmission line between Aboadze and Tema. The conductors will be of the 3 x 265mm^2 ACSR (triple bundle Toucan) type or equivalent. The steel strands of the conductors will be aluminised or suitably coated to withstand the salty moist air along the coast.

Modifications and civil works will also be carried out at the Aboadze and Volta switching stations (Tema) to accommodate line terminations. Two (2) 450MVA, 330/161KV autotransformers will be installed at the line ends (one at each end) to provide connection to the rest of the system.

The steel transmission towers will be erected at specified intervals along the route, which will span approximately 215 km. The line will be designed to carry 330 KV, however, initially it will carry 161 KV (up to about the year 2010). All other design considerations including RoW, clearances, tower parts etc will be for 330 KV. The height of the towers (approximately 40 m) will be such as to provide a minimum of 8 – 8.5 m clearance between the lines and the ground (i.e. at the lowest point) with a RoW of 40 m.

2.1 Pre-Construction Phase Activities

Prior to the start of construction, the main activities that are carried out are:

- **Line Route Survey** – A conventional survey of the proposed route was carried out in the year 2000 by Surveyors (Rudan Ltd) engaged by VRA. In accessing the route, the Surveyors used existing maintenance routes (for the existing line) and other farm tracks and footpaths. In some places they had to clear some vegetation (including crops) by slashing, in order to gain access to the route and for installing the concrete pegs/pillars. Eventually, the selected project contractor will be required to carry out another survey to verify the route. Plate 2.1 below shows an example of an access path used by the Surveyors, with inserts showing some of the pegs marking the route. A total of over 420 pegs have been placed along the entire 215 km route.

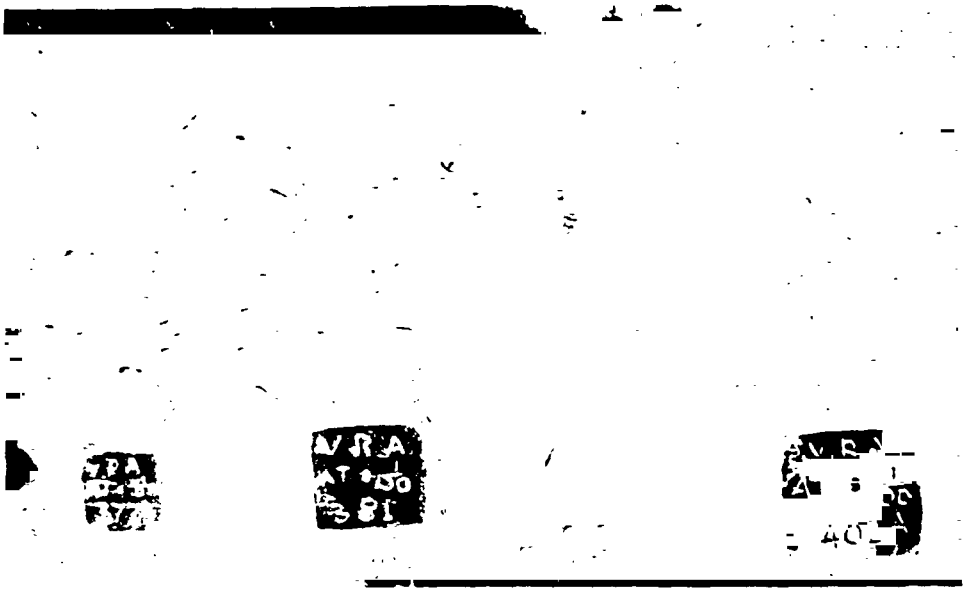


Plate 2.1 – Typical Line Route access path used for Survey with inserts of some concrete pegs

After confirming the line route, the contactor would carry out soil tests at every tower location (at approximately 400 m intervals) to ascertain the nature of the soils and this would determine the type of foundation to be used for the tower footing. The data on soil types presented in this report shall be available to the contractor.

- **Tower Spotting** – The specific sites (spots) for locating the individual towers will be finally determined based on various criteria including information gathered during this Environmental Impact Assessment. Generally, wherever possible, the towers will be located at or near the summits of the uplands to maximise the clearance between the lines and the ground.

2.2 Construction Phase Activities

A duly qualified contractor shall be engaged by VRA to execute the project. The main aspects of the construction activities are outlined below.

- **Construction Base Camps** – At the start of construction, Base Camps which are essentially "materials storage depots" equipped with mobile offices and workshops would be set up within 1 or 2 selected urban settlements along the proposed route. For the now ongoing POTP, campsites have been located at Prestea and Dunkwa. For the AVTP, possible locations could include Sekondi, Shama, Elmina, Cape Coast, Mankessim, Apam, Winneba and Accra/Tema Plate 2.2 below is a set of pictures showing a view of the ABB campsite at Prestea used for the POTP.

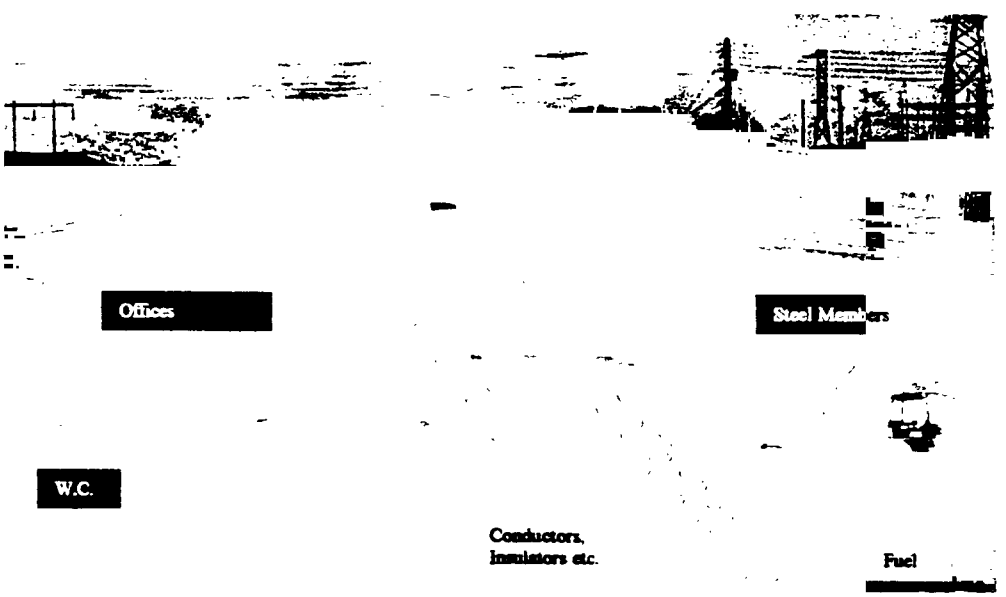


Plate 2.2 – Views of a typical Base Campsite for Transmission Line Project

Usually, there is no provision made for accommodation at the campsites and therefore urban locations are preferred, so that the contractor can rent rooms for the workers within the towns. Typically, a workforce of up to 150-200 persons, working in gangs, is required. Apart from the skilled technicians who are brought in by the contractor, all casual labourers and security personnel are engaged from among the local communities.

- **Transporting of machinery and equipment to site** – The typical machinery used during construction for such projects include the following:
  - ✓ Haulage Trucks fitted with crane
  - ✓ Tipper trucks
  - ✓ Excavator
  - ✓ Bulldozer
  - ✓ Concrete mixing plant (Batch Plant)
  - ✓ Fork lifts

  The trucks are used to transport construction materials and tower members/accessories, through public roads and along the access routes, to the erecting points.

- **Construction Access road** – Plate 2.3 below shows an example of the construction access road. At various selected points along the proposed route, access roads of approximately 3.5-5 m width (linking from public roads) will be cleared and used in transporting equipment and materials to the sites chosen for erecting the towers. Depending on the terrain, one (1) such route may provide access for erecting up to 10 towers or more. These roads will be cleared completely of all scrub and vegetation.

Plate 2.3 – Typical Construction Access Track off a main road

- **Clearing the Right-of-Way (RoW)** – the specifications for the 330 KV line prescribe a RoW of 40 m width. All tall trees and scrub within a distance of 20 m on either side of the centreline of the transmission line (i.e. approximately 40 m wide area) shall be cut down to a height of not more than 1.25 m above ground. All tall trees outside the RoW, but of such height as could fall within 2 m of the conductors, shall also be felled. During the field visits, it has been observed that in practice, this process of "bush clearing" is done in a very selective manner so as to do minimal damage to the vegetation cover and crops.

- **Clearing of the Tower Corridor track** - for the purpose of erecting the towers and for subsequent maintenance during the operational phase, a tower corridor track of approximately 2.5 – 3 m width, will be cleared under the towers, as far as is practicable. The specifications require the removal of all tree stumps and roots from this track leaving a graded path to permit the transit of "Land Rover" or other similar 4-wheel drive light vehicles for patrol and maintenance purposes. A view of a typical tower corridor track is shown in Plate 2.4 below.

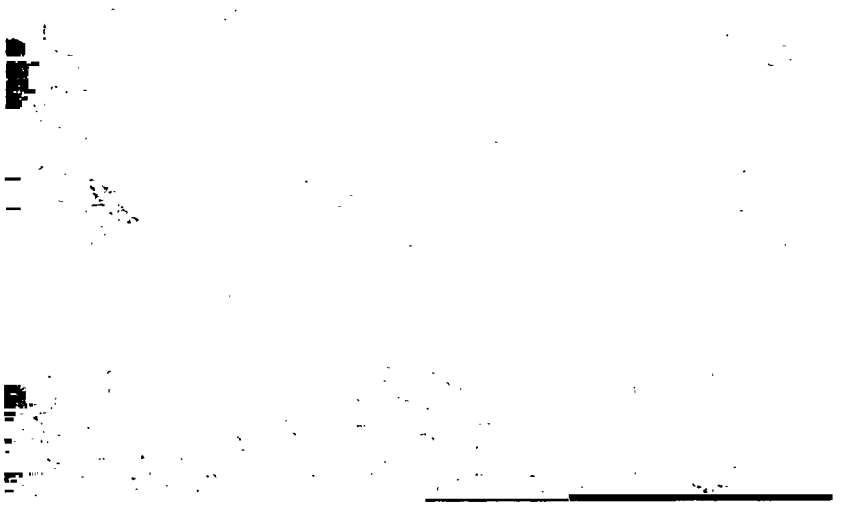


Plate 2.4 – A view of a Tower Corridor Track

- **Excavating for tower foundations** – at the sites selected for erecting the towers, the tower corridor track will be widened further to accommodate the tower foundations (pads).

The area to be cleared will cover an area equal to the dimensions of the tower base (about 5 m^2) plus an additional 2 m on each side. Stumps in the tower spot area shall not project more than 10 cm above ground. The tower foundations will consist of concrete footings of the "pad and chimney" type. Excavation for the foundations will depend on the soil type at the selected spot but will usually be between 2 – 3 m deep. The ground surface at each tower site shall be graded to provide drainage away from the tower legs.

- **Erection of towers** – the AVTP project will involve the erection of over 400 towers along the route. The towers (up to 40 m high) may be erected either by assembly on the ground and lifting or by erecting in stages. The contractor would determine the appropriate method to use subject to approval and supervision by VRA. Plate 2.5 shows a Tower erection ("in-stages" method) in progress and gives an idea of the size of area cleared for such activity. The inserts show the "chimney" end of the tower footing and the machinery used for hoisting the steel members.

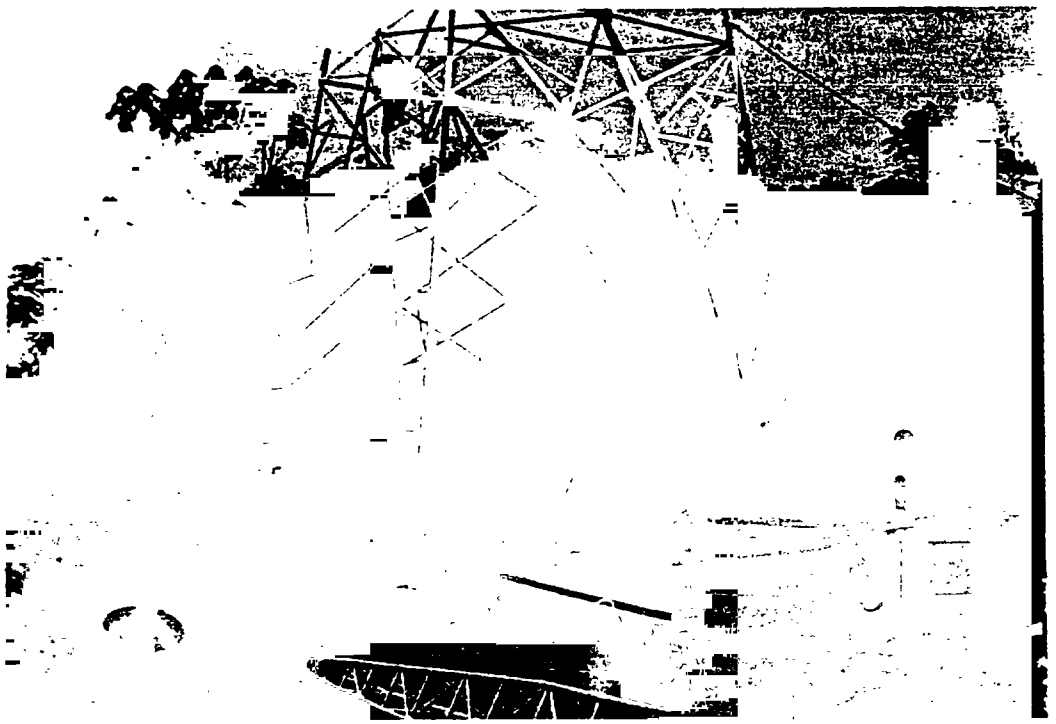
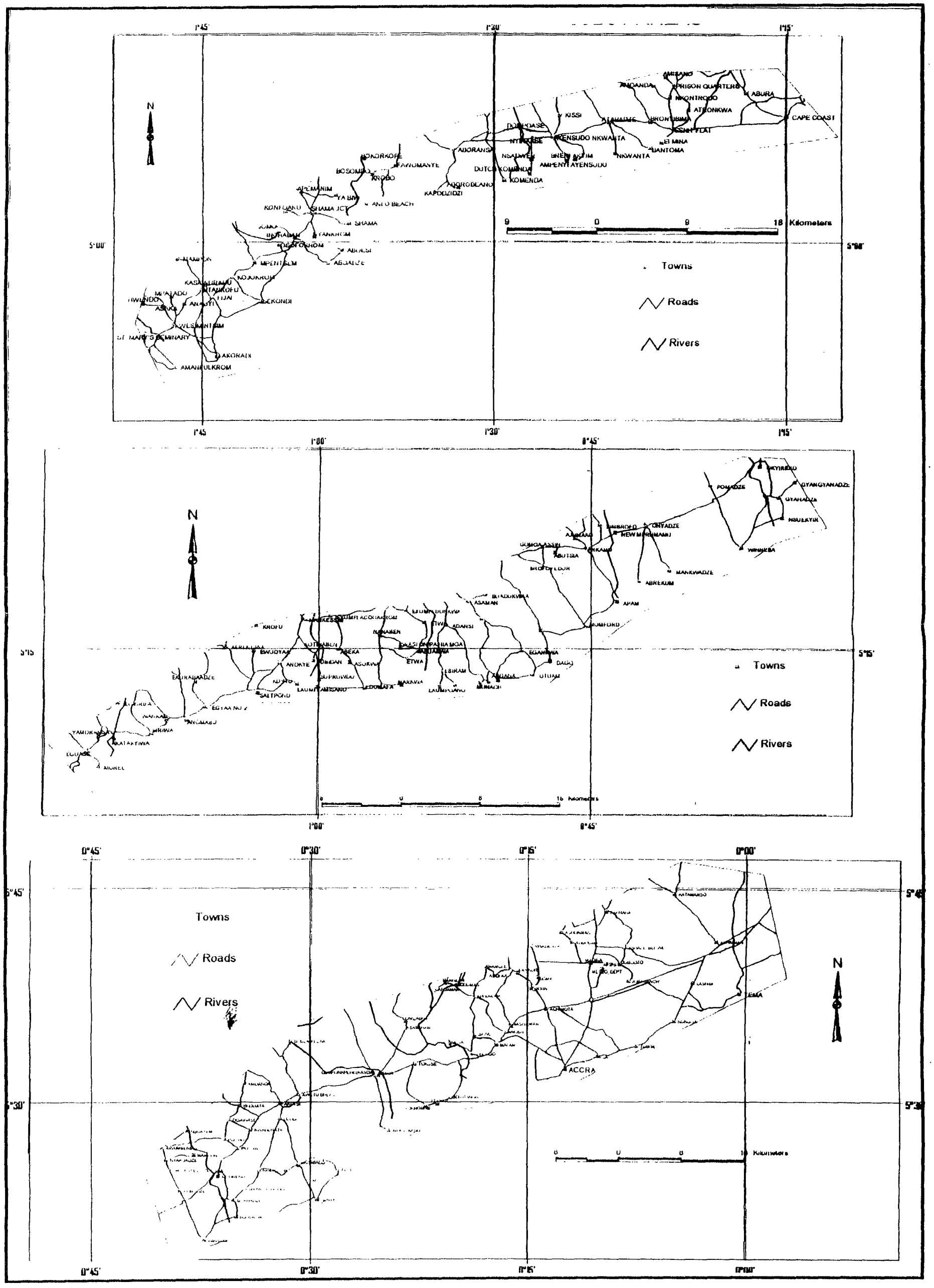


Plate 2.5 – Erecting of Tower in progress on the POTP Line

PROPOSED 330 KV ABOADZE-VOLTA TRANSMISSION LINE PROJECT



SOURCE: CERSGIS, LEGON FIG. 3.7. SETTLEMENT MAP OF PROJECT AREA

- **Erection of conductors, shield wires and other accessories** – the conductors (wound on wooden or metal drums) and accessories (insulators, fittings etc packed in wooden cases) shall be transported to site by trucks equipped with cranes. The stringing method to be used by the contractor will be subject to prior approval by VRA. In all cases where stringing will cross power lines, telephone lines, public roads etc, due notification to appropriate authorities will be given and the prescribed minimum clearances observed.

  When stringing across public roads, public safety (of persons, vehicles etc) is assured by the use of expandable aluminium scaffolds erected at both sides of the road. The wire is passed over the scaffolds to provide the necessary fixed, safe clearance from the road. Further protection is provided by the use of safety nets slung across the scaffolds beneath the line.

  For this project, two steel shieldwires will be strung along the lines, and no optic fibre cable (OPGW) will be installed.

- **Modification Works at Aboadze and Tema (Volta) Switching stations** – a summary of the civil works required at both substations is as given below:

  Aboadze Switching station works

- Demolition of entire existing TICO yard to make room for more expansion of existing switchyard
- Extension of existing switchyard to accommodate 3 more bays
- Installation of a 450 MVA 330/161 KV autotransformers at the line end.

  Tema Switching station works

- Extension of existing switchyard to accommodate 3 more bays
- Installation of a 450 MVA 330/161 KV autotransformer at the line end to provide connection to the rest of the system.

The lands to be taken up in the extension of the switchyards already belong to VRA, so no compensation issues would arise.

2.3 Operational Phase Activities

Upon completion of construction, the line will be put into service, operated and maintained by VRA. As previously stated, the AVTP will be operated initially at 161 KV until around the year 2010 when it is expected to transmit power at 330 KV. The major aspects of the operational phase (of environmental interest) will involve the following:

- **Security, public/occupational health and safety issues** - after the line is commissioned and transmitting power, issues of safety and security would become of paramount concern. The main operational activities will focus on maintaining the system integrity at all times with provision for rapid response to fault conditions along the line.

  The operation and maintenance of the transmission network is the responsibility of the VRA Transmission Department, with its head office at Tema (Volta substation). Within this department, the Line Maintenance section has direct responsibility for line maintenance (including towers, conductors and associated RoW). There are three (3) broad categories of Line Maintenance activities and these are discussed below.

- **Running Maintenance** – this comprises the normal checks and remedial actions taken to ensure reliability and safety of operations of the lines. Activities undertaken under the Line Running Maintenance are the following:
- Helicopter Patrol: aerial patrols provide a means of visually examining line sections and their associated RoW to detect any defect or potentially hazardous situation, which may jeopardize the security and reliability of the lines and the safety of the general public. All VRA transmission line sections are patrolled aerially once a year.
- Ground (Foot) Patrol: ground patrols provide a means of carefully examining a line section and the associated RoW to detect any defect or potentially hazardous situation that may jeopardize the security and reliability of the line and the safety of the general public.
  Ground patrols complement the helicopter patrol in evaluating the status of the lines. Special attention is given to line components and parts of components which are not easily observable from a helicopter. Ground patrols are carried out on all line sections twice a year.

- Security Patrol: these patrols are conducted on some line sections located in the outskirts of urban areas and towns, which are prone to acts of vandalism. Security patrols are conducted at least every fortnight throughout the year on the selected line sections. They ensure that any vandalism is detected promptly and necessary remedial actions taken quickly to repair the structures.

- Tower Auditing (Climbing Maintenance of Towers): auditing of towers provides a means of assessing the ageing process of towers. This activity starts one year after the commissioning of a line section and it follows a one-year cycle. In a cycle of tower auditing, 10% of all suspension towers and all dead-end towers are thoroughly examined. As the line ages, it is subjected to wear and fatigue which are not noticeable by distant visual inspection. Early detection and tightening of loose bolts on supports and hardware can reduce premature wear and identify worn components for replacement before failure.

  The checklist for this activity includes the following:

  - critical inspection of tower and line for signs of physical damage and deterioration
  - checking tightness of bolts on structures
  - evaluation of the degree of wear on hardware
  - checking of the alignment of vibration dampers
  - vibration studies
  - radio and television surveys
  - testing of insulators
  - checking the condition of joints and bolted connections using infra-red equipment
  - measurement of the thickness of galvanization on towers
  - checking of tower ground resistance
  - inspection of the right-of-way and condition of access roads

- Correction of Defects: following the patrols and tower auditing activities outlined above, a work schedule is drawn to correct all the minor defects observed. This work schedule normally covers the whole year with prioritisation of activities and includes the following:
  - replacement of flashed over insulators

- replacement of pieces of damaged conductor and shield wire
- replacement of defective dampers and other hardware
- replacement of vandalized components
- improvement of tower footing ground resistance
- insulator washing at substations and on selected towers
- spot/extensive clearing of tall vegetation growth on the RoW
- maintenance of access roads and tracks

All the activities indicated above are undertaken by VRA personnel except for "bush clearing" i.e. clearing of vegetation growth on the lines' RoW and the maintenance of access roads and tracks, which are carried out by private contractors and supervised by VRA staff. In all cases the procedures prescribed in the VRA Health and Safety Rules (1993) are complied with.

- Major Maintenance - defects found to occur repetitively during Running Maintenance are dealt with during major maintenance activities. Examples of these activities include line re-insulation and hardware replacement.

There are refurbishment/rehabilitation programmes carried out on ageing lines especially those routed through aggressive environments (e.g. mining, industrial and coastal). Major activities to combat acts of vandalism on older lines are also included in these programmes.

Activities undertaken under the VRA Transmission Line Major Maintenance programme include the following:

- Re-insulation of Transmission Line Sections.
- Treatment of rust and re-painting of tower components,
- Replacement of corroded towers and transmission line hardware.
- Replacement of conventional bolts and nuts with anti-theft fasteners on older line sections.
- Rehabilitation of access roads and tracks.

- **Emergency Maintenance** - these are activities relating to the clearing of sustained line faults. Emergency maintenance takes about 5% of the annual activities of the Maintenance Section. Emergency maintenance could be minor (e.g. hardware or insulator failure) or major (e.g. one or more tower failures). The following are the usual Emergency Maintenance activities undertaken:

  - Helicopter and/or ground patrols to locate sustained line faults.
  - Clearing of sustained line faults e.g. replacement of failed insulators, clamps or repositioning/repair of conductors.
  - Construction of temporary by-pass line to replace collapsed sections of lines.
  - Re-construction of collapsed portion of lines.

VRA personnel usually carry out emergency maintenance activities. However, some components such as re-construction of collapsed lines may be carried out by contactors under VRA supervision.

2.3.1 Other Operational Considerations

When the line becomes operational, issues related to the effects of electromagnetic fields, corona discharge and induction effects would become relevant. These phenomena and their effects on the environment (including health and safety) continue to be the subjects of ongoing research worldwide. The discussions on these effects are presented in detail under a sub-topic "Special Issues" in Chapter 4 (Impacts and Mitigation).

3 DESCRIPTION OF EXISTING ENVIRONMENT

The evaluation of the potential impacts of the proposed project requires a clear understanding of the nature and characteristics of the existing (baseline) environment (i.e. both bio-physical and socio-economic/cultural). The proposed AVTP from Aboadze to Tema, spans a total distance of about 215 km and lies roughly between longitude 1°40"W and 0° 00" and latitude 4° 75"N and 5° 45"N. This chapter focuses on the baseline environmental factors.

Format of Presentation

The AVTP is a "linear" project within a relatively narrow corridor (40 m wide), traversing a wide area of influence (215 km) with diverse characteristics. In order to facilitate the discussions, the route has been divided into three (3) segments of approximately 75 km lengths. The maps of the project areas - Fig. 3.4 (Land Cover/Vegetation), Fig. 3.5 (Soils) and Fig. 3.6 (Settlements) - show this segmentation, which is only for convenience of presentation.

3.1 Bio-Physical environment

This section discusses the natural resources occurring in the project area. The major natural resources are the Flora-Fauna, Water resources and Soils. In the Scoping Report (Chapter 4.0 pp.1-1), the relevant details on the existing bio-physical environment were duly presented. The discussions here will therefore focus on the specific aspects such as forest reserves, sacred groves and conservation issues. The section on water resources also focuses on the water bodies that lie directly within the proposed corridor.

3.1.1 Climate

The project areas, lying in the South of Ghana, experience a bi-modal high rainfall, separated by two dry spells. These conditions are driven by two major air masses that dominate the entire West African sub-region. These are the northerly trade wind (Harmattan), which blows from the north-east (the Sahara Desert), and the south-west trade wind (south-west Monsoon), a moisture laden wind which blows in from the Atlantic Ocean.

In order to properly represent the climate spanning the entire route, data (Rainfall, Temperature and Relative Humidity) from the Meteorological Services for Takoradi, Cape Coast, Saltpond, Winneba and Accra covering the period 1990-2002 have been obtained and presented as follows:

Table 3.1 Rainfall (mm) for Project Areas 1990 -2002

LOCATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Accra	15.0	13.1	51.1	74.7	126.4	165.8	68.7	11.4	22.4	48.8	33.3	28.1
Winneba	11.8	15.7	49.9	93.4	161.2	203.7	60.7	17.2	28.9	57.2	37.8	20.9
Saltpond	16.9	18.2	81.3	108.4	201.7	210.7	65.4	25.0	31.7	76.1	48.0	25.3
Cape Coat	17.2	15.1	63.3	100.6	177.3	199.8	72.3	28.7	29.0	76.3	41.0	40.7
Takoradi	15.4	23.9	54.9	138.7	198.0	272.9	106.9	49.3	42.5	125.5	64.1	32.1

Source: Meteorological Services Dept. - 2002

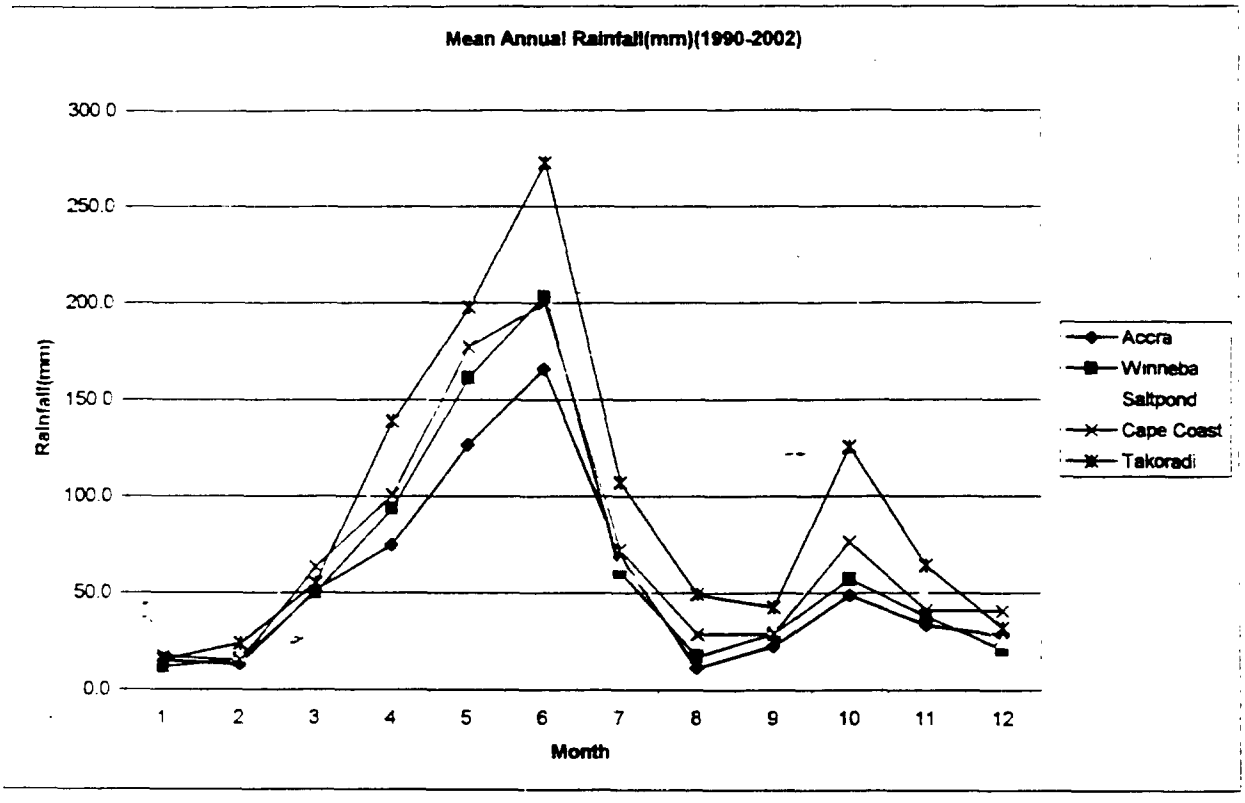


Fig. 3.1 – Mean Annual Rainfall (mm) 1990-2002 for Project areas

Temperature: Table 3.2 below shows the mean monthly temperatures for selected locations within the project areas averaged over the period 1990-2002. The average temperatures ranging from 24.8 °C to 29.2 °C are generally high especially within the Winneba to Accra segment as shown in Fig. 3.2 below.

Table 3.2 – Mean Monthly Average Temperatures (°C) in Project Areas

LOCATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Accra	28.2	29.1	29.2	28.8	28.2	26.9	26.0	25.7	26.6	27.5	28.3	28.1
Winneba	27.5	28.6	26.3	28.6	27.9	27.0	26.1	25.7	26.5	27.1	27.7	27.6
Saltpond	26.7	27.6	27.5	27.5	27.1	26.0	24.9	24.5	25.2	26.1	26.8	27.0
Cape Coast	27.4	28 4	28.7	28.5	27.9	27.0	26.1	25.8	26.6	27.2	25.5	27.8
Takoradi	27.2	27.9	28.0	28.0	27.5	26.4	25.2	24.8	25.4	26.4	27.2	24.9

Source: Meteorological Services Department - 2002

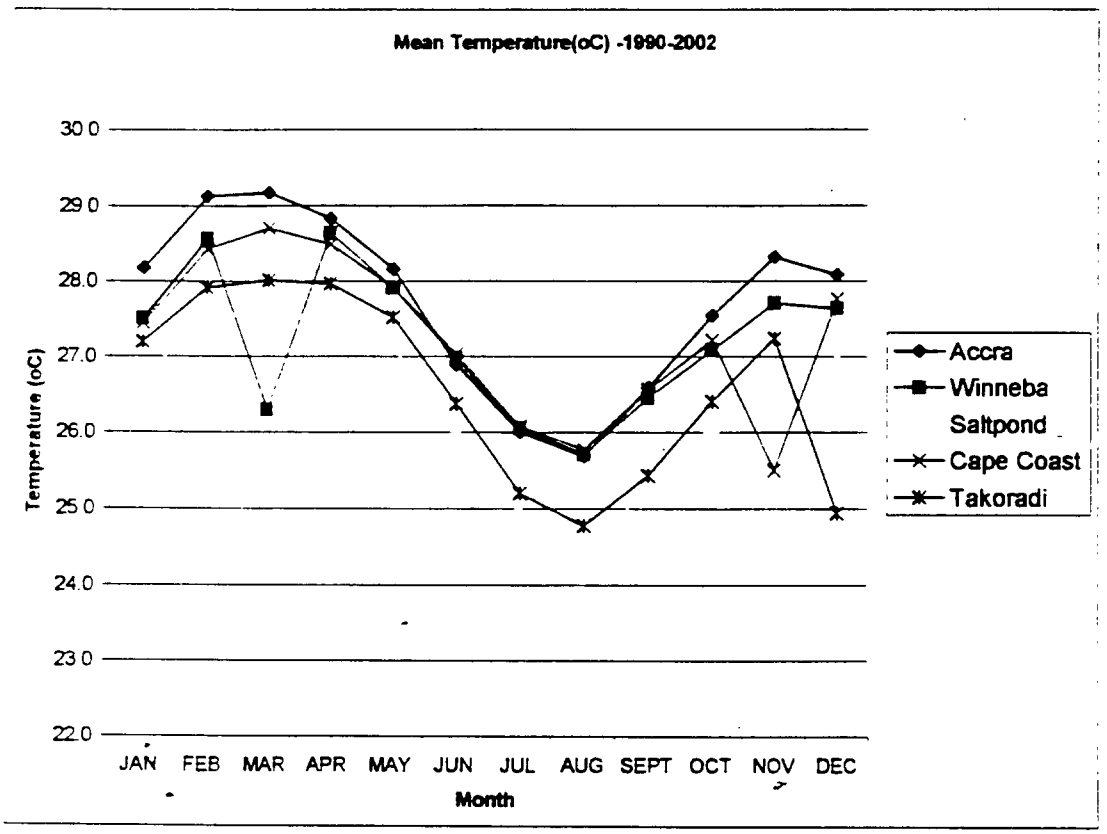


Fig. 3.2 – Mean Monthly Average Temperatures (°C) in Project areas (1990-2002)

Relative Humidity: Table 3.3 below gives the average percent Relative Humidity data for the selected locations within the project areas for the period 1990-2002. The data shows that the

Relative Humidity: Table 3.3 below gives the average percent Relative Humidity data for the selected locations within the project areas for the period 1990-2002. The data shows that the

coastal areas are generally humid and the transmission lines would need to be suitably protected against corrosion.

Table 3.3 – Mean Percentage Relative Humidity in Project Areas (1990 – 2002)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Accra	75	77	78	80	82	84	84	83	82	81	80	78
Winneba	84	85	85	86	87	90	90	90	89	87	87	86
Saltpond	85	85	86	87	88	90	91	91	89	89	87	86
Cape Coast	85	83	75	84	87	88	88	88	87	86	78	84
Takoradi	84	84	85	85	87	89	90	90	89	87	85	85

Source: Meteorological Services Department - 2002

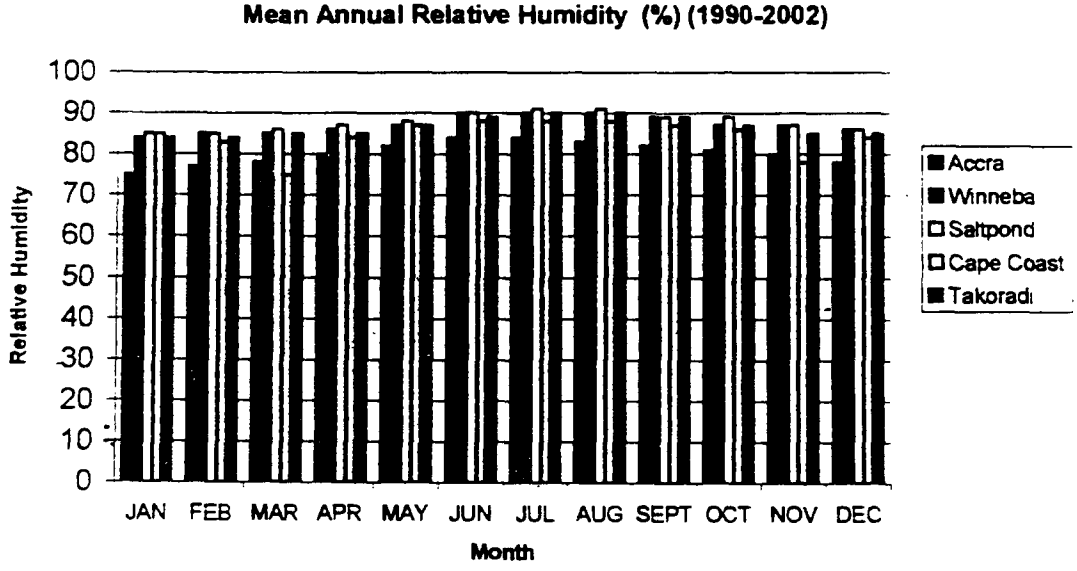


Fig. 3.3 – Average Percentage Relative Humidity in Project areas (1990-2002)

3.1.2 Flora

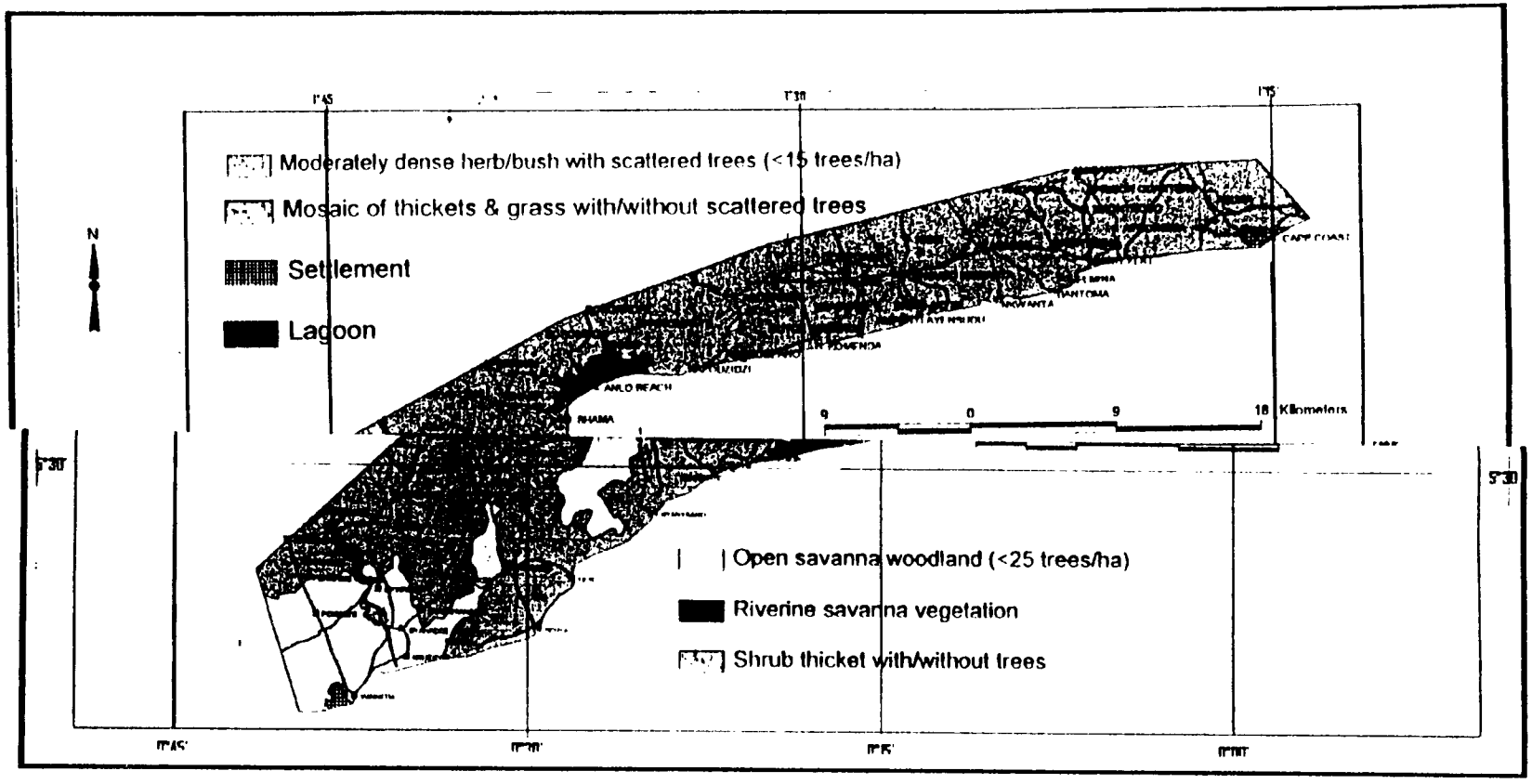
Floral Survey Methodology

A reconnaissance survey was conducted to identify the vegetation zones traversed by the transmission line ROW. Checklists of the plant species were then produced for the major vegetation zones identified along the route. Frequency symbols were used to subjectively determine the abundance of plant species at various sections of the route; species were thus rated as Dominant, Abundant, Frequent, Occasional or Rare. The prefixes 'Very' and 'Locally' were used to qualify the symbols where necessary. The **conservation** statuses of the of the forest species on the checklists were determined using the star rating system developed by Hawthorne (1995) as follows:

Black Star species:	Species rare internationally and at least uncommon in Ghana; urgent attention to conservation of populations needed
Gold Star species:	Fairly rare internationally and/or locally
Blue star species:	Widespread internationally but rare in Ghana or vice-versa
Scarlet star species:	Common, but under serious pressure from heavy exploitation
Red Star species:	Common, but under pressure from exploitation
Pink Star species:	Common and moderately exploited. Also non-abundant species of high potential value
Green Star species:	No particular.

The proportions of species in the various categories were estimated and used in evaluating the ecological significance of the areas to be traversed by the RoW. The ecological guild of the species is indicated as Pioneer, Shade Bearer (SB), and Non Pioneer Light Demander (NPLD).

The nomenclature used is after Hutchinson and Dalziel (1954-1972). The Vegetation description is based on Hall and Swaine (1981) for forest vegetation and Taylor (1960) for non-forest vegetation. Various sections of the route were walked and species lists compiled. Sacred groves and forest reserves along the route were identified and the appropriate authorities consulted.



SOURCE: CERSGIS, LEGON FIG. 3.4 LAND COVER MAP OF PROJECT AREA

Survey Results and Discussion

Fig. 3.4 shows the vegetation in the project area segments. The floral survey identified three (3) main vegetation zones as follows:

i. Maritime Vegetation
ii Dry Semideciduous Inner Zone forest sub-type/ Southern Marginal Forest and their intergrades
iii. Coastal Grassland and Thicket

- **The Maritime Vegetation**

This vegetation type has 3 sub-types viz., Strand, Mangrove and Former Lagoons. Two of these, Strand and Mangroves were readily identified along the RoW. Some marshes found in the RoW near the coast may well be former lagoons. The strand vegetation starts from the sand bar along the beach behind the Aboadze thermal plant and stretches for about 100 m inland. The *Cyperus-Ipomoea* association typifies the vegetation. The dominant species encountered are *Cyperus maritimus*, *Ipomoea pres-caprae* and *Canavalia rosea*. A list of the species found in the area is presented in Table 3.4 (a).

A marshland dominated by *Cyperus articulatus*, occurs to the West of the thermal plant and it is likely to be a Former Lagoon, which has been sealed off from the sea. A list of the species found in and around the marshland/swamp is provided in Table 3.4 (b).

The RoW traverses mangrove vegetation at the Pra River estuary in Shama. The mangrove vegetation here is composed of *Rhizophora racemosa*, *Avicennia germinans* and *Laguncularia racemosa*. *Achrostichum aureum* (a fern) and *Sesuvium portulacastrum* were found growing in association with the mangrove species. The *Achrostichum aureum* occupies mostly degraded areas of the vegetation. The mangrove forest is about 6 m high in most places.

Table 3.4 (a) Species list of Strand Vegetation at Aboadze Thermal Plant Area

Species	Family	Habit	Abundance
Canavalia rosea	Papilionaceae	Creeper/Herb	Very Abundant
Crotalaria retusa	Papilionaceae	Shrub	Frequent
Cyperus maritimus	Cyperaceae	Herb	Very Abundant
Ipomoca pes-caprae	Convolvulaceae	Creeper/Herb	Very Abundant

Species	Family	Habit	Abundance
Sporobolus virginicus	Graminae	Herb	Abundant
Paspalum vaginatum	Graminae	Herb	Abundant
Sesuvium portulacastrum	Ficoideae	Herb	Very Frequent
Sansevieria liberica	Agavaceae	Herb	Occasional
Remirea maritime	Cyperaceae	Herb	Abundant
Euphorbia sp.	Euphorbiaceae	Herb	Occasional
Cocos nucifera	Palmae	Tree	Frequent
Scaevola plumieri	Goodeniaceae	shrub	Occasional
Agave sisalana	Agavaceae	Herb	Occasional

Table 3.4 (b) Species list of Marshland/Swamp vegetation at Aboadze thermal plant

Species	Family	Habit	Abundance
Abutilon mauritanum	Malvaceae	Shrub	Frequent
Dactyloctenium aegyptium	Graminae	Herb	Frequent
Ludwigia erecta	Onagraceae	Herb	Locally Frequent
Sida linifolia	Malvaceae	Herb	Occasional
Oldenlandia corymbosa	Rubiaceae	Herb	Frequent
Passiflora foetida	Passifloraceae	Herb/Climber	Frequent
Mimosa pudica	Mimosaceae	Herb/Creeper	Frequent
Schrankia leptocarpa	Mimosaceae	Herb/Creeper	Frequent
Sporobolus pyramidalis	Graminae	Herb	Very Frequent
Leonotis nepetifolia	Labiatae	Herb	Occasional
Pennisetum pedicellatum	Graminae	Herb	Occasional
Chromolaena odorata	Compositae	Shrub	Abundant
Indigofera hirsute	Papilionaceae	Shrub	Very Frequent
Imperata cylindrical	Graminae	Herb	Abundant
Croton lobatus	Euphorbiaceae	shrub	Frequent
Cyperus articulatus	Cyperaceae	Herb	Locally Dominant
Euphorbia hirta	Euphorbiaceae	Herb	Frequent
Euphorbia heterophylla	Euphorbiaceae	Herb	Frequent
Lantana camara	verbenaceae	Shrub	Frequent
Phoenix reclinata	Palmae	Tree	Occasional
Fimbristylis trifiora	Cyperaceae	Herb	Locally Frequent
Desmodium triflorum	Papilionaceae	Herb	Frequent
Spigelia anthelmia	Loganiaceae	Herb	Very Frequent
Stachytarpheta cayennensis	verbenaceae	Herb	Frequent
Schwenkia americana	solanaceae	Herb	Frequent
Ruellia tuberosa	Mimosaceae	Herb/Climber	Occasional
Phyllanthus amarus	Euphorbiaceae	Herb	Frequent
Physalis angulata	solanaceae	Herb	Frequent
Uraria picta	Papilionaceae	Herb	Frequent
Waltheria indica	Sterculiaceae	Shrub	Frequent

Species	Family	Habit	Abundance
Triumfetta rhomboidea	Tiliaceae	Shrub	Frequent
Hygrophila auriculata	Acanthaceae	Herb	Occasional
Eleusine indica	Graminae	Herb	Frequent
Crinum ornatum	Amaryllidaceae	Herb	Occasional
Evolvulus alsinioides	Convolvulaceae	Herb/Creeper	Frequent
Asystasia calycina	Acanthaceae	Herb	Frequent

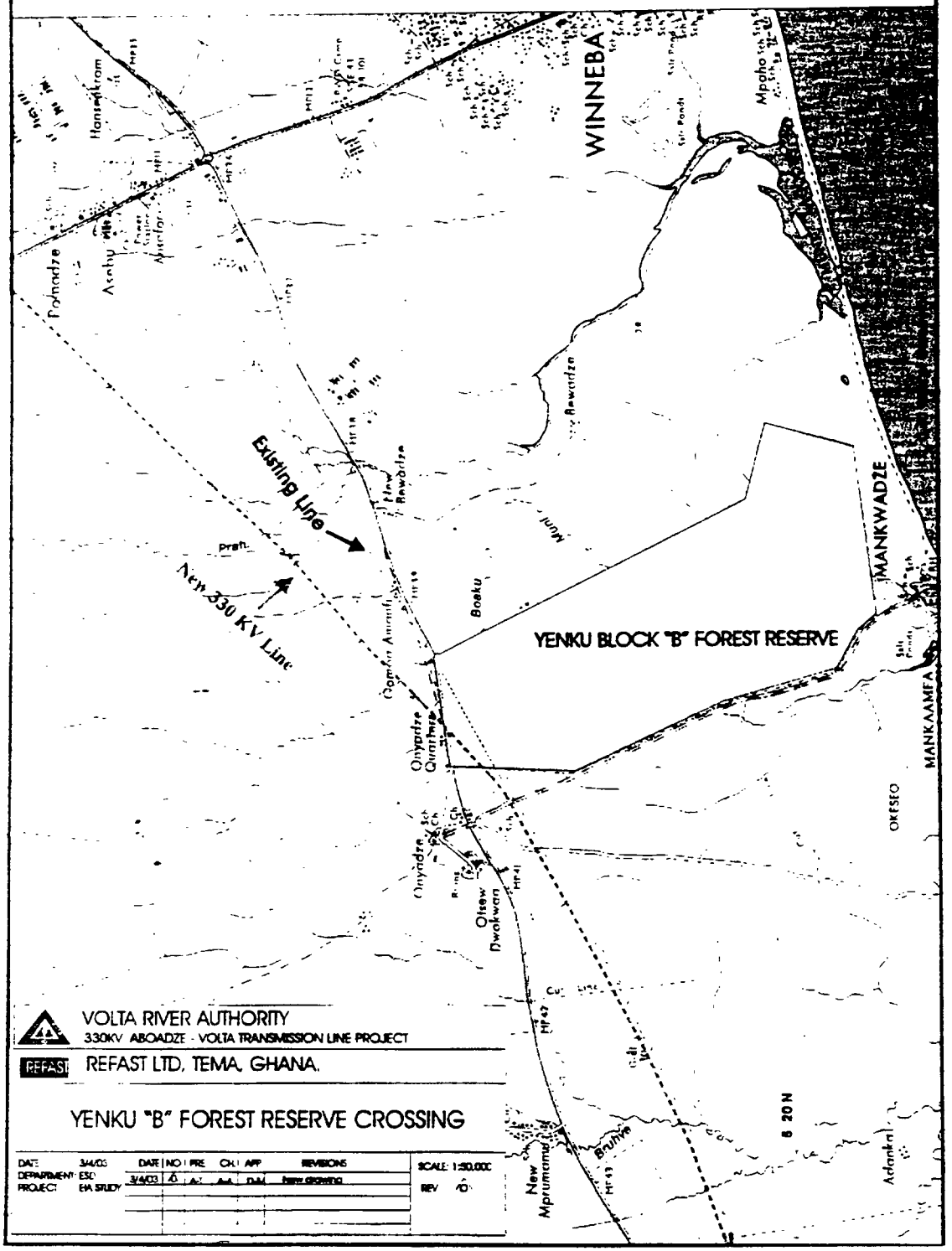
- **Dry Semi-deciduous Inner Zone forest subtype/ Southern Marginal Forest Zone**

The Dry Semi-deciduous Inner Zone (DSIZ) and the Southern Marginal (SM) forest types, and their transitions or intergrades, form the dominant vegetation of the transmission line route. Away form the maritime vegetation described above and to the east of Takoradi to near Cape Coast, the transmission line passes through the DSIZ. From Cape Coast to Winneba, the route passes through the SM forest type. The route passes through the Yenku block B forest reserve (at Onyadze) and the proposed Apra Hill forest reserves (near Awutu Breku) in the SM zone. Both reserves were visited in the company of officials from the Winneba District office of the Forest Services Division who assisted in locating the surveyors' pegs.

The Yenku 'B' forest reserve is basically a plantation of *Eucalyptus* and Neem (*Azadirachta indica*). About 1.12 km of the route passes through the Yenku forest (since the width of the RoW is 40 m, this approximates to an area of about 0.05 km^2 that should be cleared. Fig. 3.5 overleaf shows the proposed route crossing relative to the existing line. This area (0.24%) appears to be insignificant compared to the overall size of Yenku, 21.2 km^2. Since the affected area is an artificial forest, no species of conservation concern would be affected by the project. The Yenku Block "B" forest has the main Winneba – Cape Coast road traversing a small portion of the forest at its northern tip. Also, the existing Winneba-Cape Coast double circuit line passes through the forest, a little southern to the proposed 330 KV line. Logging is strictly prohibited in the forest. However, hunting activities are permitted at the officially approved, on season periods. The affected parts of the forest, with their access and tracks maintenance tracks may open up the forest to encroachers.

PROPOSED 330 KV ABOADZE - VOLTA TRANSMISSION LINE

FIG. 3.5 YENKU "B" FOREST RESERVE CROSSING



The proposed Apra Hill forest is a relatively small forest with a perimeter of 9.59 km (Forest Service Division, Winneba District) that is yet to be designated a reserve by the Government. It is a relatively undisturbed secondary forest with trees reaching up to 30 m in height. The canopy is open in some places, a situation that is typical of forests on slopes and hilltops. About 1.96 km of the reserve is directly affected by the route (equivalent to 0.08 km^2 of forest). Table 3.4 (c) is a list of some of the species in the reserve. The species composition indicates that it is a more of a DSIZ type of forest rather than SM. This is because it is located on higher ground and could be a transition of the two types mentioned above. Some of the species found here are important to the commercial timber trade e.g. *Nesogordonia papaverifera* (Danta), *Milicia excelsa* (Odum), *Triplochiton scleroxylon* (Wawa) and *Mansonia altissima*.

Table 3.4 (c) Species list of Apra Hill forest

Species	Family	Habit	Star rating	Guild
Acanthaceae indet.	Acanthaceae	Shrub		
Anchomanes difformis	Araceae	Herb	Green	SB
Aningeria robusta	Sapotaceae	Tree	Pink	NPLD
Antiaris toxicaria	Moraceae	Tree	Pink	NPLD
Baphia nitida	Papilionaceae	Tree	Green	SB
Baphia pubescens	Papilionaceae	Tree	Green	SB
Blighia sapida	Sapindaceae	Tree	Green	NPLD
Ceiba pentandra	Bombacaceae	Tree	Green	Pioneer
Celtis mildbraedii	Ulmaceae	Tree	Green	SB
Celtis zenkeri	Ulmaceae	Tree	Green	NPLD
Chromolaena odorata	Compositae	Shrub	Green	Pioneer
Cola gigantea	Sterculiaceae	Tree	Green	NPLD
Crinum sp.	Amarylidaceae	Herb		
Dracaena arborea	Agavaceae	Tree	Green	Pioneer
Drypetes singroboensis	Euphorbiaceae	Tree	Gold	SB
Elytraria sp.	Acanthaceae	Herb		
Hymenostegia afzelii	Caesalpiniaceae	Tree	Green	SB
Hypselodelphys violacea	Marantaceae	Herb	Green	Pioneer
Lecanodiscus cupanioides	Sapindaceae	Tree	Green	SB
Mallotus oppositifolius	Euphorbiaceae	Shrub	Green	SB
Mansonia altissima	Sterculiaceae	Tree	Pink	NPLD
Melanthera scandens	Compositae	Shrub	Non forest	
Milicia excelsa	Moraceae	Tree	Scarlet	Pioneer
Morus mesozygia	Moraceae	Tree	Green	Pioneer

Nesogorgonia papaverifera	Sterculiaceae	Tree	Pink	SB
Newbouldia laevis	Bignoniaceae	Tree	Green	Pioneer
Panicum maximum	Graminae	Herb	Non forest	
Paullina pinnata	Sapindaceae	Climber	Green	Pioneer
Pterygota macrocarpa	Sterculiaceae	Tree	Red	NPLD
Sansevieria liberica	Agavaceae	Herb	Non forest	
Sterculia oblonga	Sterculiaceae	Tree	Green	Pioneer
Triplochiton scleroxylon	Sterculiaceae	Tree	Scarlet	Pioneer

Table 3.4 (c) indicates that the 32 species encountered during the inventory of the Apra Hill reserve belong to 17 families. The family Sterculiaceae had the largest number of species (6) followed by the Moraceae and Sapindaceae with 3 members each. The forest is rich in tree species (66%). The low representation of herbs (19%), shrubs (13%) and climbers (3%) indicates that the forest is largely undisturbed. The forest has a good proportion (25%) of species of conservation concern, most of which are important timber species.

Sacred Groves/Shrines

During the consultations and field studies for the EIA, eleven (11) sacred groves/shrines have been found along the proposed route and these are shown in Table 3.4 (d) overleaf. The groves/shrines vary in size from a single tree (the Nana Abeka shrine is a single *Triplochiton scleroxylon*, Wawa, tree) to several hectares (the Guako grove is about 11.28 ha).

The Guako grove is a remnant SM forest at Pokuase, a peri-urban fast-growing town near Accra. The transmission line route passes through the northwestern tip of the grove. Only one (1) surveyors peg, No. 378Q, (see insert in Plate 3.1 below) is located in the grove. Table 3.4 (e) is a species list for the Guako grove. It is relatively rich, having been preserved by tradition. The canopy of the forest is broken in several places and the tallest trees reach up to 30 m in height.

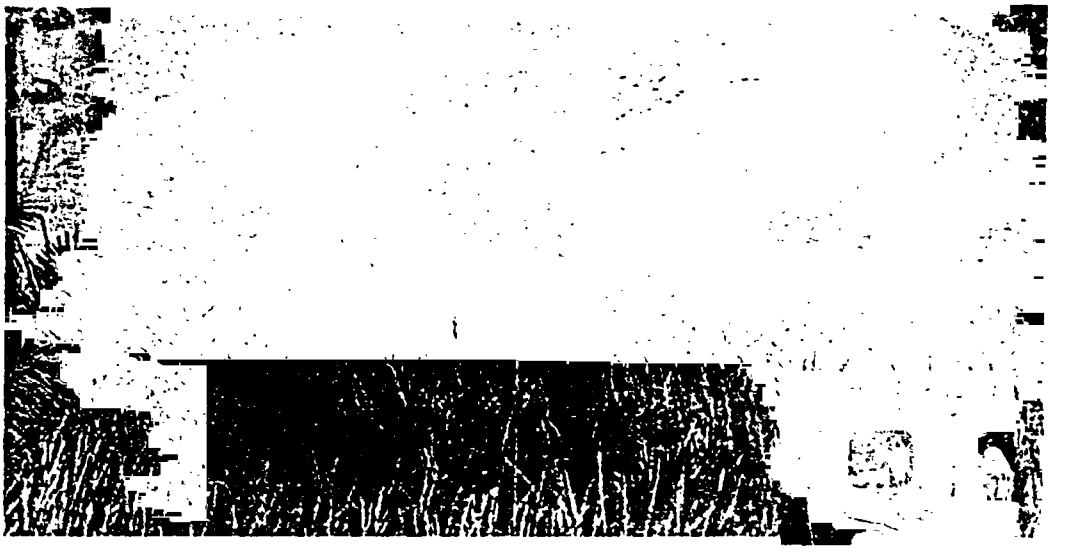


Plate 3.1 - A view of The Guako Grove at Pokuase (Peg 378Q insert)

Table 3.4 (d) Sacred Grove/Shrines in the Transmission line route RoW

No.	Name of Grove/Shrine	Settlement
1	Obokyem	Ekurabadze
2	Public Cemetery	Ekurabadze
3	Nana Ebolise	Amosima
4	Public Cemetery	Kwasi Kwaa
5	Bobogbema	Nyankrom
6	Nana Abeka	Aboransa
7	Nana Tawien	Abeka Ano
8	Amisa	Mankessim
9	Dewendi	Gomoa Dumase
10	Abekapow	Edukrom
11	Guako	Pokuase

Table 3.4 (e) Species list of the Guako sacred Grove near Pokuase

Species	Family	Habit	Star rating	Guild
Acacia kamerunensis	Mimosaceae	Climber	Green	Pioneer
Acacia pentagona	Mimosaceae	Climber	Green	Pioneer
Acridocarpus alternifolius	Malpighiaceae	Climber	Green	Pioneer
Adenia rumicifolia	Passifloraceae	Climber	Green	Pioneer
Aframomum geocarpum	Zingiberaceae	Herb	Green	SB
Afzelia africana	Caesalpiniaceae	Tree	Red	NPLD
Agelaea obliqua	Connaraceae	Climber	Green	Pioneer
Alafia barteri	Apocynaceae	Climber	Green	Pioneer

Species	Family	Habit	Star rating	Guild
Albizia adianthifolia	Mimosaceae	Tree	Green	NPLD
Albizia zygia	Mimosaceae	Tree	Green	NPLD
Alchornea cordifolia	Euphorbiaceae	Tree	Green	Pioneer
Alstonia boonei	Apocynaceae	Tree	Green	Pioneer
Amorphophallus johnsonii	Araceae	Herb	Green	SB
Anchomanes difformis	Araceae	Herb	Green	SB
Andropogon gayanus	Graminae	Herb	Non forest	
Antiaris toxicaria	Moraceae	Tree	Pink	NPLD
Artabotrys velutinus	Annonaceae	Climber	Green	Pioneer
Asparagus warneckei	Liliaceae	Herb	Gold	Pioneer
Asplenium emarginatum	Fern	Herb	Green	SB
Baissea breviloba	Apocynaceae	Herb	Green	Pioneer
Baphia nitida	Papilionaceae	Tree	Green	SB
Blighia sapida	Sapindaceae	Tree	Green	NPLD
Byrsocarpus coccineus	Connaraceae	Shrub	Green	Pioneer
Campylostemon angolens	Celastraceae	Climber	Green	Pioneer
Capparis erythrocarpos	Capparaceae	Climber	Green	Pioneer
Ceiba pentandra	Bombacaceae	Tree	Green	Pioneer
Celtis mildbraedii	Ulmaceae	Tree	Green	Pioneer
Celtis zenkeri	Ulmaceae	Tree	Green	NPLD
Chromolaena odorata	Compositae	Shrub	Green	Pioneer
Chrysophyllum sp.	Sapotaceae	Tree		
Cissus araloides	Vitaceae	Climber	Green	Pioneer
Clausena anisata	Rutaceae	Tree	Green	SB
Cnestis ferruginea	Connaraceae	Climber	Green	Pioneer
Cola gigantean	Sterculiaceae	Tree	Green	NPLD
Cola milleni	Sterculiaceae	Tree	Green	NPLD
Dialium guineense	Caesalpiniaceae	Tree	Green	
Dioscorea prachensilis	Dioscoreaceae	Climber	Pink	Pioneer
Diospyros abyssinica	Ebenaceae	Tree	Green	Pioneer
Dracaena arborea	Agavaceae	Tree	Green	Pioneer
Drypetes gilgiana	Euphorbiaceae	Tree	Green	SB
Drypetes singroboensis	Euphorbiaceae	Tree-	Gold	SB
Elaeis guineensis	Palmae	Tree	Pink	Pioneer
Erythroxylum emarginatum	Erythroxylaceae	Tree		
Flagellaria guineensis	Flagellariaceae	Climber	Green	Pioneer
Gongronema latifolium	Asclepiadaceae	Climber	Green	Pioneer
Gouania longipetala	Rhamnaceae	Climber	Green	Pioneer

Species	Family	Habit	Star rating	Guild
Grewia carpinifolia	Tiliaceae	Climber	Blue	Pioneer
Griffonia simplicifolia	Caesalpiniaceae	Climber	Green	Pioneer
Imperata cylindrical	Graminae	Herb		
Kigelia africana	Bignoniaceae	Tree	Green	NPLD
Lantana camara	Verbenaceae	Shrub	Green	Pioneer
Leca guineensis	Lecaceae	Shrub	Green	Pioneer
Malacantha alnifolia	Sapotaceae	Tree	Green	Pioneer
Mallotus oppositifolius	Euphorbiaceae	Tree	Green	SB
Memecylon sp.	Melastomataceae	Tree	Green	SB
Millettia thonningii	Papilionaceae	Tree	Blue	
Momordica charantia	Cucurbitaceae	Climber		
Monodora tenuifolia	Annonaceae	Tree	Green	SB
Morinda lucida	Rubiaceae	Tree	Green	Pioneer
Newbouldia laevis	Bignoniaceae	Tree	Green	Pioneer
Olyra latifolia	Graminae	Herb	Green	SB
Palisota hirsute	Commelinaceae	Herb	Green	SB
Panicum maximum	Graminae	Herb		
Pennisetum purpureum	Graminae	Herb		
Pisonia aculeate	Nyctaginaceae	Climber	Green	Pioneer
Psychotria schweinfurthii	Rubiaceae	Shrub	Green	SB
Rothmania urcelliformis	Rubiaceae	Tree	Green	SB
Sporobolus pyramidalis	Graminae	Herb		
Sterculia tragacantha	Sterculiaceae	Tree	Green	Pioneer
Strombosia glaucescens	Olacaceae	Tree	Green	SB
Strophanthus gratus	Apocynaceae	Climber	Pink	Pioneer
Strophanthus hispidus	Apocynaceae	Climber	Pink	Pioneer
Strychnos floribunda	Loganiaceae	Climber	Pink	Pioneer
Trichilia pricuriana	Meliaceae	Tree	Green	NPLD
Triplochiton sclerooxylon	Sterculiaceae	Tree	Scarlet	Pioneer
Uvaria ovata	Annonaceae	Climber	Gold	Pioneer

Table 3.4 (e) shows that 76 species belonging to 45 families were encountered during the inventory. The Graminae (grasses) were the largest family with 6 species followed by the Apocynaceae with 5 species and then the Sterculiaceae and Euphorbiaceae with 4 species each. The abundance of non-forest grasses and climbers is indicative of a high degree of disturbance. Close to 70% (55 Green star species) of the species are common and of no conservation concern,

12% are not rated because they are non-forest species. Three (3) species (4%) are Gold star species and are of high conservation concern.

- **Coastal grassland and thicket vegetation**

The Coastal grassland and thicket vegetation occurs in the coastal areas between Winneba and Tema. The transmission route does not pass through any forest reserve or sacred grove in this zone. The route runs through farms and fallows and grassland. Some of the common species encountered in this zone are presented in Table 3.4 (f).

With the exception of *Uvaria chamae*, all the species encountered on the route are common and are of no conservation concern. The thickets usually form around old termite mounds.

Table 3.4 (f) Species list of the coastal grassland and thicket vegetation

Species	Family	Habit	Abundance
Nauclea latifolia	Rubiaceae	Shrub	Locally Frequent
Panicum maximum	Graminae	Herb	Very Abundant
Millettia thonningii	Papilionaceae	Tree	Frequent
Calotropis procera	Asclepiadaceae	Shrub	Frequent
Zanthoxylum xanthoxyloides	Rutaceae	Tree	Frequent
Dichrostachys cinerea	Mimosaceae	Shrub	Abundant
Griffonia simplicifolia	Caesalpiniaceae	Shrub	Frequent
Chromolaena odorata	Compositae	Shrub	Abundant
Azadirachta indica	Meliaceae	Tree	Very Abundant
Borassus aethiopium	Palmae	Tree	Frequent
Mallotus oppositifolius	Euphorbiaceae	Shrub	Frequent
Lantana camara	Verbenaceae	Shrub	Frequent
Ceiba pentandra	Bombacaceae	Tree	Occasional
Elacophorbia drupifera	Euphorbiaceae	Tree	Locally Frequent
Heteropogon contortus	Graminae	Herb	Abundant
Grewia carpinifolia	Tiliaceae	Shrub	Frequent
Ximenia americana	Olacaceae	Tree	Frequent
Cassia rotundifolia	Caesalpiniaceae	Herb	Very Frequent
Desmodium tortuosum	Papilionaceae	Shrub	Occasional
Centrosema plumieri	Papilionaceae	Climber	Frequent
Carissa edulis	Apocynaceae	Tree	Frequent
Asystasia calycina	Acanthaceae	Shrub	Frequent
Vetiveria sp.	Graminae	Herb	Frequent
Mangifera indica	Anarcadiaceae	Tree	Frequent
Ctenium spp.	Graminae	Herb	Abundant
Dactyloctenium aegyptium	Graminae	Herb	Abundant
Sporobolus pyramidalis	Graminae	Herb	Abundant
Digitaria horizontalis	Graminae	Herb	Abundant

Securinega virosa	Euphorbiaceae	Shrub	Frequent
Waltheria indica	Sterculiaceae	Shrub	frequent
Dialium guineense	Caesalpiniaceae	Tree	Frequent
Clausena anisata	Rutaceae	Tree	Frequent
Uvaria chamae	Annonaceae	Climber	Rare
Byrsocarpus coccineus	Connaraceae	Shrub	Frequent
Crotalaria retusa	Papilionaceae	Shrub	Frequent
Capparis erythrocarpos	Capparaceae	Climber	Frequent

3.1.3 Fauna

Survey Methodology

The RoW route was demarcated into three (3) main faunal zones:

- Western Zone comprising the Shama-Ahanta East Metropolitan Area (SAEMA) of the Western Region
- Central Zone comprising Komenda-Edina Eguafo Abirem (KEEA), Cape Coast Municipal, Abura-Asebu-Kwamankese, Mfantseman, Gomoa, and Awutu/Effutu-Senya Districts of the Central Region
- Eastern Zone comprising Ga District and Tema Metropolitan Area (TMA) of the Greater-Accra Region

Entomological Survey

Four main methods were used in the entomological survey, in addition to opportunistic collection of insects on sight. *Sweeping nets* were used to collect or sample insects from the undergrowth and stems of trees. *Butterfly nets* were used to collect butterflies along transects, in undergrowth and open areas. Butterflies identifiable in flight were recorded on the spot. *Charaxes traps* baited with a mixture of ripened banana and palm wine were mounted at selected locations, examined for insects during the morning and early evening of each sampling day, and *pitfall traps* containing few drops of formalin for killing and preservation of any insect catches, were set on the to collect crawling insect species, etc. The traps were examined daily throughout the survey period.

Herpetofaunal Survey

There was *direct opportunistic observation* of mammals and herpetofauna, as well as *refuge examinations* using reptile hooks to search for herpetofauna, which often conceal themselves under and in fallen logs, rotten tree stumps, under rocks, in leaf litter, rodent burrows, ponds, old termite mounds, etc.). Smaller herpetofaunal species were surveyed using 100-metre *pitfall traps* (sinking 17-litre buckets flush with the ground at 10-metre intervals) with *drift fences* (made from 0.5-metre wide mosquito netting nailed in a vertical position to wooden stakes (modified from Raxworthy & Nussbaum, 1994) inspected every morning for four consecutive days.

Avifaunal Survey

Avifaunal (bird surveys) were carried out using *transect counts* (twice-daily walk by two observers, of transects ranging in length from 0.5 to 1.5 kilometres through selected habitats at the various survey areas in the morning and evening) and *mist-netting* (involving mist nets set at right angles to cut and opened from about 6.30 am to 5.30 pm, and inspected every two to three hours for trapped birds, which were identified and released), as well as through direct *opportunistic surveys* (recording all birds seen and heard during the surveys) and *spot counts* (observer remains stationary for about 20 minutes and records all birds seen and heard).

Mammal Survey

Mammals were recorded through *direct opportunistic observation*, use of *animal spoors* (any sign left by a living animal, such as feeding sites, regular pathways, tracks, footprints, faecal pellets, nests, etc.), *transect walks*, and *interviews* of a cross-section of the local population.

Survey Results

Faunal Diversity

Table 3.5 (a) provides a checklist of faunal species known to occur along the entire length of the RoW from Aboadze in the West to Tema in the East. Even though this suggests a fairly high faunal diversity, this increases as one moves farther inland, especially in the Western and Central regions, which are characterized by heavy rainfall and high floral diversity. Since the proposed RoW is largely coastal, and covers only a narrow corridor, the threats posed to the fauna are very

minimal, especially since the eastern portion of the RoW is characterized by grassland and thicket with low annual rainfall and lower species diversity.

CONSERVATION SIGNIFICANCE

- *Global Criteria*

IUCN

The IUCN (International Union for the Conservation of Nature) publishes a Threatened Species List *(Hutton-Taylor, C. 2000 IUCN Red List of Threatened Species; 2000, IUCN, Gland, Switzerland/Cambridge, UK.)*, which categorises globally threatened animals as follows:

- ***Critically Endangered/Critical (CR):*** A taxon, which is facing an extremely high risk of extinction in the wild in the immediate future.
- ***Endangered (EN):*** Species in danger of extinction, because both numbers and habitats have been reduced to a critical level, with survival therefore unlikely if the causal factors continue operating
- ***Vulnerable (VU):*** Species believed likely to move to the *EN (Endangered)* category, if the causal factors continue operating, because of rapidly decreasing populations and extensive habitat destruction.
- ***Rare (R):*** Species which are at risk because of small world populations concentrated in restricted geographical areas or habitats, but which are presently not in categories *E* or *V*.
- ***Lower Risk (LR):*** Taxa that have been evaluated but do not satisfy the criteria for any of the above categories. There are three sub-categories:
  - ***Conservation Dependent (cd):*** Taxa which are the focus of continuing taxon-specific or habitat-specific conservation programmes targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years
  - ***Near Threatened (nt)*** Taxa which do not qualify for *Conservation Dependent*, but which are close to qualifying for *Vulnerable*
  - ***Least Concern (lc):*** Taxa which do not qualify for *Conservation Dependent* or *Near Threatened*
- ***Data Deficient (DD):*** A taxon on which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well-studied, and its biology well-known, but appropriate data on abundance and/or distribution is lacking.
- ***Not Evaluated (NE):*** A taxon which has not yet been assessed against the criteria

CITES

CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna publishes a list of three Appendices (*CITES Appendices, 1975*) which limits global trade of certain categories of animal species.

- *Appendix I* species are threatened species which cannot be traded in
- *Appendix II* species are species for which levels of trade are limited

- *National Criteria (Ghana Wildlife Conservation Regulations)*

Ghana's Wildlife Laws (Ghana Wildlife Conservation Regulations, 1971, and Ghana Wildlife Conservation (Amendment) Regulations, 1988; 1995) also categorise animal species into two main Schedules based on the level of protection required for a particular species:

- *Schedule I* species are completely protected (i.e., their hunting, capture or destruction is prohibited at all times)
- *Schedule II* species are partially protected (i.e., their hunting capture or destruction is absolutely prohibited between 1st August and 1st December of any season, and the hunting, capture and destruction of any young animal, or adult accompanied by young, is absolutely prohibited at all times).

Table 3.5. Fauna of the RoW Areas and their Conservation Significance

		ROW Location			Conservation Significance		
Species	Common Name	West	Central	East	IUCN	CITES	National
INVERTEBRATES							
Butterflies							
Actaea egina			x				
A. epaea			x				
A. eponina		x	x	x			
A. natalica				x			
A. nebule			x				
A. pseudegina			x				
A. terpsichore				x			
A. zetes			x	x			
Amauris niavius			x				
A. tartaria			x				
Appias epaphia			x				
Ariadne enotrea			x				
Aterica galena			x	x			
A. lucretia				X			
Axiocerses harpax			x				
Bebearea sophus			x				
Belenois calypso			x				
B. creona			x	X			
B. gidica			x				
B. neavie			x				
B. zanthe			x				
Bicyclus angoinoa			x				
B. milyas			x				
B. safitza			x				
B. vulgaris			x				
Byblia anvatara			x				
Catacroptera cloanthe		x	x				
Catopsilia florella			x	x			
Charaxes fulvescens			x				
C. jasiades			x				
C. varanes			x				
Cocliaaes chalybe			x				
C. pisistratus			x				
Colotis antevippe			x				
C. euippe		x	x	x			
Danaus chrissipus				x			
Eicochrysops hippocrates			x				
Euchrysops osiris			x				
Eumaeara azeli			x				
E. harpalyce			x				
E. medon			x				
E. nearrezia			x				
E. rezioides			x				
Eurema brigitta			x	x			
E. hecabe			x	x			
E. senegalensis		x					
Graphium adamastors			x				
G. agamedes			x				
Hamanumida daedalus		x					
Hypolicaena philipus			x				
Hypolimnas antedon			x	-			
H. missipus		x		x			
H. salmacis			x				
H. solenacis				x			
Junonia chorimena		x	x				
J. cononc		x	x				
J. hierta		x	x				
J. Sophia		x	x				
J. stygia			x				

		ROW Location			Conservation Significance		
Species	Common Name	West	Central	East	IUCN	CITES	National
J. terea			x				
Lepiosia alcesta			x				
L. medusa				x			
L. wigginsi			x				
Leptoles pirithous			x				
Melanitis leda			x				
Mylothris chloris			x	x			
Nepheronia argia			x				
N. pharis			x				
N. thalassina			x				
Neptis morosa							
N. serena							
Neptis sp		x	x				
Papilio demodocus		x	x	x			
P. nemesicus			x				
P. nireus			x				
Phalanta phalanta		x	x	x			
Pseudacraea lucretia			x				
Pyrrhiades lucagus			x				
Pyrrhochalcis iphis		x	x				
Salamis anacardii		x	x				
S. cacta			x				
Tereas hecabe				x			
Ypthima doleta			x				
Ypthimorpha itonia			x				
Zizula hylax			x				
Hesperidae			x	X			
Lycaenidae		x	x	x			
Nymphalidae			x	x			
Papilionidae			x	x			
Pieridae			x	x			
Satyridae		x					
HERPETOFAUNA							
Amphibia							
Afrixalus dorsalis			x				
bufo maculates	Toad		x				
B. regularis	Common Toad	x	x	x			
B. superciliaris	Giant Toad	x					
Dicroglossus occipitalis	Common Frog	x	x	x			
Hylarana galamensis	Common Frog	x	x	x			
Hyperolius concolor	Reed Frog		x				
H. nasutus	"		x				
H. viridiflavus	"	x					
Kassina senegalensis	Running Frog		x				
Phrynobatrachus accraensis	Sharp-nosed Frog		x	x			
P. calcaratus	"		x				
Phrynomerus microps			x				
Ptychadena longirostris	Ridged Frog		x				
P. oxyrhynchus	Stump-nosed Frog		x				
Reptilia							
Chelonia (Tortoises/Terrapins)							
Kinixys homeana	Hinged Tortoise	x	x	-	DD	II	II
Pelomedusa subrufa	Marsh Terrapin	x	x	x			II
Squamata Lacertilia							
Agama agama	Rainbow Lizard	x	x				
Chamaeleo gracilis	Chameleon	x		x		II	
Hemidactylus brookii	House (Wall) Gecko	x	x				
H. mabouia	Gecko		x				
Lygodactylus conraui	Gecko	x	x				
Mabuya affinis	Skink	x	x	x			

		ROW Location			Conservation Significance		
Species	Common Name	West	Central	East	IUCN	CITES	National
M. perroteti	Orange-flanked Skink		x	x			
Panaspis togoensis	Skink		x	x			
Varanus exanthematicus	Savanna Monitor	x	x	x		II	II
V. niloticus	Nile Monitor	x	x	x		II	II
Squamata Serpentes							
Bitis arietans	Puff Adder			x			
Boithropthalmus lineatus	Red-lined Snake		x				
Calabaria reinhardtii	Calabar Python		x				
Causus maculatus	Night Adder			x			
Dasypeltis scabra	Egg-eating Snake	x	x	x			
Dendroaspis viridis	Green Mamba		x	x			
Lamprophis fuliginosus	House Snake			x			
Naja melanoleuca	Black Cobra	x					
N. nigricollis	Spitting Cobra		x	x			
Philothamnus semivariegatus	Green Tree Snake		x	x			
Psammophis sibilans	Hissing Sand Snake		x	x			
Python regius	Royal Python	x	x	x		II	II
P. sebae	African Python	x		x		II	II
Rhamphiophis oxyrhynchus	Beaked Snake		x	x			
Thelotornis kirtlandii	Twig Snake	x		x			
Aves (Birds)							
Ardeidae							
Ardea cinerea	Grey Heron	x					
Bubulcus ibis	Cattle Egret	x		x			
Egretta garzetta	Little Egret	x					
Nycticorax nycticorax	Night Heron	x					
Accipitricidae							
Accipiter melanoleucus	Great Sparrow Hawk		x				I
A. toussenelii	West African Goshawk		x				I
Buteo augularis	Red-tailed Buzzard	x		x			I
Milvus migrans	Black Kite	x		x			I
Neophron monachus	Hooded Vulture	x		x			I
Falconidae							
Falco naumanni	Lesser Kestrel			x	VU		I
Phasianidae							
Francolinus ahantensis	Ahanta Francolin	x	x				I
Ptilopachus petrosus	Stone Partridge			x			I
Charadriidae							
Charadrius hiaticula	Ringed Plover			x			
Haematopus ostralegus	Eurasian Oystercatcher			x			
Himantopus himantopus	Black-winged stilt			x			
Jacanidae							
Actophilornis africana	African Jacana			x			
Burhinidae							
Burhinus senegalensis	Senegal Thick-knee			x			
Columbidae							
Columba livia	Pigeon			x			II
Streptopelia semitorquata	Red-eyed Dove	x	x	x			II
S. senegalensis	Laughing Dove	x	x	x			II
Turtur afer	Red-billed Wood-dove	x	x	x			II
T. tympanistra	Tambourine Dove		x				II
Psittacidae							
Agapornis pullaria	Red-headed Lovebird	x					II
Musophagidae							
Crinifer piscator	Grey Plantain-eater	x		x			II
Tauraco persa	Green-crested Touraco		x	x			II
Cuculidae							
Centropus leucogaster	Black-throated Coucal		x				
C. senegalensis	Senegal Coucal	x	x	x			
Ceuthmocares aereus	Yellow-bill		x				
Chrysococcyx klaas	Klaas Cuckoo	x	x	x			
Apodidae							

		ROW Location			Conservation Significance		
Species	Common Name	West	Central	East	IUCN	CITES	National
Apus affinis	Little Swift	x		x			
Cypsiurus parvus	Palm Swift	x		x			
Alcedinidae							
Ceryle rudis	Red Kingfisher	x		x			
Halcyon malimbicus	Blue-breasted Kingfisher	x	x				
H. senegalensis	Senegal Kingfisher	x					
Bucerotidae							
Tockus fasciatus	Allied Hornbill	x					
Tockus nasutus	Grey Hornbill	x	x	x			
Capitonidae							
Lybius vieilloti	Vieillot's Barbet			x			
Pogoniulus subsulphureus	Yellow-fronted Tinkerbird			x			
Indicatoridae							
Indicator indicator	Black-throated Honey-guide		x				
Corvidae							
Corvus albus	Pied Crow	x		x			
Estrildidae							
Estrilda melpoda	Orange-cheeked Waxbill	x					II
Lagonosticta rufopicta	Bar-breasted Fire-finch		x				II
L. senegalena	Senegal Fire-finch		x				II
Lonchura bicolor	Black-and white Mannikin		x				II
L. cucullata	Bronze Mannikin	x	x	x			II
Nigrita bicolour	Chestnut-breasted Negro-finch		x				
N. canicapilla	Grey-crowned Negro-finch	x					
Pirenestes ostrinus	Red-bellied Seed-cracker		x				
Spermophaga haematina	Blue-bill		x				
Fringillidae							
Serinus mozambicus	Yellow-fronted Canary		x				II
Hirundinidae							
Hirundo rustica	European Swallow			x			
Laniidae							
Dryoscopus gambiensis	Gambian Puff-back Shrike		x				
Lanarius barbarus	Barbary Shrike			x			
Lanarius ferrugineus	Bell Shrike		x				
Lanius collaris	Fiscal Shrike	x					
Muscicapidae							
Bias musicus	Black-and-white Flycatcher		x				
Cossypha niveicapilla	Snowy-crowned Robin-chat			x			
Platysteira blissetti	Blisset's Wattle-eye		x				
P. cyanea	Scarlet-spectacled Wattle-eye	x	x	x			
Terpsiphone rufiventer	Red-bellied Paradise Flycatcher	x	x				
Trochocercus nitens	Blue-headed Crested Flycatcher	x	x				
Nectariniidae							
Anthreptis collaris	Collared Sunbird						
Nectarinia adelberti	Buff-throated Sunbird		x				
N. chloropygia	Olive-bellied Sunbird	x	x				
N. coccinigaster	Splendid Sunbird		x	x			
N. cuprea	Copper Sunbird	x	x				
N. fuliginea	Carmelite Sunbird	x					
N. olivacea	Olive Sunbird	x	x				
N. oritis	Blue-headed Sunbird	x					
N. verticalis	Green-headed Sunbird		x				
Ploceidae							
Euplectes orix	Red Bishop	x		x			II
Hirundo abyssinica	Lesser-striped Sparrow	x					
Malimbus scutatus	Red-vented Malimbe	x					
Passer griseus	Grey-headed Sparrow	x					
Ploceus cucullatus	Village Weaver	x	x	x			II
P. nigricollis	Spectacled Weaver	x	x	x			II
Tchagra senegala	Black-crowned Tchagra	x		x			
Pycnonotidae							
Andropadus curvirostris	Cameroon Sombre Greenbul	x	x				

		ROW Location			Conservation Significance		
Species	Common Name	West	Central	East	IUCN	CITES	National
A. latirostris	Yellow-whiskered Greenbul		x				
A. virens	Little Greenbul	x	x				
Bleda canicapilla	Grey-headed Bristle-bill		x				
Chlorocichla simplex	Simple Leaf-love	x	x	x			
Nicator chloris	West African Nicator	x	x				
Pycnonotus barbatus	Common Garden Bulbul	x	x	x			
Sturnidae							
Lamprotornis purpureus	Purple Glossy Starling			x			
Sylviidae							
Camaroptera brachyura	Grey-backed Camaroptera		x	x			
C. superciliaris	Yellow-browed Camamptera		x				
Cisticola natalensis	Striped Cisticola			x			
Hylia prasina	Green Hylia	x	x				
Macrosphenus concolor	Olive Longbill		x				
M. flavicans	Kemp's Longbill		x				
Prinia subflava	West African Prinia	x	x	x			
Sylvietta brachyura	Nuthatch Warbler		x				
S. virens	Green Crombec		x				
Timalidae							
Turdinides plebejus	Brown Babbler			x			
T. reinwardii	White-capped Babbler			x			
Turdidae							
Luscinia megarhynchos	Nightingale			x			
Turdus pelios	West African Thrush	x	x	x			
Mammalia							
Insectivora							
Crocidura olivieri	White-toothed Shrew	x	x		VU		
Erinaceus albiventris	White-bellied Hedgehog						II
Chiroptera							
Eidolon helvum	Straw-coloured Fruit Bat			x			
Hipposideros commersoni	Leaf-nosed Bat		x				
Nanonycteris veldkampi	Flying Calf		x				
Primates							
Cercopithecus aethiops	Green Monkey/Guenon			x		II	II
C. mona lowei	Mona Monkey		x			II	II
C. petaurista	Lesser Spot-nosed Monkey		x			II	II
Galago senegalensis	Senagal Galago	x				II	I
Galagoides demidoff	Demidoff's Galago			x			I
Perodicticus potto	Bosman's Potto	x				II	I
Rodentia							
Atherurus africanus	Brush-Tailed Porcupine	x					II
Cricetomys gambianus	Gambian Giant Pouched Rat	x	x	x			II
Dasymys incomtus	Shaggy Swamp Rat	x					
Euxerus erythropus	Unstriped Ground Squirel		x	x			II
Hylomyscus alleni	African Woodmouse		x				
Hystrix cristata	Crested Porcupine	x	x				I
Lemniscomys barbarus	Striped Zebra Mouse		x				
L. striatus	Spotted Zebra Mouse	x	x				
Lophuromys flavipunctatus	Brush-furred Mouse	x					
Mastomys erythroleucus	Multimammate Mouse		x	x			
Praomys tullbergi	Soft-furred Rat			x			
Rattus rattus	Common Rat			x			
Tatera kempi	Kemp's Gerbil		x				
Thryonomys swinderianus	Grasscutter	x	x	x			
Uranomys ruddi	Uranomys Mouse		x				
Lagomorpha							
Lepus zechi	Togo Hare			x			II
Pholidota							
Phataginus tricuspis	Tree Pangolin	x					I
Uromanis tetradactyla	Long-tailed Pangolin	x					I
Carnivora							

		ROW Location			Conservation Significance		
Species	Common Name	West	Central	East	IUCN	CITES	National
Civettictis civetta	African Civet	x	x				I
Crocuta crocuta	Spotted Hyena		x		LR/cd		I
Mungos gambianus	Gambian Mongoose	x	x	x	DD		II
Panthera pardus	Leopard		x			I	I
Hyracoidea							
Dendrohyrax dorsalis	Tree Hyrax	x					II
Procavia ruiceps	Rock Hyrax			x			II
Artiodactyla							
Cephalophus dorsalis	Bay Duiker		x		LR/nt	II	II
C. maxwelli	Maxwell's Duiker	x	x	x	LR/nt		II
C. niger	Black Duiker		x		LR/nt		II
Neotragus pygmaeus	Royal Antelope	x	x	x	LR/nt		II
Potamochoerus porcus	Red River Hog	x	x				
Tragelaphus scriptus	Bushbuck	x	x	x			II

Issues of Conservation Concern

Of the listed faunal species (Table 3.5), 21 are of international conservation significance, nine out of which are of listed in the IUCN Red List of Threatened Species. The rest are listed under CITES (see Legend for Table 1). Only two species are of real concern (*Falco naumanni*- Lesser Kestrel and *Crocudura oliveri*- White-toothed Shrew), having been categorized as **"Vulnerable"** (VU). Since the vegetation within the access routes and the RoW will have to be cleared during construction of the transmission line, due consideration shall be given to the protection of delicate habitats (e.g. wetlands, sacred groves, etc.) which may harbour some rare and endemic species.

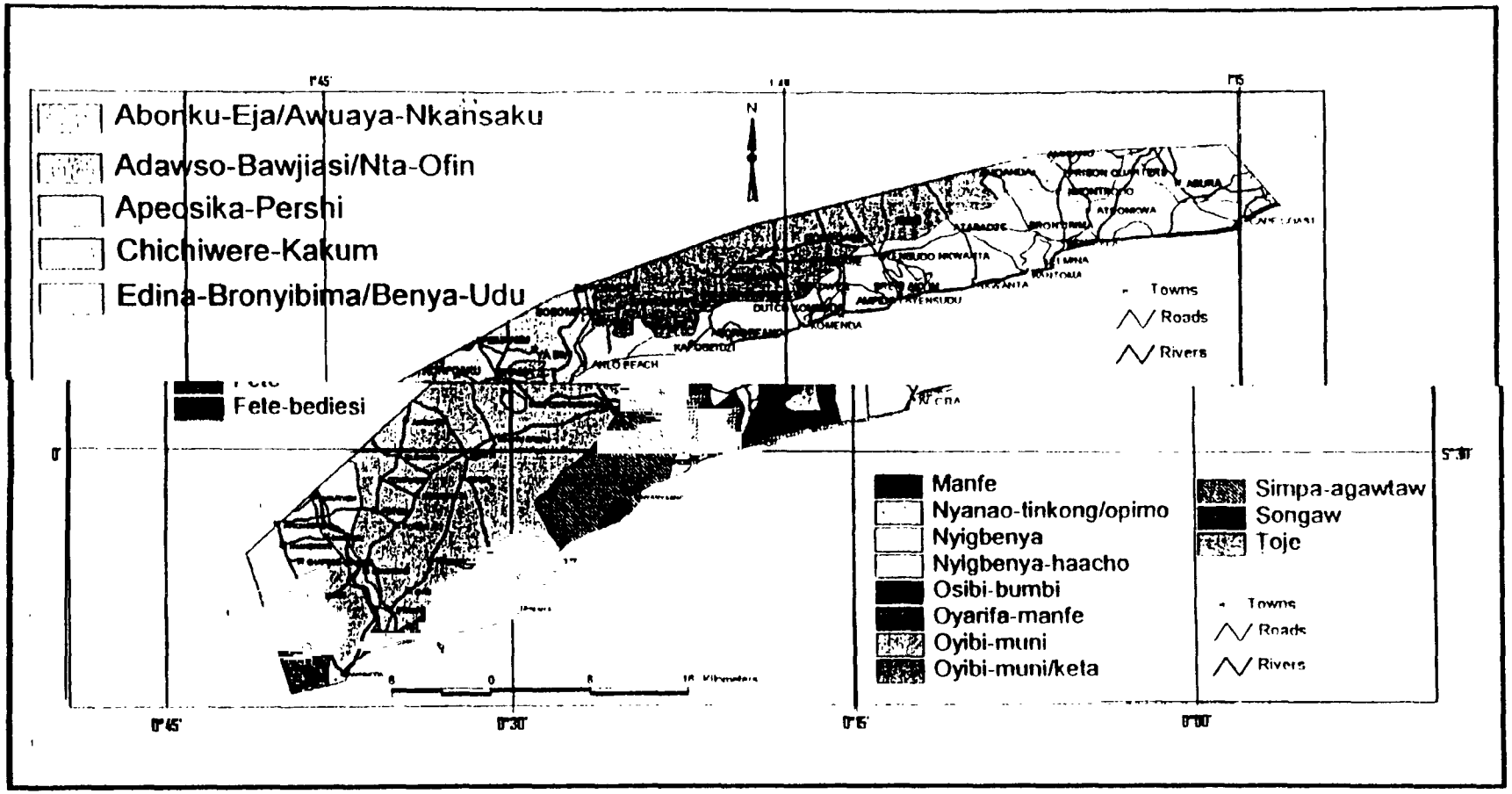
How?

3.1.4 Water Resources

The water resources in the project areas include available surface and ground water resources. In addition water is available from riversides and the various tributaries both intermittent (seasonal) and perennial. Some of the people in the settlements were noted to be using both surface and ground water as drinking water sources.

The various surface water bodies lying directly in way of the proposed route, from West to East, have been identified and presented in Table 3.6 below.

ABOADZE - TEMA



REFAST **FIG. 3.6. SOIL MAP OF PROJECT AREA**

Table 3.6 Surface Water Bodies traversed by the Proposed Line Route

Line Route Profile Sheet No.	River/Stream	Width At Crossing Pt. (m)	Distance from spanning pegs		Nearest settlement
			From proximal peg	From distal peg	
2	Lake Tropo	86	303m (#19)	813m (#20)	Yawbiw/Kofitsikope village
3	Pra	127	289m (#24)	573m (#25)	Beposo
6	Ante/Ante	5	1,032m (#44)	399m (#45)	Antado
7	Hua/Ehoa	3	630m (#54)	119m (#55)	Nyinase
8	Taiwin	6	587m (#56)	414m (#57)	Abaka ano
10	Baka	5	249m (#124A)	148m (#124B)	-
11	Anomadua	15	145m (#124B)	165m (#125)	-
11	Nkontro	22	101m (#126A)	86m (#127)	Nkontrodo
12	Kakum	12	359m (#128B)	336m (#128C)	Akotokyer
13	Kakum	12	406m (#128C)	349m (#128D)	Kakumdo
16	Wonkom	11	285m (#155)	279m (#156A)	Asafora village
19	Woraha tributary	4	199m (#186A)	578m (#187A)	-
19	Woraha	4	528m (#187A)	285m (#188A)	-
21	Amisa/Okyi	11	895m (#204)	92m (#205A)	Mankessim
24	Nakwa	23	659m (#222)	322m (#224)	Ekotsi
25	Nakwa	12	40m (#225A)	37m (#226)	Essuehyia Junction
29	Bruhye	4	1,155m (#255A)	48m (#256A)	Ankamu Town
29	Bruhye	13	516m (#261A)	106m (#262A)	New Mprumem
31	Boaku	13	113m (#271A)	745m (271B)	Gomoa Amenfi
31	Pratu tributary	6	356m (#272)	884m (#273)	-
31	Pratu	13	828m (#272)	405m (#273)	-
31	Pratu tributary	3	161m (#273)	181m (#274)	-
33	Ayensu	25	311m (#306)	296m (#307)	-
34	Ayensu	25	928m (#307)	43m (#308)	Adukrom

These rivers and streams are clearly marked on the route profile sheets. The impacts of construction activities on these water bodies are discussed in Chapter 4.

3.1.5 Geology and Soils

Fig 3.6 shows the soil types in the project areas. The major soil types encountered within the corridor of the proposed 330 KV transmission line route are the Forest Ochrosols, Coastal Savannah Ochrosols and the Laterite Sandy soils. The Forest Ochrosols are the most extensive soils type along the propose route. They stretch from the Aboadze Thermal plant right down to around Haatso area into the Coastal Savannah Ochrosols at the northern part of Accra and finally into the Laterite Sandy soils between Accra and Tema.

- **Forest Ochrosols**

The Forest Ochrosols are developed in forest and savannah environment under rainfalls between 900 mm and 1650 mm. Their profiles may contain iron pan or gravel at depths, which are shallower in the savannah areas. The organic matter content of these soils is low.

The Forest Ochrosols are developed from weathering product of moderately acidic rocks in peneplain drifts covering the intermediate erosion surface and in terrace alluvia on upland portions of gently undulating to strongly rolling topography. The soils therefore occupy summits as well as upper, middle and lower slopes. Generally the Forest Ochrosols consist of the well-drained upland concretionary and moderately well drained colluvial clay loams developed over granite, sandstone and quartzite. This is the most extensive soil within the corridor of the proposed 330 KV line route.

The Forest Ochrosols have an average organic matter content of more than 1.5% in the A-horizon but fall below 1% in the lower horizons. The pH is generally less than 5.5 and their cations exchange capacity is below 16 cmol(+)/kg because they contain low activity clays especially kaolinite. Major soil associations that the proposed 330KV line will traverse under the forest ochrosols are: Keta-Goi, Nzima-Bekwai/Oda, Oyibi-Muni, Kumasi-Asuasi-Nta, Chichiwere-Kakum, Edina-Bronyima/Benya-Udu, Adawso-Bawjiasi/Nta-Ofin, Abonku-eja/awuaya-nkansaku, Fete-bediesi and Osibi-bunbi.

The main soil type around the Aboadze Thermal plant is the Keta-Goi Association. This consists of the discontinuos coastal sand dune. It consists of pale brown to pale yellow loose sand containing shells in the lower part of the profile. The line route then continues into the Bekwai-Oda Compound Association. These are soils developed over Birrimian rocks, mainly phyllites, schists and greywacks on undulating to gently rolling topography. The soils in this compound association consist of well-drained to moderately well-drained, upland simple association of Bekwai and Nzima; and an imperfectly to very poorly drained, lowland simple association of Temang and Oda series.

The next soil association the line route traverses is the Edina-Bronnyibim/Benya-Udu. The swampy valley bottoms of these soils are cultivated to sugar cane with oranges, pineapple and cassava on the surrounding high grounds.

Chichiwere-Kakum association are the next soil associations found on the proposed 330 KV route. Chichiwere consists of very deep, pale brown or yellowish brown, fine sand developed in the Ayensu and Densu levees. The textures of these soils vary from sand to loamy sand but may occasionally be sandy loam further away from the rivers. Kakum series occur as alluvial levees along the Ayensu and Densu rivers.

They are moderately drained yellowish brown to brownish yellow alluvial sandy loams to clay loams. Their normal profile consists of 0-15 cm of grey brown to pale brown, slightly humuous, sandy loam overlying, from 15-45 cm, yellow brown sandy loam. This grades into yellowish brown mottled yellow fine sandy clay loam to clay. The soils are subject to flooding for short periods in the rainy season when the rivers floods their banks but on the whole they have medium internal drainage, slow to medium run-off, moderate permeability with fairly high water holding capacity. They are strongly acidic (pH 4.7 - 5.1) in reaction. These soils are cultivated to orange, palm, coconut, pineapple, cassava, plantain and Acacia. Bamboo groves are also found on these soils within this area.

Following the Chichiwere-Kakum is the Adawso-Bawjiasi Association. This association consist of Adawso and Bawjiasi series. These soils are found on lower slopes to summits of hills.

Adawso series consists of grey-brown loamy humous horizons, which overlie pale yellow-brown subsoils consisting of sandy clays containing very frequent to abundant quartz gravel and ironstone gravel. Below 2 m depth, little decomposed rock is encountered and this consists of pale granite with sparse biotite, often with veins of pegmatite and quartz.

Adawso soils are found as middle and lower slope associates of Bawjiasi series. Bawjiasi series consists of grey-brown loamy sand with humous horizons overlying a reddish brown sandy or gritty clay subsoil containing much quartz gravel and sometimes ironstone gravel as well. It grades at a few meters below into little decomposed biotite granite, which is sometimes very well

foliated. The next soil association that the line crosses is the Edina-Bronyima/Benya-Udu Association (described earlier on).

From the Edina-Bronyima/Benya-Udu, the proposed 330 KV line runs into the Abonku-eja/awuaya-nkansaku association around Cape Coast and then into the Azitntam-yenku Association around Saltpond. It then traverses the Oyibi-Muni association (described earlier on) into the Osibi-Bumbi association. The Osibi-Bumbi soils are the lower simple association of the Azintam-Bumbi compound association. The Osibi series are lower slope soils comprising of moderately deep to very deep, olive brown, imperfectly to poorly drained clays, whilst the Bumbi series are very dark grey moderately deep to very deep, very poorly drained clay loams or clay

The line route then crosses the Nzima-Bekwai/Oda Association (described earlier on) into Adawso-Bawjiasi/Nta-Ofin Association. Adawso soils are found on middle slopes. Bawjiasi series consists of grey-brown loamy sand humous horizon overlying a reddish brown sandy or gritty clay subsoil containing much quartz gravel and some times ironstone gravel as well. It grades at few metres below into little decomposed biotite granite, which is sometimes very well foliated

- Coastal Savannah Ochrosols

The next soil association that the line traverses after the Adawso-Bawjiasi/Nta-Ofin Association is the Adzintam-Yenku. This association belongs to the Azintam-Bumbi Compound Association. The soils in this compound association are underlain by greenstone, mainly amphibolites. Yenku series are summit soils with solid rock within a depth of less than 30 cm. On the upper and middle slopes are found shallow to moderately deep, gravelly and stony, red, well-drained clay loams. This soil is a typical Savanna Ochrosols.

Savanna Ochrosols are group of soils, which are mainly red, and brown, moderately well drained, medium to light-textured soils developed over Voltaian sandstone, granite, phyllites and schists. They are generally low in organic matter due to insufficient accumulation of biomass

(less than 2% in the topsoil). Soil reaction ranges from near neutral, pH 6.0 - 7.0, in the A-horizon, becoming generally between 1 and slightly to moderately acid with depth. Cation exchange capacity is generally between 1 and 15 cmol(+)/kg.

From the above-mentioned association, the line route then traverses the Osibi-bumbi Association around Apam and back to the Nzima-Bekwai/Oda (described already) around Winneba. The Osibi and Bumbi series belong to the Azintam-Bumbi Compound Association. Osibi series are lower slope soils comprising of moderately deep to very deep, olive brown, imperfectly drained clays, whilst the Bumbi series are very dark grey moderately deep to very deep. It is very poorly drained and it is made up of clay loams or clay.

The line crosses the Oyibi-muni-Keta (described already) association again after Winneba into the Fete-Bediesi Complex Association. Fete series comprise of excessively drained, pale-brown brashy soils developed on steep slopes over quartzite and sandstone of the Togo range. The profile consists of a shallow, sandy, humous, topsoil, often containing small pieces of rock, merging directly into pale grey-brown to pale yellowish brown sand, sandy loam or sandy clay loam containing abundant pieces of rock. Where the rock is sandstone, this is crumby and rather iron stained; in the case of quartzite, the rock is hard and little weathered and rock outcrops are frequent. Bediesi series are found on summits and upper slope sites.
The profile consists of 0 - 10 cm of dark reddish brown fine sandy clay loam to clay. Below this layer may be 120 - 150 cm of red sandy clay to clay underlain by ironstone concretions or deeply weathered sandstone.

The line route again enters into a thin strip of Nzima-Bekwai/Oda series and then into the Simpa-Agawtaw. Simpa series comprises of soils with pale brown or grey-brown loamy sand at the surface overlying several metres of brown, often mottled, very gravelly sandy loam becoming sandy clay with depth. This is an upper slope soil, hence it is free draining and becomes draughty during dry spells, but drainage is impeded in the more clayey horizons. Agawtaw series are sandy loam, porous and greyish brown coloured in their topsoil. Their subsoils are dark brown or dark grey-brown, slightly mottled yellow and brown, very compact.

The next soil association that the line crosses is the Ayensu-Chichiwere (described earlier on) and then into the Manfe and Oyarifa-Manfe Associations. Manfe soil series comprises of red concretionary clays occurring on gentle to moderate upper slopes. The topsoil consists of dark greyish brown humous sandy loam or clay loam, often including a moderate amount of ironstone and quartz gravel, This grades at 15 - 30 cm into brownish red to red clay loam or clay full of spherical ironstone concretions and varying amounts of quartz stones and gravel together with small pieces of reddish decomposed quartzite and phyllite. At 60 - 180 cm this is underlain by red often-mottled yellow, crumby decomposed rock. This is often quartzite but sandstone or phyllites occur locally.

Oyarifa series includes important soils developed in deep slope-wash deposits at the foot of the Togo range. The profile consists of a dark grey-brown, humous, loamy topsoil grading at 15 - 30 cm into several centimeters of orange-brown to bright red, porous, sandy clay loam to sandy clay which becomes mottled with yellow below a depth of 90 - 150 cm. The soils are typically bright red in colour but they become more brownish in colour towards the lower slopes where they grade into Bereku series.

The line then traverses Nyigbenya-Haatso complex and finally onto Simpa-Agawtaw (described earlier on) at Tema.

The Nyigbenya-Haatso complex is developed in similar parent materials as Oyarifa-Mamfe complex, but occur under a drier climate and under savannah vegetation. There is little organic matter in these soils.

Nyigbenya series consist of red loam overlying ironstone-concretionary clay or iron pan. The topsoil consists of brown or dark reddish-brown sandy loam followed by red loam or light clay; but most commonly, red sandy light clay to sandy clay containing abundant ironstone concretions and variable amounts of quartz gravel. The concretionary layer has locally become cemented to form iron pan. Where rock has been encountered, it has been found to be thoroughly decomposed to a red, rather mottled and usually gritty clay. Dahomeyan crystalline rocks underlay the complex; but in Accra, the underlying rocks are Accraian shales and sandstones, but Togo quartzite schists occur locally elsewhere.

Haatso series is fairly extensively developed in seasonally poorly drained, lower-slope, slope wash materials. The soils consist of pale brown sand increasing to sandy clay with depth, humus stained near the surface and slightly mottled orange in the subsoil, but occasionally found with seepage iron pan.

3.1.6 General Land Use

The land uses along the proposed route include agriculture, gathering, hunting, urban development, quarrying, sand winning, grazing and fishing.

Agriculture is the major category of land use along the right-of-way. Agriculture land use types include cultivated annual crops, bush fallow and associated gathering, cultivation of tree crops and unimproved pastures. The major annual crops are cereals, root crops, the pulses and vegetables. The major perenniais are mainly trees, coconut and palm.

Farmers along the route grow maize. Cassava and sweet potato are the major root crop with citrus, mango and avocado the main tree crops, other crops of economic importance observed includes the oil palm, coconut, plantain, pineapple, pawpaw and sugar cane.

3.2 Socio-Economic/Cultural Environment

During the EIA field survey, some communities have been identified as being affected by the project. . These are those communities whose lands, farms and/or properties fall within the right-of-way (RoW) of the proposed transmission line. These communities extend across eight administrative districts along the length of the transmission line, and are as presented in Table 3.7 below, with the number of affected persons in each district.

Table 3.7 List of Affected Districts, Communities and Affected Persons

	DISTRICT	COMMUNITIES	NO. OF AFFECTED PERSONS
1	Shama-Ahanta East Metro	Nyaakrom	17
2		Kwasikwaa	16

	DISTRICT	COMMUNITIES	NO. OF AFFECTED PERSONS
3	Komenda-Edina-Eguafo-Abirem	Kissi	1
4		Abaka-Ano	3
5		Old Atabadze	3
6		Eduagyei	14
7		Mpeasem	15
8		Benyaadze	7
9		Agyeikrom	3
10		Nkantrodo	5
11	Asebu-Abura-Kwamankese	Abura Edukrom	42
12	Gomoa	Gomoa Potsin	30
13		Gomoa Abutsia	5
14		Gomoa Amanfi	14
15		Gomoa Ankamu	24
16		Kyiren	7
17		Gomoa Adam	8
18		Gomoa Fawomanye	2
19	Awutu Effutu-Senya	Gomoa Amanful	2
20		Gomoa Odumase	11
21		Domenase junction	11
22		Ohiamadwen	1
23		Nyame Bekyere	11
24	Mfantseman	Asafora	10
25		Eyisam	4
26		Mankessim	49
27		Ekurabadze	20
28		Waakrom	41
29		Ekumfi Bogyano	3
30		Ekumfi Swedru	4
31		Ewuoyaa	6
32		Ekumfi Akwakrom	1
33		Ekumfi Akotsi	17
34		Anotema	3
35		Segus Farms- (farms)	1

	DISTRICT	COMMUNITIES	NO. OF AFFECTED PERSONS
36	Ga	Danchiraa	2
37		Ga-Odumasi	22
38	Tema	Ashaiman	16

Some of the settlements lie directly under the transmission lines, while others lie within one (1) to two (2) km of the RoW. In either case, some inhabitants of these communities had farms or properties in the RoW.

The EIA study covered the following areas of the affected persons and communities:

- Ethnic, Cultural and Religious backgrounds
- Historical Resources
- Land tenure and Land Ownership
- Land use
- Employment/Commerce
- Agriculture
- Public Health

3.2.1 Methodology

Background socio-economic data on the affected districts were obtained from the updated District Development Plans prepared by each District Assembly. The essential data for the study were gathered through personal consultations with the affected communities.

Initially, reconnaissance visits were made to the communities along the route in order to make arrangements with opinion leaders to organize all persons affected by the AVTP in their respective communities for the main socio-economic survey (see Annex 5).

During the actual field surveys, the teams interacted with the residents, briefing them on the various relevant aspects of the proposed project and interviewed them to ascertain their concerns

and expectations. Appropriate questionnaire were duly administered. The questionnaire and analysis are presented in detail in Annex 3 and the findings form the basis for discussions on socio-economic impacts in Chapter 4.

3.2.2 Profiles of the Districts in the Project Area.

The AVTP project affects communities in seven districts in three administrative regions. Fig 3.7 shows the settlements found within the project area. Background information on the socio-economic profiles of the districts is provided in the following sections.

3.2.2 (a) Shama - Ahanta East Metropolitan Area

The Metropolitan area is located in the southeastern part of Western Region. It has a total land size area of 334.34 sq. km. The metropolis shares boundaries with Ahanta West, Mpohor-Wassa East, Komanda-Edina-Eguafo-Abrem districts. It is located on the coast about 200 km. West of Accra, and comprises four traditional areas, namely, Shama, Essikado, Sekondi and Ahanta.

- Demographic Characteristics

Total population for the metropolitan area according to the year 2000 population census (2000PHC) is 366,579. Currently, the population density for the district stands at about 1,096 persons per sq. km., an increase from the 1984 figure of 746 persons per sq. km. This indicates an increased in pressure on land resources.

The sex ratio of the population is given as 96.8 males to every 100 females implying that there are more females in the district then males. As a metropolitan area the majority of the people live in urban and semi-urban areas with the minority in the surrounding rural settlements.

The age distribution of the population shows that about 45 percent of the population are in the school-going ages of (0-14) years. The active population in their productive age (15-65) constitutes about 52 percent while the remaining 3 percent are aged above 65 years. This means

that technically about 48 percent of the people are dependants. However, practically the district is likely to have more than 48 percent of its population being dependants in relation to the number of those in the productive years who may actually be in active employment. The district is among those with high population growth rate.

- **Social Development**

Education: Educational institutions in the metropolis are categorized under nursery/kindergarten, primary, junior secondary, senior secondary, technical, teacher training and polytechnic. The metropolitan area has 102 nurseries and kindergartens, 118 primary schools, 11 senior secondary and 3 senior secondary/technical schools.

Teacher/pupil or student ratio at various levels of education in the metropolitan area are 1:25 for nursery schools, 1:28 for primary, 1:26 each for junior and senior secondary schools. Some major challenges facing development of education in the metropolis are serious overcrowding in older and well-established schools, bad conditions of physical structures for schools, and large number of untrained teachers teaching in the schools

Health: Common health complaints recorded in the district are malaria as the most common disease, followed by upper respiratory infections, acute eye infection, accidents and fracture. The rest are oral cavity, diarrhoea, ear infections, hypertension and intestinal worms.

Major health facilities in the district are 2 government hospitals, 31 private hospitals and clinics, 5 government health centers, 5 community clinics and maternity homes. There are 57 medical doctors and 248 nurses in the district giving doctor/population and nurse/population ratios of 1:4,011 and 1:922 respectively.

One major developmental challenge facing the district is concentration of health delivery facilities and services in the metropolis leaving a larger proportion of the people in the semi-urban and rural settlements without health facilities and services.

Water Supply: About 90% of the population in the metropolis depends on pipe borne water, which takes its source from the Pra River at Daboase and Anankwari River at Inchaban. However, both sources are not reliable, especially when there is inadequate rainfall and long dry seasons.

Other problems associated with water supply in the metropolis are sea intrusion at the Daboase in-take during dry seasons, frequent breakdown of old pumping equipment and frequent bursts of rusty and weak transmission pipelines. The rest of the population (about 10%) depends on wells for water supply source.

Environment: The relatively high concentration of industrial activities in the metropolis and rapid urbanization has led to a high degree of pollution and inadequate waste disposal facilities. Specific environmental and sanitation problems in the metropolis include widespread and indiscriminate defecation, fecal droppings from herds of cattle, extensive use of pan latrines, dumping of waste into drains, littering of environment and inappropriate techniques of disposal of domestic waste (both liquid and solid).

- Economic Development

The major economic activities in the area are agriculture (crop farming, forestry, fishing); mining and quarrying; transport, storage and communications; manufacturing; trade and commerce; community, social and personal services.

Trading and commerce constitutes the single largest employer, engaging more than 30 percent of people in employment, followed by agriculture and fishing (24.7%), community, social and personal services (19.2%), manufacturing (16.6%) transport/storage/communication (10.6%).

Agriculture: Agriculture activities in the metropolitan area comprise crop and livestock farming, fisheries and agro-forestry. The common farm crops in the area include oil palm, coconut, cocoyam, plantain, cassava, rice, pepper, tomatoes, garden-eggs, maize and yam. The popular

farming practices in the area are shifting cultivation and mixed cropping. Land preparation is usually done manually with the use of very simple farm tools.

The metropolis is ranked fourth in livestock production in the Western region. Popular among the livestock produced in the metropolis are cattle, sheep, goat, pig and rabbit as well as poultry. Again the metropolitan area produces marine fish in the order of about 16,692 metric tones annually. This constitutes about 36 percent of the total marine fish production in the Western region. In addition to the marine fish production there are also inland fish farmers who operate fishponds for mainly tilapia and catfish.

The Ministry of Food and Agriculture assists farmers to produce and market fuel wood. The aim basically is to check soil degradation and also sustain food production on the same land under continuous cropping.

Problems facing agriculture in the metropolis include crop diseases and pests, low productivity, post harvest losses, inadequate credit facility, pressure on land etc.

Industry: the metropolis is ranked the third most industrialized city in the country. The major industries process basically agricultural, forest and mining products. Examples are West African Mills Company, Western Veneer and Lumber, Ghana House Hold Utilities Manufacturing Company, British-American Tobacco Factory, Multi-Wall Paper Sacks, Distilleries, Ghana Cement Company etc.

Tourism: The metropolis is one of the areas in the region that offers important tourism facilities and other peculiar sites of tourist attraction. Tourism assets in the metropolis are categorized into three:

a). **Site attractions**: these involve historical and scenic attractions that are identified by their permanency and natural existence. Examples are Beaches, sports club, Whin River Estuary, Lagoon, Factories, Forts etc.

b) **Event attraction**: they are events undertaken at specific times for tourist consumption. Examples are Kundum festival, sports festivals and Beach parties.

c) **Tourism facilities**: such as Hotels, Restaurants and Entertainment sports.

Some of the major challenges to economic development are lack of room for expansion of market resulting in congestion, land degradation due to sand winning and stone quarrying, pressure on land for development.

3.2.2 (b) Komenda-Edina-Eguafo-Abrem (KEEA) District

Komenda-Edina-Eguafo-Abrem (KEEA) district is located in the Central region of Ghana. It is made up of four traditional areas namely Komenda, Edina, Eguafo and Abrem. The district has a total land size area of 372.49 sq. km.

- **Demographic Characteristics**

The 2000 PHC figures put the total population of the district at 112,437, accounting for 7.1% of the total population in the Central region. The district has a sex ratio of 92.2 males to 100 females implying there are more females in the district than males. The majority of the population in the district (66%) lives in rural settlements, with the minority (34%) in urban settlements.

- Social Development

Education: - There are 157 schools in the district. They comprise 48 pre-primary schools, 59 primary schools, 45 Junior Secondary Schools, 3 Senior Secondary Schools, 1 Teacher Training college and 1 Vocational/Technical School.

The district has teacher/pupil ratio at the primary level of 1:46; teacher/student ratio of 1:20 for both senior secondary and teacher training college.

The number of schools available in district, their concentration in certain parts of the district, and the population of the district all give a picture of inadequacy of educational facilities and denial of certain potential individuals of the opportunity of having access to educational facility.

Also worthy of mention are the poor conditions of the physical structures for most of the schools, ill equipped JSS and SSS workshops in the district. This implies that even most of the persons who go through the available schools do not have most of the things that it takes for efficient and effective learning or training.

Health: The district has 2 specialist hospitals (psychiatric and leprosarium), 1 health centre, 2 health posts and 2 clinics. There are also 7 maternity homes and 40 outreach clinics.

In terms of personnel, the district has only 1 preventive physician, 3 medical assistants and 32 nurses (16 preventive and 16 curative). In view of the inadequate health services, the district has registered 264 Traditional Birth Attendants (T.B.A.) and has so far trained 49 of them in modern maternity and child delivery practices. Besides, the district has 18 environmental health personnel. They comprise 2 environmental health officers, 1 environmental health technician and 15 environmental health assistants. The major challenges facing health delivery system in the district, apart from inadequacy of health facilities and services are logistical, inequitable distribution of the facilities in the district and ill-equipped facilities.

Policing and Security: The main policing and security tasks in the district are under the Ghana Police Services through three police stations located at Elmina, Kommenda and Abrem Agona. There is also a fire station located at Komenda to provide services to the rest of the district.

Water Supply: The main sources of water in the district are pipe borne, streams, rivers, wells and boreholes. As many as 62% of the people in the district have access to treated water. This means that almost 40% of the population rely on rivers, streams and other untreated sources of water for survival.

- **Economic Development**

The economy of the district relies basically on agriculture, fishing, manufacturing, services, commerce and petty trading, and support services.

Agriculture: The major agricultural activities in the district are crop farming and fishing. Like many other districts in Ghana agriculture offers employment to about 48% of the labour force in the district.

The major farm crops produced in the district are maize, cassava, cocoyam, plantain, vegetables, citrus, oil palm, pineapples, sugar cane and coconuts, cocoa and cashew. The total land area suitable for agriculture in the district is 335.24 km^2. But a total cultivable land is 268.19 km^2 out of which 150.86 km^2 is already under cultivation.

Farming in the district are basically rain fed, subsistence in nature and characterized by use of less efficient techniques. The common farming practices are mixed cropping shifting cultivation.

CEDECOM, a non-governmental organization in the district is also supporting export of non-traditional crops by assisting some selected farmers who constitute the Rural Export Development Association to produce Cashew and Black Pepper for export.

In the case of fishing the district contributes about 15% of total fish production in Ghana. Types of fish that are popular in the district's waters are herrings, mackerel, tuna, lobsters, shrimps and barracuda. Apart from the people who go to the sea for fishing, there are a number of them, particularly women who also process the fish through smoking, salting or drying. The main problems facing the fishing industry in the district include silting of the Edina harbour, post harvest losses during peak season and inefficient fishing methods.

Services: The services sector of the economy comprises both formal and informal. Services in the informal sector include dressmaking, carpentry, masonry, electrical repairs, beauticians, etc. The formal services sector on the other hand, includes hotels, restaurants, tourism facilities, public administration and other support services. The majority of these services are found in Elmina and Komenda meaning that the larger part of the population who live in rural communities has no direct access to most of the services in the district.

Industry: Manufacturing activities are not very common in the district. The few of such activities in the district include cassava processing, pineapple processing, fish processing and sugar cane and palm kennel processing. Others are salt mining, brick and tiles, boat building, canoe building. The manufacturing sector faces the major problems of accessing credit, technical know-how and management skills.

3.2.2 (c) Mfantseman District

Location: Mfantseman district is located along the coast of the Central region. It is bounded on the West and Northwest by Abura-Asebu-Kwamankese district, on the East by the Gomoa district and the South by the Gulf of Guinea. The district capital is Saltpond. It covers a total land size area of 612 sq. km., extending from latitude 5.07' to 5.20' north of the equator, and between longitudes 0.44' and 1.11 west of the Greenwich.

- **Demographic Characteristics**

The figures from the 2000 PHC put the district's population at 152,858 and accounts for 9.3 percent of the total population of the Central region. Females constitute the larger proportion (54.2%) of the population, giving a sex ratio of 85.2 males to every 100 females. The rapid increase of the district's population is partly attributed to the growing commercial activities in towns such as Mankessim, Yamoransa and Tekyiman, and fast growing fishing activities in some fishing villages that have attracted more migrants into the district. People in the district are basically Fantes who may be grouped as Fantes of Ekumfi, Nkusukum and Abura.

- **Social Development**

Education: Educational institutions in the district range from nursery to senior secondary schools. Available data show that the district has 92 Primary schools, 56 junior secondary schools (JSS) and 5 senior secondary schools (SSS).

Problems confronting education in the district include inadequate educational infrastructure and concentration of educational facilities in a few towns, low enrolment especially for girls, high school drop out and inadequate supply of textbooks and other logistics.

Health: There are ten (10) principal health facilities in the district. They are made up of two (2) hospitals, one (1) health centre, two (2) health posts and five (5) clinics. However, all the health facilities are concentrated in a few towns, namely, Saltpond, Mankesim, Anomabo, Esuahyia,

Dominase, Abor junction and Otuam. This means that a large number of people in many settlements do not have modern health facilities easily available to them. They rather have to travel to the few towns where the facilities are located which are also incidentally the major commercial and administrative centres in the district.

The major health problems in the district are high doctor/patient ratio, inequitable distribution of health facilities and services, high mortality and morbidity rates, high incidence of malaria and high prevalence of preventable communicable diseases.
The district administration has targeted to increase life expectancy at birth and significantly reduce infant and child mortality; reduce incidence of communicable and preventable diseases, water borne and other environmental-related diseases and ensure equitable access to health service for all persons in the district.

Water Source: The main sources of water to people in the district are pipe-borne, boreholes, wells, dams/ponds/lakes, dugouts and streams/rivers. Only a few settlements in the district have pipe-borne water. Many people in rural settlements of the district depend on rivers/streams, borehole, well and dugout for their sources of water.

The district administration intends to ensure equitable access to reliable supply of safe water for all communities and eradicate water-borne disease.

- **Economic Development**

Economic activities in the district are categorized under agriculture (farming and fishing), trading and commerce, other services and industrial.

Agriculture: Agriculture is the most common economic activity in the district. In the inland areas crop farming is the most important economic activity as against fishing along the coast, notably Biriwa, Saltpond, Otuam, Abandze and Kormantse. Among popular food crops grown in the district are cassava, maize, vegetables, plantain, cocoyam, and legumes. Cash crops common in the district are cocoa, coffee, oil palm, pineapples, citrus, sugar cane and coconut.

Trading: Trading is another important economic activity in the district involving the sale of both agricultural and manufactured goods. The major markets structures in the district serving as trading centres are located in Mankesim, Saltpond, Essuehyia and Otuam.

Industry: Industrial activities in the district are grouped under food processing, light industries and large-scale industries. The food processing industry involves corn milling, sugar cane crushing, garri processing and palm oil extraction.

The light industries also comprise pottery and ceramics, soap making, distillery, fish processing and boat building. The two large-scale industries in the district are ceramics and crude oil drilling all at Saltpond.

Tourism: There are a number of tourist attractions in the district. Notable among them are beach resorts in Saltpond and Biriwa; an irrigation Dam at Baafikrom; Castle/Forts at Anomabo and Abandzi; Historical places at Akatakyiwaa, Kormantse and Mankessim and "Nananom Pow" in Mankessim.

Other economic potentials in the district in the form of natural resources are Timber, Game, Minerals (Kaolin, Feldspar, Beryl, Crude oil, Diamond, Manganese and Salt).

Some major development problems in the district are low levels of income due to subsistence agriculture putting the bulk of the people below the poverty line. Another has to do with poor nature of feeder road linkages to the various farming areas leading to high transportation cost and post harvest losses.

3.2.2 (d) Awutu-Effutu-Senya District

The district is located in the Central region and has a total land area of 163 square miles. It is bounded to the South by Gulf of Guinea, to the East by the Ga Rural district, to the West and North by the Gomoa and Agona districts respectively.

The district is made up of three paramountcies, two constituencies and forty-two electoral areas. There are one hundred and fifty-seven (157) villages and six (6) towns in the district. Winneba is the capital town of the district.

- **Demographic Characteristics**

The year 2000 national population census figures put the district's total population at 169,974. The female population is more (89,420) than the males (80,554), giving a sex ratio of 90.1 males for every 100 females.

The larger percentage of the population (61.5%) lives in the six semi-urban and urban settlements (Winneba, Senya, Bawjiase, Kasoa, Awutu Bontrase, Gyeikrodua) in the district with the remaining 38.5% living in rural settlements.

- **Social Development**

Education: The number and types of schools in the district at various levels are 71 primary schools, 41 Junior Secondary Schools, 3 Senior Secondary Schools, 6 other second cycle schools and 2 tertiary institutions. However, most of the schools are located in the 6 towns in the district making it difficult for the substantial number of the district's population in the rural settlements have access to education. Besides the skewed nature of the distribution of educational facilities the physical structures and equipment for learning for most of the schools are in bad state and the Assembly has planned to rehabilitate them. The Assembly also plans to provide more schools, reduce the rate of school drop-out and improve the general standard of education.

Health: The main health facilities in the district are 3 hospitals, 1 family planning centre, 3 health posts, 2 clinics and 1 maternity home. The common health challenges facing the district include low life expectancy, high infant and child mortality, and incidents of communicable and preventable diseases. Water-borne dieses and diseases related to insanitary environment.

Other challenges are high patient-doctor ratio, inequitable distribution of health facilities and services, and generally high morbidity and mortality rates.

Water supply: The sources of water for people in the district are pipe borne, river/streams/brooks; bore hole, wells and ponds. A significant number of people in the district do not have access to safe drinking water. Some water sources are also known to be infested with water-borne diseases.

- **Economic Development**

The economic activities of the district are in the areas of agriculture, industry, commerce and fishing.

Agriculture: Common crops grown in the district include cocoa, cassava, yam, pineapple, pepper and other vegetables, oil palm, maize, yam, plantain, cocoyam, groundnuts, tiger nuts, mangoes, sugar cane.

A number of farmers are also involved in animal husbandry. The common livestock are cattle, poultry, sheep, goats and pigs.

Industry: Industries in the district are basically small scale and medium scale. They include soap making, edible oil processing, rice processing, distillery, fish processing, metal works, brick and tile, ceramics, saw milling, boat building, quarrying, pharmaceutical, and pottery. The only industry in the district classified under large scale is the Pomadze hatchery.

Some natural resources that constitute economic potentials in the district are sand, clay, gold, salt, timber, kaolin, beryl, gravel and granite. The main problems facing the district's economic development are inadequate transportation system, low savings, lack of credit facilities, inadequate market and lack of storage facilities, indiscriminate citing of industries in towns, low productivity and lack of irrigation facilities.

3.2.2 (c) Tema Municipal Area

Tema is one of five districts of the Greater Accra Region and is located 25 km East of Accra, the national capital. Tema is bordered on the northwest by Ga District, northeast by Dangbe-West and the South by the Gulf of Guinea. The Greenwich Meridian passes through the Tema township.

The Tema township is a modern, well planned industrial and port city. The residential section lies to the north and the industrial area is built up around the port in the south.

- **Demographic Characteristics**

The estimated population of Tema municipality is about 506.637 (2000 PHC). Most of the population is concentrated in the urban part of the Municipality comprising of Tema Township, Sakumono, Ashaiman and Tema Manhean. Urban Tema with about 90 % of the population covers about 15% of the total land area while Rural Tema has 10% of the population occupying the remaining 85% of the land area. It is estimated that nearly 280.000 people live in the Tema township which includes the area of immediate significance to the project.
The Government owns 45% of the land in the Municipality, while 55% is owned by the various Stools (Chiefs) and families of indigenous settlers.

Tema lands belong to the indigenous Ga people. However, presently almost all the ethnic groups are represented in the city. Among the major ethnic groups are the Ga-Adangbe, Akan, Ewe, Guan, Mole-Dagbani, Gurma, etc. There is also a sizeable group of immigrants, Non-Ghanaian Africans, Europeans and Asians. The bulk of the African group of immigrants is mainly from the neighbouring West African countries.

- Social Development

Health: There are 6 government and 28 private health facilities available in the municipality. These include the Tema General Hospital, (which is located directly on the road project), the Tema Polyclinic, the Port Health Services, 2 Health Centres at Ashaiman and Manhean and a clinic at Kpone. Besides these, there are 69 satellite clinics organised by staff of the Government facilities. Facilities are available for dealing with various occupational related health problems.

Services rendered include Maternal and Child Health (MCH), Family Planning, Home Visits, supervision of Traditional Birth Attendants (TBAs) and Psychiatric Health. Lastly, there are over 72 pharmacies, and at least 8 Animal Clinics in the Metropolis. A good number of the residents of Tema and a few from Accra work in these facilities.

Roads: There are about 220 km of roads in the Municipality. These comprise mainly of first class roads in the urban areas of Tema township, Tema Manhean, Ashaiman. The Department of

Urban Roads working with the Tema Municipal Assembly, are responsible for the maintenance of roads in the Municipality.

Water: A large majority of settlements within the Municipality have access to pipe-borne water from the Kpong water works. However, in the rural parts of the Municipality some settlements still lack this basic facility and depend on water from streams, rivers and wells.

Electricity: Adequate provision has been made for the supply of electricity for the urban community. Industries in Tema consume the largest part of all electric power generated in the country. The Volta Aluminum Company (VALCO) for instance, consumes a greater portion of the total power produced by the Akosombo dam. Presently, the industrial and domestic requirements for power in the Municipality, excluding VALCO, is about 65 MW

All the major utility services – electricity, water and telephone are present in the project area. Most of the electricity cables in the township are buried underground. Field investigations are currently underway in collaboration with the utility companies to identify the exact location of all pipelines, cables, plants and facilities.

- Economic Activities

Tema is the focus of a range of economic activities, namely, Manufacturing Industry, Health, Education, Services, Fishing, and Agriculture.

The industrial sector in Tema, which consists of over 185 manufacturing and industrial organisations, represents the most important productive sector in terms of local revenue generation. It is also a major source of employment for the urban population. There is also a large number of small-scale and informal sector manufacturers, especially in the wood processing, metal fabrication, food production, and textiles industries.

Tema has a huge number of organisations in the Services Sector, among them, are Ports (Commercial and Fishing), Warehousing, Transport, Tourism and Travel Agencies, Stevedoring, Shipping, Clearing and Freight Forwarding.

Subsistence and commercial fishing is a significant activity along the Ghanaian coast with the Tema district being of prominence. Fishermen number approximately 4800 within the district. This district contributes approximately 27% of the national fish production with the artisanal sector contributing about 20% in the Greater-Accra region.

Tourism Resources: The major tourist and cultural sites in the Tema Municipality are the beaches and the "Meridian Rock" which is believed to be located at the exact centre of the world. The Greenwich Meridian passes through the town and a point at the Presbyterian Church in Community One has been selected to represent it and serves as a tourist site.

3.2.2 (f) Abura-Asebu-Kwamankese District

The district is located in the Central region of Ghana. Abura-Dunkwa is the district's capital. The district shares boundaries with Mfantseman, Cape Coast, Twifu-Hemang, Denkyira and Assin districts.

- **Demographic Characteristics:**

The population of the district keeps on increasing significantly from census to census. Thus, the district's population that stood at 27,039 in 1960 increased to 37,177 by 1970, 61,376 in 1984 and 89,269 by the year 2000. That is, the population in the district has increased for a little more than 230 per cent between 1960 and the year 2000. Females constitute about 53 per cent of the population while males constitute 47 per cent. The district's population is generally young with about 54 percent lying within zero and 19 years (0-19). About 40 percent of the population lies in the productive ages of between 20 years and 60 years, with the remaining constituting the old or the aged. This gives a picture of high dependency ratio.

- **Social development**

The conditions of the social life of people in the district give indications of major problems as discussed in various sub-headings below:

Education: The district has 62 primary schools, 40 Junior Secondary Schools (JSS), 5 Senior Secondary and 1 Technical school. Apart from the fact that the number of schools in the district does not commensurate with such large youthful population most of the primary and JSS are located in temporary structures. Most of the permanent physical structures are also defective.

There are about 240 teachers in the district comprising about 75 percent trained and 25 percent untrained. Many children walk over long distances to attend school due to unavailability of educational facility close to them.

General speaking educational facilities and infrastructure are woefully inadequate and the conditions of the few available are nothing to write home about. The situation is not motivating enough to encourage high enrolment and retention of pupil and students in the school. The quality of education given to pupil and students in the district also needs much to be desired because of inadequate logistics and teaching aid, coupled with widespread poverty among parents in the district.

Health: -Some common diseases recorded in the district are malaria, skin diseases and diarrhoea. The courses of these diseases are attributed to mosquito and poor environmental management practices.

The main health facilities available in the district are 3 health posts, 2 clinics and 1 maternity and child health care centre (which also provides mobile health services). In the event of any serious illnesses or casualty, patients have to be rushed to Cape Coast, Saltpond or Nyankomasi (of different districts) for medical attention and treatment.

The major challenges confronting the district's health delivery include poor and inadequate health facilities and services, and lack qualified health personnel. For example, there is no qualified medical doctor in any of the health facilities in the district.

in addition, the few health posts and clinics in the district are located only in a few communities, mainly in the district capital and a few surrounding communities. This means that the majority of the population in the rural communities has to walk long distances to have access to modern the facilities.

Seeking for modern health care in the district is further hampered by widespread poverty among the population. The consequences are the widespread practice of self-medication including herbal medicine, while other sick persons go without medical care.

Water and Sanitation: The main sources of water for people in the district are streams and rivers, hand dug wells, boreholes and pipe-borne. Only four settlements (Abura Dunkwa, Abakrampa, Moree and Ekroful) in the district have access to pipe-borne water. The remainder of the settlements relies on water from the other sources.

Sanitary conditions in the district are generally poor. Indiscriminate dumping of refuse in open places is a very common practice among the people, and toilet facilities are seriously lacking. The common toilet facilities available are a few public aqua-privies and pit latrines.

- Economic Development

The district's economy is basically sustained by agriculture and fishing. Popular crops grown in the district are citrus (oranges and lime) oil palm, cocoa, coffee, tubers, vegetables etc. However, poor conditions of roads and road networks greatly affect marketing of the farm produce. Middlemen rather buy the produce at cheaper price and transport them to urban areas to sell them. Most of the farmers hardly recover their production cost and are constantly kept in poverty.

Fishing is the main economic activity for the people in Moree who are along the coast. They produce about 2,000 tones of fish monthly.

Industrial, constructional and tourist activities are not well developed in the district.

3.2.2 (g) Ga District

Ga district is one of the five districts in the Greater Accra region. It is located to the west and partly to the north of the region, and lies in the coastal savanna agro-ecological zone. The district lies between latitudes 5°48'34"N and 5°29'N and longitudes 0°30'0"W and 0°8'47"W. It is bordered on the West by the Central region, north by the Eastern region, East and South b the Tema Metropolitan Assembly (TMA), and Gulf of Guinea and Accra Metropolitan Assembly (AMA) respectively.

- **Demographic Characteristics**

Figures from the national population census in Ghana show that the Ga district is one of the districts with high population growth rate in the country. The 1960, 1970 and 1984 censuses put population of the district at 31,308, 58,674 and 136,358 respectively. The year 2000 census however, recorded as many as 556,581 persons, an increase of 420,223 persons more than that of 1984 data (within 16 years).

The male population in the district is slightly more than the females, with a sex ratio of 100.4 males per every 100 females. This means, population density has been increasing significantly over the years. 1960 - 36.4, 1970 - 68.3, 1984 - 158.7.

About 74 percent of the population lives in the urban and peri-urban communities while the remaining 26 percent live in rural communities. Some of the urban communities in the districts are Madina, Mallam, Bortianor, Pokuase and Amasaman, which is the district's capital.

The district's population has a high proportion of youths of ages' 14 years and below who account for about 47 percent. The remaining age distribution of the population in the district is 15-14 years (39%), 45-64 years (10.4%) and 64 and more (2.5%). Thus, the population have relatively high dependency ratio.

- **Social Development**

Education: The district has 42 nursery schools, 142 primary schools, 63 Junior Secondary Schools (JSS) and 6 Senior Secondary Schools. The teacher: pupil ratios are 1/28.2 nursery, 1/31.7 at primary and 1/17.9 at the JSS level. A lot of physical structures for education are incomplete, dilapidated or ill equipped.

Enrolment in schools is relatively low and near constraint at about 4,370 in 1994/95 and 4,244 in 1990/91; and the male: female distribution is adverse against females at 75 males to 25 females. The drop-out rate in schools is generally high in the district, particularly among females.

Health

The district's basic health facilities are 3 rural health centres, 5 Maternal and Child Health (MCH) clinics and 150-outreach point for growth monitoring and immunization services in 173 of the communities. The Pantang Psychiatric hospital is also located in the district, and also one communicable diseases hospital sited at Weija.

Endemic diseases in the district are schistosomiasis, yaws, Buruli Ulcer and Tuberculosis. Other common diseases recorded in the district are malaria, upper respiratory infection, diarrhoea, skin diseases, cholera, chicken pox, measles, acute eye infections and hypertension. A little more than 62 percent of all diseases recorded at the OPD is malaria, followed by UCI and diarrhoea. The six childhood killer diseases in the district are mainly controlled by immunization. However, immunization coverage I low compared to the other districts in the region.

Water: One of the major problems facing the district is water supply, in spite of the fact that the Weija water reservior and treatment plant is located in the district. The district data on water show that the larger numbers of people in the district depend on dams/dug outs, rivers, streams and boreholes for source of water. The majority of the population has access to treated water. The district capital itself (Amasaman) does not have potable water. The situation was created when the old pipe system was damaged during the construction of the main Accra-Nsawam road.

Sanitation: Dumping of refuse in open places (both approved and unapproved) is the most common practice in the district. Only about half of the 40 refuse containers needed for the urban and semi-urban communities of the district are currently provided.

Pit latrines constitute the main method of disposing human waste in while pan latrine and KVIP are the most common in the urban communities.

- Economic Activities

The main economic activities in the district are agriculture, industry, commerce, mining, quarrying and recreation.

Agriculture: Agricultural activities comprise crop production, fisheries and livestock.

Major crops that are produced in the district include cereals and legumes, root tubers, vegetables and fruits.

Fishing is done along the coastline l the district and provides range of fishes including tuna, sardines, mackerel, snapper, tiger fish, cassava fish, grouper shrimps and lobsters. Fishing in the district is basically the canoe type, and a significant number of women also engage in the processing and selling of fish in the district.

Livestock production in the district also comprises both remnants (eg. cattle, sheep, goat etc) and non-remnants (eg. poultry, pigs, rabbits etc). Poultry production in the district has been increasing steadily over the years.

Industry: Industrial activities in the district are made up of processing of primary product and manufacturing. Some primary product processing include akpeteshie (local gin) distillation, soya cake, copra cake and feed-meal processing.

Manufacturing also resolves around brick and concrete blocks, salt ponds, pharmaceuticals and beverages.

There are also sand winning, mining and quarrying activities carried out in the district. These activities are carried out in places where there are clay, sand and stone deposits. The activities are carried out at both approved and unapproved sites.

The construction industry is another vibrant industry in the district. It accounts for about 15 percent of the industrial sector employment in the district. The constructional activities have been greatly boosted by the presence of a significant number of estate developers who are operating in the district. They include ACP estates at Pokuase, Ashongman estates at Ashongman, Adenta estates at Adenta and Redco estates at Madina.

- **Trade And Commerce**

Trading and commercial activities serve as major source of economic life for many people in the district. These activities are carried out in stores, stalls, hawking and established market centres. Major established market centres are located in Amaaman, Obom, Hobor, Ngleshie, Amanfro and Madina. Adeiso and Kasoa markets are just outside the boundary of the district, but still serve as major marketing centres for people in the district.

- **Cultural Value And Festival**

Traditional Administration: The traditional administration revolves around chieftancy institution. The indigenous nature of the traditional political system makes it most acceptable and respected as such. The chiefs at all levels still perform executive legislative and judicial functions. The paramountcies are the highest traditional authorities and the divisional chiefs are the main links between the paramountcy chiefs of the constituent towns/villages.

Festivals: Three major festivals are celebrated in the Ga district, namely, Homowo, Yam and Awoba festivals. Homowo is celebrated annually to commemorate their victory over hunger during their migration westward to Accra, from Nigeria. The Yam festival on the other hand is celebrated by twins and stools at the end of the farming season.

There are also some Visual Arts. They are in the forms cooking pots, water jugs, woodcarving, door mats, rope etc. in Nsobu; basket and bag weaving bamboo/cane furniture etc in Pokuase, Ashoman, and Afiaman.

3.2.2 (h) Gomoa District

Gomoa district is located between latitudes 5°14' north and 5°35' north and longitudes 0°22' west and 0°54' west. It is situated on the eastern part of the Central region of Ghana and has a total land size of 1,022.3 square kilometers. The district is the second largest (next to Assin district) in the Central Region.

Gomoa district shares boundaries with Agona and Awutu-Efutu-Senya districts on the northeast and east respectively, west and northwest by Mfantseman and Ajumako-Enyam-Essiam respectively, and on the south by the Atlantic Ocean.

The district has two paramountcies, namely Gomoa-Assin and Gomoa Ajumako, and the seats of the paramountcies are located at Pomadze and Gomoa Assin respectively. There are 186 settlements in the district with Apam as the district capital.

- Demographic Characteristics

Gomoa district is the most populous district in the Central region, and census data from 1960 to the year 2000 show significant inter-census growth. Thus, the district's population as at 1960 stood at 102,838, which increased to 128,553 in 1970, showing a 25 percent increase in the ten-year period. The 1984 population census also recorded a total population of 134,632 (4.7% increase over 1970 figure) and 196,756 in year 2000 (46% increase of 1984 figure). There are more females than males in the district's population with a sex ratio of 84.4 males to every 100 females. The dominance of female population in the district is attributed to widespread emigration of males from the district to other districts and regions to engage in cash crop farming, especially emigration towards cocoa growing areas. The district also has young population having a little more than 60 percent of them lying between zero and thirty-four (0-34) years. The majority of the population lives in rural area with the minority in urban settlements.

Available household data show that the district has an average household size of 6.63 persons per household, a figure much higher than that of the national average household size.

- Social Development

Health: Common diseases recorded in the district are malaria, pregnancy complications, acute respiratory infections, skin diseases, gynecological disorders, diarrhoea, hypertension/heart diseases, sexually transmitted diseases, anemia, rheumatism, eye infections and malnutrition.

Malaria is the most common disease among the people. It accounts for a little more than 30 percent of all recorded diseases in the district. Next to malaria is pregnancy related diseases, which also account for about 20 percent of all recorded diseases, acute respiratory infections (9.5%) and skin diseases (9.2%).

The district has one Mission hospital (Catholic) located in the district's capital (Apam). The district has 2 qualified Medical Doctors, 42 nurses and 35 paramedical staff. Besides the hospital there are 2 health posts situated at Gomoa Oguaa and Gomoa Buduatta and 3 community clinics also at Anyadze, Ojobi and Nyanyano. The doctor-patient ratio in the district is about 1: 75,000. The distribution of health facilities and services is skewed towards the district's capital (Apam). The implication is that many people in the district have difficulties of having access to health facilities and services by virtue of the fact that they live farther from the district capital where these facilities are located

Other problems associated with accessibility to health services include widespread poverty, illiteracy and poor conditions of roads and road networks in the district.

Some of the consequences of inaccessibility to modern health facilities include high patronage of quasi-healers camps and self-medication, late reporting of treatable diseases and the consequent high mortality rate.

Other health related challenges in the district are poor sanitation facilities, inadequate safe drinking water, etc.

Education: There are 280 schools of various levels and types in the district. They comprise 65 kindergartens, 126 primary, 85 Junior Secondary School and 4 Senior Secondary Schools. As pertains to many other districts there are more male pupils and students in schools than their female counterparts. But school enrolment rate is unacceptably low in the district. And drop out rate is also very high, especially for girls. The teacher/pupil ratio at the primary and JSS stands at 1:31 and that of SSS is 1:16.

- Economic Activities

Economic activities in the district revolve around agriculture, commerce, services and industry. But agriculture constitutes the main economic activity for the majority of the people. It employs almost 80 percent of the districts' labour force. Next to agriculture is trade and commerce, which also employs about 8 percent of the labour force.

Agriculture production in the district is mainly at the subsistence level. It comprises both crops and animal production.

Major crops grown in the district are maize, cassava, pepper, tomatoes and pineapple. Problems facing crop farming in the district include insufficient and unreliable rains, lack of credit facilities, low prices for farm produce, high cost of farm inputs and the use of simple and less efficient farm tools.

Livestock production is also at both subsistence and commercial levels. The two popular livestock farms in the district are VIMS farms located at Gomoa Manso and Pomadze Poultry at Pomadze.

For the communities along the coast fishing constitutes their main economic activity. Major fishing communities in the district include Mumford, Apam, Dago, Mankoadze, Abrekum, Nyanyano and Fetteh.

- **Manufacturing And Processing**

The district virtually lacks large scale manufacturing enterprise. The only known large-scale enterprise is the Cleaner Soap and cement factory at Pomadze. However, there are a number of small-scale enterprises in the district. They include salt mining at Apam and Mumford, brick and tile factory at Gomoa Nsrumem and Adawakwaa, pottery making at Dawurampong and Abankwaamu. Other small -scale industrial activities are carpentey, masonry, hairdressing and tailoring.

3.3 Results Of Socio-Economic Surveys (Communities, Persons And Property)

This section presents the results of socio-economic surveys relating to communities, persons and properties that are expected to be affected directly by the implementation of the proposed 330 KV Aboadze-Volta Transmission Line project.

In all 38 communities in three regions (Western, Central, Greater Accra) indicated that the project along the coastline would directly affect persons and properties. The communities concerned are found in eight districts in the three regions, namely Gomoa, Mfantseman, Asebu-Abura-Kwamankese (AAK), Komenda-Edina-Eguafo-Abrem (KEEA) and Awutu-Effutu-Senya

(AES) districts of the Central region, Shama-Ahanta East district of Western region, and Ga district and Tema Municipal of Greater Accra region.

Constraints Encountered

A total of four hundred and fifty one 451 persons from the eight districts presented their names as those who will have the Right-of-Way (RoW) as presently indicated by the survey pegs, passing through their various properties. However, it is important to note that some of the communities contacted are still trying to locate the VRA pegs on their land to enable them present the list of affected persons and properties.

Moreover, some of the persons who presented their names could not locate the pillars on their properties, but claimed that they could remember that the surveyed line passed through their properties when it was constructed about two years ago before this study.

The difficulty in identifying all those affected by the project arises from the fact that the survey of the proposed route and placing of pegs/pillars was done nearly 2 years earlier and that the line route has overgrown with bushes in many areas.

Some of the respondents also claimed that the surveyors did not inform the people in the communities about the purpose of their exercise or involve them in any way. Many people, therefore, did not take any serious note of pillars on their land.

3.3.1 Information On Affected Persons And Properties

Demographic Characteristics

This section discusses the socio-demographic characteristics of affected persons identified so far.

3.3.1.1 Age Distribution of Affected Persons

Age Bracket	Total	Percentage
17-26	25	5.54
27-36	107	23.72

37-46	103	22.83
47-56	99	21.95
57-66	71	15.74
67-76	35	7.76
77-86	11	2.43
Total	**451**	**100**

Table 3.8 Age Distribution of Affected Persons

The ages of the affected persons range from 17 years to 86 years. The majority of the affected persons are in their productive (economic, social and biological) years of between 17 years and 56 years. A total of 334 of all the affected persons, accounting for 74.06%, lies within this age category. This implies that a significant proportion of the affected population has financial and economic responsibilities. Thus, if the sources of livelihood of these people are to be adversely affected by the project, there have to be mitigation measures to ameliorate any economic and social implications before the implementation of the project.

It is also important to note the implications of the project on the significant number of old people (57 years and older). Most of the aged are not strong enough to engage in any active social and economic activities for survival. Therefore any disruption in their economic and social lives without immediate measures to mitigate the possible impact is likely to hamper their survival.

3.3.1.2 Gender Distribution of Affected Persons

DISTRICT	MALE	FEMALE
Gomoa	87	39
Mfantseman	108	47
KEEA	56	11
AAK	34	9
Shama-Ahanta East	15	2
Ga	36	7
Total	326	115

Table 3.9 Gender Distribution of Affected Persons

The larger proportion of the affected population is composed of males, who make up 72.2%, while females make up 27.8% of the population.

In a cultural matrix where males are assigned leading roles and responsibilities in the family system, it is essential that appropriate measures be put in place to mitigate the potential impacts of the project on the affected persons before implementation. This will go to ensure that the affected persons are effectively cushioned against the adverse impacts of the project. The substantial number of females to be affected (115) by the project is also worth noting. It means that support for their families and for their own welfare is at stake, and therefore must be factored into any plans for the implementation of the project.

3.3.1.3 Marital Status of Affected Persons

Status	Frequency	Percentage %
Married	369	81.81
Divorced/separated	59	13.08
Widowed	8	1.77
Never married	15	3.32
Total	451	100.0

Table 3.10 Marital Status of Affected Persons

The data shows that almost 81.81 per cent of the affected person are married, some others are single parents through divorce (13.08%), and loss of spouse/widowed (8.0%), while a few 3.32%) had never married. Apart from directly denying the married ones some properties, the project also has the potential to adversely affect marriage stability. This may result from lack of transparency in the use of compensation sums received for lost property on the part of some spouses, as well as inability to cope with hardship on the family that may result from the delay or non-payment of compensation from VRA for affected properties.

The project also has the potential of bringing some hardship on single parents who have to struggle alone to sustain their households, who may have their sources of livelihood destroyed or ceded to make way for the construction of the right of way.

3.3.1.4 Ethnic Composition of Affected Persons

Ethnic group	No of Affected Persons	Percentage
Fante	277	61.41
Ahanta	22	4.87
Other Akan	68	15.07
Ewe	28	6.2
Ga/Adangbe	38	8.42
Zambrama	6	1.33
Hausa/Northern ethnic group	12	2.66
Total	451	100

Table 3.11: Ethnic Composition of Affected Persons

Table 3.11 above shows the ethnic origins of the affected persons. There are substantial numbers of migrants in all the districts. And the extent of worries and frustrations that may confront migrants if their properties are to be affected by the project may not be the same as the indigenes. As result any measure to mitigate the impact of the project on the people must take into account the element of immigrants in order not for them to suffer unduly.

3.3.1.5 Household Size/Dependants of Affected Persons

The affected persons, who have dependants, were asked to indicate the number of persons who depended on them for living (socially, economically etc). Their responses are presented in the table below

Household Size	No. of Affected Persons	Percentage
2-4	93	30.3
5-7	101	32.9
8-10	67	21.8
11-13	21	6.8
14-16	11	3.6
17-19	2	0.7
20-22	8	2.6
23-25	3	1.0
26-28	-	-
29-31	1	0.3

Household Size	No. of Affected Persons	Percentage
Total	307	100

Table 3.12 Household size/Dependents

Although some of the affected person did not indicate the size of their households the majority (307) gave numbers of persons in their households. The household sizes range from two (2) to thirty-one (31) giving a mean household size range in the various districts of between 5.1 persons to 8.6 persons. This situation is an indication of high dependency ratio among the affected persons. As a result, any significant disruption in their social and economic lives would be difficult to manage to sustain meaningful lives in their households.

Secondly, although 451 persons have indicated that they would be affected by the project, if one is to consider a general average of 6.45 household size per affected person for the 307 affected persons who mentioned their households, then some 1,974 persons would be affected directly by the construction and maintenance of the Right of way. This figure is very significant, and appropriate mitigation measures need to be put in place before the implementation of the project.

3.3.1.6 Religious Backgrounds of Affected Persons

Religion	No of Affected Persons	Percentage
No Religion	23	5.09
Christianity	323	71.61
Islam	61	13.52
Traditional	22	4.8
No response	22	4.8
Total	451	100

Table 3.13: Religious Backgrounds of Affected Persons by District

Christianity (71.61%) is the most popular religion among the respondents themselves in all the districts. Islam (13.52%) is second to Christianity among the respondents. Traditional religion is also significant among the respondents. A total of 22 respondents said they belonged to Traditional religion. The general impression that one gatners from this is that people in the affected communities are generally religious. As a result any significant effect of the project on

religious objects and practices are likely to have significant effects on their emotions, sensitivity and sense of security from the supernatural.

3.3.2 Economic Indicators

3.3.2.1 Occupation of Affected Persons

Another important factor in the analysis of potential impact of the project has to do with occupation of the affected persons. This becomes more relevant particularly where major occupations of the population stand the risk of being affected adversely by the project. The various occupations of the affected persons are presented below.

Occupation	Total	Percentage
Farming	281	62.3
Business/trading	29	6.48
Driving	15	3.3
Public service	14	3.1
Carpentry	8	1.77
Masonry	8	1.77
Machine operation	5	1.1
Dressmaking	2	0.44
Chop bar operator	2	0.44
Pensioner	2	0.44
Unskilled casual labour	4	0.886
Mechanic	6	1.33
Sand winning	1	0.22
Native doctor	1	0.22
Security service	4	0.88
Seaman	2	0.44
Fisherman	2	0.44
Teaching	4	0.88
Not disclosed	61	13.52
TOTAL	451	100

Table 3.14 Occupation of Affected Persons

Although quite a number of occupations were mentioned by the affected persons as their sources of livelihood the overwhelming majority (281) accounting for more than 62 per cent depend on farming as their main source of livelihood. Other significant occupation among them is commerce and trading (29) out of which many trade in farm produce.

This means that significant adverse impact on farming activities and farm lands will have far reaching adverse social and economic consequences not only for the population of the affected communities, but also for the surrounding communities.

3.3.2.2 Affected Properties

Property	Total	Percentage
Undeveloped land	103	17.0
Cassava	118	18.4
Cashew	12	1.9
Pineapple	43	3.6
Oil palm	49	7.9
Teak farm	1	0.2
Ceramic factory	1	0.2
Acacia plantation	64	9.7
Plantain farm	21	3.4
Pepper farm	25	3.7
Maize	19	2.9
Cocoa	1	0.2
Beans	2	0.3
Orange	14	1.8
Pawpaw farm	5	0.8
Poultry farm	3	0.5
Garden eggs	14	2.3
Borehole	2	0.3
Piggery	3	0.5
Tomato farm	9	1.5
Okro farm	6	1.0
Building	74	12.2
Mango trees	5	0.8
Water melon	1	0.2
Pottery factory	1	0.2
Sugar cane	6	1.0
Coconut	40	6.4
Water reservoir	3	0.5
Banana	4	0.6
TOTAL	670	100

Table 3.15 Affected Properties

Properties that are likely to be affected by the project more significantly are undeveloped land (both farmlands and residential land)), farm crops. (food crops and cash crops), buildings, etc. Thus, the construction and maintenance of the RoW will have significant implication for farming

activities not only for the farmers themselves, but also for farm labourers, the purchasing power of the people and their general economic life.

The demolition of buildings to make way for the project will also lead to displacement of families which also has implications for disruption of social life of the people

3.3.3 Land Tenure Arrangements

The land tenure systems in the communities were determined by questioning the wider community. A number of conditions were given by the respondents to illustrate how land is given out to people for use in the communities. The various terms and arrangements in various districts are presented in Table 3.16 below.

Terms of Arrangement	Gomoa	Mfantseman	KEEA	AAK	Shama	Ga	Total
Tenants pay for its use for specific time period	15	35	30	8	13	19	120
Tenants use and share proceeds with landlord	9	12	7	5	4	8	45
Tenants use and shared produce/property in completion	27	13	13	5	5	18	81
Outright sale	-	24	14	1	7	25	68
Gift	4	3	1	3	5	3	19
Right to land by family lineage membership	51	47	21	23	11	27	180
No specific arrangement depends on individual	-	13	14	17	7	21	79
N/R	12	18	-				30
Total	132	155	100	62	52	121	622

Table 3.16: Terms and Conditions of Land Tenure in Affected Communities

Table 3.16 shows the various terms and arrangements by which one gets access to land as tenants paying for the use of a piece of land for specified period of time; tenants using the land, selling the produce and sharing the proceed with the land owner; tenants using the land and sharing the produce on completion of the work; selling land outright to users; giving land out as gifts, and automatic right to family/lineage land by family/lineage members.

However, substantial members of the respondents said terms and arrangements for land use depend on individual landowners and tenants. According to them there are no specific general arrangements and terms by which land is given for use. The most popular conditions for access to land in almost all the affected communities are membership of a family/lineage, tenants paying for use of land for a period and tenants sharing proceeds or produce with land owners. Outright sale of land is particularly popular in the Ga district.

3.3.4 Health

The pattern of illness and diseases in the various affected district are similar to one another. The dominant illnesses in the districts are Malaria and headache. They are followed by bodily pains and stomach problems in all the districts. A few of them from Gomoa (2), Mfantseman (3) AAK (2) and Ga (1) also mentioned and HIV/AIDS as a common disease in their communities.

	District						
Illness	Gomoa	Mfantseman	KEEA	AAK	Shama	Ga	Total
Malaria/Fever	44	49	31	12	8	16	
Headache	27	38	13	8	6	14	
Body pains	8	20	9	10	3	14	
Stomach upset/problems	5	16	5	7	3	9	
HIV/AIDS	2	3	-	2	-	1	

Table 3.17: Common Illnesses in the Some Affected Communities

The respondents attributed the causes of diseases in their communities to mosquitoes, filthy environment, drug abuse, prostitution, poor diet and eating habit and hardworking. Mosquito, filthy environment and hardworking were mentioned more than the other causes. Poor diet and eating habit is also somewhat popular (see Table 3.18)

	District						
Causes	Gomoa	Mfantseman	KEEA	AAK	Shama	Ga	Total
Mosquito	47	47	28	10	9	13	
Filthy environment	19	24	13	9	5	12	
Drug abuse	2	4	2	-	-	-	
Prostitution	2	2	-	2	-	1	
Mainutrition/Poor diet	7	5	-	3	5	6	
Hard work	12	17	4	4	7	9	

Table 3.18: Causes of Diseases in Some Affected Communities

Thus, the construction of the right of way will have a significant impact on the health of the people in the communities if the activities involved create stagnant water that will facilitate the breeding of mosquitoes, worsen the already filthy environment, destroy food crops or compel the people to suffer even harder.

The health implication was also assessed from the various sources of treatment for diseases that are available to the people. The various sources of treatment mentioned by the respondents are chemical shop/drug store, pharmacy, herbs/herbalist, hospital/healthcare and drug hawkers.

3.3.5 Affected Community Properties

Community properties to be affected by the project include schools, shrines, cemeteries etc. These are presented below.

COMMUNITY	PROPERTY
Ekotsi	Cemetery and Omanyawuo shrine
Ekurabadze	Obokyem shrine, Obesiwa shrine and Adambo shrine (3)
Amosima	Nana Ebolise shrine
Kwasi Kwaa	Cemetery
Nyaakrom	Bobobgema shrine
Nkontrodo	Nana Abeka shrine
Mankessim	Baptist Church building, Hameed Islamic JSS building, Headmaster's bungalow, Amisa (river god)
Abaka-Ano	Nana Tawien shrine
Edukrom	Abeka mpow, cemetery
Old Atabadze	Residential quarters belonging to the District Assembly.
Mpeasem	Bosom Broni shrine

3.3.6 Concerns of Affected Communities

Some of the concerns raised by the affected communities are as follows:

1. That affected farmlands will become smaller in size and in some cases right of way will split some farmlands.
2. Possibility that affected persons may not be adequately compensated and may worsen their poverty situation.
3. Fear that those who will administer the compensation may not be fair to all affected persons.
4. Neglect of community leaders in decision for the use of the land for the project.
5. Communities to be educated on health implications of the transmission of power through the communities.

3.3.7 Expectations of Affected Communities

Usually with such projects, people generally have high expectations for improvement in their living conditions etc. People in affected communities have expressed the following expectations:

1. More investors to be attracted to the communities because of the VRA project.
2. Employment opportunities during construction of the right of way, and also local people to be recruited to maintain the right of way.
3. Affected communities without electricity to be connected to power.
4. VRA to provide health facilities to affected communities to take care of any eventualities.
5. VRA to provide portable water for communities whose sources of water will be affected.

3.4 Identified Survey Pegs (VRA Pillars) by District

As mentioned earlier, some community members have encountered difficulties in identifying line route pegs (VRA pillars) on the surveyed line for the RoW. This is due to the fact that the line route has been overgrown by bush. However, the people managed to identify some of them as presented below:

A) GA DISTRICT

AT 1/00 369, AT 1/00368, AT 1/00377Q, AT1/000361N, AT 1/00 378 Q, R

B) **ABURA-ASEBU-KWAMANKESE (AAK) DISTRICT**
AT 1/00138, AT 1/00139, AT 1/00136, AT 1/00140

C) **KOMENDA-EDINA-EGUAFO-ABREM (KEEA) DISTRICT**
AT 1/0037, AT 1/0038, AT 1/0036, AT 1/0035, AT 1/0034, AT 2/03/0, AT 2/03/03, AT 2/03/04, AT 2/03/05, AT 2/03/09/, AT 2/03/10, AT 2/03/11,

D) **MFANTSEMAN DISTRICT**
AT 1/00157, AT 1/00156, AT 1/00155, AT 1/00152, AT 1/00211A, AT 1/00 158, AT 1/00159, AT 1/00160, AT 1/00222, AT 1/00196, AT 1/00198, AT 1/00194, AT 1/00195, AT 1/00213, AT 1/00210, AT 1/00209, AT 1/00208, 107 2/042

E) **GOMOA DISTRICT**
AT 176 1/076, AT 1/00255, AT 1/00257, AT 1/00254, AT 1/00252, 166 1/076, AT 1/00258, AT 1/00256A, AT 1/00316, AT 1/00317, AT 1/00318, AT 1/00241 1/A, AT 1/00243 1/A, AT 1/00239 1/A, AT 1/00237 1/A, AT 1/00238 1/A, AT 1/00245 1/A, AT 244 1/A, AT 236 1/A, AT 240 1/A, AT 246 1/A, AT 235 1/A, AT 234 1/A, AT 1/00249A, AT 1/00250A, AT 1/00251A, AT 1/00252A, AT1/00252B, 031/2/013, 0301/013, 0281/1012, 0301/013

3.5 The Existing Coastal Transmission Lines (Tema – Takoradi)

VRA has operated transmission lines along the coastal areas since the early 1960's. Although the proposed AVTL does not run close to the coast for most of the route, sections of the proposed line (particularly in the Yamoransa to Winneba and Ashaiman toTema sections) run close to and parallel with the existing line. Therefore as part of the baseline information, data on the existing coastal lines has been obtained and presented in the following section. Furthermore, it will inform the discussions following on in Chapter 4 on Operational Impacts and Mitigation.

Currently, VRA operates and maintains a total of 488 circuit kilometers of transmission lines routed along the coastal area stretching from Tema to Takoradi comprising of a total of 707 towers. About 95% of these towers were constructed in the early 1960's. The rest were constructed around 1996/97 under the Takoradi Thermal Project.

Table 3.19: **Details of Existing Coastal Transmission Line Segments (Tema – Takoradi)**

No.	Transmission Line section	Circuit kilometers.	No. of Circuits	No. of Towers
1	Takoradi – Takoradi Thermal	13	2	35
2	Takoadi thermal – Cape Coast	60	2	60

No.	Transmission Line section	Circuit kilometers.	No. of Circuits	No. of Towers
3	Cape Coast – Winneba - Mallam	122	2	303
4	Mallam – Achimota	10	2	31
5	Achimota – Tema (Volta)	26	3	278

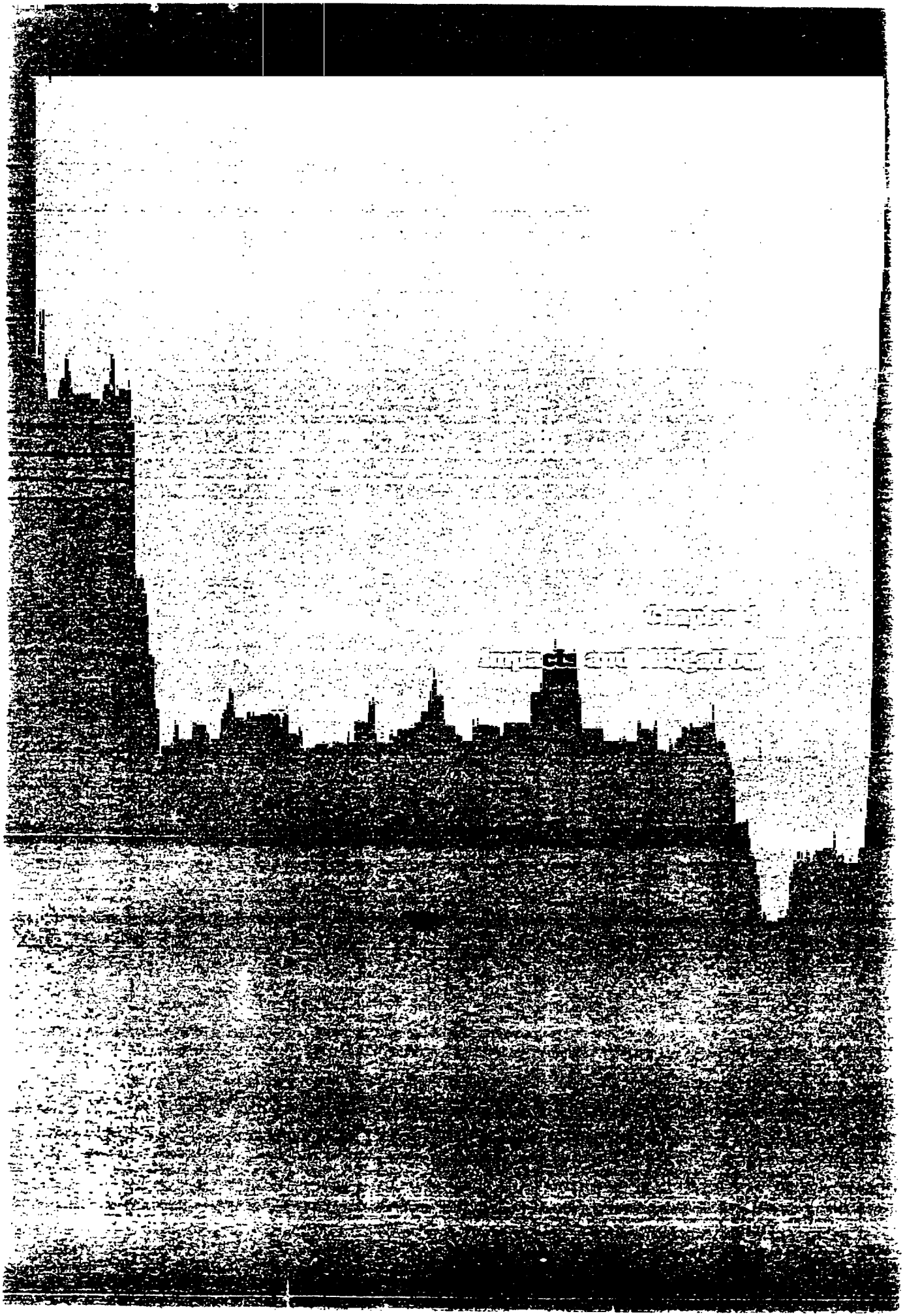
Maintenance activities on these coastal transmission lines have been relatively high compared to line sections routed through other areas in the country. This is due to the salt spray in the marine environment coupled with the absence of high vegetation growth, which could provide a form of "screening effect" for the transmission line installations. Maintenance activities undertaken include the following:

Re-insulation: This activity involves the replacement of with rusted metallic components on majority of the towers. Since the commissioning of the coastal lines in 1965, this activity has been undertaken twice, at intervals of about 14 to 16 years.

Replacement of Tower Components: Under a major rehabilitation project, severely rusted bolts and assemblies, struts and cross-arms on the towers were replaced between 1995 and 1998.

Painting of Towers and Securing of Tower bolts: As part of the rehabilitation works noted above, all the towers commissioned in 1965 were painted and their bolt and nuts assemblies tack-welded. The welding was to combat acts of vandalism, which had been responsible for the collapse of 3 towers on the Winneba to Achimota section previously.

From the foregoing, it is noted that the major challenges to the transmission lines along the coastal stretch is the excessive corrosion due to the aggressive marine environment. Improvements in corrosion protection will be discussed in Chapter 4.



4 SIGNIFICANT ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION

It has been established at the Scoping phase that some environmental effects would occur from the pre-construction, construction and operation (and maintenance) activities of the 330 KV Aboadze-Volta Transmission Project (AVTP). These activities have been described in sufficient detail in Chapter 2 of this report. This Chapter discusses these impacts and proposes actions to mitigate the adverse impacts and enhance the benefits of the positive aspects.

Methodology and Presentation Format

Table 4.1 overleaf, is the **Impact Matrix** that has been drawn up from the impact assessment. The information used in the impact identification and evaluation have been based on:

- Environmental Guidelines and literature review (including EPA Standards)
- Public and institutional consultations
- Experience gained by the Proponents (VRA) and the Consultant (Refast) in carrying out similar "linear" projects (POTP and various road projects).

The matrix was drawn with the project activities listed on the vertical axis and the aspects of the environment on the horizontal axis. The interrelationship between each project activity and each element of the environment was then evaluated to arrive at the results indicated in the matrix. The discussions follow after the matrix.

Part 1 focuses on the construction and operational activities and their impacts, mainly on the bio-physical environment.

The project is expected to have diverse social impacts as it traverses many settlements. Some of the affected persons have been identified during the study and interviewed on various relevant issues (see Annex 3). Part 2 of this chapter discusses these socio/cultural issues.

Finally, special issues of concern related to implementation of the project, such as the EMF effects, corona discharge and payment of compensation which require more clarification are discussed in Part 3 under "Special Issues of Concern".

Table 4.1: Impact Identification Matrix

Activities	Bio-physical Environment							Socio-cultural Environment										
	Geology, Soils	Climate, air quality	Noise	Water Resources	Flora	Fauna	Ecological sensitive site	Population	Cultural Heritage	Historical resources	Visual Intrusion	Infrastructure	Occupational Health &Safety	Land tenure, Ownership	Land use	Employment	Agriculture	Public Health
Pre-construction																		
Route Survey	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0/1	0
RoW Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0			0		0
Construction																		
Clearing Access Route		0					0	0		0	0	0						0
Transportation of Plant to Site		0				0	0	0	0	0	0	0	0			0	0	
Clearing RoW	0	0					0	0		0	0	0						0
Clearing Tower Corridor		0					0	0	0	0	0	0						0
Excavating Tower Foundations	0	0			0	0	0	0	0	0	0	0	0			0		0
Erecting Towers	0	0	0	0	0	0	0	0	0	0		0		0	0	0	0	0
Stringing Lines	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Operation																		
EMF effects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Vegetation Control	0	0	0			0	0	0	0	0	0	0						0
Line Maintenance	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Tower Maintenance	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0

Key: 0 No potential impact or not significant
Potential effect, expected to be less significant
Potential significant adverse impact
Potential significant beneficial impact

PART 1

4.1 Potential Pre-construction Impacts and Mitigation

The pre-construction activities to be undertaken for the transmission line project are line route survey (including tower spotting) and acquisition of the right-of-way (RoW).

- Line Route Survey – this has been described in detail in section 2.1 p 11. At selected points on the route, concrete marking pegs have been installed.

Impacts

The impacts arising from the route survey and related activities are those resulting from the partial clearing of vegetation including some food and cash crops within a path/line of about 1 m wide. This results in loss of income for the affected farmers.

During the consultations, a more significant impact identified from this activity was the anxiety related to uncertainty of the Project schedule. Some farmers, who had identified route pegs installed on or close to their farms, claimed they were unable to proceed with further cultivation; not knowing exactly when the project would commence and the extent of possible damage to their crops.

Mitigation

Existing and available farm tracks and footpaths shall be used to provide access for surveyors. For the Yamoransa to Winneba stretch where the proposed route runs close to the existing line, existing maintenance access routes shall be cleared and used. Destruction of crops shall be kept to the barest minimum and owners will be duly consulted and given adequate notification prior to any such action and compensated for any losses.

Prior to commencement the farmers/land owners shall be fully briefed about the project, time schedule and expanse of land to be affected by the project. For example, if they are made aware that clearing of the RoW is limited to only tall trees that can pose a threat to the line,

they could maintain cultivation of crops (especially perennial, short cycle food crops) without undue anxiety until the project finally commences.

- **Acquisition of Right-of-Way** – Once the line route has been selected, VRA will acquire the RoW prior to construction of the transmission line. The VRA Transmission Line Regulations (LI 542), defines the various activities (including farming, cultivation and mining), which are restricted in the RoW [LI 542 section 1(g)(ii)].

what are these?

Impacts

Acquiring the RoW will have a significant impact on the land ownership and land use in the area. Any land use activities that are not compatible with the RoW will have to cease or be removed. During the field studies a number of buildings, farms and community properties have been identified as falling directly within the proposed RoW (see Annex 3).

Mitigation

The loss of access to land and use under the RoW may be classified as a residual impact. The restriction of access to the RoW is necessary for the safety of both the transmission line and the public. LI 542 empowers VRA to restrict access to the RoW, however, the process of acquisition of the RoW shall be carried out with due consultations with all stakeholders.

All properties such as buildings, lands, crops shall be duly compensated for, in accordance with the provisions of the law at the appropriate replacement values in line with VRA/Land Valuation Board procedures. To this end, a property impact report, which identifies all affected properties, owners and estimated prevailing market replacement values, is being prepared by Refast for the guidance of VRA.

In accordance with international environmental practice, the proposed route shall be diverted to avoid all cultural and religious properties. The list of these properties has been presented in the baseline in Table 3.4(d) p 31.

Cind. sacred trees + graves? (p.30)

How about biological sites avoiding sensitive (p. 43)

Messrs. Construction Pioneers (CP) proposed a diversion of the line route to avoid their quarry site at Eduagyei (see correspondence in Annex 5) and this has been addressed by VRA.

- **Impacts on Land use**

In theory, the total land area to be taken up by the RoW will be approximately (40 m x 215 km = 8.6 km^2) running along a 40 m wide strip over the entire proposed 215 km route. The land use along the proposed route is mainly agricultural.

From the survey results, 281 (62.3%) of the affected persons identified are farmers (Table 3.14 p83). Many are engaged in cultivation of a combination of food and cash crops (Table 3.15 p 84

As is typical of coastal areas, the cash crops likely to be affected are mainly coconut (8.6%) and oil palm (10.8%); the food crops will be mostly plantain, cassava and maize. Some fruit plantations such as pineapple and oranges may also be affected.

Some of the farms that do not fall within the RoW could still be affected if the selected routes for construction access have to pass through them. However, in such instances, the impact of loss of land use may be only short term as the land can be re-used for farming when construction is over except if the road is required as permanent access for maintenance).

In some instances, construction access roads may benefit some farmers who would be able to use these tracks to allow trucks to reach their farms to haul farm produce.

Mitigation

The Lands (Statutory Wayleaves) Act, 1963 (Act 186) is the law governing the acquisition of RoW for the transmission line. Section 6 of this Act provides for payment of compensation for such acquisitions. All landowners whose lands are permanently affected by the project shall be paid the due compensation for the loss of use of those portions. The mode of payment of compensation is discussed under "Special Issues" in Part 3.

4.2 Potential Construction Impacts and Mitigation

Construction impacts associated with transmission line projects at any given location are transient and of limited duration. The AVTP would take up to 18 months to complete. The main construction activity of concern has to do with clearing of vegetation. Constructing the transmission line involves various levels of vegetation clearing for the different areas and these are discussed below:

- **Construction Access Road** – The construction of the access roads is described in detail in section 2.2 p 13. During consultations with project contractors on the on-going POTP line, they indicated that on the average each access road would provide for the construction of up to 10 towers. This means that for the AVTP, about 40 of such access roads (measuring approx. 5 m x 1 km), equivalent to an area of 0.2 km^2, shall be constructed. Relevant information on existing access tracks in the project area is as attached in Annex 3.

  Impacts

  Loss of crops and land use with the attendant loss of income, are the main impacts arising from clearing these access roads. The contractors indicated that as much as possible, efforts are made to avoid routeing through farmlands.

  Clearing of vegetation and compaction of soils could lead to death and/or dispersal displacement of some faunal species.

  From the nature of soils encountered, it is likely that the clearing of the land (especially at the high spots) and use of heavy plant and machinery will loosen the soil and lead to erosion of the land.

  Noise and dust generation will arise from the process of land clearing using machinery. Noise impacts and changes in air quality are considered to be of very limited duration. However impacts from dust could be significant in places near streams or water bodies or where the tracks have to cross these water bodies. there is the possibility of dust particles and silt contaminating the water and possible siltation due to increased sediment loading. During

consultations, it was noted that in the past, when such water bodies get silted during construction, communities downstream are starved of their water sources.

Access roads open up closed areas and could enable unscrupulous persons to enter to carry out illegal/unauthorised activities such as hunting of wildlife (e.g. grasscutter).

Mitigation

Loss of land use has already been discussed under "Acquisition of RoW". As much as possible, access to the line route shall be through existing access tracks. Construction of new tracks shall be kept to the barest minimum. Access routes shall be selected in such a way as to minimise any damage to farms and crops.

After the construction phase is over, the roads shall be replanted immediately with appropriate ground cover, such as fast growing grasses, to check erosion and reduce sediment runoff. The replanting of grass shall be timed to coincide with the onset of the rainy season to ensure that the grass thrives.

The path of access roads shall be selected so as to avoid crossing streams and other water bodies. Removal of stream bank vegetation shall be avoided as much as possible. Sediment traps or screens shall be installed to control runoff and sedimentation.

Warning notices ("NO ENTRY", "NO TRESSPASSING" etc.) shall be placed at entry to access roads. In addition, random security patrols shall be carried out. The Unit Committees in the communities shall be involved in educating the people and enforcing these provisions.

- **Transporting of machinery and equipment to site** – Once the access roads are prepared, trucks equipped with cranes, will be used to transport construction machinery, lifting gears and tower members/accessories, through the public roads and along the access roads, to the erecting points.

Impacts

Transporting heavy machinery through the relatively narrow roads in the rural communities poses risks to traffic and public safety.

Trucks moving on the graded access tracks will cause soil compaction and increased exposure to erosion.

Mitigation

Trucks and machinery shall display appropriate road safety signals (red flag and flashing amber lights). Deliveries shall be made in daylight hours and speeds limited to prescribed safe levels (10-20kph) especially within towns and settlements.

Compaction of soils along the graded tracks may be reduced by regulating the number of passes of trucks to and from the sites.

- **Clearing of the tower corridor track** – This has been described in detail in section 2.2 p 14. Based on a maximum width of 3 m, the entire tower corridor track area to be cleared over the 215 km route is estimated to be about 0.645 km^2.

Impacts and Mitigation

Impacts arising from this activity are similar to those discussed for constructing the access roads since in both instances the land is completely cleared to leave graded surfaces. The mitigation recommendations discussed above are therefore similarly applicable here.

Experience gained from many field trips has shown that it is not necessary to maintain a graded surface for vehicle access. Therefore, re-growth of limited ground cover shall be encouraged along these tracks to protect against soil erosion.

- **Clearing and excavating for tower foundations** – This is described in detail in section 2.2 p 14. For the estimated 430 towers required by the AVTP, the additional total area to be

cleared for tower foundations is estimated to be about 1.5 ha over the entire length of the route. Excavation for the foundations will depend on the soil type at the selected spot and will usually be between 2 – 3 m deep.

Impacts

Excavating for tower foundations will destabilise the soil structure and expose the soils to erosion. In swampy areas (Aboadze to Kwasi Kwaa area), there may be the need to pump out water from the excavations and this would further increase erosion from surface runoff and increase sediment flow into nearby water bodies.

Mitigation

The specifications provide design parameters for three classes of soil namely, Type A (poor soil – swampy areas), Type B (good soil) and Type C (unfractured rock).

The ground surface at each tower site shall be graded to provide drainage away from the tower legs. Where necessary (particularly on hillsides), terracing, cribbing or riprap may be used to provide protection for tower foundations.

- Clearing the Right-of-Way (RoW) – This is also described in detail in section 2.2 p 14. During the field visits, it has been observed that in practice, this process of "bush clearing" is done in a very selective manner so as to do minimal damage to the vegetation cover and crops.

Impacts

Clearing the RoW and its immediate environs of all tall trees will result in loss of closed canopy and reduction in the number of tree species. Cutting of trees presents occupational/public safety risks to the workers and farmers in the vicinity. Falling trees (especially tall trees beyond the RoW) will cause extensive damage to vegetation/crops in the landing area.

Some faunal displacement/dispersion (especially birds) could result from to the cutting down of some trees. Loss of tree cover would lead to increase evaporation particularly of small

streams/water bodies.

Mitigation

Removal of tall trees from the RoW is essential and unavoidable for the safety of the power lines and may be classified as a residual impact. The baseline studies (3.1.2 Flora. p 25) indicate that there are not many tall trees in the vegetation zones traversed by the proposed line route. However, in selecting the final route, care shall be taken to minimise the number of trees that will have to be cut. Within the reserves, the guidelines of the MOU between VRA and the Forest Service Division will be strictly adhered to.

what are these?

Cutting of trees shall be done strictly in line with VRA prescribed safety guidelines; those involved shall be competent workers. The landing area of falling trees shall be carefully selected to minimise damage to farms. Adequate warning shall be given to ensure that public safety is not compromised.

- Erection of towers – this has been adequately described in section 2.2 p 15.

VRA/Ecowas should have and procedures manual that EIA can refer to(+ mitigations)

Impacts

The impacts arising from erection of towers are mainly related to occupational health and safety. Working at heights could present hazards to the climbers and to those on the ground from falling objects, tools etc.

Working with cranes and other lifting equipment also present potential injury from broken wires and lifting tackle and swinging objects.

When erected in place, the towers are quite imposing and in areas near to settlements and at entry into the substations, they create visual intrusion. During the consultations, some road users complained that during daylight hours, the new, shining tower members produce a "glare" effect as they reflect the sunlight.

A positive impact of erecting the towers is that they become nesting sites for birds and provide perching platforms. In discussions with the Ghana Wildlife Society, they suggested

that bird perching platforms could be incorporated into the tower design. Some drivers interviewed indicated that when driving through the countryside, the towers serve as landmarks.

Mitigation

The relevant provisions of the Factories, Offices and Shops Act, 1970(Act 328) and the VRA Corporate Safety Rules 1993, shall be applied at the construction sites. Cranes, lifting gear, wires and other such items shall be tested and duly certified.

All workers shall be provided with the necessary safety clothing, helmets, boots, climbing belts etc. (see Plate 2.5 p 15) in addition to being trained on every aspect of the work required including operation of specialised tools and machinery.

The impact of the "glare" effect is of limited duration, and dulls with time, especially in the coastal environment, where a dull oxide sheen quickly forms on the tower members. Moreover, during the routine maintenance, the tower members are painted with anti-rust coating that effectively dulls the glare.

The VRA Safety rules provide comprehensive instructions/precautions on all aspects of the work covering areas such as Forestry work and Line work.

- Erection of conductors, shield wires and other accessories (stringing) – this is described in detail in section 2.2 p 16. In certain locations, the lines will cross power lines, telephone lines, rail crossings and public roads. The appropriate agencies shall be duly notified and consent obtained prior to stringing.

Impacts

Stringing of lines creates impacts on occupational health and safety similar to those discussed above. In addition, stringing the lines across public roads and railway lines will require some temporary disruptions to traffic.

Placing of the lines limits ground and aerial movements in the vicinity of the lines. Lines can pose collision hazards to birds and low flying aircraft as well as obstructing road haulage of tall structures.

Mitigation

All safety precautions prescribed for tower erection shall apply to the stringing. Only skilled personnel shall operate the stringing winches. In all cases where stringing will cross power lines, telephone lines, public roads etc, due notification to appropriate authorities shall be given.

When stringing across public roads, public safety (of persons, vehicles etc) shall be assured by the use of expandable aluminium scaffolds erected at both sides of the road. The wire is passed over the scaffolds to provide the necessary fixed, safe clearance from the road. Further protection shall be provided by the use of safety nets slung across the scaffolds beneath the line. Also traffic warning signals "SLOW DOWN, LINE STRINGING IN PROGRESS" and similar notices shall be placed along the road and personnel shall be assigned to man the road crossings.

The minimum clearance for road crossings shall be 8m and that for rail crossings shall be 9m. In the vicinity of known or common aircraft activity (e.g. around the Michel camp area), warning-spheres shall be clamped at intervals on the shield wire according to international standards for aerodromes issued by ICAO. The specifications stipulate that the colour shall be "International Orange" and the diameter shall not be less than 600 mm.

- **Modification works at Aboadze and Tema Switching stations** – these modifications, as outlined in Chapter 2, are mainly civil works involving minor rehabilitation, demolition and extension of existing buildings and erecting line termination structures.

Impacts

The impacts arising from these construction activities are mostly similar to those discussed above. Dust generation during demolition and occupational health and safety hazards are very significant in such situations.

Mitigation

Safety provisions of the Factories, Offices and Shops Act, 1970 (Act 328), shall be applied at construction sites. All workers shall be provided with the relevant safety clothing and working gear. Prior to demolition, the area shall be appropriately barricaded and warning signals posted.

Drains from the work areas shall be directed to existing drains and prevented from polluting any nearby water bodies. All paints and solvents shall be stored in safe and secure locations. Any tanks containing fuels and oils shall be properly marked and appropriate warning notices posted on them.

4.3 Operation and Maintenance Impacts and Mitigation

The operation and maintenance of overhead transmission lines pose various problems that affect the technical performance of the system itself as well as creating risks to the health and safety of both the line workers and the general public.

Operational hazard impacts – these arise from the safety risks associated with transmitting power along the overhead conductors. Although generally very rare in well maintained systems, the following are some of the major hazards that could impact on public/occupational health and safety during the operation of overhead transmission lines:

- Dropping of Conductor - A "live" conductor could snap and fall to the ground (drop) as a result of either a mechanical failure of insulator string on the tower or snapping of the conductor. The failure of an insulator string could be caused by lightning stroke, rusting of the insulator pins or a heavy object (possibly a tree), falling on the line. The snapping of a conductor could also be caused by the failure of a conductor joint.

The power system protection provides that the dropping of a conductor would lead to a ground fault, which would automatically remove the line section involved from service and this would immediately affect the supply system. Any living object on which a live conductor falls could sustain severe burns.

- **Shattering of Insulator Units** – insulator units can shatter in service. Shattering of an insulator unit produces very sharp edges of the fragmented pieces that are normally thrown about in all directions from the tower. This is a potential safety risk to persons who would happen to be passing near by the tower locations at the time of occurrence.

- Collapse of Tower(s) - Tower(s) could fail due to the following reasons:

    - Rain/Wind Storms
    - Vandalism of the tower parts
    - Lapses in Maintenance

The collapse of tower(s) would have the same effect as dropping of conductors since the collapsed tower(s) themselves normally fall within the right-of-way.

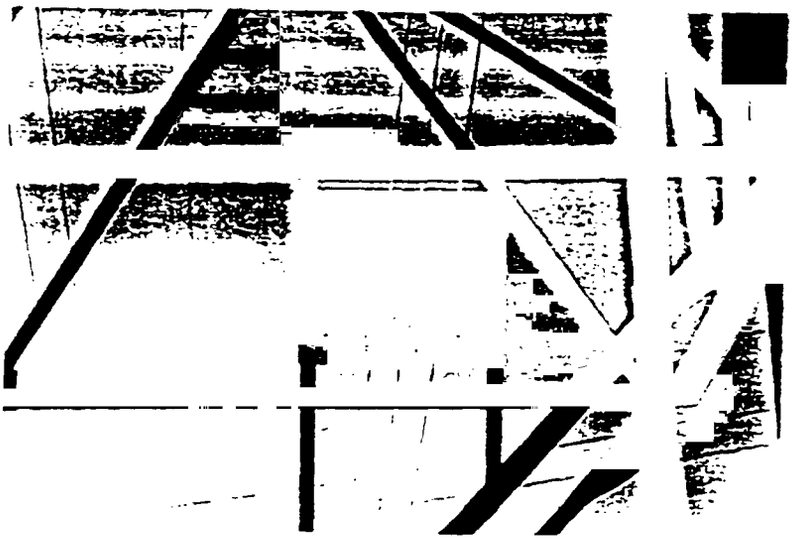
Collapses due to rain/wind storms are not common since the lines are designed and constructed to stand most extreme weather conditions. During the over 40 years of VRA's transmission line operation and maintenance activities, the network has experienced only two collapses caused by rain/wind storms.

As discussed in section 3.5, the existing Coastal line has experienced 3 tower collapses in the Winneba-Achimota section due to acts of vandalism.

Mitigation of Operational hazard impacts

Although they occur only rarely, almost all the harmful effects noted above have maximum effect within the immediate vicinity of the lines. It is therefore essential, for the safety of the public, that the right-of-way is acquired and access to it by the public restricted. As is the

existing practice, all towers shall be clearly marked with a "DANGER – 330.000 Volts" signal in red on white background. Plate 4.1 overleaf shows a typical tower warning sign.



[illegible] Warning sign on existing VRA Tower

[illegible] from natural causes such as lightning strikes and extreme wind gusts are [illegible] however tower design includes adequate factor of safety that takes the [illegible] speeds into consideration.

[illegible] improvements be planned and emergency maintenance routine for the transmission [illegible] These shall be applied on the new lines. Regular [illegible] maintenance shall be enforced to eliminate dangers posed by corroded and worn out [illegible] towers and accessories [illegible]

[illegible] on-going VRA plans, improvements for the new line, such as the use of anti-theft fasteners on the tower members will help to check vandalism and its harmful consequences. Other improvements include fixing of bird nesting sites using aluminium covered steel shield wires and improved insulator materials. Lightning normally causes the shattering of the insulators, and accumulated grime or dirt may also give the same result. The use of high quality insulators as well as periodic washing of the insulators eliminates this problem.

Maintenance impacts - The maintenance procedures developed by VRA from more than 40 years of operating the national transmission network, shall be applied on the new line.
Some aspects of the maintenance activities raise issues of environmental concern such as:

- Maintenance of right-of-way (vegetation/bush clearing)
- Rust treatment and painting of towers
- Occupational safety risks to line maintenance staff

Contractors under VRA supervision carry out vegetation control in the RoW. All tall trees and scrubs within the RoW are cut down by mechanical means. Rust treatment and painting of towers also pose concerns of potential pollution of nearby water bodies. Line maintenance has occupational health and safety implications for the staff, as they have to patrol the usually overgrown tower tracks on foot and climb the towers to carry out needed checks and repairs.

Mitigation of Maintenance impacts

As much as possible painting shall be carried out in the dry seasons to minimise paint failure and subsequent wash/run off into water bodies.

Work safety procedures as prescribed in the VRA Corporate Safety Rules 1993 and the relevant requirements of the Factories, Offices and Shops Act on occupational safety shall be strictly complied with by line maintenance staff.

- **Waste Generation and Management**

All aspects of the construction and operational phases discussed in sections 4.2 p 96 and 4.3 p 103 above will result in generation of mainly solid waste and these will have to be disposed off accordingly. Wastes expected to be generated from the construction phase includes:

- Vegetation - felled trees and tree stumps, leaves, under brush, shrubs etc
- Packaging materials – conductor drums, wood, plastics, metal parts etc

Liquid waste will result from concrete works, washing of equipment, handling of fuels, oils and pumping out water from excavations.

Waste generated from repair and maintenance of the lines include:

- Damaged conductors and cables
- Broken insulators (both glass and porcelain)
- Packaging materials such as wooden crates and paper cartons
- Organic waste from bush clearing
- Rags and waste cloths used for cleaning
- Special wastes in the form of empty oil and solvent containers.

All wastes shall be stored in areas that are isolated from surface drains. Trees and tree stumps shall be gathered together and made available to the communities for use as fuelwood. Other forms of vegetation wastes shall be piled up at the sites and used for mulch or burnt depending on the situation.

Each drum of wire covers approximately 3 km length. For the 215 km. the wooden drums used for the conductors and shield wires will be nearly 350 units and these will constitute substantial waste. The residents of the various communities could use the wood for carpentry works or even as firewood.

Most of the non-metal solid wastes shall be disposed of through the public waste collection system. The metal waste will be collected and sold as scrap to dealers.

Special wastes of hazardous nature (if any), shall be segregated and disposed of by total destruction. The use of empty chemical and oil containers for storage of water shall be prohibited.

PART 2

4.4 Socio-Economic/Cultural Impacts and Mitigation

The main impacts of the AVTP project will be on the inhabitants in the settlements within the project area. Field studies were conducted to assess those aspects of the socio-economic/cultural environment that would be most impacted by the project.

The affected communities are those whose lands and properties fall within the right-of-way (RoW) of the proposed transmission line. Within these communities, the affected persons are those who claimed ownership of the farms/structures that may fall within the RoW. The surveys have so far identified and interviewed 451 persons who may be directly affected by the project.

The questionnaire used, and the results and analysis of the findings of the field survey are presented in Annex 3 and Section 3.3 respectively, and form the basis for the discussions and evaluations following.

The main socio-economic/cultural impacts are expected to arise from the acquisition of the RoW and subsequent enforcement of the provisions of L.I 542, which restricts and prohibits various activities within the RoW.

Based on information gathered from consultations with the contractors on the ongoing POTP who have also been involved in several previous VRA transmission line projects, it is expected that the project will take up to 18 months to complete. The main construction campsites would be located in selected urban settlements along the proposed route and the total workers required would be about 150-200.

- **Impacts on Population and Demography**

The project is not expected to have any significant adverse impacts on the size of the populations within the communities. At its peak, the project will require about 200 workers. Out of this number, 60% –70% is expected to be employed from among the local communities. The skilled workers from outside the communities will be about 80 in number.

The workers will be all males but their numbers are such that this would not alter the gender balance within the communities to any appreciable extent.

The ethnic composition of the affected persons shows that most of them are indigenes of the affected communities (Table 3.11 p 81) and this will not be significantly altered during the duration of the project implementation phases.

- **Impacts on Religious/Cultural Resources**

The majority of the affected persons (323 out of 451) are of the Christian faith (Table 3.13 p 82). A number of shrines, sacred groves and cemeteries have been identified along the proposed line route within the communities and presented in Table 3.4 (d) p 31.

Mitigation

In line with international environmental practice, final selection of tower spots shall be made in such a way as to avoid all cultural and religious properties completely.

- **Impacts on Employment and Incomes**

The project is expected to provide direct job opportunities for about 120-140 persons from the local communities. They will be used mainly as labourers and for the main non-specialized tasks such as watchmen. This will be a positive impact on the communities. Some of the people will acquire skills on the job which could lead them to other opportunities when the project is over.

During the operation and maintenance phase, contractors who will carry out line maintenance (vegetation clearing on behalf of VRA would employ some of these people and this would be an additional benefit. Apart from these direct jobs, the project would also create indirect job opportunities like food vending and sale of petty items to the workers, which would be taken up mostly by women in the communities.

Loss of crops during the land clearing phase and loss of land use for farming within the RoW will impact adversely on the incomes of the people. With a generally high level of dependency

(average of 2-10 dependants per household, Table 3.12, p 81), any appreciable loss of income will affect many more persons and possibly entire communities.

Employment created by the project and the incidental indirect jobs created, such as petty trading and food vending, will help to boost the levels of incomes. This impact, though positive, will only be of a rather limited duration.

As per Table 3.16, p85, Terms and Conditions of Land Tenure in Affected Communities), 28.93% of the affected persons have access to the land by right of family lineage, 19.29% by land lease, 13% are tenants who use the land and share the produce or property on completion, and 12.7% have no definite arrangement with the land owners. Some (10.93%) have purchased the land outright while 3.05% have their land parcels as gifts. Sharecroppers constitute7.2%. Thus the majority of the affected persons are themselves not land owners but users. In effect, the land owners would also lose their sources of income but not necessarily their employment, while the users would lose their sources of income and their employment.

Mitigation

Loss of income resulting from loss of crops and land use shall be adequately compensated for. As much as possible, the farmers shall be assisted through the District Assemblies, Unit Committees and Traditional Authorities, to acquire new lands to restore the farm income base. Compensation shall be paid promptly at economic rates and shall include provision for loss of future incomes. In any case, the law governing compensations prescribes the payment of compensation for crops and/or properties on the land, as well as for the land itself. Therefore, largely, both land owners and land users would be appropriately compensated.

- **Impacts on Public Health and Safety**

Some aspects of the construction and operation of the transmission line could affect water sources in the project area. This would impact adversely on the health of the people in the communities, many of whom do not have access to safe water sources such as pipe borne water or boreholes.

A major potential adverse impact on public health and safety arises from dangers associated with the likelihood of sexual interactions between migrant workers and the inhabitants. In the face of the HIV/AIDS pandemic, such interactions are likely to result in the transmission and spread of the virus.

Another potential adverse impact include operational problems that could occur on the live transmission lines that have been covered under Section 4.3. The other issue is that relating to the effects of electromagnetic fields on human health. this is also discussed in sufficient detail under "Special Issues"

Mitigation

Some mitigation measures for protecting water bodies from effects of construction have already been recommended under 4.2. In addition, during site clearing activities, a minimum buffer of at least 20 m from stream banks shall be maintained. These would be monitored for strict compliance to ensure adequate protection of these sources of water for the communities. The Provisional EMP in Chapter 7 (section 7.3) also outlines guidelines for pollution prevention. which shall be implemented accordingly.

Maintaining strict adherence to the RoW protection regulations is the best way of ensuring protection of the public from the hazards of transmission lines.

VRA will undertake an HIV/AIDS Educational & Outreach Programme as part of its public information campaign, sensitise the people in the affected communities against the spread of the pandemic.

PART 3

4.5 Special Issues of Concern

This section discusses various issues of concern relating to the implementation of the AVTP project. These are issues that require a clearer understanding in order to properly evaluate them

and the discussion does not follow strictly in the order of impacts and mitigation as used in Parts 1 and 2.

The issues identified and discussed are:

- Electromagnetic Field (EMF) effects
- Compensation issues

4.5.1 Electromagnetic Field (EMF) Effects

- Introduction

Electromagnetic fields (EMF) (properly called Electric and Magnetic fields) occur whenever a voltage is present or whenever a current is flowing.

In nature EMF effects occur, as in lightning and in other phenomena such as the northern lights (aurora borealis) caused by the interaction of solar wind and the earth's magnetic field.

Since the early 1880s when public electricity supplies were introduced, man has lived increasingly in electric and magnetic fields that vary with time (oscillate). However, electricity transmission, distribution and generating equipment are by no means the only source of man-made EMF. Such fields are everywhere, and are created by wiring circuits in homes, including currents that are induced in water and gas pipes.

In addition, all electrical appliances and equipment together with electric trains and other forms of transport, even the motorcar, all produce EMF. It is almost impossible to avoid man-made electric and magnetic fields.

- Transmission lines and Electromagnetic fields

Transmission lines produce both electric and magnetic fields:

- Electric fields are produced whenever there is a voltage – the pressure behind the flow of electricity. The higher the voltage the stronger the field.

- Magnetic fields are produced by current – the quantity of electricity flowing. The greater the current the stronger the field.

Over the last two decades, debate has raged on over the impact of electro-magnetic fields (EMF) on human health. Power lines in particular have become a focus for conflicting conclusions. The Environmental Health Division of the Minnesota Department of Health (USA) has collated the current available results of research into EMF and health carried out worldwide. The information is readily available at their web site www.health.state.mn.us.

In Table 4.2 below, the conclusions from the available research information have been duly summarised and presented. The relevant details are in Annex 4.

Table 4.2 – Summary of Research Findings on EMF and Health

No.	Research Institution	Country	Year	Main Conclusions
1	American Physical Society	USA	1995	No plausible biophysical mechanisms for the systematic initiation or promotion of cancer by power line fields have been identified.
2	National Research Council	USA	1997	The conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human health hazard.
3	National Institute of Environmental Health Science	USA	1999	The scientific evidence suggesting that EMF exposures pose any health risk is weak. However EMF exposure cannot be said to be entirely safe.
4	Institute of Electrical and Electronic Engineers – Engineers in Medicine and Biology	USA	1999	There is not enough relevant scientific data to establish whether common exposure to power-frequency fields should be considered a health hazard. There is general agreement that more research is needed to define safe limits of human exposure to EMF.
5	National Radiological Protection Board	UK	2001	Laboratory experiments have provided no good evidence that EMF causes cancer. However the possibility remains that intense prolonged exposure to EMF can increase the risk of leukaemia in children.

No.	Research Institution	Country	Year	Main Conclusions
6	International Agency for Research on Cancer	10 Countries US, UK, Japan etc	2001	There is no evidence that EMF is associated with childhood leukaemia, and there is no consistent relationship between EMF and childhood brain tumours.
7	Health Council of the Netherlands	Holland	2001	It is not likely that children (or adults) living near to high voltage power lines are at risk through exposure to EMF generated by those lines.
8	Japan EMF Research Program	Japan	2001	There is little evidence of any adverse effects from EMF exposure. Very high intensity EMF (over 10000 times higher than real-world environments) can have certain biological effects, which are positive.

Source: Minnesota Department of Health, Environmental Health Division: www.health.state.mn.us

- Potential EMF impacts of the proposed Aboadze-Volta Transmission Project.

- Human health impact

In the light of the findings presented in Table 4.2, it is not expected that the proposed 330 KV Aboadze-Volta Transmission Project will have any adverse impacts on human health. During the field surveys, the various community groups were briefed in very simple terms on the current state of knowledge about EMF effects in order to allay their fears.

- Fear impact

Perhaps the most serious impact is that due to fear, i.e. the perceived danger of the transmission lines. The public does not generally understand electromagnetic fields. They cannot be felt, tasted, seen, or touched. Most of the people interviewed were more concerned with electrocution (electric shocks) and they were admonished to comply strictly with the warning signals posted by VRA on the towers. In some developed countries, the "fear impact" has been known to affect property prices and mobilise local action against the construction of new transmission lines.

- **Corona Discharge**

Transmission lines are known to experience 'corona discharge' and this tends to increase with the increasing voltage. Since the AVTP is intended to operate ultimately at 330,000 volts (much higher than previous voltages operated by VRA), it is essential to consider this phenomenon as an issue of environmental relevance.

Corona is defined as a discharge occurring at the surface of a conductor or between two (2) conductors of the same transmission line, accompanied by ionisation of the surrounding atmosphere. Corona is frequently luminous (spark of light) and produces noise of a hissing character. Corona is known to produce Ozone, but this is unstable and reacts quickly with other gases (see Annex 4).

Corona is caused by the electric field next to an object exceeding the breakdown value of air. The starting voltage for corona is typically 30 KV/cm radius. This may be lowered by the presence of dust, water particles and sharp edges on the object.

Corona causes loss of power as energy is lost in the discharge process. Corona also encourages corrosion of the line conductors as the reaction with the surrounding air sometimes produces nitrous acid (in the presence of adequate moisture).

Corona is also known to cause radio interference on radio sets and TV sets in close proximity to high voltage transmission lines.

The moist environment in the coastal areas tends to promote corona discharge and therefore every care shall be taken in the design, construction and operation of the AVTP to ensure that corona discharge is minimised. This shall be achieved by avoiding sharp edges and ensuring that adequate protection is built into the design of insulators and other power line accessories.

- **Effect on Telecommunication**

Aside from the corona effect discussed above, resonance from the various frequency harmonics generated from the power line transmission frequency (50 Hz) are known to interfere with some communication frequencies. Consultations with Ghana Telecom indicated that in most cases this

does not occur with VRA transmission lines as they usually run outside the settlements. The problem encountered by GT is more of induction effect caused by proximity of telephone lines to ECG's transmission lines.

However, in view of the potential interference from high voltage transmission lines, VRA adopts the procedure of 'transpositioning' of the conductors (interchanging the individual phases from tower to tower) along the line route, in order to reduce the impedance that causes resonance. The phases are restored to the original at the termination of the lines.

p.116-120 Needs to be consistent with RAP

4.5.2 Payment of Compensation

In the light of safety risks and other phenomena discussed above, establishing and protecting the RoW for transmission lines is essential for the safety of both the lines and the public as a whole. A major issue of concern for the implementation of the project has to do with the payment of compensation for lands acquired for the RoW.

- VRA Procedures for acquisition of RoW and payment of compensation

VRA acquires land for the RoW under the provisions of the Lands (Statutory Wayleaves) Act, 1963 (Act 86) and the Volta River Development Act, 1961 Act (46). When the RoW has been acquired and the lines are in place, then the VRA (Transmission Lines Protection) Regulations, 1997 (L.I. 542) regulates activities within the RoW.

Both Acts 46 and 186 provide that compensation must be paid to people whose estates or interests are adversely affected by the acquisition of RoW. The procedure for applying for compensation is duly outlined in the Lands (Statutory Wayleaves) Regulations, L.I. 334, which contains a sample of the form to be used by potential applicants. Compensation may be claimed for damages caused by survey works as well as damages arising from actual site works. Additionally, L.I. 346, which is an amendment of L.I. 334, outlines the procedures for appealing against compensation awards.

The Ghana Land Policy, 1999, provides policy guidelines and actions for the various forms of land use – agricultural, forestry, extractive, human settlement, infrastructure etc. These are aimed at achieving sustainable development, i.e. enhancing conservation of environmental quality, preserving options for the present and future generations and securing human sustenance.

The objectives of the Land Policy that are relevant to the AVTP project are:

- Protection of the rights of landowners
- Payment of fair and adequate compensation for land acquired within reasonable time
- Promoting community participation and public awareness at all levels in sustainable land management.

The supreme law of Ghana, the 1992 Constitution of Ghana, under Article 20 prescribes that fair and adequate compensation shall be paid to all persons affected by state acquisitions.

The procedures used by VRA to ensure that all persons affected by the transmission line project are catered for are as outlined below:

1. Referencing of all properties, both crops and buildings, by officers of the Land Valuation Board (LVB) to be supervised by Estate Surveyors from VRA.
2. Assessment of the values would be done by the LVB and the valuation advice forwarded to VRA.
3. The assessed report would be vetted and corrections effected where necessary to ensure that the amounts are accurate and fair to the Authority. These would then be processed for payment.
4. Offers would be made to the claimants on the basis of the LVB's advice.
5. Claimants dissatisfied with the offer have a right to petition for reconsideration. In this regard, such claimants are required to submit counter proposals supported by valuation prepared by private property valuers of their choice.
6. The private valuers' reports are considered by VRA in conjunction with the LVB to ensure that claimants are treated fairly.

7. Where necessary the dissatisfied victims would be invited to negotiate and arrive at acceptable figures.
8. Where the parties, after all the negotiations, are not satisfied then they can seek redress at the court.

- **Community concerns**

During the field surveys, many fears and concerns were expressed by the communities regarding loss of land use and payment/non payment of compensation. Some of the concerns are presented below:

1. That available land for farming will become smaller in size and in some cases the right-of-way will split some farmlands.
2. Possibility that affected persons may not be adequately compensated and may worsen their poverty situation.
3. Fear that those who will administer the compensation may not be fair to all affected persons.
4. Lack of consultation with community leaders in the decision to use their land for the project.
5. Communities to be educated on health implications of the transmission of power through the communities.

- Expectations of Affected Communities

Usually with such projects, people generally have high expectations for improvement in their living conditions etc. People in affected communities have expressed the following expectations, though some of them may be unrealistic:

1. More investors to be attracted to the communities because of the VRA project.
2. Employment opportunities during construction of the towers and also local people to be recruited to maintain the right-of-way (bush clearing etc.).
3. Affected communities without electricity to be connected to power.
4. VRA to provide health facilities to affected communities to take care of any eventualities.
5. VRA to provide potable water for communities whose sources of water will be affected.

- **Comments on the compensation issues**

Currently, VRA pays compensation only for the structures and crops that are destroyed during the implementation of the project and not for the value of the land affected (including future land use). This is the main issue of contention of the affected persons, since after receiving payment for the actual crops destroyed, they can no longer farm freely within the RoW and therefore expect to be paid fully for the value of the land to which they have lost access.

As much as possible, the owners of affected farms will be allowed to harvest their mature crops before the clearing of vegetation for the right-of-way will be done. This would go to minimise the compensation value that VRA would have to pay for crops.

For many of these farmers, delays in payment of compensation would affect them adversely as credit facilities for such farmers are non-existent. Field data gathered on the AVTP indicate that about 99 percent of the affected people would prefer their compensation packages in cash terms. Their major reasons ranged from the replacement buildings taking too long in coming or not being to their satisfaction, to their desire to sell the property anyway, and in the case of farmers, a shortcut to their ultimate objective of selling their farm produce.

The same percentage also acquiesced to the proposed arrangement of 50 per cent down payment of the value amounts and the rest paid after the verification of the rates by LVB, on condition that their acceptance of the 50 per cent was not going to be taken as their acceptance of whatever value that will come out of the LVB assessment.

So far, as part of the Property Impact Assessment, 624 farms have been identified as being affected with a total replacement value of ø 1,691,022,348.00. The buildings and structures are 123 in number with a total replacement value of ø 4,465,107,992.10 (see Annex 3).

- **Recommendations for Action**

The issue of compensation was discussed in detail during the EIA of the POTP. The recommendations made then, still apply in the case of the AVTP as follows:

In the light of the concerns raised by the communities, and considering the current developments in participatory approach to resolving social conflicts, the following shall apply:

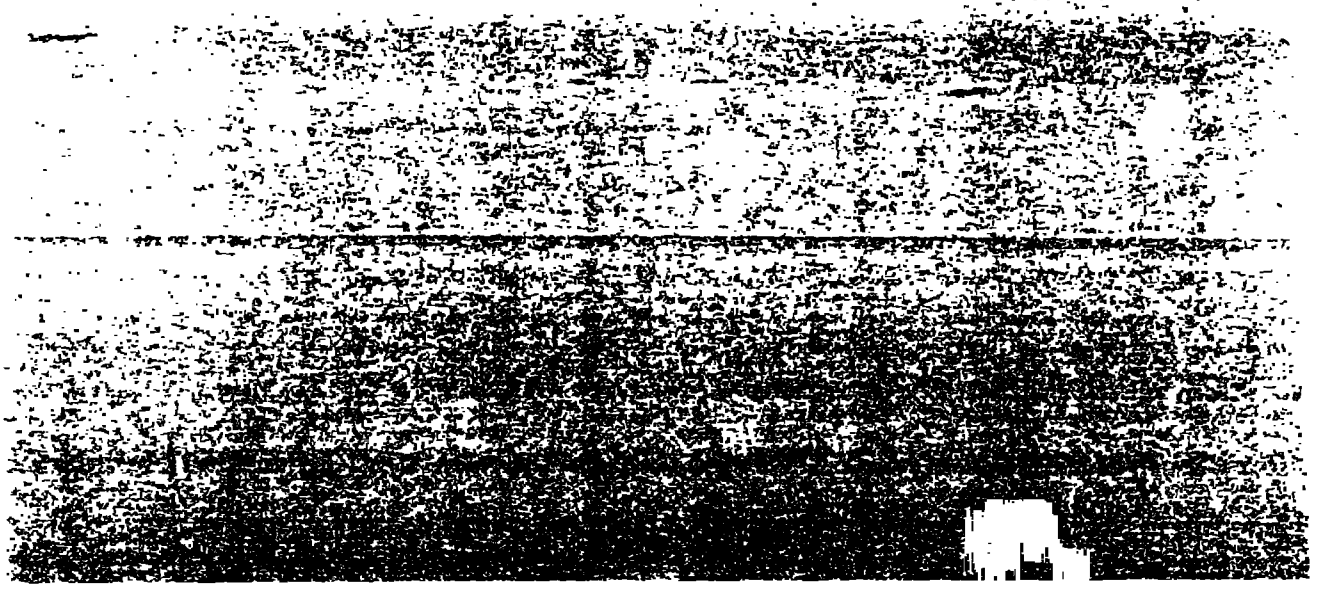
1. The procedure for payment of compensation for affected persons shall be reviewed to ensure that "fair" compensation covers loss of future land use and that prices shall reflect the prevailing market values (economic rates).
2. Since most of the farmers are illiterates, District Assemblies, Unit Committees and other community-based organisations shall be involved in the whole process to safeguard their interests.
3. Compensation payments shall be handled promptly to avoid imposing undue hardship on the rural farmers and also avoid any conflicts with the communities.

The requirements of the Energy Commission for obtaining licence for development projects in the energy sector include proper title to lands on which the project is implemented. In the light of conflicts arising from the earlier legislation on RoWs (Act 156, Act 46, L.I. 234, L.I. 346) and the Transmission Lines Protection Regulations (L.I. 542), the Executive Secretary of the Energy Commission at the time of the POTP (Year 2000) decided to initiate action towards harmonisation of all legislation affecting the acquisition of land for energy based utilities. VRA at that time also offered the necessary cooperation. So far this has not been effected. The Energy Commission has since been re-constituted and they are yet to take this up.

Until the laws are changed, VRA would abide by the existing legal arrangements procedures in acquiring and preserving the RoW for the AVTP.

Chapter 5

Monitoring



5 MONITORING

Appropriate monitoring criteria shall be established to verify the predicted impacts of the project on the environment and adjust the mitigation measures where necessary.

The Project Implementation Unit shall ensure that monitoring programmes are instituted and carried out to cover the under listed areas and relevant records shall be kept to ensure compliance with sound environmental practices recommended in this report.

The Project Environmental Coordinator shall oversee and report all monitoring activities and reports to the Director of Environment and Sustainable Development Department (ESDD), VRA through the Project Engineer.

The monitoring criteria are outlined under the following headings:

- Construction Phase
- Waste management
- Operations and Maintenance Phase
- Socio-economic/cultural issues

5.1 Constructional Phase

- Transportation

Guidelines provided under section IV of the VRA Corporate Safety Rules 1993 concerning equipment, motor vehicles and transportation of personnel and materials shall be applied and closely monitored and recorded. These will include monitoring the following activities:

- Speed Limits of vehicles
- Trucks conditions and maintenance
- Vehicular accident records
- Vehicle safety signals (flares, warning lights, reflectors etc)
- Vehicle fuelling procedures
- Vehicle loading/off loading procedures
- Vehicle daily check outs

- Driving licenses and permit to drive
- First Aid and Fire Extinguishing kit
- **Civil Works**

Activities to be monitored under civil works shall cover safe working practices in accordance with VRA Corporate Safety Rules 1963 and Factories, Offices and Shops Act 1970 (Act 328). Monitoring criteria shall include:

- Protective clothing and safety working gear (helmets, boots, safety belts etc)
- Noise levels (settlements, shrines, etc)
- Plant and equipment maintenance
- Safety Test - lifting plant gears (wires, hoisting blocks etc.)
- Dewatering operations
- Concrete works
- Fire patrols (site camps)
- Dust levels (settlements/watercourses)

- **Vegetation Clearing**

Clearing of vegetation cover at tower tracks, construction accesses, and right-of-way shall be monitored under the following activities:

- Tree felling
- Clearing of farms lands
- Clearing of right-of-way (vegetation cut only to 1.25m height)
- Clearing of tower corridor track (graded width 2.5m-3m)
- Clearing access roads (graded width 3.5 - 5 m)

5.2 Waste Management

- Burning of waste bush
- Waste water handling
- Waste segregation
- Waste dump sites
- Disposal of conductor drums
- Disposal of metallic waste
- Disposal of empty paint containers

5.3 Operations and Maintenance Phase

- Routine ground/aerial inspection of lines
- Towers (vandalism, corrosion)
- Insulators and accessories (damages, replacements)
- Accidents involving lines and structures
- Occupational hazards and accidents
- Accidents affecting public safety

5.4 Socio-economic/cultural issues

- Shrines and Sacred Groves
- Archaeological chance finds
- Identifying all affected persons
- Assessment of compensation
- Payment of compensation (adequate amounts, timely payments)
- Employment and job creation

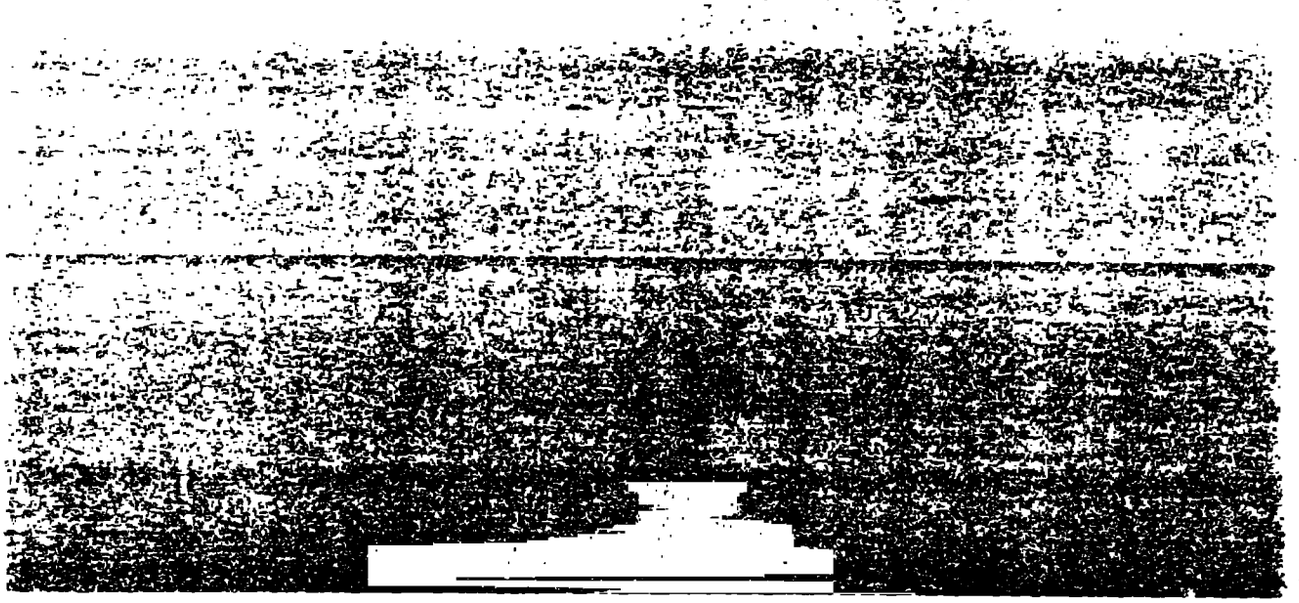
For archaeological chance finds, the procedures as outlined in the National Museum Decree, 1969, (NLCD 387) will be followed. Comprehensive record keeping and documentation shall be maintained for the above as proposed in the Provisional Environmental Management Plan in Chapter 7.

5.5 Weekly Checklist for Monitoring Activities

Activity	Frequency	Remarks	Responsible Officer
Occupational Health			
Safety Issues			
Environmental compliance			

Chapter 6

Consideration of Alternatives



6.0 CONSIDERATION OF ALTERNATIVES

Various alternatives to the project have been considered during the project-planning phase, and also as a major component of the EIA process. These have been discussed in sufficient detail below.

6.1 "No-development" scenario

As already indicated in Section 1.3, the new 330 KV line is required for efficient evacuation of the additional power expected to be generated from Aboadze and Effasu by 2003. The new line will also facilitate interconnection with Nigeria through the existing arrangements with Togo/Benin (CEB) and also to the proposed West African Grid System. Therefore, a "no-development" option will interfere with VRA's planned developments and will have adverse implications on the overall National power supply systems.

6.2 Upgrading existing facilities

A possible alternative to constructing the new line is to upgrade the existing 161 KV Coastline towers to handle the expected increases. This would pose major problems, in that the existing network has sections that are more than 30 years old. Its conductors are also of the 282 mm² AAC (Mistletoe) type, which have become degraded over time and therefore sag seriously in long span sections.

Further, they have had to be de-rated from 170 MVA to 150 MVA. Thus any upgrading of the existing line will require extensive periods of power outage. Without any power evacuation from Aboadze, there will be serious stress on the remainder of the national network, which will be an unacceptable scenario.

6.3 Alternative modes of transmission

Aside from overhead transmission, the other alternative mode of transmission that has been considered is underground transmission. Within the existing VRA network, underground

cables are used mainly in the NED operational areas and in limited situations over very short distances (i.e. linkages to some ECG Bulk Supply points).

For the high voltage and the length under consideration on the AVTP (i.e. 330 KV over approximately 215 km), this option is very expensive, as the underground conductors will require a high level of insulation. Additionally, the cable route will have to be ducted and the conductors insulated with oil under pressure of around 8.5 bar.

Such an underground transmission would encounter serious constraints at various points along the route. In some places, there will be the need for the line to traverse streams, rivers and other natural obstacles, which will create major problems.

Underground systems require specialized equipment and much longer time for maintenance, fault detection and repairs. They are also relatively quite expensive to maintain. All these factors could mean longer periods of power outage in the event of faults occurring on the line

6.4 Alternative tower design and material

Anotner alternative considered is the type of material used for the towers and their designs. Tower structures depend on the level of voltage and capacity on the line. Wood is either used as single pole towers for up to 46 KV (e.g. as used by VRA in their NED domestic network and extensively by ECG in Ghana for their 33 KV and 11 KV networks) or as "H-frame" towers for voltages ranging between 46 KV and 230 KV (e.g. in Canada for their 115 KV). However, for the AVTP which will ultimately transmit power at 330 KV, the best option is self-supporting steel lattice towers.

Apart from the need to conserve forests, other constraints with the use of wood include the height limitations in relation to the required minimum clearance, which will mean much shorter spans and more towers. Further, wood is susceptible to degradation by termite attack (special chemical treatment required) and by bush fires, which are common in many parts of Ghana. These could jointly and severally place the line at serious risk.

Concrete is another possible alternative material that may be considered in tower design. Here again, the voltage level and the height requirements for maintaining safe clearances between the lines and the ground limit the choice. Concrete has been used in the domestic ECG network in the form of reinforced concrete poles (using iron rods) for low voltage transmission and for street light supports. It has been observed that in the harsh coastal environment, iron corrodes relatively quicker and the concrete poles become fragile, posing serious risks to the system and to public safety.

6.5 Alternative routes

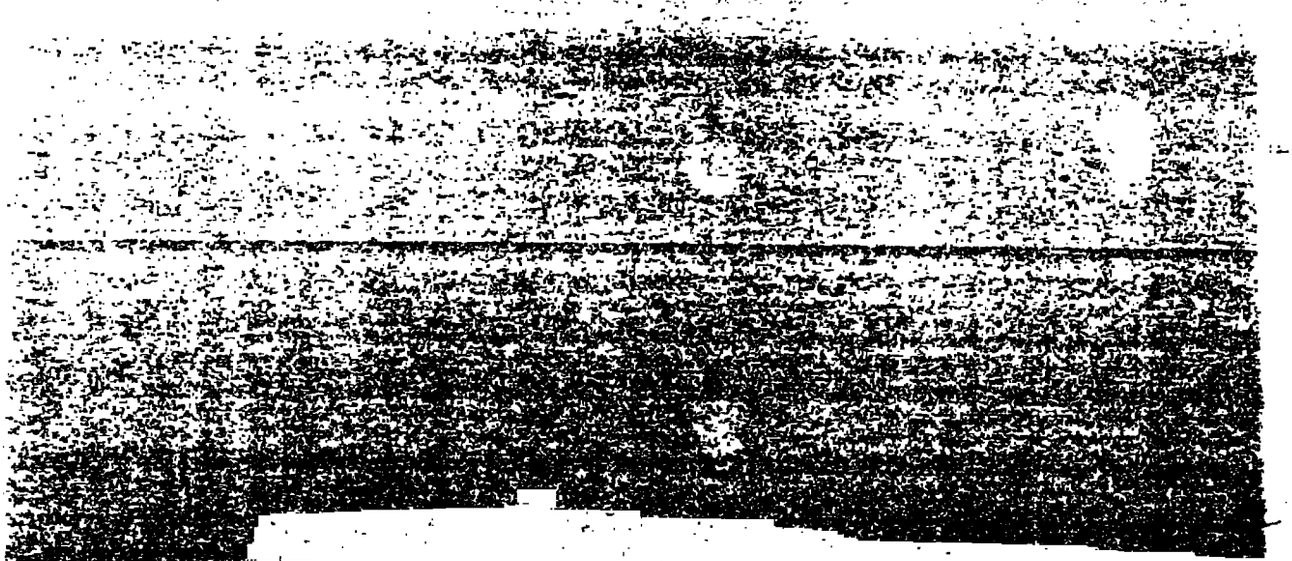
A major component of the EIA has been the consideration of the best possible route for the AVTP. The route for the new line has been proposed to run mostly north and inland of the coastal area. Deviations have been made in way of major human settlements such as Weija and Accra.

Resulting from this EIA, other diversions of the route shall be made to avoid interfering with religious and cultural properties found along the route.

Considering the various environmental factors discussed earlier in Chapters 3 and 4, and from the above discussions, it is considered that the AVTP, using steel towers and running generally along the proposed route, with the recommended diversions, is the best option for the required system reinforcement.

Chapter 7

Provisional EMP And Training



7 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN AND TRAINING

This section outlines a provisional environmental management plan and identifies training needs, to ensure sound environmental practices during the various stages of the project. It discusses and allocates appropriate resources for items discussed under mitigation and monitoring. Issues relating to training as well as procedures for the management of unexpected change that will result by the implementation of the project are also addressed in this section.

VRA shall appoint a Project Environmental Coordinator who will also serve on the Project Implementation Unit with support from the Environment and Sustainable Department, to oversee site construction activities and monitor specific environmental criteria. The personnel once adequately trained shall carry on this assignment into the operational phase of the project.

The provisional plan discussed in this section has taken into consideration guidelines provided in the ISO 14000, which deals with Quality Standards associated with the management of the environment.

7.1 Environmental Management Structure

Effective 2001, the corporate structure of the VRA provides for a Department of Environment and Sustainable Development, headed by a Director.

A Project Environmental Team headed by an Environmental Coordinator shall be appointed and would work under the Environment and Sustainable Development Department (Fig. 7.1).
The Project Environmental Team (PET) shall be responsible for all environmental issues at the pre-constructional and constructional phase of the project. Management of the post constructional operational phase shall be incorporated into the Authority's Corporate Environmental Management Plan, which is presently administered by VRA.

7.1.1 Qualifications of Project Environmental Personnel

The major environmental specialties associated with the management of electrical transmission line projects such as this are ecological and social impact assessment. In addition familiarity with health and safety management would be necessary.

Personnel with good background in these areas shall be engaged to form the environmental team. Training of appointed environmental staff who constitute this team would be necessary to meet these requirements.

7.1.2 Functions of Project Environmental Team.

The functions of the PET shall include:

- Ensuring project compliance with all relevant environmental, social, health and safety regulations
- Liaison with all relevant regulatory bodies and organizations – EPA, Factories Inspectorate, Energy Commission (Inspectorate unit), Forest Services Division.
- Formulation and review of environmental and social policies and practices associated with the project.
- Liaison between Environment and Sustainable Development and relevant VRA departments on all health, environment, safety and social matters connected to the project.
- Assist in the education and training of project staff in environmental, social and safety awareness.
- Make budgetary provision for project environmental programmes
- Undertaking environmental and social monitoring activities for the project

7.1.3 Project Environmental Coordinator

The coordinator shall be responsible for all environmental matters associated with the project. He shall be part of the PIU and will work closely with the project contractors and would report through the Project Engineer. The Director and staff of the Environment and Sustainable Development Department would ensure that quality service is provided by the coordinator to the PIU.

The coordinator should preferably be either an ecologist or a sociologist with a strong environmental background in transmission work or linear projects. Special environmental training in ecological and social impact assessment programmes would be necessary for the selected candidate who does not have this background.

The responsibilities of the coordinator shall include:

- Monitoring all environmental programmes for pre-construction and construction phases of the project, including those related to bio-physical and socio-economic/cultural components.
- Working closely with project contractors to ensure that all monitoring and mitigation guidelines recommended for the project are strictly adhered to during the various phases. This will include following all heath and safety guidelines outlined and following strictly the Authority's environmental policy guidelines.
- To organise activities to motivate and maintain the interest of project staff in environmental issues
- To increase project staff awareness of environmental issues through training programmes and review meetings
- To coordinate investigations on all types of accidents.

- To conduct environmental audits in accordance with project monitoring guidelines.
- To serve as liaison between project contractors, the Authority and relevant regulatory agencies.
- To produce environmental reports covering the project
- To work closely and coordinate efforts with the EPA and other enforcement bodies to ensure full compliance with all legal and regulatory requirements
- To develop a work plan for the implementation of the EMP
- To establish and run a reporting system on progress (or otherwise) in implementing mitigation measures (including contractors obligation), training etc.

7.1.4 Project Environmental Assistants

Responsibilities of the 2 assistants would be mainly assisting the project coordinator in his environmental duties. They would report directly to the coordinator.

Appointed personnel for this position should have a background in sociology or ecology. Experience with environmental work relating to transmission line project will be useful. However, if selected personnel lack this background, short-training programmes in this area may be organised.

7.2 General Health and Safety Procedures

VRA Health and Safety Rules (1993) and guidelines provided in the Factories, Offices and Shops Act, 1970 (Act 328) given below shall be strictly complied with at all stages (pre-constructional, constructional, operational) of the project. These regulations cover the major safety areas. Further details of the two major safety sections (forestry work and line work) relating to this project are also outlined below.

- General Safety Rules for workers engaged in construction, operation or maintenance work.

- Safety guidelines related to the use of tools and equipment
- Safety procedures associated with the transportation and of personnel and materials
- Safety procedures in relation to Forestry work.
- Safety procedures relating to Transmission line work.
- Safety procedures for materials handling, storage and disposal

7.2.1 Safety guidelines for Forestry work

Important guidelines provided in the VRA Corporate Safety Rules 1993 for forestry work (rules 600 to 615) shall be strictly adhered to. These include:

- Protection for work
- Working near live conductors
- Permission to work on public roads and nearby properties
- Disposal of bush
- Felling trees
- Reporting location of forestry work
- Climbing precautions

7.2.2 Safety Guidelines for Transmission Line work.

Some of the important safety guidelines (line work) to be followed as per VRA Corporate Safety rules 1993 (rules 700 to 826) include:

- Transportation and handling of transmission towers
- Climbing precautions
- Installation of towers
- Installing ground rods

- Stringing, sagging or lowering conductors
- De-energizing new circuits
- Trimming of tree branches
- General safety rules for work on live lines

7.3 Pollution Prevention

In addition to the safety guidelines relating to health and safety, strict pollution prevention guidelines shall also be enforced during all phases to the project.

Most pollution incidents are avoidable if careful planning and management procedures are instituted. Pollution prevention measures are much more cheaper to implement than costly clean up after the incident. For the prevention measures to be effective it is important that the environmental team must first be adequately trained in pollution prevention for this assignment.

Some of the important pollution prevention guidelines to be followed for this project shall include the following:

7.3.1 Planning and Preparation

Careful planning can reduce the risk of pollution significantly. As a first step environmental site meetings shall be organised between the local EPA officer(s), the project team and contractors prior to commencement and during construction operations.

7.3.2 Site Offices (Base Camp)

A common cause of pollution is through acts of theft and vandalism. Project site camps/offices shall be adequately protected by fences and locked accesses where possible. Security personnel shall be engaged at site offices/yards.

Care shall be taken to ensure that any contaminated site drain water does not flow into nearby rivers and streams.

Fire precautions to be observed at site offices shall include:

- Provision of adequate and suitable portable fire extinguishers
- Adequate ventilation for storage rooms containing flammable chemicals
- No smoking signals posted at sensitive locations such as fuel storage points
- Handling of flammable liquids by competent personnel only
- Rags soaked with flammable liquids shall be stored in metal containers and disposed of safely

7.3.3 Storage, Handling and Disposal of Materials / Oils / Chemicals

The Authority's Corporate Safety Rules 1993 (section ix) regarding above shall be strictly adhered to. In addition, the following guidelines shall also be followed in the handling of materials, oils and chemicals.

- Materials shall be stored in an orderly manner and in safe stacks, tiers or piles. Materials shall be stored so as not to obstruct passageways. Where necessary warning signals, lights and barricades shall be provided.

- Most chemicals used in construction operations such as oils, cement, cleaning materials, and paint have potential pollution hazards. All such materials shall be stored on an impervious base within a bund wall to contain any spillages.

- The VRA corporate safety rule (rule 219) concerning the use and handling of toxic and hazardous material shall be strictly complied with.

- Leaking or empty oil / chemical drums shall be removed from the site and safely disposed

- Contents of all tanks / drums containing chemicals shall be clearly marked.

- Disposal of all tanks and drums shall be done safely. All contents of tanks/drums to be disposed shall be emptied and perforated by competent personnel before final safe disposal.
- Fuelling of project equipment (trucks, bulldozers etc.) and vehicles may constitute the greatest spillage risks. This shall be done in designated areas with impermeable surfaces located away from drains or watercourses. Drip trays and spill kits shall be immediately available. Fuel hoses and valves shall be regularly checked for leakages and wear and tear.
- Emergency spillage procedures shall be clearly outlined and posted conspicuously. Absorbent materials for containing spillages shall be readily available on site. These shall include sawdust, sand, etc.

7.3.4 Concrete Works.

The construction of the tower pads and the minor extensions at the substations involve concrete works. Concrete and cement are very alkaline and corrosive and can have serious pollution impacts on watercourses. Therefore all concrete works shall be so sited and carefully monitored to ensure that such material do not contaminate any streams and water bodies.

7.3.5 Silty Water Discharge.

Construction works in swampy areas may necessitate dewatering of excavations. Silty water could also arise from run off from the exposed tower corridor track surfaces, graded access roads and the washing of plant and vehicle wheels.

The following guidelines shall be followed where necessary to avoid pollution of surface water sources and damage to river ecosystems:

- When discharging clean water to river courses pumping rates shall be carefully controlled to avoid disturbing riverbeds and eroding or creating silty river water damage.

- Where possible water entry into excavations shall be prevented by the use of cut-off ditches.
- The amount of soil stockpiles shall be kept to a minimum.

7.4 Waste Disposal.

For the AVTP, the major sources of waste would be from the vegetation clearing activities. A common way of bush disposal is by burning. The following guidelines shall be followed in the event of bush burning.

- Starting of fires shall be governed by local fire regulations
- Permission shall be obtained from relevant local Authorities
- Site for burning shall be chosen so that there is minimum danger to surrounding vegetation or settlements
- Burning shall not take place under power or communication lines or at locations where smoke might interfere with road traffic.
- The fire shall be completely quenched with water or soil after burning and all necessary steps shall be taken to prevent re-ignition and spread.

Other major sources of waste would be packing materials such as wood, plastics, metal scraps etc. Appropriate waste bins shall be provided at site for collection and disposal through public waste disposal system.

7.5 Training Programme

A basic training programme, recommended for project management staff and key personnel of the contractor assigned to the project, in environmental awareness and environmental management will cover the following:

1. Basic environmental terminology and definitions

2. Environmental laws, regulations and compliance
3. Ghana EIA procedures (including familiarization with provisions of Environmental Assessment Regulations, 1999 (LI 1652)).
4. Basic elements of Environmental Management Planning
5. Environmental policies
6. Health and Safety policies
7. Impact assessment – identification and prediction techniques
8. Mitigation plans
9. Monitoring
10. Environmental audit

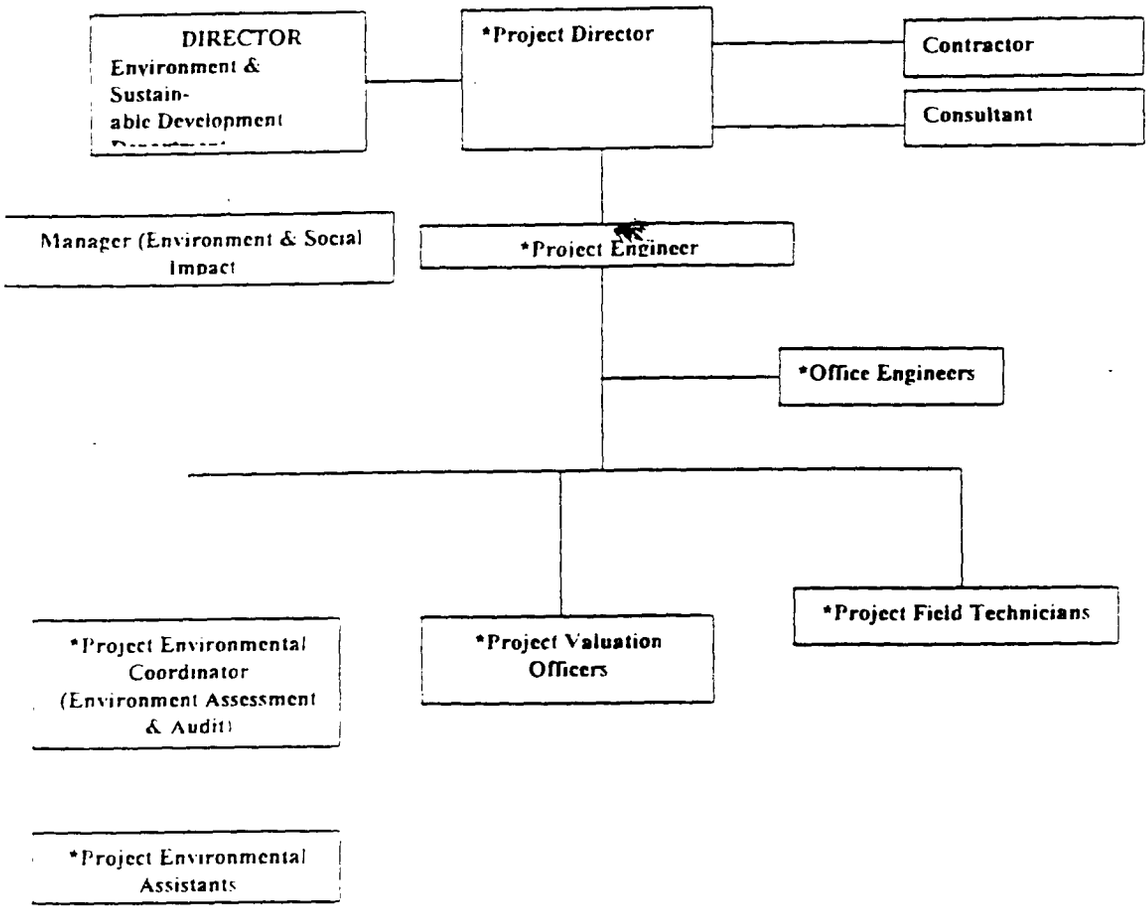
7.6 Allocation of Resources for Environmental Management

Apart from the human resources to be made available in 7.1, financial provision would be made to ensure that mitigation (including compensation), monitoring and training programmes are effectively implemented.

It is estimated that financial resources for environmental management require up to 1-2 % of the project cost. However with an already established environment department in place, the Authority will make the necessary budgetary provisions to cover all the commitments.

Table 7.1 below shows an impact mitigation table, by which project activities, their anticipated impacts, proposed mitigation measures and their expected net effects are outlined and

PROPOSED ORGANISATIONAL CHART OF PROJECT ENVIRONMENTAL TEAM



- Members of VRA Project Implementation Unit that would co-ordinate with the Contractor/Consultation

Figure 7.1

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	LOCATION	PROPOSED MITIGATION MEASURE (S)	MONITORING/FOLLOW-UP	NET EFFECTS
PRE-CON-STRUCTION PHASE.	Clearing of vegetation for Route survey.	Along entire length of line route	Vegetation clearing shall be kept to the barest minimum. Existing and available farm tracks and footpaths shall be used as access routes for surveyors.	VRA Project Implementation Unit	Will minimise vegetation clearing and exposure of soil surface
	Impact of RoW acquisition on Land ownership and use.	"	RoW acquisition shall involve consultations with stakeholders. Compensation shall be paid for all properties in the RoW excluding land as per the various Land (Wayleaves) legislation. All cultural and religious properties shall be avoided.	VRA to acquire RoW as per LI 542. Refast Ltd (Environmental Consultants) shall prepare Property Impact Report. VRA to pay appropriate compensation in consultation with Lands Valuation Board.	Payment of Compensation will offset economic losses of affected persons

CONSTRUCTION PHASE		Tower sites	Avoiding routing of construction access roads through farmlands as much as possible. Existing and available farm tracks to be used as much as possible. Replanting of access roads with fast growing grasses to check erosion.	Project Contractor	Minimised damage to crops and hence of compensation to be paid by VRA. Avoidance of exposure of soil surface.
		"	Number of passes of trucks to and from site will be regulated. Access roads shall be selected to avoid crossing streams and water bodies.	Project Contractor	To minimise soil destabilisation
		"	Constructional activity shall be limited to daylight hours when noise impacts are minimal.	Project Contractor	To minimise the risk of accidents
		"	Warning notices "NO ENTRY, NO TRESPASSING" shall be placed at entry points of access roads.	PIU/PEU	To minimise the risk of accidents

CONSTRUCTION PHASE			Trucks and machinery shall display appropriate road safety signals. Safe speed limits shall be observed (10-20 kph)	Project Contractor	To minimise the risk of accidents
			Existing access tracks shall be used as much as possible. Construction of new access tracks will be kept to a minimum. After construction, regrowth of limited ground cover shall be encouraged.	PIU/Project Contractor	To minimise damage to crops and vegetation
			Ground surface at tower sites shall be graded to drain run-off away from tower legs. Terracing, cribbing or rip-rap may be used to protect tower foundations.	Project Contractor/PIU	To avoid erosion around tower legs and possible tower collapse

CONSTRUCTION PHASE			Bush clearing shall be restricted to tower spots only to ensure minimal damage to vegetation cover. Final selection of line route shall consider minimal number of trees to be cut. Forestry Services guidelines shall be adhered to in forest reserves. Tower designs to include nesting sites and perching platforms for birds.	Forestry Services/ Project Contractor	To minimise damage to vegetation and trees
			Strict adherence to safety precautions as per Factories, Offices and Shops Act, 1970 (Act 328) and VRA Corporate Safety Rules 1993. Appropriate traffic warning signals such as "SLOW DOWN, LINE STRINGING IN PROGRESS" shall be placed along the road. ICAO safety standards shall be observed near the vicinities of known aircraft activity.	Project Contractor/ PIU	To ensure workside safety and avoid accidents

			Strict adherence to safety regulations and precautions as per Factories, Offices and Shops Act, 1970 (Act 328) shall be observed at all construction sites.	PIU/Project Contractor	To ensure workside safety and avoid accidents
			Drains leading from work areas shall be directed to existing drains to prevent them polluting nearby water bodies.	PIU/Project Contractor	To avoid contamination of nearby natural water bodies
OPERATION	Dropping of "live" Conductors	Along entire length of line route	RoW shall be acquired and access restricted. Towers shall be marked "DANGER-330 KV".	VRA Maintenance Team	To minimize possible effects ofearthing and electrocution.
AND	Shattering of insulator units	"	Regular routine and emergency maintenance of line route. Improved insulator materials	VRA Maintenance Team	Minimise incidence of insulator shattering
	Collapse of tower		Use of anti-theft fasteners to check tower vandalism and its consequences.	VRA Maintenance Team	Avoid theft of tower components.
	Maintenance of RoW vegetation clearing	Along entire length of	To be done only when necessary	VRA Maintenance Team	To minimise vegetation

		line route			clearing and exposure of soil surface
	Rust treatment, painting of Towers	"	Painting in dry season to minimize paint failure and run-off into water bodies.	VRA Maintenance Team	Avoid contamination of nearby water bodies
	Occupational Safety risks	"	Work Safety procedures as per VRA Corporate Safety Rules 1993 and Act 328.	VRA Maintenance Team	Minimise risks of accidents and injury
MAINTENANCE PHASE	Waste generation from vegetation clearing and Packaging materials (solid wastes).	"	Trees, stumps, cut brush and conductor drums shall be made available to the communities for firewood. Non-metal solids will be disposed of through the public waste collection system. Waste cloths used for cleaning, special wastes in the form of empty chemical, oil and solvent containers. Hazardous wastes will be segregated and disposed by total destruction. Metal waste will be sold as scrap to dealers. All wastes will be stored in areas	Project Contractor/PIU	Avoid environmental degradation

	Liquid wastes		isolated from surface drains. Liquids from concrete works, washing of equipment, fuel, oil and chemical spills, pumped-out water from excavations and storm water will be directed into drains away from nearby water bodies.	Project Coordinator/PIU	Avoid contamination of nearby water bodies

Table 7.1 Impact Mitigation Table

8 CONSULTATIONS

The EIA process has involved consultations with identified stakeholders. This section presents a disclosure programme the purpose of which is to ensure participation of all stakeholders adequately as well as the findings of various public consultations held in connection with the proposed Aboadze-Volta transmission Line Project and with the relevant agencies, NGOs and the public.

8.1 Consultations with District Assemblies

The authorities in the affected District/Municipal Assemblies were also contacted and briefed about the project and their concerns and expectations were also noted. In particular they all made commitments to assist in the process (including identification of affected persons and properties) to ensure that the affected persons in their Districts were compensated appropriately.

Table 8.1 below is a list of the authorities contacted.

Table 8.1 List of District Authorities Consulted

DISTRICT	NAME	POSITION
Shama Ahanta East Metropolitan	Clement Dandori	Municipal Coordinating Director
Komenda Eguafo Edina Abirem District	Nana S. Ato Arthur	District Chief Executive
Cape Coast Municipal	Solomon Asiedu	Municipal Coordinating Director
Mfantseman District	K. A. Wilson Alfred Ahumah Frank Neequaye	District Chief Executive District Coordinating Director Presiding Member
Gomoa District	Joyce M. Aidoo Yaw Adu Asamoah	District Chief Executive District Coordinating Director

STRICT	NAME	POSITION
Nutu Efutu Senya District	Francis Asare Boateng	Higher Executive Officer
	Josephine B.B. Danquah	Executive Officer
District	S.N. A Attoh	District Chief Executive
	Christina Hammond (Mrs)	T & C Planning Officer
	Victor Mensah	District Engineer
ma Municipal	Alhaji IMJ Husseini	Municipal Coordinating Director
	F. Asante	PRO

2 Public Consultations

arious consultations with the communities concerned were undertaken to brief them about the oposed project and to ascertain their concerns and expectations. Socio-economic surveys were rried out among the communities and these formed parts of the socio-economic baseline data ed in Chapter 3.3.

summary of the community consultations is in Annex 5.

3 Concerns Raised

uring the consultations, various concerns raised by the people contacted were noted and dressed in the EIA. The main concerns raised are discussed below:

Loss of crops and land use

any of the residents in the communities contacted raised concerns about the loss of crops, loss inçome and loss of land use. They complained about the mode of acquisition of land and the yment of compensation. They intimated that under the existing legislative regime, people nose lands are affected by VRA and other utility projects only receive compensation for lost ops, or physical structures that need to be destroyed as part of the project implementation. The ss of land use is not considered in the property evaluation process.

8.4 Consultations with Agencies, NGOs and Others

Consultations held with the various relevant agencies, NGOs and affected organisations are discussed below.

- **Consultations with the Ministry of Energy (MOE)**

The Ministry was consulted on the Government's general policy direction on energy, and how the proposed AVTP will impact on the energy sector. Mr. Emmanuel Antwi-Darkwa, Director of Power indicated that the status quo indicates a clear picture of national demand for energy far outweighing supply. This demand is highest around the highly industrialized areas of Tema and Accra.

In order to rectify the imbalance, plans are far advanced to upgrade Aboadze Thermal Plant to increase its output from the current 550MW to 660MW. This will serve to reduce the shortfall in the national energy demand. Also, it will reduce dependence on imported power from Cote d'Ivoire and save the nation some foreign exchange. The AVTP, apart from transmitting power from the Aboadze Thermal Plant to the high-demand areas of Tema and Accra, will also serve to evacuate power to be generated from the gas turbine barge to be stationed at Effasu, also in the Western Region to the Volta substation at Tema.

Thus from the point of view of MOE, proposed AVTP will serve to carry out the above outlined projections that are of immense national importance.

- **Consultation with Electricity Company Ghana**

Discussions were held with the Design Manager of the Electricity Company Ghana, on how the power to be evacuated by the AVTP on completion will impact on their main activity of power distribution. ECG intimated that it would go to ensure system stability and enhance reliability of supply to customers.

The three main performance indicators of power supply systems would all be positively enhanced by the AVTP. Thus, the frequency of power outages would reduce, the duration of outages will be shortened and the availability of supply to new development areas through the Self Help Electrification Project (SHEP) will be enhanced. The SHEP is also expected to benefit some communities that lie along or close to the proposed route.

- **Consultation with Energy Commission (EC)**

The Energy Commission is the main national agency in charge of energy matters in Ghana. The Energy Commission Act, 1997 (Act 541) vests the Commission with the authority to manage all developments in the energy sector. A meeting was therefore held with the Mr. Francis Gbeddy (Acting Chief, Power) of the Commission.

The EC indicated that VRA currently holds only a provisional licence as a service provider in the energy sector. There is therefore the need for the Authority to complete the necessary requirements in order for it to be fully licensed. He further indicated that the AVTP itself has not also been registered with the Commission as required by regulation (see letter in Annex 5). To receive a licence for the AVTP, the VRA is required to submit the following:

- Relevant drawings of the project
- An Environmental Report approved by EPA
- Documentation proving acquisition of the land on which the project is to be sited, such as title deed/lease of land.

Prior to the commencement of the project, the VRA is also required to submit a formal application for registration, and a final EIS approved by the EPA concludes the list of requirements the VRA needs to meet. These are being duly handled by the VRA.

It was also noted, the VRA Transmission Line Protection Regulation, 1967 (LI 542) defines "transmission line right-of-way" to include the area extending for a distance of fifty feet (50 feet or approximately 16 m) on either side from the centre line of the transmission towers.

Therefore the law will have to be amended to accommodate the proposed 330 KV AVTP, the RoW of which is expected to be 40 metres. The EC intimated that VRA would have to ensure that this is done to provide for the protection of the RoW in the project areas for smooth implementation and operation of the AVTP.

- **Consultation with Telecommunication Companies (Ghana Telecom and Scancom)**

Resonance effects of power frequency fields may also affect telecommunication. Electric power in Ghana is provided at an alternating current (AC) with a frequency of 50 Hertz, with a wavelength of 5,000 kilometres. These features have the potential of disrupting telecommunication. VRA takes care of this effect during stringing by changing the positioning of the conductors from tower to tower (transpositioning).

As recommended by the EPA in their comments on the Terms of Reference, Ghana Telecom as a telephone service provider has been consulted on the effects of transmission lines electromagnetic forces (EMF) on communications. Discussions have been held with the General Manager, Network Management and Operations.

According to GT, some overhead telephone lines experience interference from "induction effect" when they run parallel and close to power transmission lines. Generally telephone lines are strung in road reservations while VRA transmission lines run in the hinterlands. In view of the vertical separation between telephone lines and the proposed transmission lines (the towers are about 40 m high), interference at spots where the two sets of lines cross each other are expected to be minimal.

Scancom, a mobile phone network operator was also consulted on the potential effect of the transmission line on their operations. According to Mr. Somenath Ganguly, the Operations Manager of the company, their systems have been standardised taking all these factors into consideration. Therefore he does not anticipate any problems at all from the stringing of the

330KV line, adding that similar systems are in use in other countries where higher voltages are in use, without any problems.

- **Consultation with Construction Pioneers (CP)**

CP is a construction company that undertakes quarrying activities to provide aggregate materials for their projects. One of their quarry sites at Eduegyei near Elmina in the Central Region lies in the proposed RoW.

Consultations have been held with CP regarding the impact of the AVTP on active quarry sites and the potential impact on future exploitation activities. CP requested that the proposed route be diverted to avoid their site (see letter in Annex 5). VRA Engineering department has diverted the relevant sections of the line to avoid the said area.

- **Consultation with Conservation International (CI) Ghana**

Discussions have been held with CI as an environmental NGO concerned with biodiversity conservation in Ghana. The Programmes Director, Mr. David G. Kpelle iterated that the Southern Marginal/Dry Semi-deciduous forest through which the greater portion of the transmission lines passes is already a much disturbed vegetation zone. Therefore, most of the original wildlife species, especially mammals, have migrated from the area. The remaining ones are hardy species that may not be really affected by the temporary construction activities of the transmission lines or the transmission lines themselves.

CI however cautioned against extensive disturbance of wetlands and, mangrove areas, the traditional hunting grounds of the Effutu (Winneba) people, where there are such mammals as duikers, bushbucks, grasscutters and green monkeys. It was recommended that the construction phase should be made as short as possible to enable mammals that may drift away because of the noise and other activities to re-establish themselves afterwards. Regarding birds, especially migratory ones, particular attention is to be paid to their roosting sites and their flyways. Since the transmission lines do not traverse any forest reserve extensively, and lagunal/wetland areas

are not expected to be seriously disturbed. CI would rate the AVTP as having minimal impact on the environment and biodiversity.

- **Consultation with Friends of the Earth-Ghana (FOE)**

FOE Ghana as an environmental NGO has been consulted with regard to perceived impacts of the AVTP on the natural and environmental resources along the corridor on the line route. The Programmes Coordinator, George Awudi, affirmed that there are no threatened or endangered species within the ecological areas that the AVTP straddles.

Therefore so long as the wetlands and water bodies are minimally disturbed during the construction phase, and vegetation clearing and soil disturbance are kept to the barest minimum, the AVTP would have minimal impact on environmental and natural resources, especially wildlife and biodiversity.

- **Consultation with Ghana Wildlife Society**

Ghana Wildlife Society is an environmental NGO with a focus on wildlife conservation. Dr. Erasmus H. Owusu, the Director of Conservation Programmes expressed concern about the impact of the project on bird species. Some bird species such as the pied crow (*Corvus albus*) and the rough wing swallow (*Psalidoprocne obscura*) that tend to have a natural preference for perching on transmission lines would be exposed to great risks of electrocution.

Also during the construction phase, it would be expected that the mammalian inhabitants might drift away to the remaining pockets of forests that are usually characterized by *Ceiba* species. If the construction phase is made transient enough, these mammals may come back to re-establish after construction. They, however, stand the risk of being hunted down by people living within the outlying communities.

It was recommended that where tall trees are removed to make way for the towers, nesting spots and roosting sites be provided through the tower designing and engineering for birds. This will

tend to give the project an environmentally friendly outlook since birds are important bio-indicators.

- **Consultation with Wildlife Division of the Forestry Commission**

Consultations have been initiated with the Wildlife Division and their officials. Principal Wildlife Officer, Ernest Lamptey and Mr. Adu Nsiah are studying the line route maps. Their comments are yet to be received.

- **Consultation with Forest Services Division of the Forestry Commission**

Consultations have also been held with the Forest Services Division. The Winneba District office is responsible for the Yenku 'B' and the proposed Apra Hills forest reserves, which are of relevance to the AVTP. A Memorandum of Understanding (MOU) has been prepared to guide the harvesting of trees in these reserves that will be affected by the project.

Consultations have been held with Mr. K.K. Mensah, the Forest Service Officer at Winneba who provided assistance with information on the proposals to create the Apra Hills reserve (see Chapter 3 p.29). During the field survey, he provided forest guards to accompany the team in evaluating the forests.

- **Consultations with Ghana Museums and Monuments Board**

The law regulating the activities of the Board was consulted regarding chance finds of historical and archaeological artefacts in the course of vegetation clearing or excavation for erection of the transmission towers. The procedures derived from the provisions of the National Museum Decree, 1969, (NLCD 387) are as follows:

Upon the discovery of any such artefact:

i. The Director of the Ghana Museums and Monuments Board shall be notified immediately in writing, stating the exact site or location of the item. The letter shall include adequate photographs of the antiquity.

ii. VRA shall permit and facilitate such access to, and inspection of the site of discovery as the Director may so require. VRA shall also permit to be affixed or applied thereto, any seal or identification mark of the Board.

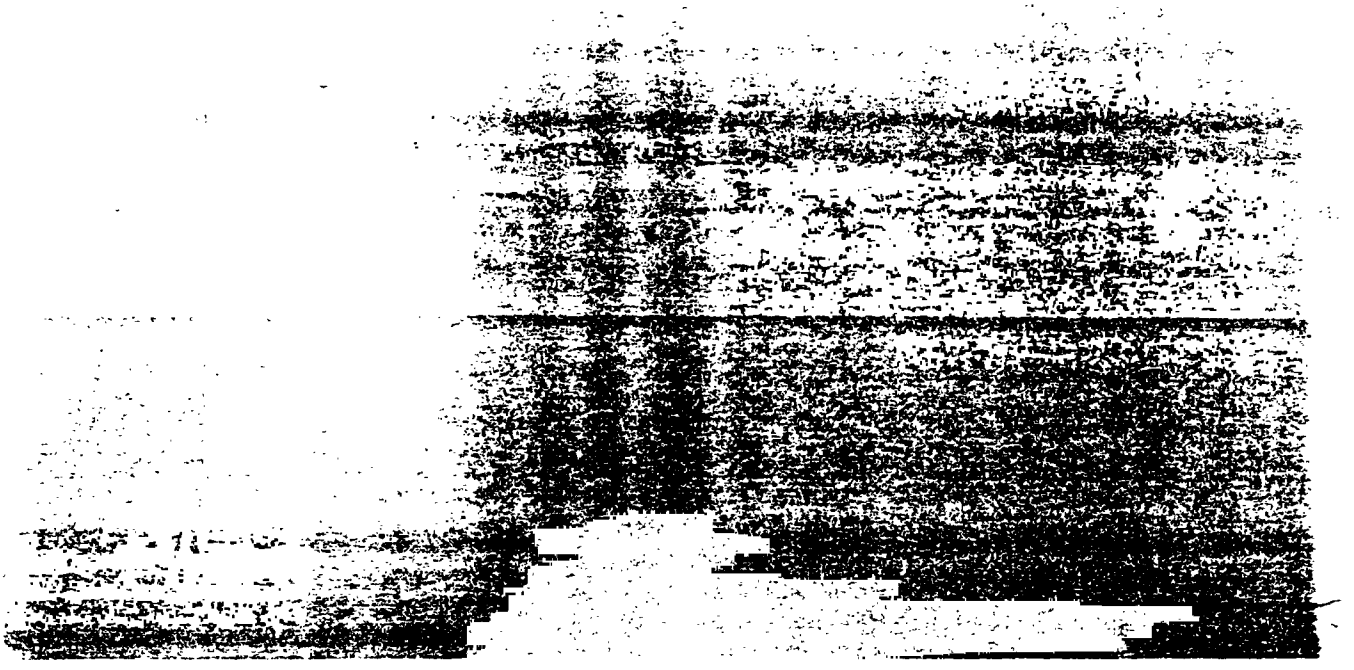
iii. VRA shall not alter, damage, destroy or remove any antiquity from its original site without the consent of the Board. If the removal of the item becomes immediately necessary for safety or security reasons, the exact location shall be noted and the retrieved artefact shall be sent to the custody of the Board.

iv. Through liaising with the Board, the lawful owners of the land shall be duly informed and where necessary, payment shall be made by the Board after due assessment.

v. Further decisions with respect to site sampling, or further excavation shall be at the jurisdiction of the Board.

Chapter 9

Conclusions



The proposed route has been chosen so that the proposed line will run along the hinterland of the coastal areas to avoid settlements and sensitive sites as much as possible. The EIA has identified that the proposed project will have some significant impacts mainly on the people residing in the settlements along the proposed route. These impacts are related to the acquisition of the RoW. The acquisition will lead to loss of farmlands along the 40 m wide reservation required for the RoW. The loss of farmlands will then lead to loss of income for the affected farmers. This will be mitigated by payment of fair and adequate compensation.

Aspects of the construction activities will have some limited impacts on the ecology along the route but these will be sufficiently mitigated to minimise their effects. Most of the constructional impacts are generally short term, lasting only for the duration of the source activities.

There will not be the need for any resettlement of persons for the implementation of the project. The proposed route has been selected to avoid the heavily built up areas in the many urban settlements along the route. Recommendations have been made for the selection of tower spots to be made so as to avoid the religious and cultural properties noted along the line route.

Effective management of the potential environmental impacts and careful monitoring will help to keep predicted impacts to tolerable levels.

In the light of the various considerations and particularly for the future stability and integrity of the national transmission network and the need to link up with the proposed West African Grid System, it is recommended that the 330 KV Aboadze-Volta Transmission Line Project should be permitted to proceed.

inappropriate

ANNEX 1

TERMS OF REFERNCE

EPA COMMENTS ON SCOPING

(Annex 1) **PROPOSED COASTLINE 330 KV TRANSMISSION LINE PROJECT**

ENVIRONMENTAL IMPACT ASSESSMENT STUDY

TERMS OF REFERENCE

Executive Summary

- Concise description of proposed project
- Brief account of affected environment
- Outline of significant impacts and findings
- Main mitigating measures
- Monitoring/management programme

1.0 Introduction

- Project background and objectives
- Regulatory and Administrative requirements. - all applicable local and international regulations and standards relating to the project will be identified and outlined. Numerical standards (where applicable) will be specified in summary tables. This section will discuss the relevant policies, their implications and the regulatory conditions that must be considered for the successful implementation of the project, including the requirements by co-financiers (World Bank etc).

  The legal frameworks to be considered have been identified during the Scoping and emphasis will be on the Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542).

- Scope of study - TOR as approved by EPA

2.0 Description of the proposed project

A reasonably detailed description of the project will be given using maps, figures and tables as necessary and will highlight the following:

- Constructional activities – right-of-way and access routes, land clearing and site preparation, tower erection etc.
- Operational activities – commissioning of line, line maintenance, tower maintenance, right-of-way maintenance.

3.0 Description of the Baseline environment

The proposed line passes mainly through the coastal scrub. Data relating to the existing environment have been identified during the Scoping and these will be studied further. The areas of emphasis will be:

3.1 Bio-Physical Environment

i. Flora – identification of protected species and conservation issues
ii. Fauna – identification of protected species and conservation issues
iii. Water Resources

3.2 Socio-cultural/economic Environment

i. Religions and Cultural properties
ii. Historical resources
iii. Land tenure and Land ownership
iv. Land Use
v. Employment
vi. Agriculture
vii. Public Health

4.0 Significant Environmental Impacts and Proposed Mitigation

Some environmental effects will occur during the construction, operation and maintenance phases of the project. In the Scoping report the potential impact identification has been done using an **Impact Identification Matrix**. As far as possible, all the identified impacts will be quantified and assessed for significance based on magnitude, extent, duration, reversibility etc.

Some of the significant impacts arising from the construction will be mainly those associated with land clearing which could result in loss of farmlands and crops and dispersal of fauna. All tall trees within the right-of-way will also have to be cut to prevent them falling on the lines and this may be regarded as a residual impact. Other issues arising from construction would include noise from machinery, soil erosion, pollution of water sources from dust etc.

During the operational phase, some of the impacts are likely to arise from issues related to restriction of access to areas within the right-of-way and will be mainly of socio-economic/cultural significance. In addition, the aspect of the impact of electromagnetic field effects produced by high voltage 330 KV transmission systems will be addressed.

From the assessment of impacts, the necessary mitigation actions will be prescribed and wherever possible design or implementation will be altered accordingly. Issues regarding compensation for loss of crops and land use resulting from right-of-way (RoW) acquisition will be presented as part of the mitigation.

5.0 Monitoring

An appropriate monitoring programme to determine impacts on the physical, biological and human environments will also be developed. This programme will be used to verify whether predictions of environmental impacts, developed in the design phase, are accurate and that unforeseen impacts are detected at an early stage.

6.0 Analysis of Alternatives

This section will present a discussion on all alternative and subsequent designs/options that have been considered to date.

7.0 Provisional Environmental Management Plan

An Environmental Management System will be developed as part of the provisional Environmental Management Plan. This will also incorporate a training programme which will be implemented for the staff who will be responsible for the construction, operation and maintenance of the line. Environmental management and training will include the following:

- Proper storage/handling of hazardous materials,
- Fire prevention systems,
- General health & safety procedures,
- Monitoring procedures
- Effective record-keeping and reporting system.

The EMP will incorporate the following:

a. composition and job description of environmental management team.
b. structure of reporting for environmental management team and this should be linked with operational and administrative activities,
c. training and development.
d. parameters to be monitored, e.g. electromagnetic force (EMF)
e. monitoring programme,
f. proper and adequate record keeping,
g. places to be restricted to unauthorised persons

8.0 Consultations, Interagency & Public/Non-Governmental Involvement

This section will present the findings of all the consultations held in connection with the proposed Coastline Transmission Lines Project with agencies, NGO's and the public. The discussions will cover the various issues of concern raised and how they have been addressed in the EIA.

9.0 Conclusion

This section will present the main conclusions and recommendations resulting from the EIA.

Annexes: Illustrative Materials

The Environmental Impact Statement (EIS) will be illustrated with relevant photographs, maps, plans, diagrams and any other illustrative material that would make it easy to appreciate the content of the EIS.

Tel. (233)664697/664698,
780175 - 9
Fax: 233 (021) 662690
Tlx: 2609 Environ - Gh

Environmental Protection Agency
P. O. Box M 326
Ministries Post Office
Accra, Ghana

Our Ref.: CE: 707/01/07

November 5, 2002

THE CHIEF EXECUTIVE
VOLTA RIVER AUTHORITY
P. O. BOX M77
ACCRA

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED 330KV COASTLINE TRANSMISSION LINE PROJECT, ABOADZE – TEMA

We refer to the Scoping Report submitted on the above proposal to the Agency, in accordance with the Environmental Assessment Regulations, 1999 (LI 1652).

The Report has been duly reviewed. The attached additional areas/issues have been identified for consideration and inclusion in the EIA terms of reference.

You are advised to proceed with the Environmental Impact Assessment (EIA) for the proposed 330KV coastline transmission line project and submit twelve (12) copies of a draft Environmental Impact Statement (EIS) in line with LI 1652. It is important that effective consultations are held with all the Districts Assemblies along the transmission corridor and copies of the draft EIS sent to the offices of the relevant District Chief Executives.

Do not hesitate to consult with the Agency for any further guidance in this regard.

Yours faithfully,

D. S. AMLALO
DIRECTOR OPERATIONS
FOR: AG. EXECUTIVE DIRECTOR

cc. The Honourable Minister, Ministry of Environment & Science, Accra
The Honourable Minister, Ministry of Energy, Accra
The Executive Secretary, Energy Commission, Accra
The Municipal Chief Executive, Tema Municipal Assembly, Tema
The Metropolitan Chief Executive, Shama Ahanta East Metropolitan Assembly, Sekondi
The Regional Officer, EPA Greater Accra Region, Amasaman
The Regional Officer, EPA Western Region, Sekondi
The Regional Officer, EPA Central Region, Cape Coast

PROPOSED 330KV COASTLINE TRANSMISSION LINE PROJECT, ABOADZE – TEMA

SCOPING REPORT – REVIEW COMMENTS

1.0 Amendment to legislation

How soon will amendments to the right of way (RoW) regulation be effected and its implication for the project if it is not done early enough (pg. 4)

2.0 Active quarry sites exploitation activity

The impact of the active quarry sites as well as potential impact of future exploitation activities on the proposed development should be considered and appropriately addressed.

3.0 Stringing activities

Impact of stringing activities on road users/crossers should be considered.

4.0 Identification of streams and rivers

Identify the streams and rivers on the project's right of way (RoW) and how they could be impacted upon

5.0 Consultation

Consult with Telephone service providers on the effects of high electromagnetic forces (EMF)

ANNEX 2

PROJECT FEASIBILITY EXTRACTS

VOLTA RIVER AUTHORITY

THIRD COASTLINE FEASIBILITY STUDY

Volta River Authority
ED&C Dept

November 1995

1.1 Objective of the Study

The objective of the study is to:

- establish the transmission system reinforcement requirement that will reliably evacuate power from the 660MW Aboadze power plant and 125MW Effasu plant to the major load centres.

- develop conceptual designs, cost estimates, implementation plans and preliminary construction schedules for the required transmission facilities.

2 EXISTING FACILITIES

2.1 Existing Generation Facilities

The hydroelectric plant at Akosombo has six generating units with an installed capacity of 912 MW. The second hydroelectric plant at Kpong, commissioned in 1981 has an installed capacity of 160 MW making a total of 1,072 MW.

The Authority has recently constructed a 330MW combined cycle thermal plant comprising 2x110 MW combustion turbine units and a 110 MW steam turbine at Aboadze near Takoradi.

The Ministry of Mines and Energy in 1998 contracted Independent Power Producers (IPPs) to construct, own and operate generating facilities in the country on short-term basis to supplement generation from the VRA facilities. Two IPPs, namely AGGREKO and CUMMINS have each developed 30MW generating plants at Tema. These generating plants will be phased out at the end of 1999 and 2000 respectively.

2.2 Existing Transmission Facilities

The transmission system is characterised by a 161kV loop serving the southern part of the country and a long 161KV radial transmission line from Kumasi to Bolgatanga in the north. The existing transmission system is shown on the attached map of Ghana (Fig. 1). The transmission network consists of 3,670 circuit kilometres of 161 kV transmission lines and 34 HV/MV substations. About 600 circuit kilometres of these 161kV transmission lines are currently operated at 34.5 kV. In addition, a 225 kV single-circuit inter-tie connects the VRA network to the network of Compagnie Ivoirienne d'Electricité (CIE) of la Côte d'Ivoire at Prestea and Abobo respectively. A double circuit 161 kV transmission line from Akosombo to Lome also connects the VRA network to the network of Communuate Electrique du Benin (CEB) of Togo/Benin.

Electric power is evacuated from the hydroelectric plants of Akosombo and Kpong by eleven transmission circuits including the double circuit interconnection with Togo/Benin. Power

generated at the Aboadze power plant is also evacuated through five (5) transmission lines to Achimota (Accra), Takoradi and Prestea.

The reactive power compensation for the VRA transmission system is provided by several capacitor banks, shunt reactors and synchronous condensers. The capacitor banks are located at Smelter substation (120 MVAr), Achimota (40MVAr), Kumasi (30MVAr), Tema (10 MVAr) and New Obuasi (10 MVAr). Smaller units at various locations provide reactive power compensation requirements of the southern loop.

Four variable shunt reactors (8.5 -17 MVAr) used to mitigate high voltages on the long lightly loaded radial lines in the north. These reactors are located at Techiman, Tamale and Bolgatanga. Two 25MVAr synchronous condensers are located at Prestea.

3 PLANNED FACILITIES

3.1 Planned Generation Facilities

In order to meet the increase in system load demand, the Aboadze plant is being expanded to its ultimate capacity of 660 MW with the construction of another 330 MW combined cycle block. As part of the expansion, two (2) 110 MW Combustion Turbine (CT) units were commissioned in 2000. A 110 MW heat recovery Steam Generator had been scheduled for commissioning in 2003.

The Akosombo Retrofit Project, which started in 1992 and suspended in 1993, resumed in November 1999. Apart from the replacement of generator windings and other equipment, runners on all six units will be replaced. It is expected that one unit will be taken out consecutively for retrofitting up to the year 2004 when the project will be completed.

Ghana National Petroleum Corporation (GNPC) has recently acquired a 125MW barge mounted gas-fired power plant at Effasu in the south-western corner of the country. The Effasu plant is expected to come on line in the year 2006.

VRA and Marathon Power Antares of USA through a joint venture arrangement, is planning to develop a 300MW combined cycle plant at Tema scheduled for completion in 2003/4.

The Bui Hydroelectric Power Plant, a 400 MW plant in the northwestern part of the country is to be commissioned in 2008.

3.2 Planned Transmission Additions

3.2.1 Committed Transmission Developments

The committed transmission additions are:

- A second bulk supply point (substation) for the city of Accra (Accra 2BSP), expected to be commissioned in the year 2001. This substation will be supplied by four transmission lines, two from Achimota and one each from Winneba and Cape Coast.

- The Techiman-Wa transmission line, insulated for 161 kV operation but operated at 34.5 kV will be upgraded from Techiman to Sawla and operated at 161 kV with a 161/34.5kV substation at Sawla. The remaining portion of this line, from Sawla to Wa will still be operated at 34.5 kV.

- In order to ensure a secure and reliable evacuation of 440 MW from the Aboadze plant, a 120km 161 kV transmission line be constructed from Prestea to Obuasi by the end of the year 2000 using Toucan twin bundle conductor (2X265mm^2 ACSR)

3.2.1 Planned Transmission Additions

Planned transmission additions for the study period are:

- A 115 km 161kV transmission line from Kumasi to Sunyani to improve system performance in the northern sector in 2004.

- Transmission lines for the reliable evacuation of power from the Bui hydroelectric plant to be commissioned in 2008. These lines are:

  a) 135 km 161kV transmission line of 2x265mm2 ACSR from Bui-Teselima-Sunyani and,

  b) 225-km 161kV transmission line of 2x265mm2 ACSR from Bui-Teselima-Techiman- Kumasi. This line will be terminated at the Kumasi-ZBSP substation - a new Bulk Supply Point being planned for the city of Kumasi to be commissioned in the year 2005.

5.0 TECHNICAL ANALYSIS

The construction and operation of transmission lines of voltages higher than 161 kV has been the subject of considerable studies by VRA. The most recent studies include:

- The VRA-CEB-NEPA Interconnection Study, conducted by Danish Power Consult in a joint venture with SwedPower. The objective was to link the NEPA (Nigeria) 330 kV system with that of CEB (Togo/Benin) and Ghana.
- 330 kV overlay of the VRA Transmission System Study, conducted by Acres International as part of the Takoradi Thermal Plant Project, and,
- Volta-Lome Transmission line feasibility study, conducted by VRA in 1997.

The 330 kV transmission lines have the advantage of higher power transfer capability and improvement of system reliability. Other benefits of the 330 kV line include:

- Improvement system angular and voltage stability.
- Reduction in the outage rate of the system as the operational failure rate of 330kV lines is about half that of 161kV lines.
- Reduction in transmission line right of way as 330kV lines have a larger capacity and will therefore require fewer lines.
- Reduction in system losses.
- Will be required for future interconnection with Nigeria and the development of the West African Grid System.

5.1 Evacuation of 660MW from Aboadze

5.1.1 2002 Peakload Conditions

These conditions reflect existing generation and transmission systems as well as committed and planned facilities that to be commissioned in the year 2002. Case TP-660-02 is the network single line diagram for the year 2002 peakload conditions.

Results of the loadflow simulations show overloads on the coastlines even under normal operating conditions, which indicates the inability of the transmission system (including the reinforced Prestea-Obuasi line) to evacuate the full capacity of the two plants (Aboadze and Effasu). It is therefore necessary to reinforce the Aboadze-Volta transmission line to ensure reliable evacuation of 660MW from the Aboadze plant and 125MW from Effasu.

The third coast line is therefore required to reliably evacuate the high power flows from the generating sources in the West to the large load centres in the east.

5.1.2 330 kV Third Coastline Reinforcement

The load flows show that the 330 kV line improves system improves system performance. The loading on the existing 161 kV lines is about 90MW while the 330 kV tline carries 236MW. There is an even power sharing between the 330kV line and the parallel 161kV lines, and improved system voltages. There is no violation of the line loading criteria with system losses of 49MW.

This system configuration can also support up to 120MW import from the CIE. The capability of the system to import power from the CIE is however limited by the Elubo-Prestea 225kV line. This line has a capability of carrying about 200MW. However, it carries about 80MW from the Effasu plant, limiting power imports from CIE to 120MW.

The system cannot however withstand critical line contingencies. The loss of the Prestea-Obuasi transmission line will result in overload on Prestea-Bogoso line and the loss of the third coastline will overload the remaining coastlines by about 20%.

5.1.3 2006 Peakload Conditions

The generation expansion plan for 2006 proposes to construct a 400MW hydroelectric plant at Bui with associated 161kV transmission lines as follows:

- Bui-Tesclima-Sunyani-Kumasi transmission line, and
- Bui-Tesclima –Techiman-Kumasi

Steady state loadflow for 2006 conditions with the Bui hydroelectric plant is shown in CASE TP-660-06. Results of the loadflow simulations indicate that, this generation development results in significant changes to the pattern of power flow. Most of the power generated from the Bui hydro-power plant feeds into the Kumasi substation thus reducing the flow of power from Akosombo and Aboadze towards Kumasi.

Power generated from Akosombo feeds directly into the Volta substation while most of the power generated from the Aboadze power plant is fed onto the coastlines towards Achimota and Accra-2BSP substations. A large amount of reactive power is drawn into Accra-2bsp substation (about 109MVAr) from Achimota, resulting in heavy loading and high losses on Accra-2bsp-Achimota line. Moreover, the voltage at the Accra "BSP substation is unacceptable low. This calls for the installation of a 40 MVAr shunt capacitor bank at Accra-2BSP substation to minimise the transfer of reactive power between the two substation and also to improve system voltages. The installation of the shunt capacitor improves system voltages with 66MW losses.

The transmission system cannot withstand the loss of the third coastline, as remaining coastlines tend to overload by about 30%. This increase in the margin of overload over 2002 conditions can be attributed to the reduced power flow from Aboadze towards Kumasi. The effect of this contingency can however be minimised by generation re-scheduling (i.e. taking one units out of service at Aboadze/Effasu and increasing generation at Akosombo).

5.1.4 2010 Peakload conditions

For 2010 peakload conditions, there is heavy power flow on the Achimota-Accra-2BSP transmission line resulting in 30% overload. There is therefore the need to terminate the Achimota-Winneba line at Accra 2BSP. Results of steady state loadflow with Achimota-Winneba line terminated at Accra 2BSP shown in CASE TP 660-10 indicate that power flows on the Achimota-Accra-2BSP lines is reduced to acceptable levels. However, unacceptable voltages are registered at Kumasi, Konongo and Asawinso as a result of reactive power deficiency at these substations. Installation of capacitor banks of various sizes at these locations (i.e. Kumasi-10MVAr, Konongo-10MVAr and Konongo-5MVAr) improves the situation with system losses of 62MW.

The loss of the third coastline results in over-loads on the remaining coastlines. Under this contingency, the loading on the remaining coastlines is increased to 182-192 MW (case-TP-660-10-D). The effect of this contingency can however be minimised by generation re-scheduling (i.e. taking one unit out of service at Aboadze/Effasu and increasing generation elsewhere, such as Akosombo).

5.1.5 2015 Peakload Conditions

Case TP-660-15 shows that the transmission system is capable of sustaining the 2015 loads with 62MW losses. The voltage at Asawinso and New-Obuasi substations is below acceptable limits requiring further shunt capacitor compensation at these locations. The system will however stand all critical contingencies except the loss of the third coastline.

--

5.2 Off-Peak Conditions

In order to achieve the objective of establishing the transmission system requirements for the evacuation of power from the Aboadze plant, the Aboadze plant is maintained at maximum generation while Akosombo and other generating sources are reduced to match system load requirements.

5.2.1 2002 off-peak Conditions,

During 2002 Off-peak conditions the system is still uniformly loaded under normal system operation (CASE OFF-660-02). However, overloads occur under contingencies of Prestea-Obuasi and the third Coastline. The loss of Prestea-Obuasi places 172MW on Prestea-Bogoso and the loss of the third coastline places 199 MW on Aboadze-Winneba line.

7.0 PROJECT SCOPE, COST ESTIMATES AND SCHEDULE

7.1 Project Scope

The project comprises the following:

1) **Transmission lines**

Construction of approximately 210km of a 330kV transmission line using 3x265 sq. mm ACSR (triple bundle toucan) conductors on lattice steel towers fitted with two (2) shield wires from Aboadze switchyard to the Volta substation.

2) Substations

a) Installation of 450MVA, 330/161kV auto-transformer and extension of Aboadze switchyard

b) Installation of 450MVA, 330/161kV auto-transformer and extension of Volta Substation extension

7.2 Project Cost Estimates

The total cost of the project including contingencies and engineering is estimated at about US$ 37 million. The detailed cost estimates are shown in Table 7.1

7.3 Project Implementation Schedule

It is assumed that the third coastline project would be implemented under international competition bidding process. The target commissioning date is 2002.

The project cycle is split into three main components:

a) Transmission Line.

Construction of the 330kV third coastline is expected to start in January 2001 and end in March 2002. Works to be covered under line construction are Right Of Way acquisition and clearance, erection of tower, and stringing of conductors, shield wires and other accessories.

b) Substation Works

These include substation civil and electro-mechanical works, supply of transformer and other substation equipment, erection testing and commissioning at Aboadze and Volta substations. This component is expected to take thirteen (13) months to complete

c) Communication and SCADA

The Communication and SCADA component of the project will involve the upgrade and modification of the screens and mimic board at the System Control Centre (SCC) at Tema, the provision of tele-protection and control systems at Aboadze and Volta substations. This component will take ten (10) months to complete.

A detailed project implementation schedule is attached.

SOCIO-ECONOMIC IMPACT ASSESSMENT FOR VRA 330 KV COASTLINE POWER TRANSMISSION PROJECT

QUESTIONNAIRE FOR PERSONS WITH AFFECTED BUILDING AND ECONOMIC ACTIVITIES

Questionnaire Identification

1. Name of community.....

2. Name of District. .....

3. Region.....

Name of Interviewer. .....

Date of Interview.....

Demographics

4. Name of respondent.....

5. Position of respondent in family/lineage.....

6. Sex of respondents 1. Male 2. Female

7. What is your age ?

1. 18-22 years
2. 23-27 ..
3. 28-32 ..
4. 33-37 ..
5. 38-42
6. 43-47
7. 48-52
8. 53-57
9. 58-62
0. 63 and above

8. Which region do you come from?

1. Greater Accra
2. Eastern
3. Western
4. Central
5. Ashanti
6. Volta
7. Upper West
8. Upper East
9. Brong Ahafo
0. Northern

(Other specify).....

9. Which religions do you belong to?

1. No religion
2. Christianity
3. Islam
4. Traditional religion

Other (specify).....

10. What is your marital status?

1. Never married
2. Married/consensual relationship
3. Divorced/separated
4. Widowed

11. What is your occupation or main sources of income? .....

.....

12 How many members are in your household (dependants).....

AFFECTED BUILDING

13 Who owns the affected house?

1. Myself
2 Family/Lineage
3. Parents
4 Children
5 Spouse
Other (specify)

4 How many households live in the house?

1 1-2 4 7-8
2 3-4 5 9-10
3 5-6 6 11-12
Other (specify).....

15 Are the occupants of the house
1 Tenants only
2 Family/Lineage members only or non tenants
3 Both tenants and non-tenants
Other (specify).....

PERSONS WITH AFFECTED ECONOMIC ACTIVITIES

16 The type of affected activity (ies)

.....

17 Identification name/inscription of the firm.....

18 Who is the owner of the firm? (INTERVIEWER, WRITE NAME, SEX AND AGE if different from respondent)

14 How many people work in the firm?.....

19. Do you pay any thing in the form of rent, commission etc. to any body for the use of any input/asset e.g. land, premises, tool, etc. for your business ?

1. Yes 2. No

20. If yes, for what input do you pay, and why?

SOCIO-ECONOMIC IMPACT ASSESSMENT FOR VRA 330 KV COASTLINE POWER TRANSMISSION PROJECT

QUESTIONNAIRE FOR COMMUNITY LEADER

This questionnaire is meant to seek opinions of members of the communities that are to be affected by the above project. The opinions are basically concerned with how members expect the construction of the Right of Way for the erection of pylons for the above project through their communities socially, culturally and economically, positively and/or negatively. Members are therefore encouraged to give their candid opinions freely and objectively to enable the Consultant advise VRA appropriately to enable them execute the project with minimum negative impact as possible.

Questionnaire Identification

1. Name of community .....

2. Name of District .....

3. Region.....

4. Name of Interviewer .....

5. Date of Interview .....

6. Name of respondent .....

7. Position/status of respondent.....

Sex of respondents 1. Male 2. Female

GENERAL INFORMATION (WARENESS,PERCEPTION AND APPRECIATION)

Q1. Are you aware of the proposed power line transmission project between Aveisize and Tema that passes through your community?

1. Yes Go to Q5 2. No.(Go to Q6)

Q1a. If you are aware, were you involved in any way in the decision to construct the Right of Way through your community?

1. Yes 2. No

Q1b. Did you have any problems with agreeing to the decision.?

1. Yes 2. No

Q1c. Give reason for your answer in Q11b.

12a. If you were not involved in the decision, would you have agreed to the decision to have the Right of Way (ROW) through your community if you were consulted?

1. Yes 2. No

12b Give reason for your answer in Q6.

13. If you were given the opportunity now to decide whether or not the ROW should pass through your community what would be your decision and why?

14. In what specific ways do you expect the proposed project to benefit your community?

15 How important is the land expected to taken for the power transmission line to your community? (specific purposes for which the land serve?

16. Which other communities benefit from the use of the land and/or what is produced on the land, and how do these communities benefit from the land??

17. What other alternative lands (if any) can be available for use by persons whose lands may be affected by the power transmission project.

LAND OWNERSHIP, TENURE SYSTEM AND USE

18. Which paramountcy/stool does the community's land fall by custom?

19 Who is the care-taker (chief/stool, lineage/family, individual etc.) directly responsible for the land on behalf of the paramountcy?

20. On what terms/conditions are portions of land given out for use in the community?

1. Tenants pay for the use for specified period of time
2. Tenants use and share proceeds with land- owners
3. No specific arrangement/ Depends on land-owner and Tenant
4. Property to be shared on completion

Other (specify).....

21. For what purposes are land mostly used in the community?

1.Farming
2. Residential Accommodation
3.Business/industrial sites/accommodation
4. Quarrying
Other (specify)

22. What are the main occupations in the community?

1. Farming
2. Artisan
3. Public/civil service
4. Trading/Commercial
5. Construction
Other (specify) .....

23. What significant changes have you observed about the following for the past ten years.

...land ownership and control

...land tenure system

...land use

...Land use?

24. What factors brought about these changes?

25. How do you expect the proposed ROW through the community to affect/ bring about changes in land ownership and control, tenure and use?

INFRASTRUCTURE (SOCIO –ECONOMIC FACILITIES/UTILITIES)

25 Which of the following facilities/utilities do you have in the community?

1. Piped water
2. Electricity
3. Telephone
4. Post office
5. Police station.
Other(specify).....

26 For how long have you been enjoying the facilities mentioned in Q 26?

27. How did you get those facilities in the community?

28. Do you expect the proposed ROW to affect any of the facilities/utilities in the community?
1 Yes 2. No.

28b If yes, mention the specific facilities/utilities and how they may be affected.

HISTORICAL/AESTHETIC AND CULTURAL VALUES

29a. Are there any sites/objects on the right of way for the proposed project that are preserved/ to be preserved for any historical, religious and/or tour reasons?

1 Yes 2 No

29b If yes what are these sites/objects, and what historical/religious/cultural events do the sites mark?

30 If there are any shrines to be affected by the ROW, can they be relocated?

1 Yes 2 No

30c If the shrines can be relocated, what rites need to be performed for the relocation?

31 Are there any sites that you consider attractive enough for tourism, that can be affected by the proposed ROW?

1 Yes 2. No.

32 If there are any sites for tourist attraction, what are these sites and what makes the site/scene attractive?

33 Are there any cultural events that attract or has the potential of attracting tourists to the community eg. Festival etc.?

1. Yes 2. No.

34. If yes, in which ways can the construction of the ROW affect the events negatively and/or positively.

EMPLOYMENT

35. What are the jobs/work that people do in the community?

1. Farming
2 Construction
3.Industry
4.Trading
5.Public/civil service
Other (specify).....

36 Who are the main employers in the community?

1 Self- employment
2 Private employers
3 Government
Other (specify).....

37 What significant changes have you observed in employment situation in the community for the past ten years? And what brought about those changes?

38 How do you think the proposed project can bring about changes in employment situation in the community?

PUBLIC HEALTH

39. Which are the common illnesses in this community?
11. Malaria/fever
12. Headache
13. Bodily pains
14 Stomach problems
15 Other (specify).....

40. What are the causes of these illnesses the community?

41. What illnesses/diseases do you personally usually suffer from?

42. How do the people treat illnesses/sicknesses in this community?
(Where and what do they use)
1. Chemical/Drug store
2. Pharmacy
3. Herbalist/Traditional
4. Hospital/Health Center/Clinic
5. Drug hawkers
Other (specify).....

43. Which treatment types do you use when you are sick/ill?

44. Mention two of the treatment types that are most common in the community and why?

1

2

45. Which of the following health facilities do you have in the community

1 Chemical/Drug store
2 Pharmacy
3 Herbalist/Traditional
4 Hospital/Health Center/Clinic
5 Drug hawkers
Other (specify)

46. What significant changes have you observed in health/illness situation in the community for the past ten years and why that change?

47. Do you think the proposed transmission of electricity power through your community can bring any diseases/illnesses, or does the project poses any health danger to people in the community?. 1. Yes 2. No.

48. Give reason(s) for your answer.....

49. What are your general comments about and recommendations for the proposed transmission line through your community.

a Comments

b Recommendations

BUILDING COMPENSATION

OWNER	LOCATION	PILLARS/DISTANCE FROM ATP (KM)	DESCRIPTION OF PROPERTY	AREA (SQ.FT)	DEPRECIATED REPLACEMENT VALUE ¢
Idrusu Zakari	Kwesi Kwaa Village	34 - 35	Single storey swish building	260 00	4,914,000 00
		15 833 - 19 833 km			**4,914,000.00**
Francis Mensah	Ayensudo Town		Single storey sandcrete block building (uncompleted)	6,101.00	204,481,116 00
Elder Baah Church of Pentecost	Ayensudo Village	58 - 59	Single storey bamboo building	936.00	8,373,456 00
Uncle Ackon H/No. A27/2	Ayensudo Village	28 833 - 31 833 km	Single storey swish building	144.00	2,721,600 00
Uncle Ackon H/No. A27/3	Ayensudo Village		Penstock (swish)	35.00	485,100 00
Papa Kweku Mensah	Ayensudo Village		Single wattle and daub building (kitchen)	132.00	287,595 00
Papa Kweku Mensah	Ayensudo Village		Penstock (bamboo)	100.00	217,875 00
Kweku Gyaka H/No. A28/2	Ayensudo Village		Single storey swish building	143.00	2,342,340 00
Kweku Gyaka H/No. A28/2	Ayensudo Village		Penstock uncompleted (bamboo)	156 00	815,724 00
Mena Ekua Enketiaba H/No. A30/2	Ayensudo Village		Single storey swish building	314.00	5,143,320.00
Madam Maami Aba Dede H/No. A/30A/2	Ayensudo Village		Single landcrete block building	132.00	5,405,400 00
Madam Maami Aba Dede H/No. A/30A/2	Ayensudo Village		Single storey sandcrete block building	708.00	53,524,800 00
Atta Peters H/No. A31A/2	Ayensudo Village		Single storey landcrete block building	723.00	42,512,400.00
Atta Peters H/No. A31A/2	Ayensudo Village		Penstock (with bamboo roof)	875.00	9,132,375 00
Kwame Asiifi H/No.A29/2	Ayensudo Village		Single storey landcrete block building	156.00	6,388,200 00
Abena Kyintor	Ayensudo Village		Single storey swish block building	273.00	5,159,700.00
Atom Kwabena H/No. A 58/2	Ayensudo Village		Single wattle and daub building (kitchen)	143.00	747,747.00
Kow Awotwey	Ayensudo Village		Single landcrete block building	132.00	5,405,400 00
Nyame Yadom H/No. 096	Ayensudo Village		Single landcrete block building	319.00	13,063,050.00
Opanyin Kweku Awotwey	Ayensudo Village		Single landcrete block building	654.00	35,708,400.00
Maame Aya Anoa	Ayensudo Village		Single sandcrete block (pigsty)	510.00	14,779,800 00
Kobina Nkum	Ayensudo Village		Single storey swish building	120.00	2,268,000.00
Kobina Nkum	Ayensudo Village		Single storey swish building (kitchen)	108.00	1,769,040 00
TOTAL					**420,732,438.00**
KEEA Sewerage Disposal Site	Atabadze	64 - 69/121	Single storey sandcrete block building (Good)	654.00	51,030,000 00
		31 833 - 35 363 km			
TOTAL					**51,030,000.00**
Mobarac Olaba	Abura Edukrom Village	133 - 146	Single storey sandcrete block building (uncompleted)	480.00	12,337,920 00
Ibrahim Sunday	Abura Edukrom Village	51-852 - 55.833 km	Single storey swish building (uncompleted)	451.00	2,898,126.00
Ibrahim Seidu	Abura Edukrom Village		Single storey brick building	130.00	4,144,140.00
Kofi Nuhu	Abura Edukrom Village		Single storey brick building	293.00	9,340,254.00
Efua Abokuma	Abura Edukrom Village		Single storey swish building (delapidated)	240.00	3,931,200.00
Kojo Ntsie	Abura Edukrom Village		Single storey swish building	160.00	3,024,000 00

Prepared By Messrs PROPICON

OWNER	LOCATION	PILLARS/DISTANCE FROM ATP (KM)	DESCRIPTION OF PROPERTY	AREA (SQ.FT)	DEPRECIATED REPLACEMENT VALUE ¢
Community Toilet	Abura Edukrom Village		Single storey sandcrete block building	193.00	15,401,400.00
Kofi Adu	Abura Edukrom Village		Single storey landcrete block building	154.00	6,306,300.00
Uncle Kobina Essoun	Abura Edukrom Village		Single storey landcrete block building	162.00	6,633,900.00
TOTAL					64,017,240.00
Kwame Fynn	Asafora	151 - 157A	Single storey landcrete block building (Fair)	185.00	5,985,000.00
Kobina Ntsiful	Asafora	59.856 - 63.835 km	Single storey landcrete block building (Fair)	234.00	7,035,000.00
Kwame Brebo	Asafora		Single storey landcrete block building (Poor)	100.00	3,990,000.00
Kwesi Adumadzi	Asafora		Single storey sandcrete block building (Uncompleted)	1,227.00	13,650,000.00
Esi Beduah	Asafora		Single storey burnt brick building (Fair)	859.00	28,875,000.00
Elizabeth Amissah	Asafora		Single swish building (Fair)	385.00	13,755,000.00
Francis Aidoo	Asafora		Single storey landcrete building (Fair)	208.00	5,250,000.00
Kofi Amponsah	Asafora		Single storey landcrete building (Fair)	346.00	7,140,000.00
James Kojo Amakye	Asafora		Single storey sandcrete block building (Fair)	1,035.00	34,230,000.00
Kobina Dadzie	Asafora		Single swish building (Fair)	372.00	7,980,000.00
Kofi Boison	Asafora		Single storey landcrete building (Fair)	473.00	11,445,000.00
Alaba Kakraba	Asafora		Single storey swish building (Fair)	154.00	4,515,000.00
Anthony Tsikwah	Asafora		Single storey swish building (Fair)	712.00	14,794,500.00
Esi Esaaba	Asafora		Single storey sandcrete block building (Good)	2,021.00	227,430,000.00
Kofi Anyanya	Asafora		Single storey swish building (Fair)	1,454.00	33,075,000.00
Alaba Atta	Asafora		Single storey sandcrete and landcrete building		
	Asafora		(Fairly Good)	1,657.00	67,305,000.00
Kofi Ntsiful	Asafora		Single storey swish building (Fair)	391.00	10,290,000.00
Bentsil	Asafora		Single storey swish building (Fair)	324.00	8,925,000.00
TOTAL					505,669,500.00
Yaw Mensah	Ewuoyaa Village	195A - 199A	S/S Wattle and duab (not rendered)	372.00	6,665,400.00
		75.838 - 79.842 km			
TOTAL					6,665,400.00
Ghana Muslim Mission (H'master's Bung.)	Mankessim	200A - 205A	Single storey sandcrete block building (Fairly Good)	593.00	35,175,000.00
Esi Kwakwah	Mankessim	79.842 - 83.839 km	Single storey sandcrete block building (Uncompleted)	1,397.00	43,995,000.00
Joseph K. Taylor	Mankessim		Single storey sandcrete block building (Fairly Good)	1,244.00	65,310,000.00
Abayaa Penyin	Mankessim		Wooden Kiosk (Poor)	75.00	236,250.00
Opanyin Afanyi	Mankessim		Single storey wooden structure	362.00	6,615,000.00
Stephen Okwan	Mankessim		Single storey sandcrete block building (Good)	5,688.00	245,700,000.00
John Kweku Eyison (Toppers Club)	Mankessim		Single storey wooden structure	2,386.00	40,950,000.00

OWNER	LOCATION	PILLARS/DISTANCE FROM ATP (KM)	DESCRIPTION OF PROPERTY	AREA (SQ.FT)	DEPRECIATED REPLACEMENT VALUE ¢
Minatex I.T.C. Ltd (LPG Retail Service Stn	Mankessim		Single storey block structure (Good)	103.00	30,870,000 00
Joana Otaboah	Mankessim		Single storey sandcrete block building (Fiarly Good)	1,245.00	69,615,000 00
Dzea Onyim	Mankessim		Single storey sandcrete block building (New)	312 00	23,310,000.00
Joana Essel	Mankessim		Single storey sandcrete block building (Good)	1,861.66	110,040,000 00
Kwesi Otseba	Mankessim		Single storey sandcrete block building (Good)	1,297.00	64,470,000 00
Joseph P. K. Mensah	Mankessim		Single storey sandcrete block building (Uncompleted)	2,083.00	107,520,000.00
Joseph Nsodoo	Mankessim		Single storey sandcrete block building (uncompleted)	3,853.00	112,140,000 00
	Mankessim				-
Isha Adwoa Menu	Mankessim		Single storey sandcrete block buiding and wattle &		-
	Mankessim		duab (Fairly Good)	2,083.00	99,540,000.00
Opanyin Kojo Kyere	Mankessim		Single storey sandcrete block building (Fair)	746.00	36,225,000 00
Kobina Emintsin	Mankessim		Single storey sandcrete block building (Fair)	760.00	39,165,000.00
C. Koomson	Mankessim		Single storey sandcrete block building (Uncompleted)	1,501.00	48,615,000.00
Felicia Ahiagbedey	Mankessim		Single storey sandcrete block building (Good)	2,010.00	305,130,000.00
Madam Gifty Forson	Mankessim		Single storey sandcrete block building (Uncompleted)	3,364.75	44,100,000.00
TOTAL					**1,528,721,250.00**
Twelve Apostles Church	Kwaakrom Village	206A - 211A	Single storey swish building	370.00	6,993,000 00
Twelve Apostles Church	Kwaakrom Village	83.839 - 87.836 km	Holy Pulpit	350.00	4,851,000.00
Adwoa Haruna	Kwaakrom Village		Single storey swish building	180.00	3,175,200 00
Adwoa Haruna	Kwaakrom Village		Penstock (swish)	140.00	1,940,400.00
Nana Attah	Kwaakrom Village		Single storey sandcrete block building	120.00	6,048,000.00
Kweku Ahinakwah	Kwaakrom Village		Single storey sandcrete block building	130.00	6,552,000 00
Kwame Essoh	Kwaakrom Village		Single storey brick building	240.00	7,197,120.00
Alex Eshon	Kwaakrom Village		Single storey swish building	140.00	2,646,000.00
Kobina Ntsin	Kwaakrom Village		Single storey landcrete block building	165.00	6,756,750.00
Kwame Essandoh H/No. ABLK/53	Kwaakrom Village		Single storey swish building	264.00	4,989,600.00
Francis Kwakwah	Kwaakrom Village		Single storey swish building	168.00	3,175,200 00
TOTAL					**54,324,270.00**
Isaac Aidoo	Ekumfi Ekotsi	218 - 224	Single storey sandcrete block building (Fair)	2,236.00	93,975,000 00
Amba Oduwa	Ekumfi Ekotsi	83.839 - 87.836 km	Single storey sandcrete block building (Fairly Good)	502.00	25,305,000 00
TOTAL					**119,280,000.00**
Kwame Egyir	Ankamu	256A - 263A	Single storey sandcrete block building (Fair)	1,599.00	58,275,000 00
Thomas Cofie	Ankamu	111.874 - 115.861 km	Single storey sandcrete block building (Fairly Good)	4,663.33	153,930,000 00
Kojo Appiah	Ankamu		Single storey sandcrete block building (Fair)	1,250.00	55,545,000 00

Prepared By Messrs PRODICON

BUILDING COMPENSATION

OWNER	LOCATION	PILLARS/DISTANCE FROM ATP (KM)	DESCRIPTION OF PROPERTY	AREA (SQ.FT)	DEPRECIATED REPLACEMENT VALUE ¢
Peter Essandoh	Ankamu	-	Single storey sandcrete block building	608.00	30,450,000 00
J. K. Odu	Ankamu	-	Single storeysandcrete block building	1,327.00	73,605,000 00
TOTAL					**371,805,000.00**
Agbega Kofi	Domiabra Village	50 - 56	Single storey wattle and daub	223.00	1,404,900 00
		23.833 - 27.833km			
TOTAL					**1,404,900.00**
Samuel Biney	Potsin Village	308 - 313B	Single storey sandcrete block building	2,189.00	96,534,900 00
TOTAL					**96,534,900.00**
Spio Gabra Ekow	Musakrom - Potsin Nkwanta	308 - 318B	S/S Odum Building with mass concrete floors	561.00	24,493,770.00
Spio Gabra Ekow	Musakrom - Potsin Nkwanta	131.845 - 135.833 km	Barn - Rafia Palm	465.00	11,193,000 00
Spio Gabra Ekow	Musakrom - Potsin Nkwanta		Coop - Odum	600.00	-
TOTAL					**35,686,770.00**
Mr. Mills (Emill Farms)	Dankyira	368 - 369	Single storey sandcrete block factory building	2,045.00	67,638,375 00
TOTAL					**67,638,375.00**
Joseph Ahwiren (Osofo)	Nsakinaa Village	375 - 377A	Single storey sandcrete block building(roofing level)	1,345.00	46,957,312 50
Idrusu Ayata	Nsakinaa Village	171.851 - 175.840 km	Single storey sandcrete block building	302.00	15,220,800 00
Unknown (Repd. by Douglas Quaye)	Nsakinaa Village		Single storey sandcrete block building(foundation)	2,260.00	45,087,000.00
Unknown	Nsakinaa Village		Single storey sandcrete block building(roofing level)	195.00	6,807,937.50
Armaatse Argyin	Nsakinaa Village		Single storey sandcrete block building(roofing level)	3,445.00	101,283,000.00
Auntie Mercy	Nsakinaa Village		Single storey sandcrete block building	6,041.00	256,893,525.00
Auntie Akweley	Nsakinaa Village		Single storey sandcrete block building	1,124.00	49,568,400 00
TOTAL					**521,817,975.00**
Agbo Deka	Pokuase	378 - 383	Single storey swish building	192.00	4,233,600 00
Kwedwo Atsu	Pokuase	179.842 - 183.859 km	Single storey wattle and daub	90.00	1,512,000 00
Joyce Andoh	Pokuase		Single storey swish building	393.00	8,665,650 00
Unknown	Pokuase Town	378Q - 383	Carpentary workshop with store	220.35	11,347,350.00
		179.842 - 183.859 km			
TOTAL					**25,758,600.00**

Prepared By Messrs PROPICON

330KV ABOADZE - VOLTA TRANSMISSION LINE PROJECT
BUILDING COMPENSATION

OWNER	LOCATION	PILLARS/DISTANCE FROM ATP (KM)	DESCRIPTION OF PROPERTY	AREA (SQ.FT)	DEPRECIATED REPLACEMENT VALUE ¢
Nii Korley Joseph	Abokobi - Seseme Village	390 - 395	S/S Sandcrete block buildin(roofing & foundation)	360.00	34,694,184.00
Nii Korley Joseph	Abokobi - Seseme Village	187.874 - 191.887km	Water tank	48.00	-
Henry Kuorno	Abokobi - Seseme Village		S/S Sandcrete building (foundation)	144.00	18,178,440.00
Alex Okunor	Abokobi - Seseme Village		S/S Sandcrete building (roofing stage)	1,439.00	112,207,126.50
Naai Abbey	Abokobi - Seseme Village		S/S Sandcrete block building (foundation level)	83.85	13,958,367.15
Robert Dowuna	Abokobi - Seseme Village		S/S Sandcrete block building (roofing stage)	825.55	67,846,410.45
Christiana Abbey	Abokobi - Seseme Village		S/S Sandcrete block building (roofing stage)	129.60	17,158,596.00
TOTAL					**264,043,124.10**
Community Borehole Pumping pipe	Ga - Odumase	375 - 377	Pipe stand	225.00	5,315,625.00
Nii Nortey Theo	Ga - Odumase	171.851 - 175.840 km	Single storey sandcrete block building(roofing level)	1,623.00	61,349,400.00
Unknown	Ga - Odumase		Single storey landcrete block building	195.00	7,371,000.00
TOTAL					**74,036,025.00**
Francis Okine	Odumase Village	375 - 377A	Single storey sandcrete block building	979.00	49,341,600.00
Community Pumping Pipe	Odumase Village	171 - 175 Km	Pipe stand	225.00	5,315,625.00
Sonny Asomani	Odumase Village		Single storey sandcrete block building	3,376.00	127,612,800.00
Kweku Asameni	Odumase Village		Single storey sandcrete block building	1,224.00	46,267,200.00
Ashie Asomani	Odumase Village		Single storey sandcrete block building	595.00	22,491,000.00
TOTAL					**251,028,225.00**

Prepared By Messrs PROPICON

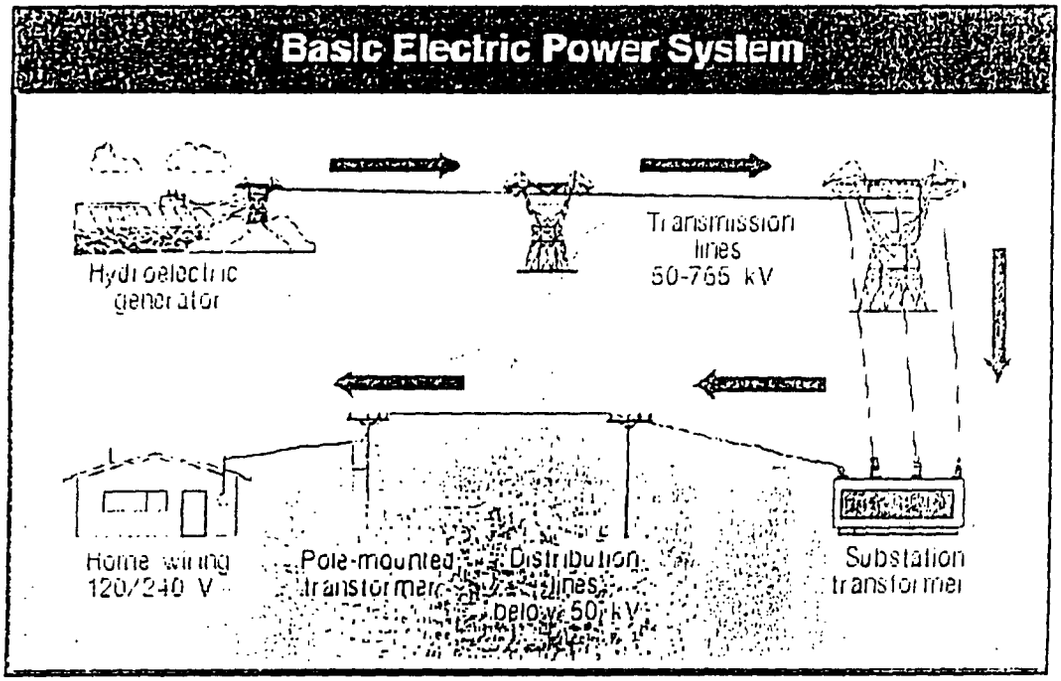
ANNEX 4

EMF INFORMATION

OTHER TECHNICAL DATA

Minnesota Department of Health

Environmental Health in Minnesota



Return to > EMF Home page.

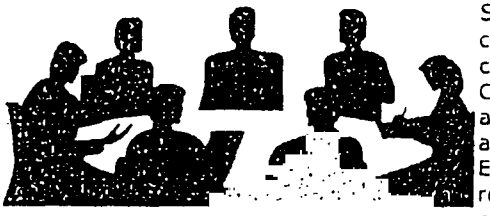
{contact us}

Minnesota Department of Health
Environmental Health Division
Suite 220
121 East Seventh Place
St Paul, Minnesota 55164-0975

Updated Sunday, 13-Oct-02 08:50:49

Conclusions of Scientific EMF Review Committees

printer-friendly document



Several scientific committees have been convened by the US Congress, and federal and international health agencies to evaluate EMF health effects research. These committees have included researchers with expertise in a wide variety of disciplines (e.g., epidemiology, cellular biology, biostatistics, and risk and exposure assessment). The following are brief descriptions of each review, followed by the committees' conclusions.

- American Physical Society
- National Research Council
- National Institute of Environmental Health Sciences
- Institute of Electrical and Electronics Engineers, Committee on Man and Radiation
- British National Radiological Protection Board
- International Agency for Research on Cancer
- Health Council of the Netherlands
- Japan EMF Research Program

American Physical Society (1995)

In 1995 the American Physical Society (APS), which is a national professional organization of US physical scientists, developed a position statement about EMF.

Statement: "Physicists are frequently asked to comment on the potential dangers of cancer from electromagnetic fields that emanate from common power lines and electrical appliances. While recognizing that the connection between power line fields and cancer is an area of continuing study by research workers in many disciplines in the United States and abroad, we believe that it is possible to make several observations based on the scientific evidence at this time. We also believe that, in the interest of making the best use of the finite resources available for environmental research and mitigation, it is important for professional organizations to comment on this issue.

The scientific literature and the reports of reviews by other panels show no consistent, significant link between cancer and power line fields. This literature includes epidemiological studies, research on biological systems, and analyses of theoretical interaction mechanisms. No plausible biophysical mechanisms for the systematic initiation or promotion of cancer by these power line fields have been identified. Furthermore, the preponderance of the epidemiological and biophysical/biological research findings have failed to substantiate those studies which have reported specific adverse health effects from exposure to such fields. While it is impossible to prove that no deleterious health effects occur from exposure to any environmental factor, it is necessary to demonstrate a consistent, significant, and causal relationship before one can conclude that such effects do occur. From this standpoint, the conjectures relating cancer to power line fields have not been scientifically substantiated.

These unsubstantiated claims, however, have generated fears of power lines in some communities, leading to expensive mitigation efforts and, in some cases, to lengthy and divisive court proceedings. The costs of mitigation and litigation relating to the power line/cancer connection have risen into the billions of dollars and threaten to go much higher. The diversion of these resources to eliminate a threat which has no persuasive scientific basis is disturbing to us. More serious environmental problems are neglected for lack of funding and public attention, and the burden of cost placed on the American public is incommensurate with risk, if any."

Go to > top.

National Research Council (1997)

In 1991 the National Research Council convened an expert committee with experience in several scientific disciplines. The committee reviewed and evaluated the existing scientific information on the possible effects of exposure to electric and magnetic fields on the incidence of cancer, on reproduction and developmental abnormalities, and on neurobiologic response, as reflected in learning and behavior. The committee summarized the following conclusions in their 1997 report, "Possible Health Effects of Exposure to Residential Electric and Magnetic Fields."

Conclusions: "Based on a comprehensive evaluation of published studies relating to the effects of power frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive developmental effects.

The committee reviewed residential exposure levels to electric and magnetic fields, evaluated the available epidemiologic studies, and examined laboratory investigations that used cells, isolated tissues, and animals. At exposure levels well above those normally encountered in residences, electric and magnetic fields can produce biologic effects (promotion of bone healing is an example), but these effects do not provide a consistent picture of a relationship between the biological effects of these fields and health hazards. An association between residential wiring configurations (called wire codes) and childhood leukemia persists in multiple studies, although the causative factor responsible for that statistical association has not been identified. No evidence links contemporary measurements of magnetic field levels to childhood leukemia."

Go to > top.

National Institute of Environmental Health Sciences (1999)

In 1992 the US Congress instructed the National Institute of Environmental Health Sciences (NIEHS) to direct a program of research and analysis to evaluate the potential for health risks from EMF exposure. In 1999 the NIEHS released their report, "Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields."

Conclusions: "The scientific evidence suggesting that ELF [extremely low frequency] EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. While the support from individual studies is weak, the epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of

small increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia. In contrast, the mechanistic studies and the animal toxicology literature fail to demonstrate any consistent pattern across studies although sporadic findings of biological effects (including increased cancers in animals) have been reported. No indication of increased leukemias in experimental animals has been observed.

The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the "right" species, are tied to "real life" exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF EMF has been identified.

Epidemiological studies have serious limitation in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF EMF at environmental levels and changes in biological function or disease status. The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF EMF, but cannot completely discount the epidemiological findings.

The NIEHS concludes that ELF EMF exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of risk to currently warrant concern."

The US Congress directed the National Research Council to conduct a follow-up evaluation of the NIEHS EMF RAPID Program (NRC, 1999). In 1999, the NRC determined that the NIEHS research leaves the 1997 NRC conclusions "essentially unchanged from their most recent (1997) review."

Go to > top.

Institute of Electrical and Electronics Engineers, Committee on Man and Radiation (1999)

In 1999 the Institute of Electrical and Electronics Engineers, Engineering in Medicine and Biology Society convened the Committee on Man and Radiation (COMAR). This committee included experts on health and safety issues related to electromagnetic fields, from power line through microwave frequency ranges. The committee issued a technical position statement with their conclusions.

Conclusions: "In recent years concerns have been raised about the biological effects of exposure to electric and magnetic fields at extremely low frequencies (ELF), particularly those associated with the distribution and utilization of electric power. In 1989, the Institute of Electrical and Electronics Engineers (IEEE) issued an "Entity Position Statement" which stated that "there is not enough relevant scientific data to establish whether common exposure to power-frequency fields should be considered a health hazard" and that "there is general agreement that more research is needed to define safe limits of human exposure to power-frequency fields." After examination of

relevant research reports published during the last ten years, COMAR concludes that it is highly unlikely that health problems can be associated with average 24-hour field exposure to power frequency magnetic fields of less than 1 microT (10 mG). Good laboratory evidence shows that magnetic fields 100 to 10,000 times higher than this level, either ELF sinusoidal or pulsed, can induce a variety of biological effects, including beneficial health effects such as bone or tissue healing. Many of the reports of effects of weaker fields should be considered preliminary, as some observations have not been reproduced in different laboratories, while others, observed in cells, have not been clearly connected to effects in intact animals. Also, the means of interaction of low-level ELF fields with cells, tissues or laboratory animals is not fully understood; therefore the health impacts of such weak fields on intact animals and humans, if any, cannot be predicted or explained. Further research is needed to confirm or negate reports of effects of weak fields, and to determine mechanisms and relevance of these effects to actual health hazards. Continued study in this complicated area will enhance our understanding of biological systems, as well as help identify levels and types of ELF exposure that may be deleterious to human health."

Go to > top.

British National Radiological Protection Board (Advisory Group on Non-Ionizing Radiation) (2001)

In March 2001, the British National Radiological Protection Board , Advisory Group on Non-Ionizing Radiation, conducted an extensive review of the EMF research. The group was chaired by Sir Richard Doll, who is a world recognized expert in cancer research and epidemiology.

Conclusions: "Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general. There is, however, some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukaemia in children. In practice, such levels of exposure are seldom encountered by the general public in the UK [United Kingdom]. In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify a firm conclusion that such fields cause leukaemia in children. Unless, however, further research indicates that the finding is due to chance or some currently unrecognized artifact, the possibility remains that intense and prolonged exposures to magnetic fields can increase the risk of leukemia in children."

Go to > top.

International Agency for Research on Cancer (2001)

In June 2001, the International Agency for Research on Cancer convened a meeting of 21 scientific experts from 10 countries to evaluate possible carcinogenic hazards to humans from exposures to EMF.

Conclusions: "Since the first report suggesting an association between residential electric and magnetic fields and childhood cancer, notably leukemia, was published in 1979, dozens of studies have examined this association. Overall, for the vast majority of children who are exposed to residential ELF [extremely low frequency] magnetic fields less than 0.4 microtesla [4

milligauss], there is little evidence of any increased risk for leukemia. There is no evidence that electric fields are associated with childhood leukemia, and there is no consistent relationship between childhood brain tumors and residential ELF electric and magnetic fields. However, pooled analyses of data from a number of well conducted studies show a fairly consistent statistical association between childhood leukemia and power-frequency residential magnetic field strengths above 0.4 microtesla, with an approximately two-fold increase in risk. This is unlikely to be due to chance, but may be affected by selection bias. Therefore, this association between childhood leukemia and high residential magnetic field strengths was judged limited evidence for excess cancer risk in exposed humans.

There is no consistent evidence that residential or occupational exposures of adults are related to excess risks of cancer at any site [in the body], although in one Swedish study combined residential and occupational exposures were associated with a significantly increased risk for leukemia subtypes except chronic lymphocytic leukemia. Evidence for excess cancer risks of all other kinds, in children and in adults, as a result of exposure to ELF electric and magnetic fields was considered inadequate.

Numerous studies to investigate carcinogenicity of magnetic fields have been conducted in experimental animals. These have included long-term bioassays of exposures to magnetic fields alone, and exposures of rats and mice to magnetic fields in combination with known carcinogens. Bioassays of magnetic fields alone generally were negative, although one study that was conducted in both mice and rats of both sexes showed non-exposure related increases in thyroid C-cell tumors in male rats only. Multistage carcinogenesis studies showed no consistent enhancement of chemically initiated mammary tumors in rats or of skin tumors in mice. Magnetic fields had no effects on the incidence of chemically initiated liver tumors in rats or of leukemia/lymphoma in mice or rats. Overall, evidence of carciongenicity of ELF magnetic fields in experimental animals was judged inadequate. No data on carciongenicity to animals of static magnetic fields, or of static or ELF electric fields, were available to the working group.

Although many hypotheses have been put forward to explain possible carcinogenic effects of ELF electric or magnetic fields, no scientific explanation for carciongenicity of these fields has been established.

Overall, extremely low frequency magnetic fields were evaluated as possibly carcinogenic to humans (Group 2B), based on the statistical association of higher level residential ELF magnetic fields and increased risks for childhood leukemia. Static magnetic fields and static and extremely low frequency electric fields could not be classified as to carcinogenicity to humans (Group 3)."

*[Note that the term "possible carcinogen" is the lowest IARC category for chemicals or agents which have been determined to have the potential to cause cancer (i.e., scientists cannot completely dismiss the possibility that EMF causes cancer even though the evidence is weak].

Go to > top.

Health Council of the Netherlands (2001)

In May 2001 the Health Council of the Netherlands, Electromagnetic Fields Committee, completed an annual review of the research on possible health effects of exposure to electromagnetic fields. This review included several recently published EMF studies.

Conclusions: "The committee concludes that these recent meta-analyses show a consistent association between relatively high measured or calculated magnetic field strengths and an increased risk of childhood leukemia. However, from an

epidemiological point of view, an association with a relative risk of smaller than 2 is to be considered weak. Furthermore, the committee does not think that either 0.3 uT [3 mG] or 0.4 uT [4 mG] should be regarded as a definite threshold field strength, above which the risk is suddenly increased. This view is based upon the belief that it is not appropriate to consider measured and calculated fields strengths in the same light. Where researchers have obtained field strength data by measurement, the contributions made by all sources inside and outside the home are taken into account, with the result that the study data is reasonably consistent with overall exposure. Where calculated data is used, however, only the strength of the field generated by a single external source (typically a high voltage power line) is considered. In studies using calculated field strength data actual exposure is therefore underestimated. Furthermore, it is apparent from research carried out in the UK and elsewhere that in a large proportion of homes where relatively high field strengths occur, the fields are not primarily attributable to external sources such as high-voltage power lines (Day 99).

The committee would emphasise that there is no known mechanism that could account for the association referred to above. Because the association is only weak and with out a reasonable biological explanation, it is not unlikely that it could also be explained by chance or by an artefact. The committee therefore sees no reason to modify its earlier conclusion that the association is not likely to be indicative of a causal relationship.

It therefore remains the committee's belief that it is not likely that children (or adults) living near to high-voltage power lines are at risk through exposure to electromagnetic fields generated by those lines. This view is consistent with that of the Advisory Group on Non-ionising Radiation - a committee of the UK's National Radiological Protection Board, chaired by Sir Richard Doll - as published in early March 2001."

Go to > top.

Japan EMF Research Program (2001)

In the 1990's Japan conducted an EMF research program comparable in scope and magnitude to the NIEHS EMF RAPID program. The focus of this program was laboratory (i.e., in vitro, in vivo) testing for possible cancer effects (e.g., changes in gene expression; increased risks for tumors in animals). In 2001 the results of this research program were published in the book, "Biological and Health Effects from Exposure to Power-Line Frequency Electromagnetic Fields: Confirmation of Absence of Any Effects at Environmental Field Strengths."

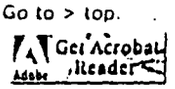
Conclusions: "By the middle of 1999, as mentioned in the EMF RAPID report, there was little evidence for any adverse health effects from EMF exposure. About half of the epidemiological studies have suggested possible health effects, but almost all of the experimental studies with animals have been negative. Thus it appears there is little possibility of finding new adverse health effects from EMF in the future. Very high intensity EMF can have certain biological effects, but they occur only with EMF more than 10,000 times higher than those found in real-world environments. Furthermore, even with the biological indicator which gave the positive results with 400 mT [4,000,000 milligauss] for 1 hour, elongated exposure with 5 mT [50,000 milligauss] for 6 weeks did not yield any effect. We conclude that adverse human health effects as a result of environmental power-frequency EMF either do not occur or that they are undetectable because they occur so rarely they cannot be separated by other processes."

> **Note:** In a new 2002 study, Japanese researchers have reported finding a weak association between magnetic fields and childhood leukemia. These results are considered preliminary until a final report is published, and a careful analysis of the study's methods is conducted.

Results of this study should be viewed in the context of the widely acknowledged limitations of epidemiological studies and the lack of supporting evidence that magnetic fields cause leukemia or other adverse health effects in animals - even at high levels of exposure.

The Minnesota Department of Health will continue to track important EMF research developments in Japan, the United States, and other parts of the world, including the current scientific review being conducted by the World Health Organization.

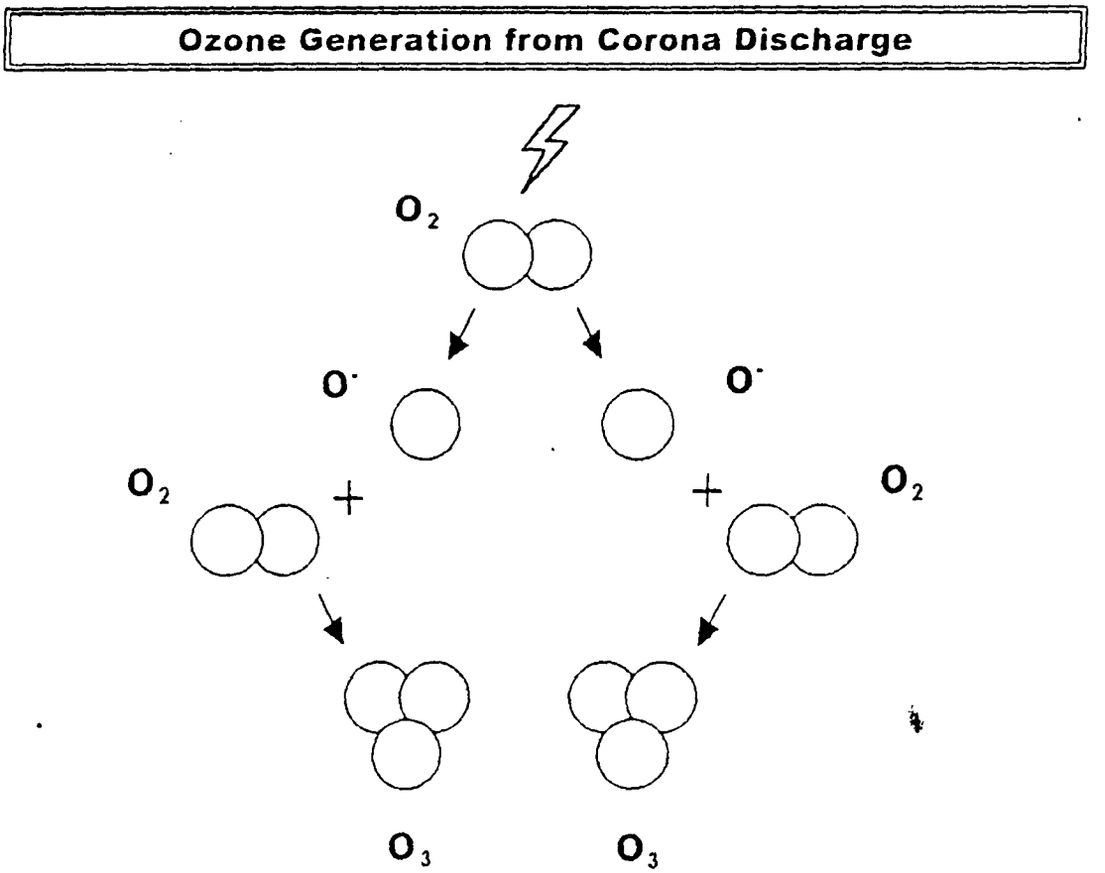
Go to > top.



To view PDF files you will need Adobe Acrobat Reader (free download from Adobe Web site.)

For questions about this page, please contact our Environmental Health Division:
chweb@health.state.mn.us
See also > Environmental Health Home

How Ozone is Created:



An electrical discharge splits the oxygen molecule into two oxygen atoms. These unstable oxygen atoms have excess electrons and combine with other oxygen molecules to lower their energy state. This combination forms ozone. Ozone is also unstable and reacts with other gases changing their molecular structure.

Home | About Us | Information | Interesting Links

Content on this page supplied from the web site of Jim Lux

Corona

Corona is caused by the electric field next to an object exceeding the breakdown value for air (or whatever it is immersed in). Since the magnitude of the field is inversely proportional to the radius of curvature, sharper edges break down sooner. The corona starting voltage is typically 30 kV/cm radius. Dust or water particles on the surface of the object reduce the corona starting voltage, probably by providing local areas of tighter curvature, and hence higher field stress.

The easiest case to analyze is that of a sphere. The magnitude of the electric field at the surface of a sphere in free space is simply the voltage/radius. Note that if the sphere is near another conductor, the field is no longer uniform, as the charge will redistribute itself towards an adjacent conductor, increasing the field.

Since corona is fundamentally a breakdown phenomenon, it follows Paschen's law the voltage is a function of *pd*. Double all the dimensions and halve the gas pressure, and the corona voltage will be pretty much the same.

Corona Surface Factor

The following table gives empirically determined correction factors for various surface conditions. These factors are multiplied by the corona starting voltage (or field) to determine the corrected voltage.

Condition of Conductor	m0
New, unwashed	0.67-0.74
Washed with grease solvent	0.91-0.93
Scratch-brushed	0.88
Buffed	1.00
Dragged and dusty	0.72-0.75
Weathered (5 months)	0.95
Weathered at low humidity	0.92
For general design	0.87-0.90
7 strand concentric lay cable	0 83-0.87
19, 37, and 61 strand concentric lay cable	0.80-0.85

Source. Cobine, p278 quoting W.S. Peterson, *AIEE Trans*, 52, 62, 1933

Eliminating or reducing corona

Smoothly radiusing the corners of objects at high voltages relative to nearby objects will reduce the local field strength.

Put the sharp corner in something with a higher breakdown strength than air. The trick here is to make sure that you have really got the replacement substance in contact with the conductor. By

making the high field occur within a substance with a higher breakdown than the surrounding air, corona can be reduced.

Covering sharp corners with an insulating film increases the corona starting voltage at the points with high E-field stress. Generically known as "corona dope", this is an enamel or polystyrene paints or gels that you can apply. Glyptal is one example, and clear nail polish has also been used. Clear acrylic spray paint is another alternative, although the coating is quite thin.

Potting the entire assembly in an insulator (traditionally paraffin or sulfur were used, silicone RTV is a more popular modern alternative) achieves the same result. Immersing the assembly in oil or other insulating fluids will also work. All of the potting and immersion techniques depend on removing the air or gas bubbles to work. Commercial manufacturers pull a vacuum on the container while the assembly is being potted to facilitate the removal of the air bubbles. Experimenters building polyethylene and aluminum foil capacitors for tesla coils run them at low powers using the electrostatic forces between the plates to vibrate and pump the air bubbles out.

A popular approach to reducing corona on wires is to surrounding the conductor by a semiconducting film or layer of greater radius. This effectively increases the radius of the object, and hence lowers the field strength. You may not need a huge amount of copper to carry the required current (often micro or milliamps), but you want the diameter of the conductor large enough to reduce the corona. Wire of this type is manufactured by Belden, Rowe-Talley, and Caton, among others.

Field grading rings are often used on high voltage equipment to control the electric field distribution Rather than rely the field that would exist in free space between two charged conductors, a series of other conductors are interposed at intermediate voltages. The intermediate voltages are derived from a capacitive or resistive divider. A capacitive divider may be a simple as the interelectrode capacitances of the grading rings themselves.

Running the system in a tank at high pressure, or in an insulating gas, will increase the corona starting voltage

Main Links Directory

Subscribe to energy2000

Electromagnetic Interference, Shielding, Earthing and Electrical Safety

The space we live in is so full of electromagnetic (EM) waves that it is little wonder that they interfere with each other. Sunlight, radio and television waves are useful, but the waves radiated and conducted from lightning and switching arcs and sparks are not. Also there is still uncertainty about the long-term effects on the human body of the EM radiations from some of our most common aids to modern living, such as electric power transmission lines and even microwave ovens. The latter are now designed with shielding for radiation.

Sources of Unwanted EM Radiation

- Lightning
- Switching of electric circuits, including large circuit breakers
- Sparking of commutators e.g. the universal motors of vacuum cleaners
- Distributors in car ignition systems
- Arcing of welding equipment in workshops and factories
- Rectifiers and wave chopping circuits
- Large transformers
- Traffic lights

Transmission of EM Waves

There are two broad classifications of transmission EM waves:

Guided

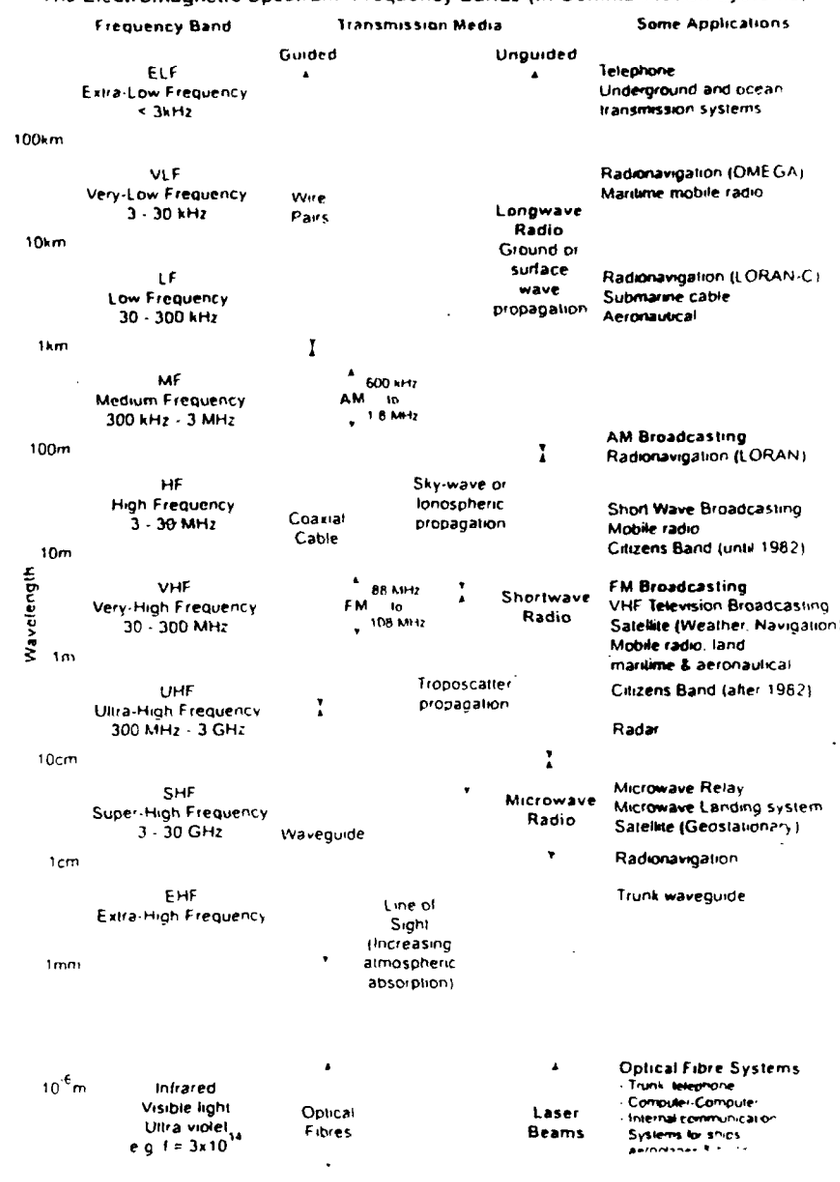
- Wires
- Co-axial cables
- Wave guides
- Optical fibres

Unguided

- Long wave AM radio
- Short wave FM radio
- VHF television
- Microwave satellite Laser

Similarly, unwanted EM waves may intrude along wires, or become unguided through the ether.

The Electromagnetic Spectrum: Frequency Bands (in Communication Systems)



Signal to Noise Ratio

An important measure of EM interference is the ratio of signal (wanted) to noise (unwanted)

Some methods of reducing unwanted signal are

1. A series inductor, L, or a shunt capacitor, C, may be sufficient to reduce the noise
2. More effective would be a complicated "passive" LC circuit, or an "active" transistor circuit
3. Differential amplifiers could separate a 1mV signal from 1V of noise
4. Cross-correlation

Shielding

Enclosures made of electrically conducting materials are effective in shielding equipment from electric fields. For example, a "screened" room or travelling van (for investigative purposes perhaps) may be screened with steel chicken wire, or, more effectively, with copper gauze. This would not screen out low frequency magnitude fields. In co-axial cable, the outer covering may be plaited copper braid. It is used to shield connecting wires running between pieces of equipment. Most shields are more effective when solidly earthed at more than one point

Earthing

Besides increasing the effectiveness of shielding from EM radiation, earthing is used to protect us from electric shock

Electric Shock

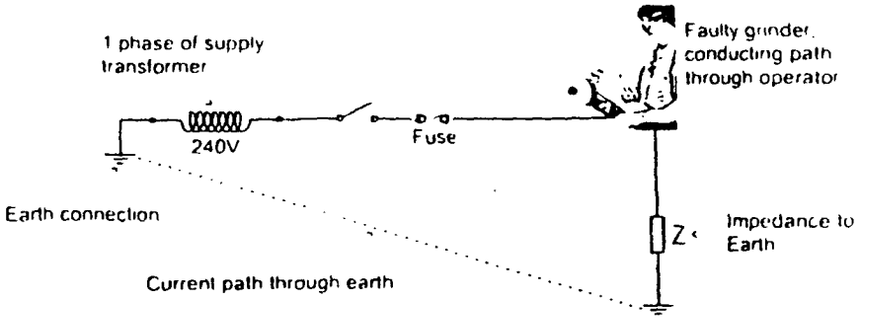
When a person comes in contact with a conductor at a voltage V, the current flowing through the body (or part thereof) will depend not only on the voltage and the impedance of the body, but also on the impedance of the voltage source. However, the impedance of the electrical supply to a house or factory is so low in comparison to that of the body that we will neglect it here

If the body's impedance is Z, and there is no other impedance, the current flowing will be

$I = V / Z$

Currents between 100 and 200mA may be fatal. In the case of AC, a muscular oscillation known as "fibrillation" is set up which leads to death if not interrupted. The situation is complicated by the fact that the product of current and duration ($I \times t$) is more significant than current alone. Thus the Australian standard on electric fences embraces this aspect, and requires a source impedance high enough to ensure the safety of humans

Safe and Unsafe Situations



The victim shown is touching a 240V active conductor and the current which flows will depend upon the body resistance and the impedance (Z) between the body and earth. Predicting the current that is likely to flow is very difficult because of the many factors that influence it. This includes, for example, whether the body skin is moist or dry, the contact area and pressure (ie whether the object is touched or gripped) and the impedance between the body and the general mass of the earth. The skin resistance may vary from 1000Ω for wet skin to over 500kΩ for dry skin

Human Resistance for Various Skin-Contact Conditions

Condition (Area to Suit)	Resistance (Ω)	
	Dry	Wet
Finger Touch	40k – 1M	4 – 15k
Hand holding wire	15 – 50k	3 – 6k
Finger-thumb (grasp)	10 – 30k	2 – 5k
Hand holding pliers	5 – 10k	1 – 3k
Palm touch	3 – 8k	1 – 2k
Hand around a 1½ pipe (or drill handle)	1 – 3k	0.5 – 1.5k
Two hands around a 1½ pipe (or drill handle)	0.5 – 1.5k	250 – 750
Hand immersed	-	200 – 500
Foot immersed	-	100 – 300

Resistance Values for Equal Areas (100cm^2) for Various Materials

Material	Resistance (Ω)
Rubber gloves or soles	More than 20M
Dry concrete	0.2 – 1M
Leather sole, dry, including foot	0.1 – 0.5M
Leather sole, damp, including foot	5 – 20k
Wet concrete	1 – 5k

ANNEX 5

CONSULTATIONS

ENERGY COMMISSION

Private Mail Bag
Ministries Post Office
Accra - Ghana

Tel: 660716 - 7
Fax. 660718
IDD Code: (233-21)
E-mail: ecom_act541@yahoo.com

EC/EPA

25 November 2002

Managing Consultant
REFAST
Tema

Dear Sir,

Environmental Impact Assessment Study
Proposed 330kv Coastline Transmission Line Project

Please refer to your letter No. RE/EIA/0102 dated October 14, 2002 on the above subject.

We wish to inform you that the Energy Commission is yet to receive a formal request from the VRA purporting to register the captioned project as required under the Commission public notices, EC 001 and EC 003.

We look forward to receiving a copy of the Scoping Report for the Environmental Impact Assessment (EIA) Study on the project, which will be made available to us through the Environmental Protection Agency for our study and comments.

We assure you of our cooperation and support in subsequent deliberations on the project.

Yours faithfully,
ENERGY COMMISSION

Kofi Asante
EXECUTIVE SECRETARY

cc: Dr. Charles Wireko-Brobby, Chief Executive, VRA, ACCRA

CPconstruction Pioneers

BAUGESELLSCHAFT ANSTALT

Construction Pioneers · Meierhofstrasse 2, FL 9490 Vaduz

The Managing Director,
REFAST,
P. O. Box CE11233,
Tema

FAX: 22 205 071

Accra Office:
Gunnisberg Avenue
James Town
P. O. Box 781
Accra - Ghana
Tel-No (021) 66 46 62/66 89 91/2
Fax-No (021) 66 47 23
Telex-no 2318 BEPLOT GH
E MAIL cpghana@africaonline.com.gh

Office Eimina:
Edueyeo Quarry
P. O. Box 1427
Cape-Coast, Ghana
Tel (042) 32199
Fax (042) 32199

Ihr Zeichen Your Ref	Unser Zeichen Our Ref RVB/RPI/gen /LT	Datum Date 04.12.02

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT STUDY OF PROPOSED 330 KV COASTLINE TRANSMISSION LINE PROJECT (ABOADZE – TEMA)

Reference is made to your letter Ref. RF/EIA/003 and dated 20/11/02 with regards to the above project.

We have studied the projected power line and comment as follows:

The projected line is passing close to the quarry pit where we are blasting and request that the line be shifted either parallel south by approximately 50m or to the North by approximately 170m.

Yours faithfully,
CPconstruction Pioneers

ROBERT PLOETNER
Managing Director

cc: TD – CP
GM – "

ANNEX 6

MEMORANDUM OF UNDERSTANDING BETWEEN VRA AND THE FOREST SERVICES DIVISION

MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

VOLTA RIVER AUTHORITY

AND

FOREST SERVICES DIVISION OF THE FORESTRY COMMISSION

Dated 20TH OCTOBER, 2003

THEREFORE IT IS AGREED AS FOLLOWS:

0 NATURE AND EXTENT OF BUSH CLEARING AND TREE CUTTING

1.1 VRA shall inform the FSD, either through registered mail or facsimile, of any construc activities that it intends to undertake in any forest reserve in Ghana.

1.2 VRA shall upon formal approval from the FSD, which approval shall not be unreasor withheld, undertake line route survey for any of its proposed transmission line proj traversing through forest reserves

1.3 The FSD shall undertake inventory of all trees that will be felled during any construction operation and maintenance work of the VRA which passes through forest reserves

1.4 VRA shall establish its right-of-way and access tracks for any of its proposed transmission li traversing any of the forest reserves and advise FSD accordingly.

1.5 VRA shall make available to the FSD, a survey map of the approved right of way.

1.6 Felling of all trees in the forest reserves shall be to the specification of the VRA.

2.0 MAINTENANCE OF RIGHT OF WAY AND ACCESS TRACKS

2.1 The VRA shall be solely responsible for carrying out periodic maintenance within the right of wa and the access tracks in the forest reserves

2.2 The VRA or its authorized representative shall give notice to the District Forest Manager through registered mail or facsimile, of any intended routine maintenance activities within forest reserves In the event of an emergency, notice shall be given to the District Forest Manager of the route maintenance activities as soon as practicable after they have taken place

2.3 The FSD shall write to notify VRA by registered mail or by facsimile as soon as it is aware of any action that may affect accessibility to the right of way and access tracks

2.4 In the event of an action by FSD that may occur under Section 2.3, FSD shall after necessary discussions and agreement with the VRA provide alternate routes to such right of way and access tracks

2.5 VRA shall notify the FSD for the removal of any tree outside the right of way that poses danger or is likely to pose danger to the transmission line.

3.0 PAYMENT OF REPARATION

3.1 That the FSD in consultation with the VRA shall contract a concessionaire to fell any matured economic trees within the right of way in forest reserves.

3.2 In the event of a concessionaire felling the matured economic trees, VRA shall not be responsible for paying for such trees

3.3 That in the event of FSD's inability to contract a concessionaire to undertake the felling, V shall fell and pay for all matured trees, above 50 cm in diameter, within the right of way a access tracks in forest reserves at going approved Forestry Commission rates.

3.4 That the VRA shall fell and pay for all immature economic trees, between 20 to 50 cm diameter only, within the right of way and access tracks in forest reserves at existing rates eq to the minimum size of 50 cm in diameter for the specie.

3.5 That in the event of VRA undertaking activities indicated under Section 3.3 and Section 3 4, VR shall own the logs unless VRA directs otherwise

3.6 That the VRA shall compensate FSD for any acquired right of way in forest reserves as may b agreed upon.

3.7 That the compensation shall be structured in such a way as to cater for any additional fores guards required to protect the forest reserves, arising out of VRA's activities.

4.0 - ENVIRONMENTAL MITIGATION PLAN

4.1 FSD shall arrange, upon approval from VRA, to employ additional forest guards to protect forest reserves if it is determined that, as a result of construction or operation and maintenance work of the VRA, there is an extraordinary increase in potential for encroachment.

4.2 FSD shall use all reasonable endeavours to ensure that activities of concessionaires do not affect VRA's operations within forest reserves.

5.0 - INFORMATION SHARING

5.1 VRA and FSD shall endeavour to share any relevant information that will help both parties to perform their functions effectively.

5.2 VRA and the FSD shall meet annually to review the implementation of the MOU

6.0 - AMENDMENTS

6.1 This MOU may be amended upon the request by any of the parties

6.2 In the event of any such request, the party requesting the amendment shall serve the other a written notice of the nature of the amendment.

6.3 All amendments to this memorandum shall be in writing and signed by both parties

7.0 - FAIRNESS AND GOODFAITH

7.1 That the parties undertake to act in good faith with respect to each other's rights under memorandum of understanding and to adopt all reasonable measures to ensure realization of the objectives of this memorandum of understanding

8.0 - SETTLEMENT OF DISPUTES

8.1 That the parties shall use their reasonable efforts to settle amicably all disputes arising out of or in connection with this memorandum of understanding or the interpretation thereof

8.2 Any dispute between the parties as to matters arising pursuant to this memorandum of understanding which cannot be settled amicably within sixty (60) days after receipt by one party of the other party's request for such amicable settlement may be submitted by either party to arbitration in accordance with the Arbitration Act 1960 (Act 38)

IN WITNESS WHEREOF the parties hereto have caused this MEMORANDUM OF UNDERSTANDI to be executed the day and year first before written

FOR AND ON BEHALF OF)
VOLTA RIVER AUTHORITY)
BY ITS CHIEF EXECUTIVE)

In the Presence of

FOR AND ON BEHALF OF)
FOREST SERVICES DIVISION)
BY ITS EXECUTIVE DIRECTOR)

In the Presence of

ANNEX 7

PUBLIC DISCLOSURE NOTICE

No. 14137 ISSN 0855-1502
THURSDAY 7th AUGUST 2003 Pg 7.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) NOTICE

PROPOSED 330KV ABOADZE-VOLTA TRANSMISSION LINE PROJECT

The Environmental Protection Agency (EPA) has received an Environmental Impact Statement from the Volta River Authority on a proposed 330 KV transmission line project as required under the EPA Act 490 Section 12(1) and Regulation 16 of LI.1652.

Copies of the report are available at EPA Library, Ministry of Energy, Shama Ahanta East Metropolitan Assembly, Sekondi, Cape Coast Municipal Assembly, Cape Coast, Mfantsiman, District Assembly, Saltpond, Gomoa District Assembly, Apam, Awutu-Efutu District Assembly, Winneba, Ga District Assembly, Amasaman, Komenda-Edina-Eguafo, District Assembly, Elmina, Abura Asebu Kwamankese District Assembly, Abura Dunkwa, Tema Municipal Assembly, EPA Greater Accra Regional Office, Amasaman, EPA Central Regional Office, Cape Coast and EPA Western Regional Office, Sekondi for the public notice and information.

Any person (s) having an interest or concern relating to the potential environmental implications of the said project shall within twenty one (21) days from the date of this notice submit in writing such concerns etc. to

The Ag. Executive Director or The Regional Officer
EPA EPA Greater Accra Region
P.O. Box M326 P.O. Box 416 Accra
Accra
Tel: 664697/8
Fax: 233(021) 662690

SOCIO-ECONOMIC IMPACT ASSESSMENT FOR VRA 330 KV COASTLINE POWER TRANSMISSION PROJECT

QUESTIONNAIRE FOR GENERAL COMMUNITY

This questionnaire is meant to seek opinions of members of the communities that are to be affected by the above project. The opinions are basically concerned with how members expect the construction of the Right of Way for the erection of pylons for the above project through their communities socially, culturally and economically, positively and/or negatively. Members are therefore encouraged to give their candid opinions freely and objectively to enable the Consultant advise VRA appropriately to enable them execute the project with minimum negative impact as possible.

Questionnaire Identification

1. Name of community.....

2. Name of District.....

3. Region.....

Name of Interviewer.....

Date of Interview.....

Demographics

4. Sex of respondents 1. Male 2. Female

5. What is your age ?

1. 18-22 years	6. 43-47
2. 23-27 ..	7. 48-52
3. 28-32 ..	8. 53-57
4. 33-37 ..	9. 58-62
5. 38-42 ..	0. 63 and above

6. Which region do you come from?

1. Greater Accra	6. Volta
2. Eastern	7. Upper West
3. Western	8. Upper East
4. Central	9. Brong Ahafo
5. Ashanti	0. Northern

Other, (specify).....

7. Which religions do you belong to?

1. No religion
2. Christianity
3. Islam

4. Traditional religion
Other (specify).....

8. What is your marital status?

1. Never married
2. Married/consensual relationship
3. Divorced/separated
3. Widowed

9. What is your occupation or main sources of income? .....

.....

10. How many members are in your household (dependants).....

POPULATION/DEMOGRAPHY

12.Which of the following categories of people would you say are more than the other in your community

	Yes	No
1a. Males.....		
1b. Females.....		
2a. Young		
2b. Older persons.....		
3a. .Children.....		
3b. Young		

13. About how many ethnic groups are in the community? (INTERVIEWER, LIST ALL ETHNIC GROUPS).....

14. Mention three of the ethnic groups which are dominant in the community?.

15. Which are the various religions in your community?

1. No religion
2. Christianity
3. Islam
4. Traditional religion

Other (specify).....

16.Mention two of the religions in the community that you will say are dominant?

1. Christianity
2. Islam
3. Traditional religion

Other (specify).....

17.Has there been any significant changes in the composition of the population in the community for the past ten years in terms of :

1.Yes 2. No

Ethnicity.....
Religion.....
Age.....
Sex.....

18. If yes, what changes have you observed about the population composition?

19. What are the causes of those changes?

20. Do you expect the construction of the Right of Way for VRA's Pylons through your community's land to affect the population size and composition in any way?
1 Yes 2. No

21. If yes, what do you expect and how will that happen?

22. How will that happen? .....

23. If no, why do you think the population size and composition are not going to be affected by the project.....

24. What will you not like about the interactions of the technical personnel who may come to work on the project and those in the community,(consider interactions between males and females, young and old) .....

.....

.....

25. What will you like about the interactions of the technical personnel who may come to work on the project and those in the community,(consider interactions with males and females, young and old etc..) .....
.....

.....

PUBLIC HEALTH

26. Which are the common illnesses in this community?
1. Malaria/fever
2. Headache
3. Bodily pains

4. Stomach problems
5. Other (specify).....

27. What are the causes of these illnesses the community?

28. What illnesses/diseases do you personally usually suffer from?

29. How do the people treat illnesses/sicknesses in this community?
(Where and what do they use)
1. Chemical/Drug store
2. Pharmacy
3. Herbalist/Traditional
4. Hospital/Health Center/Clinic
5. Drug hawkers
Other (specify).....

30. Which treatment types do you use when you are sick/ill?

31. Mention two of the treatment types that are most common in the community and why?

1

2

32. Which of the following health facilities do you have in the community
1. Chemical/Drug store
2. Pharmacy
3. Herbalist/Traditional
4. Hospital/Health Center/Clinic
5. Drug hawkers
Other (specify)

33. What significant changes have you observed in health/illness situation in the community for the past ten years and why that change?

34. Do you think the proposed transmission of electricity power through your community can bring any diseases/illnesses, or does the project poses any health danger to people in the community?. 1. Yes 2. No.

35. Give reason(s) for your answer.....
.....

EMPLOYMENT

36. What are the jobs/work that people in the community do?
1. Farming
2. Construction
3. Industry
4. Trading

THIS MEMORANDUM OF UNDERSTANDING is made the 20th day of October 2002

BETWEEN THE VOLTA RIVER AUTHORITY (herein referred to as VRA) whose registered address is Electro-Volta House, 28th February Road, P O Box MB 77, Accra, Ghana of the one part AND the FOREST SERVICES DIVISION (herein referred to as FSD) OF THE FORESTRY COMMISSION whose registered address is P O. Box GP 527, Accra

WHEREAS:-

1. Section 10 (b) of the Volta River Development Act 1961 (Act 46) mandates the VRA to construct and operate a transmission system for the distribution of her electrical power

2 Some of these transmission line routes will pass through national forest reserves which the Forestry Commission Act 571 the FSD is mandated to manage

. The VRA is mandated under Section 12 of the Volta River Development Act 1961 (Act 46) to pay compensation to any person whose property is affected by VRA's transmission line construction works

4. The VRA is also mandated to collaborate and consult with other agencies in its various operations ensure sound development

5. The parties in pursuance of this collaboration have found it necessary to set out the separate roles and responsibilities of the partnership to strengthen the collaborative initiative between the two agencies for the efficient management of power related activities in national forest reserves

6. The VRA and the FSD met on June 20, 2002 at the FSD Conference Room to discuss modalities for ensuring that the affected forest reserves do not suffer any unreasonable degradation due to VRA's activities, which involves major reinforcement, expansion and operation and maintenance of transmission and distribution lines

7 At the end of the meeting the FSD and VRA have recognised their complementary roles for the careful management of forest reserves and the provision of cost-effective and reliable supply of electricity to the people of Ghana

5.Public/civil service
6. Fishing
Other (specify).....

37.What is/are your occupation(s).....

38. Who are the main employers in the community?
1. Self- employment
2. Private employers
3. Government
Other (specify).....

39. What significant changes have you observed in employment situation in the community for the past ten years?

40. What brought about the changes in employment situation in the community ?

41. Do you expect the proposed power transmission line through the community to affect employment situation in any way? ?. 1. Yes 2. No.

42. If Q 40 is yes, in which specific ways do you expect the project to affect employment situation in the community

43.If Q40 is no give reason(s) for your answer

LAND OWNERSHIP, TENURE SYSTEM AND USE

44. On what terms/conditions are portions of land given out for use in the community?

1. Tenants pay for the use for specified period of time
2. Tenants use and share proceeds with land- owners
3. No specific arrangement/ Depends on land-owner and Tenant
4. Property to be shared on completion
5.Outright sale
6. Gift
7. Right to land by family/lineage membership
Other (specify).....

45. Mention any three of the land tenure/ownership systems in Q44 that are more common in the community

46. For what purposes are land mostly used in the community?

1.Farming
2. Residential Accommodation
3.Business/industrial sites/accommodation
4. Quarrying
Other (specify)... .....

47. What significant changes have you observed in the following about land in the community for sometime now?

i land ownership and control

ii. land tenure system

iii land use

iv occupation

48. What factors brought about these changes?

49. How do you expect the proposed power transmission line through the community to affect land ownership and control, tenure and land use?

50. What are your general comments about and recommendations for the proposed transmission line through your community.

a) Comments

b) Recommendations

METHOD OF VALUATION

The appraisal of landed properties entails the use of one or more valuation approaches depending upon the nature of the properties and/or the availability of data. The methods normally used are the Cost, Income and Market Approaches. In the subject valuation the Cost Approach has been adopted, for the assessment of buildings

THE COST APPROACH

By this method the capital value of property is ascertained by estimating the cost of erecting the building or a modern substitute having the same gross internal floor areas as that existing at prices current at the relevant date.

An amount representing accrued depreciation, physical deterioration, functional obsolescence and environmental constraints is determined and subtracted form the gross cost of improvement to arrive at the net replacement cost of the building. To this is added the value of the bare site by the Market Approach to arrive at the capital value.

PROPICON analyzed cost data of similar structures relevant to this assignment, provided by the Land Valuation Board, A.E.S.L and indigenous private developers.

From our analysis we derived unit rates for the various structures by considering the types of materials used for construction, the location as well as services and amenities available.

LAND

We assumed 90 years leasehold interests for the subject plots. The term 90 years is varied to conform to the use of the land.

The field data was captured by visits to affected areas. Physical inspection and referencing of relevant structures and properties were carried out by our well-trained and experienced staff.

330KV ABOADZE - VOLTA TRANSMISSION LINE PROJECT

SUMMARY OF VALUES BUILDING COMPENSATION

SHEET NO.	SETTLEMENT	COMPENSATION AMOUNT ¢
	KWESI KWAA VILLAGE	4,914,000.00
	AYENSUDO VILLAGE	420,732,438.00
	ATABADZE	51,030,000.00
	ABURA ADUKROM	64,017,240.00
	ASAFORA	505,669,500.00
	EWUOYAA VILLAGE	6,665,400.00
	MANKESSIM	1,528,721,250.00
	KWAAKROM VILLAGE	54,324,270.00
	EKUMFI EKOTSI	119,280,000.00
	ANKAMU	371,805,000.00
	DOMIABRA VILLAGE	1,404,900.00
	POTSIN	96,534,900.00
	MUSAKROM-POTSIN NKWANTA	35,686,770.00
	DANKYIRA	67,638,375.00
	NSAKINAA VILLAGE	521,817,975.00
	POKUASE	25,758,600.00
	ABOKOBI - SESEME VILLAGE	264,043,124.10
	GA - ODUMASI	74,036,025.00
	ODUMASI VILLAGE	251,028,225.00
	TOTAL	4,465,107,992.10

Prepared By: Messrs. PROPICON

330KV ABOADZE - VOLTA TRANSMISSION LINE PROJECT
CROP COMPENSATION

SUMMARY OF VALUES

SHEET NO.	SETTLEMENT	COMPENSATION AMOUNT ¢
1	NYANKROM VILLAGE	278,941,000.00
4	KWESI KWAA VILLAGE	25,960,007.00
7	DOMPOASE	45,398,455.00
8	ABAKA-ANO VILLAGE	17,468,940.00
8	AYENSUDO VILLAGE	69,291,616.00
9	OLD ATABADZE VILLAGE	19,461,454.00
10	EDINA ESSAMAN VILLAGE	62,273,311.00
13	NTANOA VILLAGE	682,328.00
13	INKONTRODO VILLAGE	8,650,400.00
14	ABURA EDUKROM	91,690,600.00
14	AMOSIMA VILLAGE	53,850,266.00
15	YAMORANSA	214,716,100.00
16	ASAFORA VILLAGE	33,596,157.00
16	WAAKROM VILLAGE	184,359,824.00
18	EKURABADZE	55,217,886.00
20	EWUOYAA VILLAGE	17,742,014.00
21	MANKESSIM	20,460,347.00
22	AKWAA KROM	315,507.00
22	EKUMFI SWEDRU	18,864,384.00
24	EKUMFI BOGYANO	3,672,558.00

Prepared By: Messrs PROPICON

330KV ABOADZE - VOLTA TRANSMISSION LINE PROJECT
CROP COMPENSATION

SUMMARY OF VALUES

24	EKUMFI EKOTSI	38,838,750.00
26	GOMOA ODUMASI	632,204.00
27	BROFOYEDRU VILLAGE	665,012.00
28	GOMOA ABUTIA	11,390,000.00
29	ANKAMU JUNCTION	27,836,204.00
29	FAWOMANYE VILLAGE	4,044,533.00
30	YENKUFIELD STATION	10,500,000.00
34	OKYEREKO VILLAGE	40,981,300.00
34	POTSIN NKWANTA	29,828,178.00
35	OHIAMA ADWEN VILLAGE	34,922,639.00
35	GOMOA DABEYIN	658,024.00
41	ANOTEMAN VILLAGE	4,301,601.00
42	DANTSERA	1,283,010.00
44	GA - ODUMASI	26,580,000.00
44	NSAKYINA VILLAGE	21,236,000.00
46	POKUASE VILLAGE	4,969,901.00
53	ASHAIMAN VILLAGE	5,780,039.00
	NEW DIVERSION	
1	ADU AGYEI	70,485,655.00
2	BENYADZE	54,054,053.00
3	MPEASEM VILLAGE	66,500,390.00

Prepared By: Messrs PROPICON

330KV ABOADZE - VOLTA TRANSMISSION LINE PROJECT
CROP COMPENSATION

SUMMARY OF VALUES

4	AGYEI KROM	12,921,701.00
	GRAND TOTAL	1,691,022,348.00

Prepared By Messrs PROPICO

330KV ABOADZE-VOLTA TRANSMISSION (ABOADZE - TEMA)
A SECOND VISIT FOR BACKGROUND INFORMATION OF PROJECT AFFECTED PERSONS

DATE OF THE TRIP: 14th October 2002

DATES OF INSPECTION: 14TH – 17TH October 2002

PURPOSE OF INSPECTION: To inspect and have background information *of* affected persons involved in the project.

MEETING HELD WITH OPINION LEADERS

On the last day *of* inspection. the following towns and villages were inspected and these are the activities that took place.
On the 14th October 2002 at about 7:35 a.m. a team made up *of* two Consultants and a representative *of* Mr. Stephen A. Bediako the Managing Consultant (Messrs. PROPICON) led by Mr. Opare Addo visited Danchira Lands *of* which the team met Togbe Ocloo III. He directed the team to Mr. Emmanuel Lamptey Mills fann owner. where the High Tension line passes through.

Some pillars were located on the fanns as Pillar Nos. VRA 1/100 368 and 369 partly broken and other relevant figures could not be identified. There was another point *of* identification, which was partly cut down date palms trees. The farm has a teak tree plantation, and a cassava farm that has recently been planted. However the corn had been harvested during the time *of* inspection.

PLACES VISITED ON 14TH OCTOBER 2002

DOMEABRA VILLAGE

The team met Mr. C. K. Amoo the Assemblyman *of* Domeabra at about 10:35 a.m on the same issue.

AWUTU BEREKU VILLAGE

They went to the Assemblyman's office and met the secretary Mr. Nyamavor and questionnaire was left with him to contact the respective farmers whose properties fall within the proposed acquired area.

GOMOA POTSIN VILLAGE	-	The Assemblyman could not be contacted due to his being hospitalized.
GOMOA MAMPONG VILLAGE	-	The team visited the above named town where we met the opinion leaders and the Assembly member Mr. J. K. Amfo at Mr. Kwame Ahor's House No. MA 014 on the issue.
AGONA NYARKROM VILLAGE	-	Samuel Yaw Duodu Assemblyman, was contacted by the team in respect of the project to identify the owners of the affected farmers House No. NA 58/1. The team later found the affected area after Shama Junction in the Western Region instead of Agona area. The team then contacted Mr. Isaac Quacoo, unit committee member (Alias KOBEE) and requested to inform and organize the community members on the issue.
POMADZE (ASEBU)	-	The team contacted the unit committee chairman, Mr. Jacob Nassa with whom we discussed the issues of contacting the affected claimants.
GOMOA BEWADZE VILLAGE	-	The team contacted Mr. Kojo Yaw the spokesman for the inhabitants who disclosed that they were formerly farming along the pylons and they saw some workers carrying out demarcation along the area.
GOMOA AMENFI VILLAGE	-	The team met the secretary Mr. Richard Yawson and some opinion leaders on the same issue.
GOMOA ONYADZE QUARTERS	-	This site was formerly acquired by the Forestry Department for seed multiplication and stands but the project has since been abandoned and the area is over grown with weeds at the time of inspection.
GOMOA ADAH VILLAGE	-	At about 4:15p.m the team met some of the town folks and a unit committee member, Madam Ama Entsie and were briefed on the issue. Nana Okotrower Bekere IV Chief of Gomoa Adah Village was however not present as he in an employee at the Tarkwa Mines. Unit committee member Mr. Jacob was present.
KYIREM NKWANTA VILLAGE	-	At about 5:00 p.m, the team contacted the

Assemblyman of Kyirem Nkwanta area to mobilize and inform the affected people on the issue.

GOMOA ODUMASE VILLAGE - The team met Mr. Anthony Bedu the unit committee member at 5:18 p.m. The spokes person was requested to mobilize the affected people.

GOMOA ANKAMU VILLAGE - The team met Mr. Paul Mensah, G.P.R.T.U secretary for Gomoa District, when the team had fruitful discussion to organize those would be claimants along the proposed High Tension Line.

PLACES VISITED ON 15TH OCTOBER 2002

EKUMFI AYISAM - On the 15th October 2002, the team met the Assemblyman Mr. Abeka on the same issue.

EKUMFI KWAAKROM VILLAGE- Contact man: Unit committee member Mr. John Enchil was the quest.

EKURABADZE VILLAGE - The team arrived at the above town and were informed about the absence of the Assembly-man and the unit commette members. Mad Juliana Amma Anorfu (Ex Assemblywoman). However a lady who owns Okyeso Nyame drinking bar in the township was the contact person, Mad Esi-Mansah was also present.

ANOMABU TOWN - The Assembiyman for the area was not present at the time of meeting. Contact person was Mr. Francis Quansah (alias Kofi Atsiawa) a mason.

ASAFUA VILLAGE - The team met Mr. Paul Crankson, one of the elders to inform and organize the affected community for the impending project.

YAMORANSA AREA - The team contacted one Augustine Koomson to inform the newly elected Assemblyman Mr. Raphael on the issue.

EKUMFI SWEDRU VILLAGE - The team met some elders, unit committee members and some town members in the house of opanyin Kofi Adukwei, Israel Obimpeh (unit committee member) Nana Kwesi Edwin the regent of the town were present.

EKUMFI EDUKUMA VILLAGE - Contact person: Kodjo Hamidu Mohammed Babe, unit committee member was at the meeting.

ESUAHYIA TOWN - The team arrived at Essuahyia town around 6:30 p.m. We were taken to the residence of the town Assembly-man whom we were informed had traveled. However, we contacted one committee member Madam Araba Kum whom we discussed the project issue with her to later communicate with the affected farmers. The Assemblyman Mr. George Duncan later arrived to meet us.

EKUMFI EKOTSI VILLAGE - The team met Mr. Osmanu Ottoo unit committee chairman and Isaac Katanga (Ex-Assemblyman) on the issue.

EKUMFI BADZANO VILLAGE - The Ex-Assemblyman Mr. Isaac Katanga to Assist in contacting the affected people.

EKUMFI AYISAM VILLAGE - Contact Person: Mr. Abekah (Assemblyman).

EKUMFI AKWANKROM VILLAGE - Contact Person: Mr. John Enchil (Unit committee member)

GOMOA ABUTSIA VILLAGE - Richmond Mensah spokesman for the area Promised to educate the affected farmers on the issue.

GOMOA BROFOYEDRU VILLAGE- The team met the chief of the town, Nana Kwa-kety IV and John Boadi (Assemblyman), Madam Cynthis Otuwah (unit committee member). The team met one uncle Joe who was a worker during the erection of the pillars for the construction of the proposed project. Mr. Joe according to him a nephew to the Chief of Apam (Ankamu).

MANKESSIM AREA - At about 9:12 a.m the team met the Assemblyman who is also a teacher of Nananom J.S.S and Mr. Frank Efruc Hayford for Nkusukum Electoral Community. We were accompanied by Mr.Yakub Mobarak head teacher of Hamid-Islamic J.S.S. and had fruitful

conversation. However, his school will be affected by the project as it presently sand witched between the old and the new Transmission Pylons.

EKUMFI EWOYA VILLAGE - The team met Mr. Kwesi Essuamang (unit committee chairman) at the house of Twafo-hene Kwabena-Benuye to inform and organize affected claimants.

SALT POND AREA - The team contacted Mr. Francis Ejaku Donkor, the Assemblyman for Nkubem Electoral area to inform and organize the affected people in respect of the proposed project.

WAAKROM VILLAGE - The team contacted some elders of the village and informed them on their mission and requested that the village community members be organized and informed.

The team was conducted to inspect one of the erected pillar No. V.R.A AT 1/100 155 by Opanyin Kwa Badu. Isaac Kwentsir Secretary to the unit committee was present.

AMOSIMA VILLAGE
(ABURA/KWAMANKESE DISTRICT)- The team was informed about a proposed survey line by a team of private surveyors but pillars were not located on the survey line, according to Mr. Abaka the survey line located is in respect of a gas pipe line.

ABURA EDUKROM VILLAGE - The team was taken to a site to inspect a pillar on the survey line constructed by V.R.A No. 1/100 140 by Kofi Nzema a native of Edukrom, the survey pillar stands on the right hand side of the untarred road which leads from Amosima-Edukrom and about two hundred yards away from the Edukrom Anthony Catholic Church Street. At the time of the visit we were reliably informed the Assemblywoman Madam Kate Etsue resides at Amosima, however we had fruitful discussion with the unit committee members namely Messrs. Nicholas Ansah and Mr. Saiel Quayson.

NTONOA / NKUNTRODO VILLAGE- The two communities are under one Assemblywoman in charge of the electoral area.

The team did not meet her when we called and was to come back by 7:30 p.m. Team later met her on her way from an Assembly meetings and had discussion with her. (Madam Flora Hagan)

NKUNTRODO VILLAGE - The team met former Assemblyman Mr. John Annor to assist them to inform and organize affected farmers and landlords.

Nkuntrodo – (Regent) Francis Nyan, as the old chief of (Nkuntrodo) has died a few weeks before our inspection – Nana Atom III (Late)

ESUEKYIR (CAPE COAST) - At 8:15 p.m. the team visited the house of Assembly member and was informed he has not returned from his place of work. The team got in him in his residence and all meetings and discussions were held.

KAKUMDO (CAPE COAST) - The team met Mr. Kwesi Nunoo the Ex-Assembly member and Ebenezer Quacoo (Present Assemblyman for the area) and was briefed on the issue relating to the team's mission.

PLACES VISITED ON 16TH OCTOBER 2002

EDINA ESAAMAN VILLAGE - The team met Kwesi Thompson and Willie Eshun, Unit Committee Members and Government appointees at the chief palace.

OLD ATABADZE VILLAGE (K.E.A DISTRICT) - At about 8:08 a.m. on Wednesday, the team contacted Messrs. Robert Onaman (unit committee member alias teacher), Robert Mensah and J.A. Andohkoh and all members of the area opinion leaders on the issue.

AYENSUDO VILLAGE - We were informed of Assemblyman's travel outside the town, however we were taken to an Ex-unit committee member Mr. Abbas Mohammed Yaro's house and had a lengthy discussion with him and requested that he should inform and organize those who would be affected. Address: Samuel E. Asafua, H/No. CWI Q 079.

NYINASE VILLAGE	-	Contact Person: Samuel Mensah and Patrick Okrah. They assisted the team to inspect the site of survey demarcation.
BAKA – ANO VILLAGE	-	Nana Kwame Anim, chief of Baka-Ano, Okyiame Kofi Awotwe, Kweku Asiam and some members of the community accompanied the team to the demarcated High Tension Line.
KOMENDA JUNCTION	-	The team could not meet the Assemblyman Mr. John Ebo Mac-cathy (teacher) but contacted a unit committee member Mr. Sampson-Amoah and briefed him on the issue to inform and organized the affected people.
ABURANSA VILLAGE	-	The team were led by Nana Yaw Opan, unit committee member to the demarcated area and requested to organized farm owners.
SHAMA ALAUANYO VILLAGE	-	The team met the Assembly member Mr. Arthur, who is also a teacher at the Shama Senior Secondary School. The Assemblyman disclosed that most part of the acquired area falls within individual plots.
NYAMKROM VILLAGE (After Shama Junction)	-	Contact man: Mr. Isaac Quacoo, unit committee member (alias Kobee) requested to inform and organize the community members on the issue.
POTSIN JUNCTION	-	Contact man: Mr. Ebo Quansah (unit committee member)
SEGU FARMS	-	Contact man: Kwegyir Arthur Tel: 024-381927 C/o Peter Agyir (Osofo) Israel Prayer Camp
NYAME BEKYERE VILLAGE	-	Contact man: Robert Gyandu, opinion leader to inform and organize the farmers and land owners.

PLACES VISITED ON 17TH OCTOBER 2002

ASABAHAN VILLAGE	-	Contact man: Robert Sackey
ANOTEYMAN VILLAGE	-	Contact man: Atukwei Sackey

NSAKINA VILLAGE (GREATER ACCRA DISTRICT	-	Contact person: Madam Naomi Ayeley Aryee wife of the town secretary, Mr. Albert Lamptey).
MANHEAN (GREATER ACCRA DIST.)	-	Contact person: Mr. E. K. Sackey (unit committee member) and Hon Kofi Acquah (Assemblyman).
AFUAMAN VILLAGE (GREATER ACCRA DISTRICT)	-	Contact person: Mr. Ayi Aryitey, H/No. 079
OHIAMADWEN VILLAGE	-	Contact man: Mr. John Mensah or Mr. Kwagyesi (unit committee member).
DABANYIN (GOMOA DISTRICT	-	Contact Mr. Charles Kumi (upit committee member).
AKRAMANG (GT. ACCRA DIST)	-	The team met the Assemblyman Mr. Seth Kwame, alias Kwame Budu.
AKRAMPA VILLAGE	-	The team met Mr. Francis Larbi and Mr. Lava and had information that there were no properties on the acquired area.
OKLO OR OCLOO JUNCTION	-	Contact man: Evans Attah
KASOA AREA	-	The team decided to meet at a fixed date to introduce our mission as the Assemblyman Mr. Mustapha Alex was not present at the time of our visit.
OSHIUMANG VILLAGE	-	The team met Nii Okyeame Abekah and his elders and discussed all matters concerning the subject matter. (Oshaiumang Okyeame, H/No. A 0/003)
ODUMASE VILLAGE	-	Contact person: Mr. Patrick D. Amuzu, unit committee member (Cathechist)
AMANFRO VILLAGE	-	Contact person: Mr. Ashong Okoe (alias Alhaji) to inform and organize the affected people. Assisted by Madam Yaa Nyongloh.

Time is yet to be arranged for the next inspection to cover the other areas from Amanfro village through Ashiamang to Tema.

VILLAGES COVERED

14TH OCTOBER 2002

1. Dankyira Lands
2. Gomoa Adah
3. Pomadze Asebu
4. Gomoa Bewadze
5. Gomoa Amenfi
6. Onyiadze Quarters

15TH OCTOBER 2002

1. Waakrom
2. Yamoransa
3. Amosima
4. Ekura Bedze
5. Anomabu
6. Asafua
7. Abura Edukrom
8. Ntranoa
9. Nkuntrodo
10. Esuekyir
11. Kakumdo
12. Mankessim
13. Ekumfi Ewoyaa
14. Saltpond
15. Ekumfi Ayisam
16. Ekumfi Akwankrom
17. Ekumfi Swedru
18. Ekumfi Edukuma
19. Esuahyia
20. Ekumfi Ekotsi
21. Gomoa Ankamu
22. Gomoa Abotsia
23. Gomoa Brofoyedru

16TH OCTOBER 2002

1. Aburansa
2. Kwesi Kwaa
3. Shama Alavanyo
4. Edina Esaaman
5. Old Atabadze
6. Ayensudo
7. Nyinase
8. Baka-Ano
9. Komenda Junction
10. Nyankrom
11. Domeabra
12. Awutu Breku
13. Gomoa Mampong

17TH OCTOBER, 2002

GREATER ACCRA DISTRICT

1. Nsakinaa
2. Manhean
3. Afuaman
4. Abeman
5. Oshiuman
6. Ashaiman

AWUTU-BREKU DISTRICT

7. Ohiama Adwen
8. Gomoa Dabanyin
9. Akramang
10. Gomoa Potsin Junction
11. Segu Farms
12. Nyame Bekyere
13. Akrampa
14. Ocloo Nkwanta
15. Kasoa

GOMOA DISTRICT

16. Asabahan
17. Anorteyman
18. Odumase
19. Amanfro
20. Ekumfi Ewoyaa
21. Ekumfi Bodzano
22. Kyirem Nkwata

ACCESS ROAD IDENTIFICATION FORM

LINE SECTION:.....C1W.....

NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS	
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)		
1	Cape -Coast	250m.	-	-	200m access is eroded with gullies to T4/1. T5/1 Is 200m from Highway.	
2	Ghana National College	500m	-	-	Motorable acess to 2/2.	
3	Aggrey Memorial College	300m	-	-	Motorable access to 1/3.	
4	Moree Junction - Yamoransa	100m - 200m	-	-		
5	Yamoransa	650m	-	-	Motorable with difficulty (erosion and gullies) to 1/6.	
6	Waakrom	1.5km	-	-	Motorable access to 1/7-2/7. 1/7 in town. 2 River crossing between 2/7 x 3/7	
7	Asafora/Biriwa	3.1km	-	-	Feeder road, motorable to 4/7	
8	Anomabo-Nanafo	2.4km	-	-	Feeder road motorable to link between 1/2 - 2/9.	
9	Anomabo-Brofoyedru	3km	-	-	Feeder road poor surface to lonk between 5/10 - 1/11.	
10	Anomabu-Ekurabaadze	3km	-	-	Feeder road. Good to link between 4/11 - 1/12.	
11	Otsir/Kromantse	3km	-	-	1.6km from Otsir out of the 3km need to be repaired to reach span 2/14 and 3/14	
12	Saltpond/Afrangoa	2.2km	-	-	Motorable feeder road (Poor Surface) to meet span 4/14 - 5/14	
13	Saltpond/Ewoyaa	1.8km	-	-	Motorable feeder road to reach 3/15 - 4/15.	

ACCESS ROAD IDENTIFICATION FORM

LINE SECTION:.....C1W.....

NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)	
14	Mankessim	1.2km	-	-	Access Road to be repaired to reach 3/18 - 5/18
15	Mankessim road crossing				Good track to reach 2/19
16	Mankessim	950m	-	-	Motorable through private properties (Houses).Prove to flooding to reach 1/20. Tower 1/20 x2/20 low lying area
17	Mankessim	1.2km	-	-	Access not motorable. Repairs needed to link towers 4/20 x 5/20.
18	Ekumfi Esaafa junction	650m	-	-	Motorable feeder road to meen span 3/21 - 4/21
19	Kyiren junction	800m	-	-	Motorable feeder road to link between 3/32 - 4/32.
20	Gomoa Brofoyedru	2.2km	-	-	Motorable from Highway to link 3/34 - 1/35
21	Gomoa Brofoyedru	1.5km	-	-	Motorable feeder Rd. to ling 1/35 - 2/35
22	Apam junction	500m	-	-	Motorable road to 2/38 - 3/38. 2/38 is 20m from road . River crossing 4/39-1/40
23	Gomo Abrekum junction	500m	-	-	Good motorable feeder road to meet span 4/41 - 1/42
24	Mankoadze junction	450m	-	-	Motorable feeder road to meet span 1/42 - 2/42. 1/43 - river crossing
25	Gomoa Amanfi	90m	-	-	3Towers (2/43, 3/43 x 4/43) are located 50m to 90m from Highway. Motorable to reach 3/43 - 4/43.

ACCESS ROAD IDENTIFICATION FORM

LINE SECTION:.....C1W.....

NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)	
26	Gomoa Bewadze	300m	-	-	Motorable through grassland to reach 1/44 - 2/44. River crossing between 2/44 - 3/44 - 1/45.
27	Winneba	700m	-	-	Motorable through grassland and farm to reach 1/46 - 2/46.
28	Winneba (lorry park)	600m	-	-	Motorable through private property (Horses) to reach 3/46 - 4/46
1	Ahenkofi-Krom	300m	-	-	Motorable Access Road but 30m of access needed to meet tower 2/1
2	Kojokrom (Christ Divine School)	700m	-	-	Motorable Access Road but a little narrow to tower 3/1 through school compound
3	Kojokrom (Nana Katabra 'A' School).	400m			Motorable through kojokrom 50m of extra access requird to tower 4/1.
4	Kojokrom	600m	-	-	Motorable with difficulty through private properties (Houses & Coconut plantation). 100m of extra access required to link tower 1/2.
5	Mpintsin	2km			Motorable to Mpintsin which is 800m from Highway. 1.2km of access road to be repaired to link span 4/2-5/2 and towers. 4/2 - 5/2.
6	Osofokrom	600m			Motorable from Highway through private property (House). 200m of access road through planted cassia trees required to reach tower 4/4
7	Inchaban (GWSC)	900m			Good tarred road to GWSC treatment plant. Extra 100m of track required to link tower 3/5 span 2/5 - 3/5 crosses river

ACCESS ROAD IDENTIFICATION FORM

LINE SECTION:.....C1W.....

NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)	
8	Inchaban	450m			Motorable Inchaban-Domo feeder road links span 4/5-5/5
9	Shama junction	800m			Motorable Shama-junction Konfo-eky feeder road linking 1/7 - 2/7
10	Shama junction	700m			Motorable Highway Appimenyin feeder road linking 3/8 - 4/8.
11	Essaman	900m			Motorable through Essaman town but narrow at points. 200m of extra access needed to reach 5/8.
12	Aboso	300m			Partly motorable tolonk span 2/11 - 3/11. Tower 1/11 is 50m off Highway.
13	Anto	450m			Motorable through school compound to 4/11.
14	Atwereboanda junction	800m			Motorable to link towers 3/12 x 4/12 which are 50m from road.
15	Daboase junction	600m			Motorable with difficulty flooded portions needs repairs 5/12 - 1/13
16	Dunkwa-Beposo	2km			Old access road not motorable. Through cocoa farm. Hence compensation required. (1/14 - 3/13)
17	Asamas a	200m			Motorable to 4/16 which is in town.
18	Aburanza	2.5lm			Motorable, links span 4/19 - 1/20.
19	Antaxu (near Kissi)	700m			Motorable access road to span(4/19-1/20) some areas are prone to flooding. Tower 1/21 could be reached
20	Kissi	300m			Motorable to link 3/21 - 4/21

ACCESS ROAD IDENTIFICATION FORM

LINE SECTION:.....C1W.....

NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)	
22	Kissi	200m			Bushy access road from Kissi - Kyease road to tower 1/22.
23	Komenda junction	300m			Motorable access road to link 2/22 - 3/22
24	Kissi	80 - 300m			Towers 4/22 - 1/24 (1 towers) located 80-300m from Highway. No access.
25	Dompuase junction	80m	-	-	Motorable to 2/24 x 3/24. 3/24 stream across
26	Enyinase	90m	-	-	Motorable to 1/25
27	Ayensudo	20M	-	-	3 Towers (2/25-1/26) are 20m from Highway 2/26 and 3/26 located in town.
28	Ayensudo	80m	-	-	No access to towrs 4/26 - 3/27 (3towers). 80m from Highway.
29	Mpeasem	250m	-	-	No access from 3/27 to 3/28 (5towers) 250m from Highway on Hilly terrain.
30	Mpeasem	25m	-	-	No access from 4/28 - 1/30 (towers) 25m from Highway 3/29 in town.
31	Atabadze	100m	-	-	Motorable to 2/30
32	Atabadze - Yesunkwa	300m	-	-	Motorable to 3/30 - 4/30
33	Bronyibima	500m	-	-	Motorable to 3/32 on Somka Road swamp in span 3/32 - 4/32
34	Elmina	1.2km	-	-	Motorable to 3/33 - 1/34 Archbishop Porter's School. (3/33) accessible
35	Elmina/Ankafu	1km	-	-	Motorable access to 3/34 200m extra access to rach 4/34 and 5/34. (1/34x2/34 - Hilly terrain

		ACCESS ROAD IDENTIFICATION FORM				
LINE SECTION:.....C1W.....						
NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS	
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)		
36	Ankafu	4km	-	-	Motorable through Ntranoa narrow Road	
					at village (3m) wide to T. 1/35. Good terrain	
					for track to U.C.C. T. 1/37 x4/37 are on U.C.C.	
					campus. Major street crosses span 3/37x4/37.	
37	Cape-Coast	70m	-	-	No access to 1/39x2/39 located in town	
					70m from Highway.	
38	Cape-Coast	120m	-	-	Motorable access to 3/40 off Mfantsipim -	
					Substation Road.	
LINE SECTION W2H						
1	Winneba	1.3km	-	-	Motorable through grass land to 5/1x1/2.	
2	Winneba	600m	-	-	Motorable through grass land to reach	
					1/2x2/2 and 3/2.	
3	Assin Mampong	600m	-	-	Motorable to link span 2/3-3/3 River crossing	
					between 4/3 - 1/4. Span is prone to flooding.	
4	Okeyeko junction	600m	-	-	Motorable to link span 2/4 - 3/4.	
5	Gomoa Potsin	600m	-	-	Access to span 4/5 - 1/6 not motorable	
					should be constructed	
6	Gomoa Potsin	600m	-	-	Motorable feeder road to reach span 3/6 - 4/6	
7	Korbiate-Dominase Road	250m	-	-	Motorable road to 3/8 - 4/8	
8	Near Dominase junction	250m	-	-	Motorable with difficulty to reach 1/9-2/9.	
					Access to be repaired.	

		ACCESS ROAD IDENTIFICATION FORM			
LINE SECTION:.....C1W.....					
NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)	
9	Gomoa Buduatla	80m	-	-	Motorable road to link 4/9 - 1/10
10	Ewulu	90m	-	-	8 towers (2/10-4/11) are 90m from Highway. No access.
11	Gomoa Fetteh junction	100m	-	-	Motorable road to link 4/11 - 1/12 4towers (2/12 -3/13) are 150m from Highway No access
12	Senya Breku junction	150m	-	-	Motorable through private property (Houses to 3/13. Road Eroded
13	Ewulu-Efulu	100m	-	-	Motorable to reach 14/13-1/14 Road closer to4/13. Another road ahead also closer to 1/14 and to AKRAMPA GRANITE QUARRY
14	Bududuram	80m	-	-	Could be accessed from Highway T/5/15 is 10m from Highway T. 1/16 in town. T.2/16 in town.
15	Refugee Camp	200m			Motorable through refugee camp to reach 2/16 - 3/16
16	Kasoa	70m	-	-	Motorable to reach 3/18 - 4/18 which is 70m each from Highway.
17	Kasoa	500m	-	-	Motorable road to tower 1/19. Another link to tower 2/19 about 200m from Highway.
18	Kasoa Bawjiase Road	200m	-	-	Motorable road to reach span 3/19-1/20
19	Kasoa-Krodua Road	200m	-	-	Motorable road to reach span 1/20 - 2/20.
20	Ngleshi Amanfro junction	500m	-	-	Motorable through town to 4/20 4/20-1/20 is low lying area.

ACCESS ROAD IDENTIFICATION FORM

LINE SECTION:.....C1W.....

NO.	ACCESS ROAD		BRIDGES / CULVERTS		REMARKS
	LOCATION	ESTIMATED DISTANCE	LOCATION	ESTIMATED (SIZE WIDTH)	
21	Galilea junction (kasoa)	220m	-	-	Motorable road through town to 4/21. T.2/22 is 30m from Highway. 3/22 x4/22 - 100m from Highway.
22	Krokobite junction	100m	-	-	Motorable road to 4/22 - 1/23
23	Weija-GBC Station Road	100m	-	-	Motorable road to reach span 3/24-4/24. T.5/24 is 10m from Highway. T. 1/25 - 50m from Highway.,
24	Weija	600m	-	-	Motorable with difficulty (slippery when it rains) to reach span 1/26 - 2/26.
25	Weija (Police Barrier)	600m	-	-	Motorable with difficulty (slippery when it rains) to access span 3/26 - 4/26.
26	Weija (Police Barrier)	600m	-	-	Motorable with difficulty (low lying area). River crossing between 3/27 -2/27
27	Oblogo Road	1-8km	-	-	Motorable road to span 3/27 - 4/27. Tower 3/27 to prove to flooding. 4/27 - 1/28 - Weija Stone Quarry.
28	Malam - Gbawe Road		-	-	Motorable road through Malam to reach span 3/29 - 4/29.
29	Achimota s/s - Malam		-	-	Line routed through a complex road network the contractor be accompanied by staff from Volta. Built up area compensation on Humanitarian ground

161KV TRANSMISSION LINE REHABILITATION PROJECT					
MAJOR ACCESS ROADS AND TRACKS CONSTRUCTION					
LINE SECTION: WINNEBA - ACHIMOTA (W2H)					
1	Winneba Sub-Station		4.744	1/1 - 4/3	Span 2/2 - 3/2 could be slippery when it rains. Farm road
					exist near Assin Mampon link track at span 2/3 - 3/3 600m
					from the Highway.
2	Okyereko Junction - Outside Winneba		3.558	1/4 - 2/6	Span 3/3 - 4/3 and 1/4 - 2/4 could be slippery in the rainy
					season
3	Gomoa Potsin area		3.668	3/6 - 3/8	
4	Koblete Dominase road		0.784	3/8 - 1/9	Span 3/8 - 4/8 could be swampy in the rainy season. Water
					channel runs across span 1/9 - 1/9. A football park located
					in the same span Span 3/9 - 4/9, 4/9 -1/10, 2/10 - 3/10 could
					be muddy in the rainy season.
5	DO		4.49	1/9 - 4/11	
6	Odembo/Gomoah Buduala road.				Feeder road exist to link track in span 4/9 - 1/10
7	Gomoah Fetteh junction.		1.2	4/11 - 1/13	Track was not constructed from 2/12 - 3/12 because of
					rocky nature of terrain.
8	DO	0.169			Access constructed from Highway to link track in span
					3/12 - 3/13. River crosses 1/13 - 2/13. Tower 3/13 is
					located at Awutu town.
9	Awutu area		0.946	1/13 - 1/14	Portion of span 3/13 - 1/14 is swampy in the rainy season.
					Private road exist through fitting shop enar Awutu junction
					to tower 3/13. Another Road exist through Akrampa Granite
					Quarry to tower 1/14.
10	Awutu to Gomoah Budumburam		2.675	1/14 - 5/15	
11	Budumburam to Kasoa area		6.362	3/16 - 3/20	Tower 1/16 and 2/16 are locted at Budumburam town.
					Water Channel crosses span 2/28 - 3/18. Span 3/19 - 1/20
					is used as refuse dump by Kasoa residents. Span 1/20 - 2/20
					would be difficult to access in rainy season. A stream
					crosses span 2/20 - 3/20. Road exist from Kasoa town to
					link span 3/18 - 4/18, tower 1/19 - 2/19 and 4/19.
12	Kasoa to Weija area		2.752	1/22 - 2/22	
13	Kasoa to Bawjiase road				This road links span 3/19 - 1/20.

161KV TRANSMISSION LINE REHABILITATION PROJECT						
MAJOR ACCESS ROADS AND TRACKS CONSTRUCTION						
14	Kasoa Krodua road.				This road also links span 1/20 - 2/20	
15	Galclea road				Span 2/21 - 3/21 could be accessed from this road	
16	Weija area - Irrigation Dam area		0 93	2/22 - 4/22	Span 3/22 - 4/22 is flood prone are.	
17	Krokobile road		1.38	1/23 - 1/24	Irrigation canal crosses span 4/22 - 1/23 so track was not	
					constructed through No track was constructed from	
					1/24 - 2/24 due to rocky nature of terrain.	
18	G.B.C. TV Station road.		0.99	2/24 - 5/24		
19	Weija Police Barrier		3.69	1/25 - 3/27	2/26 - 3/26 is prone to flooding Could also be slippery when	
					it rains. River channel across span 2/27 - 3/27. Both	
					towers are prone to flooding in the event of spillage from	
					Weija dam.	
20	Oblogo Town		0 1	3/27 - 4/27	Track is not through to 2/27 - 3/27. Tower 4/27 cannot be	
					reached from 3/27 due to rocky nature of terrain.	
21	Gbawe		1.732	1/28 - 2/29		
NOTE: DEFINITION						
ACCESS ROAD: Road linking the Transmission Line Right-Of-Way to a public road						
TRACK:- Graded route along the direction of the Transmission line and within the Right-Of-Way.						
	161KV TRANSMISSION LINE REHABILITATION PROJECT					
	MAJOR ACCESS ROADS AND TRACKS CONSTRUCTED					
	LINE SECTON: CAPE COAST - WINNEBA (C1W)					
NO.	ACCESS ROAD/TRACK LOCATION	DISTANCE (KM)		TOWERS	CONDITION/REMARKS	
		ACCESS RD.	TRACK	EXPOSED		
39	Gomoah Abrekum area	1.100		3/40	Access links tower to Highway	
40	Gomoah Abrekum Road/Mankwadze					
	road area		5.425	3/39 - 4/42	River crosses span at 3/39 - 1/40. Gomoah Abrekum road	
					and Mankwadze road link the track atspan 4/41 - 1/42 and	
					1/42 - 2/42 respectively.	

161KV TRANSMISSION LINE REHABILITATION PROJECT					
MAJOR ACCESS ROADS AND TRACKS CONSTRUCTION					
41	DO	0 041		1/43	Access links tower to Highway River crosses span 1/43-2/43
42	Gomoah Amanfi to Gomoah		5 00	2/43 - 4/46	River crosses span 2/44 - 3/44 at two locations. Road
					exists through commercial farm to tower 2/44. Road exists
					Permission required to use this road.
1	Cape Coast Sub-Station. Through				
	Agric. Dept.		0.650	1/1 - 3/1	
2	Cape Coast where line first crosses				
	Crosses Coast Yamoransa road.	0.371		4/1	
3	DO	0.152		5/1	
4	Cape Coast near Ghana National	0.391		1/2	Portion of access to tower 1/2 is muddy in the rainy season.
	School.				
5	Ghana National/School for the Deaf		0.475	3/2 - 4/2	Tower 2/2 and 3/2 are located at Ghana Ntional School.
					Portion of track in span 3/2 - 4/2 is muddy in the rainy sea-
					son. Tower 4/2 could be reached through school for the deaf.
6	Cape Coast Aggrey Memoral School	0.252		2/3	
7	Moree Junction area	0.238		3/3	
8	DO	0.144		4/3	
9	Moree Junction area	0.157		1/4	Access passes through hilly areas.
10	Yamoransa area	0.50		2/4 - 3/4	
11	Yamoransa area - road crossing	0.104		2/5	
12	Old Yamoransa road.	0.321		3/5	Portion of road is flooded in the rainy season.
13	Yamoransa/Waakrom area		1.6	4/5 - 2/7	Hilly area. Stream crosses span 4/6 - 1/7. Road exists from
					highway to tower 1/7 at Waakrom. River across span 2/7 - 3/7.
14	Asafora near Biriwa		4.2	3/7 - 4/9	3km of feeder road exist from highway to tower 4/7 at Asafora.
					Hilly and rocky terrain. Steep hills and deep valleys in span
					4/7 - 5/7 and 4/8 - 5/8.
15	Anomabu/Nsafo road.		0.600	4/9 - 2/10	2.5km feeder road exist from highway to link span 1/9 - 2/9.
16	Akurabadze.	0.200	2.786	3/10 - 4/11	Track ends at 2/10. Deep valley in span 2/10 - 3/10. Bypass
					road constructed to link existing farm road which leads to
					tower 3/10.

161KV TRANSMISSION LINE REHABILITATION PROJECT						
MAJOR ACCESS ROADS AND TRACKS CONSTRUCTION						
17	Brofoyedru road				Feeder road from Highway to Brofoyedru links span	
					5/10 - 1/11 3km away	
18	Aduradze		6.375	1/12 - 4/15	Steep hill in span 3/13 - 1/14, 2/13 - 3/13 and 2/15 - 3/15	
19	Otsir road				2.5km feeder road highway to Otsir village exist.	
20	Otsir Village	1.719		2/14 - 3/14	Access link track at span 2/14-3/14from Otsir village.	
21	Afrangua junction near Saltpond			4/14 - 5/14	2.2 km of feeder road from highway to Afrangua links track	
					at span 4/14 - 5/14.	
22	Ewuya near Saltpond			3/15 - 4/15	1.8km feeder road from highway to Ewuya links tracks at	
					span 3/15 - 4/15.	
23	Saltpond area		1.057	4/15 - 3/16	Steep hill at span 4/15 - 1/16 Some portions could be season.	
					flooded in the rainy season.	
24	DO		0.9	3/16 - 1/17		
25	Mankesim area		3.13	1/17 - 1/19	Span 1/18 - 2/18 is hily, likewise 3/18 - 4/18. Stream	
					crosses track at 3/18 - 4/18.	
26	Mankesim area.	0.595		4/18	Access constructed from Highway to bypass stream to	
					link tower 4/18.	
27	Mankesim area where line crosses		0.675	1/19 - 5/19	A road exist outside Mankesim through crowded commu-	
	the Highway				nity to tower 1/20. Span 5/19 - 1/20 is swampy. Track not	
					constructed. River crosses span 1/20 - 2/20. Road not	
					constructed to 2/20 due to difficult terrain.	
28	Mankesim. After the bridge from	1.492		4/20 - 3/20	Tower 4/20 and 3/20 are located at areas that experience	
	Saltpond end.				seasonal flooding	
29	Mankesim/Ekumfi Ayisam area		6.6	4/20 - 1/25	Track passes through fairly good terrain	
30	Ekumfi Asaafa road.				Feeder road exists from highway to link track at span 3/21 -	
					4/21 0.650 km away.	
31	Asaafa area	0.443		2/22 - 3/22	Access road highway links track span 3/22 - 2/22.	
32	Ekumfi Ayisam to Ekumfi Ekotsi area		3.331	2/25 - 1/27		
33	Ekotsi area where line crosses					
	Highway	0.146		2/27		
34	DO		2.763	3/27 - 2/29	Stream crosses span 1/28 - 2/28. Motorable in the dry	
					Season, but difficult to pass in the rainy season. Road	
					exists from Essuehyia to link span 3/28 - 4/32.	
35	Essuehyia		6.286	2/29 - 2/33	Existing feeder road from highway to Kyiren links track at	
					span 3/32 - 4/32	

161KV TRANSMISSION LINE REHABILITATION PROJECT						
MAJOR ACCESS ROADS AND TRACKS CONSTRUCTION						
36	kyiren Road					
37	Gomoah Brofoyedur			8.041	2/33 - 2/38	Stream runs seasonally across span 2/36 - 3/36 and 5/37 -
						1/38. River crosses span at 3/39 - 4/39. Feeder roads
						cross span 3/34 - 1/35 2.2km from highway and span 1/35 -
						2/35 1.5 km from highway near Gomoah Brofoyedur.
38	Apam road			2.247	2/38 - 3/39	
39	Gomoah Abrekum	1.100			3/40	Access links tower to Highway.
40	Gomoah Abrekum Road/Mankwadze					
	road area			5.425	3/39 - 4/42	River crosses span at 3/39 - 1/40. Gomoah Abrekum road
						and Mankwadze road link the track at span 4/41 - 1/42 -
						2/42 respectively
41	DO	0.041			1/43	Access links tower to highway. River crosses span 1/43 - 2/43
42	Gomoah Amanfi to Gomoah					
	Bewuadze area.			5.00	2/43 - 4/46	River crosses span 2/44 - 3/44 at two locations. Road exists
						through commercial farm to tower 2/44. Permission
						required to use this road
	LINE SECTION TAKORADI - CAPECOAST (T2C)					
1	Takoradi Sub-Station.			0.069	1/1	
2	Takoradi Sub-Station.	0.238		0.229	2/1	
3	Kojokrom Christ Divine Church	0.132			3/1	Road passes through school compound. Tower 3/1 is
						located near a burial ground
4	Kojokrom/Mpintim area			4.620	4/1 - 3/4	There is an existing road from the Highway tghrough
						crowded community to tower 4/1 near Nana Katabra 'A'
						J.S.S. school. There are two water channels in span 3/2 -
						4/2. Hilly terrainfrom 4/1 - 3/4. Could pose problem to
						none 4x4 vehicles.
5	Mpintin	0.740		4/2 - 5/2		Access road starts from Mpintin park near the cemetery.
6	Sofokrom, near Latter Day Saints	0.287		4/4		Some portion of access is routed through private property
	Church					(houses).
7	Sofokrom, near school for the Deaf			0.745	5/4 - 3/5	Some portion of road could be muddy. Approach tower
	area					1/5 cautiously. Dangerous and deep valley ahead.

	LINE SECTION TAKORADI - CAPECOAST (T2C)					
8	Inchaban Water Works	0.234		3/5	Access begins from Inchaban water treatment plant.	
9	Inchaban/Wsoko road		2 983	4/5 - 1/7	Span 5/5 - 1/6 and 2/6 3/6 are prone to flooding. Deep	
					valley at one side of track in span 1/6 -3/6. Careful driving	
					is required	
10	Shama junction Konfuku road	0 333		2/7		
11	Shama junction/Appimenyi		4 723	2/7 - 1/10	Water channel crosses span 2/7 - 3/7 at midspan. Deep	
					valley at side of span 1/8- 3/8. Span 4/8 - 5/8 is prone to	
					floding at midspan A road exists from Shama junction to	
					span 1/8 - 2/8. Appimenyi road also crosses span 3/8 - 4/8	
					700 metres from the highwayy. Span 1/9 - 2/9, 3/9 - 4/9	
					4/9 - 1/10, 2/10 - 3/10, are prone to flooding.	
12	Asoku Essman	0 147		5/8 - 1/9	Access leads to midspan of 5/8 - 1/9.	
13	Asoku Essman	0.350		2/9 - 3/9	Access begins from school park andlinks span 2/9 - 3/9.	
14	Kofi Anokrom	0 124		2/10	Access passes through coconut trees.	
15	DO		0.846	2/10 - 1/11		
16	Anto	0.084		4/11	Access from Anto town to towr 4/11.	
17	Aboso area where line crosses the		1.881	2/11 - 2/12	Span 1/12 -2/12 is swampy in the rainy season	
	Highway					
18	Atwereboanda junction near old		0 400	3/12 - 4/12	Existing Aatwereboanda road links span 3/12 - 4/12 . Track	
	Daboase junction.				ends at tower 3/12 - It could be muddy in the rainy season.	
19	Daboase junction.	0 475		5/12 - 1/13	Few metres from the Highway could be swampy in the rainy	
					season. Track to 4/12 could be slippry in the rainy season.	
20	Daboase junction		2 710	5/12-1/14	River crosses span 4/12 - 5/12. A stream crosses span	
					5/12 - 1/13 - Culvert required. Span 1/14 - 2/14 could be	
					flooded.	
21	Beposo Dunkwa near the fuel station.	1 824		3/13 - 1/14	Stream crosses the access road attwo locations. Culverts	
					could solve problems.	
22	Amasa		3.193	1/15 - 4/16	Spans 3/15 - 4/15 and 1/15 - 2/15 could be flooded in rainy	
					seasons. Culverts required. Track is routed through hilly	
					terrain.	
23	Asamasa /Sefwi		1.149	4/16-3/17		
24	Sefwi		0 400	4/17 - 1/18		

LINE SECTION TAKORADI - CAPECOAST (T2C)						
25	Aburansa area			3 917	2/18 - 4/20	A road exists from Aburansa to link span 4/19 - 1/20. Track
						from tower 3/18 - 1/19 could be muddy and slippery. Farm
						road exists from Antadu junction near Kissi to tower 4/20 and
						1/21. Portions of the road are however swampy in the rainy
						season.
	1/21 - 2/21					junction.
27	Antadu/Kyiase area area near Kissi					
	Midspan 3/21 - 421			0.900	4/21 - 2/22	Portions oftrack could be slippery in the rainy season.
						Alternative road exist from Kissi to towr 1/22 and 2/22.
						Shieldwire insulated from tower 2/22 to Cape Coast
						Tower 3/22 is located few metres off the Kissi Kommenda
						junction road.
28	Kissi area near Abandoned fuel					
	station on Highway	0.200			4/22	
29	DO			0.927	4/22 - 3/23	Span 4/22 - 5/22 could be swampy.
30	DO		0.148		1/23 - 2/23	Access links span 1/23 - 2/23
31	DO			0.275	2/23 - 3/23	Road ends at 3/23.
32	Dompoase junction area		0.144		4/23 - 5/23	Access links span 4/23. Swamp close to tower 4/23.
33	Dompoase junction area			0.753	4/23 - 1/24	
34	DO		0.026		2/24	Towers are close to highway, so short acces roads were
						constructed to link individual towers. Tower 1/25, 2/26
						and 3/26 are located in towns, Anyinase and Ayensudo
						respectively. Steep hills and valleys at side of access road
						linking tower 3/37 and 4/37.
35	DO		0 167		3/24	
36	DO		0.252		4/24	
37	Anyinase		0 089		2/25	
38	DO		0 024		3/25	
39	DO		0.027		1/26	
40	Anyinase	0.100			4/26	
41	DO		0 078		1/27	
42	DO	0 090			2/27	

LINE SECTION TAKORADI - CAPECOAST (T2C)						
43	DO	0 497		3/37		
44	DO	0.262		4/37		
45	Adu-Agyei area	0 293		1/28	Tower 1/28 and 2/28 are located in hilly areas	
46	DO	0 224		2/28		
47	Adu-Agyei area	0 121		3/38		
48	DO	0 024		5/28	4/28 is located very close to Highway; no access road	
					constructed.	
49	DO	0 03		1/29		
50	Mpasem	0 093		2/29		
51	DO	0 066		4/29	Tower 3/29 is located at Mpasem town, no access road	
					constructed.	
52	Alebadze	0 068		1/30	Portion of access to 1/30 could be swampy.	
53	Alabadze/Bronyibima area		0 800			
54	Bronyimbima		2.9	4/30 - 3/32	Sanka road exists from Highway to link tower 3/32. Large	
					swamp in span 3/32 - 4/32.	
55	Bronyimbima - Elimina Junction		1.185	4/23 - 2/33	Track in span 5/32 - 1/33 could be swampy. Tower 3/33 is	
					located at Archibishop Porter Girls Pol; technic.	
56	Elimina/Ankafo road Near Archibi-		1.524	1/34 - 5/34	Deep valley at side of track to tower 1/34. Track to 5/34 is	
	shop Porter School.				slippery. River crosses span 5/34 - 1/35.	
57	Elimina/Ankafo road after SSNIT Flats	0.921		3/34	Access links tract at tower 3/34.	
58	Afrakwan road near Ankafo prisons			1/35	A road exists from Akrakwan village where tower 1/35 is	
					located.	
59	Afrakwan		1.393	1/35 - 4/35	Spans 3/35 - 4/35 and 2/35 - 3/35 could be flooded in rainy	
					seasons. Large river across span 4/35 - 1/36.	
60	Cape Coast Highway		2.0	1/26 - 1/37	Portion of track in span 1/37 - 4/36 is muddy in rainy season.	

FROM :

PHONE NO. : 0023321666476 Jan. 03 2003 12:42PM P2

WILDLIFE DIVISION

(FORESTRY COMMISSION)

In case of reply the number
And the date of this
Letter should be quoted
Tel: 664654/662360
Fax: (233)-21-666476
TELEX: 2851 GH. WILDLIFE

Head Office
Post Office Box M.239
Ministry Post Office
Accra

Our Ref No. WD/A.186/VOL.5/7
Your Ref. No.

REPUBLIC OF GHANA

December31, 2002

MR. E. DARKO-MENSAH
MANAGING CONSULTANT
REFAST
GHANA

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY OF PROPOSED 330KV COASTLINE TRANSMISSION LINE PROJECT (ABOADZE-TEMA)

Re. Your letter number RF/EIA/0205 dated 20th November, 2002.

Please find below our concerns on the EIA study of the proposed 330KV Coastal Transmission Line Project (Aboadze-Tema).

- The proposed 330 KV Coastline Transmission Line Project passes through the Muni-Pomadze wetlands from Onyadze – Ahwerenkwanta. The area was designated a Ramsar Site in 1992 under the International Convention on Wetlands (Ramsar, Iran, 1971).
- Two areas within the site, and making up about 10% of its total land area, have been designated as forest reserves; Yenku Block A Forest Reserve and Yenku Block B Forest Reserve.
- Over 60% of known wetland bird species are represented with the site being particularly important for terns including the "rare" (IUCN) Roseate Tern.
- The area supports internationally significant numbers of black-winged stilt, and an estimated population of 23,000 waterfowl, including 27 species of waders, eight species of terns, and seven species of herons and egrets.
- Majority of the avifauna are palaearctic migrants.
- The adjoining wetland is especially important for its populations of the following economically important terrestrial vertebrate fauna: *Tragelaphus scriptus, Cephalophus niger, C. maxwelli, Neotragus pygmaeus, Thryonomys swinderianus, Python regius, Varanus niloticus, V. exanthematicus*. Other important fauna are *Criccetomys gambianus, Lemniscomys strietus*, the rare *Calabaria rainhardtii, Naja nigricolis, Dendroaspis viridis, Kinixys belliana*, and several anuran species (Amphibians)

We would therefore be grateful if the pylons to be used shall take care of nesting and roosting birds as the trees and shrubs serving these purposes will be destroyed in the execution of the project.

FOR: EXECUTIVE DIRECTOR
MIKE ADU-NSIAH