SWISS AFRICAN PETROLEUM AG

YNYS MON CONSULT

SCOPING REPORT

FOR

2D SEISMIC SURVEY PROJECT IN THE KETA DELTA BLOCK OF THE VOLTAIAN BASIN



Prepared for Swiss African Oil Company (SWAOCO)

Report No. SA-KDB-SR

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1.0. BACKGROUND

Ghana is endowed with sedimentary basins with significant hydrocarbon accumulation. These basins are offshore Western Basin, Central Basin, Eastern Basin and Onshore Voltaian Basin. Hydrocarbon exploration in Ghana started in 1896. Commercial production began in 1970 from the Saltpond discoveries in the Central basin.

The promulgation of PNDCL 64 (1984) establishing the GNPC resulted in increased offshore activities. GNPC accelerated the exploration process leading to the acquisition, processing and interpretation of first 3D seismic over the South Tano Field and subsequently to the drilling of three wells over the field by GNPC between 1991 and 1994.

In the Onshore areas the British Geological Survey Department and other researchers conducted some initial studies in the Basin over 100 years ago. The Soviet Geological Team drilled 10 hydrogeological boreholes down to 150-750 m in the 1960s. Shell acquired wide grid aeromagnetic data (18,000 line km) and 2D seismic data (208 line km) between 1971 and 1977.

From around 2000, there was a gradual and systematic shift of focus in the offshore from the shallow water (depth of 0-200metres) to the deep-water (depths of over 200metres) areas. The spate of activity in the deep-water areas was occasioned by other deep-water discoveries in the region and more importantly, by the results of four deep-water wells drilled between 1999 and 2003. The results of these wells proved the existence of an active petroleum system in the deep-water area.

The most significant result occurred in 2007 with the Mahogany and Hyedua discoveries by a consortium of Kosmos Tullow and Anadarko in the West Cape Three Points concession area. Preliminary evaluation proved that these discoveries, lying in two separate concession blocks, are of common origin. The discoveries were therefore unitized and developed as a single field named Jubilee Field to mark the coincidence of the discoveries with Ghana's Golden Jubilee year.

Ghana is making strides in the development of its oil and gas resources and now focusing on the Keta Basin. The Keta Delta Block is approximately 3,000km^2, and lies in water depth of varying ranges both onshore and offshore. The Keta Delta Block covers the southern-most part of the Volta Delta and transitions into offshore and encompasses the entire Keta Lagoon complex. The onshore part of the block covers all of the Keta Municipality, part of Ketu South, part of South Tongu and part of Ada East. The block covers over 200 communities located in the municipalities and districts listed above.

The Swiss African Oil Company (SWAOCO) is a subsidiary of Swiss African Petroleum AG has a mission to establish a niche, mid-tier independent exploration and production company focusing on crude oil, natural gas and gas liquids in coastal Africa. SWAOCO has a proven commitment to Africa and a track record of developing and operating successful natural resource business interests. SWAOCO provides a full complement of technical, managerial,

and financial expertise in the energy and natural resource industry and also forms technical alliances for specialty work. SWAOCO's business objective is to build sustainable, long-term growth. This objective also assures responsible protection of environments in which the Company operates with safety and security for all concerned. The Company is committed to mitigating any negative impact of its operations while creating shared prosperity for all stakeholders. Good corporate and operating governance from the Board of Directors to all employees and contractors ensures that risk management is in place and ultimately protects all those involved as well as the Company's reputation. Shared prosperity through employing local people, purchasing local goods and services as well as building local capacity is a core Company value. This is accomplished through a strong team with excellent skills; experience and a "can-do" attitude.

In December 2014, SWAOCO was awarded the newly defined 3,000km^2 Keta Delta Block. Pet Volta Investments Limited and GNPC are participants to this block and SWAOCO is the designated operator amongst these partners to spearhead this campaign by carrying out both onshore/offshore seismic surveys in the basin.

As part of exploration activities, the partners intends to shoot a seismic over the entire block to obtain the needed data necessary for further exploratory activities in the basin. To comply with environmental regulations, an Environmental Impact Assessment (EIA) has to be carried out, which is a prerequisite to obtaining an environmental permit from the Environmental Protection Agency (EPA) for the proposed activities to commence.

In line with the Environmental Protection Agency (EPA) Act 1994 (Act 490) and the Environmental Assessment Regulation 1999, LI 1652 an EIA study is required to understand the likely environmental implications of the proposed project viz., the potential environmental and social impacts, as well as the project alternatives and to propose mitigation measures. It is expected that, the outcome of the EIA study will assist SWAOCO to consider the consequences of a range of actions early in the planning process, to choose the most appropriate action on environmental as well as socio- economic grounds, and to minimize any cumulative impacts.

In keeping with LI 1652, the proposed project has been registered with the Environmental Protection Agency (EPA) under the cover of Swiss African Oil Company (SWAOCO). The EPA in a response letter referenced **CE:5793 and dated 31st October,2016**, shown as Annex 1 confirmed that the project falls in a category for which an EIA study is required, and thus requested the preparation of a Scoping Report as per the provisions of LI 1652. A Scoping Notice, which aims at inviting public comments on the proposed project, was advertised in The Daily Graphic, a national newspaper on **Tuesday, 3rd October 2017** and a copy is attached to this scoping report as Annex 2.

1.1 Project Justification

Ghana has potential oil and gas reserves onshore too and the Keta Basin provide the potential for onshore oil and gas exploration and production. While historical indications of hydrocarbons were identified in the Keta Delta, offsetting wells in Togo, within 50km of the Delta, demonstrated excellent oil and gas potential in the cretaceous and paleozoic successions. Industry analysts believe that there is unrealized hydrocarbon potential within the Keta Basin including the Volta Delta. Some analysts have put expected barrels of oil from the Keta Basin area at about 100 million hence the need for the seismic activities to acquire the necessary data required for locating drilling "sweet spots".

A number of explorations have been carried out in the Keta basin suggesting that the petroleum potential shows exploration plays both in the Tertiary and in the Upper cretaceous. These include an Albian growth fault play, Cretaceous basin floor fans, ponded turbidites, Tertiary basin floor fan and drape anticlines. Uncertainties include migration pathways, seals and potential reservoir quality.

Significant leads have been identified in this basin and may develop into drillable prospects with further analysis. Most of the leads will receive and entrap oil expelled in late Cretaceous and early Tertiary. The quality of reservoirs remains an uncertainty in the area and has been assessed mainly by analogy with nearby oil and gas fields. In summary, seismic interpretation of this area suggests that the area is highly prospective.

1.2. Objectives of the Scoping Study

The objectives of the scoping study are to:

i. identify the main stakeholders and their concerns and values;
ii. identify environmental and social impacts of the proposed project;
iii. assess mitigation and management measures proposed to mitigate environmental and social impacts;
iv. identify reasonable and practical alternatives to address identified environmental and social concerns for the project activities where necessary;
v. focus on the important issues and significant impacts to be addressed in the EIA study;
vi. define the boundaries for the EIA in time, space and subject matter;
vii. set requirements for the collection of baseline data and other relevant information; and
viii. establish the Terms of Reference (ToR) for the EIA study.

1.3. Approach /Methodology for the Scoping Study

The approach and methodology adopted for the study included:

i. Field Visits;
ii. Consultations;
iii. Literature Review; and
iv. Data analysis and Reporting.

1.3.1 Field Visits

A number of surveys were carried out to the site of the proposed project to inspect and confirm the project area, and to identify the potential impacts of the proposed project.

1.3.2. Consultation of Stakeholders

Initial one-on-one stakeholder consultations have been carried out to obtain comments and concerns on the proposed project with the following groups:

i. EPA Head Office, Accra- Petroleum Department;
ii. Project Staff of GNPC;
iii. Chiefs and People of the Keta Municipal, Ketu South Municipal, Ada East District and South Tongu; and
iv. Institutions that have jurisdiction and regulate activities/ operate in the basin e.g., Fisheries Commission (FC), Water Resources Commission (WRC), Ghana Maritime Authority (GMA), Petroleum Commission (PC), Forestry Commission (FC), Lands Commission (LC).

Indeed, a multi-stakeholder consultation had been carried out in 2015/2016 in all the affected District Assemblies (DAs) by the partners, GNPC and SWAOCO at strategic locations in the districts with the aim of seeking concerns and sensitizing the citizens regarding the proposed seismic survey so as to put in place appropriate mitigation measures to address any concerns in the EIA study. Some key issues raised in the stakeholder consultations are as summarized hereunder:

i. concerns with regards to land compensations and the modalities for payment where the onshore seismic survey will affect their farm lands and communities'
ii. concerns with regards to whether the onshore seismic survey will cause cracks in their buildings or even cause earthquakes to occur;
iii. concerns with regards to employment opportunities for the local people in the affected communities during the seismic survey; and
iv. concerns with whether offshore seismic survey will affect fishing activities and how SWAOCO intends to mitigate these concerns.

1.3.3 Literature Review

A number of documents were reviewed for the Scoping Study. These included project documents on activities carried out by GNPC and its partners over the years. The literature included the following:

a. The Project Description;
b. Preliminary Engineering Drawings Showing Location of the project;
c. Information from some relevant environmental reports; and
d. Internet sources.

1.3.4. Data Analysis and Reporting

The data obtained from the desk and field studies were analysed and the results have been presented in this Scoping Report. The major headlines making the report are:

a) Introduction;
b) Legal and institutional framework for the project;
c) Description of the proposed project;
d) Alternative consideration;
e) Description of existing environmental and social conditions;
f) Consultations;
g) Environmental issues and considerations;
h) Proposed terms of reference; and
i) Conclusion

2.0.LEGAL FRAMEWORK OF THE PROPOSED PROJECT

2.1. Policy Framework

The relevant national policies to guide the proposed project implementation include the following national and international policies:

i. 1992 Constitution of the Republic of Ghana;
ii. Environment Policy;
iii. Energy Policy;
iv. Land Policy; and
v. Water Policy.

2.1.1 Relevant National Policies

1992 Constitution of the Republic of Ghana

The implementation of the proposed project may involve expropriation of land/ property and/ or acquisition of right of way by SWAOCO. Since the Constitution provides for the protection of property rights and natural resources, all affected properties and natural resources along the proposed seismic lines will be appropriately identified, properly valued and adequate compensation paid as outlined in clause 20 of 1992 Republican Constitution.

National Environmental Policy

The Ghana National Environmental Policy was formulated in 1995 and re-launched in 2014. The ultimate aim of the National Environmental Policy of Ghana is to improve the surroundings, living conditions and the quality of life of the entire citizenry, both present and future. It seeks to promote sustainable development through ensuring a balance between economic development and natural resource conservation. The policy thus makes a high quality environment a key element supporting the country's economic and social development.

The Ghana National Environmental Policy presents a road map to address major environmental threats jeopardizing the natural and common resource base of the country and has integrated the most urgent environmental concerns of present time to provide clear strategies for overcoming existing hurdles.

Energy Policy

The Energy Policy formulated in 2010 provides that the vision of the sector is to develop an Energy Economy to secure a reliable supply of high quality energy services for all sectors of the economy and also become a major exporter of oil and power by 2012 and 2015 respectively.

National Land Policy

The Land Policy of Ghana aims at the judicious use of the nation's land and all its natural resources by all sections of the Ghanaian society in support of various socio-economic activities undertaken in accordance with sustainable resource management principles and in maintaining viable ecosystems. The specific objectives of this policy include: -

i. Ensure that Ghana's international boundaries are maintained at all times and cross border activities are managed jointly.

ii. Ensure that shared water bodies are utilised to the mutual benefit of all stakeholder countries.

iii. Ensure that every socio-economic activity is consistent with sound land use through sustainable land use planning in the long-term national interest.

iv. Protect the rights of landowners and their descendants from becoming landless or tenants on their own lands.

v. Ensure the payment, within reasonable time, of fair and adequate compensation for land acquired by government from stool, skin or traditional council, clan, family and individuals.

vi. Instill order and discipline into the land market to curb the incidence of land encroachment, unapproved development schemes, multiple or illegal land sales, land speculation and other forms of land racketeering.

vii. Minimise, and eliminate, where possible, the sources of protracted land boundary disputes, conflicts and litigations in order to bring their associated economic costs and socio-political upheavals under control.

viii. Create and maintain effective institutional capacity and capability at the national, regional, district, and where appropriate, community revels for land service delivery.

ix. Promote community participation and public awareness at all levels in sustainable land management and development practices to ensure the highest and best use of land, and thereby guarantees optimum returns on land.

x. Promote research into all aspects of land ownership, tenure and the operations of the land market and the land development process.

xi. Ensure continuous education of the general public on land matters.

National Water Policy

The Water Policy of Ghana provides a framework for the sustainable development of Ghana's water resources. It is targeted at all water users, water managers and practitioners, investors, decision-makers and policy makers within the central Governmental and decentralised (district assemblies) structures, non-Governmental organisations and international agencies. The policy also recognises the various cross-sectoral issues related to water-use and the links to other relevant sectoral policies such as those on sanitation, agriculture, transport, energy etc.

Most part of the project area is wetland will be constructed which will necessitate working on water ways.

2.1.2. Relevant International Policies

World Bank Safeguard Policies

The World Bank's environmental and social safeguards policies covering ten (10) key categories in a form of Operational Policies (OPs) are operationalised when triggered by the proposed project's scope. The policies/procedures are to ensure the safe development of

projects it is funding. That is to prevent and mitigate unintended adverse effects on third parties and the environment in the development process. These Environmental and Social Safeguard Policies are discussed briefly in ***Table 1*** and provides an indication of whether the WB policy is triggered by the proposed Keta Delta seismic project.

Table 1: Summary of World Bank Safeguard Policies

No	*World Bank Safeguard Policy*	*Summary of core requirements*	*Potential for Trigger under proposed project*	*Remarks or recommendation for proposed project*
1	**OP 4.01 Environmental Assessment**	Requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. The EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and transboundary and global environmental aspects. It categorises proposed projects into categories A, B, C or FI based on the extent of adverse impacts anticipated from the project.	Triggered	The proposed project requires the conduct of an ESIA
2	**OP 4.04: Natural Habitats**	Do not finance projects that degrade or convert critical habitats. Support projects that affect non- critical habitats only if no alternatives are available and if acceptable mitigation measures are in place. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water areas where most of the native plant and animal species are still present).	Potentially triggered	The Keta Lagoon Complex is within the project area and a designated RAMSAR Site. All potential impacts to the RAMSAR Sites/ Wetlands will be identified and mitigation measures provided
4	**OP 4.36: Forest**	Aim is to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development. Support sustainable and conservation oriented forestry. Do not finance projects that involve significant conversion or degradation of critical forest areas.	Not triggered	Project location and design will not affect any critical forests.

6	**OP 4.11: Physical Cultural Resources**	Investigate and inventorise cultural resources potentially affected. Include mitigation measures when there are adverse impacts on physical cultural resources or avoid if possible	Potentially triggered	Potential impact on culturally sensitive areas will be identified in this project and mitigation measures provided.
7	**OP 4.12: Involuntary Resettlement**	Assist displaced persons in their effort to improve or at least restore their standards of living. Avoid resettlement where feasible or minimise. Displaced persons should share in project profits. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts. The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.	Potentially triggered	The seismic lines/ operations may impact peoples properties including farmlands etc. As much as possible, buildings will be bypassed while crops will be compensated for when damaged in course of the works etc
8	**OP 4.10: Indigenous Peoples**	Screen to determine presence of indigenous peoples in project area. Policy triggered whether potential impacts are positive or negative. Design mitigation measures and benefits that reflect indigenous peoples' cultural preferences.	Not triggered	No indigenous groups have been identified
9	**OP 4.37: Safety of Dams**	Requires that experienced and competent professionals design and supervise construction, and that the borrower adopts and implements dam safety measures through the project cycle. The policy distinguishes between small and large dams by defining small dams as those normally less than 15 meters in height. Large dams are 15 meters or more in height.	Not triggered	Proposal does not involve the construction of a dam
10	**OP 7.50: Projects on International Waterways**	Ascertain whether riparian agreements are in place, and ensure that riparian states are informed of and do not object to project interventions.	Not triggered	Proposed site is neither a bay, gulf, strait, or channel bounded by two or more states nor a necessary channel of communication between the open sea and other states
11	**OP 7.60: Projects in Disputed Areas**	Ensure that claimants to disputed areas have no objection to proposed project.	Not triggered	The project area is not in a disputed/ conflict zone

IFC Performance Standards

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing.

The Performance Standards may also be applied by other financial institutions electing to apply them to projects in emerging markets. Together, the eight Performance Standards establish standards that the client is to meet throughout the life of an investment by IFC or other relevant financial institution:

- Performance Standard 1: Social and Environmental Assessment and Management System
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

In addition to meeting the requirements under the Performance Standards, proponents/ clients must comply with applicable national laws, including those laws implementing host country obligations under international law.

Equator Principles

The Equator Principles are a voluntary set of guidelines developed by leading financial institutions for managing environmental and social issues in project finance lending. The guidelines are based on the environmental and social standards of the IFC (i.e. IFC Performance Standards), and apply globally to development projects with a capital cost of US$10 million or more in all industry sectors. These principles are intended to serve as a common baseline and framework for the implementation of participating institutions' individual, internal environmental and social procedures and standards for project financing activities across all industry sectors globally.

The Equator Principles of July 2006 is fully consistent with recently revised IFC Performance Standards. Currently, over 60 financial institutions have adopted the Equator Principles.

The Equator Principles aim is to ensure that prior to agreeing to provide financing, (a) a project has been subject to an appropriate level of environmental and social assessment in accordance with the requirements of the IFC Performance Standards (2006) and (b) that the project will implement appropriate measures for the management of environmental, social and health issues during construction, operation and decommissioning phases.

By adopting the Equator Principles, financial institutions undertake to review carefully proposals for which their customers request project financing. They commit not to provide loans to projects where the borrower will not, or is unable to, comply with the requirements of the IFC Performance Standards.

2.1.3. Relevant National Legislations

The relevant Ghanaian environmental and other statutory laws and regulations to guide SWAOCO from conception of the proposed project to implementation and monitoring include the following:

i. Ghana National Petroleum Corporation (GNPC) Law 1983, PNDC Law 64;
ii. Petroleum Commission Act, 2011 Act 821;
iii. Petroleum (Local Content and Local Participation) Regulations 2013, LI 2204;
iv. Petroleum (Exploration and Production) Act 2016, Act 919;
v. Petroleum Fees and Charges Regulation 2015 LI 2221,
vi. Ghana Maritime Authority Act 2002, Act 630;
vii. Ghana Investment Promotion Centre Act 2013, Act 865;
viii. Environmental Protection Agency Act 1994, Act 490;
ix. Environmental Assessment Regulations 1999, LI 1652;
x. Fees and Charges (Amendment) Instrument, 2015, LI 2228;
xi. Local Government Act 1993, Act 462;
xii. Factories, Offices and Shops Act 1970, Act 328;
xiii. The Labour Act 2003, Act 651;
xiv. The Fire Precaution (Premises) Regulations 2003, LI 1724;
xv. Abandoned Property (Disposal) Act 1974, NRCD 308
xvi. Oil in Navigable Waters Act 1964, Act 235;
xvii. Wetland Management (RAMSAR Sites) Regulations, 1999; and
xviii. Relevant international conventions such as MARPOL, ISPS etc.

Ghana National Petroleum Law1983, PNDCL 64

GNPC was established in 1983 by the Ghana National Petroleum Law 1983 PNDCL 64. GNPC is a corporate body established under the Ministry of Energy to promote, explore, develop and regulate Ghana's hydrocarbon resources. GNPC is empowered to conduct petroleum operations and partner with foreign investors to promote the economic development of Ghana.

Petroleum Commission Act, 2011 Act 821

As the Upstream Petroleum Regulator, the Petroleum Commission established under Act 821 is mandated to regulate, manage and co-ordinate all activities in the Upstream Petroleum Industry for the overall benefit and welfare of Ghanaians. The commission work to promote local content and local participation programmes, creating the best possible values through prudent and sustainable management of oil & gas resources.

SWAOCO will ensure that all permits relating to the seismic project obtainable from the Petroleum Commission is duly acquired.

Petroleum (Local Content and Local Participation) Regulations 2013, LI 2204

The regulations apply to local content with respect to petroleum activities in the country. It enjoins all entities engaged in upstream petroleum activities to ensure that local content is a component of the petroleum activities engaged in by the entity and that technology transfer in the petroleum industry should be a priority.

SWAOCO is require under LI 2204 to provide a local content plan to the commission.

Petroleum (Exploration and Production) Act 2016, Act 919

The Petroleum (Exploration and Production) Act 2016, Act 919 all relates to petroleum activities within the jurisdiction of Ghana including all activities in, under and upon all its territorial land, inland waters, territorial seas, exclusive economic zone and its continental shelf. The objective is to provide for and ensure safe, secure, sustainable and efficient petroleum activities in order to achieve optimal long term petroleum resource exploitation and utilisation for the benefit and welfare of the people of Ghana. The law confirms that all petroleum resources in its natural state within the confines of Ghana is for the people of Ghana and vested in the President on behalf of and in trust for the people of Ghana. Hence the necessary licenses and agreements is required to exploit the resource.

Petroleum Fees and Charges Regulation 2015, LI 2221

The regulation specifies the need to register and obtain a permit from the Petroleum Commission to provide service in the upstream petroleum industry in Ghana. It provides the fees and charges applicable to operators in the upstream petroleum industry in Ghana.

Ghana Maritime Authority Act 2002, Act 630

The Ghana Maritime Authority (GMA) Act 2002, Act 630 gives mandate to the Ghana Maritime Authority to advise Government on maritime matters and assist the Ministry of Transport (MOT) to formulate policies, monitor, regulate and coordinate activities and programmes of the various sub-sectors in the maritime industry.

GMA is mandated to ensure the safety of navigation, fulfil flag state and port state responsibilities in an effective and efficient manner, regulate the activities of shipping in the inland waterways including the safety of navigation in inland waterways. GMA is the main body for national planning purposes in relation to the maritime sector.

The seismic activities will occur within maritime and inland waters in the Keta Block, hence the need for close collaboration with GMA.

Ghana Investment Promotion Centre Act 2013, Act 865

The Ghana Investment Promotion Centre (GIPC) Act 2013 (Act 865) which repeals the GIPC Act 1994 (Act 478) requires Ministries, Departments and Agencies (MDAs) to collaborate with GIPC in the performance of its duties under the Act. The Act further specifies that "A person who intends to establish an enterprise for the purposes of this Act shall incorporate or register the enterprise in accordance with the Companies Act 1963, Act 179 and other laws that are relevant to the establishment of the enterprise."

The other laws mentioned in the above statement may include EPA Act 1994, Act 490 and the Environmental Assessment Regulation (EAR) 1999, LI 1652, which ensures environmental compliance of the proposed undertaking.

Environmental Protection Agency Act 1994, Act 490

The Environmental Protection Agency (EPA) Act 1994 (Act 490) gives mandate to the Agency to ensure compliance of all investments and undertakings with laid down Environmental Assessment (EA) procedures in the planning and execution of development projects, including compliance in respect of existing ones.

Environmental Assessment Regulations 1999, LI 1652

The Environmental Assessment Regulations 1999 (LI 1652) enjoins any proponent or person to register an undertaking with the Agency and obtain an Environmental Permit prior to commencement of the project. Environmental Impact Statement (EIS) and other related reports are necessary prerequisites to empower EPA issue the environmental permit for any undertaking.

The Fees and Charges (Amendment Instrument, 2015 (LI 2228)

The Fees and Charges (Amendment) Instrument, 2015 (LI 2228) gives regulation to the fees and charges (Miscellaneous Provision) Act 2009, Act 793. The law provides comprehensive rates, fees and charges collectable by Ministries, Department and Agencies (MDAs) for goods and services delivered to the public. The LI 2228 therefore repeals the Fees and Charges (Amendment) Instrument, 2014 (LI 2216) and previous instruments including the Environmental Assessment Regulations (Amendment) 2002 (LI 1703) which originally stipulated the fees and charges to be paid by proponents with respect to Environmental Permits and Certificates.

SWAOCO will be required to pay the appropriate Processing and Permit fees for the Environmental Permit to be issued by EPA.

Local Government Act 1993, Act 462

Development control functions are principally carried out under the Local Government Act 1993, Act 462, Town and Country Planning Law Cap 84 of 1945 and Building Regulations 1996, LI 1630. The Local Government Act 462 stipulates that a written permission is required from the relevant District Assembly to undertake any physical development. Section 49 subsection 1 of the Act 462 states that "No physical developments shall be carried out in a district without prior approval in the form of written permit granted by the District Planning Authority". Subsection 2 of section 49 of the Act indicates that the National Building Regulations 1996 shall specify the type of development and the form and procedure for securing a permit.

The Local Government Act 1993, Act 462 also empowers the Assemblies to establish Waste Management Departments to be responsible for the development and management of waste disposal within their areas of jurisdiction.

SWAOCO will be required to liaise with the respective district/ municipal assemblies for any waste to be disposed of appropriately and to acquire permits for any physical development necessary for the seismic operations.

Factories, Offices and Shops Act 1970, Act 328
The Factories, Offices and Shops Act of 1970 (Act 328) requires all proponents to register every factory/workplace with the Chief Inspector of Factories Inspectorate Division (FID). The Act makes provision of among others, the notification of accidents/dangerous occurrences including safe passages and the prevention of fires etc.

A close collaboration should therefore be sought with the FID of the Ministry of Employment and Labour Relations in ensuring safety at the project site.

The Labour Act 2003, Act 651
Section 118(1) of the Labour Act 2003 (Act 651) stipulates that it is the duty of an employer to ensure that every worker employed works under satisfactory, safe and healthy conditions.

A close collaboration should therefore be sought with the National Labour Commission (NLC) in ensuring agitation free labour environment and to ensure project sustainability.

The Fire Precaution (Premises) Regulations 2003, LI 1724
The Fire Precaution (Premises) Regulations 2003 (LI 1724) requires all premises intended for use as workplaces to have Fire Certificates.

The appropriate fire certificates should be sought with the Ghana National Fire Service (GNFC) as stipulated by LI 1724.

The Abandoned Property (Disposal) Act 1974, NRCD 308
The NRCD 308 provide for the vesting of scrap metal, the manner in which scrap metal should be dealt with, and for related matters. The act applies to how scrap metal, timber, hoarding and signboards that are on public land, roads and or obstruct a road user may be removed by an authorised officer and disposed of. The Act provides the procedures by which such “abandoned property” could be disposed of by an authorized officer.

SWAOCO and partners may provide the needed applications to the relevant authorities to remove any scrap or abandoned property that may be in the Right of Way (RoW).

Oil in Navigable Waters Act 1964, Act 235
The Oil in Navigable Waters Act, 1964 (Act 235) makes provision for preventing the pollution of the sea and of navigable waters by oil. Methods approved by international authorities (i.e. MARPOL 73/78) for containing or treating discharges would be strictly followed to prevent or minimise any oil pollution.

Wetland Management (RAMSAR Sites) Regulations, 1999
These Regulations, in exercise of the powers conferred on the Minister responsible for Forestry by section 11 of the Wild Animals Preservation Act 1961, establishes wetlands ("RAMSAR sites") for purposes of the Convention of Wetlands of International Importance especially as Waterfowl Habitat and assigns specified powers to the Minister responsible for lands and forestry, the Director of the Wildlife Division of the Forestry Commission and District Assemblies in respect of such sites. The Regulations also define activities in such sites that are prohibited or restricted. The Minister may declare closed seasons during which

certain activities such as fishing are prohibited. A District Assembly at where a RAMSAR Site is located may in consultation with the Minister, by Bye-law, prescribes custody and traditional conservation practices which are compatible with the RAMSAR Convention and permitted under these Regulations.

SWAOCO will ensure that all activities in the basin do not adversely impact on the designated Ramsar site of the Keta Basin.

2.2. National Environmental Guidelines

The environmental guidelines considered included:

i. National Effluent Quality Discharge Guidelines;
ii. National Ambient Air Quality Guidelines; and
iii. National Ambient Noise Level Guidelines.

2.2.1. National Effluent Quality Discharge Guidelines

The national general effluent quality discharge guideline levels as administered by the EPA are as provided in Table 2.

Table 2: General Effluent Quality Guidelines for Discharge into Natural Water Bodies – Maximum Permissible Levels

Parameter	EPA Recommended Guideline Value
pH	6 – 9
Temperature Increase	<3^{o}C above ambient
Colour	200 TCU
Turbidity	75 NTU
Conductivity	1500 uS/cm
Total Suspended Solids	50 mg/l
Total Dissolved Solids	1000 mg/l
Oil/Grease	5.0 mg/l
Sulphide	1.5 mg/l
Total Phosphorus	2.0 mg/l
Biochemical Oxygen Demand	50 mg/1
(BOD_5)	250 mg/1
Chemical Oxygen Demand (COD)	50 mg/1
Nitrate	1.0 mg/l
Ammonia as N	150 mg/l
Alkalinity as $CaCO_3$	2.0 mg/l
Phenol	0.005 mg/
Mercury	1.0 mg/l
Total Arsenic	0.1 mg/l
Soluble Arsenic	0.1 mg/l
Lead	0.5 mg/l
Total Pesticides	10 mg/l
Fluoride	250 mg/l
Chloride	200 mg/l

Parameter	EPA Recommended Guideline Value
Sulphate	400 MPN/100ml
Total Coliforms	0 MPN/100ml
E. coli	0.1 mg/l
Cadmium	0.1 mg/l
Chromium (+6)	0.5 mg/l
Total Chromium	5.0 mg/l
Copper	0.5 mg/l
Nickel	1.0 mg/l
Selenium	10.0 mg/l
Zinc	5.0 mg/l
Silver	5.0 mg/l
Tin	5.0 mg/l
Aluminum	5.0 mg/l
Antimony	0.05 mg/
Benzo (a) pyrene	

(Source: Environmental Protection Agency, Accra 1997)

2.2.2. National Ambient Air Quality Guidelines (NAAQG)

The guideline provides for permissible levels for a variety of air pollutants as shown in **Table 3.**

Table 3: National Ambient Air Quality Guideline Values

Substance	Time Weighted Average (TWA)		Averaging Time
Sulphur Dioxide (SO_2)	900 µg/m^3	Industrial	1 hr
	700 µg/m^3	Residential	1 hr
	150 µg/m^3	Industrial	24 hr
	100 µg/m^3	Residential	24 hr
	80 µg/m^3	Industrial	1 yr
	50 µg/m^3	Residential	1 yr
Nitrogen Oxides (measured as $N0_2$)	400 µg/m^3	Industrial	1 hr.
	200 µg/m^3	Residential	1 hr.
	150 µg/m^3	Industrial	24 hr
	60 µg/m^3	Residential	24 hr
Total Suspended Particulate	230 µg/m^3	Industrial	24 hr
	150 µg/m^3	Residential	24 hr
	75 µg/m^3	Industrial	1 yr
	60 µg/m^3	Residential	1 yr
PM_{10}	70 µg/m^3		24 hr
Smoke	150 µg/m^3	Industrial	24 hr
	100 µg/m^3	Residential	24 hr
	50 µg/m^3	Industrial	1 yr
	30 mg/m^3	Residential	1 yr

Substance	Time Weighted Average (TWA)		Averaging Time
Carbon Monoxide	100 mg/m^3 60 mg/m^3 30 mg/m^3 10 mg/m^3		15 min 30 min 1 hr 8 hr
Hydrogen Sulphide	150 µg/m^3		24 hr
Mercury	1 µg/m^3		1 yr
Lead	2.5 µg/m^3		1 yr
Cadmium	10 - 20 ng/m^3		1 yr
Manganese	1 µg/m^3		24 hr
Dichloromethane (Methylene Chloride)	3 mg/m^3		24 hr
1,2-Dichloroethane	0.7 mg/m^3		24 hr
Trichloroethane	1 mg/m^3		24 hr
Tetrachloroethene	5 mg/m^3		24 hr
Toluene	8 mg/m^3		24 hr
Arsenic	30 ng/m^3	Industrial	24 hr
	15 ng/m^3	Residential	24 hr
Flouride	10 µg/l		24 hr
Ozone			

(Source: Environmental Protection Agency, Accra 1997)

2.2.3. National Ambient Noise Level Guideline (NANLG)

The guideline provides for permissible night and day noise levels for variety of settings ranging from residential areas with negligible or infrequent transportation to predominantly heavy industrial areas as shown in **Table 4**.

Table 4: National Ambient Noise Quality Guideline Values

ZONE	DESCRIPTION OF AREA OF NOISE RECEPTION	PERMISSIBLE NOISE LEVEL IN dB(A)	
		DAY 0600 - 2200	NIGHT 2200 - 0600
A	Residential areas with low or infrequent transportation	55	48
B1	Educational (school) and health (hospital, clinic) facilities	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, places of entertainment or public assembly, and places of worship located in this zone	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

(Source: Environmental Protection Agency, Accra 1997)

2.3. Relevant International Conventions

The proposed project will cover both marine and inland waters of the Keta Delta system, which is a designated Ramsar site.

Also, there are a number of Conventions that address the issues relating to marine environment protection. These are broadly categorised into Liability and Compensation Conventions and Marine Environment Protection Conventions.

Ghana is signatory to a number of International Maritime Organisation (IMO) conventions and the relevant ones include the following:

i. International Code for the Security of Ships and Port Facilities (ISPS Code);
ii. International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78);
iii. International Convention for the Safety of Life at Sea (SOLAS), 1974;
iv. UN Convention on the Law of the Sea (UNCLOS);
v. Basel Convention on Shipment of Trans boundary waste;
vi. Convention on Civil Liability for Oil Pollution Damage (CLC); and
vii. Convention for Co-Operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region.

2.3.1. The International Ship and Port Facility Security (ISPS) Code

The International Code for the Security of Ships and Port Facilities (ISPS Code) is the brain child of the Maritime Safety Committee and Maritime Security Working Group under the auspices of the International Maritime Organization (IMO). It was adopted at the Conference of contracting Governments to the International Convention for the Safety of Life at Sea in 1974, and came into effect on the First of July 2004.

The most remarkable feature of this code, apart from the detailed and well grafted mode of security for ships and port facilities, is the adoption of a hierarchical and collaborative system of operation. This system which operates in a bilateral form involving the efforts of the Company Security Officer (CSO), the ship security officer and the port facility officer on the one hand, and the ship security officer and the port facility officer on the other. The Convention was made applicable to ships named in the Convention which engage in international voyage. The mode of achievement of the objectives of the code includes the gathering, assessment and exchange of information on security threats and measures.

2.3.2. International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)

A number of the provisions and guidance outlined in the MARPOL Convention are relevant to marine activities, including general requirements over the control of waste oil/ engine oil discharges and grey and black waste water discharges. In addition, a number of the Annexes of the Convention are relevant such as Annex V (Prevention of Pollution by Garbage from Ships) and Annex VI (Prevention of Air Pollution from Ships).

With regard to the marine environment protection, the key conventions are the International Convention on the Prevention of Pollution from Ships (MARPOL),1973/78 the International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), 1972 and its Protocol of 1996, the International Convention on Oil Pollution, Preparedness, Response and Cooperation (OPRC),1990 as well as the provision dealing with the protection of the environment, contained in Part XII of the United Nations Convention on the Law of the Sea, 1982.

MARPOL is the main international treaty dealing with the prevention of pollution of the marine environment by ships from operational and accidental causes. The regulations covering the various sources of ship-generated pollution are contained in six technical annexes of the Convention. Ghana has ratified I and II which deals with prevention of pollution by oil and the control of pollution by noxious liquid substances in bulk.

These Annexes give contracting parties the mandate to inspect ships including tankers and other supply vessels to ensure that their operations are safe and will not pollute the marine environment.

The London Dumping Convention is intended to promote the effective control of all sources of marine pollution and regulate dumping into the sea of waste materials, whilst the OPRC provides a framework for cooperation among countries for responding and combating oil spillage. The OPRC Convention has been ratified by Ghana but MARPOL Annexes III - VI and the London Dumping Conventions are yet to be ratified.

2.3.3. International Convention for the Safety of Life at Sea (SOLAS), 1974

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been complied with. Control provisions also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the Convention - this procedure is known as port state control. The current SOLAS Convention includes Articles setting out general obligations, amendment procedure among others.

2.3.4. UN Convention on the Law of the Sea (UNCLOS)

The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.

2.3.5. Basel Convention on Shipment of Trans Boundary Waste

This is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the

source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.

2.3.6. Convention on Civil Liability for Oil Pollution Damage (CLC)

The key Conventions under liability and compensation are the International Convention on Civil Liability for Oil Pollution Damage (CLC), 1992 and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, (FUND) 1992. The CLC places liability for pollution damage in the event of oil spillage on the ship owner and ensures that compensation is paid for the destruction of the shoreline ecosystem as well as to affected victims such as fishermen, beach resort hotels and recreational facilities, restaurants etc.

However, in situations where the compensation paid under the CLC is inadequate, countries can access additional funding from the FUND, provided they are contracting parties to it. Through the initiative of the Ghana Maritime Authority, Ghana has ratified the CLC and the FUND Conventions and has become a beneficiary country which can claim international compensation for oil pollution damage.

2.3.7. Convention for Co-Operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region

The objective of this convention is to protect the marine environment, coastal zones and related internal waters falling within the jurisdiction of the States of the West and Central African region. Parties to this convention agree to take all necessary measures to prevent, reduce, combat and control pollution of the Convention area (art. 4), particularly pollution from ships and aircraft (arts. 5 and 6), land-based sources (art. 7), and activities relating to exploration and exploitation of the sea bed (art. 8) and pollution from or through the atmosphere (art. 9).

They undertake to prevent, reduce, combat and control coastal erosion (art.10) and protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other marine life in specially protected areas (art. 11). Parties are to co-operate in dealing with pollution emergencies in the Convention area (art. 12), and in exchanging data and other scientific information (art. 14). Moreover, they undertake to develop technical and other guidelines regarding environmental impact assessment of their development projects (art. 13) and establish roles and procedures for the determination of liability and the payment of adequate and prompt compensation for pollution damage of the Convention area (art. 15).

2.4. Legal Boundaries of the Ocean

The proposed project will be in the territorial waters of Ghana as illustrated in **Figure 1**. The UNCLOS has set limits, navigation, archipelagic status and transit regimes, exclusive economic zones (EEZs), continental shelf jurisdiction, deep seabed mining, the exploitation regime, protection of the marine environment, scientific research, and settlement of disputes. The convention set the limit of various areas, measured from a carefully defined baseline. The areas are as follows:

Internal Waters

It covers all water and waterways on the landward side of the baseline. The coastal state is free to set laws, regulate use, and use any resource. Foreign vessels have no right of passage within internal waters.

Territorial Waters

Out to 12 nautical miles from the baseline, the coastal state is free to set laws, regulate use, and use any resource. Vessels were given the right of innocent passage through any territorial waters, with strategic straits allowing the passage of military craft as transit passage, in that naval vessels are allowed to maintain postures that would be illegal in territorial waters. "Innocent passage" is defined by the convention as passing through waters in an expeditious and continuous manner, which is not "prejudicial to the peace, good order or the security" of the coastal state.

Contiguous Zone

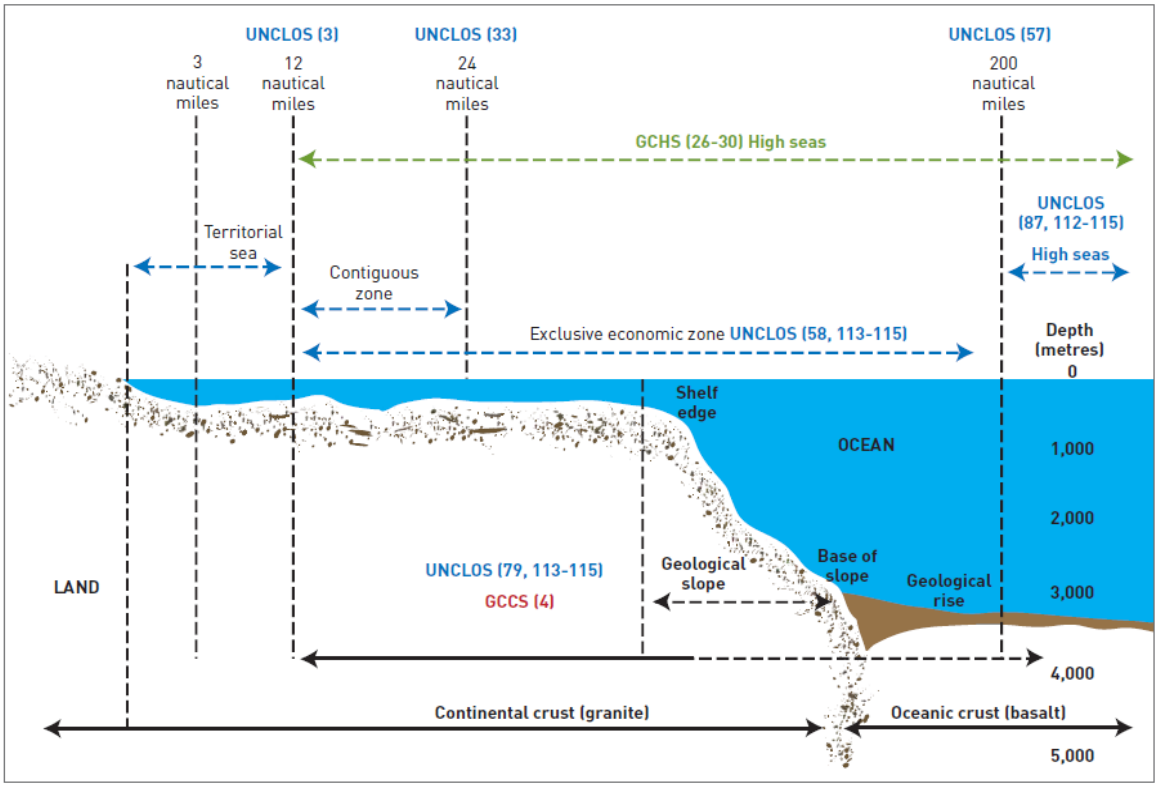
Beyond the 12 nautical mile limit there was a further 12 nautical miles or 24 nautical miles from the territorial sea baselines limit, the contiguous zone, in which a state could continue to enforce laws in four specific areas: pollution, taxation, customs, and immigration.

Exclusive Economic Zones (EEZs)

This zone extends from the edge of the territorial sea out to 200 nautical miles from the baseline. Within this area, the coastal nation has sole exploitation rights over all natural resources. In casual use, the term may include the territorial sea and even the continental shelf. Foreign nations have the freedom of navigation and over flight, subject to the regulation of the coastal states.

Continental Shelf

The continental shelf is defined as the natural prolongation of the land territory to the continental margin's outer edge, or 200 nautical miles from the coastal state's baseline, whichever is greater. Coastal states have the right to harvest mineral and non-living material in the subsoil of its continental shelf, to the exclusion of others. Coastal states also have exclusive control over living resources "attached" to the continental shelf, but not to creatures living in the water column beyond the exclusive economic zone.



Source: D. Burnett

Figure 1: Legal Boundaries of the Ocean from Territorial Sea to Exclusive Economic Zone and onto the High Seas (figures in parenthesis refer to treaty articles)

2.5. Other International Law Principles

The following other International Law Principles have been considered in this study and the seismic data acquisition processes will take them into account:

i. Polluters Pay Principle (PPP);
ii. Principle of Intergenerational Equity;
iii. Sustainability;
iv. Best Available Technology Not Entailing Excessive Cost (BATNEEC).

2.6. Ensuring Safe Implementation of the Proposed Project

The legislation and guidelines concerning oil spill contingency planning, occupational health and safety, waste and pollution management, etc., as addressed in this Environmental Assessment provides guidance for rolling out the seismic activities envisaged for the Keta Basin. It is to encourage proper resource use and waste management at the proposed project location and to ensure adoption of international health, safety, environmental and security (HSES) standards and promote sustainable operations.

3.0. DESCRIPTION OF THE PROPOSED PROJECT

3.1. Project Location

In December 2014, Swiss African Oil Company (SWAOCO) a subsidiary of Swiss African Petroleum AG was awarded the Keta Delta Block in the Keta Basin.

SWAOCO is proposing to undertake seismic surveys in order to delineate potential hydrocarbon prospects in the Keta Delta Block (which covers an area of 3,000 km^2) in the Keta Basin (see Figure 2). The Keta Delta Block is approximately 3,000km^2, and lies in water depth ranging from 0m and 50m. The Block is located in the Keta Basin and covers the southern-most part of the Volta Delta and transitions into offshore, and located north of the Keta Block. The onshore part of the block covers all of the Keta Municipality, part of Ketu South, part of South Tongu and part of Ada East. The block covers over 200 communities located in the municipalities and districts listed above.

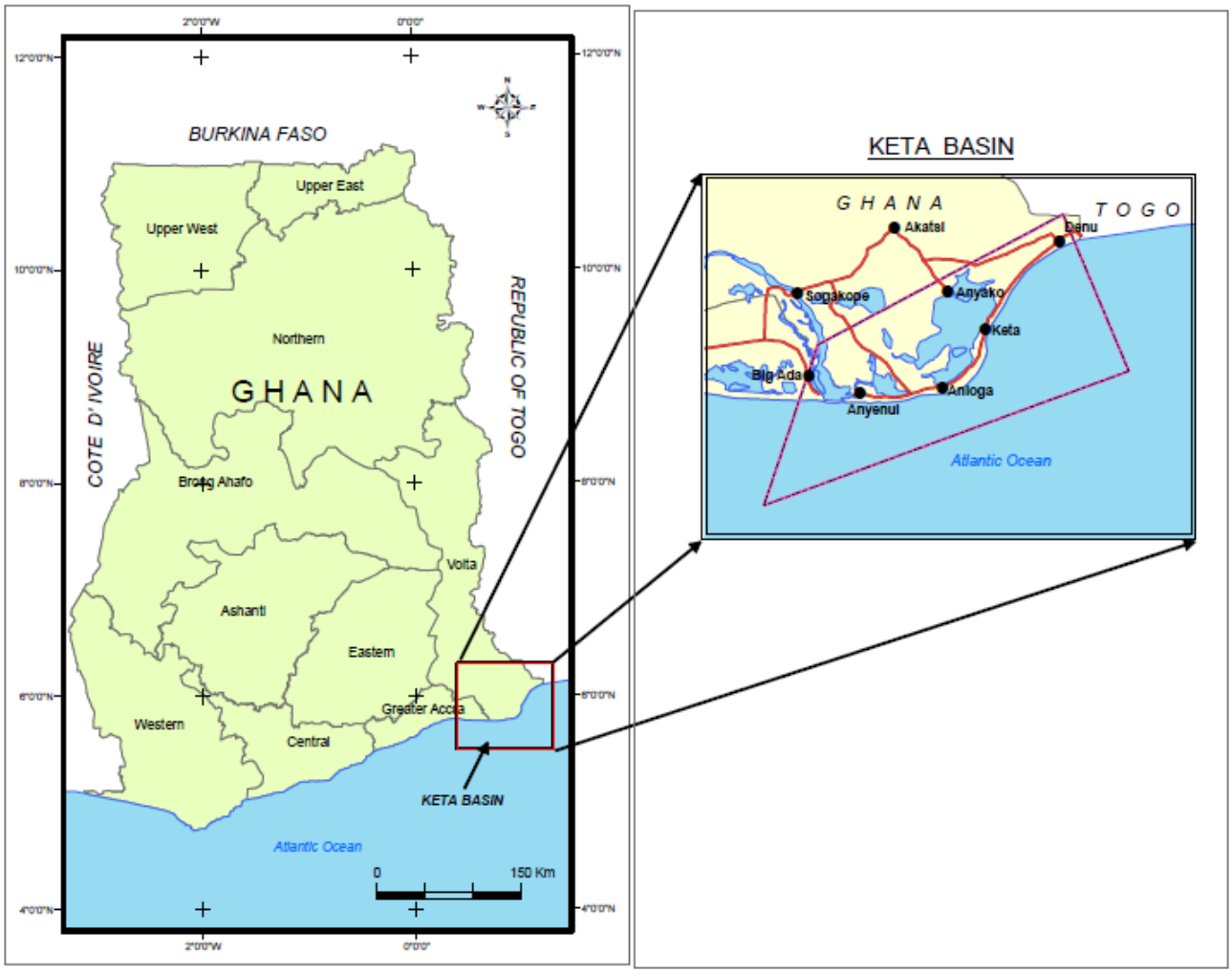


Figure 2 Shows the Location of the Keta Delta Block in the Keta Basin of Ghana.

3.2. Overview of a 2D Seismic Survey

3.2.1. Principles of Seismic Survey

The Keta Delta Block consists of offshore and Onshore Zones that require different seismic methodology for data acquisition. Seismic surveys are carried out to allow the mapping of the subsurface geological formations and to allow the identification of potential hydrocarbon deposits by measuring the differing reflective properties of sound waves on on the surface of the ground or over water along a predetermined line, using an energy source.

Offshore Zone:

A pulse of low-frequency acoustic energy is directed as a wave into the ground (below the sea floor) and is reflected back to the surface, where it is received by several cables (streamers) towed behind the seismic vessel, each containing a string of sensors (hydrophones) (see Figure 3). The pressure signals are digitized by the hydrophones and transmitted along the streamers to recording and processing systems on the vessel. The data acquired is analyzed and used to create a computer-generated image of the subsurface geology.

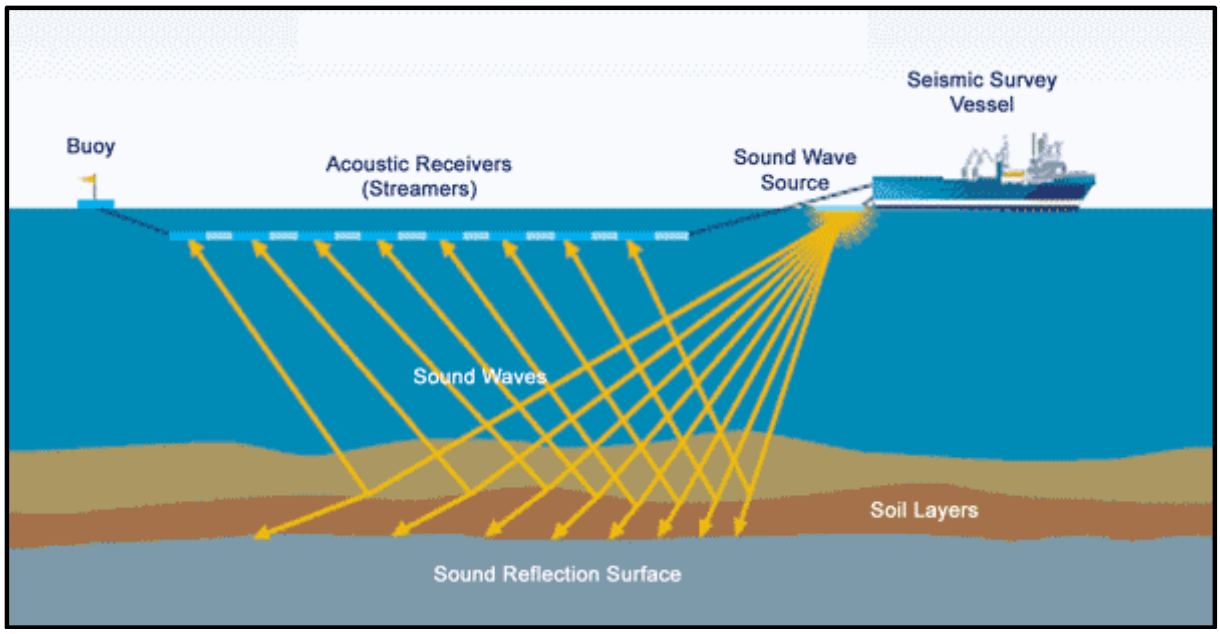


Figure 3: Typical Offshore Seismic Survey Operation

Onshore Zone:

The sound waves travels into and through the earth strata, where it is reflected and refracted by various subsurface formations, and returns to the surface where receivers called geophones are used to detect the waves and convey them to a recorder for analysis. Seismic waves can be induced by the following methods: small explosives charges, primarily dynamite, set off in shallow holes known as “shot holes”; or by large “Vibroseis” trucks equipped with heavy plates that vibrate on the ground. By analyzing the time it takes the seismic waves to reflect off subsurface formations and return to the surface, formations can be mapped and potential oil and gas deposits identified.

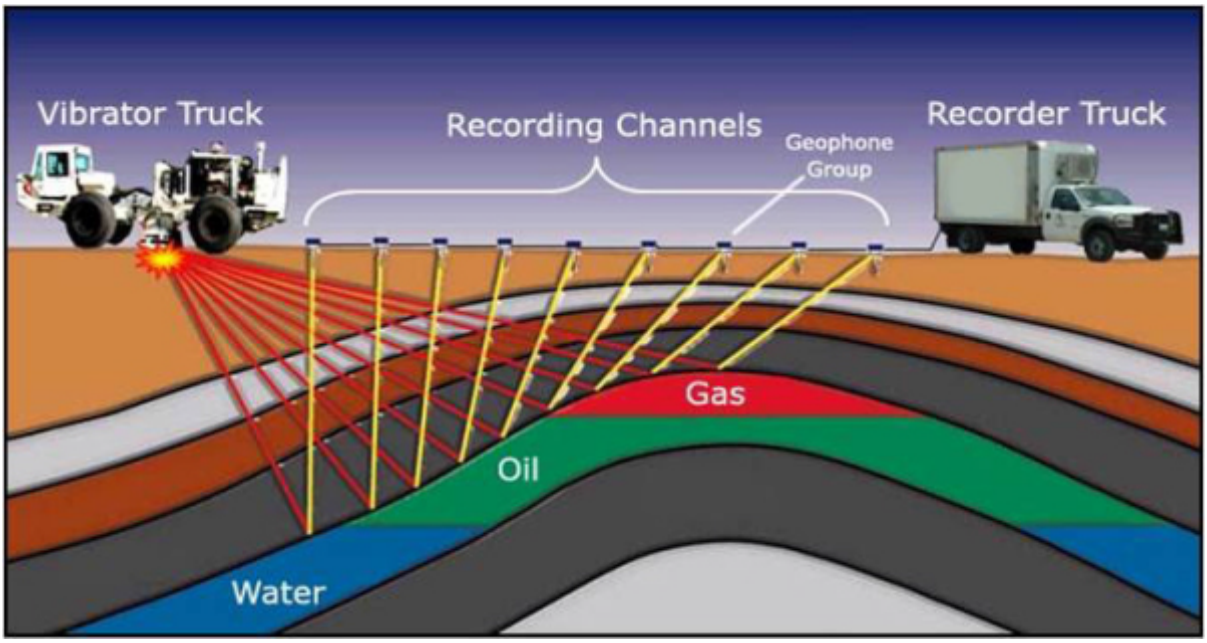


Figure 4: Onshore Seismology using a Vibrator Truck as a Seismic Energy Source

3.3. The Proposed 2D Seismic Survey

3.3.1. Seismic Survey Objectives

The objective of the proposed seismic survey is to identify and delineate potential prospects, if any, in sufficient detail to be able to, at a later and different stage, test one or more by drilling.

3.3.2. Seismic Survey Scale and Extent (Area of Influence)

The seismic survey survey will involve the collection of seismic data within the Keta Delta Block (see figure 5). The seismic survey operation will be constrained along the seismic survey lines and to the base and fly camps, as well as to the access roads to these areas.

The area of influence is defined as the area that will be covered by the activities performed during the seismic survey. The proposed 2D Seismic survey traverses from offshore into onshore areas. The activities involved in the 2D seismic acquisition project include:

- Establishment of camp sites;
- Mobilization and demobilization of personal and equipment;
- Clearing of the seismic acquisition lines;
- Seismic data acquisition; and
- Site restoration

In the selection of camp locations and alignment of the proposed 2D seismic lines, the proponent shall ensure communities and environmentally sensitive areas (forest reserves, sacred groves, cemeteries, mosques, churches, archeological sites) will be avoided where practicable.

The seismic data acquisition onshore shall be conducted within a seismic line corridor of **100 meters** and will form the basis of assessing the environmental and social impacts in order to focus on the key issues within the project area.

3.3.3. Seismic Survey Design

The seismic survey will be conducted using standard onshore and offshore seismic survey operations and procedures described in the above sections. The survey will be carried out in phases, beginning with the offshore area which will cover an area of approximately 1,800 km^2 and onshore area of approximately 1,200 km^2, that consist of well sites. The seismic lines will have a width of approximately 3m to 5m.

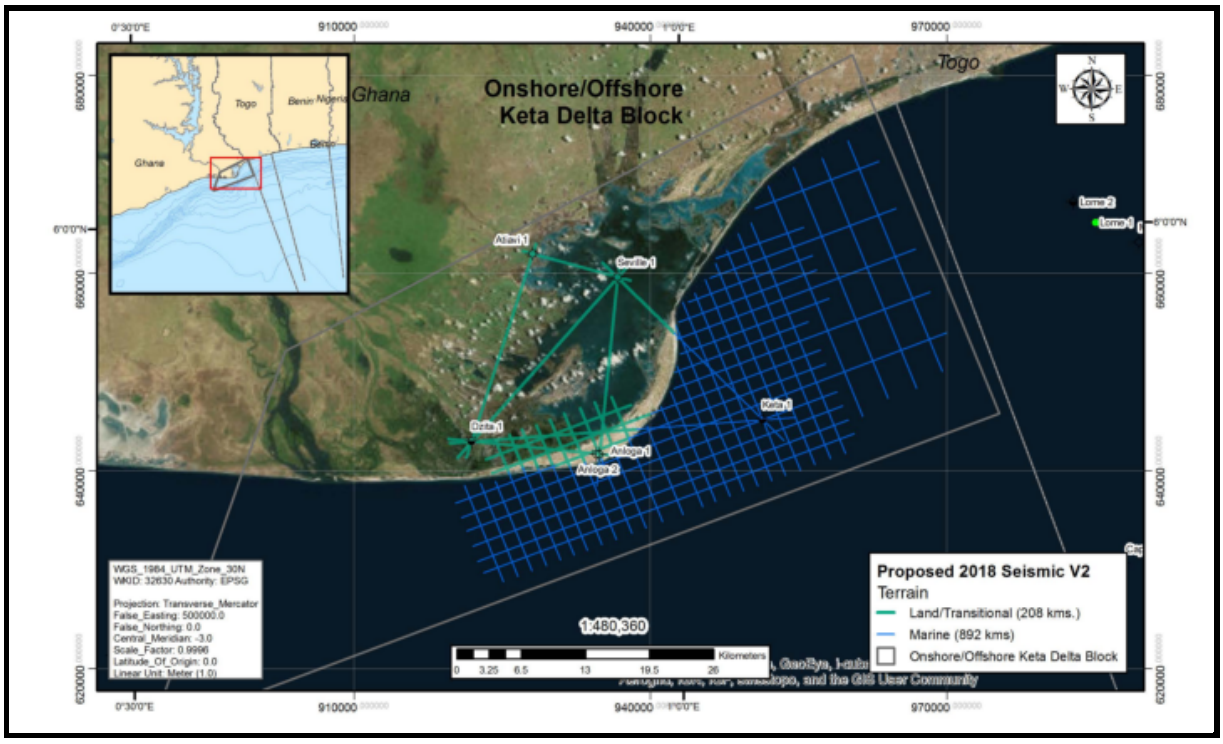


Figure 5 Map Showing the Proposed Seismic Lines and Area

Preparation of the seismic lines, including rolling, raking or scraping for line delineation, will take place a few days before the lines are acquired. The seismic survey data acquisition will take approximately 150 to 180 days. The preparation of seismic lines and data acquisition activities will be run concurrently such that the duration of the proposed 2D seismic survey from mobilisation to demobilisation shall be approximately 250 days depending on daily production rates.

It should be noted that while there are pre-determined seismic line transects based on analysis of pre-existing data, the actual locations of the seismic transects may be varied prior to and/or during the seismic data acquisition exercise.

3.3.4. Seismic Survey Acquisition Method and Equipment

There are a number of alternative survey methods available to SWAOCO. The method that would be adopted to acquire seismic data would depend on physical restrictions of the area, environmental considerations, the cost of acquiring data and the timing of the surveys.

The method to be used can only be finalised after a contractor has been assigned to perform the work. The differences between the alternative seismic survey methods are mainly related to the depth of the water (deep or shallow) in which the survey is undertaken, which affects the size of the vessels and the number of streamers that are towed behind the vessel. A separate set of alternative survey methods are used for surveys in the transition zone, (area between dry land and the low water mark).

3.3.4.1 Offshore Seismic Survey Logistics

The offshore seismic survey system will mainly be composed of the following equipment:

- Seismic vessel and support vessels;
- Seismic sources (airguns); and
- Seismic receiver cables (streamers).

Offshore seismic surveys are undertaken with purpose-built or converted vessels. The seismic vessel tows the energy (sound) sources, which are typically pneumatic devices (airguns) that can release high-pressure air into the surrounding water and the seabed, as well as the streamers that contain the hydrophones. Survey vessels are typically equipped with airguns of various sizes. The survey vessel that will conduct the survey is equipped with a tune bolt airgun array with three strings of airguns, the size and configuration of which will be confirmed once a contractor has been appointed.

A support vessel is used to patrol the survey area and warn any other vessels about the operation, the presence of the seismic streamers and the limited manoeuvrability of the seismic vessel. It is expected that at least one support vessel and chase boat will be employed during the seismic survey in the Keta Delta Block. The survey vessel cannot stop and must continue moving at an average speed of 5 knots. Due to the vessel's limited manoeuvrability, a 'safety zone' is in place around the vessel and towing configuration.

The survey will be completed in three steps:

- deployment of the streamers;
- initialization of the airgun firing sequence and carrying out of the seismic survey and;
- recovery of the streamers.

3.3.4.2 Onshore Seismic Survey Logistics

The seismic surveys will require a crew of approximately 200 to 300 persons. A base camp will support the crew, and "fly camps" will accommodate smaller-sized groups of personnel in outlying areas, and will be set up as and when required. A 'fly camp' is a temporary advanced camp located at a distance from the main base camp. A fully equipped and staffed ambulance will be on standby in case of any accidents or emergencies, and will be supported by a fully equipped and staffed clinic that will be located in the base camp.
Where possible unskilled and semi-skilled workers will be hired from the local communities; this will be done following consultations with the relevant local authorities and communities. The aim will be to ensure a fair distribution of employment opportunities.

Vehicles will be required for movement of personnel and equipment and to support camp operations. A number of Vibroseis trucks will be used for acoustic energy generation, and there will also be recording trucks to receive the data relayed from the geophones. Bulldozers and mulchers will be used for improving or opening up new access roads (the latter only if absolutely necessary), and for cutting the transect lines, respectively.

3.3.4.3 Onshore Data Acquisition Methods and Equipment

The seismic survey will be conducted using Vibroseis and/or dynamite charges. The seismic acquisition methodology has been designed to minimize disruption to local flora and fauna as well as the local communities. Low Impact Seismic technologies will include: the use of Vibroseis as acoustic energy sources; line-cutting with mulchers to minimize line width and accelerate re-growth of vegetation; and use of bulldozers to open up new or improve existing access roads.

The 2D seismic data acquisition process is as follows:

- Surveying-The main tasks during survey exercise include initial installation of a small number of survey control points, then setting-out source points and receiver stations for use. This would be done by the conventional survey method of using RTK GPS backpack surveying units and biodegradable markers. Cutting activities though minimal for the receiver and source lines shall be done manually or mechanically where appropriate. In open areas where there is clear line of sight no cutting shall be done.
- Recording-This involves laying of geophones on the receiver stations and generating energy (vibrations) on the perpendicular source lines to generate seismic energy, which are reflected and recorded on magnetic tapes via the recording instrument.

The proposed onshore seismic survey will involve the use of vehicles, vibroseis trucks, and recording trucks, small ‘shot holes’ drill rigs, a mulcher, and a bulldozer to provide vehicular access roads (cut-lines).

3.3.4.4 Onshore Seismic Shot Holes

Seismic 'shot holes' will be drilled (20–25m in depth) and placed at regular intervals (25 m) along exploration seismic lines. Shot hole shooting allows estimation of the thickness and seismic velocity of the weathered zone as well as the sub-weathering velocity. These data are then used in computing time corrections to a nominal seismic datum, which is a fundamental step in computer processing of seismic field data. Shot hole shooting involves successive detonation of a series of small charges at varying depths inside the drill hole and recording of the shot hole time with a surface geophone placed near the shot hole.

Seismic shot holes will be drilled at regular intervals along the seismic lines. The shot holes will be drilled by a small truck-mounted rig usually using compressed air to lift soil cuttings, adding water occasionally to lift gravelly material. Shot hole drilling will take place during the seismic survey.

Shot hole drilling is a relatively simple process and no drill casing is used. The drilling fluids used in shot hole drilling consist of soil, ground sandstone and locally sourced groundwater as a wet mix. Apart from soil, ground sandstone and groundwater, no chemicals will be

added to the drilling fluid only small quantities of bentonite clay if required during backfilling to seal off any encountered groundwater. Once recordings have been made, the majority of the cuttings will be returned to the hole. The cuttings present no risk to the environment in toxicity terms. Excess cuttings at each shot hole, if any, are placed on top of the shot hole and will integrate into the soil over time.

Seismic refraction survey will be undertaken along the land seismic lines at approximately 7 km intervals. This survey is required to collect data on the shallow weathered layers, allowing for accurate seismic processing.

3.3.5. Seismic Schedule

The 2D seismic data acquisition campaign (mobilisation to demobilisation) will take approximately 150 to 180 days beginning in February to July 2018 timeframe.

4.0 ANALYSIS OF PROJECT ALTERNATIVES

4.1. Introduction

Alternatives to the project are defined as functionally different ways of achieving the same end. Currently, seismic testing, both on land and in marine settings, is a critical and proven technology for refining knowledge about geological formations with a relatively high potential for containing petroleum hydrocarbons in commercial quantities. There are no functionally different alternatives for defining potential for hydrocarbon resources that are not cost prohibitive.

4.2. The No-Go Alternative

Under the "no-go" or "no-action" alternative, the project does not go ahead, thus the status quo remains. Oil and gas production, however, cannot occur in the absence of exploration activities. It should be noted that this project is a data acquisition project that will enable evaluation of the newly acquired data to identify potential oil and gas prospects. If no oil and gas prospects can be delineated based on the data, then the project will end at that point. If, however, the data indicates that potential oil and gas prospects are likely, then the project would move on (with a time interval of several months during which the seismic data will be processed and analyzed, and likely prospects delineated) to an exploratory drilling phase to determine actual presence and amounts of oil and/or gas. In this case, a new EIA would have to be carried out.

As a precursor to the drilling of petroleum exploration wells, seismic acquisition is an accepted and well-developed method of petroleum reservoir delineation. While surface mapping, gravity, magnetic, and other forms of geophysical exploration are commonly employed to further understand the geological character of a sedimentary basin, they are generally considered complimentary techniques rather than stand-alone methods of data collection and interpretation. It is, therefore, considered that the proposed seismic acquisition activity is the only viable means to assess the hydrocarbon prospects of the Keta Delta Block. If the project does not go on at this stage, then the potential benefits will be foregone.

4.3. Project Site Alternatives

An alternative to the project is to leave the assigned project area. The Government of Ghana through the Petroleum Commission is mandated to award blocks with potential for oil and gas to interested companies. These oil and gas potential areas are found in the offshore and onshore zones of Ghana. SWAOCO has been awarded the licence for the Keta Delta Block in the Keta Basin; therefore, the concept of 'alternative site' does not apply as each block within the country is agreed upon by the Government of Ghana and the interested party and subsequently licensed.

4.4. Technology Alternatives

The technology to be employed for the seismic survey is the latest state-of-the-art for activities of this nature, and has been outlined in ***Chapter 3***. Approximately 382 square kilometres of seismic data acquisition will be carried out in the project area. The company will construct a number of seismic survey lines (track lines) along which seismic data will be collected. The seismic survey operations and related activities will be constrained to the

seismic survey lines once they are confirmed, and to the base camp, fly camps and access roads to these areas within the block. On an area-wide survey such as this, there is considerable scope to adjust line placements and program size to bypass habitations or areas of particular sensitivity.

A detailed evaluation of each line will be carried out as work progresses and line placements will be adjusted to achieve the survey objectives with minimum disruption and impact to the environment and resident communities. Thus, the actual coordinates of the proposed survey lines on land shall be based on analysis of pre-existing data and the information acquired on the area through the EIA study, and will be subject to adjustments based on specific issues or conditions encountered when the operation is ongoing. Three (3) methods will be used to generate the seismic waves:

(1) Vessel towed cables for offshore seismic data acquisition
(2) Truck mounted vibroseis units for land-based seismic data acquisition, and
(3) Dynamite charged shot-holes for land-based seismic data acquisition.

The following equipment which will be dedicated solely to the proposed seismic survey activity that will be carried out in Block:

- Seismic source generators (airguns, vibroseis, dynamite charges for land-based data acquisition);
- Data recording units and truck;
- Transport equipment: e.g. vessels, trucks, pick-ups, 4WD vehicles;
- Communication equipment including handheld satellite phones, and vehicle-mounted VHF radio, and will also establish a communication base station at the main camp site;
- Mulchers, Bulldozers, and light-cutting hand-held equipment for clearing of seismic lines;
- Surveying equipment;
- GPS equipment;
- Associated electronics, data processing and printing equipment, and;
- Ambulances.

Additional equipment and facilities that will be available will include:

- Fully serviced and self-contained base camp and seismic vessels for all personnel and equipment;
- Adequate fire-fighting equipment, and first-aid kits;
- Fully equipped clinic for medical care of the personnel, and;
- Emergency trained paramedic(s).

5.0. ENVIRONMENTAL BASELINE CONDITIONS

The existing biophysical and socioeconomic characteristics of the project area are described in this chapter.

5.1. Physical Environment

5.1.1. Location and Size

The project area falls within the Keta Municipal Assembly, Ketu South Municipal Assembly and South Tongu District Assembly all of the Volta Region and Ada East District Assembly of the Greater Accra Region. Figure 6 shows the location of the project in Ghana.

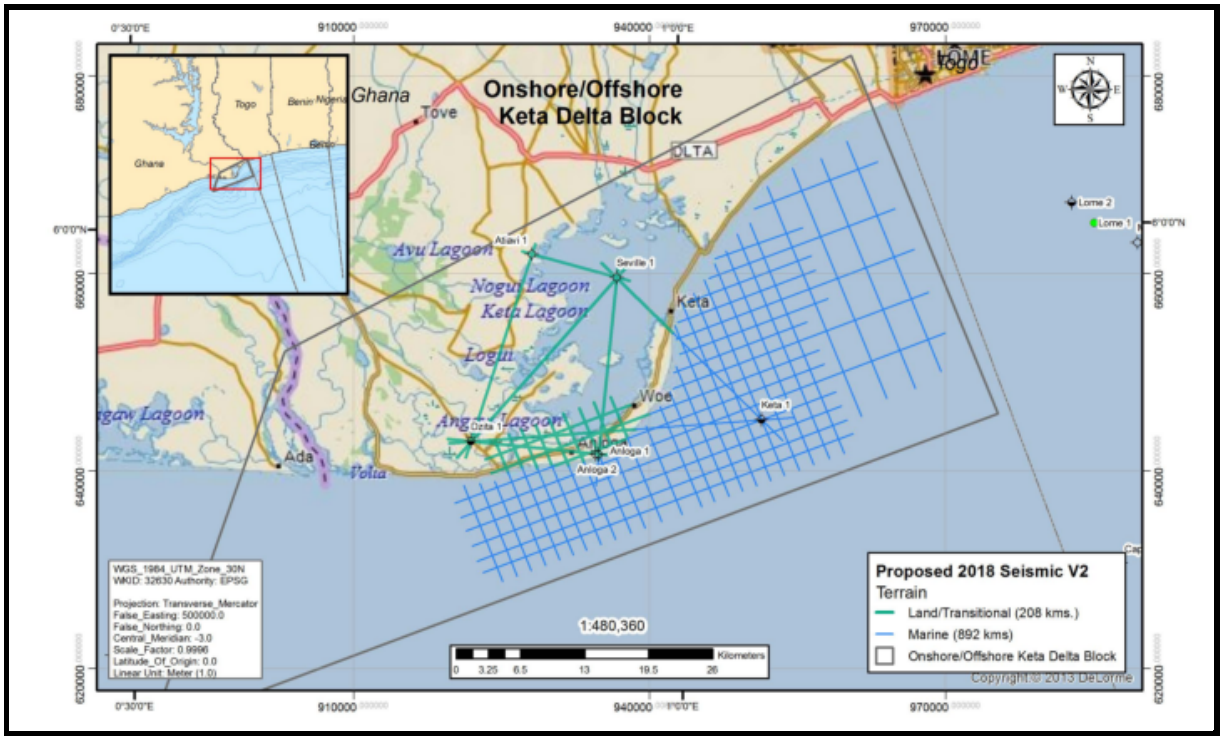


Figure 6 Shows the Location of the Keta Delta Block

The Keta Delta Block is approximately 3,000km^2. The block covers over 200 communities located in the municipalities and districts listed above and with some of the communities shown in Figure 7.

In Ghana, the landward extension of the coastal zone has been defined in the Coastal Zone Indicative Management Plan (CZIMP) as the line joining the landward limits of the lagoons, lagoonal depressions, marshes and estuarine swamps together with the intervening interfluve areas. "On the average, this line approximates 10km extension from the coastline (except at river estuaries and some lagoons) and is enclosed by the 30m contour. The rationale behind the extended landward limits is to ensure the inclusion of the catchment areas of the coastal streams or parts thereof for the purposes of effective land use, environmental planning and monitoring", (Armah, AK & Amlalo DS, 1998).

Most part of the proposed project location falls within the coastal zone of Ghana.

Figure 7 Shows the Communities within the Keta Delta Block

5.1.2. Topography

The topography of the area is a flat land with extensive lagoon coverage. Most of the wetland areas are below 30m contour while the upland areas are usually between 40m – 50m above mean sea level. The project area forms part of the coastal plains in the south eastern part of Ghana. The relief is generally gentle on a low plain with heights ranging between 30m to45m. The site has generally a flat summit, sloping gently south and eastwards into the Keta Lagoon.

5.1.3. Geology and Hydrogeology

The Keta Basin is a fault-controlled Mesozoic/Tertiary sedimentary basin along the coast of the Gulf of Guinea (Jørgensen and Banoeng-Yakubo, 2001). The sedimentary sequence in this basin is known from borehole and well logs to comprise Lower to Middle Devonian marine shale, sandstone, and siltstone, overlain by Jurassic dolerites and sills (Akpati, 1978). A series of Cretaceous – Eocene marine sediments, composed of limestone, shale, and glauconitic sandstone crops out on the eastern edge of the basin close to the Togo – Ghana boundary (Jørgensen and Banoeng-Yakubo, 2001). Two limestone horizons exist in the subsurface in the Keta basin. The upper horizon is exposed by boreholes in the Anyako and surrounding areas northwest of Keta. The lower limestone horizon is exposed in the Keta area and probably represents a single hydrogeologic unit that is recharged from areas at higher altitudes farther inland.

Four major aquifers are distinguished on the basis of geography and geology. These are (Nerquaye-Tetteh, 1993; Jørgensen and Banoeng-Yakubo, 2001):

i. The weathered Dahomeyan gneisses along the northeastern rim of the basin. These outcrop at Akatsi and surrounding areas overlain by Neogene to Recent continental sedimentary deposits of sands and gravels;
ii. The surficial Noegene continental deposits of unconsolidated to semi-consolidated limonitic argillaceous sands in the northeastern and central parts of the basin;
iii. The Cretaceous – Eocene marine limestones and sandstone beds that are exploited for drinking in the central and southeastern parts of the basin. These units constitute the major and most important deeper aquifer in the Keta Basin (Jørgensen and Banoeng-Yakubo, 2001); and
iv. The Quaternary coastal marine sands and gravels in the Volta River estuary and Keta Lagoon area. These deposits of unconsolidated sand and gravel are generally associated with high groundwater recharge. However, areas below sea level may periodically undergo salinization due to seawater intrusion (Gill, 1969; Nerquaye-Tetteh, 1993).

5.1.4. Geology and Soils

Most of the soils found in the Keta Basin are recent, and have been developed over coastal and lagoon deposits. The main soil types belong to the Topohydric and Luthochronic Earth Orders, and in the sub orders of depressioped, alluvioped and regoped. Along the coast and most of the northern parts, are recent additions to the parent materials. These additions consist of a few feet of yellowish incoherent, coarse sands sometimes made grayish by humus-staining near the surface while deeper down are yellowish coarse sands containing shell fragments and hard laminate calcareous pan. There are several soil series that have been classified and mapped, however the Keta series, the Fredericksburg series and Goi series are part of the soil group Regosols found along the coast.

5.1.5. Drainage

The Basin is dominated by open lagoons, rivers, creeks and swamps which are subject to periodic inundation. Among the large water bodies that form the basin complex are Keta Lagoon, Avu Lagoon, Angor Lagoon and the waters of the Lower Volta River estuary.

Together, these water bodies form the largest natural lagoon water body in Ghana and cover an area of CIRCA 300km^2, stretching 40km along the coast and acting as a reservoir for the flood waters of the Lower Volta River as well as major rivers flowing from the central part of the Volta Region such as River Tordze, Nuyi, Belikpa and Aklikpa.

Thus, two key water bodies dominate the project area namely the Volta Estuary and the Keta Lagoon Complex. While the Volta is an estuarine system at Ada in the Greater Accra region it is in close proximity with the Keta lagoon complex which is a lagoonal wetland.

Volta Estuary System

The Volta estuary is at Ada in the Greater Accra Region where the Volta River empties into the Gulf of Guinea with linkages into the Keta Lagoon. The estuary undergoes considerable seasonal variation in size and shows both close and open lagoon characteristics due to prolong droughts, cessation of seasonal flooding as a result of the impoundment of the river at Akosombo and Akuse and poor tidal flushing due to build-up of sand bars at the estuary after construction of the dams.

Keta Lagoon Complex

The Keta Lagoon Complex is fed by three main water bodies namely: (i) Tordzie, (ii) Aka and (iii) Belikpa rivers. Following the scoping study in the project area, the following sources of water inflow into the Keta lagoon have been confirmed:

i. runoff from the Tordzie River into the Avu lagoon during the rainy season and overflows into the Keta lagoon via the Aglor and Agbatsivi lagoons and other smaller streams;
ii. runoff from the Aka and Belikpa streams which enter the lagoon directly from the north;
iii. overwash from the sea across the sandbar at the Havedzi end of the lagoon during high tides;
iv. hydrostatic induced flow of seawater through the sandbar separating the lagoon from the sea;
v. direct precipitation into the lagoon; and
vi. interflow between the lagoon and the Volta estuary through the Anyanui creek.

The sixth source, which was very important prior to the construction of the Akosombo and Akuse dams, is currently not very significant as a source of inflow to the lagoon (Piersma and Ntiamoa-Baidu, 1995). This phenomenon was also observed during another study which showed that the tidal force experienced in the Volta estuary was not strong enough to move fresh water through the Anyanui creek into the lagoon. This has resulted in increased deposition and siltation along the canal, further decreasing the flow through the creek.

The only identifiable source of water loss from the lagoon is by evaporation. The freshwater inflow to the lagoon is greatly reduced during the dry season resulting in a drastically increased salinity in the lagoon during such periods (Piersma and Ntiamoa-Baidu, 1995).

Tordzie/ Aka River Basin

This is part of the coastal river system located in the volta region of Ghana. The Tordzie river basin is drained by a number of rivers into the keta lagoon. The major rivers draining the basin include Waya, Awamo, Klemu, Gogodji, Nukpehui and Belikpa. River Tordzie flows from the forest on the eastern slopes of the Akwapim Togo mountain ranges at an elevation of 762m above mean sea level and through the Ho- keta plains into the Avu- keta lagoon (kankam Yeboah, 1997). Rivers Aka and Belikpa have a combined catchment area of 700km^2 (Aka has an area of 420km^2 and Belikpa 280km^2).

5.1.6. Climate

General

The Southeastern coastal plain of Ghana, which encompasses the project area, is one of the hottest and driest parts of the country. It lies within the Dry Equatorial Climatic Region of Ghana. Temperatures are however subjected to occasional and minimal moderating influences along the coast and altitudinal influences affected by the mountain ranges in the northwest. Temperatures are appreciably high for most parts of the year with the highest during the main dry season (December - March) and lowest during the months of July and August.

The project area experiences two rainfall maxima in the months of May/ June and September/ October. During these periods, the area is affected by the warm moist South Westerly Monsoon Winds (Tropical Maritime).

The dry season generally occurs from December to March. During the period of December/ January/ February, the project area is usually affected by the dry dusty North East Trade Winds (Tropical Continental). The north east trade wind is locally referred to as Harmattan.

The climate of the Project Area is determined by the movement of air masses which differ in air moisture and relative stability rather than temperature. Two air masses can easily be identified, the tropical continental air mass which moves from the Sahara Desert towards the sea and the tropical maritime air mass which moves from the South Atlantic Ocean towards the land. Temperatures are rather lower near the coast than they are further inland due to the cooling effect of the sea.

Like most parts of the country, two main physical phenomena, the equatorial trough and the associated Inter Tropical Convergence Zone (ITCZ)/ Inter Tropical Boundary (ITB) influence the climatic conditions of the project area. The ITCZ/ ITB influences the attraction of the alternate air masses from the north and the south called the tropical continental (northeast trade winds) and the maritime continental (southwest monsoon) winds respectively. The tropical continental winds are associated with a dry cool wind known as the harmattan which affects most part of the country during the months of December to February when it's very intense.

Climatic data, comprising monthly rainfall data and monthly temperatures and monthly relative humidity is provided in Table 5 based on 112 years of data obtained from weatherbase.com (downloaded on 26 October 2017). The climate data is further illustrated in Figures 8 to 12.

Table 5 Climate data for Keta Area- 112 Years of Record

Parameter	Unit of Measure	Annual Total	Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Precipitation	mm	1,059.2	13.2	36.3	84.7	128.0	163.9	254.8	87.0	41.4	76.7	102.2	49.0	22.0
Average No of Days with Precipitation	Days	106	3	5	7	9	14	18	11	8	10	11	6	4
Average Temperature	°C	-	27.4	28.5	28.6	28.4	27.8	26.5	25.6	25.2	25.8	26.8	27.7	27.4
Average Relative Humidity	%	-	76.1	77.7	78.7	79.9	81.3	84.6	85.1	84.7	83.5	82.5	80.2	78.3
Average Wind Speed	km/h	-	7.9	9.4	10.1	9	7.9	8.6	10.1	9.7	9.4	9	7.9	6.8

(source: weatherbase.com)

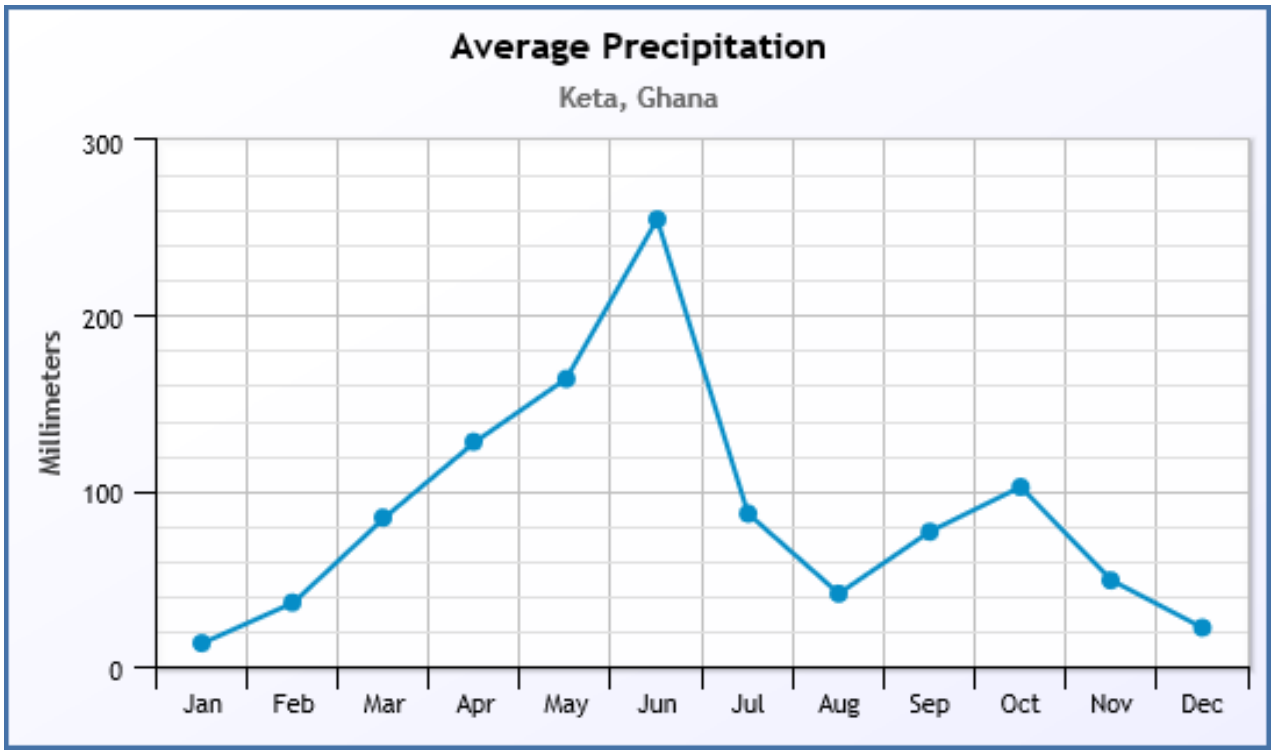


Figure 8 Average Precipitations in Keta Area

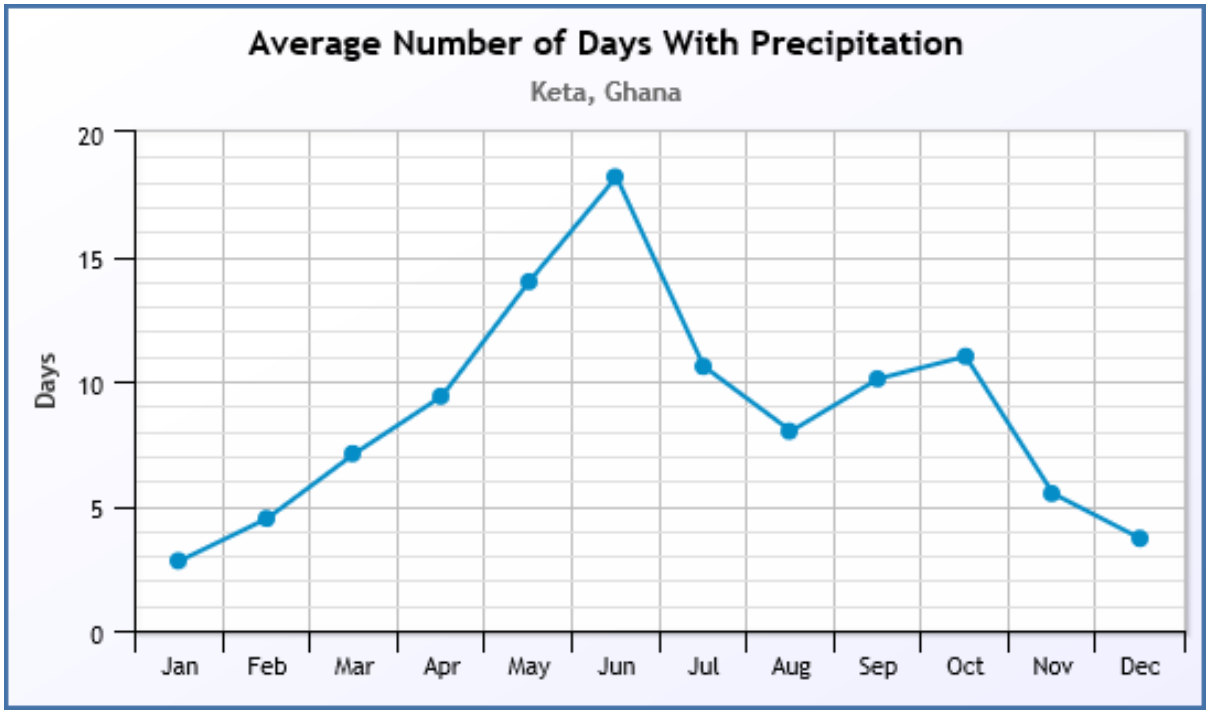


Figure 9 Average Numbers of Days with Precipitation in Keta Area

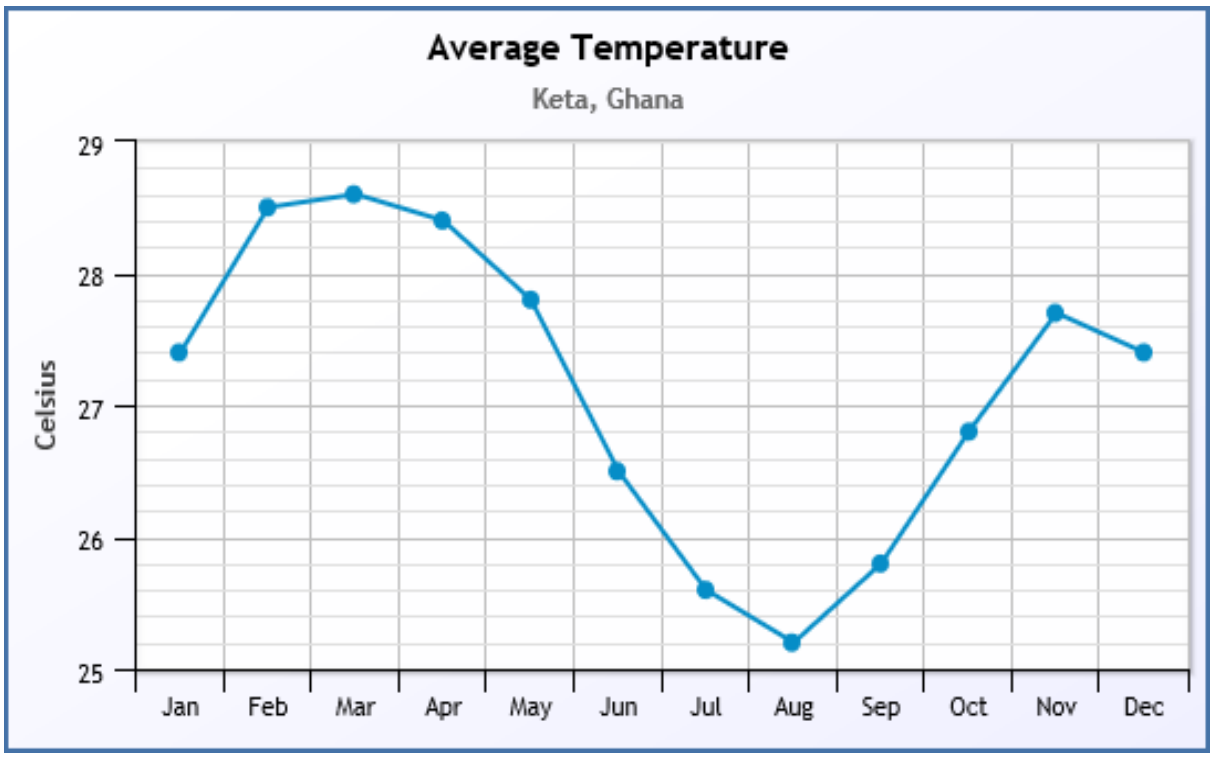


Figure 10 Average Temperatures in Keta Area

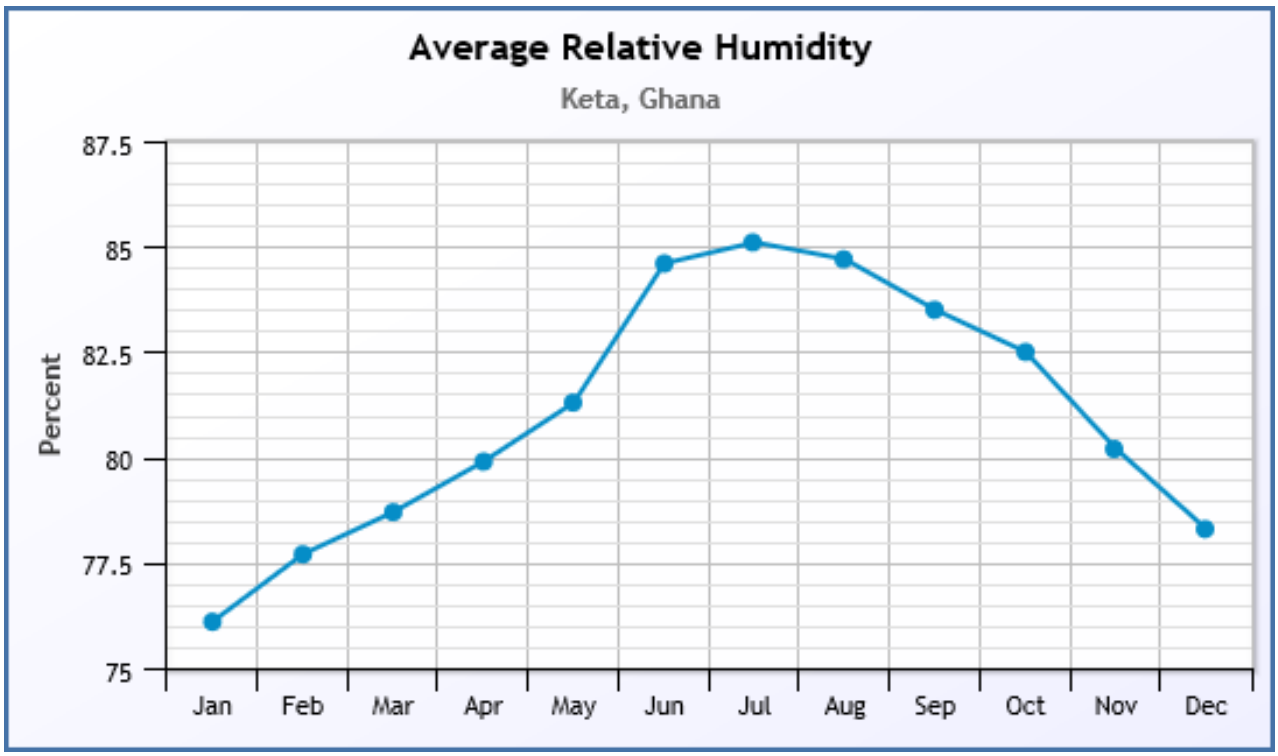


Figure 11 Average Relative Humidity in Keta Area

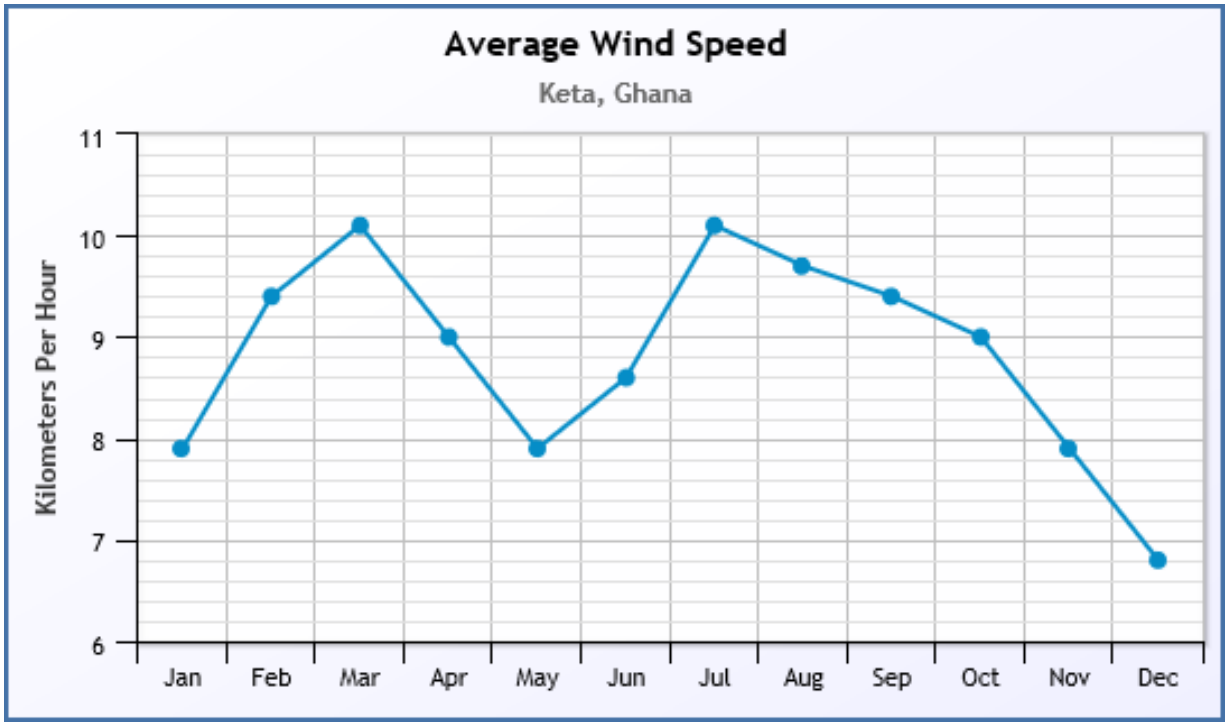


Figure 12 Average Wind Speed in Keta Area

5.2. Biological Environment (Ramsar Site)

The Keta lagoon also referred to as Anlo-Keta Lagoon ((EPA, 2004) is the most important wetland on the coast of Ghana for water-birds and together with the Ada Songor Lagoon constitutes the fourth most important water-birds site on the coasts of the Gulf of Guinea. It is a designated Ramsar Site and internationally recognised as Ramsar Site No. 567. It covers

part of the Volta River estuary with a catchment area of 1,280km^2. It comprises several small islands and a complex of lagoons with varying salinity.

5.2.1 Aquatic Flora and Fauna

The dominant vegetation includes swamps, scrublands, and mangrove forests, which are heavily exploited by resident communities for fuel woods and commercial fishing. The Site provides safe nesting grounds for the threatened olive ridley sea turtle (*Lepidochelys olivacea*), leatherback turtle (*Dermochelys coriacea*) and the green turtle (*Chelonia mydas*), and it is particularly important for the Nile monitor (*Varanus niloticus*) and the vulnerable West African Manatee (*Trichechus senegalensis*). It is considered the most important coastal wetland for birds in Ghana, and supports over 72 resident and migratory bird species estimated to number over 100,000 individuals. The wetland supports the livelihood activities of hundreds of thousands of people. Sea erosion and pollution are the major threats.

5.2.2 Bird Life

The Keta Lagoon Complex/ Ramsar Site supports over 72 water-bird species with an estimated total population of well over 100,000, including globally significant numbers of 21 species. The site is particularly important for waders, supporting almost one third of the estimated East Atlantic Flyway population of *Tringa erythropus*. Other species which occur in large numbers at the site include *Calidris ferruginea*, *C. minuta, Himantopus himantopus, Dendrocygna viduata*, as well as several heron and egret species. The most important parts of the lagoon for water-birds are the Fiahor, Woe, Tegbi, Adina and Afiadenyigba sections.

5.2.3 Freshwater Fisheries

Some of the freshwater species encountered in the Keta Basin include *Oreochromis niloticus*, *Tilapia zillii*, *Hemichromis fasciatus* and *H. bimaculatus.*

5.2.4 Terrestrials Flora and Fauna

The project area falls within the coastal savannah vegetative zone of Ghana dominated by grasses, with patches of trees and shrubs. Five vegetation zones can be delineated in the project area. These are:

The Coastal Strands

On the higher sands bordering the seashore is sparse grassland interspersed by woody shrubs known locally as 'Fortigba'. This 'fortigba' forms a dense grove in some parts of the coastline with creeper like Ipomoeabilobea. The spear grass (*Imperata cylindrica*) and the African foxtail (*Cenchris ciliaris*) and other tussocks are also found in most parts of the higher sands. Neem, mangoes and wild oil palm trees can be seen scattered all over the higher sands some distance from the shore. Coconut trees (*Cocos nucifera*) are found all over the coastline, even though the Cape St. Paul Wilt disease has devastated over 90% of the coconut plantations previously in existence in the area.

The Brackish Water Vegetation

The common grass species found along the margins of the non-tidal brackish lagoons and streams and on the silt clay islands are the *Paspalum vaginatum.* Other plant species found along the creeks and lagoons especially the Angaw lagoon, are the mangroves, which constitute a major source of fuel wood for the fish processing industry. The red mangrove (*Rhizophor aracemosa*) forms a shrubby thicket reaching a height of 30 metres and is

provided with stilt roots, which grow down from branches into the mud. The stilt roots increase support to the stem, the sub-stratum being soft and unstable.

The white mangrove (*Avecinea nitida*) usually grows further from the open waters than the Rhizophora and its substratum is less exposed to the waves and currents. The Avecinea lacks stilt roots, but possess specialized pneumatophores (breathing roots) that grow upwards through the mud from horizontal root systems. The pneumatophores are rich in air spaces that connect the atmosphere through lenticels, which provide an oxygen supply for the lateral absorbing roots. These two important mangroves are found along the Angaw stream and lagoons in the west but are currently almost completely absent along the Keta lagoon and other lagoons in the mid-west. A very recent development in the non-tidal parts of the Angaw stream and lagoon is the growth of cattail grass (*Typado mengensis*). This grass is now choking up most of the non-tidal portions of the streams and lagoons.

Fresh Water Vegetation

The commonest plant species found in the fresh waters along most of the northern parts of the basin where salinity is less than 10 ppt is known locally as "Ketsi". This grass type is used extensively for the manufacture of local mats ("Ketsiba"), bags ("Kevi") etc. The cattail grass (*Typado megensis*) is also found in this fresh water swamps. Water lettuce, (*Pistea stratiotes*), salvinia species, ceratophyllum species and water lily (*Nymphaea lotus*) are some of the fresh water flora found in the basin. Most of these fresh water plants float on the surface, supported by large air spaces in the lower parts of the leaves as well as in the stems and roots.

The Salt Flat Vegetation

The salt flats are found scattered on pieces of land between streams and on islands in the lagoons. The vegetation on most parts of the islands nearer the lagoons or streams are the *Rhizophora racemosa* and *Avecinea nitida* in the west followed by the *Paspalum vaginatum* – the paspalum being very common in most places. On the drier parts are tussocks of various grass species, the commonest of which is known locally as the 'gamgbe'. Along the edges of the saline lagoons and streams, on bare or scantly covered patches, are scrambling succulent herbs known locally as the 'soli'. The 'soli' herb is typical of the immediate outer margin of the salt flats, and is used extensively in the fish smoking industry for giving that appreciable brown tint to smoked fish.

The Guinea Savannah

The Guinea Savannah zone is found predominantly in the northern part of the basin. Very tall grasses mainly *Panicum maximum* and *Andropogon gayanus* and *Andropogon canticulatus* are found scattered all over the place. There is however other tall grass species.

The other woody species found on the silt clay soils are the borassus palm, the fan palms ('eso'), the date palm and wild oil palm trees. The neem tree (*Azadirachta indica*) is also found scattered all over the Guinea grassland.

The Baobab tree (*Adansonia digitata*) and the silk cotton tree (*Ceiba pentandra*) are found in many places.

Fauna

The project area is abundant with birds and has all the 72 seashore bird species recorded for the cost of Ghana. Reptiles and insects mainly butterflies abound in the project area. The endangered waterbuck is also found in the project area.

5.3 The Marine Environment

The Keta Basin project area falls within the East Coast of Ghana which is about 150km of shoreline extending from Prampram to Aflao, on the border with Togo. The project area coastline however, extends from Ada to Denu, an extent of about 50km.

5.3.1 Coastal Processes

The Marine conditions of the project area are directly influenced by the Atlantic Ocean and the South Westerly Monsoon winds. The principal oceanic factors that influence the coastline of the project area include tides, currents and waves.

Currents

The hydrography of the area, which is within the Gulf of Guinea, is influenced largely by subtropical gyres of the north and south Atlantic oceans (see **Figure 13**). The major current influencing the area is the Guinea Current flowing from west to east. This current runs opposite to the south westerly equatorial current between Africa and South America. The Guinea Current reaches a maximum between May and July during the strongest South-West Monsoon Winds when it peaks at 1 to 2 knots. For the rest and greater part of the year, the current is weaker. Near the coast, the strength of the current is attenuated by locally generated currents and winds. The current is less persistent near-shore than farther offshore. Geostrophic effects induce the tendency of Guinea Current to drift away from the coast especially during its maximum strength.

It is however subject to periodical and usually short-term reversals. The reversal of the Guinea current is probably due to the effects of the varying strengths of the Equatorial Current and the waters of Benguela origin. The general dynamics of the ocean currents in the Gulf of Guinea depends on the large-scale oceanic climatic seasonal exchanges which occur in the oceans and the morphology of the shelf and the orientation of the coast.

The coastal surface currents are predominantly wind-driven and are confined to a layer of 10–40 m thickness. Littoral drift, which is the main driving forces in coastal circulation in this area, is generated by breaking waves. These littoral drifts, generally flowing in an eastward direction, flows at rates less than 1 m/s, but are responsible for transporting large volumes of littoral sediments. The direction of tidal current around the coast of Ghana is mostly North or North-East. The velocity of the tidal current is generally less than 0.1 m/s. the maximum velocity of tidal current observed in a day of strong winds is about 0.5 m/s. The wave induced longshore currents are generally in the west to east direction which is an indication of the direction the waves impinge the shoreline. The longshore currents may average bout 1m/s and vary between 0.5m/s and 1.5m/s. The magnitude increases during rough sea conditions.

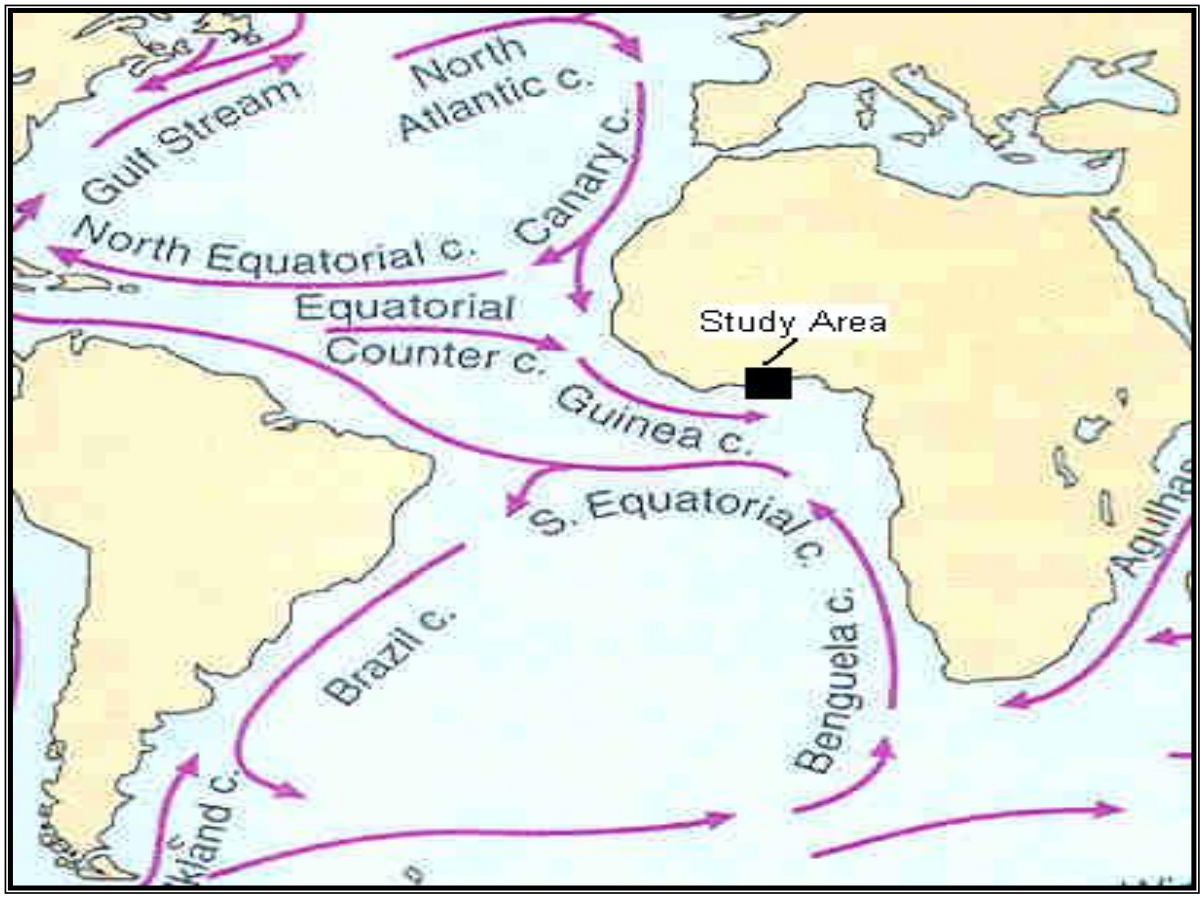


Figure 13: Major current systems influencing the Gulf of Guinea

Tide Level

The tide in Ghana is semidiurnal pattern which has generally two high and low tide levels each day. Average tidal heights of 1.6m at MHMS and 1.3m at MLWS and 0.7m at MLWN are recorded twice daily.

Waves

Waves reaching the shores of Ghana consist of swells originating from the oceanic area around the Antarctica Continent and seas generated by locally occurring winds. The significant height of the waves generally lies between 0.9m and 1.4m and rarely attains 2.5m or more. The most common amplitude of waves in the region is 1.0m but annual significant swells could reach 3.3m in some instances. Swells attaining heights of 4.8m - 6m, however, occur with a 10 year - 20 year periodicity. The peak wave period for the swells generally falls in the range of 7s to 14s. The swell wave direction is almost always south or south-west (**Figure 14**).

Other observations on the wave climate include a long swell of distant origin and with wavelengths varying between 160m and 220m. This swell has a primary period of 12s and a relatively regular averaged height between 1.0m and 2.0m. The swells generally travel from southwest to northeast.

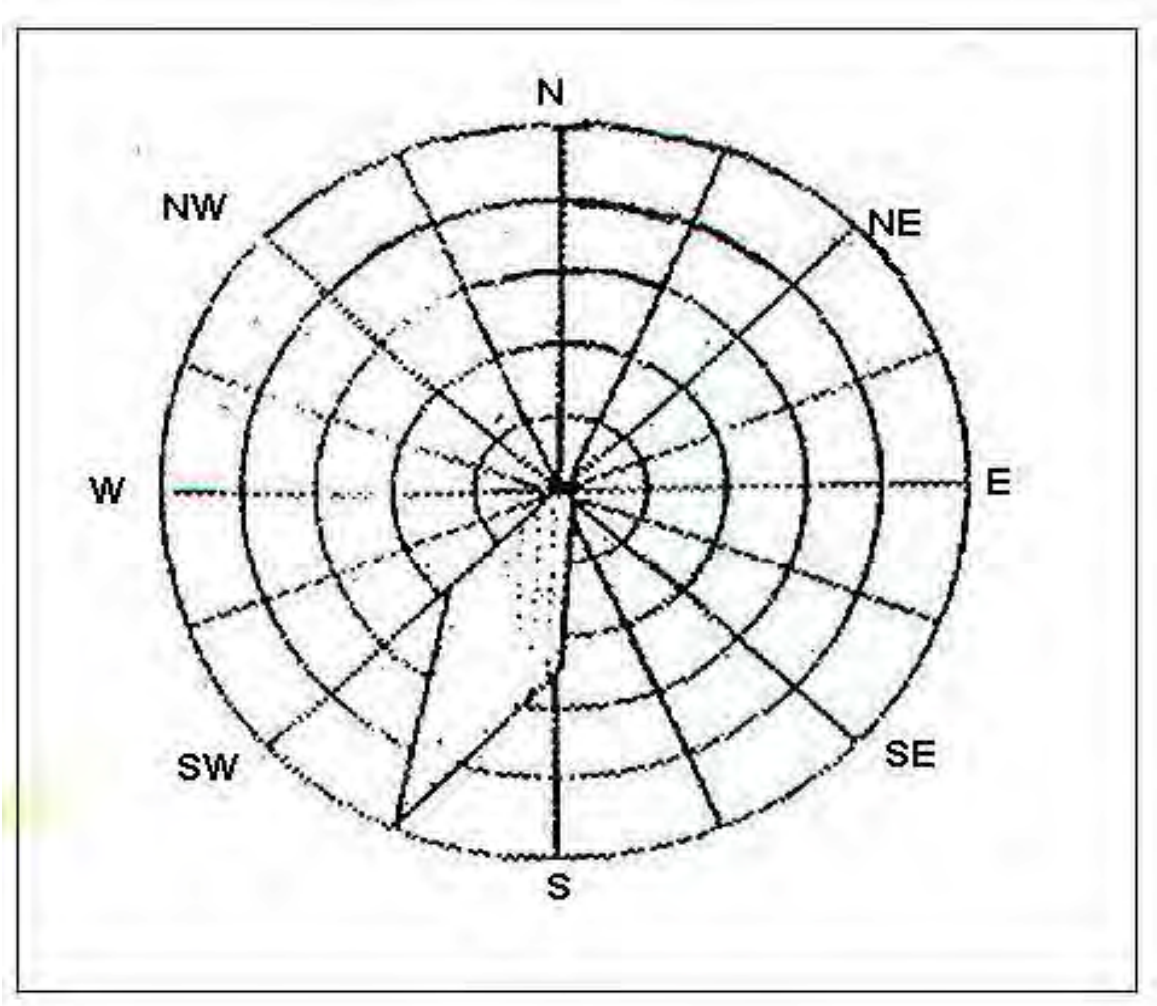


Figure 14: Wave Rose Indicating Predominant Swell Wave Direction

5.3.2 Sediment Type and Transport

The entire coastline is a sandy beach with mean grain size of 1.0 phi – 2.0 phi. The lagoon system is primarily responsible for depositing sediment into the marine environment while other sources include erosion of the shores and cliffs. The sediments along the coastline are redistributed primarily by the eastward longshore current, in the form of littoral drifts and, less importantly, tidal currents. Thus, sediment transport in the project area is by both longshore transport parallel to the shoreline and onshore transport perpendicular to the shoreline. Currently, there is a lot of sand accretion along the entire coastline of the project area as a result of the Keta Sea Defence Project.

5.3.3 Marine Fisheries

The common marine species found in the lagoon were the mojarra (*Gerres melanopterus*), half beak (*Hyporhampus picarti*) and the needle fish (*Strongylura senegalensis*). Juveniles of the flat sardine (*Sardinella mardrensis)*, mullets (Mugil curema and *Liza falcipinn* as well as *Caranx hippos*) were also encountered. The endemic fishes in the lagoons is mostly cichlids. *S. melanotheron* is the dominant fish with *L guineensis*, *L zillii* and *H fasciatus* also found in the catches. In Keta Lagoon, *Pellonula leonensis* was most abundant. As part of the Keta Sea Defence Project, was dredged and an open link was created with the ocean to enable shrimps

to swim into the lagoon which has also enabled the lagoon to regain some of its economic significance. This protected environment allows valuable shrimps increase in size quickly.

The Keta Lagoon is home to numerous species of fresh and salt water fish species. There are local species of finfish and crustaceans that are prospective candidates for fish culture which are high value species and include the grey mullet (Mugil cephalus) and other mullet species. Others are Tilapia species with euryhaline habits (Sarotherodon melanotheron, S. galilaeus and T. zillii,) Shrimps (Penaeus notialis, P. dourarum and Parapaeniopsis atlanticus).

5.4 Human Environment

The project area is principally within the Keta Lagoon complex which is located in the south-western end of the region settled by the Ewe people. The project will principally impact the people of Keta Municipal Assembly, Ketu South Municipal Assembly and South Tongu District Assembly all of the Volta Region and Ada East District Assembly in the Greater Accra Region of Ghana.

5.4.1. Socioeconomic Setting of Keta Municipality

Population

The population of Keta Municipality, according to the 2010 Population and Housing Census, is 147,168 representing 7.0% of the region's total population. Males constitute 46.4% and females represent 53.6% of the total population of the Municipality. More than half (53.3%) of the population in Keta Municipality live in urban areas. The sex ratio of the Municipality is 86.7, which implies that there are about 87 males per 100 females. The Municipality has a youthful population with 34.6% of the population below 15 years. This depicts a broad base population pyramid which tapers off with a small proportion of elderly persons (12.1%) aged 60 years and older. The total age dependency ratio for the Municipality is 77.5.

Ethnicity

Ewes are historically the traditional ethnic group in the Municipality and constitute 98.7% while the other tribes constitute the remaining 1.3% (GSS, 2010). This indicates that the population of the Municipality is highly homogeneous as far as ethnicity is concerned.

Religious Affiliations

According to the 2010 Population and Housing Census, the most predominant religion in the Municipality is the Christian religion (Catholic, Protestant, Pentecostal and Other Christian faiths), which constitutes about 72.8% of the population followed by traditional religion 25.4%; Islam constitutes 1% and other religions is <1%.

Education

Of the total number of persons 3 years and older in the municipality which is 53,084, about 22.4% had never been to school, 38.8% are currently in school while an equal proportion (38.8%) attended school in the past. The female (30.5%) population who has never attended school is higher than the male (13.0%) proportion who never attended school. For the population which is attending school now, the male proportion (45.0%) is more than the

female (33.6%). About 42% of the male population has attended school in the past whilst for females it is 36%.

Access to Portable Water and Electricity

Households in the Municipality derive their drinking water from diverse sources but the four main sources are pipe-borne outside dwelling (40.5%), public tap/ standpipe (22.4%), Pipe-borne inside dwelling (9.0%), protected well (7.7%). In the urban areas the main source of drinking water is pipe-borne water inside their dwellings (50.4%) which is higher than the proportion in the rural areas (28.8%). Other sources of drinking water for households in urban areas are pipe-borne inside dwelling (13.0%), protected well (11.7%) and public tap/standpipe (11.6%) whilst in the rural areas, the main source of drinking water for households is public tap/standpipe (35.6%). Other sources of drinking water for households in the rural areas include pipe-borne inside dwelling (4.2%) and rain water (4.8%). Almost 8% of households in rural areas obtain drinking water from river or stream and 5.6% obtain drinking water from tanker supply or vendors. 24% of households' use protected wells for other domestic purposes, while the percentages are 34.4% and 9.9% for urban and rural areas respectively. Almost 21% of households use water from unprotected well for other domestic activities, and 4.7% use water from river or stream.

The main source of lighting for most housing units is kerosene lamp (53.1%) with urban to rural proportions of (46.6%) and (61.0%) respectively, followed by electricity (41.8%) and flashlights/touch (2.9%). The use of crop residue, gas lamps, solar energy, candle and other lighting systems recorded <1%.

Local Economy

Households in agriculture account for 34.4% of the total households in the Municipality. In the rural localities, 43.2% households are agricultural households while in the urban localities, 27.0% of households are into agriculture. Most households (67.7%) in the Municipality are engaged in crop farming. Poultry (chicken) is the dominant livestock reared in the Municipality.

Occupation

Almost 35% of the employed population 15 years and older in the municipality are engaged as skilled agricultural, forestry and fishery workers. This is followed by craft and related trades workers (25.4%) and services and sales workers accounting for 21.8%. Clerical support workers and technicians and associate professionals recorded the lowest with (1%) and (1.2%) respectively. The proportion of males and females was higher in the following categories: managers, service and sales workers, craft and related workers, and elementary occupations.

Industry

Agricultural, forestry and fishing employs almost 36% of the employed population. The proportions for males and females are 55.8% and 19.1% respectively. This is followed by manufacturing (21.5%) and wholesale retail; repair of motor vehicles and motorcycles account for 18.5 %. The mining and quarry, electricity gas stream and air conditioning supply industries recorded the lowest proportions. Agriculture, manufacturing, wholesale and retail account for 75.7% of the industrial base of the Municipality. The same three industries are engaged in by males (73.0%) and females (78.0%). However, the proportions for males and

females differ, whereas 55.8% of males are in the agriculture, forestry and fishing the proportion for females is only 19.1%.

Telecommunication

According to the 2010 Housing and Population Census 105,884 persons are 12 years and older. A total of 44,334 persons representing 41.9% of persons 12 years and older own mobile phones. 46.2% own mobile phones, whilst of the female population 12 years and older 38.4% own mobile phones. Thus, the proportion of males who owned mobile phones is higher than females. Ownership of desktop and laptop computers is essential for easy access to the internet, electronic mail (e-mail) and other services. Of the total number of households which is 37,705, only 1,109 households (2.9%) own desktop or laptop computers. With regard to sex, ownership of desktop/laptop computers is higher for male headed households (4.0%) than for female headed households (1.8%) in the Municipality.

5.4.2. Socioeconomic Setting of Ketu South Municipality

Population

The population of Ketu South Municipality, according to the 2010 Population and Housing Census, is 160,756 representing 7.6% of the total population of the Volta Region. It comprises 52.9% females and 47.1% males. A little over half (53.4%) of the population is rural and has a sex ratio of 88.9. The population is youthful with the population under age 15 constituting 37.8%. The total age dependency ratio is 77.8, the age dependency ratio for males is higher (83.0) than that of females (73.4).

Ethnicity

According to the 2010 Population and Housing Census, it is evident that the Municipality is dominated by one major ethnic group, Ewe (97.0%). There are other minor ones including the Akan, the Dangme and a negligible proportion of the other ethnic groups.

Religious Affiliations

Majority of the population are Christians (59.0%), followed by the traditionalists (27.9%) and Islam (3.5%). Among the Christians, those belonging to Pentecostal and Charismatic group (27.0%) are in the majority followed by Catholics (15.3%) and Protestants (12.7%). However, almost one (9.1%) out of every 10 persons in the Municipality has no religious affiliation. There are slightly more males (3.85%) practicing Islam than females (3.22%).

Education

Of the total number of persons 3 years and older in the municipality which is 145,669, 25.6% had never been to school, 37.1% are currently in school while 37.1% have attended school in the past. The proportion of females who have never attended school is higher (33.7%) than for males (16.3%). For the population which is currently attending school, the male proportion (42.1%) is more than the female (33.2%). About 41.6% of the male population has attended school in the past while for females it was 33.1%. About 81% of persons currently in school are enrolled at the basic level (kindergarten, primary and JSS/JHS), 8.4% in secondary/senior high school, 0.2% in vocational/technical/commercial school, and 0.9% in tertiary institutions.

Access to Potable Water and Electricity

The households depend on several sources for drinking water but the four significant sources are wells (protected and unprotected), borehole, standing pipe and sachet water. The most dominant source of drinking water in the Municipality used by the households include unprotected well (34.0%) followed by protected well (17.8%), sachet water (16.8%) and borehole/pump/tube well (11.9%). Water apart from it being used for drinking, has other domestic uses such as cooking, bathing and washing. About 45.9% households use water from unprotected wells for other domestic purposes in the Municipality. This is followed by protected well (22.5%) and bore-hole/pump/tube well (12.5%).

Major sources of lighting for households in the Municipality include kerosene lamps and electricity from the national grid. These two sources of energy are used by 96.4% of the households. Whereas in urban communities, majority of households (74.2%) depend on electricity, the rural areas depend heavily on kerosene lamp (75.5%). The use of gas lamp and solar energy in both rural and urban areas within the Municipality is relatively low. However, quite a number of households use flash light/torch (1.6%) as the main source of lighting.

Local Economy

The Ketu South Municipality unlike other districts in the Volta Region is less of an agrarian economy as relatively low proportion of the population derives their livelihoods from agricultural activities. The Municipality depends heavily on the sale of food crops and extraction of the sea resources. About 98 percent of the total farmlands are under subsistence food crops production mainly maize, cassava and vegetables. The rest of the farmland is devoted to the cultivation of non-traditional cash crops mainly, mango and chili pepper.

Occupation

A higher proportion of those employed are engaged in craft and related trades (31.0%), followed by services and sales (28.2%) and those in skilled agriculture, forestry and fishery (17.3%). On the other hand, only a small proportion of employed persons are in the technical and associate professionals (2.2%), managerial (2.0%), and clerical support services (1.6%).
It can be observed that craft and related trades is the dominant occupation for the males (34.3%) while services and sales are dominated by females (43.1%). However, there are more males (10.8%) than females (0.6%) operating and assembling plant and machine. On the basis of sex, variation is observed among managers and elementary occupations with females recording a higher percentage than males. However, percentage of males working as professionals, technicians, associate professionals and operators of plants and machine is higher (21.8%) than that of their female counterparts (6.7%).

Industries

The 2010 Population and Housing Census indicates that manufacturing is the largest industrial sector, employing about 25.8% of the employed population 15 years and older. The other two major industries are wholesale and retail trade, repair of motor vehicles and motorcycles (24.0%) and agriculture, forestry and fishing (17.7%).

For males and females, wholesale and retail trade, repair of motor vehicles and motorcycles; agriculture, forestry and fishing; and manufacturing remain the major industries for employment. However, the proportion of males in agriculture, forestry, and fishing (25.4%)

is higher than that of females (11.3%), while the opposite is the case for wholesale, retail trade as well as accommodation and food service activities (47.3% of females and 12.7% of males).

Telecommunication

Among the population aged 12 years and older totaling 110,005 and representing 45.8% of the population in the Municipality who own mobile phones, males (51.7%) dominate the females (40.9%). Only 3.9% of persons 12 years and older use internet facilities in the Municipality. The low usage of the internet could be attributed to the non-availability of the infrastructure and institutions that supports ICT. A larger percentage of males (6.0%) than females (2.1%) use internet facility.

5.4.3. Socioeconomic Setting of South Tongu District

Population

The population of South Tongu District, according to the 2010 Population and Housing Census, is 87,950 representing 4.1% of the region's total population. Males constitute 45.5% and females represent 54.5%. About 87.1% of the population resides in rural localities. The District has a sex ratio of 83.5. The population of the District is youthful (39.9% are less than 15 years) depicting a broad base population pyramid which tapers off with a small number of elderly persons (7.8% are 60 years and older). The total age dependency ratio for the district is 90.9, the age dependency ratio for males is higher (95.7) than that of females (87.1).

Ethnicity

The dominant ethnic group is Ewe. There are other minor ones including the Akan, the Dangme and a negligible proportion of the other ethnic groups.

Religious Affiliations

There are three dominant religious groups in the country; Christianity, Islam and Traditional religion. Christians make up 74.9% of the total population in the District. 2% of the population profess Islamic faith. A total of 12% of the population practice Traditional religion whilst 9.4% profess no faith at all and those belonging to other religions (not specified) accounted for <1% (0.9%). In terms of sex distribution, males belonging to Catholic and Islam outnumber their female counterparts. The same observation can be made among those who profess no religion.

Education

Out of a total of 32,264 people currently attending school who are 3 years and older, 50.1% and 48.9% are males and females respectively. A total of 92.1% are enrolled in basic school (nursery, kindergarten, primary and JSS/JHS) and 6.8% in secondary/senior high and vocational/ technical/commercial schools is just less than one percent of the population in tertiary institutions.

An interesting revelation is at the post secondary and tertiary level. Surprisingly, <1% (0.9%) of the population currently in school is at the tertiary level as against 0.3% representing persons in post secondary school. there is higher proportion of females than males at the basic level. However, from SSS/SHS to tertiary level, a reversal of the situation is

experienced. Thus, the gap between males and females increases with the level of education in favour of males.

Access to Portable Water and Electricity

The main sources of water that households use for drinking and other domestic purposes in the district is tap water. The use of Public tap/standpipe is dominant in the District accounting for 46.4% of drinking water. Rivers or streams and pipe borne outside dwelling as sources of drinking water account for 21.5% and 13.4% respectively with the rest recording insignificant percentages. The District is endowed with the biggest river in the country, Volta River (Lower Volta). This accounts for the high proportion of the population using it as a source of drinking water.

A high proportion (43.4%) of households access pipe-borne water from inside their dwelling for other domestic purposes other than for drinking. With regard to urban and rural localities, wide variation is observed in terms of access to pipe-borne water. In urban areas, majority of households (93.2%) uses water from pipe-borne water from inside and outside their dwellings and from public tap/standpipe. In the rural localities, only 56.3% of households actually access water from pipe-borne water from inside and outside dwelling and from public tap/standpipe.

Majority of households 88.7% rely on kerosene lamp and electricity to provide light. Analysis by locality reveals that majority of households (55.2%) in the rural areas use kerosene lamp extensively to provide lighting and those who use flashlight or torch form a significant proportion (10.1%). However, in urban centres, a greater proportion (75.5%) of households uses electricity with only 17.1% using kerosene lamp. It can be observed that <1% (0.1%) of households uses gas lamp and solar energy. It also indicates that there is a wide gap between urban and rural households in terms of access to electricity.

Local Economy

About 52% of the active population is engaged in agriculture in the District. Rice is cultivated commercially on about 3,500 hectares. Other food crops cultivated in the District are maize, cassava, tomatoes and okro. Pepper or chilli farming predominates as the main cash crop undertaken by farmers. Cattle rearing dominate livestock activities in the District. In terms of herds of cattle, the District ranks second highest to the Nkwanta North District in the Volta Region. The absence of tsetse fly, short grasses and low rainfall pattern provide a favourable environment for animal husbandry.

The Volta River which flows through the District is extremely rich in fishes such as tilapia and fresh water clam (Adodi). Besides fishing, it is used as means of transport and sometimes, a passenger boat plies Akuse - Ada-Foah route and covers Sogakope, Tefle, Agordomi, Sokpoe, Vume and Agave. There are numerous creeks and lagoons running parallel to the Volta River, which serves as good breeding grounds for tilapia, shrimps and mud fish.

Occupation

There is a total population of 35,973 of 15 years and older which males constitute 43.4% and the females 56.6%. More females are found to be engaged in craft and related trades than their male counterparts. On the other hand, higher percentage of males undertakes skilled agriculture, forestry and fishery than their female counterparts in the District. It is observed

that there is a low percentage of the population engaged as managers and professionals (6.3%). Further analysis show that the percentage for males in this category is almost two times (9.5%) that of their female counterparts (4.5%). This could be attributed to the relatively low percentage of females who have attained post-secondary and tertiary levels of education. On the other hand percentage of persons working as technicians and associated professionals is quite low (1.1%). It is also observed that the proportion of females (0.6%) in the group is very low compared to their male counterparts (1.8%).

Industries

Majority of the people (15 years and older) in the District are into agriculture, forestry and fishing (46.7%), followed by those in wholesale and retail, repair of motor vehicles and motorcycles (14.3%). More males (53.9%) are working in agriculture than their female counterparts (41.3%).

It is interesting to note however, that there are a higher proportion of females into manufacturing (22.5%) than males (11.5%). In terms of the proportion of the population employed, the three important sectors are agriculture, manufacturing and wholesale/retail, maintenance of vehicles and motorcycles. Together they employ 78.9% of the entire workforce. Analysis by sex shows that these sectors employed 72.2% and 83.9% of males and females respectively.

Telecommunication

Ownership of mobile phones by the population 12 years and older in the District is 39.4%. Males (47.4%) ownership is slightly higher than female (33.2%) ownership. This finding is important because it goes to affirm that females fall behind males when it comes to ownership of assets in Ghanaian society.

It also indicates that population aged 12 years and older in the District in general has a significantly low access (2.7%) to internet usage. Comparatively, a higher proportion of males (4.3%) than females (1.4%) have access to internet in the District.

5.4.4. Socioeconomic Setting of Ada East District

Population

The population of Ada East District according to the 2010 Population and Housing Census is 71,671 representing 1.8% of the region's total population. Males constitute 47.5% and females represent 52.5%. About 68.3% of the population reside in rural localities. The District has a sex ratio of 90.3. The youthful population i.e., population less than 15 years in the district account for 54% depicting a broad base population pyramid which tapers off with a small number of elderly persons (6.5% of population aged 60 years and older) percent. The total age dependency ratio 85.5, the age dependency ratio for males is higher (89.8) than that of females (88.9).

Religious Affiliations

Among the religious groups, the Pentecostal/Charismatic constitutes the highest proportion (52.6%), followed by Protestants (19.6%), other Christians (8.8%), and Catholics (4.2%). Persons with no religion are about 8% while those who profess Islam constitute 4.6% of the population. Adherents to traditional religion and other religious groups are 2.2% and 1.1% respectively. The sex disaggregated data shows no marked differences in the distribution

except where there are more Protestant/Charismatic Christian females (54.8%) than their male counterparts (50.2%) and 8.9% males with no religion, compared to their female counterparts (5.4%).

Education

Overall, 25.1% of the population 3 years and older have never attended school while 40.2% are currently attending school and 34.7% attended in the past. The proportion of females who have never attended school is 31.2% whiles on the part of males it is 18.3%. It is observed that nearly half (49.7%) of the population currently attending school are in Primary school, (17.4%) are in JSS/JHS, (11.8%) are in kindergarten and (6.5%) are in SSS/SHS. Only a small proportion (1.4%) each are in vocational/technical and tertiary institutions.

Access to Portable Water and Electricity

In the district, Sachet water (20.8%), Pipe-borne water outside dwelling (20.6%) and Public tap/Standpipe (20.3%) are the main sources of drinking water for households. Quite significant proportions of households also depend on protected wells (11.7%), river/stream (8.5%) and unprotected wells (7.4%) as sources of drinking water in the households.

More urban households (39.2%) use sachet water for drinking compared to 10% of their rural counterparts. However, more households in rural areas (28.2%) and (24.2%) use the Public/standpipe and Pipe-borne outside dwelling for drinking than (14.3%) and (6.3%) of urban households. There are also more households (18.7%) that use the protected wells in urban areas compared to 7.7% in rural areas while a higher proportion (10%) of rural households than 2.6% of urban households drink from unprotected wells.

According to the 2010 Population and Housing Census the main source of lighting show that 60.6% of households are connected to the national grid. Almost three quarters (74.3%) of the households connected to the national grid are in the urban areas while 52.7% are in the rural areas. This may be attributed to the concentration of the rural population in over thirty-five (35) island communities of the Volta River Estuary where there are challenges in connecting them. It is therefore not surprising that not even a single island community is connected to the national grid. The Kerosene lamp is therefore used by significant proportion of households (34.5%) with its use higher in rural areas (42.0%) than urban areas (21.5%). In addition, 3.8% of rural households use the flashlight/torch than 3.3% of rural households.

Local Economy

The major activities of the people in the district is fishing and farming. Farming in the district is mainly done under irrigation which involves crops such cassava, maize and among others. Vegetables including tomatoes, onions, shallots, garden eggs, pepper, carrots, and okra are cultivated while fruits such as water melon also feature predominantly to sustain the livelihood of farmers. Fishing is another major economic activity in the district. Fishing is done in the River Volta and the Gulf of Guinea. Fish farming involving Tilapia is done in both in the Volta River and in ponds, and shrimp farming in ponds; mining of oysters by inhabitants living along the Volta river bank is also common in the district.

Occupation

The main occupation of the people is skilled agriculture, forestry and fishery employing 32.9% of the population. This is followed by Service and sales workers and Craft and related trades workers constituting 25.7% and 20.6% respectively. There are more males who are

skilled agricultural, forestry and fishery workers (48.1%) than females (20.2%). On the other hand, the female dominates the service and sales workforce (39.3%), than their male counterparts 9.5%. The data also reports a higher percentage of females (23.3%) as craft and related trades workers than males' 17.4%. Again, males (7.1%) are almost two times more likely than females (3.7%) to be engaged as professionals.

Industries

The predominant industries for the population are agriculture, forestry and fishing (33.3%), wholesale and retail; repair of motor vehicles (22.2%) and manufacturing (16.0%). The distribution by sex shows 48.6% of males in the agricultural, forestry and fishing industry than females 20.5%. However, in the other industries such as wholesale and retail; repair of motor vehicles and motorcycles 32.5% are females while only 9.8% of the employed are males. Similarly, there are more females 22.5% in manufacturing and 12.2% in accommodation and food service activities than males 8.3% and 2.0% respectively.

Telecommunication

Of the population of 12 years and older, 44.7% own mobile phones with a higher percentage (50.3%) of males than females (40.0%) reported as having mobile phones. For persons 12 years and older, only 3.8% have access to the internet facility in the district. Again, only 5.6% of males and 2.2% of females in the district use the internet facility.

6.0. CONSULTATION

6.1. Objectives of Stakeholder Engagement

Stakeholder participation during project planning, design and implementation is now universally recognized as an integral part of environmental and social impact assessment process. Local communities, their representatives, government, and non-governmental organizations (NGOs) may all be able to contribute to and benefit from dialogue directed at identifying and resolving key project-related issues.

The Stakeholder consultation has been a two-way flow of information and dialogue between project proponents and stakeholders and it is specifically aimed at developing ideas that can help shape project design, resolve conflicts at an early stage, assist in implementing solutions and monitor ongoing activities.

A number of organizations and individuals have been consulted as part of this project under the auspices of the various district assemblies and the objectives of the consultations were to:

i. provide information to the local people and their leaders about the activities of the proposed seismic project;
ii. facilitate and maintain dialogue among stakeholders;
iii. seek participation of all interested parties;
iv. enhance the project by learning from, and incorporating the expertise of individuals, professionals, communities and organisations.
v. to establish if the local people foresee any positive and/or negative impacts associated with the proposed seismic survey project, and suggest possible ways of mitigating negative impacts and enhancing positive impacts arising from it.
vi. to identify and document the diverse socio-cultural and economic setups in the project area that could be potentially impacted by the project activities.

6.2. Groups Consulted

Initial consultations have thus been established with different interest groups and individuals and concerns/ issues raised are presented in **below in the District Consultations.** The groups already consulted include:

The consultation afforded Swiss African Oil Company Limited (SWAOCO) to provide information on the onshore/offshore seismic survey to stakeholders. The consultation took place in selected districts and municipalities within the project area from 6th to 18th November, 2016. A team of 9 persons from GNPC, a representative from the Environmental Protection Agency (EPA) and with key representatives from SWAOCO undertook this activity during the period.

Notice of the proposed 2D Seismic Survey was served for public information as required under the procedure for the conduct of EIA in accordance with Regulation 15(1) of Environmental Assessment Regulations, 1999 (LI 1652). This process allows any person who has an interest, concern, or special knowledge relating to potential environmental effects of the proposed undertaking to provide information.

The consultations conducted as part of this study were the first in the field of onshore/offshore 2D seismic, as such there were many questions about how the survey was to be performed, why it being done, what were the potential impacts, and what were the safeguards. Some of the feedback which came early in the consults was how appreciative the communities were to receiving this knowledge in light of the fact that work has been performed in the past within the marine environment without similar consultations taking place.

The mitigation measures proposed for this survey, will ensure that any potential interaction is kept to a minimum. As this survey is a single event and the lines are widely spaced, it is highly unlikely that any measurably impact will occur during the survey considering the mitigation methods adopted. The proposed program is an exploration survey only, designed to map the sub-sea geology, and is a first step in the exploration cycle. The issues pertaining to drilling and development were not considered here, as they represent separate processes which would occur in the future.

Further consultations are ongoing with relevant stakeholders and other interested groups/institutions and their concerns will be addressed in the EIS, and they include:

i. Water Resources Commission;
ii. Wildlife Division of the Forestry Commission;
iii. Petroleum Commission; and
iv. Volta River Authority

6.3.District Consultations

6.3.1 Ketu South Municipal Assembly

Date of Meeting	
Location	Ketu South Municipal Assembly Hall
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Salakofe, Adafienu, Afekotuime, Adafienu, Tagbato, Klikor, Blekusu, Akaglakope, Agbozume, Avoeme, Adzablikope
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours

Issues/Concerns Expressed:

- Asked whether crude oil has been discovered in the Keta Basin yet or not.
- Suggestion to include EPA in conducting stakeholder consultation and community education in affected communities for the exploration phase of Keta Basin.
- Asked whether exploration will affect livelihood of community members or not.
- Asked if community members have already been informed about intention of oil company to explore the Keta Basin.
- How will the oil company address places of exploration where they have dedicated shrines/smaller gods of spiritual importance to the members of the affected communities?
- Most of the affected community members are unaware of ongoing stakeholder being conducted. Suggestion to also include EPA rep in stakeholder consultation team.
- Are there any plans by oil company to compensate land owners where the proposed seismic survey will them?
- During EIA baseline survey, data will be collected and based on that, appropriate compensation plans will be developed to address such as situations.
- Suggestion for total coverage area of seismic survey must be made known to community members.
- Asked whether there are any mitigation plans for the impacts associated with the seismic survey.
- Asked whether there are any job opportunities for the community members during seismic survey.
- All information presented on slides compiled by Suggestion that bribery of Paramount/Sub Chiefs & Opinion leaders should professionals and some are localized information from not be encouraged in order to lay bare the real facts of the exploration and community members so the facts are true and real. In its associated impacts to the community members.
- Suggestion to consult Paramount/Sub chiefs before meeting larger community.
- Suggestion for Oil Company to give feedback regards to when seismic survey commences, whether positive or negative.

Responses:

- Project only in exploration phase where seismic survey is yet to be carried out to determine where there is likely to be crude oil in order to guide as to where to drill. Exploration phase takes a long time of about 2 to 6 years before oil can be said to be found.
- EPA rep already part of stakeholder consultation team.
- Exploration will affect community both negatively and positively, hence the need to carry out stakeholder consultation to seek concerns from community members in order to address them in the future during the seismic survey.
- EPA has directed the oil company to conduct stakeholder consultation in order to inform affected communities of intent to explore Keta Basin
- Opinion leaders & Paramount/Sub chiefs will be consulted where such a situation arises
- Presiding Members in communities to disseminate information about stakeholder consultation to community members for subsequent meetings. EPA rep already part

of stakeholder consultation team. • During EIA baseline survey, data will be collected and based on that, appropriate compensation plans will be developed to address such as situations. • Total coverage mentioned as 3,000 kilometres squared. • Mitigation measures will be developed and form part of the Environmental Management Plan when final version EIS is submitted to EPA. • Cannot be addressed now until later in the • We have no intentions to bribe Paramount/Sub Chiefs in order to influence them in any negative way. • Paramount/Sub Chiefs for Ketu South met earlier on before meeting larger community • This will be addressed via community education before, during and after the proposed seismic survey to ensure appropriate feedback is given to community.

6.3.2 Keta Municipal Assembly

Date of Meeting	
Location	Keta Municipal Assembly Hall
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Asadame, Afife, Blemazado, Agbeve, Amedome, Dzorgborve
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours
Issues/Concerns Expressed: • Clarification as to whether oil spill equipment exists to be able to cater crude oil spillage when it occurs. • What compensation will be given to fishermen during the offshore seismic survey? • How will farmers be compensated in cases where the onshore seismic survey will affect them? • Specific educational courses should be made known to community for them Community advised to look through KNUST admission to be able to advise their wards appropriately as to what courses are relevant for employment in the upstream oil and gas industry. brochure for courses relevant to the Petroleum industry • Will rivers be affected during the seismic survey period? • Will the exploration project company recruit capable/qualified youth to work	

during the seismic survey? • Swiss African oil company is committed to adhering to the local content laws and will not neglect qualified community members
Responses: • An oil spill contingency plan will be developed and submitted to the EPA to be approved upon inspection of all oil spill equipment during drilling, field development and production phase. • This will be addressed comprehensively when the oil company develops its compensation plan. • This will be addressed comprehensively when the oil company develops its compensation plan. • Rivers and other inland water bodies will not be affected at all.

6.3.3 South Tongu District Assembly

Date of Meeting	Day 1
Location	South Tongu District Assembly Hall
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Sogakofe, Gonu, Agortaga, Adutor, Sukladzi, Dzetorkoe, Fevie, Klonu-Dzogborve, Dzorgbove, Galo-Sota
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours
Issues/Concerns Expressed: • Will the proposed seismic survey commence in all affected communities simultaneously or from community to community? • What are some of the factors that will delay the seismic survey from commencing on the planned date? • What will happen to community members who own lands that will be affected during the seismic survey? • What will happen to affected communities where dredging will be carried out during the seismic survey and will there be any evacuation of community members during such a period? • With reference to the Volta River Dam Project that deprived communities of their	

livelihood, what benefits will your project impact on the affected communities concerning employment & infrastructure? • Will there be any further engagements with the community after the current stakeholder consultation? • A recommendation to land owners not to be in a rush to either sell or lease out their lands to foreigners now until oil production has actually began after some years of exploration. In addition, they should always seek expert advice in such matters before either selling or leasing out such lands to foreigners. • Will Swiss African Oil Company inform the community of available job opportunities during the seismic survey?
Responses: • Seismic survey will be carried out from one community to another depending on where the planned line cutting will commence. Three factors can affect the delay the commencement of the seismic survey; o where the environmental permit is not granted by EPA on time o unforeseen challenges in mobilization of the seismic equipment o where the community members do not offer their support and cooperation o unforeseen adverse weather conditions o An appropriate compensation plan will be developed to handle such issues. • Neither dredging nor evacuation of community members will occur during the seismic survey

Date of Meeting	Day 2
Location	South Tongu District Assembly Hall
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Sogakofe, Gonu, Agortaga, Adutor, Sukladzi, Dzetorkoe, Fevie, Klonu-Dzogborve, Dzorgbove, Galo-Sota
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours
Issues/Concerns Expressed: • How long the seismic period take will before drilling begins?	

• Will the exploration project company recruit capable/qualified youth to work during the seismic survey? • Will the use of explosives affect the humans, their livelihoods and other resources as rivers? • Wants clarification on whether the seismic survey will be carried out deep into the sea offshore? • Will community members have access to the base camps that will be set up? And will Swiss African Oil Company sell these base camps and other equipment after the seismic survey? • How will you go about the usage of explosives in order to avoid causing damage to the environment? • Will there be another stakeholder consultation with the community when drilling begins? • What will happen to the Keta Delta Block when the oil found is not in commercial quantities?
Responses: • Seismic survey will begin in June 2017 and will last for about three and a half months, after which there will be processing and interpretation of seismic data. Drilling will commence after another environmental permit has been granted by the • Swiss African Oil Company is committed to adhering to the local content law which will ensure that local resources utilized during the seismic survey. Community education will be carried out before, during and after the seismic survey. • Furthest water depth offshore will be 200 metres from the beach during the seismic survey. • These base camps will be rented and so cannot be sold to the community members because they will be returned to the owners of the hiring company. • Appropriate security measures will be put in place to prevent the indiscriminate use of explosives in order to avoid causing damage to the environment • After the seismic survey, before drilling begins, another stakeholder consultation will be carried out in fulfilment of EPA requirements. • Swiss African oil company is hopeful that the oil that will be discovered will be in commercial quantities in order for the community to benefit

6.3.4 District Assembly

Date of Meeting	
Location	Trekume Roman Catholic Church
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Tregui, Devnu, Azanu, Trekume, Suife, Adzato
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and

	Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours

Issues/Concerns Expressed:

- What are some of the residual effects of treating waste brought form offshore to onshore on the environment and how will they be handled during the seismic survey?
- Will there be any percentage for the community during the production of the crude oil in the future?
- What will happen to the project where there is a change of Government after the impending elections?
- Percentage from the oil production will go to government who will manage it on behalf of the whole country, of which the community is inclusive
- Will there be any compensation for those whose livelihood is dependent on the rivers where they are affected by the seismic
- survey?
- Where one is leasing a farmland and it is affected by the seismic survey will that person also be compensated?
- What happens in scenarios where there is accidental spillage of toxic chemicals into the environment during seismic survey?
- What will Trekume as a community benefit from the oil when it is discovered?
- Will farm produces be destroyed and will compensations paid be adequate & sustainable during the seismic survey?
- Will oil be discovered in commercial quantities and what happens if they are not discovered?

Responses:

- This will be addressed in Swiss African Oil Company's Environmental Management Plan that will be developed as part of their final Environmental Impact Statement that will be submitted to the EPA for approval
- Assurance given that the project will not cease and will continue even if there is a change of government. Reference was made to the Jubilee project.
- Seismic survey will not affect rivers and other onshore water bodies
- Community education will be carried out to discuss the oil company's compensation plan to handle such situations when they arise.
- Swiss oil company will develop an appropriate emergency plan to handle such a situation. In addition, EPA has a mandate to ensure the protection of the environment and so will ensure that the oil company puts in adequate measures.
- This question not relevant to the seismic survey as oil has not yet been discovered.

- Community education will be carried out to discuss the oil company's compensation plan to handle such situations when they arise.
- There is evidence of the presence of hydrocarbons in the Keta Delta Block from previous data on wells drilled there. However, further investigation in the form of a seismic survey is required to confirm this. Where oil is not discovered, the partnership will decide the next step to take

6.3.5 Ada East District Assembly

Date of Meeting	
Location	Ada East College of Education, Ada-Foah
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Kabiawe, Lolo Nyakpoe, Alokpem, Azizanye, Big Ada, Akiage, Abosu, Kabiawe, Ada Foah, Ada East
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours

Issues/Concerns Expressed:

- What provision will be made for unforeseen emergencies during the seismic survey?
- What will be the effects of the seismic survey on the atmosphere, especially explosives?
- What negative impacts will drilling have on the environment?
- Do previous work done on the Keta Delta Block have any impact on seismic survey about to commence?
- Will Swiss Oil Company provide reflective lifejackets to fishing vessels to make them more visible to the offshore seismic vessel?
- How will land compensations be paid out where these are affected by the developing the company's compensation plan and seismic survey?.
- Will there be job opportunities for those from other communities who will not be affected by the seismic survey?
- Will farm lands still be fertile where they are affected by the seismic survey?

• On what basis will compensation be paid to farm owners where their farms are affected by the seismic survey? • How will the Swiss Oil Company handle simultaneous operations with regards to the VRA wind power project in the same area? • Will the use of explosives cause an earthquake? • Will seismic affect organisms on both land and sea? • Will offshore seismic affect dragging net and deep sea fishing activities?
Responses: • An appropriate Environmental Management Plan will be developed as requirements for the environmental permit to handle such situations. • Explosives will be buried in hole of about 20 to 30 metres deep and so will have no adverse effects on the atmosphere. • This question not relevant to the seismic survey and will be addressed later when • drilling is about to begin • Definitely influenced the identification of a basin in the Keta block and also helped to indicate the presence of a petroleum system. Reference made to previous works carried out on the Jubilee and TEN fields. • These will be provided before and during the seismic survey to avoid unwanted collisions • Land commission laws will be duly applied in developing the company's compensation plan and also when it comes to payment • Members from the affected community will be a priority first, after which other members from other communities may be considered. • Lands will still be fertile because explosives will be buried in hole of about 20 to 30 metres deep and so will have no adverse effects on the environment. • Land commission laws will be duly applied in developing the company's compensation plan and also when it comes to payment • GNPC have already met VRA on this issues and will be in constant communication throughout the duration of project to avoid any possible conflicts as part of EPA requirements • Explosives will not cause any earthquake as vibrations will be very minimal deep in the earth due to new technology that will be used. • Swiss oil Company will adhere to Best International Environmental Practices in order to avoid harming such organisms on both land and sea. • Offshore seismic is in shallow waters of about 200 m water depth and son will not affect such fishing activities

6.2.6 Ada East District Assembly

Date of Meeting	

Location	Omega Hotel, Agbozume
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Adina, Denu, Adafienu, Tegbi Agblekagor, Vui, Abutakope, Dzelukope, Kedzikope
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours

Issues/Concerns Expressed:

- What happens when a natural mineral other than oil is found during the seismic survey and what will be the compensation modalities?
- What assurance is there that this exploration project will continue to its end and not be suspended like the previous ones?
- Will explosives affect water bodies onshore during the onshore seismic survey?
- Recommendation to send some of the Volta chiefs to the Western region where oil and gas activities are ongoing in order for them to become more informed.
- Does plebiscite on ban with regards to exploitation of natural resources in the Volta region have any influence on the seismic survey?
- What assurance is there that the oil company will manage the identified environmental impacts associated with the seismic survey adequately?
- Will offshore seismic survey interfere with fishing activities to the extent of halting them and will there be any compensation due to this situation?
- Will use of explosives during offshore seismic survey cause sea to over flow its banks and cause a tsunami, considering that the Keta land is mostly below sea level?
- Comment made that previous perception that during the onshore seismic survey communities will be displaced has been very well clarified.
- What influence does previous exploration works have on the current seismic survey to be carried out?

Responses:

- Seismic survey equipment will only be able to detect the presence of hydrocarbons and no other natural minerals
- Assurance given that exploration will continue to its end because of Petroleum Agreement signed which must be adhered to
- Explosives will only be used on land, buried in hole of about 20 m to 30 m deep

and so will not affect water bodies. • Recommendation noted and Swiss Oil Company may consider it in the future. • Clarification to be sought on such existence of a plebiscite and feedback given later on to the community • Swiss Oil Company will be bound by environmental permit conditions to fulfill requirements of their Environmental Management Plan as approved by the EPA. • Fishermen advised to fish elsewhere while offshore seismic is ongoing and that there will be no compensation as there will still be other areas on the sea where they can go to carry out same fishing activities • Only air guns and not explosives will be used during the offshore seismic and these cannot cause the sea to overflow its banks to cause any tsunami. • Previous work established the presence of hydrocarbons and the probable existence of a petroleum system and hence the need to further investigates in order to verify such in the Keta Basin via current seismic to be done.

6.2.7 Keta Municipal Assembly

Date of Meeting	
Location	Jubilee Hall in Keta
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Vodza, Afeadenyegba
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours
Issues/Concerns Expressed: • Will air guns used during the offshore seismic survey kill the fishes? • Will onshore seismic activities affect their drinking water in wells? • Will local youth be employed during seismic survey? • Direct and indirect job opportunities will be created. However, with the direct jobs, community members will have to be qualified for vacancies in order to be duly employed.	
Responses: • No, air guns only produce sound waves and not bullet shots, via compressed air and	

will not kill fishes. • Direct and indirect job opportunities will be created. However, with the direct jobs, community members will have to be qualified for vacancies in order to be duly employed.

6.2.8 Keta Municipal Assembly

Date of Meeting	
Location	Anloga Roman Catholic Church
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Whuti, Agota, Anloga, Woe, Atiteti, Anloga
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours

Issues/Concerns Expressed:

- Will chiefs, opinion leaders and elders be informed of seismic survey before it begins?
- What percentage of the oil proceeds will come to the community?
- Can the community halt the seismic work at any time should they find any untruth with regards to information given out during the stakeholder consultation?
- Will seismic acoustic sources cause the sea to overrun its banks?
- Will oil produced be sent outside Ghana to be sold?
- Will seismic survey cause sea weeds to drift & disturb them on the sea and water bodies?
- Will offshore seismic affect fishing activities and will compensation be paid to fishermen?
- No, fishermen advised to fish elsewhere whiles offshore seismic is ongoing. In addition, during the community education the timing and location of the seismic vessel will be notified to the fishermen.
- Will onshore seismic affect underground water sources such as water wells?
- Where explosives used during the onshore seismic cause cracks in buildings will compensation be paid to affected people?
- Has any agreement been signed between the Swiss Oil company and the landlords of the community prior to the onshore seismic survey?

Responses:

• Community education will be carried out. • Question not relevant to the seismic survey and will be addressed later prior to oil production. • This is not to be encouraged as efforts are being made to establish good community relations via unadulterated education on seismic survey & its impacts/benefits through the stakeholder consultations/community educations. • No, as air guns used will not cause sea to rise and overrun its banks. • Question not relevant to seismic survey so will be addressed later when oil production begins • No, drifting floating sea weeds will not be caused by seismic survey in any way whatsoever. • Most water wells are dug between 2 to 5 metres and the explosives will be used well below the water table of these water wells. As such the onshore seismic will not affect underground water sources in anyway • Explosives will not cause cracks in buildings as they will be buried in a depth of about 20 to 30 m & the vibration will be directed downwards into the reservoir and not above. • This will be done during the community education when the company's compensation has been fully developed.

6.2.9 Keta Municipal Assembly

Date of Meeting	
Location	St Theresa of the Child Jesus Basic School, Abor
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Lawoshimi, Atiave, Asadame, Abor, Atiave, Tsiame, Hotagbe, Anyako
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours
Issues/Concerns Expressed: • What compensation plans are in place for lands that will be affected by the onshore seismic survey? • Where crude oil spills occur how will they be managed? • What happens when a pipeline containing crude oil gets burst? • What happens in the case where oil is discovered on a piece of land that has houses	

on it or a whole community?
- Who bares the cost if oil is not discovered after the seismic survey?
- How will seismic equipment be mobilized to places which are hard to reach and remote?
- What employment opportunities will be available to community members during the seismic survey?
- What will the affected communities benefit from the crude oil that will be sold after production?
- Will explosives and trucks with vibrators being used during onshore seismic cause earthquakes?
- What are some of the tangible benefits from the exploration project that the affected communities will enjoy since there are rumours that towns in the Western Region have been left worse off after oil find?
- What happens when bauxite rather is found on someone's land during the onshore seismic survey?
- Seismic equipment can only detect the presence of hydrocarbons and so cannot detect the presence of any other minerals.
- What happens where explosives or trucks with vibrators cause cracks in buildings during the onshore seismic survey?

Responses:
- Compensation plan will be developed to handle such issues when they arise. In addition, during the community education affected members will be enlightened on the modalities for paying such compensations.
- Both questions not relevant to seismic survey and will be addressed later when drilling is about to begin.
- Compensation plan will be developed to handle such issues when they arise. In addition, during the community education affected members will be enlightened on the modalities for paying such compensations. Alternative methods such as directional drilling could be used in order not to tear buildings down or displace community too.
- Per Petroleum Agreement, the operator and other partner apart from GNPC will bare all cost of exploration.
- Professional seismic companies with rich experience will be awarded the contract so they will have the necessary know how to handle such terrains.
- Both indirect and direct jobs will be created during seismic survey to employ qualified members of affected communities. In addition, Swiss Oil African Company is committed to adhering to local content law to ensure the use of local resources.
- Question not relevant to seismic survey and will be addressed later when production begins.
- No, since the explosives and trucks with vibrators will produce only compressional waves deep into the earth which cannot cause earthquakes in any way possible.
- Reference made to the Western Region where most people have benefited from scholarship schemes from oil companies and continue to do so are some of the similar tangible benefits affected communities in the Keta Basin can also enjoy.
- Seismic equipment can only detect the presence of hydrocarbons and so cannot

detect the presence of any other minerals. • Explosives or trucks with vibrators use new technology that ensure that all sound wave energy produced are directed into the earth and way from buildings. As such cracks occurring in buildings will not occur.

6.2.10 Keta Municipal Assembly

Date of Meeting	
Location	Awomefia's Residence, Anloga
Attendance	**Institutions:** GNPC, SWAOCO, EPA **Communities:** Anloga
Proponent Speaker	Dela Anthony Morty, Philomina Donkor, Osei Afriyie and Bill Brumbaugh
Advertisement for the meeting	Direct e-mail contact/Telephone, Letters, Community Liason Officers
Delivery of the meeting	Power Point Presentation
Duration of the meeting	3 hours
Issues/Concerns Expressed: • How do you explain the process of seismic acquisition well enough to the laymen in the community during the stakeholder consultation sessions? • What are some of the key challenges faced during the stakeholder consultation sessions?	
Responses: • Videos and pictures are shown during the presentation in order to explain well to the laymen the process of seismic acquisition both onshore & offshore. • Some requested to see videos of examples of onshore seismic being undertaken in Ghana but these couldn't be shown since such videos did not exist yet. • Assurance that he will lend his unwavering support throughout the entire period of the exploration project and help to solve any issues that will crop up from the community to hamper the project in any way.	

7.0 POTENTIAL IMPACTS IDENTIFICATION AND PROPOSED MITIGATION

7.1 Introduction

The baseline parameters are critically examined in this section in relation to the potential environmental impacts of the proposed seismic survey. It should be noted that seismic surveys are of short duration, typically less than six months, and are generally considered to be a low impact activity that generally permits the immediate return of the operational sites to its previous land use. This is indirectly supported by the fact that a number of seismic surveys have already been conducted in the offshore (marine) areas of Ghana, and no adverse or long-lasting impacts have been reported from these activities. All such seismic survey Environmental Assessment that have previously been submitted have been approved by EPA.

This Chapter identifies the potential environmental and social impacts of the proposed project, based on the components of the proposed survey (Chapter 3), and in the context of the baseline conditions that have been established, and with due regard to applicable legislation.

7.2 Valued Ecosystem Component (VEC) Selection

This assessment will use a valued ecosystem component (VEC) approach to define and focus the issues and factors considered in this assessment. These include components that are important for a variety of reasons, such as their economic or social value, their status (e.g. at-risk species), or their importance to/as habitat. The selection of VEC's is limited, however, to those components that have some reasonable potential for interaction with, or sensitivity to, the planned project activities, most notably the Field Data Acquisition Program during the period of active profiling.

7.2.1 Impact Definitions and Criteria

The criteria for determining significance include magnitude, geographic extent, duration and frequency, irreversibility, ecological context" and that the assessment considers the likelihood of an adverse impact occurring. Significant adverse environmental effects are those that will cause a change in the VEC, such that its status or integrity is altered beyond an acceptable level. In other words, a significant adverse anthropogenic environmental effect may alter the assigned VEC in terms of its physical, chemical, or biological quality or extent to such a degree that there is a detrimental change in its ecological integrity beyond which natural mechanisms would not return that VEC to its former level of ecological integrity within the system. The following (see Table 13) describes the criteria applied for this project within the ecological context described in this report. Residual impacts are determined after application of applicable mitigation measures.

Table 13 Impact Definition Criteria

Magnitude	LOW > within natural variations/less than one generation
	MEDIUM > permanently outside natural variation / whole population affected
	HIGH > permanently outside natural variation / whole population affected
Geographic Extent	LOW > localized
	MEDIUM > sectoral
	HIGH > widespread
Duration	LOW > less than one month
	MEDIUM > one to two months
	HIGH > greater than two months
Frequency	LOW > one time event
	MEDIUM > several events low duration
	HIGH > continuous
Reversible / Irreversible	Reversible > by natural processes and / or mitigation
	Irreversible > permanent regardless of mitigation
Limits of Confidence	LOW > high degree of scientific uncertainty
	MEDIUM > medium degree of scientific uncertainty
	HIGH > low degree of scientific uncertainty (conclusions are accurate)
Significance Characterization Post-Mitigation	No Significant Residual Impact Significant Residual Impact Positive Residual Impact

The assessments for each VEC will consider: impact pathways, a review of relevant literature / research, evaluation of potential effects, and identification of specific appropriate mitigation.

7.3 Impacts Identification and Proposed Mitigation Measures

The components of the seismic survey and survey-related activities that could result in environmental impacts and its proposed mitigation measures are indicated in Table 14 below.

Table 14: Onshore Survey Project Environmental Impacts

	Environmental Parameter	Impact Source	Potential Impacts	Proposed Mitigation
1.	• Physiography and Geology	• Vibroseis and associate equipment • Bulldozer • Dynamite shots	• Cut lines leave long-lasting residual impacts (tracks, and/or scarring on surface landscapes) • Vibrators/bulldozers and dynamite use near steep slopes may lead to minor landslips and rock topples	• Use existing access roads to the extent possible; • Pre-survey possible access routes, and use the selected routes rather than accessing work sites through free-ranging driving across the open country • Explosives (dynamite) should be used as source instead of vibroseis in areas with highly dissected and incised surfaces. • When laying cut lines, use will be made of existing roads and tracks to avoid creating unnecessary tracks and trampling of pasture; • Minimise, to the extent possible, the use of bulldozers to open up cut lines and access roads to minimise landscape scarring; • Avoid cut lines on slopes steeper than 40º to minimise risk of landslips and rock topples; • Optimise source energy to

				achieve the survey objectives to minimise risk of landslips and rock topples; • Buffer zones of 50m should be maintained from areas posing landslip and topple hazards.
	• Soils	• Vibroseis and associate equipment • Bulldozer • Transport Vehicles • Oil or chemical leaks from vehicles and machinery, garage and • storage areas	• Compaction of soft sediments in waterlogged areas along cut lines • Disturbance of soil along cut lines • Cut lines may enhance gulleying and erosion (wind and water) • Rutting in loose soils • Contamination of soils	• Machinery and equipment should use existing routes as much as is practicable to avoid compaction of the surface soil; • Construct drainage channels on cut lines where natural drainage may be affected; • Vehicles should steer away from natural drains and waterways wherever practicable, but a buffer zone of 20m should be maintained except at crossing points; • Minimize vegetation and grassland clearance as much as possible when cutting the survey line transects; • Seismic survey should aim to be carried out as far as possible during the dry seasons; • Use only essential vehicles and low pressure/low impact tyres in areas with wet soils or that are susceptible to ponding or are prone to erosion; • Ensure that all vehicles and

				machinery operating in the field and in the campsite are properly maintained so as not to have oil leaks that could contaminate the soils; • Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available; • All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures; • Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks; and • Installation and proper management of camp sanitation facilities.
	• Air Quality	• Vehicles and machinery • Sanitary systems • Waste disposal points	• Pollution from exhaust emissions • Fugitive dust generation from traffic • Offensive odours • Health risks	• Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation; • Field vehicles, trucks and any other machinery should be switched off when not in use; • Regular servicing of all trucks, service vehicles, and any other machinery powered using fossil fuels to ensure efficient combustion and minimisation

				of exhaust emissions; • Use low sulphur fuels if available and where suitable; • Employees working in dusty conditions must use appropriate PPE; • Installation and proper management of camp sanitation facilities.
	• Surface and Groundwater Resources	• Water supply source for the camp • Heavy vehicles and machinery • Drilling of shot holes	• Conflict with neighbouring communities if water source is shared • Compaction of near-surface aquifers such as springs, reducing yield • Downward draining of groundwater through drill holes, reducing yield at springs	• A water supply borehole should be drilled to provide the water required for the project; this could be donated to the community on completion of the seismic survey; • It is recommended that an efficient water-use policy be adopted by the project proponent at the camp site and other work areas; • An efficient sanitation system should be put in place in the campsite(s) to handle effluents; • Hazardous and toxic waste material should be managed according to international protocols and best practices and in compliance with Ghanaian legislation, specifically the Hazardous,

				Electronic and Other Wastes Regulations (LI 2250); • Buffer zone distances between seismic lines and water sources will be established through extensive in-field ground vibration testing. Distances may vary between seismic source types. • When water is encountered during shot hole drilling, bentonite, or a tapered concrete (or other suitable material widely accepted in the industry), can be used to plug the hole up to 3m above the static water level or to a depth of 1m from the ground surface; • Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available; • Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks.
	• Water Quality	• Liquid effluent discharges from sanitation systems at the campsite • Oil or chemical leaks from garage and	• Contamination of water supply source for the camp • Contamination of underlying aquifers	• Refueling areas must be underlain with spill-proof hardstanding or bund, with spill kits readily available and operatives trained in their use; • All fuels and other non-

		storage areas, vehicles and machinery • Subsurface detonation of dynamite charges		aqueous fluids to be stored in suitable bunded enclosures; • All refuelling operations to be carefully overseen and managed; • Pits for disposal of domestic and sanitary effluents should be sited with knowledge of the geological and soil characteristics of the area; • Buffer zone distances between seismic lines and water sources will be established through extensive in-field ground vibration testing. Distances may vary between seismic source types; • Spill kits to be carried with vibe truck service vehicle, refuelling bowser vehicles, drill crews. All staff to be briefed on use of these; • When water is encountered during shot hole drilling, bentonite or a tapered concrete plug may be used to plug the hole up to 3m above the static water level or to a depth of 1m from the ground surface; • Ensure that all vehicles and machinery operating in the field (and in the campsite) are

				properly maintained so as not to have any oil leaks that could contaminate the soils; • Ensure that any in-field refuelling or maintenance is performed in a bunded area or while using a drip tray with a spill-kit available; • Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks
	• Terrestrial Environment (Habitats, Flora and Fauna)	• Vibroseis and associated equipment • Mulchers • Bulldozer • Transport vehicles	• Cutting of vegetation along cut lines • Disturbance of wildlife (physical presence and noise) • Introduced weeds and pests	• The mitigations related to soils (see above) apply; • Trees with trunk diameter greater than 20cm should not be cut; • Seismic survey activities to be undertaken during daylight hours only; • Any planned lines that are considered to be a threat will be relocated; • Hunting, fishing, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. All workers to be briefed regularly on this issue; • The risk of introduction of weed and pests species to the region via contaminated

				vehicles and equipment will be mitigated by the wash-down of all vehicles and ancillary equipment at a designated location prior to the commencement of the survey.
	• Land Resources	• Vibroseis, mulchers and associated equipment • Dynamite shots • Vehicles • Presence of humans	• Cut lines affect pastoral resources	• Physiography and Geology and Terrestrial Environment above.
	• Archaeological, Historical and Cultural Sites	• Vibroseis and associated equipment • Vehicles • Dynamite shots	• Compaction by heavy vehicles and machinery may damage fossils/artifacts buried in shallow soils • Vibrations and drilling of shot holes may disturb/break up near-surface archaeological materials	• Consultations with the Museums and Monument Board should take place in the design and execution of the seismic survey in archaeologically important areas; • Close liaison should be maintained with stakeholders • Lines should be relocated if necessary after consultation with stakeholders; • Use of shot points rather than vibroseis is recommended for such areas; • Seismic survey lines will not be planned to go through known archaeological and cultural sites;

				• Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites during the survey in order to prevent conflict with the community; • Access routes and cut lines will be selected to provide sufficient offset to known archaeological sites to avoid surface disturbance; • All cultural and archaeological sites will be flagged for avoidance; • An archaeologist will monitor project operations in archaeological sites, and if archaeological materials are found during the operations, they will advise on how to proceed; • All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted; • Any archaeological finds to be noted and reported to the

				Museums and Monument Board.
	• Visual Aesthetics	• Campsite design • Cut lines	• Poor campsite design does not blend in with the environment • Cut line footprints and vegetation cover removal lower aesthetic value of landscape	• Use of modern line cutting technology, preferably mulchers for clearing of the geophysical survey transects will ensure that minimal vegetation is removed, hence ensuring that re-vegetation will occur in a much shorter period since the rootstock, and seeds will be left along the traverses and this will promote faster re-growth; • Campsite design should take into consideration the aesthetics of the selected area.
	• Noise and Vibrations	• Vibroseis and associated equipment • Dynamite charges and associated equipment • Vehicles traversing the area	• Disturbance to humans, animals and livestock • Disturbance to workers • Health risks	• To reduce the expected transient impacts on wildlife, noise levels will need to be minimized to the extent possible, correct strength of dynamite charging and vibroseis use applied to achieve the survey objectives, and human contact with wildlife should also be minimized; • All seismic operations should be carried out only during daylight hours;

				• Ensure that vibroseis and other vehicles have working silencers to muffle noise; • Provide full personal protective gear to workers as appropriate (e.g. helmets and ear • muffs/plugs); • Workers should be sensitized on hazards likely to be encountered in such a work environment, and trained accordingly; • Buffer zones distances between receptors and seismic sources/vehicles will be established through extensive in-field ground vibration and noise testing. Distances may vary between seismic source types; • Engage local leaders in sensitising the communities in the vicinity of the seismic operation areas about the project and its possible noise and vibration impacts; • The communities should be informed in advance when a seismic survey operation is to be executed along a given seismic transect/location; • Use generators with minimal

				noise production at camp sites and effect a noise mitigation policy for all operations.
	• Solid and Liquid Wastes	• Campsite • Workplaces in the field	• Pollution of surface soils, waters and groundwaters • Offensive odours • Health risks	• Waste materials (at the camp and in the field working areas) should be segregated into non-hazardous and hazardous waste, and consideration given to re-use, recycling, or disposal as appropriate; • A waste management plan documenting the waste strategy, storage (including facilities and locations), handling procedures and means of disposal should be developed and should include a clear waste-tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location; • Hygienic sanitation and disposal of grey and blackwater will be covered in the waste management plan in order to protect the general health of the workers and the general public; • Ensure that solid waste is

				removed from site for recycling/disposal only by an authorised waste handler; • Fuel and other non-aqueous liquid storage areas should be bunded; • Servicing of equipment should be carried out in a designated garage area which has regularly maintained oil drainage traps and readily available spill kits. Workers in this area will be regularly briefed on spill prevention.
	• Social Characteristics	• Workforce influx • Activities along the seismic survey lines	• Possible increase in crime rate and prostitution • Possible increase in school drop out by individuals searching for jobs • Erosion of culture and social values as a result of intermingling with workers • May interfere with grazing lands and watering points	• Employ Community Liaison Officers to keep communities informed prior to project mobilisation and on an ongoing, continual basis to ensure sensitization of the community and stakeholders vis a vis the project objectives, activities and scheduling, potential impacts; • The communities should be informed well in advance of the start of the seismic survey operation and prior to execution along a specific seismic transect/location using

				appropriate wide penetration communication media; • Awareness campaigns can be undertaken to inform/educate both the local communities and project employees; • During the seismic operations, disruption of livelihood activities in the area should be avoided where possible, otherwise minimized. • Provision to be made to compensate local property and landowners for any loss or damage caused by seismic operations. Compensation rates to be agreed with Valuation Division of the Lands Commission before operations commence.
	• Economic Characteristics	• Employment opportunities • Tenders and supplies • Possibility of a successful exploration programme	• Improved livelihood • Improved short-term business opportunities for the locals • CSR project benefits • Social friction caused by sudden financial imbalances caused by introduction of cash via local workforce into local populace • Long term economic benefits to local and national economy should the exploration	• Liaise with local community leaders during the recruitment process; • Employment policies to be strategically managed to avoid inter-community conflict and similar problems caused by migrant labourers; • Unskilled and semi-skilled manpower to be sourced locally as far as possible; • Gender should be factored into

			programme be successful	the employment criteria; • Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan.
	• Occupational Health and Safety	• Campsite and fieldwork environment	• Injuries to workers, visitors and area residents arising from project operations • Fire hazard • Other health risks	• All operations will be conducted in compliance with SWAOCO‟s EHS policy, international best practices; • Appropriate and well-stocked first aid kits and fire fighting equipment should be available to all crew, and specific crew members should be trained on first aid administration and handling of fire fighting equipment; • Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas; • A Base Camp Clinic is to be provided, manned by suitably qualified field medical staff, equipped with equipment and medication as appropriate, including ambulance vehicle(s);

				• Adequate warning or cautionary signage will be posted as required; • All electrical equipment shall be properly installed earthed and regularly inspected and where practicable; • Only properly trained and authorised employees shall operate equipment or machinery; • SWAOCO driving policy and all other project-specific driving policies and journey management plans to be strictly adhered to and enforced.
	• Security and Public Safety	• Workforce security needs	• Improvement in security due to security enhancement for project activities	• Ensure that all workers can be identified by staff uniform and badges where applicable; • Adequate security measures should be provided, e.g. perimeter fencing, safe havens and security manning at the campsites; • The company should liaise with the District Police and other agencies to provide adequate security during the seismic survey operation; • Barriers and guards will be

				installed as necessary to protect employees and visitors from physical hazards and criminal activity; • Camp population will be forbidden from interacting with local populace;

Table 15: Offshore Survey Project Environmental Impacts

	Environmental Parameter	Impact Source	Potential Impacts	Proposed Mitigation
1.	• Air Quality	• Vessels and machinery • On-board sanitary systems • Poor waste storage and disposal	• Pollution from exhaust emissions • Offensive odours • Health risks	• All vessel propulsion systems, exhaust systems, power generation equipment and incinerators shall be well and regularly maintained and operated efficiently; • Minimizing vapour loss from fuel tanks, and idling of equipment when not in use; • Use low-sulphur fuels where available; • Project emissions will not exceed applicable air quality standards or guidelines such as the MARPOL Annex VI and Maritime Pollution Act; • Sanitary facilities should be kept clean and a routine

				established for this; • Solid and liquid wastes should be properly managed in keeping with the guidelines and regulations for the specified vessel.
	• Water Quality	• Liquid effluent discharges from the vessels • Disposal of solid wastes from the vessels • Oil , fuel or chemical leaks from engines, machinery and storage areas	• Changes in water quality • Low level contamination/toxicity of water and benthic habitats	• Engineering machinery and components (e.g. engines, pumps, OBCs etc.) will be well maintained and checked regularly for leaks; • Use of bunded storage areas– spills and surface water will drain into a holding tank and treated according to MARPOL requirements; • Oil spill management kits will be available on board, and emergency response training including drills will be conducted; • Relevant authorities will be notified on detection of a spill. • The location of the spill, prevailing winds, currents and sea state will be identified and recorded; • All solid and liquid wastes shall be handled as outlined below.
	• Aquatic Environment (Habitats Flora and Fauna)	• Vessels movement • Vessels anchoring and grounding,	• Collision with reptiles, water turtles and fish • Disturbance of aquatic	**(Collisions/Strikes):** • All seismic survey vessels will carry out visual monitoring and

		accidental loss of Ocean Bottom Cable hydrophone array (OBCs) and associated equipment • Liquid effluent discharges from the vessels • Disposal of solid wastes from the vessels • Oil, fuel or chemical leaks from engines, machinery and storage areas • Use of a non-sanitised vessel that has been operating in a different marine environment	animals and benthic habitats • Physical interference with crocodile and bird breeding sites • Pollution of habitats • Introduction of exotic aquatic species	clearance of an exclusion zone around the array and in the immediate vicinity of the survey vessel; • Emphasis should be placed on proper disposal of food waste to avoid attracting birds to the vessels; • Surveys will be undertaken during daylight hours only. **(Disturbance of Benthic Habitats and Breeding/Nesting Sites):** • Seismic survey shall be undertaken during non spawning/breeding seasons in known areas; • The marine source will be an air-powered array; • The source array will be towed at a depth below water level, this will in turn restrict the array from being used in shallower waters; **Pollution:** • Carry out vessel surface cleaning to remove biofouling prior to departure from areas with known or potential aquatic pests. • Immersible equipment that has been used in

				other aquatic settings should also be cleaned (i.e. OBCs, air powered seismic sources, and accompanying cables/ropes/chains); • Coat vessel surfaces with an effective antifouling coating; • Apply proper waste management on board. **Invasive Species:** • Carry out vessel surface cleaning to remove biofouling prior to departure from areas with known or potential aquatic pests. • Immersible equipment that has been used in other aquatic settings should also be cleaned (i.e. OBCs, air powered seismic sources, and accompanying cables/ropes/chains)
	• Noise and Vibrations	• Air powered seismic sources • Vessel engines and other machinery	• Disturbance to fish, reptiles and zoobenthos • Disturbance to water birds • Changes to behavioural ecology of species (feeding, breeding, migration patterns). Species would include marine flora and fauna (including water birds). • Physical damage to aquatic flora and fauna	• Avoid unnecessary acoustic energy (noise) generation through source, array, and receiver design optimization; • To minimize vessel noise, use modern seismic survey vessels and associated equipment, ensure that all equipment including machinery are working well and are regularly serviced and maintained, and

				machinery that is not in use should not be left idling; • A sequential build-up of warning pulses (soft start) should be made to deter and warn aquatic fauna immediately before commencement of seismic activity; • Marine Mammal Observers (MMO) observers will attend on the seismic source boat to observe and report any unusual wildlife activity during acquisition. • Vulnerable ecological communities to be identified and appropriate mitigations agreed.
	• Solid and Liquid Wastes	• Liquid effluent discharges from the vessels • Disposal of solid wastes from the vessels • Oil or chemical leaks from engines, machinery and storage areas	• Pollution affecting aquatic flora, fauna, water and sediment quality	• No sewage discharge will be undertaken; • All wastes generated will be managed (i.e., appropriately stored, handled and disposed of) in accordance with MARPOL 73/78. Under no circumstances will solid and hazardous wastes be disposed of in water. The wastes will be returned to shore and will be stored, labelled and disposed of in accordance with local authorities' legislation (no hazardous waste will be

				disposed of to a facility that is not fully equipped to receive, store, treat and dispose the waste, and local authorities will be notified as to the type and quantity of waste to be disposed); • Machinery spaces will be equipped with drip trays, curbs and gutters, and other devices to prevent spilled or leaked materials from entering the water. Such wastes will be collected in a closed system designed for that purpose and transferred onshore for disposal. • Waste materials and equipment lost overboard will be recorded and recovered (where possible); • Accurate and detailed waste manifests and safe disposal records shall be maintained.
	• Social Characteristics	• Physical presence of vessels • Presence of workforce	• Interference with other water users in the area because of exclusion zones • Risk of accidents with other water users • Breaking or entanglement with fishing nets	• The local authorities will be advised of the planned survey including details of participating vessels, survey schedule and locations; • CLOs will sensitise local fishing communities about the proposed activities and

				ensure that their concerns are addressed; • A notice will be issued through the local administration informing fishermen of the proposed seismic survey activities; • The scout and guard vessels will clear the area of fishing boats and their equipment, and prevent fishing vessels from crossing the seismic array; and • A radar reflector and flashing lights will be provided on the source array tail buoy should it be required.
	• Economic Characteristics	• Physical presence of vessels • Project operations in the area	• Interference with shipping, boating and fishing in the area, diminishing economic returns • Employment opportunities for locals • Improvement of businesses and living standards • Social friction caused by sudden financial imbalances due to introduction of cash via local workforce into local populace • Long term economic benefits to local and national economy should the exploration	• A support vessel will conduct reconnaissance scouting ahead of the survey vessel; • Regular communication with fishing groups and provision of coordinates of survey area to fishermen will minimize potential impacts to commercial fishing activity; • Seismic operations should be scheduled during least sensitive period for instance during low fishing period; • Liaise with local community leaders during the recruitment process;

			programme be successful	• Unskilled and semi-skilled manpower to be sourced locally; • Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan; • Where damage occurs, for example, to fishing nets, or when project operations may lead to exclusion of fishing in a particular area, then compensation can be made for those income losses. A complaints and compensation mechanism should be developed, as well as community and relevant stakeholder organisation leaders.
	• Occupational Health and Safety	• The various workplace environments	• Potential vessel to vessel accidents • Personal injury • Fire hazard	• Monitoring of wind speeds should be undertaken, and the marine-based seismic surveys should be called off should the winds and waves thereby generated begin to reach a pre-determined and established critical threshold that may put the life of the boat crews in danger; • Watch will be maintained on the survey vessel for other craft. • The scout and guard vessels

				shall be used to caution other boats, to protect deployed equipment, and to assist/support the seismic survey vessel during abnormal or emergency situations; • All deployed equipment will be made highly visible to minimise accidents and to facilitate retrieval in case of loss; • Survey operations shall be suspended in adverse weather conditions; • The survey vessel will carry operational, navigation, bathymetry tracking, and warning lights. • The OBC hydrophone cables will be tracked via GPS to monitor their location (assisting retrieval if one or more become severed). • Well-stocked first aid kits and fire fighting equipment should be available to all crew, and selected crew members should be trained on first aid administration and handling of firefighting equipment. • Appropriate personal protective equipment (e.g. Personal

				Flotation Devices (PFDs)) and fire-fighting apparatus shall be maintained and be easily accessible on the vessels. The crew shall be competent in the use of fire fighting equipment and well-drilled on emergency response procedures; • Provisions of environmental health and safety plan (EHS) will be adhered to by all. • Adequate warning or caution signage, including "no smoking" signs, will be posted as required; • Only properly trained and authorised employees shall operate equipment or machinery.
	• Security and Public Safety	• Workforce security needs	• Improvement in security due to security enhancement for project activities	• The company should liaise with the District Police and other agencies to provide adequate security during the seismic survey operation. • Ensure that all workers have staff uniform and badges; • Adequate security measures should be provided, like perimeter fencing safe havens and security manning at the campsites and while en route to and from offshore;

				• The proponent should ensure that their drivers adhere to speed limits both for boats and vehicles. • Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity. • Camp population will be forbidden from interacting with local populace.

8.0. PROPOSED TERMS OF REFERENCE

8.1. Executive Summary

The executive summary will contain a non-technical description of the seismic project, identification of potential environmental impacts, management and design of mitigation measures including monitoring programmes and a proposed environmental management budget.

8.2. Introduction

The introduction will contain a brief background of SWAOCO and GNPC (the proponent) and legal and administrative requirements for the proposed project, and the EIA study. It will also include the justification for the seismic project.

8.3 Legal and Institutional Frameworks

The relevant environmental laws and regulations to guide SWAOCO from the conceptualization stage of the project to implementation and monitoring as well as for decommissioning will be provided.

8.4 Project Description

This section will give detailed description of the seismic project, method statements and any ancillary works including the setting up of camps.

8.5 Baseline Information

The baseline data will present a comprehensive description of the existing environment with regard to the site demarcated for the proposed project in general and the seismic lines in particular using an assumed 100m track i.e., 50m on both sides of seismic line as well as the external environment. This is important in order to establish background information in determining any future impacts when the project is operational and to identify very vulnerable environments/ areas needing special environmental management considerations. Specific areas of study will provide description of the following aspects which will be biased towards the Keta Basin of the Volta Region of Ghana, where the project will be implemented:

i. Climate (rainfall and relative humidity pattern);
ii. Hydrology of the proposed project area (flows and quality) including surface water contribution to the Keta and Ada-Songaw Lagoons) as well as connections to the Gulf of Guinea;
iii. Geology and soils
iv. Terrestrial ecology including flora and fauna;
v. Land Use;
vi. Site Specific Conditions including Ambient Air Quality and Noise Assessment; and
vii. Socio-economic and Cultural setting.

8.6 Potential Impact Identification

The perceived environmental impacts will be categorised into pre-seismic, seismic operation and decommission phases.

All identified impacts will be quantified and assessed for the level of significance based on magnitude, extent, duration, reversibility etc. Some of the significant impacts arising from the pre-seismic, seismic operation and decommission phases to be addressed exhaustively include but not limited to the following impacts identified in this scoping report:

The following potential positive impacts:

i. Employment generation;
ii. Improvement in local and national economy; and
iii. Increased Awareness of the potential of the basin for oil and gas production.

The following potential adverse impacts from the seismic project:

i. Noise nuisance;
ii. Air pollution;
iii. Oil Spillage;
iv. Water pollution- both freshwater and marine;
v. Occupational health and safety risks;
vi. Sanitation problems;
vii. Vessel and Vehicular Traffic impacts;
viii. Solid and liquid waste generation and disposal problems;
ix. Conflict with Fisher-folks and impact on fishing;
x. Impacts on agriculture/ food production;
xi. Resettlement/ Compensation issues;
xii. Occupational health and safety including public health issues (HIV/ AIDS etc);
xiii. Impacts to tourism;
xiv. and
xv. Security risks.

The following potential adverse impacts during decommissioning:

i. Oil Contamination of soils at camps;
ii. Water pollution- both freshwater and marine;
iii. Air pollution;
iv. Noise nuisance;
v. Solid waste generation and disposal;
vi. Occupational health and safety risks; and
vii. Drop in the local economic activity.

8.7 Impact Mitigation and Management Measures

From the assessment of impacts, the necessary mitigation measures will be prescribed and wherever possible design or implementation programmes will be altered accordingly and as summarised hereunder:

(i) minimizing footprints- minimisation of road and camp construction areas/ clearing of vegetation;
(ii) optimisation of operations to reduce energy and water usage;
(iii) ensuring proper handling, use and storage of hazardous materials including fuel and explosives;
(iv) management of noise and air emissions from vehicles and vessels;
(v) use of BATNEEC;
(vi) ensuring the identification, classification and protection of archaeological sites/ cultural artefacts; and
(vii) stakeholder/ community expectations management.

The mitigation measures for adverse impacts identified will however, be described for both the Seismic Operation and Decommissioning Phases as follows:

1. Mitigation Measures for Seismic Operation Phase Impacts
   a) Minimizing Air Pollution;
   b) Minimizing Noise Nuisance;
   c) Minimizing Water Pollution;
   d) Managing Waste Generation and Disposal;
   e) Managing Occupational Health and Safety Risks;
   f) Minimizing Sanitation Challenges;
   g) Minimizing Vessel and Vehicular Traffic Impacts and Public Safety Concerns;
   h) Minimizing Conflicts with Fishermen; and
   i) Minimizing Security Risks.

2. Mitigation Measures for Decommissioning Phase Impacts
   a) Minimizing Oil Spills;
   b) Minimizing Air Pollution and Noise Nuisance;
   c) Minimizing Water Pollution;
   d) Managing Waste Generation and Disposal; and
   e) Managing Occupational Health and Safety Risks.

8.8 Monitoring Plan

Appropriate monitoring programmes to manage impacts on the physical, biological and human environments will be developed. The programmes will be used to verify whether predications of environmental impacts developed in the design phase, are accurate and that unforeseen impacts are detected at an early stage. The monitoring programme will cover the management of the following:

- Noise Levels;
- Air quality;
- Water quality including Oil Spill Contingency Plan;
- Use of Personal protective gears and worker education- Malaria and HIV/ AIDs prevention etc;
- Waste generation and disposal;
- Accidents, injuries and worker health;

- Vessel and Vehicular Traffic and Public Safety; and
- Public complaints.

8.9 Provisional Environmental Management Plan

A Provisional Environmental Management Plan (PEMP) will be developed in accordance with Environmental Assessment Regulations 1999, LI 1652. The plan will incorporate an environmental budget and training programmes, which will be implemented for workers/ staff who will be working at the proposed project site. The Environmental Management Plan will include:

1. Policy on Environment, Health and Safety
    i. Environmental Policy
    ii. Occupational Health and Safety Policy

2. Potential Impacts, Identification and Assessment

3. Operations and Processes
    i. Potential Releases into Environmental Media

4. Current Environmental Management
    i. Wastewater Management
    ii. Ambient Air Quality and Noise Management

5. Environmental Action Plan

6. Occupational Health and Safety Management
    i. Occupational Health and Safety Action Plan

7. Programme to Meet Requirements
    i. Management Structure for EMP Implementation

8. Implementation of Plan
    i. Implementation Schedule
    ii. Environmental Budget
    iii. Environmental Monitoring
    iv. Environmental Audits and Reviews

8.10 Decommission Plan

A decommission plan for the seismic project will be provided as part of the EIA study.

8.11 Conclusion

This section will present the main conclusions and recommendations resulting from the EIA study.

9.0. CONCLUSION

SWAOCO/ GNPC will carry out the seismic data collection project both offshore and onshore the Keta Basin Block of Ghana to ensure that there is very little impact to the environment as much as possible and in accordance with Ghanaian as well as International standards governing projects of this nature.

The seismic survey will provide detailed information on the geology and related subject matter of the proposed project area.

The main project activities that will potentially create environmental and safety concerns include:

1. Operation of the seismic data acquisition equipment; and
2. Setting up of base camps to provide support to the seismic data acquisition operations.

The major environmental including social, occupational/ public health and safety issues and impacts associated with the proposed project during implementation will generally include oil spillage, noise nuisance, air pollution, water pollution, occupational and public health/ safety risks, sanitation challenges, traffic impacts/ public safety concerns, waste management including solid waste generation/ disposal challenges, and security risks due to the use of explosives. Specific impacts to cultural heritage artefacts, tourism, fisheries, food crops production and transport is key to the proposed project area.

The recommended mitigation measures will be implemented to help minimise any significant adverse effects and these may include (i) minimizing footprints- minimisation of road and camp construction areas/ clearing of vegetation, (ii) optimisation of operations to reduce energy and water usage, (iii) ensuring proper handling, use and storage of hazardous materials including fuel and explosives, (iv) management of noise and air emissions from vehicles and vessels, (v) use of BATNEEC, (vi) ensuring the identification, classification and protection of archaeological sites/ cultural artefacts (vii) and stakeholder/ community expectations management. An environmental monitoring programme to be carried out during project implementation will help maintain environmental quality within acceptable guidelines.

10. REFERENCES

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EPA, (June 1995). Ghana Environmental Impact Assessment Procedure. Environmental Protection Agency (EPA), Accra, Ghana.

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Legislations and Laws

11. ANNEXES

ANNEX 1: EPA SCOPING LETTER

ANNEX 2: SCOPING NOTICE