Ghana OCTP Block Phase 1 ESHIA

Attachment A

Stakeholder Engagement Report

ABSTRACT

This document provides the outcome of stakeholder analysis, consultations and engagement undertaken during the E(SH)IA process, comprehensive of list of stakeholders, meeting minutes, attendance registers and photos. The Stakeholder Engagement process was undertaken in respect of both Ghanaian and international requirements.

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ATTACHMENT A: STAKEHOLDER ENGAGEMENT REPORT

A1 INTRODUCTION

A1.1 Background

Stakeholder engagement is a key component of sustainable development and the ESHIA process. It involves those stakeholders interested in, or affected by a proposed development in actively highlighting opportunities, risks and issues of concern. Stakeholder engagement acts to communicate accurate project information, on an ongoing basis, through which stakeholders are empowered to engage with a project and thereby to become involved in the decision-making process. It also acts to gather baseline environmental, health and social data held by stakeholders and also aid project planning and development of mitigation measures and monitoring plans to address issues raised.

eni Ghana is committed to the use of sound stakeholder engagement techniques and building trusting relationships with their stakeholders. eni Ghana has therefore ensured that stakeholder engagement was a priority during the early stages of Project design and conception, and will continue to engage directly with stakeholders throughout the Project's development.

Consultations were undertaken as part of the Environmental Social and Health Impact Assessment (ESHIA) for the Ghana Offshore Cape Three Points (OCTP) Oil Block Development Phase 1. This report summaries all the consultations that were undertaken. The Stakeholder consultation team was made up of experts from ESL Consulting and eni Ghana Limited.

This Consultation Report provides a record of consultation activities which commenced in June 2012 through scoping consultation in November 2013 and were completed with disclosure of the Draft EIA in March 2014.

A1.2 Structure of the Report

This remainder of this document is structured as follows.

- ***Section 2: Stakeholder Engagement Standards*** outlines Ghanaian requirements, World Bank and IFC requirements
- ***Section 3: Methodology for Engagement*** provides an overview of the process followed to identify and define key project stakeholders, consultation tools used, documentation and issues tracking.
- ***Section 4: Consultation and Disclosure Process*** details the stakeholder consultation process followed to date, issues raised in an issue trail and the proposed plan for consultation on the ESHIA and for disclosure.
- ***Section 5: On-going Stakeholder Engagement:*** establishes continued engagement beyond the ESHIA and the intent/approach to address grievance.
- ***Section 6: Bibliography****:* A list of references and websites cited in the document.
- ***Annexes*** include:
    - *Annex A1:* List of Stakeholders consulted with so far
    - *Annex A2:* Copy of Invitation Letter & Background Information Document
    - *Annex A3:* Consultation Documentation
    - *Annex A4:* Stakeholders' Written Comments
    - *Annex A5:* Copy of Scoping Approval Letter

A2 STAKEHOLDER ENGAGEMENT STANDARDS

A2.1 Ghanaian Requirements

In Ghana, the main legislations relating to stakeholder engagement can be found in the 1992 Constitution of Ghana; the Environmental Protection Agency Act (1994) and also the Mining and Minerals Act (2006).

The EIA process is described in the Environmental Assessment Regulations (LI 1652, 1999) as amended (2002), the principal regulation under the Environmental Protection Act (1994). The Regulations require that all activities likely to have an adverse effect on the environment must be subject to environmental assessment and issuance of a permit before commencement of the activity. Ideally, stakeholder engagement occurs continuously through an EIA process. In the Ghana EIA process, consultations are required at specific stages of the EIA process. Stakeholder engagement requirements are provided specifically in Sections 11, 13(1), 15(1), 16(3), 17(2, 3), 18 and 19 of the regulation. The requirements are described as follows:

1. During Screening a list of key informants is established. This list is used to plan Scoping phase consultations. During Scoping, Project **information is presented and discussions are held with stakeholders** to get their views, identify sensitivities, and to identify additional stakeholders. Information gathered in these consultations is used to develop a Terms of Reference (ToR) for the detailed assessment.
2. After the submission of the Scoping Report, followed review and approval by the Ghana Environmental Protection Agency (EPA), the Regulations require that the **Project proponent gives notice of the proposed undertaking to the relevant Ministries, government departments and organisations and the relevant Metropolitan, Municipal or District Assembly**. The Project proponent is also to **advertise that a Scoping Report is available in at least one national and one local newspaper** using a specific format provided in the Regulation, as confirmed by EPA. Copies of the Scoping Report must be **made available to the general public** in the project locality for inspection.
3. There is no requirement for further stakeholder engagement during the detailed environmental and social assessment. In practice however, stakeholder engagement occurs in the course of environmental and social studies and the EPA will want to see that the ESIA process has **adequately engaged the public and especially the affected communities.**
4. Following completion of the assessment process, the Project proponent submits an Environmental Impact Statement (EIS) (also referred to in this report as the ESIA Report) to EPA for review. The Regulations specify that 12 copies of the report are to be submitted. The EPA may require **additional copies for sector Ministries, government departments and other relevant organisations**. At this stage the EPA will publish a notice for 21 days that an EIS/ ESIA Report has been received and that it is under review. This period allows for the general public, relevant public agencies, organisations, NGOs, Metropolitan, Municipal and District Assemblies and local communities to make comments and suggestions. **The notification** is made in a format specified in the Regulations and is done via mass media (e.g. newspaper, radio, television) and through notifications posted at appropriate locations. In practice, the EIS/ESIA report is also made available at locations where the public can easily access it.
5. The EPA can make a decision on the application for an environmental permit at this stage or may decide that **a public hearing process** is required. The decision to hold public hearings lies with the EPA. The public hearing process involves the creation of a review panel composed of three to five persons with at least a third of the panel residents of the geographical area of the proposed Project. The panel chairman is appointed from the panel

members but is not a resident of the Project area. The panel convenes open public meetings in locations in which it decides to gather information. Following completion of the hearing process, the panel makes a recommendation to the EPA.

6. The EPA then makes a decision on the application for an environmental permit in consideration of its review, comments received during the notification period, comments received during the public hearing process, and the recommendation of the public hearing panel.

A2.2 International Requirements

There are a number international requirements notably amongst them are the World Bank Group's Environmental Assessment Policy (OP 4.01) (1999), International Finance Corporation (IFC) Sustainability Framework, Equator Principles and the African Development Bank Group's Policy on the Environment.

The Project may not seek financing from any of these international bodies but their standards' are generally recognised as a benchmark of good practice for environmental and social protection and management including stakeholder consultation.

A2.2.1 World Bank Environmental Assessment Policy

The World Bank Group's Environmental Assessment Policy (OP 4.01) (1999) addresses the requirement for stakeholder consultation as part of the EIA.

- Included as part of the Environmental Management Plan.
- Moving away from consultation "at least twice" to ongoing and iterative consultation process. The key principles of the World Bank Operation Policies have been incorporated into the IFC performance standards.

A2.2.2 IFC Sustainability Framework

The **IFC Sustainability Framework (2012)** comprises three elements:

- IFC's Policy on Environmental and Social Sustainability;
- the Performance Standards' on Environmental and Social Sustainability;
- and IFC's Access to Information Policy

In terms of the project stakeholder engagement, the performance standards were applied as incorporated in the Equator principle. The Performance Standards' provide extensive guidelines for stakeholder engagement activities through the Project development process. Standards for stakeholder engagement are mostly contained in Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts, the 'umbrella' standard that describes the overarching requirements. The Performance Standards' require that a Project engage with affected communities through disclosure of information, consultation, and informed participation, in a manner commensurate with the risks to and impacts on the affected communities. A summary of stakeholder engagement requirements contained in Performance Standard 1 is provided below.

Summary of Performance Standards' for Stakeholder Engagement

Aims:

- ensure that affected communities are appropriately engaged on issues that could potentially affect them;
- build and maintain a constructive relationship with communities; and
- establish a grievance mechanism.

Who to Consult:

- directly and indirectly affected communities;
- positively and negatively affected communities/individuals;
- those with influence due to local knowledge or political influence;
- elected representatives;
- non-elected community officials and leaders;
- informal/traditional community institutions and/or elders; and
- indigenous peoples, where the Project is identified to have adverse impacts on them; and
- communities in the wider area of influence.

When to Consult:

- as early as possible or at the latest consultation should begin prior to construction.
- consultation should be an ongoing process throughout the life of the Project, ie iterative.
- consultation should also allow for a feedback mechanism where affected people are able to present their concerns and grievances for consideration and redress.

What to Consult on:

- disclosure of Project information (purpose, nature, scale);
- disclosure on the Action Plan as a result of consultation, with periodic reports to demonstrate implementation;
- risks and impacts of the Project; and
- updates, actions and proposed mitigation measures to address negative impacts and areas of concern for affected communities.

How to Consult:

- be inclusive and culturally appropriate;
- allow for free, prior and informed participation of affected communities;
- be in the language preferred by the affected communities;
- consider the needs of disadvantaged and vulnerable groups;
- feed into the decision making process including proposed mitigation, sharing of benefits and opportunities;
- be iterative;
- be documented;
- be responsive to community concerns and grievances;
- be easily understood and transparent; and
- allow for differentiated means of engagement particularly for disadvantaged or vulnerable groups.

Representation:

Where engagement relies substantially upon a community representative make every reasonable effort to:

- verify that such persons do in fact represent the views of Affected Communities; ensure that the views of affected communities are communicated accurately; and
- ensure that the representative/s can be relied upon to faithfully communicate the results of consultations back to their constituents

A2.2.3 Equator Principles

The Equator Principles (EPs) are an approach used by financial institutions to determine, assess and manage environmental and social risk in project financing. The EPs provide general requirements for stakeholder engagement, disclosure and grievance mechanisms for project proponents. Principle 2 highlights the requirement for consultation and participation of affected parties in the design, review and implementation of the project. Principle 5 highlights engagement specific requirement. It makes provision for ensuring that information, including assessment documentation or non-technical summaries , are made publicly available, disclosed early in the assessment process and on an ongoing basis, and are available for reasonable periods of time. In addition there is a need to ensure that content is communicated in a culturally appropriate way, including in relevant local languages to the project affected communities.

A2.2.4 African Development Bank Group's Policy on the Environment

The requirement of the ADB policy on the environment is entrenched in two main documents which are:

- Handbook on Stakeholder Consultation and Participation (2001)
- Environmental Review Procedures for Private Sector Operations (2001)

The Handbook on Stakeholder Consultation and Participation is intended to guide Bank staff on issues related to stakeholder engagement in practice. It provides guidelines and outlines specific actions for Bank staff to promote participation for every stage of the Bank's project cycle. The Handbook provides a description of different levels of participation and an overview of the most frequently used participatory methods.

The Environmental Review Procedures is intended for the benefit of Bank clients and prospective clients (i.e. the Project). The document provides information about the Bank's requirements as related to environmental and social impact assessment including the various steps that the Bank follows to ensure that projects are environmentally sustainable and socially responsible.

A3 METHODOLOGY FOR ENGAGEMENT

This section describes the process by which the engagements with stakeholders were carried out. It provides and describes the process by which stakeholders were identified and how consultation materials were developed and documented.

A3.1 Stakeholder Identification and Mapping

Stakeholders were defined as individuals or groups potentially affected by the project or can themselves affect the project. During the scoping, a stakeholder mapping exercise was undertaken to identify key stakeholder groups and organisations. This mapping exercise drew on knowledge of the Project area and prior experience with ESIAs in Ghana and especially the Western Region. It also incorporated experience gained by eni Ghana through initial contacts made in the country.

During this process, stakeholders were grouped in order to develop appropriate tools and methodologies and maximise the value of engagement activities. Stakeholders were identified from the following categories;

- ***National government:*** these stakeholders are of primary national political importance to the project. Also includes government ministries and regulatory authorities.
- ***Regional Government and District Assemblies****:* these stakeholders are of Regional and local importance to the project.
- ***Directly affected communities:*** Communities at local level that will directly impacted (positive and/or negative) by the project. This category also includes traditional leadership in the directly affected communities, fishermen, youth, local residents etc
- ***National and Local NGOs:*** these are local NGOs with potential interests in the project. NGOs may also have useful data or insights into the local and national issues raised by the project.
- ***Community Based Organisations and Groups:*** These are civil society non-profit groups that operate within a single local community that may have an interest in the project. Other community groups include associations for people working in a particular trade in a community.
- ***International Organisations:*** these comprise organisations based within and outside Ghana with an interest in the project. These include NGOs, multilateral and bilateral organisations.
- ***Other interest groups:*** these comprise of oil companies already with interest in Ghana, the media (both national and international), and political parties/groups, religious organisations, businesses e.g. running businesses or providing services and supplies to the project.

A3.2 Consultation Tools

To effectively interact with stakeholders, various information-sharing tools were created to disseminate information about the Project and also obtain information from stakeholders. The tools used are described below and copies of these documents can be found in *Annexes A2, A3 and A4*

A3.2.1 The Tools

- ***Background Information Document (BID) and Response Sheet:-*** During the scoping phase, copies of the BID were distributed to provide introductory information to stakeholders about the Project, the area involved, the Project proponent and the timeline for the ESHIA. Response sheets accompanied the BID and gave interested parties an opportunity to register for the Project and to raise their concerns, issues or suggestions. Additional stakeholders identified at a later stage were engaged through written communication, which included the BID and an invitation to submit written comment.
- ***Letters of Invitation:***- Letters from eni Ghana and ESL Consulting detailing dates, times and venues inviting relevant authorities and stakeholders to meetings.
- ***Attendance Register:***- Forms used to record details of all stakeholders and persons contacted during the engagement. Details such as stakeholder name, personnel name, position, phone number, email address, signature, GPS location of meeting place etc.
- ***Scoping Report Notification Letters:***- To coincide with the distribution of the Scoping Report, letters were sent out inviting stakeholders to view the report and submit comments.
- ***Scoping Report:***- The Scoping Report was submitted to the relevant authorities, as well as to stakeholders identified in the scoping process. Hard-copies of the Report were left at specified national and regional location for public review. The Scoping Report was loaded onto the Project website and all stakeholders with email contact details were directly invited to view the Report. Other stakeholders were informed of the electronic version via letters.

A3.3 Consultation Documentation

The evidence of consultation which is the consultation documentation was the minutes of meeting, signed attendance register and the photographs taken during the meeting (see Annex A3). Minutes were recorded during all formal meetings conducted during the initial consultation and scoping stage consultation. Issues raised were extracted and incorporated into the Terms of Reference for specialist studies in the ESHIA. Consultation also occurred during the baseline data gathering phase and all of the issues raised as well as the data gathered were incorporated into the relevant baseline chapters of the ESHIA.

During the writing up of the ESHIA Report all issues raised have been crosschecked to ensure that they are dealt with in one or other section of the Report.

A4 CONSULTATION AND DISCLOSURE PROCESS

This section provides a description of the public consultation and disclosure activities that were carried out during the ESHIA process.

For the purposes of this report consultation and disclosure activities have been divided into the following

- During Scoping
- During Baseline Studies
- Decision-making

A4.1 During Scoping

A4.1.1 Consultation

The stakeholder identification and mapping exercise that was done sorted out all stakeholders into various categories and a schedule was drawn. A full list of selected stakeholders is provided below.

Table A 1 Stakeholder List

Stakeholder Group	Stakeholder
National	Environmental Protection Agency (EPA)
	Fisheries Commission
	Ghana Marine Police
	Ghana Maritime Authority (GMA)
	Ghana National Petroleum (GNPC)
	Ghana Navy
	Ghana Ports and Harbours Authority (GPHA)
	Guinea Current Large Marine Ecosystem
	Marine Fisheries Research Division
	Ministry of Energy
	National Canoe Fishermen Association
	National Fisheries Association
	Petroleum Commission
	Wildlife Division of the Forestry
Regional/District/Local Communities	Regional EPA
	Regional GPHA
	Western Regional Administration
	Ahanta West District Assembly
	Shama District Assembly
	Jomoro District Assembly
	Sekondi-Takoradi Metro. Assembly
	Ellembelle District Assembly
	Nzema East District Assembly
	Western Regional House of chiefs
	Chief & Elders of Sanzule

	Paramount Chief of Ellembelle
	Regional Fisheries Commission
	Chief fishermen & Fishermen of Western Region communities
NGOs/CSOs	Coastal Resources center
	Friends of the Earth
	Friends of the Nation
	Fisheries Alliance
	Ghana Wildlife Society
	Oilwatch Ghana
	Ricerca e Cooperazione
Shareholders	Vitol
	Ghana National Gas Company

Shareholders were involved in an initial set of stakeholder consultations held with the District Assemblies of the six coastal regions of Western Region (see Annex A3 to present document).

A copy of the BID and a covering letter requesting a meeting were hand-delivered to all these stakeholders. Meetings were confirmed through subsequent telephone and email communication. A copy of the invitation letter and the BID is provided in Annex A2.

ESHIA scoping consultation was carried out in March 2012 and in November 2013 to identify the potentially significant environmental social issues relating to the implementation and operation of the Project. These issues have been used to define the ESHIA approach, to inform the design of the environmental, health and socio-economic baseline studies and to ensure that there is sufficient information to address all potential impacts and issues in the ESHIA process. During the scoping, a total of 25 meetings were held with 28 stakeholder groups or organisations. Stakeholders consulted included national, regional and district authorities, traditional leadership, Non-Governmental Organisations (NGOs) and fishermen. A list of the scoping consultation meetings undertaken is provided in Annex A1.

The general format followed during the consultation meetings is as followed

- Introduction by the meeting facilitator;
- Introduction and brief description of eni Ghana's operations
- Description of the proposed Offshore Cape Three Points oil (OCTP) development and
- Discussion of the key issues and any information that may be relevant to the Project.

An attendance register was used to record all stakeholders who participated in the consultation meetings and minutes of all the meetings were also taken. Also photographic evidence of the meeting was taken which captured all persons who took part in the meetings. The consultation team also included translators who spoke Fanti so that the key elements of the Project and the main issues arising could be discussed with non-English speaking stakeholders. Minutes of the consultation meetings, attendance registers and written comments received are provided in Annex A3.

A4.1.2 Disclosure

Issues raised during the stakeholder consultation meetings and written comments received were assessed to extract the key issues of concern which was used to formulate the Terms of

Reference (ToR). A full list of issues/concerns raised during the scoping consultations has been assessed and presented in an issues trail as shown below.

Scoping Consultation Issues trail

Nzema East District Assembly

- Deterioration of roads within the district by the constant usage of heavy duty vehicles
- Oil activities affecting livelihood of fishermen also harassment by the Ghana Navy
- In the event of the incompletion of the gas project, would the excess gas be flared?
- Alternative livelihood projects for fishermen such as aquaculture.
- How would Eni Ghana handle an oil spill when it occurs?
- The number of whales dying in recent times has increased and has been attributed to oil activities; Eni Ghana should in collaboration with a research institution investigate the cause.
- Continuous consultation with District Assembly in the implementation of any project in the community is paramount to it success.
- Incorporate CSR projects in District Assembly's development plan.

Ahanta West District Assembly

- Specific impacts on environment, health such as marine pollution, disease to human need to be stated in BID
- Negative impact of oil activities affecting fish catch and livelihood of fishermen
- Consultations should be extended to community members.
- BID did not state impacts on health, socioeconomics and cultural but only on marine environment
- Oil activities causing an increase in social vices and high cost living
- Eni Ghana should always engage district assembly in all activities in the communities
- CSR projects should be aligned with development goats of the district assemblies
- Preparedness of Eni to handle oil spill if it occurs and also effective ways of disposing off wastes generated offshore
- Cumulative impacts of all oil activities need to be addressed in ESHIS
- Local Content need to be improved by the use of local goods and services and also employment of locals.

Ellembelle District Assembly

- Alternative livelihood projects need to set up to compensate fishermen
- Eni Ghana should commission a scientific investigation into the deaths of whales.

- Public transparency in royalty payment
- Employment opportunities of locals. Quota can be given to district assembly to select best youth for such jobs
- Training schemes for the youth of the communities to be able to work in the oil industry
- Community sensitization programme aimed at educating the community to be receptive to alternative livelihood projects such as aquaculture, snail rearing, piggery etc
- Allocation of CSR programmes to dealt to HIV/AIDS situation in the district
- Measures to handle an oil spill and also offshore wastes need to be stated in the EHSIS
- Climate change adaption programmes can also be included in Eni CSR programmes
- Request to upgrade district hospital

Jomoro District Assembly

- Recommendations in previous EIA done for Jubilee production has not been adhered to and now the host communities are disadvantaged, fishermen are suffering and benefits are not getting to the right people.
- Uncoordinated approach to executing CSR projects in the districts by the Jubilee Partners.
- Eni Ghana should merge their CSR activities to fit into the developmental goals/plans of the district.
- Cumulative effect of the now two FPSO on fishing grounds and fishing in general
- Why are oil companies reluctant to send community members to the rigs/FPSO?
- Eni Ghana needs to have a Fisheries Impact Assessment done as it is stipulated in the Fisheries Act 625.
- Eni Ghana should not to just put up CHIP compounds but furnish and equip the place.
- Eni Ghana should pursue alternative livelihood projects to make the lives of fishermen including fishmongers better such as aquaculture in the Abby lagoon and microfinance schemes for fishmongers and market women.
- Eni Ghana could begin climate change adaptation programmes as part of its CSR activities.
- The need for extensive consultation before any project is started.

Shama District Assembly

- Oil find will increase revenue to the government which will in turn use it to develop social infrastructure.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish
- Eni Ghana should consider alternative livelihood for the fishermen
- Eni Ghana's preparedness to handle an oil spill
- The issue of Ballast water discharge at sea would be important with more support vessels/oil tanker vessels.

- Flaring of excess gas is occurring at the Jubilee field, is Eni Ghana also going to flare excess gas.
- There will be an increase in vessel traffic as more support vessels would use our waters thus can result in accidents, ship grounding/wrecking.
- Extensive consultations need to be done especially with local community members and fishermen
- Eni Ghana to establish scholarship schemes for children of fishermen.
- Employment of local community members will go a long way to foster cordial relationship between oil companies and communities.
- Eni Ghana to establish an oil and gas training facility at an affordable fee and or offer scholarships to student to receive training at the already existing facility at Takoradi Polytechnic.
- Build the capacity of fishermen in oil and gas activities since fishermen are the first point of contact in the event of an accident.
- ENI Ghana to incorporate a periodic health check programme into their CSR programmes.
- Incorporate CSR projects in District Assembly's development plan.

Sekondi Takoradi Municipal Assembly (STMA)

- Preparedness of Eni Ghana to handle wastes generated offshore.
- The standard of facilities and level of operation of ZEAL technologies to handle offshore wastes
- The safety and protection of the coastline , marine life and fishermen livelihood is of much concern to STMA
- Eni Ghana should handle their operation in such a manner to prevent conflict with local community members
- Eni Ghana should investigate the cause of whales dying.
- Manage high expectation of people to prevent agitation.
- Eni Ghana could support the agriculture sector to produce foodstuff to be used on the rigs/FPSO
- Eni Ghana should merge their CSR projects into the development plans of STMA so that the genuine needs of the people at large are met.
- The adequacy of Eni Ghana's health care system to handle health impacts on workers and community members.
- Capacity building on oil and gas activities for district assembly members.

Chief fisherman and fishermen of Upper Axim

- Promises made by the Jubilee partners and recommendations made during the Jubilee EIA have not been implemented.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.

- Conflicts between fishermen and security personnel/Ghana Navy at the FPSO/rigs.
- NO government official (Petroleum Commission, Ministry of Energy, EPA, GNPC etc) had consulted with the fishermen. Government need to consult with fishermen to know their plight and act to make their lives better.
- Subsidies on fishing gears and pre-mix fuel to make lives of fishermen comfortable
- No transparency in the award of benefits such as scholarships
- There is NO physical demarcation around the FPSO to prompt fishermen when they go beyond bounds. Eni Ghana should clearly demarcate the safety zone around the FPSO with moored buoys/reflectors so that fishermen can see and stay off the zone.
- Eni Ghana should enhance local content by employing local community members, also local goods and services should be used by the company thus boosting the local economy.

Chief fisherman and fishermen of Upper Dixcove

- Ghana is really blessed to find oil in its waters and he hoped this would bring about lots of economic development in the country.
- The issue of an oil spill occurring was raised and can destroy the fishing stock.
- The issue of support vessels/oil tankers discharging of ballast water into our seas. If not checked can gradually lead to decline in fish/marine life
- Request for Eni Ghana to compete a sea defence wall which was started some years back to prevent the town from eroding off.
- Another request was made to get the only primary school in the community renovated since the building is in such a deplorable state.
- Institute a scholarship scheme for brilliant children of fishermen to pursue higher education.

Chief Fisherman and fishermen of Shama Apo

- The oil find will increase government revenue to continue infrastructural development.
- There has NOT been any consultation between the community and government officials (EPA, Petroleum Commission, GNPC) regarding the impacts of the oil.
- Oil companies particular Jubilee partners have not fulfilled promises made to fishermen and not implemented recommendations made during the Jubilee EIA.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.
- An appeal was made for the wanted the hospital at Shama to be rehabilitated and adequately equipped.

Chief Fisherman and fishermen of Shama Bentsir

- The OCTP development would bring economic benefits to the nation but not the fishermen as it has been the case with the Jubilee field development.
- Promises made by the Jubilee partners and recommendations made during the Jubilee EIA have not been implemented.

- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.
- Conflicts between fishermen and security personnel/Ghana Navy at the FPSO/rigs.
- High cost of living in recent times attributed to the oil find
- Employment of local community members in the oil and gas activities
- Dealings with fishermen should be made transparent as much as possible
- Eni Ghana should help subsidize cost of fishing gears and premix fuel.

Chief fisherman and fishermen of Half Assini

- Promises, pledge and recommendations from Jubilee ESIS to make the lives of fishermen comfortable have not be fulfilled so fishermen are now in extreme hardship
- Decline in fish catch due to attraction of fish to the light on FPSO.
- Flaring gas causing skin diseases and other health issues
- Harassments by Ghana Navy
- Destruction of fishing nets by supply/support vessels
- Support vessels colliding with fishing canoes leading to death of fishermen
- Occurrence of green algae/grass along the shores hindering fishing.
- Request for clinic to cater of only fisherfolk and or a health insurance scheme for fisherfolk
- Build schools for the children and awards scholarship to children of fisherfolk,
- Subsidizing fishing implements including pre-mix fuel.
- Provide credit facilities to fishermen and
- Providing an alternative livelihood support for the fisherfolk
- Benefits due to fishermen should be given directly to the chief fisherman in a public presentation since benefits given to fishermen over the years did not get to the intended target.

Chief fisherman and fishermen of Lower Axim

- EPA of Ghana should educate fishermen on the impacts of oil activities on their livelihood
- Ever since the oil activities begun no government agency including EPA, Petroleum Commission etc. has interacted with them to find out their concerns, which is very bad
- The livelihoods of fishermen have been greatly affected since the inception of the oil business. Fishermen spend so much just to go fishing and encounter harassment by the Ghana Navy, destruction of nets, collision with supply vessels and in addition less catch which is so inadequate to defray the expenses made.
- Death of whales is negatively affecting the whale watching tourism in the region.
- Flaring of gases from the Jubilee causing skin disease
- Eni Ghana should have an oil spill contingency plan to deal with any oil spill

- Government and oil companies to subsidize fishing implement
- Government to reduce the cost of premix fuel
- Government should stop the Ghana Navy from harassing the fishermen and return all seized nets
- Oil companies should compensate the fishermen before oil production begins i.e., cash compensation
- Oil companies should roll out education scholarship purposely for children of fisherfolk
- Employment of community members as well as use of local goods and services will enhance the local content of the development.
- The fishing community of Axim is in dying need of a hospital and would be happy if one is provided.
- All the oil companies should unite in dealing with issues affecting the communities instead of pursing haphazard interests.

Chief fisherman and fishermen of Lower Dixcove

- The oil find is beneficial to the government since revenue from the development will go a long way to support the government but not fishermen
- Light on the FPSO attract fishes thus depriving the fishermen of adequate catch.
- Harassment of fishermen by the Ghana Navy.
- Employment opportunities for community members
- Eni Ghana should ensure transparency in the award of education scholarship or any other social venture.

Chief Fisherman and fishermen of Sekondi

- Issues and concerns expressed by fishermen during previous consultations have not been addressed.
- No compensation have been giving to fishermen since the oil activities begun
- Oil companies and government need to fulfil promises made to them.
- Eni Ghana could subsidize fishing gears and pre-mix fuel for fishermen
- Employment opportunities for local fishermen.
- Pair trawling problem faced by fishermen as well as selling of by-catch cheaply to market women.
- The oil companies (Eni Ghana) should help support the government in the implementation and enforcement of the fisheries regulations to preserve the fishing industry.
- Transparency in the award of scholarships and other benefits
- Eni Ghana should investigate the cause of the green algae outbreak that turn to hamper beach seining during certain times of the year.

- Eni Ghana should clearly demarcate the safety zone around the FPSO with moored buoys/reflectors so that fishermen can see and stay off the zone.
- Eni Ghana should do everything possible to prevent oil spills/leaks.

Chief and elders of Senzule

- Decline of fish catch due to oil activities
- Destruction of fishing nets by support vessels/oil tanker
- Harassments by Ghana Navy
- Shoreline invasion by sea weed caused by oil activities
- Occurrence of tar balls on the beaches
- Alternative livelihood projects need to be instituted to compensate the fishermen
- Some oil and gas companies do not respect the traditions and culture of local communities in which they operate in, thus Eni Ghana should take note and not repeat the same
- In the event of relocation, Eni Ghana should adequately compensate the community
- Local employment opportunities especially for women

Ghana Maritime Authority

- Eni Ghana should obtain permit for GMA for the FPSO and any support vessel
- Three (3) main concerns are Marine Pollution, Safety at sea including occupational safety and Maritime Security.
- In terms of marine pollution, ballast water discharge and garbage disposal as well as other water emissions including anti-fouling chemicals, domestic waste are also of concern to the GMA.
- In terms of safety at sea, GMA will be much more concerned about the sea worthiness of the support vessels and the FPSO. Also hazards from fishermen to navigation.
- Air emissions as a result of operations should be addressed well so as to minimize its impact on workers on the FPSO or rigs and also on marine birds.
- In terms of marine security, Capt. stated that GMA is concern about issues relating with piracy, armed robbery at sea, illegal bunkering, narcotic trafficking and terrorism.

Ghana Marine Police

- Clear demarcation of the safety zone around the FPSO to ward off fishermen
- Subsidize the cost of fishing gears and pre-mix fuel
- Continuous consultation with community members especially fishermen would ensure peace and a successful development.
- Requested that ENI Ghana could help provide logistical support to the Marine Police.

Regional EPA

- Complete assessment of all tourist/beach business such as hotel, resort etc. need to be done
- Fisheries impact Assessment (FIA) which is a legal requirement for the Fisheries Commission of Ghana need to be done.
- Eni Ghana should have a comprehensive health baseline data collection done.
- A comprehensive socio-cultural baseline data is also needed
- Baseline data is also needed on the Road transport System in the region
- The adequacy/efficiency of waste management firms to handle offshore waste need to be verified before contracts is giving out.
- Flagging of wells. Eni Ghana should ensure that unproductive wells are properly sealed to prevent future leakages.
- Oil spill contingency plans including modelling need to be done.
- Increase in vessel traffic in our waters would put pressure on GPHA, Eni Ghana should show how the situation would be managed.
- Eni Ghana should use floaters/buoys to clearly demarcate the extent of the safety zone around the FPSO.
- Eni Ghana should always get a chemical clearance certificate for EPA before any chemical is brought into the country
- The ESHIS should include a well laid out decommission plan
- Eni Ghana should provide in the ESHIS information about the composition of the produced water, the toxicology done on the water and all information pertaining to hydro testing.
- Eni Ghana should have a local district/community liaison representative in all the 6 districts.
- Consultation evidence should include videos
- Eni Ghana should show how cumulative impacts of their operations and other operations in Ghana would be dealt with in the ESHIS.
- Local content policy should be taken serious, thus the use of local personnel, goods and services should be paramount in the operations
- Eni Ghana should apply recognised international procedure or standards when dealing with service providers and or contractors.
- ESHIS should provide for security issues such as sabotage, terrorism, armed robbery, piracy etc.

Regional Fisheries Commission

- The main concern of Fisheries Commission is that Eni Ghana should submit a Fisheries Impact Assessment (FIA) which is legally stipulated in the Fisheries ACT 625.
- Harassment of fishermen by Ghana Navy
- Demarcation of safety zone around the FPSO/rigs
- ENI Ghana should actively engage with the fishermen and design social interventions to ease their predicaments.

- Increasing cases of support vessels colliding with fishing canoes, how would Eni Ghana help curb the situation
- Request for logistical support and training for the Fisheries Commission
- Eni Ghana should conduct an investigation into why the whales are dying.

Regional Ghana Ports and Harbours Authority

- More revenue for GPHA since ship calls would increase
- The current water supply at the port is woefully inadequate to support the new vessels.
- There is limited port space which is not sufficient to handle additional oil service providers.
- Escalating prices of the cargo storage/ warehouse which are as a result of the oil companies pricing out other commercial ships.
- The issue of discharge of ballast water into the marine environment and introduction of alien species in our ecosystem.
- Influx of foreigners/expatriate workers and its effect on the culture of the indigenes.
- Increase in social vices such as prostitution is now on an increase as well as other crimes.

Ministry of Energy & Petroleum

- **Waste Management**; is the capacity of Zeal Technologies big enough to handle the current wastes effectively and subsequently, additional wastes from Eni Ghana.
- **Air Emission;** Eni Ghana should use efficient measures to minimize or prevent air emissions.
- **Fishermen**; Eni Ghana should design alternative livelihood programs for the fishermen.
- **Marine Mammals**; Eni Ghana should do a comprehensive study of the fisheries especially marine mammals (species types, population dynamics, seasonal migration patterns etc).
- **Exclusive Zone**; Eni Ghana should clearly demarcate the exclusive zone around the OCTP field.
- **Security issues;** Eni Ghana should ensure the safety of vessels coming in and out of the OCTP field.
- **Oil spill and Mud spill**; what is Eni Ghana's first line of action before an extensive contingency plan is executed.
- **Environmental Monitoring**; Monitoring programs should be developed to regularly check the status of the marine ecosystem during exploration, drilling and actual operations.
- **Standard Operating Protocols**; Eni Ghana should make available their SOPs especially for drilling operations, offloading, maintenance and also operations on the FPSO.

Ghana National Petroleum Corporation (GNPC)

- Modelling of oil spills potentially resulting from accidental events (i.e. collisions, blowouts, ruptures, loss of containment during offloading from FPSO) should be undertaken

- Atmospheric dispersion modelling of project emissions to air should be undertaken to determine the extent of possible impacts on air quality
- Aquatic dispersion modelling of operational discharges, including drill cuttings discharges and produced water discharges should be conducted.
- An assessment of waste treatment and disposal options for priority waste streams should be conducted on all identified potential wastes identified and also on waste management options chosen to mitigate them.
- A Best Practicable Environmental Option study should be carried out to evaluate options for the treatment and disposal of drill cuttings and all identified operational discharges, considering environmental, financial, health and safety and technical criteria. These should be based on industry guidelines as provided by international bodies such as the International Association of Oil & Gas Producers (OGP) and International Petroleum Industry Environmental Conservation Association (IPIECA).
- A study on the likelihood of collision of support vessels with other fishing vessels should be conducted along with its appropriate mitigation measures. Air/marine operational transportation routes and corridors between the FPSO and Takoradi Port should be determined. These routes and corridors are necessary to avoid or minimise the perceived environmental (and safety) impacts on shoreline communities, collision with other marine vessels, offshore fishing activities, the Amansuri Wetlands and other Gazetted areas and areas of natural conservation interest.
- Increased vessel presence during installation of gas export pipeline that could affect fish populations and indirectly affect artisanal fishing communities reliant on the availability of fish for their livelihood.
- Possible gas leakage that could affect coastal communities directly and indirectly; and creation of employment opportunities and associated indirect economic benefits for local people, especially during installation of gas export pipeline.
- Eni should conduct a comprehensive stakeholder engagement with particular attention paid to health facilities and district assemblies.
- In terms of social impacts, Eni should look at assessing the following;
    - increased government revenue
    - employment and skills development
    - procurement of goods and services
    - influx of job seekers into the Region
    - issues with heightened and unmet expectations
    - impacts on commercial shipping
    - impacts from onshore bases

Friends of the Nation/CRC

- Suggested that ENI Ghana conduct a health impact assessment as part of the ESIA.
- Conflict between fishermen and (Ghana Navy) security apparatus of oil companies operating in the waters of western region.

- ENI Ghana should design measures to prevent this occurrence and foster a good relationship with the fishermen.
- Suggested that the oil companies together with Government could declare a marine protected /no go zone area in our marine environment where no oil activities will take place.
- Death of whales, ENI Ghana should ensure that marine mammals are avoided, and make available data on the population and movement of the mammals in our waters.
- Oil companies use social projects to gain community approval of projects
- The ESHIA process itself need to be reviewed properly as in some of the assessments in previous report were wrong.
- An extensive stakeholder consultations need to be done so that all relevant stakeholders are contacted especially fishermen along the 6 coastal districts.
- A Fisheries impact Assessment needs to be done, thus contact Fisheries Commission for the modalities.
- ENI Ghana needs to be very careful with making promises to the communities as the communities will not be pleased if promises are not redeemed.
- The cumulative impacts of the oil development need to be addressed in the ESIA.

Ricerca e Cooperazione

- No information was giving on impacts on health, livelihood of the people, archeological, cultural and historical sites
- Eni Ghana should mention how to handle a worst case oil spill which can destroy a lot of these archeological, cultural and historical sites scattered on the west coast of Ghana.
- Impacts to tourism should also be dealt with
- The rampant clearing of vegetation to build onshore bases for some oil companies is making the landscape aesthetically poor at the same time losing ecological significance of the vegetation.
- Positively, more jobs will be created, revenue to government will increase and communities will get social projects (CHIP compounds, hospital, schools, KVIP, etc).
- Government in partnership with the oil companies should set up a fund sourced from the oil revenue to improve tourism and maintain our archaeological, cultural and historical sites.
- No disposal of waste at sea thus effective management of offshore waste is critical.
- Eni Ghana in partnership with government agencies such as district assemblies should develop and maintain a sound building/development master plan for the districts.

Nzema Youth Association

- Make available jobs specifically to the local population.
- The oil production will bring about increase in revenue for development and thus the Oil companies should abide by laid down procedure and laws to make the positive benefits outweigh the negative effects of oil production.
- ENI should look at conducting a Fisheries Impact Assessment
- Request was made to upgrade the local hospital and equip it with ultra-modern gadgets.

A semi-quantitative method together with professional judgment and experience was used to assign a level of priority to the key issues identified during the scoping consultation to be addressed in the ESHIA. Positive issues identified during the consultation was denoted in green and measures will be designed to enhance it while the negative issues were categorized into three (3) ie High, Moderate and Low based on several factors such as likelihood of it occurring, magnitude, intensity and significance of its occurrence as shown in the table A2.The key issues/concerns extracted from the consultations with the level of priority assigned is shown in table A3.

Table A 2 Level of Priority assigned to Key Issues identified during the scoping consultation

Positive	**Negative**		
	High	Moderate	Low

Table A 3 Key issues raised during the scoping consultations and level of priority assigned

Date	Stakeholder Group	Issue Theme	Priority level	ESHIA Reference
29/11/2013	Ministry of Energy & Petroleum	Waste Management	High	Sect.9.6.7 /Attachment E
		Air Emissions	High	Sect. 7.4.1/ 8.1.1
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1
		Maritime Security	Moderate	Sect. 3.1.6
		Oil and Mud Spills	High	Sect.9.6.9/ Attachment D
		Environmental Monitoring	High	Sect. 9
		Access to Information	Low	Attachment A.- A5
N/A	Ghana National Petroleum Corporation	Oil Spill Contingency/Modelling	High	Sect.9.6.9/Attachment D
		Air emissions/modelling	High	Sect.7.4.1/ 8.1.1
		Waste Management	High	Sect.9.6.7/ Attachment E
		Accidents at Sea	Moderate	Sect. 3.1.6
		Increased Vessel traffic	Moderate	Sect. 7.5.5
		Local Content/ Employment	High	Sect. 7.5.3/ 8.1.2
		A Comprehensive Stakeholder engagement	High	Attachment A
		Critically assess social impacts (onshore effects)	High	Sect. 7.5/ 8.1.2
29/10/2013	Ghana Maritime Authority	Maritime Permitting Process	High	Sect. 3.1.6
		Marine Pollution	High	Sect.7.4.2 /8.1.1
		Safety at Sea	High	Sect. 3.1.6
		Maritime Security	Moderate	Sect. 3.1.6
		Air Emissions	High	Sect.7.4.1/ 8.1.1
05/11/2013	Ghana Marine Police	Exclusive (Safety) Zone	Moderate	Sect. 7.5.1
		Subsidize of fishing gears	Low	Sect. 7.5.6

		Frequent & Extensive Consultations	Moderate	Attachment A
		Logistical Support	Low	Sect. 7.5.6
04/11/2013	Western Region EPA	Tourism Assessment	Moderate	Sect. 5.4.2 / 7.5.1
		Fisheries Impact Assessment	High	Attachment C
		Baseline Data Collection	High	Section 6
		Waste Management	High	Sect.9.6.7./Attachment E
		Flagging of wells	High	Sect.7.4.2 /8.1.1
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Vessel Traffic	Moderate	Sect. 7.5.5
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1
		Chemical Clearance requirement	Moderate	Sect 3.1.4
		Decommission plan	High	Sect. 10
		Toxicology of Produced water	High	Sect.7.4.2 /8.1.1
		Community Interactions	Moderate	Attachment A
		Cumulative impacts	High	Attachment C
		Local Content Policy	High	Sect. 7.5.3/ 8.1.2
		Maritime Security	Moderate	Sect 3.1.6
05/11/2013	Western Region GPHA	Increased Revenue	Positive	Sect. 7.5.2/8.1.2
		Inadequate Water Supply	Moderate	Sect. 7.5.4/ 8.1.2
		Limited Port Space	Moderate	Sect. 7. 5
		Price Hikes in port facilities	Moderate	Sect. 7.5
		Marine Pollution	High	Sect.7.4.2 /8.1.1
		Influx of foreigners	Moderate	Sect 7.5
		Increase in Social vices	Moderate	Sect 7.5
04/11/2013	Fisheries Commission - WR	Fisheries Impact Assessment	High	Attachment C
		Conflicts with Fishermen	Moderate	Sect. 7.5.1

		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Accidents at Sea	Moderate	Sect. 3.1.6
		Logistical Support	Low	Sect. 7.5.6
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
04/11/2013	Sekondi Takoradi Metropolitan Assembly	Waste Management	High	Sect.9.6.7./Attachment E
		Marine Biodiversity	High	Sect. 4 / 7.4.4
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
		High Expectation	Moderate	Sect. 7.5.6/8.1.2
		Local Content Policy	High	Sect. 7.5.3/ 8.1.2
		Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10
		Health care system	Moderate	Sect.6/ 7.6/ 8.1.3
		Capacity building	Low	Sect. 7.5.6
08/11/2013	Nzema East District Assembly	Deterioration of Road network	Moderate	Sect. 7.5.6
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Conflicts with Fishermen	Moderate	Sect. 7.5.1
		Air Emissions	High	Sect. 7.4.1/ 8.1.1
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
		Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10
		Frequent & Extensive Consultations	Moderate	Attachment A
07/11/2013	Ellembelle District Assembly	Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
		Transparency in Royalty Payment	Low	Sect 7.5.2/ 8.1.2

		Local Content Policy	High	Sect. 7.5.3/ 8.1.2
		Capacity building	Low	Sect 7.5.6/ 8.1.2
		Frequent & Extensive Consultations	Moderate	Attachment A
		Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Waste Management	High	Sect.9.6.7./Attachment E
		Health care system	Moderate	Sect.6/ 7.6/ 8.1.3
07/11/2013	Jomoro District Assembly	Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10
		Cumulative impacts	High	Attachment C
		Fisheries Impact Assessment	High	Attachment C
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Frequent & Extensive Consultations	Moderate	Attachment A
06/11/2013	Ahanta West District Assembly	Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Frequent & Extensive Consultations	Moderate	Attachment A
		High Cost of Living	Moderate	Sect. 7.5.6/ 8.1.2
		Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Waste Management	High	Sect.9.6.7./Attachment E
		Cumulative impacts	High	Attachment C
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
05/11/2013	Shama District Assembly	Increased Revenue	Positive	Sect. 7.5.2/ 8.1.2
		Exclusive (Safety) Zone	Moderate	Sect 7.5.1/ 8.1.2
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D

		Marine Pollution	High	Sect.7.4.2 /8.1.1
		Air Emissions	High	Sect. 7.4.1/ 8.1.1
		Accidents at Sea	Moderate	Sect 3.1.6
		Frequent & Extensive Consultations	Moderate	Attachment A
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
		Capacity building	Low	Sect. 7.5.6/ 8.1.2
		Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10
07/11/2013	Chief and Elders of Sanzule	Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Accidents at Sea	Moderate	Sect. 3.1.6
		Conflicts with Fishermen	Moderate	Sect. 7.5.1/ 8.1.2
		Marine Pollution	High	Sect.7.4.2 /8.1.1
		Respect of Cultural Practices	Moderate	Sect 5.2
		Compensation	High	Sect. 7.5.1/ 8.1.2
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
02/11/2013	Chief Fisherman & Fishermen of Sekondi	Compensation	High	Sect. 7.5.1/ 8.1.2
		Unfulfilled promises	High	Sect. 7.5.6/ 8.1.2
		Subsidize of fishing gears	Moderate	Sect. 7.5.6/ 8.1.2
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
		Illegal fishing	Moderate	
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1/ 8.1.2
		Outbreak of Green Algae	Low	Sect. 7.4.4 /8.1.1
		Transparency in sharing benefits	Low	Sect. 7.5.1/ 8.1.2
02/11/2013	Chief Fisherman & Fishermen of Shama	Increased Revenue to Government	Positive	Sect. 7.5.2/8.1.2
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1/ 8.1.2

	Bentsir	High Cost of Living	Moderate	Sect. 7.5.6/ 8.1.2
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
		Subsidize of fishing gears	Moderate	Sect.7.5.6/ 8.1.2
		Conflicts with Fishermen	Moderate	Sect. 7.5.1/ 8.1.2
		Transparency in sharing benefits	Low	Sect 7.5.2
02/11/2013	Chief Fisherman & Fishermen of Shama Apo	Increased Revenue to Government	Positive	Sect. 7.5.2/ 8.1.2
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1
		Frequent & Extensive Consultations	Moderate	Attachment A
		Unfulfilled promises	High	Sect 7.5.6/ 8.1.2
02/11/2013	Chief Fisherman & Fishermen of Upper Dixcove	Increased Revenue to Government	Positive	Sect. 7.5.2/ 8.1.2
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Marine Pollution	High	Sect.7.4.2 /8.1.1
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
02/11/2013	Chief Fisherman & Fishermen of Lower Dixcove	Increased Revenue to Government	Positive	Sect. 7.5.2/ 8.1.2
		Conflicts with Fishermen	Moderate	Sect. 7.5.1/ 8.1.2
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1/ 8.1.2
		Effect of Light on Fishes	Low	Sect 7.5.1/ 8.1.2
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
		Transparency in sharing benefits	Low	Sect 7.5.2
06/11/2013	Chief Fisherman & Fishermen of Upper Axim	Unfulfilled promises	High	Sect. 7.5.6/ 8.1.2
		Exclusive (Safety) Zone	Moderate	Sect. 7.5.1/ 8.1.2
		Effect of Light on Fishes	Low	Seect 7.5.1/ 8.1.2
		Conflicts with Fishermen	Moderate	Sect. 7.5.1/ 8.1.2
		Subsidize of fishing gears	Moderate	Sect. 7.5.6/ 8.1.2
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
08/11/2013	Chief Fisherman &	Capacity building	Low	Sect 7.5.6/ 8.1.2

	Fishermen of Lower Axim	Frequent & Extensive Consultations	Moderate	Attachment A
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
		Air Emissions	High	Sect. 7.4.1/ 8.1.1
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Subsidize of fishing gears/premix fuel	Moderate	Sect. 7.5.6/8.1.2
		Conflicts with Fishermen	Moderate	Sect. 7.5.1/ 8.1.2
		Compensation	High	Sect. 7.5.1 /8.1.2
		Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
		Collaborate with other Oil Companies	Low	Sect 5.10
07/11/2013	Chief Fisherman & Fishermen of Half Assini	Unfulfilled promises	High	Sect. 7.5.6/ 8.1.2
		Effect of Light on Fishes	Low	Sect. 7.5.1/ 8.1.2
		Air Emissions	High	Sect. 7.4.1/ 8.1.1
		Conflicts with Fishermen	Moderate	Sect. 7.5.1 /8.1.2
		Accidents at Sea	Moderate	Sect 3.1.6
		Outbreak of Green Algae/ Sargassum	Low	Sect. 7.4.4 /8.1.1
		Subsidize of fishing gears/premix fuel	Moderate	Sect. 7.5.6/8.1.2
		Fishermen Livelihood (Alternative)	High	Sect. 7.5.1/ 8.1.2
01/11/2013	Ricerca e Cooperazione	Lack of Information on archeological, cultural and historical sites	High	Sect 5.2
		Oil spill Contingency Plan	High	Sect.9.6.9/Attachment D
		Impact on Tourism	Moderate	Sect. 5.4.2 / 7.5.1
		Loss of Biodiversity	Moderate	Sect. 7.4.4/ 8.1.1
		Increased Revenue to Government	Positive	Sect. 7.5.2/ 8.1.2
		Waste Management	High	Sect.9.6.7./Attachment E
		Synergy between CSR projects and development plans of Assemblies	High	Sect 5.10

05/11/2013	Friends of the Nation/CRC	Conduct a health impact assessment	High	Sect.6/ 7.6/ 8.1.3
		Conflicts with Fishermen	Moderate	Sect. 7.5.1/ 8.1.2
		Creating a Marine Protected zone	Low	Sect 7.5.6
		Marine Mammals (Whales)	High	Sect. 7.4.5/ 8.1.1
		Frequent & Extensive Consultations	Moderate	Sect. 7.5.6 /8.1.2
		Fisheries Impact Assessment	High	Attachment C
		Unfulfilled promises	High	Sect. 7.5.6
		Cumulative impacts	High	Attachment C
	Nzema Youth Association	Local Content/Employment	High	Sect. 7.5.3/ 8.1.2
		Increased Revenue to Government	Positive	Sect. 7.5.2/ 8.1.2
		Fisheries Impact Assessment	High	Attachment C

A scoping report detailing the issues and concerns obtained from the consultation including the minutes of the meetings, attendance sheets, photographic evidence and the Terms of Reference was submitted to the Environmental Protection Agency (EPA) of Ghana on the 20th December 2013. EPA reviewed the Scoping Report and informed eni Ghana via letter of the approval of the Scoping Report and Terms of Reference for the ESHIA study on 10th February 2014. A copy of the approval letter can be found in Annex A5.

A4.2 During ESHIA Baseline Studies

A4.2.1 Consultation

The consultation within this phase was aimed at mopping up/undertaking meetings that could not take place during initial and scoping phase consultation and also with stakeholders suggested by EPA of Ghana after the review of the scoping report.

During the baseline studies, a total of 4 meetings were carried with 4 main stakeholders. These included Fishermen of Sanzule, Women of Sanzule, Fishermen of Ewe town (Sanzule) and Fishermen and Women of Bakanta.

A similar format for consultation was used as that used during the scoping phase consultation see *A4 1.1*. Minutes of the consultation meetings, attendance registers, photographs are provided in Annex A3.

Issues raised during the consultations were assessed to extract the key issues of concern to be addressed in the ESHIA. The issues trail below shows a list of issues raised during the ESHIA baseline studies

ESHIA Baseline Studies Issues trail

Fishermen of Sanzule

- The negative effects of the emergence of seaweed on fishing.
- The negative effects of drilling activities on fish catch thus affecting their livelihood
- Alternative livelihood programme for fishermen to alleviate their worries
- Training of the youth of Sanzule to equip them to work in the oil industry
- Equal and fair distribution of benefits/compensation
- Employment of community members
- Eni Ghana can institute a monthly financial allowance for the fisherfolk of Sanzule
- Continued consultation with traditional leaders to ensure the smooth running of the project.

Women of Sanzule

- The decline in fish catch result of the oil find has affected their livelihood as fishmongers
- Eni Ghana should investigate the cause of the proliferation of sea weed which is negatively affecting the fishing industry.

- Eni Ghana should support the fishmongering business by providing them with equipment for smoking fish “chokor smoker” and also a cold store for storing excess fish catch.
- In case of resettlement the women of Sanzule as well as men hope to be adequately compensated

Fishermen and Women of Bakanta

- The decline in fishing business has been attributed to the oil industry and as such eni Ghana is expected to help alleviate this worry.
- Since fishermen are the main group of people to be affected by oil production, eni Ghana should institute a compensation package for the fishermen of Bakanta. Another suggested a monthly allowance for fisherfolk.
- eni Ghana should begin a scholarship scheme for the local community youth to acquire some knowledge and certificate to be enable them to get good jobs with the oil companies.
- People of Bakanta had an issue with where to send their grievances and concerns to since eni Ghana has no office in the community.
- A suggestion was made that eni Ghana should give some employment quota to the youth of Bakanta and that employment should be fairly distributed to both youth of Bakanta and Sanzule,
- En Ghana should support the fishmongering business by providing them with equipment for smoking fish “chokor smoker”

Fishermen of Ewe Town, Sanzule

- The negative effect of oil spill on the fish population and its rippling effect on the livelihood of fishermen
- The negative effects of oil activities such a drilling etc. on marine organisms including fishes need to be addressed by eni Ghana.
- The issue of the proliferation of sea weed was mentioned which is having a heavy toll on fishing in the community.
- Eni Ghana to ensure that appropriate and adequate compensation is giving to community members in the event of a relocation/resettlement.

Here to a similar level of priority was used to assess the issues identified during the ESHIA baseline consultations, see table A 2.

Table A 4 Key issues raised during the ESHIA baseline Studies Consultations and level of priority assigned

Date	Stakeholder Group	Issue Theme	Priority level	ESHIA Reference
20/03/2014	Fishermen of Sanzule	Outbreak of green algae/sargassum	**Low**	Sect. 7.4.4 /8.1.1
		Local Content/Employment	**High**	Sect. 7.5.3 /8.1.2
		Fishermen Livelihood (Alternative)	**High**	Sect. 7.5.1 /8.1.2
		Compensation	**High**	Sect. 7.5.1 /8.1.2
		Transparency in sharing benefits	**Low**	Sect. 7.5.6 /8.1.2
		Frequent and extensive consultation	**Moderate**	Sect. 7.5.6 /8.1.2
20/03/2014	Women of Sanzule	Fishmongers Livelihood (Alternative)	**High**	Sect. 7.5.1 /8.1.2
		Outbreak of green algae/sargassum	**Low**	Sect. 7.4.4 /8.1.1
		Compensation	**High**	Sect. 7.5.1 /8.1.2
		Request for Chokor Smoker and Cold Store	**High**	Sect. 7.5.6 /8.1.2
27/03/2014	Fishermen and Women of Bakanta	Fishermen Livelihood (Alternative)	**High**	Sect. 7.5.1 /8.1.2
		Compensation (monthly allowance)	**High**	Sect. 7.5.1 /8.1.2
		Scholarship Scheme for education of youth	**High**	Sect. 7.5.6 /8.1.2
		Establishment of a Community Liaison Office	**Moderate**	Sect. 7.5.6 /8.1.2
		Local Content/Employment	**High**	Sect. 7.5.3 /8.1.2
		Request for Chokor Smoker	**High**	Sect. 7.5.6 /8.1.2
28/03/2014	Fishermen of Ewe Town, Sanzule	Effects of Oil activities and Oil Spill on fish	**High**	Sect. 7.4.4 /8.1.1
		Fishermen Livelihood (Alternative)	**High**	Sect. 7.5.1 /8.1.2
		Outbreak of green algae/sargassum	**Low**	Sect. 7.4.4 /8.1.1
		Compensation	**High**	Sect. 7.5.1 /8.1.2

A4.2.2 Disclosure

The ESHIA process is almost complete and as such the Draft ESHIA Report will be submitted the EPA of Ghana for review. The Draft ESHIA will provide detailed information about the proposed project activities, the assessment of the impacts and the planned mitigation and monitoring measures. After submitting 12 copies of the Draft ESHIA Report to the EPA it will be advertised in any of the national newspapers and made available for public review for a period of 21 days as legally required. In addition, copies will be sent to relevant stakeholders for review and also copies will be placed at specified location. Copies of the draft ESHIA will be made available for download on the project website at http://www.eni.com.

A4.3 Decision Making

At this stage, consultation will mainly take place with the EPA and relevant stakeholders such as GNPC, Ministry of Energy and Petroleum, Petroleum Commission and any other stakeholders EPA may deem relevant. This will run in parallel to a review period that will include an open public comment process and likely public hearings.

Public hearings are an essential disclosure step for the review process of the Draft EIS, as per the EIA Regulations. The EPA will take a decision on the need for public hearings prior to making a permitting decision on the Project. If convened, the hearings will be held in line with Ghanaian EIA Regulations (L.1.1652). These would likely be held in the capital, Accra and the Western Region capital of Takoradi or anywhere the EPA may choose.

After the public hearings, all issues and comments raised will be addressed in a final ESHIA report and submitted to EPA for the final permitting decision to be made. Eni Ghana will be informed of the EPA decision on the granting or otherwise of the environmental permit. Stakeholders will then also be informed of EPA's decisions through formal letters as well as announcement in national newspapers.

A5 ON-GOING STAKEHOLDER ENGAGEMENT

In this section, strategies to facilitate and address the different needs of stakeholders for engagement will be spelt out. Also consultation aimed at facilitating the management of disputes and grievances will also be discussed.

eni Ghana will set up a Corporate Social Responsibility (CSR) department with competent staff with the sole responsibility for ongoing stakeholder engagement and dispute resolution. It will be headed by a manager whose duty together with the CSR team will be to develop the overall engagement strategy as well as tools and methods for the necessary engagement activities and disclosure. The Manager will also be responsible for co-ordinating grievances as they come into the Project and will follow the Grievance Procedure in ensuring resolution. He will be supported by competent CSR officers and a Community Liaison Officer (CLO) based in the field (onsite).

The CLO will be responsible for implementing the stakeholder engagement strategy at the local level with all relevant stakeholders on a regular basis. This will ensure the maintenance of trust between the Project and communities through transparent and predictable engagement activities. The CLO will likely be the first port of call for people wishing to submit grievances and so s/he will be responsible for ensuring adherence to the grievance procedure. The CLO will also be responsible for reporting to the Manager on activities and issues arising on the ground, including potential non-compliance with Project commitments. The stakeholder engagement strategy the engagement with the following;

National, Regional and Local Government. Engagement with Government departments and other key stakeholders will continue during this phase to ensure that all key regulators at a national, regional and local level are engaged and participate in the implementation of the project. District assemblies will be consulted to ensure that CSR activities are coordinated with district development plans.

NGOs and CBOs. Interaction will involve coordination with NGOs, CBOs and other community groups to ensure the implementation of mitigation strategies as required and to maintain transparency post disclosure of the EIS.

Local Communities. Eni Ghana's CLOs will meet community representatives at local level in areas potentially affected by the project. The purpose of these meetings would be to provide project updates, answer questions about the planned operations and elicit feedback on local concerns and issues. The grievances procedure would also be communicated.

Economically affected parties. Any directly affected parties e.g. fishermen and local businesses will be consulted during the project and ongoing consultations will be maintained by the CLO.

An information centre will be established in the region, which will, amongst other responsibilities, provide information relevant to all of the above activities as well as making available relevant brochures updated for Project phases and activities. When the CLO is not in the field s/he will run this information centre.

A grievance mechanism will be put in place by the CSR team with a main focus of ensuring that concerns raised by stakeholders at any point in the project's lifecycle can be addressed satisfactorily. The main components in this mechanism will include training of project staff (in the Project region and in the Accra office) to accept and log incoming grievances before prioritizing the issues to help identify the required remedial action, if the grievance is directly related to the Project's actions.

A6 REFERENCES

Ghana Jubilee Field Phase 1 Development (2009) Environmental Impact Statement prepared for Tullow Ghana Limited by ESL Consulting Limited, Ghana and ERM.

Ghana Oil Services Terminal (2012) Draft Environmental Impact Statement prepared for LonRho Ghana Limited by ESL Consulting and ERM.

IFC (2012). Performance Standards on Environmental and Social Sustainability, 2012. PS6: Biodiversity Conservation and Sustainable Management of Living Natural resources - 2012 IFC

IFC, (2007). Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets".

ANNEX A1 STAKEHOLDERS CONSULTED WITH SO FAR

LIST OF STAKEHOLDERS CONSULTED WITH DURING SCOPING PHASE

S/N	Stakeholder Name	Company Function Responsible for Engagement	Form of Engagement	Contact Person	Contact Number	Location	Date of Engagement
1	Environmental Protection Agency (EPA)	ESHIA Team	Kick-off meeting, BID	Kojo Efunam		Accra	12-Sept-13
2	Ghana National Petroleum Corporation (GNPC)	ESHIA Team	Kick-off meeting, BID	Mr. Tamakloe		Accra	12-Sept-13
3	Petroleum Commission (PC)	ESHIA Team	Kick-off meeting, BID			Accra	12-Sept-13
4	Ministry of Energy and Petroleum	ESHIA Team	Consultation meeting	Mr. Twum Addo	0244326364	Accra	29-Nov-13
5	Ghana Maritime Authority (GMA)	ESHIA Team	Consultation meeting	Capt. Inusah Nasir	0244037367	Accra	29-Oct-13
6	Ghana Marine Police (GMP)	ESHIA Team	Consultation meeting	Insp. Osei Charles	0208174653	Takoradi	05-Nov-13
7	Western Region Administration	ESHIA Team	BID	Mr. Osei-Poku	0243666252	Sekondi	04-Nov-13
8	Environmental Protection Agency (EPA) - Western Region	ESHIA Team	Consultation meeting	Shine Fiagorme	0244185270	Sekondi	04-Nov-13
9	Ghana Ports and Harbour Authority (GPHA) - Western Region	ESHIA Team	Consultation meeting	David Halm	0244575090	Takoradi	05-Nov-13
10	Fisheries Commission - Western Region	ESHIA Team	Consultation meeting	Theodore Kwadjosse	0244926211	Takoradi	04-Nov-13
11	Sekondi-Takoradi Metropolitan Assembly (STMA)	ESHIA Team	Consultation meeting	Capt. (Rtd) Anthony Cudjoe	0205859285	Sekondi	04-Nov-13
12	Nzema East District Assembly (NEDA)	ESHIA Team	Consultation meeting	IsaacKwakye	0244804515	Axim	08-Nov-13
13	Ellembelle District Assembly (EDA)	ESHIA Team	Consultation meeting	Evans Afful	0244186325	Nkroful	07-Nov-13
14	Jomoro District Assembly (JDA)	ESHIA Team	Consultation meeting	Abudu Amadu	0244206182	Half Assini	07-Nov-13
15	Ahanta West District Assembly (AWDA)	ESHIA Team	Consultation meeting	Alhaji J. M. Hardi	0244479877	Agona Nkwanta	06-Nov-13
16	Shama District Assembly (SDA)	ESHIA Team	Consultation meeting	Habib Mohammed	0208158378	Shama	05-Nov-13
17	Chief and Elders of Sanzule	ESHIA Team	Consultation meeting	Nana Asafo Adjei II	0244140422	Sanzule	07-Nov-13
18	Chief Fisherman and Fishermen of Sekondi	ESHIA Team	Consultation meeting	Nana Kofi Essoun	0208153734	Sekondi	02-Nov-13
19	Chief Fisherman and Fishermen of Shama Bentsir	ESHIA Team	Consultation meeting	Chief Bassaw	0505258291	Shama	02-Nov-13
20	Chief Fisherman and Fishermen of Shama Apo	ESHIA Team	Consultation meeting	Nana Kwesi Ackon	0242522193	Shama	02-Nov-13

21	Chief Fisherman and Fishermen of Upper Dixcove	ESHIA Team	Consultation meeting	Nana Kwamina Acheampon	0230756773	Dixcove	02-Nov-13
23	Chief Fisherman and Fishermen of Lower Dixcove	ESHIA Team	Consultation meeting	Nana Kojo Kra	0261318476	Dixcove	02-Nov-13
24	Chief Fisherman and Fishermen of Upper Axim	ESHIA Team	Consultation meeting	Nana Kwesi Binn	0208187976	Axim	06-Nov-13
25	Chief Fisherman and Fishermen of Lower Axim	ESHIA Team	Consultation meeting	Nana Kojo Eshun	0249712526	Axim	08-Nov-13
26	Chief Fisherman and Fishermen of Half Assini	ESHIA Team	Consultation meeting	Paul Forson	0275023607	Half Assini	07-Nov-13
27	Nzema Youth Association	ESHIA Team	Invitation to written comments	Mark Arthur	0208110441	Half Assini	N.A.
28	Ricerca e Cooperazione	ESHIA Team	Consultation meeting	Gianna Da Re	0244255089	Accra	01-Nov-13
29	Friends of the Nation / CRC	ESHIA Team	Consultation meeting	Solomon K. Ampofo	0244055951	Adiembra	05-Nov-13
30	Fishermen of Sanzule	ESHIA Team	Consultation meeting	Mr Badu	0275973569	Sanzule	20-Mar-14
31	Fishermen and Women of Bakanta	ESHIA Team	Consultation Meeting	Abusua panyin	0275504732	Bakanta	27-Mar-14
32	Women of Ewe Town, Sanzule	ESHIA Team	Consultation Meeting	Mr Badu	0275973569	Sanzule	27-Mar-14
33	Fishermen of Ewe Town, Sanzule	ESHIA Team	Consultation Meeting	Chief Fisherman		Sanzule	28-Mar-14

STAKEHOLDER CONSULTATIONS SCHEDULE

			AM1 = 0900 - 1000GMT	AM2 = 1030 - 1130GMT	PM1 = 1300 - 1500GMT	PM2 = 1500 1700GMT
Date		**Location**	**AM1**	**AM2**	**PM1**	**PM2**
12-Sept-13	Thursday	Accra	**EPA, PC & GNPC at OCTP Kick-off Meeting**			
29- Oct -13	Tuesday	Accra				**Ghana Maritime Authority**
01-nov-13	Friday	Accra	**Ricerca e Cooperazione**			
02-nov-13	Saturday	Sekondi, Shama, Dixcove	**Chief Fisherman & Fishermen of Sekondi**	**Chief Fisherman & Fishermen of Shama Bentsir**	**Chief Fisherman & Fishermen of Upper Dixcove**	**Chief Fisherman & Fishermen of Lower Dixcove**
		Shama		**Chief Fisherman & Fishermen of Shama Apo**		
04-nov-13	Monday	Sekondi, Takoradi		**Sekondi-Takoradi District Assembly**	**Western Region Administration**	**Fisheries Commission Western Region**
		Sekondi			**Environmental Protection Agency Western Region**	
05-nov-13	Tuesday	Takoradi, Shama, Adiembra	**Ghana Ports & Harbour Authority Western Region**	**Ghana Marine Police**	**Shama District Assembly**	**Friends of the Nation/CRC**

			AM1 = 0900 - 1000GMT	AM2 = 1030 - 1130GMT	PM1 = 1300 - 1500GMT	PM2 = 1500 1700GMT
Date		**Location**	**AM1**	**AM2**	**PM1**	**PM2**
06-nov-13	Wednesday	Agona Nkwanta, Axim		**Ahanta West District Assembly**		**Chief Fisherman & Fishermen of Upper Axim**
07-nov-13	Thursday	Half Assini, Nkroful, Sanzule	**Chief Fisherman & Fishermen of Half Assini**	**Jomoro District Assembly**	**Ellembelle District Assembly**	**Chief & Elders of Sanzule**
08-nov-13	Friday	Axim	**Chief Fisherman & Fishermen of Lower Axim**			
		Axim	**Nzema East District Assembly**			
29-nov-13	Friday	Accra				**Ministry of Energy and Petroleum**
20-mar-14	Thursday	Sanzule			**Fishermen of Sanzule**	
27-mar-14	Sunday	Bakanta		**Fishermen and Women of Bakanta**		**Women of Ewe Town, Sanzule**
28-mar-14	Monday	Ewe Town		**Fishermen of Ewe Town, Sanzule**		

ANNEX A2 COPY OF THE INVITATION LETTER AND THE BACKGROUND INFORMATION DOCUMENT (BID)

Invitation Letter to Comment which was Hand Delivered to Stakeholders

ESL Consulting
(environment & resource development) P. O. BOX LG 239 LEGON-GHANA
Tel: +233-24-4771707 //+233-0302-514614 //+233-302-683206 website: www.eslghana.com

22nd October 2013

Our Ref:..... .....

Your Ref:.....

The District Chief Executive
Ahanta West District Assembly
Agona Nkwanta

Dear Sir/Madam,

INVITATION TO COMMENT
STAKEHOLDER CONSULTATION FOR THE ENI GHANA OCTP PHASE 1 DEVELOPMENT

ENI E&P Ghana with assistance from ESL Consulting, request the pleasure of inviting your comments as part of a Consultation Programme for the Environmental Social and Health Impact Assessment (ESHIA) of the proposed development of the Offshore Cape Three Points (OCTP) block located about 50km off the coast of Western region.

Under the EIA regulations of Ghana, consultations are required to be undertaken by the applicant (ENI E&P Ghana) with stakeholders. We are by this letter inviting you to raise any issues and concerns you may have about the proposed development. Your comments will constitute part of the assessment process and will be submitted to the Environmental Protection Agency of Ghana. . If acceptable to you, we would like to propose to have the meeting on **Wednesday, 6th November, 2013 at 11:00am.**

A background information document (BID) of the Ghana OCTP Phase 1 development is attached for your study and comments.

We thank you very much for your cooperation.

.....
Ayaa Kojo Armah
(Director)

Ghana OCTP Phase 1 Field Development Project – Background Information Document (BID)

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OCTP : Oil Project
Background Information Document (B.I.D)

GHANA OCTP BLOCK

The Offshore Cape Three Points (OCTP) licence is located in the Gulf of Guinea, in the Republic of Ghana, and approximately 60 km south of the village of Sanzule (fig.1). The partnership of the JV is composed by: eni Ghana (Operator with 47.222% PI), Vitol (37.778% PI) and GNPC (Ghana National Petroleum Corporation, PI 15% carried).
For the exploitation of the oil and gas discoveries of the OCTP licence, a phased development plan is foreseen with:

a) Oil project (12 wells and subsea facilities, one FPSO located inside the development area) and the first oil planned in 2016;

b) Non associated gas (NAG) project (5 wells, subsea facilities, the same FPSO, a gas sea-line and one CPF onshore) where the first gas is expected in 2017.

The aim of this document is to provide background information about the Oil project and the associated EIA process and to invite comment on any issues or concerns you may have.



Figure 1: Location of OCTP Block.

Environmental Impact Assessment (EIA)

Under the Ghana Environmental Assessment Regulations of 1999 (LI 1652) an EIA is required to be submitted by the applicant (eni e&p Ghana Ltd.) in support of oil production projects.

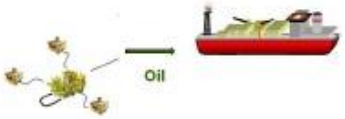
eni e&p Ghana Ltd has commissioned eni HQ with assistance from a local Ghanaian consulting firm called ESL Consulting, to undertake an Environmental Social and Health Impact Assessment (ESHIA) for the OCTP development. The ESHIA will describe the project, assess the likely positive and negative environmental, social and health impacts of the project and describe the plans to be put in place to manage these impacts. The ESHIA, along with comments received from stakeholders will be submitted to the Environmental Protection Agency (EPA) who will decide whether or not to authorise the proposed project with the issuance of and Environmental Permit.

Brief Description of the Oil Project

The project considers 12 subsea wells (8 Oil Producers, 2 Water Injections, 2 Gas Injections) production wells (2 re-entry). For the exploitation of the Oil, a new conversion double hulled Floating Production Storage Offloading (FPSO) will be installed in the middle of the Oil

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SPS	Design
Subsea Configuration	Single well
Line type	Flexible
Oil Producers	8
Water Injectors	2
Gas Injection	2

FPSO (new conversion)	Design
Oil storage (MMbbls)	2.4
Risers & Mooring Syst.	Spread Moored - double balcony
Oil Treatment (bbl/d)	80,000 (Ref. Inc. cap. 90K)
AG treat/Injection Capac. (MMscfd)	150
Water Injection (bbl/d)	80,000
Prod. Water Capac. (Bbbl)	65,000
Inl. Pressure (bar)	180
WI Pressure (bar)	450
Liquid Capacity (bbl/d)	6,800

Figure 2: Development Concept.

development area to collect and process the Oil (dehydration and stabilization) (Fig 2 & 3).

The produced Oil will be separated from both water and associated gas, stabilized and stored into storage tanks in the FPSO prior to be properly metered and offloaded. Condensates produced later on, during the following non associated gas project, will be separated offshore and blended with the oil on the topside facility of the FPSO.

The produced water will be separated and treated in the produced water treatment unit in order to comply with specification for water injection before being mixed with treated seawater and to be re-injected into the Cenomanian reservoir for pressure maintenance.

The Associated Gas (AG), produced from the oil separation train, will be compressed and dehydrated before being re-injected into the Cenomanian reservoir according to the specified demand. Part of this gas will be used for fuel for power generation.

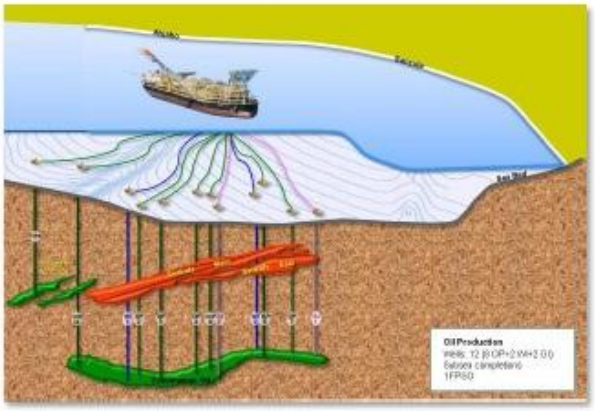


Figure 3: OCTP Schematic Layout Operational Pix

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Background Information Document (B.I.D)

POTENTIAL IMPACTS IDENTIFIED SO FAR

Drilling, installation and construction works account for the vast majority of the impact on the atmosphere, the columns of water, sea floor and biological component. This will be confined to the areas in the immediate vicinity of the field. On the other hand, impact during operations would appear to be limited to the FPSO operations.

The in-depth analysis, to be performed during the ESHIA (Environmental-Social-Health Impact Assessment), will provide further details on the characteristics of the marine environment and more precisely clarify, the potential impact the activities could cause on the marine ecosystem and on human activities (i.e. fisheries) in the area affected by the operations. Table 1 relates the project actions to impacts identified so far.

Table 1: Relationships between Project Actions with Potential Impacts identified so far

STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
WELLS DRILLING	Drilling activities	Drilling system installation and removal	damages to morphological structures and benthic biocenoses
			mobilisation and resuspension of sediments
		Drilling system operation	emission of pollutants into the atmosphere
			generation of noise in the water
		Drilling cuttings discharge	damages to benthic biocenoses
		Production test	emission of pollutants into the atmosphere
	Drilling support	Use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
WELL HEADS INSTALLATION AND REMOVAL	Well heads installation and removal	Installation/removal activities	damages to morphological structures and benthic biocenoses
			mobilisation and resuspension of sediments
			generation of noise in the water
		Use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage

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STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
			emission of pollutants into the atmosphere
WELL HEADS OPERATION	Normal operating procedures	Presence of production structures	mobilisation and resuspension of sediments
			Increased availability of organic matter
			physical presence of structures
		Protection of structures against corrosion (anodes)	release of pollutants and metals in solution
	Production support, maintenance	use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
FPSO – MOORING SYSTEM INSTALLATION	Installation activities	mooring system installation activities	damages to morphological structures and benthic biocenoses
			mobilisation and resuspension of sediments
			generation of noise in the water
		use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
	Structures normal operating conditions	protection of structures against corrosion (anodes)	release of pollutants and metals in solution
		presence of mooring system	mobilisation and resuspension of sediments
			Increased availability of organic matter
			physical presence of structures
		use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
FPSO PROCESS COMMISSIONING	Commissioning	commissioning procedures,	release of pollutants and biocides in solution

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STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
AND OPERATION		hydrotest	
	Process normal operating conditions	process operation	emission of pollutants into the atmosphere
			discharge of cooling water, hot waste water
			release of pollutants and biocides in solution
			generation of noise in the water
		production water discharge	release of pollutants and biocides in solution
		offloading activities	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
	Production support, maintenance	use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere

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THE E(SH)IA PROCESS IN GHANA

The E(SH)IA will be carried out following the process specified by Ghana EPA.

It will include the following steps:

1. Registration of the proposed development with Ghana EPA for Screening.
2. Initial consultation with stakeholders.
3. Preparation of Scoping Report
4. Submission of a Scoping Report to EPA.
5. Disclosure of the Scoping Report to the public.
6. Collection of existing environmental, social and health data for the area.
7. Further consultations with key stakeholders.
8. Submission of an Environmental Impact Statement (including an environmental management plan) to Ghana EPA.
9. Disclosure of the EIS to the public (possibly including public meetings).
10. Decision by the EPA on the application for an Environmental Permit.

ADMINISTRATIVE FLOW CHART OF THE EA PROCEDURE

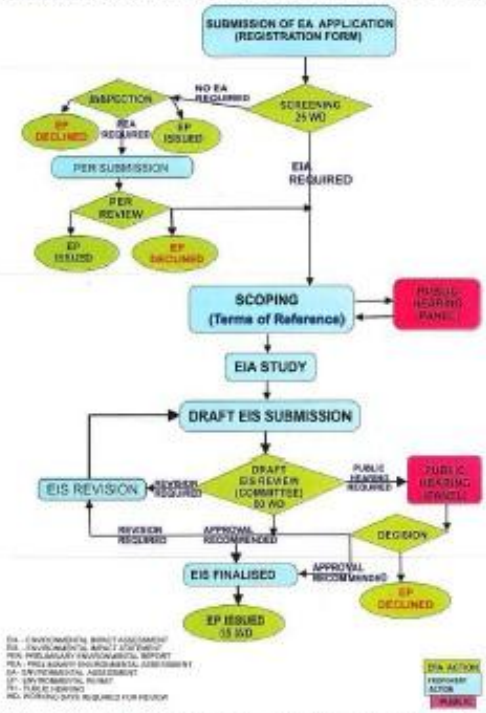


Figure 5: Administrative Flow chart of EIA process in Ghana

The administrative flow chart of the EIA process is shown in fig 4.

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STAKEHOLDER COMMENT SHEET

You are invited to participate in the E(SH)IA process and to raise any issues and concerns you may have about the proposed project.

Your comments are a key part of the assessment process and it is important that ENI E&P Ghana Limited understands your support or concerns so that they can be responded to and assessed through the E(SH)IA process.

If you wish to make any comments, please use this form. Alternatively, please do not hesitate to send an email or write separately.

To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

Name:.....

Organization: .....

.....

Position: .....

Address:.....
.....
.....
.....

Telephone:..... Cell Phone: .....

Email:.....

Please post or fax or email this form to the following address:

ESL Consulting Limited

Contact: Mr. A. K. Armah

Tel: +233-302-683206/514614
Email:akarmah@yahoo.com/
info@eslghana.com

Address: ESL Consulting Ltd,
P.O. Box LG 239
Legon, Ghana

eni Ghana Exploration and Production Limited
Contact: Mr. Juan Deffis

Tel: +233-302 761 790 ext 227
Email:
juan.Deffis@enighana.eni.com

Address: 1st Floor Una Home Building, No.12 Airport Bypass Airport City. PMB KA 185 Accra, Ghana

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Stakeholder Comment Sheet

It would be useful if you could answer the questions below but please feel free to provide any comments you would like to raise. Please continue on additional paper if required.

1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

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

2. In your opinion, what are the positive and negative aspects of the proposed project?

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

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

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

Thank You for Your Participation

ANNEX A3 CONSULTATIONS DOCUMENTATION

See document “ANNEX_A3 - Consultations Documentation - Att. A Ghana OCTP Block Phase 1 ESHIA.pdf”.

ANNEX A4 STAKEHOLDERS’ WRITTEN COMMENTS

See document “ANNEX_A4 – Stakeholders’ Written Comments - Att. A Ghana OCTP Block Phase 1 ESHIA.pdf”.

ANNEX A5 COPY OF SCOPING APPROVAL LETTER

Tel: (0302) 664697 / 664698,
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Our Ref.: 2178/02/34

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra, Ghana

February 10, 2014

The Managing Director
ENI Ghana Exploration and Production Limited
1st Floor, UNA House
No.12 Airport Bypass Road
PMB KA 185
Airport City – Accra

Attn: Juan Deffis

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED GHANA OFFSHORE CAPE THREE POINT (OCTP) BLOCK PHASE 1 FIELD DEVELOPMENT PROJECT

We refer to your the Scoping Report on the above proposal submitted to the Agency, in accordance with the Environmental Assessment Regulations, 1999 (LI 1652).

The report has been duly reviewed and attached are areas/issues identified for consideration and inclusion in the EIA Terms of Reference (ToR).

You are advised to proceed with the Environmental Impact Assessment (EIA) for the proposed Ghana Offshore Cape Three Point (OCTP) Block Phase 1 Field Development Project and submit twelve (12) copies of the draft Environmental Impact Statement (EIS) including a softcopy in line with Environmental Assessment Regulations, 1999 (LI 1652).

Do not hesitate to consult with the Agency for further guidance necessary to facilitate a satisfactory EIA study.

Yours faithfully,

Kojo Agbenor - Efunam
Deputy Director/Petroleum Dept.
for: Executive Director

ANNEX A3
CONSULTATIONS DOCUMENTATION

OCTP Kick Off Meeting among eni Ghana, ESL, EPA, Petroleum Commission and GNPC

eni	eni Ghana e&p ltd.	**OCTP Development Project**	Page 1 of 1
		ESHIA Kick of Meeting	

Meeting Purpose: *OCTP Development Project – ESHIA Kick of Meeting*	
Meeting called by: eni Ghana, HSE Dpt	**Meeting Date:** 12/09/2013
Prepared by: Maame Bartels-Kodwo	**Location:** eni Ghana, Accra HQ
Attendees: eni Juan Deffis – HSE&CI Manager eni Ghana Maame Bartels - Kodwo – HSE Engineer eni Ghana Marco Leonardi – HSE Milan HQ	**Environment & Resource Development Consulting (ESL)** **Environmental Protection Agency (EPA)** **Petroleum Commission (PC)** **Ghana National Petroleum Corporation (GNPC)** *Attendance sheet attached

Item	Description
1 **Scope of the Meeting**	• The scope of the meeting was to officially launch the planned ESHIA process for Phase 1 of the eni Ghana operated OCTP Gas Development Project, to share with the parties involved the activities concerned and the process required from authorities. • eni Ghana showed that that the eni e&p Company Standard for ESHIA is fully aligned with the process described in EPA Guidelines, "Offshore Oil & Gas Development in Ghana".
2 **Presentation**	• eni Ghana introduced the selected local Contractor, ESL Consult, and informed that ESHIA process, interfaces with the public authorities and communities will be largely supported by ESL Consult. • Local Contractor will serve in aligning with the Ghanaian legislative process, as well as providing invaluable local context and knowledge. • Local Contractors is registered with the Petroleum Commission as well as being EPA accredited • eni Ghana shall manage the ESHIA process through the support of eni e&p HQ • Input data will be based on primary and secondary data already available and the consideration of International Standards & Requirements as well. • It was highlighted that all relevant stakeholders will be engaged throughout the process as and when required. • Attention was raised to a potential request from the Ministry of Fisheries, and the need to consider developing a stand-alone document containing the fisheries study (that is normally included in the EHSIA document). • eni is in the process of preparing the main documents in anticipation to be able to expedite or fast-track the ESHIA process without affecting the requirements from authorities (i.e. without skipping any step).
3 **Way Forward**	• eni Ghana, through local contractor, will complete Application Form and submit to EPA ASAP.

Meeting with Ministry of Energy and Petroleum

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ministry of Energy and Petroleum at Ministries, Accra
Date of Meeting and Time	29th November 2013 at 1505GMT
Present	See attendance sheet attached
GPS Location	N 05° 33′ 05.4″ W 000° 12′ 02.7″

The official from the Ministry of Energy and Petroleum (MoEP), Mr Twum Addo (TA) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

The initial concern raised was with waste management. TA wanted to know how Eni Ghana intends to handle waste generated offshore. AB responded by saying that Eni Ghana has a contract with Zeal Technologies to manage their wastes. TA further wanted to know the capacity of Zeal Technologies to handle current wastes effectively and subsequently, additional wastes from Eni Ghana. He was of the opinion, that if care is not taken and alternative waste management measures are not put in place, Zeal Technologies may be overwhelmed with all the wastes from Jubilee, TEN and now Eni not to mention other exploratory wastes and that would be a recipe for disaster.

Still of wastes, air emissions into the atmosphere are issues of great concern to the ministry. TA mentioned that effective measures need to be deployed to minimize or prevent air emissions such as CO_2, SO_x NO_x and all Green House Gases.

TA went on to mention the impact on fisheries and the livelihood of fishermen. The current state of fishermen is quite bad and wanted to know what kind of alternative livelihood projects would be commissioned to make the lives of fishermen comfortable.

The current state of fish sps and marine mammals found in our waters is not known. TA wanted Eni Ghana to do a comprehensive study of the fisheries especially marine mammals so that the species types, population dynamics, seasonal migration patterns etc. would be known. This would help in

understanding/accepting/dispelling the notion that oil activities are causing the deaths of whales and other marine mammals.

TA wanted to know at what stage of the project is the demarcation of the exclusive zone around the OCTP field done. Is it done before exploration or before drilling? He was concerned because of the current increase in vessel traffic accidents recorded on our seas. A clear demarcation should be done to ward off vessels and also fishermen.

In terms of Security issues, TA mentioned that the current spate of terrorism at sea is increasing and should be of concern to Eni Ghana. He wanted to know how Eni Ghana would ensure the safety of vessels coming in and out of the OCTP field.

TA went on to mention the issue of oil spill and mud spill. He wanted to know what Eni Ghana would do in such cases especially the first line of action before an extensive contingency plan is executed. He hopes it would be clearly spelt out in the ESHIA report.

TA also touched on the issue of monitoring of the marine ecosystem in which the OCTP field is located. He wanted to find out what monitoring programs are in place to regularly check the status of the marine ecosystem during exploration, drilling and actual operations. He hoped the monitoring programmes would be very efficient to be able to quickly identify any unusual phenomenon in the marine ecosystem and action taken before it becomes a major problem.

Finally, TA lamented on the fact that the Ministry has not received the Standard Operating Protocols/procedures (SOPs) for the operations at the Jubilee field. He was of the opinion that these SOPs need to be made available to the stakeholders so that corrective checks could be made and also to aid stakeholders to better understand what goes on in the field. He hopes Eni Ghana would make available their SOPs especially for drilling operations, offloading, maintenance and also operations on the FPSO. This could be added to the Draft ESHIA report.

AB thanked TA for the issues raised and ended the meeting at approximately 1555GMT.

Attendance sheet meeting with Ministry of Energy and Petroleum



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Min of Energy & Petroleum Meeting location: Ministries, Accra Date: 27/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	Kwasi Twum Adabo	DEP. DIRECTOR	0244526864	kkadabo@energymin.gov.gh	
2	Anthony Bartel	ETU	0205760752	bartelgeatlive-gh	

GPS Location:

Meeting with Ghana Maritime Authority

eni ghana	**GHANA OCTP BLOCK Phase 1 Consultation Minutes**	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ghana Maritime Authority, Head-Office Ridge, Accra.
Date of Meeting and Time	29th October 2013 at 1505 GMT
Present	Capt. Inusah A. Nasir (Deputy Director Environment and Safety, GMA) Anthony Bentil (AB) ESL Consulting

Capt. welcomed AB to the premises of GMA and enquired of his mission. After a brief self-introduction, AB explained the purpose of the meeting. He gave an overview of the OCTP project, various stages of development, impacts identified so far, the ESIA process and invited comments and issues to be made.

Capt. wanted to know the exact location of the OCTP project site, the coordinates and distance away from the Jubilee field and other fields in the area. AB explained that the OCTP project site is located about 63km away from the nearest shore (Senzule).

Capt. noted that due to the location of the field on the BID, he wanted to know if ENI would use any of the Ghana Gas pipeline facilities. AB responded that for now the development is limited to offshore operations and there would be the use of support vessels to transport oil from the field to a refinery. Capt then added that if there would be another FPSO, ENI Ghana would require GMA's permit in addition to the support vessels coming into our waters. This is because both the FPSO and the supports are recognised as foreign ships. In addition, the FPSO after installation is seen as a permanent structure/port.

AB inquired from Capt what the main issues of concern to GMA are. Capt responded by saying that there are three (3) main concerns about the development. These are Marine Pollution, Safety at sea including occupational safety and Maritime Security.

In terms of marine pollution, GMA is very much concerned about the discharge of oil from support vessels and other operations at sea. It would be prudent for ENI Ghana to consult the management of this concern in the MARPOL (I – VI) since every issue regarding oil pollution is treated in this document by the International Maritime Organisation (IMO). He also noted that, another serious concern which was not stated directly in the BID is the disposal of Garbage from support vessels and FPSO. Another source of pollution is anti-fouling chemicals used underneath

the support vessels which end up peeling into the sea. The issues of Ballast water discharge and garbage disposal as well as other water emissions such as domestic waste are also of great concern to the GMA.

The GMA has already laid out the Marine Pollution Bill before parliament and it is expected to be passed by the end of next session of parliament. When passed, the GMA will be legally empowered to prevent/minimize marine sources pollution and as well as sanction offenders.

In terms of safety at sea, GMA will be much more concerned about the sea worthiness of the support vessels and the FPSO to be used. He noted that ENi Ghana would have to contact GMA to get the right specification in terms of sea worthiness of vessels when the time is due for their use in Ghanaian waters. An example is the International Ship Certification for the use of the FPSO in Ghanaian waters.

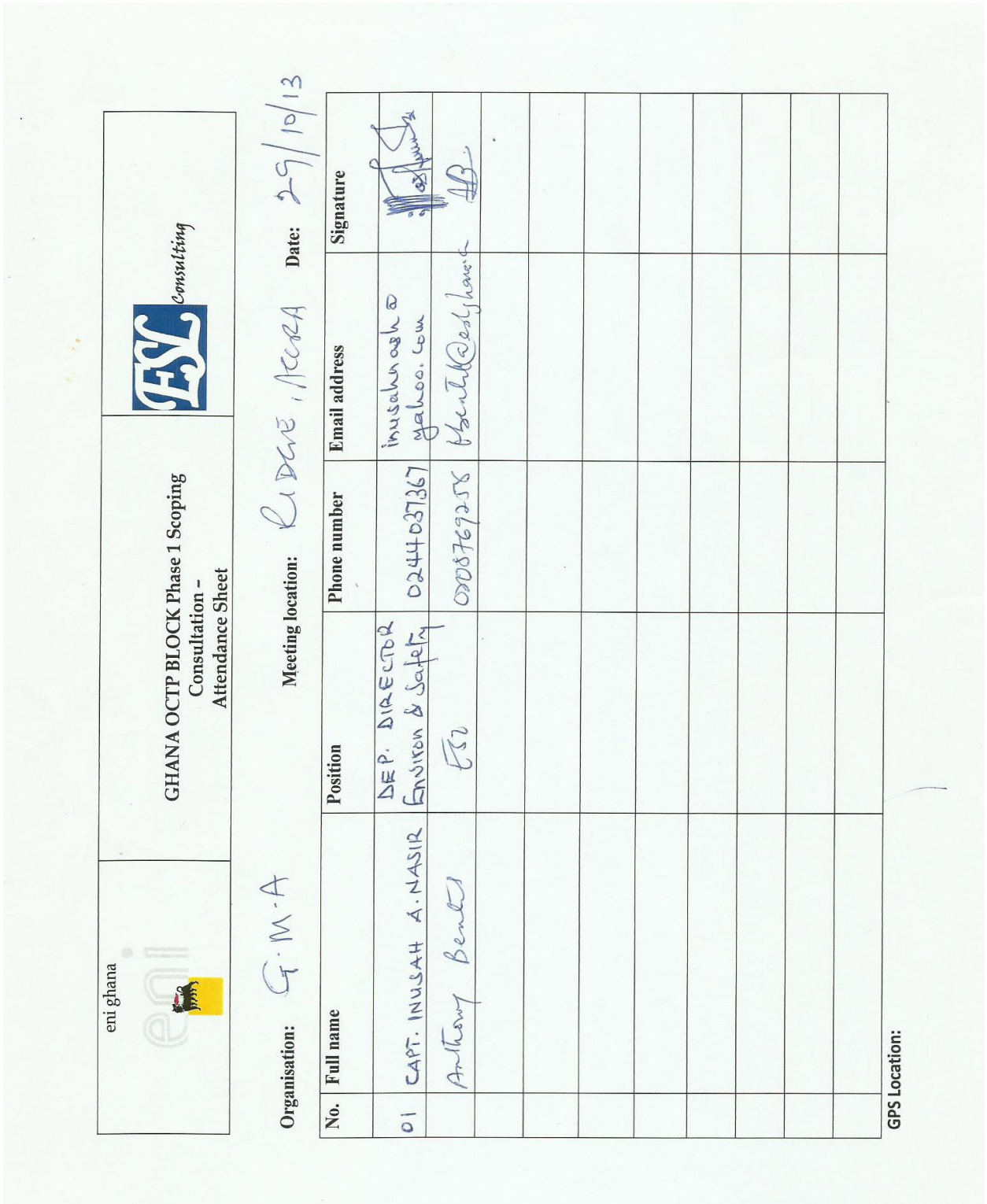
Another issue of concern is hazards from fishermen to navigation. From the experiences from the Jubilee field, the GMA had noted that some fishermen had collided with merchant ships when these fishermen were driven away from safety zone of the FPSO and end up in the route of merchant ships.

Dangerous air emissions as a result of operations are an issue that should be properly addressed so as to minimize its impact on workers on the FPSO or rigs and also on marine birds.

In terms of marine security, Capt stated that GMA is concerned about issues relating with piracy, armed robbery at sea, illegal bunkering, narcotic trafficking as well as terrorism. He however advised ENi Ghana to collaborate with government agencies to help minimize or prevent these impacts.

AB thanked Capt for the meeting and insightful information given. The meeting ended at exactly 1555GMT.

Attendance sheet meeting with Ghana Maritime Authority



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: G.M.A Meeting location: Ridge, Accra Date: 29/10/13

No.	Full name	Position	Phone number	Email address	Signature
01	CAPT. INUSAH A. NASIR	DEP. DIRECTOR Environ & Safety	0244037367	inusahnash@yahoo.com	
	Anthony Benkoh	ESO	0208769258	kbenkh@eslghana.com	

GPS Location:

Meeting with Environmental Protection Agency (EPA), Western Region

eni ghana	**GHANA OCTP BLOCK Phase 1 Consultation Minutes**	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Regional EPA at Sekondi
Date of Meeting and Time	4th November 2013 at 1345GMT
Present	See attendance sheet
GPS Location	N 04° 56′ 19.5″ W 001° 42′ 46.9″

The EPA welcomed the ESHIA team. AB of ESL introduced the team and gave a brief overview of the project, impacts identified so far and invited comments and issues to be raised.

Shine of EPA (SH) wanted to know if ENI Ghana had done a complete assessment of all tourist/beach businesses include hotels, resorts etc along the shores of western region. He asked this because in the case of an oil spill the extent of damage or loss of business could easily be quantified and the appropriate compensation paid. ENI Ghana should try and have an assessment done if not done already.

SH pointed out that Fisheries impact Assessment (FIA) which is a legal requirement for the Fisheries Commission of Ghana need to be done. It has become important because of the current spate of whales dying along the shores of western region and also the perceived decline in fish stock which the fishermen are attributing to the operations of the oil companies. People are of the opinion that the seismic surveys and other surveys done in the sea disorient the mammals leading to beaching along the shores, others dying before reaching the shores etc. An FIA could help dispel or prove some of the perceptions, also establish the current trend in fish catch, effort etc.

SH also touched on the issue of health. He wanted to find out if ENi Ghana has a comprehensive health baseline data of the western region especially in the 6 coastal districts. The baseline should contain data such as type and nature of ambulance services available, emergency service, doctor to patient ratios, nurse to patient ratio, qualification/specialization of medical practitioners etc and how ENI Ghana will handle their medical emergencies. AB responded by saying there is enough data gathered in terms of health status of the region but will take a look at

this to make sure its very comprehensive. KK also added by saying ENI Ghana has a contract with WARA to provide all medical services for their operations.

SH mentioned that the socio-cultural baseline need to be comprehensive so that certain cultures and traditions of the communities along the shores of the western region will be known and taken into consideration when executing any CSR projects or any interaction with the communities.

SH also wanted to find out if enough data has been gathered on the road transport system in the region. He said this because, in recent times a lot of heavy duty vehicles are operating in the districts and the road network were not designed to handle these heavy trucks and increase in vehicular traffic. ENI Ghana should have an idea of the state of the road transport system in the region so as not to worsen the already precarious situation.

George of EPA (GD) was of the opinion that waste management firms in the region are not adequately resourced to handle offshore oil wastes. How will ENI Ghana handle their offshore waste bearing in mind wastes generated onshore and also during exploration are different from offshore, drilling and production waste. KK responded that ENi Ghana has a contract with ZEAL Technologies to handle all their wastes both onshore and offshore. ENI Ghana has inspected ZEAL's facilities and are satisfied with their operations/facilities, thus capable of handling any type of waste generated.

GD then touched on the issue of flagging of wells. He said it was known that some oil companies elsewhere do not cap unproductive wells securely and that waste usually leaks into the oceans some few years after those wells have been abandoned. He wanted to know how ENI Ghana will handle flagging of wells if the need be.

GD also mentioned the issue of increasing vessel traffic in our seas. A lot more support vessels, tankers etc will begin operating due to ENi Ghana operation and this will put a strain on the over stretched resources currently at our ports, how will ENI manage this situation.

SH suggested that ENI Ghana should use floaters/buoys to clearly demarcate the extent of the safety zone around the FPSO so that fishermen do not go close to the rigs/FPSO.

GD wanted to know the distance between the Jubilee field and the OCTP field. He was of the opinion that looking from the map giving the exclusive zones of the individual fields may intersect and if that is the case it must be looked at critically so as to avert a potential conflict.

SH made it known that before any chemical is imported into the country, ENi Ghana would have to seek clearance from the EPA before the chemical could be brought in. This is a bit of information that ENI Ghana should take seriously.

SH reminded ENI Ghana that when preparing the main ESHIA report, a well laid out decommission plan should be included as this informs EPA on measures to be taken by ENI Ghana during that stage.

GD would like ENi Ghana to provide the EPA information about the composition of the produced water, the toxicology done on the water and all information pertaining to hydro testing.

SH proposed that ENi Ghana should have local community liaison representative who will be solely responsible for consulting with the community to determine their urgent social needs which will inform ENI Ghana on the nature of CSR projects to pursue.

SH also suggested that over the years it has come to the attention of EPA that some stakeholders deny being consulted even though their signatures are signed on attendance sheets. Thus he suggested that all contact with the communities, CSR projects should be videographed so that undeniable evidence will be available.

GD pointed out that local content issues need to be seriously incorporated into the operations of ENI Ghana. The employment of local community members, local service providers and the use of local goods of good quality will go a long way to help build a good relationship between ENi Ghana and the local community and the larger Ghanaian population.

GD again wanted ENI Ghana to take a critical look at the cumulative impacts of their operations and other operations in Ghana. He foresees a lot of FPSOs coming on board to drill oil, how will the cumulative impacts be managed with respect to the already existing Jubilee FPSO operations.

SH advised ENI Ghana to apply a recognised international procedure or standards when dealing with service providers and or contractors. This will ensure high quality in goods and services and prevent any unwanted and preventable causalities. GD also added that a comprehensive EHS procedures need to be put in place to prevent/manage environment, health and safety issues. Also oil spill contingency plans including modelling need to be done to let regulators of the industry know how prepared ENI Ghana is, in the event of an oil spill.

Finally SH touched on issues of maritime security. There are security issues in other parts of Africa such as terrorism, sabotages, armed robbery including piracy on the high seas, he wanted ENi Ghana to include how such issues will be dealt with in the ESHIS. Also natural disasters which may affect production should also

be spelt out in the report. GD on his part warned ENI Ghana to always obtain an environmental permit before any developmental project is embarked upon. He noted that some structures onshore especially in Takoradi have been built and being used without the permit from EPA. He wanted ENI Ghana to quickly rectify the situation before sanctions are met out.

The meeting ended at approximately 1450GMT.

Photo Evidence of Meeting with EPA



Attendance Sheet of Meeting with EPA, Western Region



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: EPA Western Region Meeting location: Sekondi Date: 4/11/13

No.	Full name	Position	Phone number	Email address	Signature
1.	Shine Ficgoma	chief Prog. Offical	0244485127	shinefigoma@yahoo.co	
2	George Biawuh	Senior Prog. Officer	0245086492	gkkbiawuh@gmail.com	
3.	Anthony Bentil	ESL	0208691258	thenh@esl.co.uk	
4.	Joseph-N.K. Kaitei	EPA	0546400366	nanakaritei@yahoo.uk	

GPS Location:

Meeting with Ghana Ports and Harbours Authority (GPHA), Western Region

eni ghana	**GHANA OCTP BLOCK Phase 1** **Consultation Minutes**	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ghana Ports and Harbours Authority (GPHA) at Takoradi
Date of Meeting and Time	5th November 2013 at 1005GMT
Present	See attendance sheet attached
GPS Location	N 04° 52′ 52.2″ W 001° 44′ 53.9″

The Ghana Ports and Harbours Authority (GPHA) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

David of GPHA (DA) pointed out that the main concern of GPHA has to do with port environment, anchorage and ship traffic. Positively, ship calls will increase because more support vessels will use the port facilities thus generating more revenue. Negatively, the current water supply at the port is woefully inadequate to support the vessels that come; also there is limited port space which is not sufficient to handle additional oil service providers.

AB enquired about how GPHA intends to address the above shortcomings. DA mentioned that GHPA has initiated the building of a Desalination plant at the port to produce more water to meet demand. Also the expansion works at the port has commenced with the aim of increasing the capacity of the port to handle the ever growing demand. As part of the expansion works, there will be a dedicated berth for oil service providers. Also more cargo and warehouses will be built to handle cargo from transit ships. Currently the calls of transit ships at the port have reduced due to the escalating prices of the cargo storage/ warehouse which were as a result of the oil companies pricing out the transit ships.

DA mentioned the issue of discharge of ballast water into the marine environment. With the increasing number of supply vessels the tendency of the vessels discharging the ballast water into the marine environment without treating it is great leading to a high possibility of the introduction of alien species into our marine environment.

Some social impacts identified by DA include the increase in rent at the port as the prices of warehouses are soaring, also influx of foreigners/expatriate workers and its effect on the culture of the indigenes. The increase in social vices is of concern as prostitution is now on an increase as well as other crimes.

The meeting ended at approximately 1115GMT.

Photo Evidence of Meeting with GPHA, Western Region



eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: G.P.H.A Western Reg **Meeting location:** TAKORADI **Date:** 5/11/13

No.	Full name	Position	Phone number	Email address	Signature
1.	David Halm	Ag. Ecologist & ENV.	0244750910	dhalm@yahoo.com	
2	Adu Nyarko	MANAGER ESL	0244855662	a.aduanyarko@yahoo.com	
3.	Anthony Bentil	ESL	0205769258	abentil@eslghana.com	
4.	Nana K. Karikari	ENI	0546400366	nanakarikarijoe@y.c	

GPS Location:

Attendance Sheet of meeting with GPHA, Western Region

Meeting with Fisheries Commission, Western Region

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Western Region Fisheries Commission at Takoradi
Date of Meeting and Time	4th November 2013 at 1530GMT
Present	See attendance sheet attached
GPS Location	N 04° 52′ 47.4″ W 001° 45′ 13.5″

The Fisheries Commission (FC) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

Theodore of FC (TD) quickly made it known that the only concern of FC is that oil companies should submit a Fisheries Impact Assessment (FIA) which is legally stipulated in the Fisheries ACT 625. So he expects ENI Ghana to commission and have an FIA done as soon as possible. AB acknowledged the fact that the fisheries Act stipulates that requirement but enquired whether the FC has laid down guidelines for oil companies to follow in having the FIA done. TD answered in the negative but was quick to add that ENi Ghana can write the FIA to contain all the various aspects in fisheries, including impacts and mitigation measures.

TD then went on to point out some of the impacts experienced especially by the fishermen. The already existing safety zone around the Jubilee FPSO has limited the fishing grounds of the fishermen, the light on the FPSO itself is attracting the fish into the safety zone and the constant harassment of fishermen by Navy patrol teams when fishermen get close to the FPSO are contributing to deprive the fishermen of good catch and now a second FPSO would be added to worsen their plight. ENI Ghana should actively engage with the fishermen and design social interventions to ease their predicaments.

Another worrying phenomenon is the increasing spate of accidents on the seas. The increasing number of support vessels in Ghanaian waters has resulted in accidental collision with fishing canoes and boats destroying them in the process, also destroying fishing nets and most importantly the loss of lives. ENi Ghana can help curb this trend by ensuring the support vessels adhere to stringent safety procedure to avoid collision and also provide reflectors for the fishermen to use especially at night so that they can easily be spotted and avoided. KK of ENI Ghana

responded by saying, some of the fishermen have been given reflectors but do not use them. He would educate them on the importance of using the reflectors and can only hope the fishermen use them. TD on his part said the FC can be forced to incorporate the use of reflectors by these fishermen into its permitting and licensing process so that all fishermen would show how committed they are to using the reflectors before licensing would be issued.

TD was of the opinion that the FC is faced with so many challenges which is hampering their effective regulation of the fishing sector. He request the ENi Ghana to look at empowering the FC with training and logistics to be able to function well which will bring sanity into the industry and satisfaction to all stakeholder involved in the fishing industry especially artisanal fishermen.

Finally, the issue of whales dying along shores of western region is of concern to the FC but they are limited to investigate the cause. He again request the ENI Ghana to conduct a research into why the whales are dying and what can be done to prevent it if the causative agent is the activities of the oil industry.

AB thanked the FC. The meeting closed at approximate 1630GMT.

Photo Evidence of meeting with Fisheries Commission, Western Region



Attendance Sheet of Meeting with Fisheries Commission, Western Region

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Fisheries Commission **Meeting location:** TAKORADI **Date:** 4/11/13

No.	Full name	Position	Phone number	Email address	Signature
1.	THEODORE KWAJOSSE	HEAD, MCS/I, FC TAKORADI	0244926211	adjossee@gmail.com	
2.	Anthony Benin	FIL	0208769258	Hantagesylane@	
3	Joseph N.K. Kanlan	GPI	0244400364	nanakankanfa@yl	

GPS Location:

Meeting with Ghana Marine Police

eni ghana	**GHANA OCTP BLOCK Phase 1** **Consultation Minutes**	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ghana Marine Police at Takoradi
Date of Meeting and Time	5th November 2013 at 1125GMT
Present	See attendance sheet attached
GPS Location	N 04° 53′ 32.8″ W 001° 44′ 55.5″

The Assistant Superintendent of Police of The Marine Police (ASP) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

ASP gave a brief overview of the responsibilities of the Marine Police. He said the main aim of the Marine police is to patrol the waters of Ghana both marine and freshwater. There exist the western and eastern units, the western unit patrols the waters from central region to the border with Cote d Ivoire while the eastern unit patrols the water from Gt Accra to border with Togo. The marine police in the western unit have 2 (9m) boats for patrols and do not patrol beyond the 12 nm of the territorial zone of Ghana's marine environment. Currently part of the unit is at Senzule guarding a stranded ship. In recent times the Marine Police have arrested fishermen who use light in fishing; those that go close to the FPSO and oil installations.

In terms of security, Marine Police in collaboration with the Ghana Navy would intensify surveillance patrols so as to avert any act of terrorism. The Unit will also embark on sensitization programmes to educate fishermen on the dangers of going close to an oil installation. The safety zone around the FPSO or oil installation could be marked clearly with colourful buoys. Government on the other hand can subsidize the cost fishing gears so that fishermen would appreciate the benefits of their sacrifice (not going to the FPSO to fish). Consultation with fishermen is key to the peaceful operation of oil companies in our waters thus he suggested that the government in collaboration with oil companies could deliberate with fishermen to design CSR projects that would not only benefit them but the entire communities along the shores of western region.

Finally he made an appeal to the oil companies especially ENI Ghana to help provide logistical support to the Marine Police, he specifically mentioned vessel detection radar which will help the police to quickly identify all vessels in Ghana's territorial waters.

The meeting ended at approximately 1220GMT.

Attendance Sheet of meeting with Ghana Marine Police

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: MARINE POLICE Meeting location: TAKORADI HARBOUR Date: 5/11/13

No.	Full name	Position	Phone number	Email address	Signature
1.	OTEI CHARLES.	Deputy Director	0208174623	steingtemang charles @ymail.com	
2.	Anthony Benku	ESL	0208769258	Abenku@eslghana.com	
3.	Adu Nyarko	ESL	0244855862	a.aduNyarko @yahoo.com	
4.	Joseph Nana Konkoni	ENI	0244402366	nanakonkoni@yahoo.com	

GPS Location:

Meeting with Western Region Administration

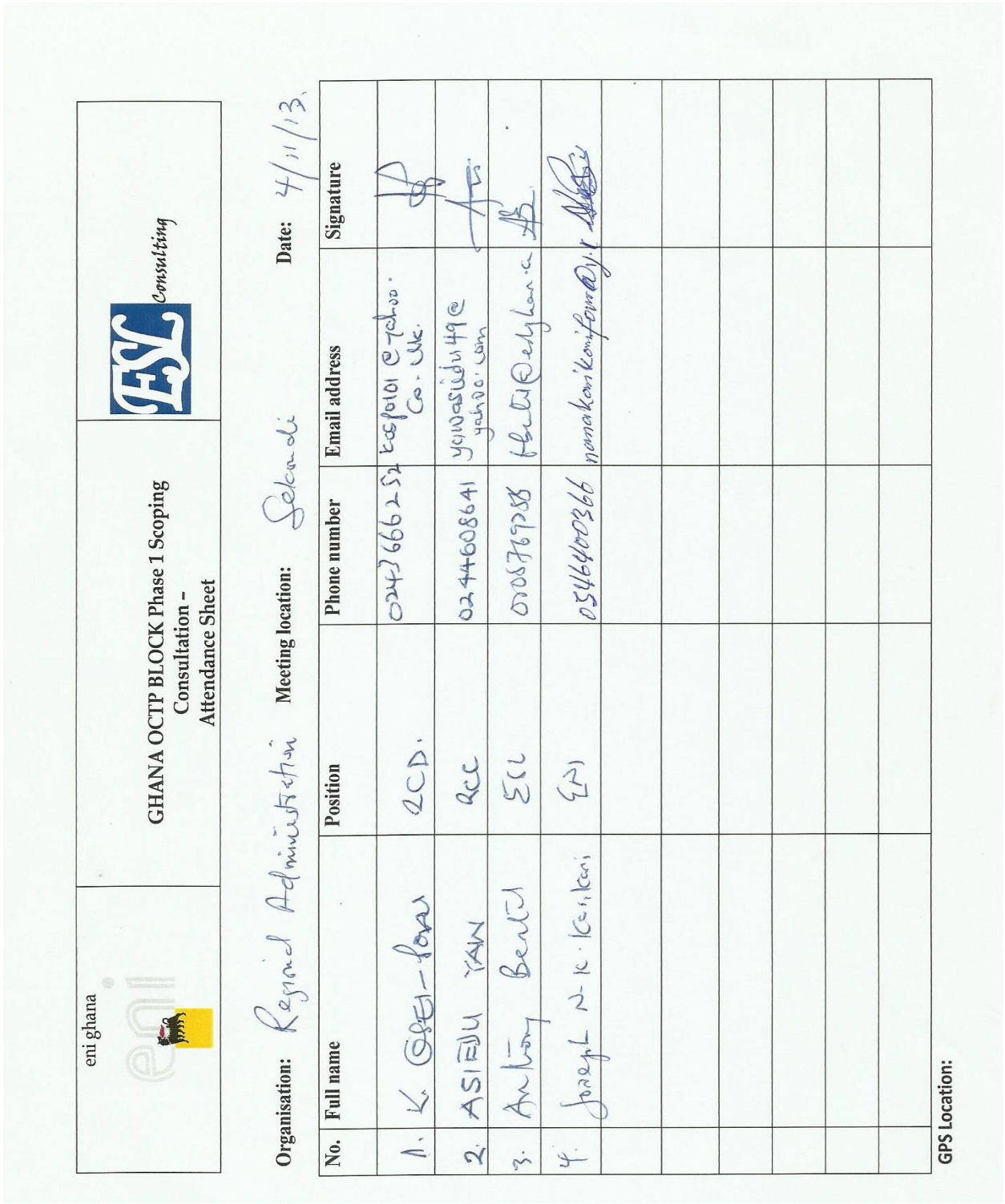
eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Western Regional Administration at Sekondi
Date of Meeting and Time	4th November 2013 at 1220GMT
Present	See attendance sheet
GPS Location	N 04° 56′ 26.8″ W 001° 42′ 46.1″

The Regional Chief Director (RCD) informed the team of the unavailability of the Minister to attend the meeting. He however made it known that it would be prudent to solicit the views of all the various heads of department under the regional administration not only The Minister. He suggested conveying a meeting in which all the regional departmental heads will be present and a presentation on the project made to them after which discussion on issues will follow. When done this way the outcome of the meeting will adequately reflect the views of the regional administration. He promised to set up the meeting at later date in the course of the month. The meeting was adjourned to a later date to be decided by the RCD and communicated to team.

The meeting ended at approximately 1235GMT.

Attendance sheet Meeting with Western Region Administration



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Regional Administration Meeting location: Sekondi Date: 4/11/13.

No.	Full name	Position	Phone number	Email address	Signature
1.	K. Ofei-Nyan	DCD.	0247666252	kofei0101@yahoo.co.uk	
2.	ASIEDU KAN	RCC	0244608641	yawasiedu49@yahoo.com	
3.	Anthony Bentil	ESU	0208767258	Abentil@ershana.com	
4.	Joseph N-K. Kwakwi	GPI	0246400366	nanakwakwi@yahoo.com	

GPS Location:

Meeting with Shama District Assembly (SDA)

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Shama District Assembly at Shama
Date of Meeting and Time	5th November 2013 at 1305GMT
Present	See attendance sheet attached
GPS Location	N 05° 00' 44.9'' W 001° 38' 09.3''

The Shama District Coordinator (DC) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

DC acknowledged the fact that the oil find will increase revenue to the government which will in turn use it to develop social infrastructure. In spite of these benefits, the negative impact of the oil operation on the marine environment cannot be over emphasized. Potential negative impact on marine organism including fish stock, whale, dolphin and sea weed need to be addressed by oil companies and in this case ENi Ghana. With the additional FPSO, fishermen will be prevented from fishing in the safety zone around the new FPSO thus depriving the fishermen of more fishing grounds. Also the light on the FPSO will attract more fish to the zone thus depriving the fishermen of fish and compounding the already precarious situation. He wanted to find out how Eni Ghana will improve the livelihood of fishermen in the face of these challenges. KK mentioned that ENi Ghana who is already involved in several social intervention projects will embark on projects purposely to help fishermen. In Cote d'Ivoire, ENI has supplied fishermen with motor engines instead of outboard motors which helps the fishermen to fish at deeper waters. Such motor engines would be introduced to the fishermen here after careful consultations, so that the fishermen can go beyond the FPSO/rigs to fish.

DC wanted to know how ENI Ghana will handle an oil spill. AB responded by saying ENI Ghana has a comprehensive Oil spill contingency plan which will be included in the ESHIS.

Tim of SDA mentioned the issue of ballast water discharges into open waters. AB responded by saying that ENi Ghana wil ensure that all support vessels will have treatment facilities on board to treat and discharge ballast water according to the MARPOL schedule.

Mr Habib of SDA mentioned that there has been flaring of gas occurring at the Jubilee fields even though the Jubilee Partners promised there will be no flaring. He wanted to find out if ENI Ghana will flare gas and if so what measures will be put in place to minimize its effects. AB responded by saying there will be no flaring of gas as all gas will be reinjected into the wells to maintain pressure for effective drilling of oil.

Mr Habib again mentioned that this new development will increase the vessel traffic in or waters as more support vessels would use our waters. This can result in accidents, ship grounding/wrecking. How will ENI Ghana prevent/minimize the occurrence of accidents offshore? He also wanted to know all the other stakeholders ENI Ghana intends to engage with. AB mentioned all stakeholders ENI Ghana is engaging with especially the local communities and fishermen.

Mr Habib was of the opinion that since the livelihood of the fishermen will be directly affected by the development, it is imperative on ENI Ghana to establish an alternative livelihood projects for the fishermen. He also wanted to ENI Ghana to establish scholarship schemes for children of fishermen. Employment of local community members will go a long way to foster cordial relationship between oil companies and communities.

Charles of SDA made it known that the oil and gas training facility established by the Jubilee Partners at the Takoradi Polytechnic is too expensive for the local population to attend. He requested the ENI Ghana can either establish their own training facility at an affordable fee or offer scholarships to student to receive training at the already existing facility.

Eugene of SDA was of the opinion that building the capacity of fishermen in oil and gas activities will help the fishermen to be able to detect any unusual development at sea and commence remediating measures since the fishermen are always at sea.

Tim suggested to ENI Ghana to incorporate a periodic health check programme into their CSR programmes so as to monitor the health status of the communities along the western region.

Finally, Mr Habib wanted ENI Ghana to incorporate some of the programmes and projects in the districts medium to long term development plans into their CSR activities. This will help provide for the communities their essential needs as well as helping the districts meet their developmental targets. The meeting ended at approximately 1412GMT.

Photo Evidence of Meeting with SDA



eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: GHANA DISTRICT ASSEMBLY **Meeting location:** GHANA **Date:** 5/11/13.

No.	Full name	Position	Phone number	Email address	Signature
1	HABIB MOHAMMED	DEPT. PLG. OFF.	0208158378	saddaca@yahoo.com	
2.	TIMOTHY AYENFU	WORKS CHAIRMAN	0208227271	timothy.ayentu@yahoo.com	
2	SAMSONDEED S. KASSIM	ASSISTANT DIR. TLB	0202356085	Salifu_sam@yahoo.com	
3.	FRANCIS TETTEH	ENVITAL HEALTH	0242553291		
4	CHARLE NERBAH	WORKS DEPT.	0562459063	challyneb@Yahoo.com	
5	PETER DOH ATEKLE	TOWN & COUNTRY PLG.	0203906633	tpd@2012Yahoo.com	
6	EUGENE NYANSAFO	TOWN & COUNTRY PLG. OFF	0203568526	nyansafo2057@gmail.com	
7	ADU NYARKO	ESL	0244855662	a.adunyarko@yahoo.co	
8.	Anthony Bell	ESL	0208769258	tbellesl@yahoo.c	
9	Joseph Nana Kwikwi	ENI	0546400366	nanakwikwifour@yahoo.com	

GPS Location:

Attendance Sheet Meeting with SDA

Meeting with Sekondi Takoradi Municipal Assembly (STMA)

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Sekondi Takoradi Municipal Assembly at Sekondi
Date of Meeting and Time	4th November 2013 at 1105GMT
Persons Present	6 persons (See attendance sheet attached)
GPS Location	N 04° 56' 22.7'' W 001° 42' 56.9''

The Municipal Chief Executive (MCE) welcomed the team. After a quick introduction, AB of ESL gave an overview of the proposed OCTP development, impacts identified so far and the invited comments and issues to be raised.

The Development Planning Officer (DPO) wanted to find out if there would be enough oil drilled from the 12 wells to be able to make up for cost of operations so far. KK of ENI Ghana responded in the affirmative saying a lot of work has been done in terms of the economic viability of the wells and results has been encouraging that is why ENI Ghana is now ready to drill.

The Environmental Health Officer (EHO) wanted to find out how ENi Ghana intends to handle its wastes generated offshore. KK informed him that ENI Ghana already has a working relationship with ZEAL Waste Mgt Company since 2009 and are confident they (ZEAL) can handle their (ENI Ghana) offshore wastes.

MCE wanted to be certain if ENi Ghana was satisfied with the facilities of ZEAL to handle offshore oil waste such as drill cuttings in comparison with treatments stipulated in the MARPOL Convention and other industry standards. KK assured the MCE that ENI Ghana has done its due diligence and is comfortable with the facilities provided by ZEAL.

MCE stressed on the fact that STMA being a coastal town just as the other 5 coastal towns in the western region is much concerned with safety and protection of the coastline , marine life and fishermen livelihood. He promised to make sure ENI Ghana conforms with all regulations in the industry so as to protect human as well as marine life. He further noted that there are so many impacts associated with the oil production, one of such impacts which he thinks is very critical is the impact to human health. In terms of medical care, he asked if ENI Ghana is ready to deal

with any health impact, if they have experiences from other countries to help guide their operations so as to forestall conflict such as in the Niger Delta?

MCE mentioned with great concern the current issue of whale beaching along the coast of western region. He was disappointed in the fact that so far no investigations have been conducted by the oil companies or government agencies on the issue. He wanted ENI Ghana to look at investigating the cause of this phenomenon, not limit it to just whales but other marine species such as dolphins so that a clearer understanding of the situation can be obtained. This would dispel all the negative connotation associated with whales beaching since whales are totems in this part of the country.

MCE pointed out that the expectation of the people with regards to social intervention is real. People in the communities are of the opinion that the current oil find would lead to increase in job opportunities, alleviate poverty and provide infrastructural development for deprived communities. These expectations have not been met and ENi Ghana should find a way to meet them that will be the only way to prevent unnecessary agitation among the communities and build/foster good neighbourliness. He mentioned one of such ways is to support the agricultural industry that is to support/or give assistance to the local communities to go into farming to produce foodstuff that can be used on the rigs/ FPSO. This suggestion about ENi Ghana supporting the agricultural sector was also reiterated by the DPO. The MCE finally added that interaction with the local communities especially the fishermen should be all year round and when promises are made they need to be fulfilled. KK responded by saying ENi Ghana already began a piggery farm at Efasu, CHIP compounds at Half Assini, KVIPs at Efasu. ENI Ghana has plans to begin an aquaculture project at a suitable location in the Ellembelle district. Finally a couple of years ago, ENi Ghana wanted to build a pedestrian walkway in the STMA bureaucracy stalled the whole project thus he made an appeal to the current MCE to help facilitate the execution of the project.

The DPO complained about the fact that no oil company has enquired from the STMA their development plans so as to incorporate them into their CSR programmes. He hopes ENI Ghana would contact the STMA to merge their development plans with the CSR projects so that the genuine needs of the people at large are met.

The EHO wanted to know what ENi Ghana intends to do about health effects associated with the oil production both to the workers on the rig/FPSO and on the local communities. KK mentioned that ENI Ghana has a contract with WARA to provide health service to workers. Also in terms of the local communities, health centers are being built for them. CHIP compounds have been constructed in some communities, immunization programmes have being organised at Efasu and Asanda.

EHO was passionate about capacity building for district assembly members. He was of the opinion that building the knowledge base of the members ,they will be empowered to be able deal with lots of enquiries into the oil activities since day in and day out local community members inquire about what is new in the oil industry. DPO also thinks such a training will also enable the assembly make an informed decision when it comes to licensing. KK mentioned that ENI Ghana has plan to offer scholarship to school children at the primary level but will also send their request to management for action to be taken.

Finally the MCE was very much appreciative of the fact the their consent as an assembly has been sort but was quick to add that he would prefer to organise all the assembly men under his jurisdiction so that a presentation can be done. This will ensure that information reaches the entire jurisdiction in the STMA and also enrich the stakeholder engagement process with lots of discussion and issues raised. He intends to have the presentation done on the 26th of November which is a normal general assembly meeting. AB and KK responded that the management of ENi and ESL will be informed about this development and appropriate measures will be taken. The meeting ended at approximately 1210GMT.

Photo evidence of meeting with STMA



Attendance Sheet of meeting with STMA

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: S.T.M.A Meeting location: Sekondi Date: 3/4/11/13

No.	Full name	Position	Phone number	Email address	Signature
1.	(Capt (rtd) AR Cudjoe	MCE	0205859285	Paakendjo@Yahoo.com	
2.	Henry Owusu	MDRO	0244736484	hkowusu@yahoo.com	
3.	Ahmed Sylley	MEHO	0244742270	ahmsyll@yahoo	
4.	Isaac Asare	MCD	0244164435	isaac.g.asare@yahoo.com	
5.	Anthony Bekui	ESL	0204769258	tbekui@eslghana.com	
6.	Joseph N.K. Kpakpo	GNI	0246400366	nanakankanjoun@yl.com	

GPS Location:

Meeting Ahanta West District Assembly (AWDA)

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ahanta West District Assembly (ADWA) at Agona Nkwanta
Date of Meeting and Time	6th November 2013 at 1125GMT
Present	See attendance sheet attached
GPS Location	N 04° 53′ 22.0″ W 001° 57′ 34.6″

After a short prayer, the District Coordinating Director (DC) of AWDA welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

Dr Sutherland of AWDA (District Director of Health) noticed that the potential impacts spelt out in the BID were not specific but more of a process impact .He wanted more specified impacts such as specific effects on marine organisms, human health such as diseases mentioned etc. He went on to mention the effect of oil activities on fish catch and its effect on the livelihood of the fisher folks.

DC reminded the team that the scope of the consultation should be extended to all the community members especially the fishermen thus community level consultation should be paramount in this process.

Dr Sutherland was not happy about the fact that the impacts listed in the BID were limited to offshore operations. He said that social and health impacts onshore should have been included. Impacts such as increase in social vices, diluting cultural practices with foreign practices, migrant-husband effect and high cost of living among others should have been mentioned. Adu-Nyarko of ESL (AN) acknowledged that but was quick to add that even though the Phase 1 is limited to offshore operations all the socio-cultural and health issues will be handled in the ESHIS.

DC advised ENi Ghana to always engage the assembly in all activities pertaining to the communities within the district. He also mentioned that ENi Ghana should always contact the District Assembly for up to date information about the communities within the districts. Current information such as health, education, socio-economic status among others can easily be obtained from the District

Assembly. CSR Projects being organised by Oil companies should be channelled through the district assembly so that the projects can be aligned with the district's developmental plans.

Dr also suggested that the Jubilee partners are currently preparing to have a Health Impact Assessment done and it will be prudent for ENI Ghana to contact the Jubilee Partners to get information on list of relevant stakeholders to be contacted.

Felix Senya of AWDA (FS) wanted to know how ENI Ghana intends to handle an oil spillage if it occurs. AB responded by saying ENI Ghana has a comprehensive Oil Spill Contingency plan which will be clearly spelt out in the main ESHIS.

Dr also wanted to know how ENI Ghana intends to handle waste generated offshore as some oil companies are fond of discharging effluents into the marine environment. Maame of ENI Ghana responded that ENi Ghana has a contract with ZEAL Technologies to handle all wastes generated both onshore and offshore.

FS mentioned that the cumulative effects of all the oil activities on the environment need to be addressed in the main report.

Dr was of the opinion that the Local Content in this development need to be paramount. He said currently the government is not getting much in terms of revenue and suggests that the local engagement of personnel, goods and services should be of importance to the management of ENI Ghana.

Finally, DC noted that the Jubilee partners had concentrated most of their initial CSR projects in Ellembelle and Jomoro Districts but not AWDA, he hopes Eni Ghana will begin some projects in AWDA as soon as possible. He expressed his disappointment in not being refreshed after the meeting. The meeting ended at approximately 1230GMT.

Photo evidence of meeting with AWDA



Attendance Sheet of meeting with AWDA

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: AHANTA WEST DISTRICT ASSEM. Meeting location: AGONA NKWANTA Date: 6/11/13

No.	Full name	Position	Phone number	Email address	Signature
1.	Ayisha M. Mahama	Assistant Dist Planning Officer (ADPO)	0243310837	ayishamahama@hotmail	
2.	Senya Felix	Env Health officer	0240588805	senyafelix@yahoo.com	
3.	Ofori Ackampong	Ast. Dir. of Agric	0244958780	Coforiackampong@live.com	
4	Albert Bonney	Management Information System officer MISO/MIDSA	0208736147	bonyalbert@gmail.com	
5.	Dr Ulf Suthaus	Director of Health Services	0209261877	ulfsuthaus@yahoo.co.uk	
6	Kingsley Attuah	Community Liaison officer Tullow	0544731257	Kingsant2008@yahoo.com	
7	Comfort Kumeshan	Secretary Assembly	0277760777	Kayehuma@yahoo.com	
8.	SETH WEDAM GAFA	Informal Advisor	0244282820	SethWedam@yahoo.com	
9.	Emmanuel Bentil	Asst Div Dir. Forestry Res. Mgt	0244179198	emmab@yahoo.com	
10	Stephen Kusakyi	DFRE Env Consulting	0244852248	stephenkusakyi@eyahoo.co.uk	
GPS Location:					
11.	Alhaji I. M. Hardi	C. Director	0244479877	jackhardi@yahoo.com	
12.	Adu Nyarko	ESL	0244855862	a.adunyarko@yahoo.com	
13.	Maame Bartels-Kakra	EGH		maame.bartels-kakra@engyes.com	

Meeting with Nzema East District Assembly (NEDA)

eni ghana	**GHANA OCTP BLOCK Phase 1** **Consultation Minutes**	Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Nzema East District Assembly at Axim
Date of Meeting and Time	8th November 2013 at 0915GMT
Present	See attendance sheet attached
GPS Location	N 04° 52′ 10.4″ W 002° 14′ 17.7″

The District Coordinating Director (DC) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

DC was very much concerned with the socio-economic impact of the oil development on the community. He said as an assembly, roads in the district have come under enormous pressure from constant use by heavy vehicle leading to certain portions of the road network deteriorating. Fishermen are also suffering as a result of the oil activities going on offshore, fish catch had declined, Ghana Navy harassing the fishermen. All these affect the livelihood of the fishermen and gradually running them out of business.

Kwabena Kesseh (KK) of NEDA wanted to find out if there would be flaring of gas. AB responded that there would be no flaring of gas as all gas generated would be re-injected into the wells.

Sherif Rockson (SR) of NEDA advised ENI Ghana to roll out CSR projects that serve the needs of the people especially alternative livelihood projects for fishermen. KK suggested the introduction of aquaculture to the fishermen. He said the aquaculture could be done either on land or in a waterbody to culture fish species such as tilapia, mudfish etc.

Peter Assan (PA) of NEDA wanted to find out how ENI Ghana intends to handle an oil spill. AB responded by saying an oil spill contingency plan would be prepared detailing out all the procedures and processes for handling an unlikely event such as an oil spill.

DC noted that there has been flooding in some part of Axim and the inhabitants of the area blame the flooding on the activities of the oil companies. He would want

ENI Ghana to investigate the occurrence of this flooding. Michael Davies (MD) also added inhabitants living in places where the flooding seems to occur could be relocated.

Stephen Bessabro (SB) mentioned the issue of whales beaching/dying on shores of western region. Whales are considered totems in some of the communities along coast and the beaching of the whales has become a major concern to the people. ENI Ghana should in collaboration of a research institution investigate to find out the cause of the situation.

Finally, the DC lamented that activities are done in the communities without consultation with the District Assembly and when a problem arise the same oil companies run to the assembly for help. He advised ENi Ghana to always consult with the District Assembly in pursing projects in the communities. Some of the projects could be incorporated into the development plan of the assembly. The meeting ended at approximately 1015GMT.

Photo evidence of meeting with NEDA



Attendance sheet of meeting with NEDA

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: NZEMA EAST DISTRICT ASSEMBLY Meeting location: AXIMA Date: 8/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	Michael Davies	Asst. Budget Analyst	0276474247	kwadav@yahoo.com	
2	Augustine Armah	AD I/C	0240/232100	augustinearmah@gmail.com	
3	Rockson Sheriff	Planning	0205746794	sheriffrockson@yahoo.com	
4	Osei Ayeyeh Edward	Planner	0246942407	yawayeyeh.nzema@yahoo.com	
5	Henry Peter Afriyie	Community Dev't Officer	0249260443	afriyieh@yahoo.com	
6	Emmanuel Azumah	Int. Auditor	0547777668	azucco@gmail.com	
7	Kwabena Kesseh	HKM	0244095437	Kwabena_kesseh@yahoo.com	
8	Stephen Bessabo	M.F.O.	0243257109	sbessabo@yahoo.com	
9.	Isaac Kwakye	MCD	0244803515	nackucc@yahoo.com	
10.	Peter P. K. Apam	MEHO	0243442041	assampeter@gmail.com	

GPS Location:
11. Pahnzie Handing Wards Emg. 0247064633 pahnzie@yahoo.com
12. Abu Nyanpo ESL 0247485246 a.nyanpo@yahoo.com
13 Anthony Beeko CPC 0208796288
14 Maame Boateng-Ackah EPA – Ghana

Meeting with Ellembelle District Assembly (EDA)

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ellembelle District Assembly (EDA) at Nkroful
Date of Meeting and Time	7th November 2013 at 1415GMT
Present	See attendance sheet attached
GPS Location	N 04° 58′ 13.9″ W 002° 19′ 11.6″

The Deputy Coordinating Director (DCD) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

The initial reaction of the DCD was for ENI Ghana to clearly spell out alternative livelihood projects for the fishermen since the oil activities will directly affect their livelihood.

William of EDA (WM) was concerned about the recent spate of whale beaching /dying along the shores of western region. He suggested that ENI Ghana should commission a research into the situation so that the fact about the situation can be known. Other than that, community members are continuously going to blame it on oil activities.

WM mentioned the issue of royalty which has to be paid to the chiefs and people of the 6 coastal districts. He said that up till date, no one knows the exact amount paid to the chiefs. Coupled to that employment of locals has been nothing to nil as not one youth in the district has been offered a job in the oil and gas industry. This situation is very bad and some youth in the district have started agitating. ENI Ghana should be transparent in their dealings with the people when it comes to paying of royalties and employing of local inhabitants. DCD also suggested that ENI Ghana could roll out scholarship schemes to train the local youth to be able to work in the oil and gas industry. He also suggested an employment quota could be given to community members through the District Assembly so that employment of the youth could be assured.

DCD suggested to ENI Ghana to begin a community sensitization programme with the main focus on educating the community on alternative livelihood projects. This will facilitate the community's acceptance of a new source of living other than

fishing. WM mentioned education can be done on piggery/ animal farming, aquaculture, coconut oil extraction business, snail rearing etc.

Richard Fosu (RF) of EDA also mentioned that allocation for CSR projects could be given to the education and treatment of HIV/AIDS cases in the District. He made it known that the current HIV infection rate of 13.5% is higher that the national rate of 1.3% and this demands urgent steps to be taken to reduce this rate.

DCD wanted to know the procedure ENI Ghana intends to employ to deal with oil spill. Maame of ENI Ghana explained that an oil spill contingency plan would be prepared to handle an event such as an oil spill.

Phillip Zutunu (PZ) of EDA suggested to ENI Ghana that in this era of climate change, adaptation programmes could be done as part of the CSR of the company. Projects such as massive tree planting exercise, wetland protection programmes, sensitization programmes among others can be organised to create the awareness of climate change and help in minimizing its effect.

DCD also touched on the issue of waste disposal and wanted to know how ENI Ghana would handle its wastes. Maame explained that ZEAL Technologies has been contracted to handle all wastes generated both offshore and onshore.

DCD made a request to ENI Ghana to help upgrade the district hospital, equip it with modern equipments and also personnel. He congratulated ENI Ghana for showing responsible behaviour towards the communities along the 6 coastal districts especially in Ellembelle District and encouraged ENI to continue the good works. The meeting ended at approximately 1515GMT.

Photo evidence of meeting with EDA





Attendance sheet of meeting with EDA

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: EJUMBEHE DISTRICT ASSEMBLY Meeting location: NKROFUL Date: 7/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	RICHARD FOSU	ASST. DEVE. OFFICER PLANNING OFFICER	0246964597	kwamefosu25@gmail.com	
2	FIDELIS ANKAMAH	ASST. Human Resource Manager	0540878025	ffankah@gmail.com	
3.	Bismark Bimba	P.A.D	0243373651	bbimba@gmail.com	
4	Essire Raphael	TDII	0244620881	chezo2010@yahoo.com	
5.	Enock Cudjoe	DPS (E.D.A)	0240622149	enockcudjoe@gmail.com	
6	Kwame Dadson	P.D	0272598158	dkwame@yahoo.com	
7.	Dorcas N. Arko	Social Dev't Officer	0242822348	orcansbk@yahoo.co.uk	
8	Philip Antwi	Env. Health	0242146744	Pantwi@yahoo.com	
9	Sarfo A. Christian	Nut. Officer	0208758102	Sarfo2k@gmail.com	
10	Ofi Gloria	AD I/B	0247478851	Ofigloria@ymail.com	

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: ELLEMBELLE DISTRICT ASS **Meeting location:** NKROFUL **Date:** 7/12/13

No.	Full name	Position	Phone number	Email address	Signature
11.	WILLIAM TEI-KPOSI	DIST. WORKS ENGINEER	0244678562	Wteikposi@yahoo.com	
12.	BERNARD L. HODOFE	SPED. OFFICER-GES	0246973972	hodofeb@yahoo.com	
13.	BEMPAH GODFRED	Community liaison officer Forestry Commission	0205974914	bempahgodfred@yahoo.com	
14	ADU NYARKO	~~SE~~ ESL	0244855162	a.adunyarko@yahoo.co	
15	Anthony Bentil	ESL	0208769258	tbentil@eslghana.com	
16.	EVANS AFFUL	EDA	0244186325	evansaffuls@gmail.com	

GPS Location:

Meeting with Jomoro District Assembly (JDA)

eni ghana	**GHANA OCTP BLOCK Phase 1** **Consultation Minutes**	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Jomoro District Assembly (JDA) at Half Assini
Date of Meeting and Time	7th November 2013 at 1115GMT
Present	See attendance sheet attached
GPS Location	N 05° 03' 19.6'' W 002° 53' 38.2''

The Deputy Coordinating Director (DCD) welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

DCD acknowledged the good working relationship ENI Ghana has with the district assembly since ENI Ghana has been involved in a number of projects in the district.

Peter Enderson (PE) of JDA questioned the essence of the EIA process as stipulated by EPA. He was of the opinion that recommendations in previous EIA done for Jubilee production has not been adhered to and now the host communities are disadvantaged, fishermen are suffering and benefits are not getting to the right people. The EIA process is a way for oil companies to access loans from international money agencies (World bank, IMF, ADB etc), after the EIAs are done and loans are secured the communities are left to suffer. EPA and the international agencies should make it a point to follow up on the activities of oil companies in the host communities. Adu Nyarko (AN) of ESL wanted PE to clarify what he meant by host communities. PE then explained by saying host communities are all communities that fall within a particular radius around the location of the project. In the case of the oil development the host communities are the 6 coastal communities in the Western region.

PE also lamented on the uncoordinated approach to executing projects in the districts by the Jubilee Partners. Partners tend to do things oblivious of others and usually end up in a fiasco. He hoped the ENI Ghana will continue to liaise with the district assembly when executing their CSR projects. DCD also added that ENI Ghana should merge their activities to fit into the developmental goals/plans of the district.

The issue of the cumulative effect of the two FPSOs was raised by the DCD. He was of the opinion that the two FPSOs will further limit the fishing grounds of the fishermen and double the current headache the fishermen are going through with respect with safety zone, Ghana Navy harassment, destruction of nets and collision with supply vessels etc. AB responded by saying the ESHIA would address the cumulative impact identified.

PE wanted a clarification on why oil companies are reluctant to send community members to the FPSO/rigs. If oil companies send community members to the rigs, the members would better understand the processes that go on and would be in a position to educate the other members of the society. Maame of ENI Ghana responded by saying it's a laudable idea but the process of sending people to the rig/FPSO is a very cumbersome one since people would have to be educated, trained and certified before allowed to embark on such a journey.

Mark Asmah (MA) of JDA reminded ENI Ghana to have a Fisheries Impact Assessment done since it is stipulated in the Fisheries Act 625.

MA also advised ENI Ghana not to just put up CHIP compounds but furnish and equip the place. He said he had observed that most the CHIP Compounds are not functioning since there are no medical personnel and equipment there. He also mentioned that the district hospital is also in dire need of medical equipment. Maame explained to MA that ENI Foundation built those CHIPs but before it was built an agreement was reached between Ministry of Health, Ghana Health Service and the District Assembly. The agreement was to allow ENI to build the CHIP while the GHS and MoH provide personnel and some equipment while the DA furnished them, but obvious after building the CHIP the other parties have not honoured their end of the agreement. The situation has been noted and steps would be taken to address them.

PE suggested to ENI Ghana to pursue alternative livelihood projects to make the lives of fishermen including fishmongers better. He mentioned the possibility of ENI Ghana beginning an aquaculture project in the Abby lagoon which is suitable for such a project. Also provide microfinance schemes to the fishmongers and market women to make their business grow.

Raymond Seworh (RS) of JDA also suggested to ENI Ghana to begin climate change adaptation programmes as part of its CSR. Planting of trees, mangroves could be done on a large scale in the district with the aim of removing CO_2 from the atmosphere.

Gifty Arthur (GA) of JDA was of the opinion that before any project is started in the district, extensive consultation need to be done so that all stakeholders are satisfied thus leading to a successful completion of the project.

DCD promised to get the District Assembly to furnish the CHIP compounds as agreed earlier and also continue to support ENI Ghana in executing CSR projects in the districts.

PE wanted to know what would be the next stage in this process. AB responded by saying that would be the scoping disclosure, when discussions would be held on the scoping report.

Finally, DCD congratulated ENI Ghana for all the projects they have been doing in the districts and encouraged ENI Ghana to continue with the good works and not to behave like the Jubilee partners. The meeting ended at approximately 1240GMT.

Photo evidence of meeting with JDA





Attendance sheet of meeting with JDA

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Jomoro District Assembly Meeting location: HALF ASSINI Date: 7/11/13.

No.	Full name	Position	Phone number	Email address	Signature
1.	PETER ENDERSON	CHAIR FXA	0243460140	pseyi2@yahoo.com	
2.	STEPHEN WILLIAMS	DFO	0208188602	sondelia@yahoo.com	
3	MARK ASMAH ARTHUR	PM REP.	0208110441	kingmark30@yahoo.com	
4.	Gifty M- Arthur	ADMIN	020-9743969	g-arthur-74@yahoo.com	
5.	ALI ABDUL-JALIL	PLANNING OFF	0207404362	abdulfaciliagmail.com	
6.	Jacob T. Ademang	Head, Works Dept	0244030148	ademangjacob@yahoo.com	
7.	RAYMOND SEWORH	DCE	0244892048	raymondbks96@yahoo.com	
8.	Ishmaelnig Koomson	IA	0208578166	praisegod22@out look.com	
9	Samuel Wiafe	ADMIN	0242887624	samuelwiafe2@gmail.com	
10	ANDAH GABRIEL G.	DISTRICT PLANNING OFFICER	0207682882	kwesiegoe84@gmail.com	

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: Jomoro District Assembly **Meeting location:** Half Assini **Date:** 7/11/13

No.	Full name	Position	Phone number	Email address	Signature
11	John Le-Grafe Abaitar	DBA	0247123238	@yahoo.com johnlegrafeabaitar	
12	Adu Nyarko	ESL	0244855662	a.adunyarko@yahoo.co	
13	Abudu Amadu	DCD JDA	0244206182	abudyamadu@gmail.com	
14	Maame Bartels-Kadwo	HSE Engineer – ENI Ghana		maame.bartels-kadwo @enighana.eni.com	
15	Anthony Bentil	ESL	0205769758	tbentil@eslghana.com	

GPS Location:

Meeting with Chief fisherman and fishermen of Sekondi

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Sekondi Fishermen at Sekondi Bosumtwi-Sam Fishing Harbour
Date of Meeting and Time	2nd November 2013 at 0940GMT
Present	See attendance sheet attached
GPS Location	N 04° 56′ 29.0″ W 001° 42′ 31.8″

NE the chief fisherman of Sekondi welcomed the ESHIA team. KK of ENI Ghana introduced the team and explained the purpose for the meeting. Adu Nyarko (AN) of ESL gave a brief overview of the proposed OCTP development, impacts identified so far and invited comments and issues to be raised.

NE thanked the team for presentation, his first issue was the fact that in recent times lots of consultations had been done with them (fishermen) by oil companies and sometimes the government, yet all their issues and comments have not been addressed leaving them(fishermen) to their fate.

NE noted that the oil activities in the western waters had lead to decline in fish catch. This is an issue they (fishermen) had raised at every consultation yet nothing in terms of compensation had been given to them (fishermen). Fishermen do not have any choice but to fish where the fish can be caught, so they are forced to go to the area of the FPSO since they get big fishes there. The leadership are still educating the fishermen on the hazard associated with fishing close to the FPSO but oil companies and government need to fulfil promises made to them.

NE recalled that at one of such consultations fishermen requested for government and the oil companies to institute a financial scheme aimed at subsidizing fishing implement, yet nothing had been done. The cost of premix fuel has been rising yet there were promises to make it fairly affordable. Also issues relating to employing locals to work in the oil fields had not been fairly addressed since there are majority of foreigners employed.

NE stated that the main concern of the local fishermen with regards to the oil activities has to do with low fish cash leading to unprofitability of the business. To compound this concern is the activities of foreign owned pair trawlers still operating in Ghanaian waters. Apart from the harm they cause to the fishing

stocks, they sell the unwanted fish (bycatch) cheaply to the market women and even other fishermen thus it difficult to get a good price for fish caught by our fishermen. The pair trawlers fish all year round since they have big engines unlike the local fishermen who currently fish for two weeks and stay off fishing for another two weeks.

NE was of the opinion that if the government could strictly implement the LI that regulates fishing activities in the country especially regulation that deals with pair trawling, transhipment of fish, bycatch and even illegal mesh sizes, the fishing industry would blossom once more. The oil companies could help support the government in the implementation and enforcement of the fisheries regulations.

NE also lamented on the fact that the oil companies have not fulfilled the promises made to the fishermen during the early stages in the oil industry. A promise to build an oven for the women to smoke and preserve fish has not been done. Some level of monetary compensation had been given to fishermen but it was inadequate. Scholarships for children of fishermen have not been fairly awarded since the fishermen do not even hear of the scholarship until it's awarded to someone they don't even know.

Finally, NE suggested the ENI Ghana should investigate the cause of the green algae outbreak that turn to hamper beach seining during certain times of the year. ENI Ghana should clearly demarcate the safety zone around the FPSO with moored bouys/reflectors so that fishermen can see and stay off the zone. Also ENi Ghana should do everything possible to prevent oil spills/leakages into the sea as this would affect the fish.

AN thanked the fishermen and closed the meeting at approximately 1045GMT.

Photo evidence of meeting with Chief fisherman and fishermen of Sekondi





Attendance sheet of meeting with Meeting with Chief fisherman and fishermen of Sekondi

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: FISHERMEN - SEKONDI **Meeting location:** SEKONDI **Date:** 2/11/13

No.	Full name	Position	Phone number	Email address	Signature
	Nana Kofi Essuman	Chief Fishermen	0208153734		
	Nana Bonsu Bonsels	Old Assistant	0244988690		
	Emmanuel Gordon	Sec.	0205786745	e.gordon2en@yahoo.com	
	Ebenezer Gordon		0272970570		
	Anthony Benhi	ESL	0208769258	benhi@esl.co.com	
	Ato-Dzato Adzyl	ESL	0244853662	a.adunyenka@yahoo.com	
	Joseph K. Korikari	ENI	0541640023866	nanakankenfourd@yahoo.com	

GPS Location:

Meeting with Chief Fisherman and Fishermen of Half Assini

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Half Assini at Half Assini
Date of Meeting and Time	7th November 2013 at 0945GMT
Present	See attendance sheet attached
GPS Location	N 05° 02′ 45.7″ W 002° 52′ 40.3″

The Chief fisherman of Half Assini (CF) welcomed the ESHIA team. Adu-Nyarko of ESL (AN) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

Okyeame to Chief Fisherman (OK) mentioned that similar consultations were done during the EIA for the Jubilee field development and nothing came out of it, all promises, pledges had not been fulfilled. The fishermen had taken a stand not be attend any meeting whatsoever again but due to pressure they have decided to partake in this exercise. He hoped that ENI Ghana would behave differently from what Jubilee partners did in past years.

CF said that initially fishermen did not know the effect of the oil production on the fishing communities but after a couple of years of production they have now come to understand the kind of impacts that afflict them. First on the list is the decline in fish catch due to attraction of fish to the area around the FPSO by the presence of light thus depriving the fishermen of adequate catch, flaring of excess gas causing health challenges, the harassment by the Ghana Navy, destruction of fishing nets by supply vessels and also collision with supply vessels have all contributed to low economic returns and increasing hardship. Other negative impacts noticed so far include the occurrence of green algae/grass on the shores along the entire coast of the western region which hindered fishing activities, disease such as some respiratory diseases, skin rashes, sight problems have all come about because of the oil activities offshore.

CF suggested the building of a clinic to cater for just fishermen, a health scheme to assist fishermen access health care at the district hospital free of charge, build schools for the children, awards scholarship to children of fisherfolks, subsidizing fishing implements, providing credit facilities to fishermen and providing an alternative livelihood projects for the fisherfolks. All of these will help alleviate the

hardship suffered by the fishermen in the coastal communities. From previous experience, benefits that were due to the fishermen was sent to the district assembly and the fishermen never got them so he made an appeal to ENI Ghana to directly deal with the fishermen through the chief fishermen. This could be done publically so that everyone in the community will be witness to any benefit coming to the community.

Finally he thanked the team and appealed to the team to make sure all comments are sent to the appropriate quarters for action to be done. ENI Ghana should continue to do the good things they are already involve in but should not desert them when production starts. The meeting ended at approximately 1030GMT

Photo evidence of meeting with Chief Fisherman and Fishermen of Half Assini





Attendance sheet of meeting with Meeting with Chief Fisherman and Fishermen of Half Assini

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: FISHERMEN - HALF ASSINI **Meeting location:** HALF ASSINI **Date:** 7/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	Paul Forson	General Sec	0275023607		
2	Sampson Munkoh	Canoe Owner	0243657493		
3	John Quansah	✓	0244928454		
4	Nana Ewuna. Odwire	Sub Chief Fisherman	0245065869		
5	Solomon K. Odwire		0272848930		
6	John Abbam	Chief Elder	0200477639		
7	Lawrence Aquaah	✓	0241565910		
8	Alfred Dabi	Fisherman	0542883817		
9	Kwame Akonu	✓	0243522759		
10	Michael Nana Dekyi	✓	0244122744		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: Fishermen - Half Assini **Meeting location:** Half Assini **Date:** 7/11/13

No.	Full name	Position	Phone number	Email address	Signature
11	Kwesi Benyah	Fisherman	0248770504		
12	Ekow Buadu	✓	0547545310	~~0542891413~~	
13	Kojo Koko	✓	0542891413		
14	Kwesi Mboroh	✓	0242846592		
15	Joseph Abban	✓	0540971786		
16	Kwasi	✓	~~0249646803~~		
17	Bro. Joe		0249646803		
18	Elder Gyasi	Canoe Owner	0542717117		
19	Anthony Bartel	ESL	0208763788	—	
20	Ofori-Agyeko Jnr	ESL	—	—	

GPS Location:
N Maame Bartel ENI GHANA — — —

Meeting with Chief fisherman and fishermen of Upper Axim

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Upper Axim at Axim
Date of Meeting and Time	6th November 2013 at 1525GMT
Present	See attendance sheet attached
GPS Location	N 04° 51′ 48.1″ W 002° 14′ 22.5″

The Chief Fisherman of Upper Axim (CF) welcomed the ESHIA team. Adu Nyarko of ESL (AN) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

CF appreciated the effort of ENI Ghana to consult with the fishermen of Upper Axim but would want a much bigger platform where a lot more fishermen could be present. The Jubilee development has not been fair to fishermen and now a second development; he was of the opinion that this second development will compound the already difficult situation fishermen are facing. All promises made during the Jubilee consultation have not been met, the Jubilee partners have failed to fulfull the promises they made but instead have contracted the Ghana Navy to harass the fishermen by seizing, destroying their fishing nets, spraying hot water on them just to mention a few. Government on the other hand is adamant to the plight of fishermen. The prices of premix fuel had gone up, the cost of fishing implement has also shot up and fishermen are spending so much to buy fishing implements when they go to fish, the Ghana Navy arrest them for coming close to the FPSO. This is killing the fishing industry and very soon fishermen may go into nefarious activities offshore.

CF was of the opinion that the Government need to consult with fishermen to know their plight and act to make their lives better. He also wants government to subsidize fishing implement such as outboard motors, nets and also premix fuel.

Atta Mensah did not understand why the prices of premix had gone up when oil was being drilled in Ghana. Now that a 2nd production is about to commence then the price of premix will shoot up more. He said this because the fishermen were of the opinion that premix prices will go down once Ghana started drilling oil but that has not been the case. He pleads with government to cut down the prices of

premix by subsidizing it. He also asked for monetary compensation to be given to all fishermen in Axim.

Agya Kofi was of the opinion that the light from the FPSO had driven the fish away from the traditional fishing ground to the area around the FPSO thus depriving them of adequate fish catch. And now that a 2nd FPSO will be installed, the fishermen are doomed.

Michael Nokue (MK) stated that the Government had failed the people of Axim especially the fishermen. He was of the view that Government had the mandate to ensure that oil companies adhere to industry best practices with respect to CSR so as alleviate the plight of fishermen. Government had done so much and the oil companies in operation are also doing their best to maximize profit at the expense of the fishermen. Ever since Jubilee started operation no government official (Ministry of Energy, EPA, GNPC etc) had consulted with the fishermen to know their plight. Even in the award of scholarships by the Jubilee partners, fishermen left in the dark and only high ranking members of the society get these awards for their children.

MK suggested that to be able to curtail some of these problems, Government need to interact with the communities, fishermen to know their plight and concerns, oil companies in collaboration with district assemblies should develop projects to address the needs of the fishermen, government should stop the Ghana Navy from seizing and destroying the nets of fishermen who go close to the FPSO/rigs, scholarships should be made open and a quota given to the chief fisherman so that he can award it to children of fishermen. Also fishermen themselves need to be serious and get involved in some of these social consultations so their issues could be taken serious.

Kojo Tandoh did not understand why fishermen still go to Cote d'Ivoire to fish even though there is oil production going on there, why do the Ghana Navy harass them when they fish close to the rig/FPSO. The government should liaise with the government of Cote d'Ivoire to allow the Ghana Navy and oil companies to understand how their system works so that they can implement it in Ghanaian waters.

MK currently there is no physical demarcation around the FPSO to prompt fishermen when they go beyond bounds. ENI Ghana should ensure there is some sort of identification around the oil installation to prevent the current conflict between Jubilee partners, Ghana Navy and the fishermen.

CF noted that during preparatory surveys before Jubilee production started, fishermen were employed and they helped the oil companies in conducting their surveys but right after they were all sent home and have not played any role in the operations. He warned ENI Ghana not to repeat this behaviour but should enhance

local content by employing and maintaining indigenes even after surveys. Local goods and services should be used by the company thus boosting the local economy and building a good relationship with the people of the 6 coastal districts

The meeting ended at approximately 1700GMT.

Photo evidence of meeting with Chief fisherman and fishermen of Upper Axim





Attendance sheet of meeting with Chief fisherman and fishermen of Upper Axim

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Fishermen - Axim Upper Meeting location: Axim Upper Date: 6/12/17

No.	Full name	Position	Phone number	Email address	Signature
1	Nana Kwesi Bimp	Abohene Hene	0208187976		
2	Michael Nokoe	Canoe Owner	0208198515	Michael Nokoe @ Yahoo.com	
3	Takyi Mensah	"	0248039427		
4	John Mensah	Fisherman	0275153989		
5	Egya Ebu - Kofi	Canoe Owner	0242255178		
6	Kwelen Mensah	Fisherman	0277664536		
7	Akoolee	"	0209219282		
8	Kwa Pamyin	"	0230206117		
9	Kojo Tanoo	"	0277451145		
10	Kwesi Bosomtwe	Canoe Owner	0207385992		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN AXIM UPPER **Meeting location:** AXIM UPPER **Date:** 6/11/13

No.	Full name	Position	Phone number	Email address	Signature
11	Ekow Yenzoda	Fisherman			
12	Kojo Akwaboa	"	0203150992		
13	Anthony Bentil	ESL	0205769258	—	
14	Ada-Nyarko Andoh	ESL	—	—	
15	Maame Bartels Kwatia	ENI-GHANA	-	—	

GPS Location:

Meeting with Chief Fisherman and Fishermen of Lower Axim

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Lower Axim at Axim
Date of Meeting and Time	8th November 2013 at 0725GMT
Present	See attendance sheet attached
GPS Location	N 04° 51' 53.7'' W 002° 14' 36.4''

The Chief Fisherman (CF) welcomed the ESHIA team. Adu Nyarko of ESL (AN) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

CF stated that the Environmental Protection Agency (EPA) of Ghana are aware of all the likely impacts associated with oil production and would very much appreciate it if the EPA could inform the communities before the oil companies begin their consultations. He was very disappointed that ever since the oil activities begun no government agency has interacted with them to find out their concerns.

CF noted that the oil activities would continue to bring in revenue for the government but would be curse to fishermen. The livelihoods of fishermen have been greatly affected since the inception of the oil business. Most fishermen are considering going out of business since the business is no more lucrative. Fishermen spend so much just to go fishing and encounter harassment by the Ghana Navy, destruction of nets, collision with supply vessels and in addition less catch which is so inadequate to defray the expenses made.

In terms of tourism, whale and dolphin watching is a big business in the western region. The beaching of whales along the shores of the western region has been attributed to the oil activities. Over the past few months over 6 whales had been found dead on the beaches. The situation is killing the whale tourism business which needs to be looked at.

CF again mentioned that the people of Axim have been experiencing strange skin diseases which he thinks is as a result of the flaring of excess gas that is going on at the Jubilee field. He hoped that ENi Ghana would not be flaring gas. He also wanted to find out what ENi Ghana intends to do about oil spill if it occurs. AB responded by saying ENI Ghana would not be flaring any gas and hopefully with

the completion of the Ghana Gas project, all the other flarings will stop. Also Eni would develop an oil contingency plan to handle any oil spill episode.

CF listed a number of remedial actions that both government and oil companies could pursue to improve the lot for fishermen. They are as follows;

- Government and oil companies to subsidize fishing implement
- Government to reduce the cost of premix fuel
- Government should stop the Ghana Navy from harassing the fishermen and return all seized nets
- Oil companies should compensate the fishermen before oil production begins ie cash compensation
- Oil companies should roll out education scholarship purposely for children of fisherfolks
- Employment of community members as well as use of local goods and services will increase the local content in oil & gas development.
- The fishing community of Axim is in dire need of a hospital and would be happy if one is provided.
- All the oil companies should unite in dealing with issues affecting the communities instead of pursing haphazard interests.

Finally the chief fishermen pleaded with the team to report everything that was discussed and send it to the appropriate quarters for redress especially the government. The meeting ended at approximately 0835GMT

Photo evidence of meeting with Chief Fisherman and Fishermen of Lower Axim





Attendance sheet of meeting with Chief Fisherman and Fishermen of Lower Axim

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: FISHERMEN - AXIM LOWER Meeting location: AXIM LOWER Date: 8/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	Nana Kojo Eshun	Chief Fisherman	0244771526	—	
2	Joseph Tandoh	Canoe Owner	0208198707	—	
3	Eggo Terkie Mensah	"	0248039427	—	
4	Kwaku Nyamei	"		—	
5	Kojo Bonsie	"	0242760871	—	
6	Kojo Kargbo	"	0208176528	—	
7	Joseph T Norley	"	0547515798	—	
8	Rosemond Akor	"	0208081884	—	
9	Joseph Arthur	"	0546[illegible]789	—	
10	Alex Nlezer	Bosson	0202387891	—	
11	S. Abaah Tetteh	"	0241646639	—	

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN - AXIM LOWER **Meeting location:** AXIM LOWER **Date:** 8/11/13

No.	Full name	Position	Phone number	Email address	Signature
12	Kojo Mekpasem	Fisherman	0206797091	—	
13	Ebenezer Akor	"	0275283117	—	
14	Kojo Banco	Canoe Owner	0570536547	—	
15	Kojo Tandoh	Fisherman	0277451145	—	
16	Frank Kwao Eshun	Bosson	020[illegible]	—	
17	Anthony Bentil	ESL	0205767758	—	
18	Ashie Nyaho Ankr	ESL	—	—	—
19	Magne Bartels Kr.	ENI - GH	—	—	—

GPS Location:

Meeting with Chief Fisherman and fishermen of Upper Dixcove

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	ENI Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Upper Dixcove at Upper Dixcove
Date of Meeting and Time	2nd November 2103 at 1425GMT
Present	See attendance sheet attached
GPS Location	N 04° 47′ 39.3″ W 001° 56′ 42.1″

The chief fisherman (CF) of Upper Dixcove welcomed the ESHIA team. KK of ENI Ghana introduced the team and explained the purpose for the meeting. AN of ESL gave a brief overview of the proposed OCTP development, impacts identified so far and invited comments and issues to be raised.

The CF mentioned that he has been the chief fisherman of Dixcove for a very long time - since 1987 and has witnessed a lot of economic situation in the country. In view of this he was of the opinion that Ghana is really blessed to find oil in it waters and he hoped this would bring about lots of economic development in the country.

In spite of all the economic benefits, CF reminded us that if not managed properly the oil find would become a curse to the country. He mentioned the issue of oil spill which can destroy the fishing stock, the issue of support vessels/oil tankers discharging of ballast water into our seas can gradually lead to decline in fish/marine life. He suggested the oil companies should make it a ppoint to check for the treatment of ballast water on all the support vessels and or oil tankers they employ. KK informed the CF that ENI Ghana is very serious about oil spills and would do everything possible to prevent an oil spill or leaks.

Frankly the CF informed the team that there has not been any decline in fish harvest as a matter of fact all the various fishing companies in Dixcove have had good harvest from August till date, thus in his opinion the oil production going on has not negatively affected the fish stocks.

CF pointed out that the sea is eroding away their coastline. The government in some year past decide to build a sea defence wall but that project has been stopped for a long time and humbly request that ENI Ghana should take a look at the project and try to complete it. If ENI Ghana can complete the sea defence, it

would save the community from imminent danger and serve as grounds to conduc fish business. KK informed the CF that ENI Ghana had already approached the community to build sheds for the fishermen to use while mending their nets but the unavailability of land has hampered this project, he however promised that his concerns will be delivered to the appropriate authorities.

CF made another request to get the only primary school in the community renovated since the building is in such a deplorable state. He further asked for scholarships for the brilliant children in the community to pursue higher education since in a lot of cases financial problems curtail the educational aspiration of some of these children.

Finally, the CF assured the team that in recent times fishermen from Dixcove had resolved not to go near the FPSO to fish thus new FPSO to be installed by ENI Ghana would be safe from any danger posed by the fishermen.

AN thanked the fishermen and closed the meeting approximately 1500GMT.

Photo evidence of meeting with Chief Fisherman and fishermen of Upper Dixcove



Attendance sheet meeting with Chief Fisherman and fishermen of Upper Dixcove

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: FISHERMEN - DIXCOVE **Meeting location:** DIXCOVE UPPER **Date:** 2/11/13

No.	Full name	Position	Phone number	Email address	Signature
	Nana Kwamina Ackampy	Chief Fisherman	0230736773		
	Glem Ekow	Fishermen			
	Anthony Benton	ESL	0205769158	tbenton@eslglobal.com	
	Joseph N. A. Kenten	ESL	0246400366	nanakwinkonfour@yahoo.co	
	Ackah-Ayeko Ardayfio	ESL	0244855862	a.ardayfio@eslglobal.com	

GPS Location:

Meeting with Chief fisherman and fishermen of Lower Dixcove

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	ENI Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Lower Dixcove at Lower Dixcove
Date of Meeting and Time	2nd November 2013 at 1505GMT
Present	See attendance sheet attached
GPS Location	N 04° 47′ 39.6″ W 001° 56′ 53.0″

The chief fisherman of lower Dixcove welcomed the ESHIA team. KK of ENI Ghana introduced the team and explained the purpose for the meeting. AN of ESL gave a brief overview of the proposed OCTP development, impacts identified so far and invited comments and issues to be raised.

CF acknowledged the fact that the oil find is beneficial to the government since revenue from the development will go a long way to support the government. The oil find has also led to decline in fish catch. The fishermen are of the opinion that light from the FPSO has attracted all the fish to the FPSO thus depriving them of good harvest. They (fishermen) do not have any choice but to follow the fishes to the FPSO so that good catches can be made.

CF praised the team for the consultation and advised that more consultations with fishermen and elders are paramount to the success of the operation since any issue can be trashed out before it escalates.

CF reported the harassment fishermen go through at the hands of Navy personnel and or security offshore when the fishermen unintentionally/intentionally go close to the FPSO. He lamented on the fact that the harassment can lead to death of fishermen. He wanted ENI Ghana to use dialogue to stop fishermen from going close to the FPSO instead of brute force currently met out to them.

CF also wanted ENI Ghana to make it a priority to employ more Ghanaian especially indigenes of the local communities so the petty vices can be curtailed.

Finally, he wants ENI Ghana to try and make any award of educational scholarship as fair, transparent as possible since the current scholarship instituted by The Jubilee Partners is shrouded in biasness, unfairness and as such no child in the Lower Dixcove area had been given any scholarship.

KK reminded the CF to make sure he disseminate this information to all the fishermen under him and if he get any new concern he relay it to the ESHIA team at the contact address given at the back of the BID. The meeting ended at approximately 1545GMT.

Photo evidence of meeting with Chief fisherman and fishermen of Lower Dixcove



Attendance sheet of meeting with Chief fisherman and fishermen of Lower Dixcove

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: fishermen Dixcove Meeting location: Dixcove Lower Date: 2/11/13

No.	Full name	Position	Phone number	Email address	Signature
	Nana Kojo Kra	Chief Fisherman	0261318490		
	[illegible]	Secretary [illegible]	0266511574/0238829930		
	Anthony Benko	ETZ	0205769258	Benko@ashlaw.com	
	Ashu-Ayede Adolfo	ETZ			
	Joseph D. K. Kwatsi	ENI	0546400366	nanakoankwafo@yahoo.com	
	~~Ashu Ayenku~~	ESL	0244235608	a.ackumyaw@yahoo.com	

GPS Location:

Meeting with Chief Fisherman and fishermen of Shama Apo

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	ENI Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Shama-Apo at Shama
Date of Meeting and Time	2nd November 2013 at 1210GMT
Present	See attendance sheet attached
GPS Location	N 05° 00′ 47.5″ W 001° 37′ 50.5″

The chief fisherman (CF) of Shama-Apo welcomed the ESHIA team. KK of ENI Ghana introduced the team and explained the purpose for the meeting. AN of ESL gave a brief overview of the proposed OCTP development, impacts identified so far and invited comments and issues to be raised.

CF thanked the team for the presentation and acknowledged the fact that the oil find in the country has brought in revenue which the government is supposed to use to continue the infrastructural development. He was quick to add that there has not been any consultation between the community and government officials regarding the impacts of the oil but praised the oil firms for continually engaging the communities. In as much as they appreciate the engagement with the community, the oil companies are not fulfilling promises made to them and he made an appeal to the oil companies to fulfil them.

CF then went on to say that even though the oil find is beneficial to the country it has limited the fishing grounds of the fishermen thus leading to low fish catch and this is threatening the fishing business. The safety zone around the FPSO has become a safe haven for the fish but depriving the fishermen of good size fish and preventing the fish from coming close to shore.

CF again made an appeal to the oil companies to fulfil promises made to them. He suggested the development of social amenities and infrastructure for future generations to also benefit. He wanted the hospital at Shama to be rehabilitated and adequately equipped. KK reminded the fishermen that even though ENI Ghana has not started oil production, ENI Ghana has undertaken lots of social interventions in various communities in Ghana especially in the western region. Some of the interventions include CHIP compounds, KVIPs, Boreholes etc.

Finally, the CF thanked the team for coming and reminded the team to deliver all their concerns to the appropriate quarters to be addressed. KK assured them that all concerns and issues raised has been noted and will be delivered. The meeting ended at approximately 1245GMT.

Photo evidence of meeting with Chief Fisherman and fishermen of Shama Apo





Attendance Sheet of meeting with Chief Fisherman and fishermen of Shama Apo

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: FISHERMEN - SHAMA APO Meeting location: SHAMA APO Date: 2/11/13

No.	Full name	Position	Phone number	Email address	Signature
	Nana Kwasi Arhin	Chief Fisherman	0244852918	—	
	Egya (Kwasi Arhin	Elders	—	—	—
	Egya Kofi Ntaho	Elders	—	—	—
	T. K. Apenkah	Elders	—	—	—
	Bartholem	Elders	—	—	—
	Anthony Bentil	ESN	0208769250	bentil@gmail.com	AB
	Ark Ayeh Andzani	ESN	0244855662	a.adunyenko@yahoo.com	AA.
	Joseph D.K. Kantai	ESN	0546480366	nanokonkantour@yahoo.com	

GPS Location:

Meeting with Chief Fisherman and fishermen of Shama Bentsir

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	ENI Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen at Shama-Bentsir at Shama-Bentsir
Date of Meeting and Time	2nd November 2013 at 1130GMT
Present	See attendance sheet
GPS Location	N 05° 00′ 18.8″ W 001° 37′ 50.7″

Kofi Rockson (KR) acted in place of the chief fisherman of Shama-Bentsir welcomed the ESHIA team. KK of ENI Ghana introduced the team and explained the purpose for the meeting. AN of ESL gave a brief overview of the proposed OCTP development, impacts identified so far and invited comments and issues to be raised.

KR was certain the OCTP development would bring economic benefits to the nation but not the fishermen as it has been the case with the Jubilee field development. Promises made by the Jubilee partners have not been fulfilled and the fishermen are not happy about that. The FPSO of the Jubilee partners has attracted lots of fish and thus depriving the fishermen of good catch making the fishing business now very unprofitable.

KR mentioned that in recent times there had been conflicts between fishermen and security personnel/Ghana Navy at the FPSO/rigs. The fishermen do go to the FPSO to fish and are harassed by the security personnel. The fishermen do not have much choice since they can only get good fish near the FPSO.

Some of the fishermen and the community members have received training in small scale business development among other skills but do not have any capital to put them to use and thus the training has become useless.

KR lamented on the fact that the fishermen in Shama-Bentsir lack good leadership and this has resulted in certain fishermen involved in light fishing, extortion in the sale of pre-mix fuel, bribery and corruption.

Chief Bassaw a fisherman noted the economic importance of the oil development but the high cost of living that has become a norm in the western region. The escalating prices of goods and services especially renting a house , a land or

properties has become so expensive that the indigenous people cannot afford and as such are moving out of Takoradi to the outskirts. To help reduce this impact, more locals could be employed in the oil industry so as to earn enough money to afford such properties. Also ENI Ghana should always try and make all dealings with fishermen very transparent and help in subsidizing the cost of fishing implement.

Finally, KR advised the team to continuously meet with fishermen to engage in more consultations and thus understand their plight.
AN thanked the fishermen and closed the meeting at approximately 1200GMT.

Photo evidence of meeting with Chief Fisherman and fishermen of Shama Bentsir



Attendance sheet m**eeting with Chief Fisherman and fishermen of Shama Bentsir**

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: FISHERMEN - SHAMA BENTSIR **Meeting location:** SHAMA BENTSIR **Date:** 2/11/13

No.	Full name	Position	Phone number	Email address	Signature
11	CHIEF BRASSAW	Assistant	0505258291		
	John Kwesi Ewusi	Fisherman	0242346536		
	John Mensah	NIL	0246484089		
	Koti Rockson	Fisherman	0244094913		
	JOSEPH DANIEL	KINGTON			
	Adu Nyanko	ESL	0244853762	a.adunyarko@yahoo.com	
	Anthony Bentil	ESL	0208769258	tbentil@esl.co.za	
	Joseph P K Kanlan	ESL	0548400366	mmakomkomfour@yahoo.com	

GPS Location:

Meeting with the Chief and Elders of Sanzule

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Chief and Elders of Senzule at Senzule
Date of Meeting and Time	7th November 2013 at 1645GMT
Present	See attendance sheet attached
GPS Location	N 04° 57′ 38.3″ W 002° 27′ 18.5″

The Chief through the linguist (Ch) welcomed the ESHIA team. Adu Nyarko Andorful of ESL (AN) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

Ch mentioned that he received an invitation letter from ESL-ENI Ghana requesting to hold a meeting to discuss the OCTP project. The chief and elders had met and deliberated on the project and had written down their comments. The comments were then given to the ESHIA team.

The Ch went on to make the following observation after oil activities had started in the western region,

- Decline in fish catch by fishermen
- Destruction of fishing nets
- Shoreline invasion by sea weeds/green algae
- Tar balls seen on beaches, making the beach unattractive and hindering fishing operations.

He went on to say that all the above issues have had negative effects on the community especially fisherfolk since catch is low thus depriving the fishermen of their livelihood. He wanted to know what ENi Ghana intends to do for fishermen to enhance their livelihood.

Experiences from the operations of Ghana Gas Company had proven that some oil and gas companies do not respect cultural practices. He warned that ENI Ghana should make it a point to always respect the traditions and customs of the people of Senzule for peaceful and smooth operations. He also added that in the event of relocation of inhabitants, adequate compensation package need to be clearly spelt out and all parties agree before any relocation could be done.

An elder spoke about employment. He requested that ENI Ghana should employ some of the inhabitants to undertake not too technical jobs. Ch also added that priority could be given to women in terms of employment and patronizing goods and services.

Ch encouraged ENI Ghana to continue engaging the community members and complete all promised projects made since some of the promises have not been fulfilled. Maame of ENI Ghana responded by saying there are plans to complete most of the projects which includes a solar village, CHIP compounds and KVIPs etc. The meeting ended at approximately 1710GMT.

Photo evidence of meeting with the Chief and Elders of Sanzule





Attendance Sheet meeting with the Chief and Elders of Sanzule

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: CHIEF & ELDERS OF SEKZULE **Meeting location:** SEKZULE PALACE **Date:** 7/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	Nana Asafo Adjei II	CHIEF	0244140422		
2.	Nana Baidoo	Krotohene	0275973569		
3.	Nana Anggms	Safohene	0241692511		
4.	Hymas Hemich	Comm. Sec.	0272549208 0243587974		
5.	Felix Ercach	Omanpanin	—		
6	Paul Nomad	Ass. Sec.	0246908554		
7	Matthew Kwofie	Safohene	0270019916		
8	Ackel Angeka	Safohene	0275078671		
9	Akrama Ahelah	Safohene	0543252433		
10	Faustina Arkoh	Safohene	0576787971		

GPS Location:
11. Adu Nyantu ESL 0244853612 aadunyantu@yahoo.co.
12. Anthony Bentil ESL 0200576928 bentila@yahoo.
13. Maame Berteh EGH

Meeting with Friends of the Nation/CRC

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Friends of the Nation (FoN) and Coastal Resources Center (CRC) at Adiembra, Sekondi.
Date of Meeting and Time	5th November 2013 at 1505GMT
Present	See attendance sheet attached
GPS Location	N 04° 56′ 23.5″ W 001° 43′ 58.8″

Mr Kusi-Ampofu (KA) of FoN welcomed the ESHIA team. Anthony Bentil of ESL (AB) introduced the team and gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

KA made it known to the ESHIA team that FoN/CRC is putting together a paper in response to the questions posed in the BID and also write down their own thoughts on the project. It will be made available to the team as soon as it done.

KA mentioned that most communities within the 6 coastal districts of the Western region are complaining about the health effect of gas flaring occurring at the Jubilee Field. He suggested that ENI Ghana conduct health impact assessment as part of the ESIA.

KA again pointed out the current conflict between fishermen and security apparatus of oil companies operating in the waters of western region. Security personnel are alleged to harass fishermen who go near the FPSO/rigs in search of big fish catch. ENI Ghana should design measures to prevent this occurrence and foster a good relationship with the fishermen.

KA suggested that the oil companies together with Government could declare a marine protected /no go zone area in our marine environment where no oil activities will take place. The aim is to preserve an area of the ocean where organism including fish can grow undisturbed.

KA was of the opinion that the oil activities are causing the death of whales in our waters. Seismic surveys are disorienting the whales leading them to beach and die. Also support vessels are colliding with the whales leading to death. ENI Ghana should ensure that marine mammals are avoided, and made available data on the population and movement of mammals in our waters.

Kyei Yamoah of FoN (KY) made it known that some oil companies undertake social projects in the communities even before operations begin. It is a good practice but on the other hand the projects turn to be tools which the companies use in getting the communities' approval for the project. The communities on the other hand do not rigorously scrutinize the intended development and just give their consent because of some of the social projects the oil company may have already started.

KY also felt the ESHIA process itself need to be reviewed properly as in some of the assessments in previous report were wrong. He gave an example as the minor impact that was associated with impact to fisheries in the Jubilee EIA which has now turn out to be a major impact.

KA advised the ESHIA team to do extensive stakeholder consultations so that all relevant stakeholders are contacted. Experiences with Jubilee EIA showed that not all stakeholders are properly contacted. The constant consultation with fishermen is very key to the success of any oil company thus ENI Ghana should make it a point to engage the fishermen on regular basis. The Fisheries Commission need to be contacted so that modalities for the commissioning of a Fisheries Impact Assessment can be agreed on. Don Mevuta of FoN also said that the consultation process needs to be very comprehensive and in such a way that communities do not think of the process as an economic way out to enrich themselves. He advised ENI Ghana to be very careful with making promises to the communities as the communities will not be pleased if promises are not redeemed.

KY also advised ENI Ghana to be responsible and ethical in their operations thus ensuring that the marine environment is protected. He felt that the management of oil activity is the problem not the oil itself. Finally the cumulative impacts of the oil development need to be addressed in the ESIA.

The meeting ended at approximately 1615GMT.

Attendance Sheet meeting with Friends of the Nation/CRC

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Friends of Nation/CRC Meeting location: Adiembra Date: 5/11/13

No.	Full name	Position	Phone number	Email address	Signature
	Solomon Kofi Ampofo	Project Officer	0244557471	Sampofoefonghana.org	
	Kofi K. Yamoah	N.F. Program Coordinator	0244870220	Kyeriyam@yahoo.com	
	Elisabeth Wagué	Comms. Off.	0540119843	e.wagué@fonghana.org	
	Joseph Mana Kankam	Community Liaison Officer (Ghana)	0546407366	manakankamfourie@yahoo.com	
	D. A. Mensah	F. O. N.	0244520686	info@fonghana.org	
	Anthony Bentil	ESL	0208769058	tbentil@eslghana.com	
	Ackn Nyarko	ESL	0244857862	a.nchunyarko@eslghana.com	

GPS Location:

Meeting with Ricerca e Cooperazione

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	ENI Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Ricerca e Cooperazione, Labone Country Office
Date of Meeting and Time	1st November 2013 at 0925GMT
Present	Dr Gianna Da Re (Project Manager) A K Armah (AK) and Anthony Bentil (AB) of ESL
GPS Location	N 05° 33′ 58.2″ W 000° 10′ 17.8″

Da Re welcome the team to the office, AK then explained the purpose of the meeting. He briefly gave an overview of the OCTP development as captured in the Background Information Document (BID), impacts identified so far and invited comments from RC.

Da Re commended ENI saying the company has a good track record in terms of intergrity, social responsibility and transparency. She had no doubt that the company would succeed in the Ghana.

Da Re noticed from the BID that not much information was given on the impact on health and livelihood of the people. She further noticed that there was nothing on the impacts on archaeological, cultural and historical sites. Even though the OCTP development is a purely offshore business she was of the opinion the coastal areas close to the development would have some impacts in case of oil spill or other hazards. There are lots of archaeological, cultural and historical sites scattered on the west coast of Ghana, thus there is the likelihood of an impact on these sites if a worst case oil spill scenario occurs. She even mentioned that there have been reported cases of tar balls and oil slicks found along some coast/beaches in the western region. Mitigation measures were also not stated in the BID. AK responded that all these concerns will be addressed in the draft ESHIA especially the mitigation measures which are paramount to the completion of the report.

Da Re observed that the BID did not mention the impacts on tourism. She was of the opinion that tourist do come to the west coast for various reason which include, relaxing on fine beaches, visiting archaeological sites, whale watching and turtle watching. There is the likelihood of impact to these tourist activities in terms of wastes, oil spills from the operations offshore, thus impacts on tourism need to be dealt with in the draft ESHIA report. She also suggested that the Ghana Museums

and Monuments Board can also be contacted to throw more light on the impacts to archaeological and cultural sites.

Da Re again mentioned that even though the operation is mainly offshore, there would be an onshore facility such as a base for logistics etc. This means ENI Ghana will be building a structure on land. She noticed looking along the stretch of land from Shama to Half Assini, there has been rampant clearing of vegetation to build onshore bases for some of the oil companies and at the current rate the entire stretch is been littered making the landscape aesthetically not good and at the same time losing ecological significance of the vegetation. She was of the opinion that ENI Ghana can liaise with the relevant government agencies such as the district assembly to clearly demarcate areas for such development so that the springing up of such buildings will be done in an orderly manner and maintaining some visual/aesthetic integrity of the landscape.

On a positive note this new development will make available some new jobs, oil revenue for government will be increased and other positives impacts including social interventions (CHIP compounds, hospital, schools, KVIP, etc.)

Finally, Da Re recommended that government in partnership with the oil companies set up a fund sourced from the oil revenue to improve tourism and maintain our archaeological, cultural and historical sites.

ENI Ghana should adequately show how to manage all wastes associated with their operation.

ENI Ghana in partnership with government agencies such as district assemblies develop and maintain a sound building master plan for the districts such as Spatial planning which was initiated some time ago by the Jubilee Partners.

AK thanked Da Re for the meeting and closed at approximately 1030GMT.

Photo evidence of meeting with Ricerca e Cooperazione



Attendance Sheet meeting with Ricerca e Cooperazione

eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: Ricerca e Cooperazione **Meeting location:** Labadi office **Date:** 1/11/13

No.	Full name	Position	Phone number	Email address	Signature
1	Gauna DA RS	COUNTRY REPRES.	024-4253089	g.dars@ongcs.org	
2	A. K. Armah	ETL			
3.	Tony Benkil	ESL	0208769358	tbenkil@esl.co.uk	

GPS Location:

Meeting with Fishermen of Sanzule

eni ghana	**GHANA OCTP BLOCK Phase 1 Consultation Minutes**	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Sanzule
Date of Meeting and Time	20th March 2014 at 1500GMT
Present	Anthony Bentil (ESL) and Nana Karikari (eni Ghana). See attendance sheet attached
GPS Location	N 04° 53′ 22.0″ W 001° 57′ 34.6″

Nana Karikari (KK) of eni Ghana introduced the team and explained the purpose of the meeting Anthony Bentil of ESL (AB) then gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised. The chief fisherman Mr Baidoo was present at the meeting.

Issues

Joshua Azumah: was of the opinion that currently the seaweed problem is adversely affecting the work of the fishermen and thus their livelihood is going down. With the new development eni Ghana intends to pursue, their livelihood will be affected the more.

He also suggested that eni Ghana should train the youth to equip them to work in the oil industry.

Nicolas Blay: also mentioned the effect of drilling activities on the livelihood of fishermen as fishing grounds will be reduced and depriving the fishermen of good catch.

John K Amarh: eni Ghana should clearly state the kind of benefits the community will enjoy since their activities will affect every aspect of the community. He mentioned that some of the benefits can be in the form of training of the youth in the community to be able to work with eni Ghana, also compensate community members in terms of cash and in employment.

He added that compensation/benefits should be done in a fair manner so that all members benefit not just the elders/heads of the families.

Michael Ahuma: also suggested a monthly allowance (cash) can be giving to all community members. More of the youth in the community should be offered employment.

Francis and Amos Ezuah: Also pointed out the importance of training the youth especially artisans to be able to work with eni Ghana.

Finally, **the Chief fishermen** was glad that eni Ghana intends to pursue this development, he prayed that the development goes on successfully and reminded eni Ghana to always consult with traditional leaders of the community in all matters.

The meeting came to an end at approximately 1610GMT.

Attendance Sheet meeting with Fishermen of Sanzule



eni ghana

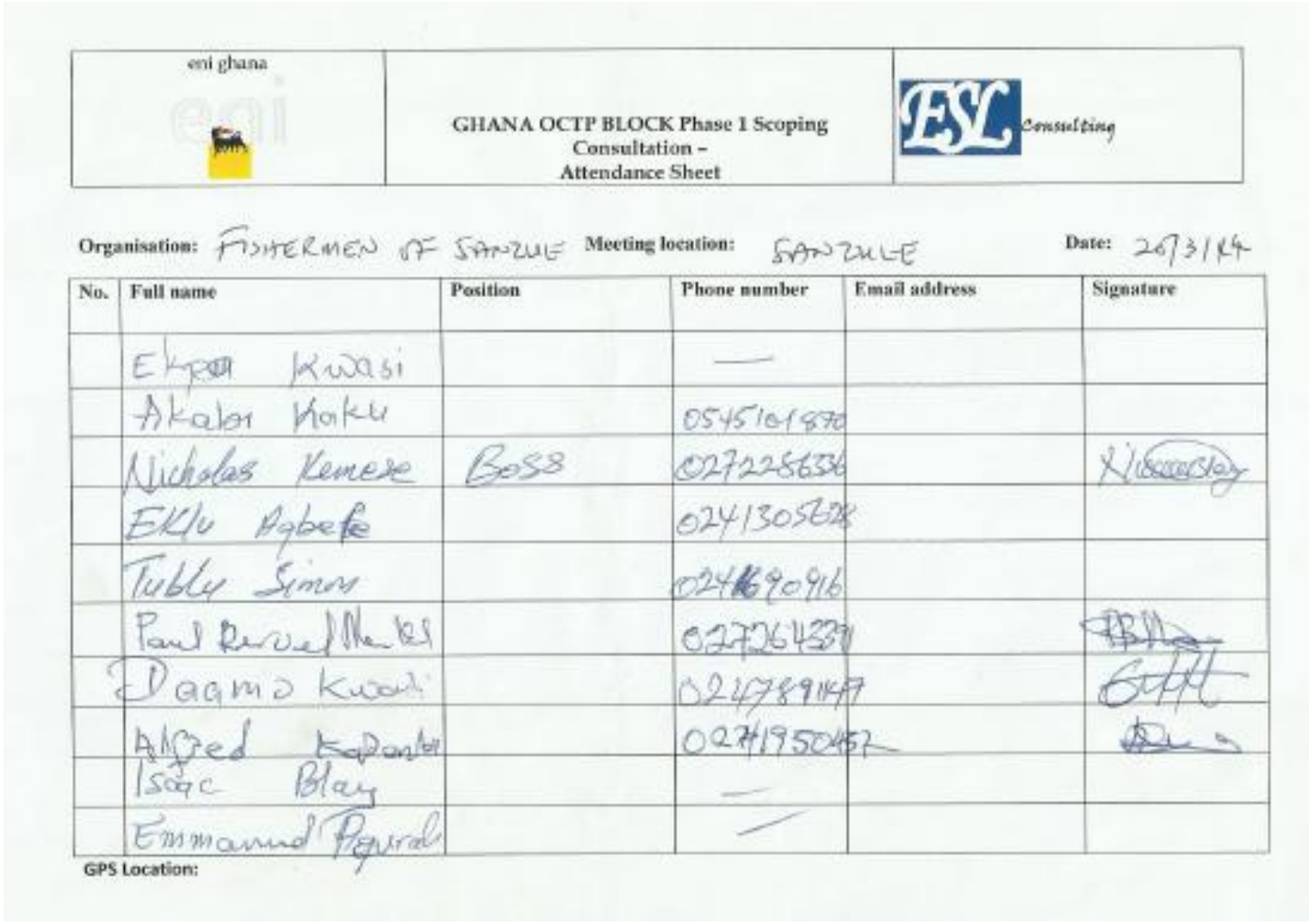
GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: FISHERMEN OF SANZULE Meeting location: SANZULE Date: 20/3/17

No.	Full name	Position	Phone number	Email address	Signature
	ISAAC AKWAH		0272841933		
	Joseph Kwofie				
	Anthony Nanuelh		0279935997		
	Awudadu Nka		0277257482		
	Albert Benson		—		
	Asaa Murua Yaw		—		
	Jacob Nuumo		0275151097		
	Francis Abaaque		0273357063		
	John Enokpa		—		
	Francis Acheaw		0241693088		

GPS Location:



eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF SANZULE **Meeting location:** SANZULE **Date:** 26/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Ekpeki Kwasi		—		
	Akaba Haku		0545161870		
	Nicholas Kemese	Boss	0272258636		
	Eklu Agbefe		0241305628		
	Tubby Simon		0246690916		
	Paul Reuel Nartey		0272643391		
	Dagma Kwadi		0247891447		
	Alfred Kpanta		0271950457		
	Isaac Blay		—		
	Emmanuel Agyirah		/		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF SANZULE **Meeting location:** SANZULE **Date:** 29/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Francis Allah		0273527[illegible]26		
	Paul Kudwo		—		
	Kofi Essuman		✓		
	Ernest Ammoah		0244720242		
	Francis Tayi		0276511083		
	Simon Kwaw		0277741440		
	Benard Tebiq		—		
	Francis Newton		0248054466		
	James Koroah		0241694474		
	Francis Morkeh		0275537045		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF SANZULE **Meeting location:** SANZULE **Date:** 20/3/14

No.	Full name	Position	Phone number	Email address	Signature
1	Francis Kwasi Blay		0247891147		
2	Nicholas Kerma		0273265735		
3	Emmanuel Adeabi		0272848321		
	Michael Ackah		0271796599		
	Joshua Azumah		0236807343		
	Charles Adaye		0201932194		
	John Mensah		0275730935		
	Joshua Blay		0244720242		
	Emmanuel Armah		0272147972		
	Stephen Badu		0540985577		

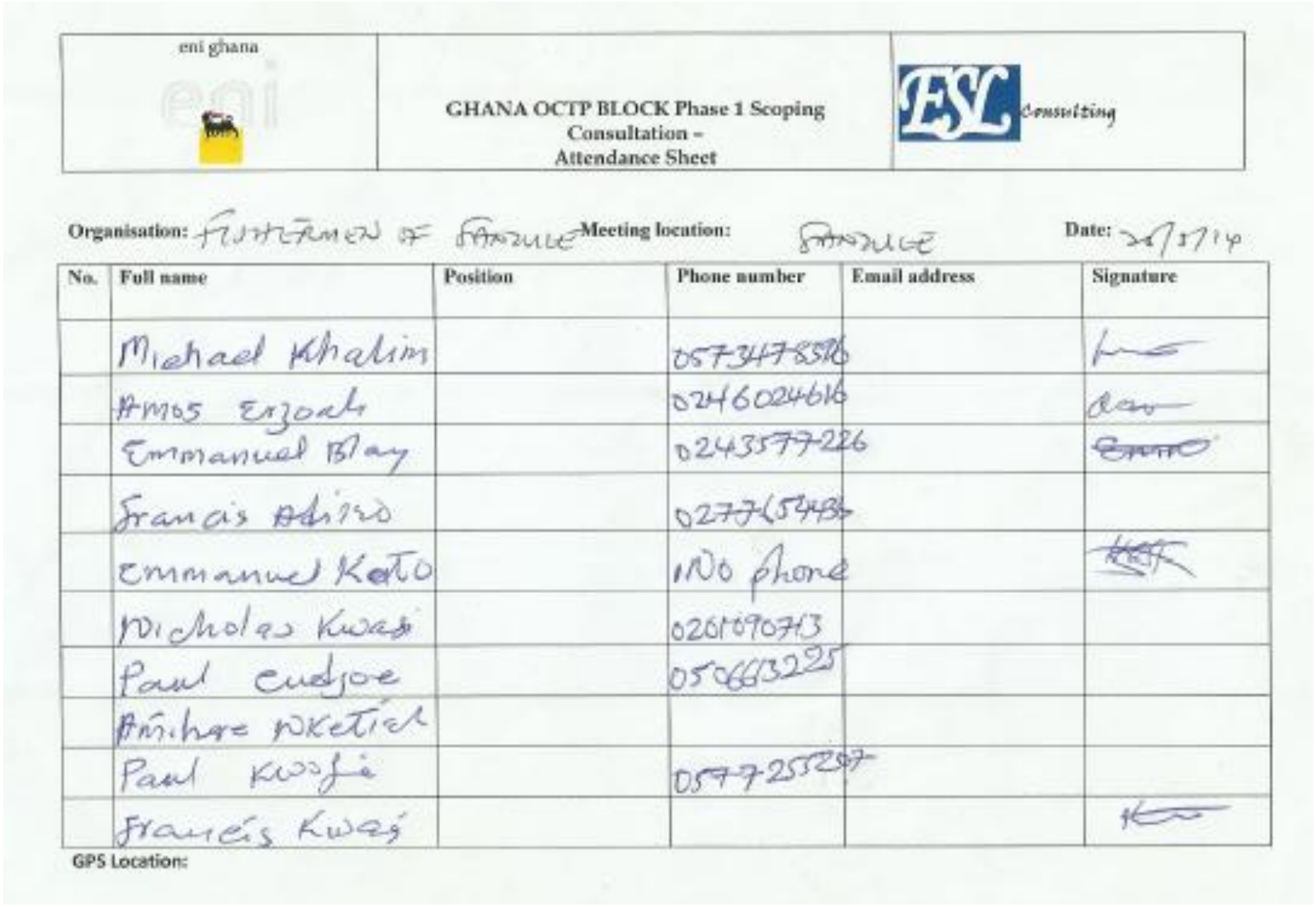
GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF GBAZULE **Meeting location:** GBAZULE **Date:** 20/7/14

No.	Full name	Position	Phone number	Email address	Signature
	Isaac Alu		0542816388		
	Stephen Naclia		057833392		
	Agbetiga Klu		0548938496		
	Emmanuel Homiah		0278969047		
	Fofone Agbekope		0540997466		
	Michael Ehumah		0570329977		
	Kwasi Abekah		0508438419		
	Sie Azumah		—		
	Francis Miezah		/		
	Joseph Miezah		—		

GPS Location:



eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF SANZULE Meeting location: SANZULE Date: 24/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Michael Khalim		0573478516		
	Amos Enjoah		0246024616		
	Emmanuel Blay		0243577226		
	Francis Abiro		0277654		
	Emmanuel Kato		NO phone		
	Nicholas Kwasi		0201090713		
	Paul Cudjoe		0506633225		
	Anthare Nketiah				
	Paul Kwofie		0577255297		
	Francis Kwaa				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF SANZULE **Meeting location:** SANZULE **Date:** 20/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Samuel Agyarko				
	Francis Kansa				
	Dogla Baidoo		0547917235		
	Lawrence Ackah				
	Ebenezer Ackah		0548828555		
	Kaingal Ackah				
	Ekobo Badu				
	Asuo				
	Kanjo				
	Kofie				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF SANZULE **Meeting location:** SANZULE **Date:** 20/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Bernard Kwaasi				
	NKrumah Azumah				
	EDi Azaumah				
	Ebenezer Bekeh				
	Asamadu Kabenla				
	Frank Zowell		0243635522		
	Ebi				
	Patrick Namoah		0573985088	0573985088	
	Akpo Yankey		0272584206	Akpo.	
	Emmanuel Kwaad				

GPS Location:

Meeting with Fishermen and Women of Bakanta

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen and Women of Bakanta at Old Bakanta Palace
Date of Meeting and Time	27th March 2014 at 10450GMT
Present	Anthony Bentil (ESL) and Nana Karikari (eni Ghana). See attendance sheet attached

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Nana Karikari (KK) of eni Ghana introduced the team and explained the purpose of the meeting Anthony Bentil of ESL (AB) then gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised. The Abusua Panyin was present in the absence of the Chief of Old Bakanta.

Issues

Peter Kasie: pointed out the fact that over the years the people of Bakanta do benefit a lot from fishing thus their main source of livelihood. But since this oil business started they are experiencing low catch and this is affecting them immensely. With this new development coming from eni Ghana their livelihood will be serious affected and so eni Ghana should come up with ways to help them.

John Ackah: he was of the opinion that since fishermen are the main group of people to be affected by oil production, eni Ghana should institute a compensation package for the fishermen of Bakanta before they started any work offshore as this would help alleviate their current woes.

McDonald Kwofie: in recent times locals are only employed to do menial jobs such as security, labourer etc in some other companies because they do not have the requisite certificate to do "good" jobs such as engineering, administration etc. He was of the opinon that eni Ghana should begin a scholarship scheme for the local community youth to acquire some knowledge and certificate to be enable them to get good jobs with the oil companies not only with eni Ghana.

KK advise the community to form groups and present a unified concern and needs to eni Ghana, this will make it easier for eni Ghana to identify and support them with their needs.

Peter Kasie: wanted to know where to send their concerns and needs after the groups/unions are formed. KK responded that for now he is always around to receive their concerns but something more permanent will be in place when the main project kicks off.

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	Consulting

Joseph Nahu: In terms of employment some foreign companies operating in the wider area come with their own staff and do not employ the local people. He suggests that eni Ghana should give some employment quota to the youth of Bakanta. KK responded by assuring them that eni Ghana always insists that contractors employ local people if available in executing their jobs but the report eni Ghana had received from thr contractors is that some of the locals employed usually abandon the jobs because the remuneration is not sufficient for them and thus delays the completion of the job. He pleaded with them to desist from such behaviours so as to encourage the contractors to employ them.

Abusua Panyin also mentioned the issue of employment by stressing that equal and fair quota of employment should be allotted to both Sanzule and Bakanta communities as this will promote cordial relationship between eni Ghana and the communities. He also reiterated the issue of compensation for fishermen as a key solution to alleviating their current predicament.

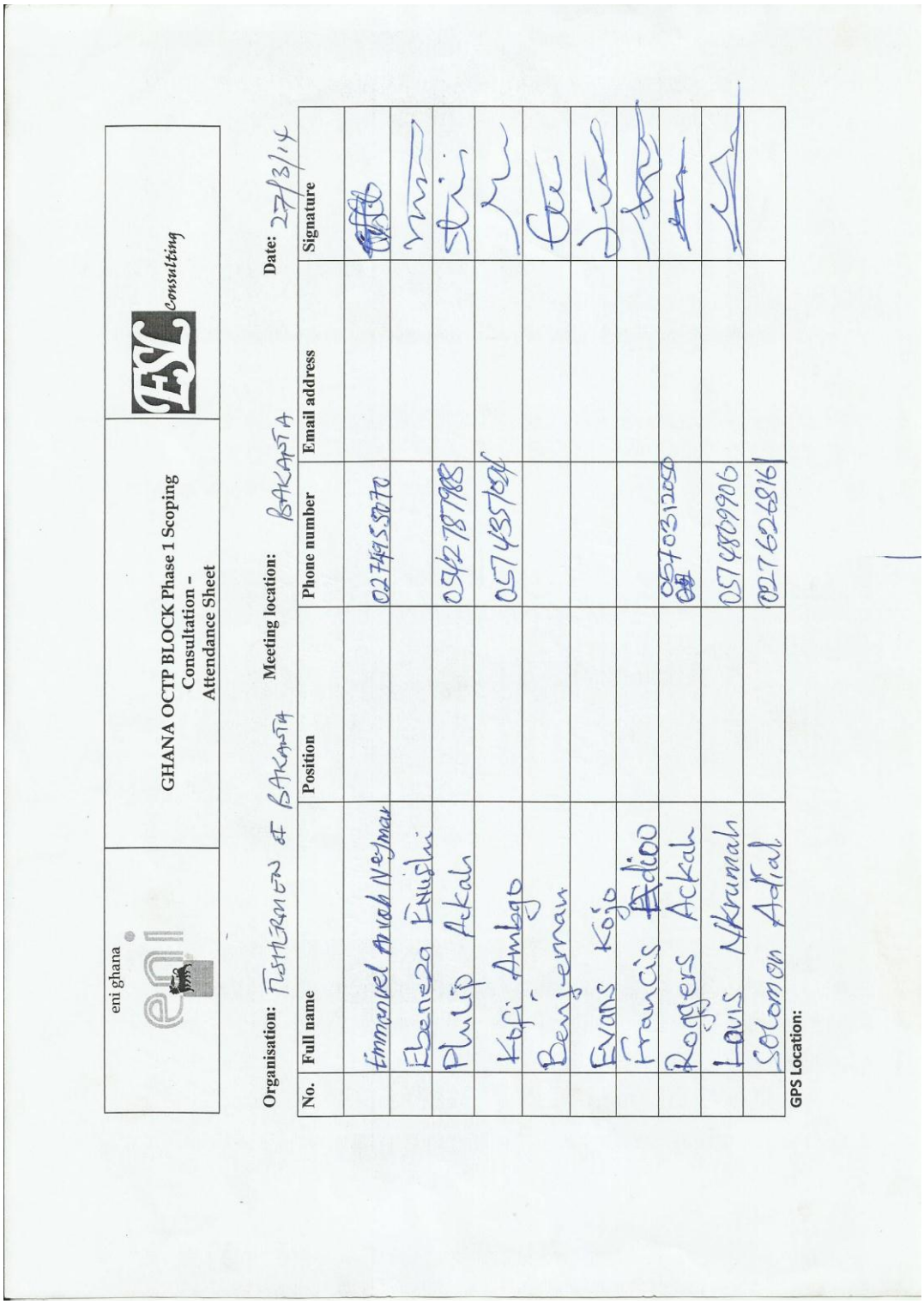
Elizabeth Fodjo also reiterated the hardship faced by fisher folks as it is difficult to pay for the school fees of their children thus is soliciting for support in this regard.

Agnes Atiboah was passionate about eni Ghana helping the women of Bakanta to acquire a "Chokor Smoker" as this will aid them in their work immensely.

Emmanuel Mensah pointed out that in some oil countries such as Libya, Algeria etc the oil companies pay stipend (compensation) to every fishermen on a monthly basis and as such urge eni Ghana to do the same by paying some amount to the fishermen of Bakanta.

AB of ESL thanked the people of Bakanta for their contributions as all what was said will be sent to to the appropriate quarters for redress. The meeting ended at approximately 1155GMT.

Attendance Sheet meeting with Fishermen and Women of Bakanta



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Fishermen of Bakanta Meeting location: Bakanta Date: 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Emmanuel Anah Nejman		0274915.8070		
	Ebenezer Enyshi				
	Philip Ackah		0242787985		
	Kofi Ambago		0574357047		
	Benjeman				
	Evans Kojo				
	Francis Adjoo				
	Rogers Ackah		0540312050		
	Louis Nkrumah		0574809906		
	Solomon Adjei		0276248161		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF BAKANTA **Meeting location:** BAKANTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Stephen Blay		~~024 7975140~~ ~~024 7975140~~		
	Mac-Donald Kwofie		0270220001		
	Joshua Cudjoe		0271120449		
	Emmanuel Arloo		0572645414		
	Emmanuel Menza				
	~~Jon~~ Moses Kwasi		0270033346		
	~~Josh~~ Joseph Kaku		0576467167 ~~0242276589~~		
	Ivan Ackah		0273363969		
	John Ackah		0275568384		
	DAVID CUDJOE		0272148114		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF BAKANTA **Meeting location:** BAKANTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
1	Peter Blay	Fisherman	0276280556		
2	Musa Wakila	✓			
3	Kangah Ayima	✓			
4	Abusi Kpomyle Nii	Boat ✓	0275504732		
5	Paul Boat Nii	✓			
6	Eba Kofi Ashaala	✓	0572121881		
7	Ambrose Blay	✓	0544898193		A. Blay
8	Joseph Erzoah	✓			
9	Erzoah Adoal	✓			
10	Enu Allu Nyameke	✓			

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: TN HOTEL OF BAKANTA **Meeting location:** BAKANTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Richard Arloo		0273835426		
	Dominic Arthur		0516969381		
	MATTHEW ADIMO		0505722193		
	ALEX ANIMAH		0573741681		
	Eric Kenyo		0576178231		
	Patrick Enzogh		0273164145		
	Albert - Icotiy		0576178231		
	Paul T. Mensah		0509446981		
	Isaac Hofiwoda				
	Martin Kwarteng				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF BAKAATA **Meeting location:** BAKAATA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Peter K. Sial		–		
	Francis Nyanzu		0543432072		
	Joseph Kaku		0576467167		
	Albert Kwamo		0272563250		
	Alfred Nyamekye		0543949391 / 0547840		
	Andrews Biney		0548718837		
	Nicholas Blay	NIF	0547880791	www.Exlond.com	
	Simon NNN		0575351348		
	Issac Ackah		os		–
	Emil Nkrumah		0545241542		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF BAKANTIA. **Meeting location:** BAKANTIA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Paul Ndede				
	Stephen Nyonro		0277536[illegible]		
	~~Atek~~ Nicholas		0547106599		
	Francis Kaku		0574804466		
	Ecckeway Tweneboah				
	Robbert Arloo		057-222491		
	Emmanuel Boto				
	Isaac Getoa				
	Alfred Nyameke		0547949391		
	Francis Ezoah				
	Musa wangela				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF BAKANTA **Meeting location:** BAKANTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
11	Kwame Goegany	Fishman	0207036944		
12	James Amo	✓	0278970559		
13	Augustine Ackah	✓	0276456930		
14	Godfred Allu	✓	0275270447		
15	Philip N. Ackah	✓			
16	Steven Blay	✓			
17	Eba Blay	✓			
18	Alluska Adwo	✓			
19	Isaac Gyaty	✓			
20	~~J. K~~ Gyaki	✓			

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: MEN 2 WOMEN BAKANSTA **Meeting location:** BAKANSTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Thomas K. Ezuah	Driver	0547079351	Box 3	
	Eric Abakopi	Driver	0203134367	✓	
	Mavis Ezuah	Seller	0547661010	-	-
	Dorcas Akainan	✓		-	-
	John Kyeiwo		0275645241		
	Cynthia Ebilehudu		0273524129		
	Elizerbeth Edele				
	Azane Avela				
	Portia Senana		0263328466		
	Elizerbeth Kaky				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: WOMEN OF BAKANTA **Meeting location:** BAKANTA **Date:** 24/3/14

No.	Full name	Position	Phone number	Email address	Signature
	ELIZABETH ACKAH				
	JOYCE ARMOOH				
	VIVIAN ERSOAH				
	GEORGINA CUDJOE				
	KAMRA AYA				
	MIEZAH TENA				
	MATILDA NKU				
	ALICE MIAH				
	AGNES ACKNAM		0275650864		
	ELIZABETH CUDJOE				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: WOMEN OF BAKAMTA **Meeting location:** BAKAMTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Elizabeth Arloo				
	KOTO NRALE				
	COMFORT REGINA				
	MARGARET MIAH				
	VICTORIAH ALUTU		0508794920		
	Veronica Miah				
	Comfort Ata				
	Elizabeth Ezoah				
	Mary Kwawo				
	Elizabeth Ackah				
	Patricia Awoyo				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: WOMEN OF BAKANTA **Meeting location:** BAKANTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Rose Nvi				
	Amoh Kwasi Adwo				
	Victoria Nvi				
	Mavis Cudjoe				
	Angate Bomo				
	Faustina Arloo				
	Hliojah Nyankeje				
	Diana K. Cobbina				
	Emelia Erzah				
	Matilda Kenya				
	Faustina cobbina				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: WOMEN OF BAIGANTA **Meeting location:** BAIGANTA **Date:** 27/3/14

No.	Full name	Position	Phone number	Email address	Signature
	ROSE NWI				
	Georgina Somanah			02716*1218	
	REBECCA BLAY-GYAN				
	CYNTHIA ADE			0279300149	
	GLADYS DONKOR H			0273524129	
	REBECCA KWASI				
	AGNES KETIBOAH				
	AGNES ANKYIRAH				
	GLADYS KWOFIE			0509467 17	
	NWIAH NYANOAH				

GPS Location:

Meeting with Women of Sanzule

eni ghana	GHANA OCTP BLOCK Phase 1 Consultation Minutes	ESL Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Women of Sanzule (Sanzule and Ewe town)
Date of Meeting and Time	27th March 2014 at 1500GMT
Present	Anthony Bentil (ESL) and Nana Karikari (eni Ghana). See attendance sheet attached
GPS Location	N 04° 57′ 30.8″ W 002° 27′ 18.5″

Nana Karikari (KK) of eni Ghana introduced the team and explained the purpose of the meeting Anthony Bentil of ESL (AB) then gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

Issues

Veronica Afful: as a fishmonger her livelihood will be affected by the project since the fishermen will not get enough fish for her to process and sell to make money. This sentiment was also expressed by Doris Edey, Christina Cobbold and Cecilia Yankey

Veronica Cudjoe: mentioned the effect of the sea weed on fishing. She said the sea weed get caught up in the net in place of the fish and thus rendering the catch unproductive. She pleaded with eni Ghana to do something about the situation.

KK advise them (women) to form a fish mongering group/cooperative union to make it easier for eni to identify them and to offer any help.

Agnes Yeboah: was of the opinion that since eni Ghana intends to operate in the area, eni should tend to some of their needs such as fish smoking equipment (choker smoker).

Asana Shaibu: also mentioned the need of a cold store to store fish in times of abundant catch.

Mamator a fishmonger from the ewe town of Sanzule also lamented on the decline in fish catch and as such affecting their work. She was of the opinion that with this new development their livelihood will be serious threatened thus eni Ghana should look at easing their current plight.

Esi also a fishmonger from ewetown wanted to what kind of compensation will they have since they are settlers on the Sanzuleland incase they are to vacate their present location.

KK of eni Ghana responded saying that there not been any agreement to relocate anyone and as such they should not worry about relocation but even in the case of such an activity there will be adequate compensation for all affected.

Christy of ewetown also wanted to know whether the new development proposed by eni Ghana would prevent the fishermen from fishing.

AB of ESL responded in the negative saying the fishing activities within the Sanzule area will not be affected since they do beach seining and do not go as far as the oil rigs/FPSO. The only disturbance to the fishing business is when pipe are being laid underneath the sea floor toward onshore but that is only temporal.

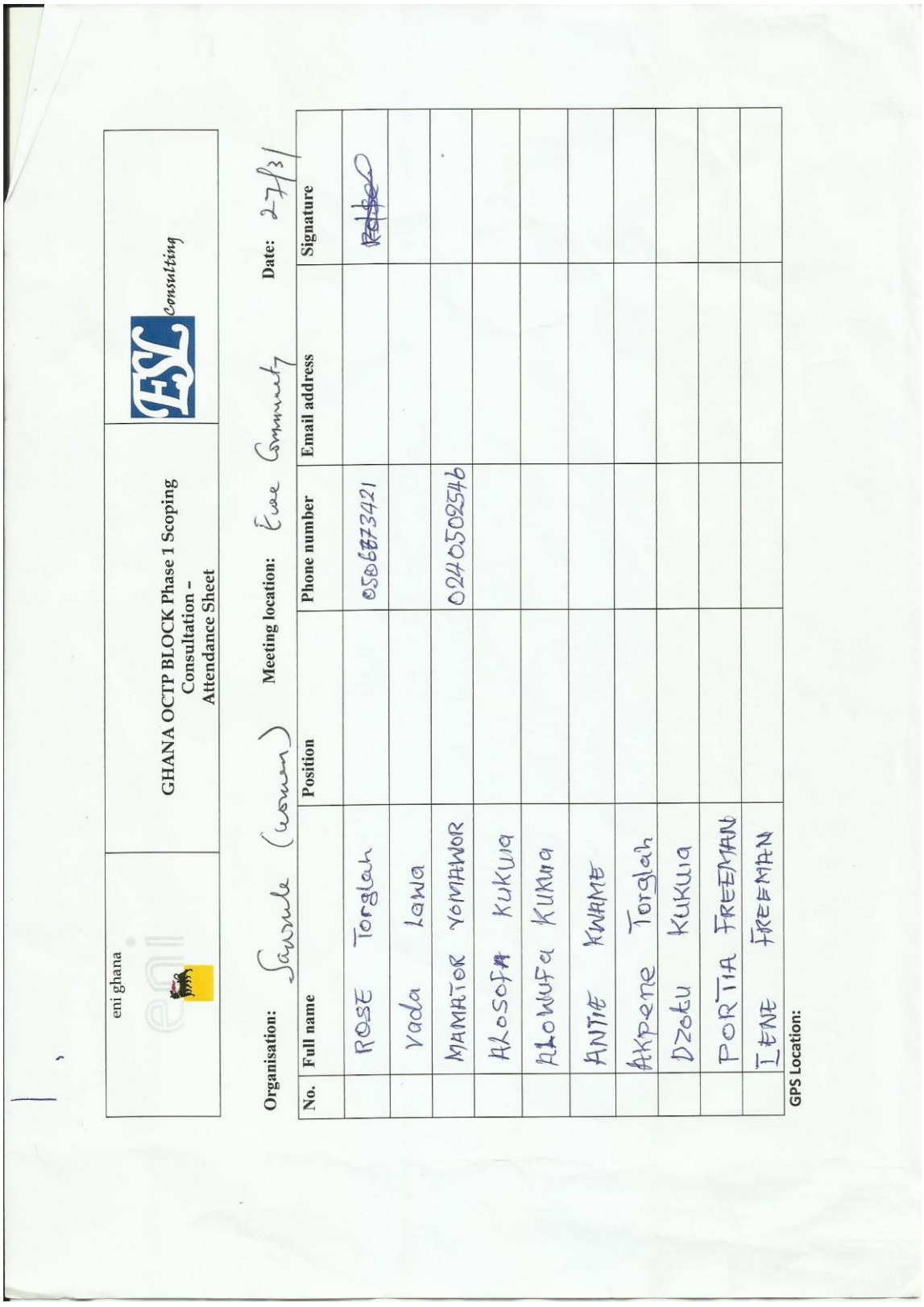
Elizabeth of ewetown also expressed her concern about forming fishmonger unions/groups since they do things individually and cannot come together to smoke fish or sell fish.

KK further explained that what he meant by asking them to form groups is to help eni Ghana to easily identify them and offer help to alleviate their worries. He gave an example that the women of Efasu came together as a group so it was easy for eni Ghana to identify and help them with a number of "Choker smokers" which they are using currently.

Mamator who was satisfied with the explanation given by KK agreed to form the union in anticipation of support from eni Ghana.

Again KK advise them to form a group and present unified needs. The meeting came to an end at approximately 1610GMT.

Attendance Sheet meeting with Women of Ewe Town, Sanzule



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping
Consultation –
Attendance Sheet

ESL Consulting

Organisation: Sanzule (women) Meeting location: Ewe Community Date: 27/3/

No.	Full name	Position	Phone number	Email address	Signature
	ROSE Torglah		0506873421		
	Vada Lawa				
	MAMATOR YAMAWOR		0240502546		
	ALOSOFA KUKUIA				
	ALOWUFA KUKUIA				
	ANTIE KWAME				
	AKPENE Torglah				
	DZOKU KUKUIA				
	PORTIA FREEMAN				
	IENE FREEMAN				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: Squmla (women) **Meeting location:** Esue Community **Date:** 27/3.

No.	Full name	Position	Phone number	Email address	Signature
	AKU KORUWO				
	Janefer Kukuia				
	Josefine Mensah				
	~~ADZO~~ Fiarosah				
	FORGIVE ~~BAKAWO~~				
	ESI ADOGA				
	ELIZABETH ~~WOSAME~~				Elizabeth
	CHRISTINA ~~ATO~~	0	0276065009		~~ATO~~
	ESI ATIENOVOR				
	AKUVI BOZEBO	~~0241111586~~	0241111586		

GPS Location:
EKLU ~~AB~~ Agiba
ESI DAFO
Mamsa henasa

Meeting with Fishermen of Ewe Town, Sanzule

eni ghana	**GHANA OCTP BLOCK Phase 1** **Consultation Minutes**	Consulting

Subject/Ref	Eni Ghana OCTP Block Phase 1: Stakeholder Consultation
Stakeholder and Venue	Fishermen of Ewe town, Sanzule.
Date of Meeting and Time	28th March 2014 at 1030GMT
Present	Anthony Bentil (ESL) and Nana Karikari (eni Ghana). See attendance sheet attached
GPS Location	N 04° 57' 30.8" W 002° 27' 18.5"

Nana Karikari (KK) of eni Ghana introduced the team and explained the purpose of the meeting. Anthony Bentil of ESL (AB) then gave a brief overview of the OCTP project; impacts identified so far and invited comments and issues to be raised.

Issues

The Chief fisherman welcomed the team. He made it known that all they do is fishing and as such knows nothing about oil production and have not experienced any impacts.

Kofi Simon was concerned about the effects of an oil spill on the fish population. He stated that in Nigeria when cases of oil spill occur, all organisms including fishes die and as such the fishermen lose their livelihood, will such a fate happen to fishermen when eni Ghana begins operations?
AB explained that eni Ghana has contingency plans in place to deal with an unlikely event such as an oil spill and that the impacts on the marine organism due to oil spill will be minimized. Eni Ghana will spell out clearly the contingency plan for dealing with oil spills.

Joseph was of the opinion that even though the oil find is a good thing for Ghana and people of Sanzule, in some years to come the population of fishes in the sea decline through the activities of the oil companies such as drilling, rock blasting, oil spills, noise and excess light. In recent times there are lots of sea weeds getting entangled in fishing nets and thus reduces the amount of fish caught. Eni Ghana should look at ways help the fishermen so that their livelihood is not affected negatively by their operations

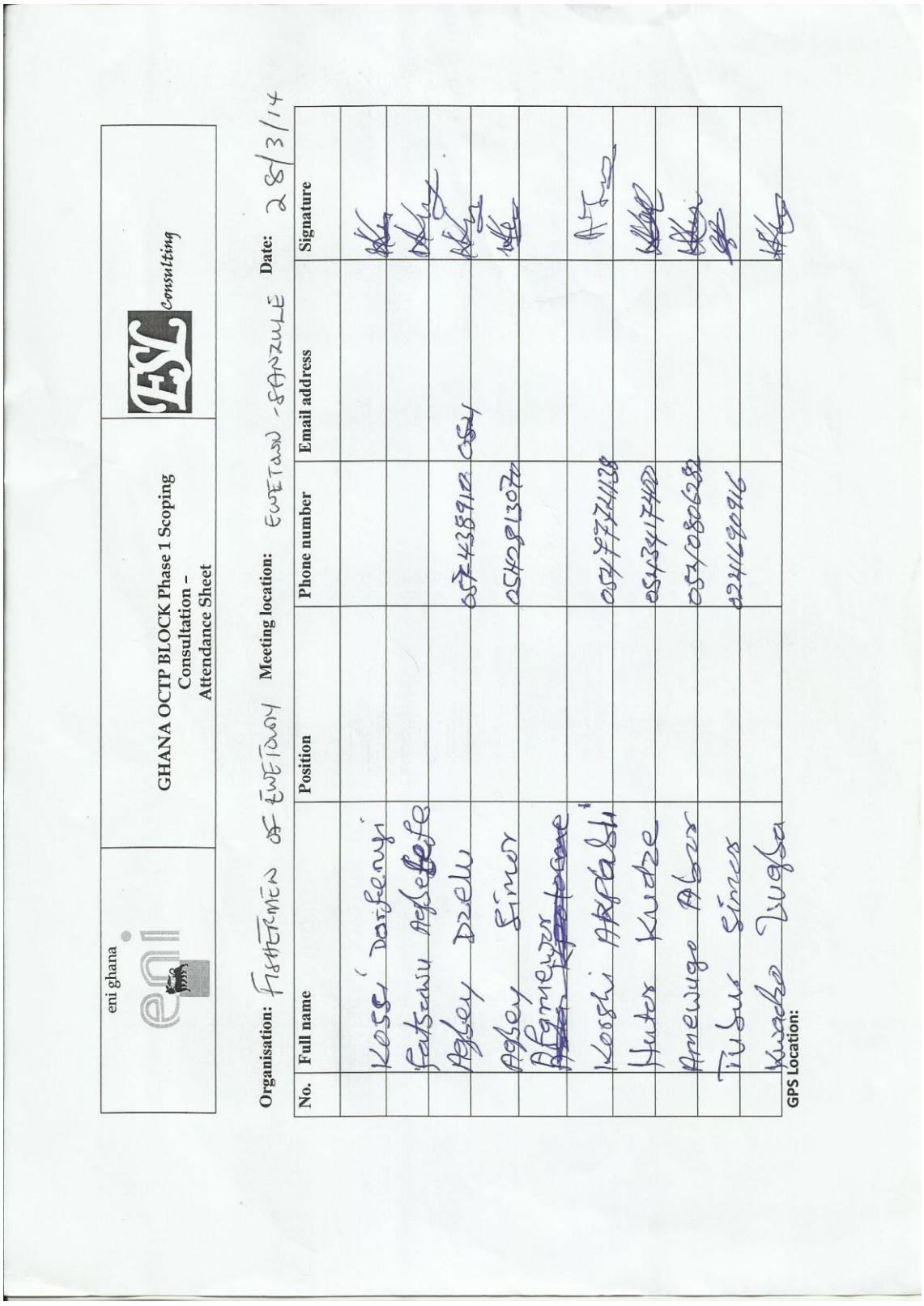
Joseph again mentioned that there have been rumours that they will be relocated from their present location to make way for the gas project. He pleaded that even

if there will be a relocation they should not be moved far inland as it will affect their fishing job since proximity to the shore is critical for their work as fishermen.

KK assured Joseph that there has not been any decision made on where to locate a gas project as such no need to heed to rumours. In the unlikely event of relocation, the appropriate step will be taken to compensate and resettle all affected communities members.

Finally KK advised them to be united and get involved in issues affecting the entire community and not stay away thinking they are migrants. He further pointed out that he was always around in the community and should feel free to contact him at any time with pertinent issues. The meeting ended at approximately 1140GMT.

Attendance Sheet meeting with Fishermen of Ewe Town, Sanzule



eni ghana

GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet

ESL Consulting

Organisation: FISHERMEN OF EWETOWN Meeting location: EWETOWN - SANZULE Date: 28/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Kesse Danfeny				
	Fatsenu Agbefo				
	Agbey Dzelu		0574389120	osy	
	Agbey Simon		0542813077		
	[illegible]				
	Kpashi Akpaki		0547274428		
	Hunter Kudze		0543417400		
	Amenuga Akpor		0540806282		
	Tutu Simon		0244690916		
	Kwaku Dugan				

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF EWETOWN **Meeting location:** EWETOWN, SANZULE **Date:** 28/8/14

No.	Full name	Position	Phone number	Email address	Signature
	Acko Atsu				
	Dzitowoko Akakpo		0240580855		
	Irene Tagbor		0246374567		
	Adotor Normegbor		0544879802		
	Ackor Gachi				
	Kofi Kukwia		0547828023		
	Yefew Tamekla				
	Ashimu Atsu				
	Easter Atsu				
	Xavor Atsu		0240881288		

GPS Location:

eni ghana	GHANA OCTP BLOCK Phase 1 Scoping Consultation – Attendance Sheet	ESL Consulting

Organisation: FISHERMEN OF ELUE TOWN **Meeting location:** ELUETOWN SAMZULE **Date:** 28/3/14

No.	Full name	Position	Phone number	Email address	Signature
	Kalodia Hotor				
	Emmanuel Agbatsiv		0273164227		
	Kwadzo Nyanii		0273653905		
	Stephen Kufughor		0546003420		
	Godfred Doni		0541614081		
	Promis Lachorpo		0545198327		
	Godson Kokodi		0243832605		
	Sievier Ladzekpo		0245399848		
	Jacko Tetley		0248556310		
	Dogbevia Ben		0540738982		

GPS Location:

Photo evidence of meeting with Fishermen of Ewe Town, Sanzule





OTHER DISTRICT LEVEL STAKEHOLDER CONSULTATIONS HELD IN 2012

Consultations Schedule:

Date	District	Location
05/06/2012	Ahanta West	Takoradi
06/06/2012	Jomoro	Half Assini
07/06/2012	Ellembele	Nkroful
08/06/2012	Nzema East	Axim

Discussions held during meetings follow the same basic structure:

1. Project presentation by eni representatives to District Assembly members;
2. Existence of Development Plans in view of ensuring a sustainable alignment between District Development strategies and the eni Project development;
3. Expression of expectations in relation to Project development;
4. Perceptions of Oil & Gas Industry in the District area of influence;
5. Inform the eni team of any sensitive issues in the District area that require specific attention;
6. Request for Environmental, Social and Health (ESH) baseline information relative to the referral District.

eni Ghana partners (shareholders in the OCTP Block Development Project) were involved throughout these District Level consultations, through the presence and participation of representatives for Vitol and Ghana National Gas Company.

Meeting at Ahanta West District Office – 05/06/2012



Meeting at Ahanta West District Office – 05/06/2012

Notes taken during meeting at Ahanta West District Office – 05/06/2012

Meeting begins with a Project presentation to District Assembly members by eni representatives.

Development Plans:

"Strategic Development Planning for Ahanta West District", elaborated in two phases: 2007-2010, 2010-2012. The elaboration of the plan was sponsored by the Korean development agency KOICA. The main development themes contained in the plan are:

- Energy-development in specific ear-marked areas
- Tourism
- Housing and urban planning
- Harbour
- Land-Use (including natural resources).

This development plan shall act as an input to the "Western Corridor" regional development strategy currently being programmed by the National Government. The district development plan acts as a referral document for all parties interested in investing/developing in the District.

Expectations:

In general for the future:

- Tourism development
- Harbour development
- Investment in Takoradi's potential to serve the land-locked areas of the Western region
- Ahanta Techno Valley development
- Polyclinics

Directed at Oil & Gas sector:

- Jobs creation
- Improvement of transport infrastructure
- Sponsorship of schools and other social infrastructure facilities development

Perceptions and Sensitive Issues:

- Oil companies are using land for logistics and are beginning to apply for further land purchases. This event has attracted persons to the area and a need for housing and other facilities has arisen.

ESH Baseline information provided:

- Main economic activities practiced are agriculture, fishing and timber milling.
- Takoradi market on Mondays, Wednesdays and Fridays.
- Government-owned land is usually granted on a 50-year lease to foreigners and a 90-year lease to locals.

Meeting at Jomoro District – 06/06/2012



Meeting at Jomoro District Office – 06/06/2012

Notes taken during meeting at Jomoro District Office – 06/06/2012

Meeting begins with a Project presentation to District Assembly members by eni representatives.

Development Plans:

- No Development Plan documents at present;
- The Western Region Coordinating Council is currently developing a "Western Region Spatial Development Framework"; therefore, given that Regional Plans have authority over District Plans, the Jomoro District Assembly has decided to wait for the finalisation of this regional framework before beginning work on their own development plan
- the assembly expressed availability to integrate/incorporate eni Project land development components into potential District development plans

Expectations (directed at Oil & Gas sector):

- Bring development to the District

- Increase local well-being

Perceptions and Sensitive Issues:

- Appreciation was expressed for the eni Foundation sponsored CHPS programme
- 18.9 ha of land were purchased in Atuabo by GNPC for the development of an oil & gas plant. Local chiefs were involved in the acquisition process. The land was considered adequate as it was an agricultural site no longer in use and situated at an acceptable distance form human settlements

ESH Baseline information provided:

- Main economic activities are:
    - Fishing (c. 139,000 fishermen in the District, open water fishing (small-scale), lagoon fishing is important at Jawai)
    - Tourism (in need of infrastructure, Amanzure is a classic example of eco-tourism)
- Land mainly belongs to the traditional authorities

Meeting at Ellembele District – 07/06/2012



Meeting at Ellembele District Office – 07/06/2012

Notes taken during meeting at Ellembele District Office – 07/06/2012

Meeting begins with a Project presentation to District Assembly members by eni representatives.

Development Plans:

- No District level development plans; direct referral to Regional Plans "Western Region Development Framework" under development
- Spatial development plans along the coastal belt shall soon be available; mapping is being sponsored by Tullow Oil and executed by the South African company Spatial Dimension Ltd.
- The GNPC site in Atuabo for the development of a plant has been ear-marked as an industrial development area
- District expressed availability to align future District development plans and eni Development proposals

- Planning for Water Protection Zones in Amanzuri area; Ghana Wildlife Society are acting as promoters of this initiative
- Plans for treatment of Kambuni River water

Expectations:

- Training of local human resources so that they may be employed in the nascent Ghanaian oil & gas industry
- Capacity building for the local youth
- 'extended funding'; i.e. not only in the areas near the coast potentially directly affected by oil and gas developments but also extend the effects of any compensation(s) to the areas of the North too

Perceptions and Sensitive Issues:

- Absence of a District Hospital
- The District is characterised by high values in school drop-out rates
- Coastal area is considered vulnerable although the District does not currently have specific scientific documentation or studies to back the statement
- Fishing communities have presented complaints regarding waste disposal at sea by oil and gas related operations which undermines fish catch amounts
- Despite low crime rates the District highlighted the worryingly small size of the police force available
- With regards to land acquisition for Project development, the District is open to communities' resettlement post the presentation of a Cost-benefit Analysis
- Any onshore project development components should not be located too close to the coastline; at least 300 m in-land from shore.
- Planning for Water Protection Zones in Amanzuri area; Ghana Wildlife Society are acting as promoters of this initiative
- Water from Kambuni River if treated could be used as safe drinking water

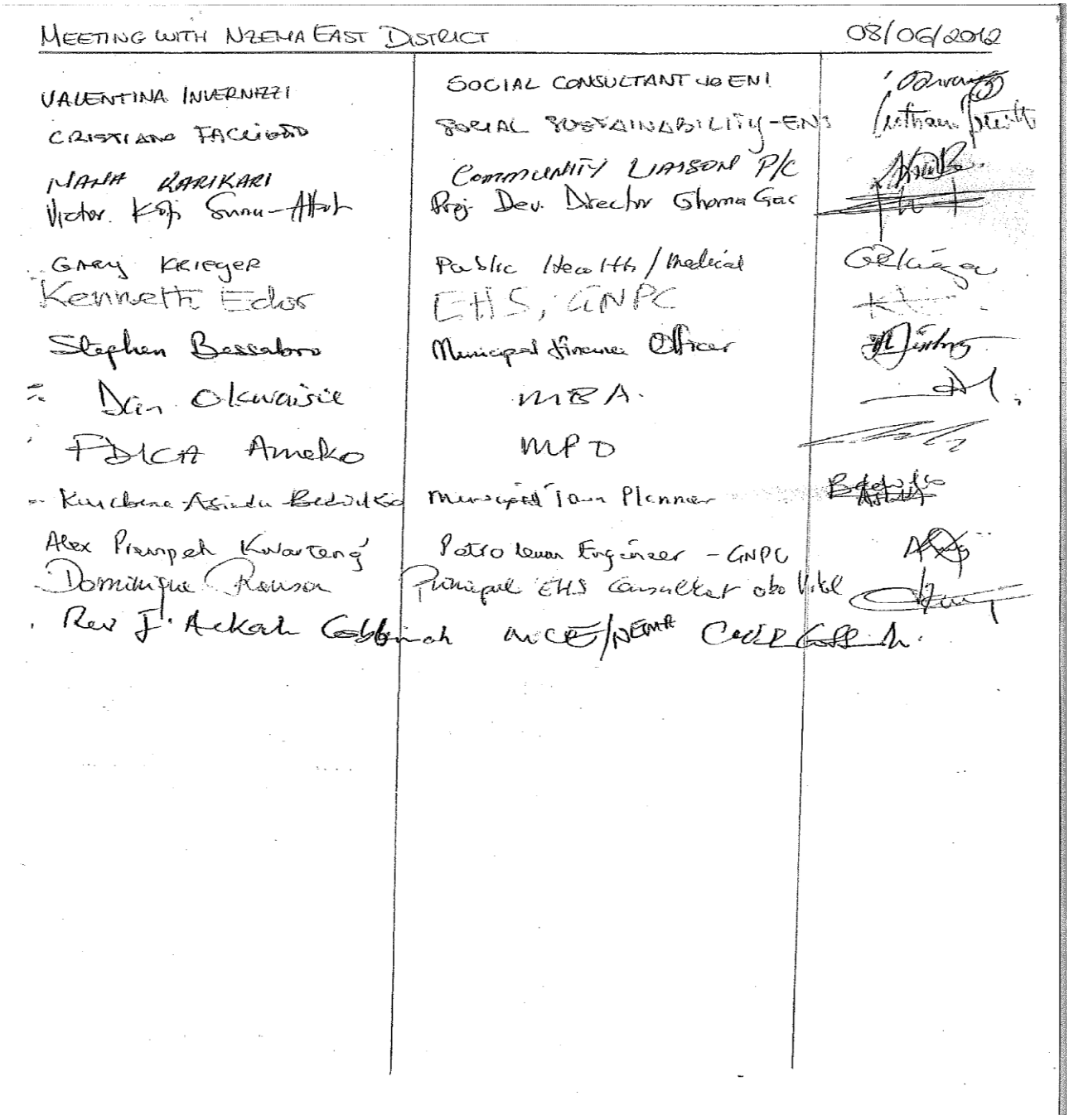
ESH Baseline information provided:

- Ellembele District was created just 4 years ago and can be divided into 3 main areas: North, Central and South.
- District population estimate: 114,000 on the basis of projections on 2000 census data
- A lot of schooling institutions: 2 vocational schools, 2 lesson training institutes, 13 secondary high schools
- No District Hospital
- Northern area of the District is considered the District's food basket
- Overall a safe district with low crime rates

- In coastal areas, land is mainly government owned or classified as family lands
- Land purchase must respect the following hierarchy of consultations and involvement: District Assembly → village chiefs → families

Meeting at Nzema East District – 08/06/2012

Scan of Nzema East District Office Meeting Attendance Sheet



MEETING WITH NZEMA EAST DISTRICT 08/06/2012

VALENTINA INVERNIZZI	SOCIAL CONSULTANT to ENI	
CRISTIANO FACCIOLO	SOCIAL SUSTAINABILITY - ENI	
MAHA KARIKARI	COMMUNITY LIAISON P/C	
Victor Koji Gunu-Attah	Proj Dev. Director Ghana Gas	
Gary Krieger	Public Health / Medical	
Kenneth Ector	EHS, GNPC	
Stephen Bassabee	Municipal Finance Officer	
Dzin Okwansie	MBA.	
PDCA Ameko	MPD	
Kwabena Asiedu Bediako	Municipal Town Planner	
Alex Prempeh Kwarteng	Petroleum Engineer - GNPC	
Dominique Rawson	Principal EHS Consultant obo Vitol	
Rev F. Ackah Gyebiah	ACE/NEMA	



Meeting at Nzema East District Office – 08/06/2012

Notes taken during meeting at Nzema East District Office – 08/06/2012

Meeting begins with a Project presentation to District Assembly members by eni representatives.

Development Plans:

- Area between Isakro junction and Ankobra junction is forecast to become an industrial area
- District expressed availability to align future District development plans and eni Development proposals

Expectations:

- The District is characterised by high bamboo growth; expression of interest in finding support for the development of this industry potential

- Improvement of road accessibility: during the rainy season roads become unusable which constitutes an obstacle in transporting goods to markets (particularly critical in the northern part of the District)
- Improvement of sanitation facilities, especially in rural areas
- Economic growth; there is need to create a market
- Improvement of schooling facilities (pre-school and primary)
- Improvement of water supply

Perceptions and Sensitive Issues:

- Observation on ground water pollution; attributed to mining industry
- Water supply: missing drilling equipment and difficulties in transporting necessary equipment to remote areas given road conditions

ESH Baseline information provided:

- 92,000 population of Axim municipality
- Axim is the only large town in the District
- There are roughly 60 communities in all the District
- Axim has two Paramount Chiefs; one for Upper Axim, one for Lower Axim
- Main economic activities are fishing, farming, in-town commerce of fishing and farming products, artisanal crafts, timbering in the North is sold in Takoradi to saw-milling industry
- Main farming crops are:
    - subsistence farming: cassava, maize and plantain
    - Cash crops: rubber/gum tree (South of District) and cocoa (North of District)
    - Coconut and Palm trees for oil extraction → both industries are in decline
- Land ownership:
    - The Administrator of Stool Lands has registrations of ownership
    - Magistrates of local Courts have power of decision upon any disputes
- Each fishing community has a registered Fishermen Chief
- Hospital facilities:

- Axim District Hospital
- Clinic at Bamiamikor
- Kutukorm Clinic
- Some 6 CHPS compounds

- Water supply: pipe-borne only in Axim town otherwise water is mainly made available through boreholes (however insufficient in number)

ANNEX A4
STAKEHOLDERS' WRITTEN COMMENTS

MINISTRY OF ENERGY AND PETROLEUM

Summary of issues raised:

- Waste Management: is the capacity of Zeal Technologies big enough to handle the current wastes effectively and subsequently, additional wastes from Eni Ghana.
- Air Emission: Eni Ghana should use efficient measures to minimize or prevent air emissions.
- Fishermen: Eni Ghana should design alternative livelihood programs for the fishermen.
- Marine Mammals: Eni Ghana should do a comprehensive study of the fisheries especially marine mammals (species types, population dynamics, seasonal migration patterns etc).
- Exclusive Zone: Eni Ghana should clearly demarcate the exclusive zone around the OCTP field.
- Security issues: Eni Ghana should ensure the safety of vessels coming in and out of the OCTP field.
- Oil spill and Mud spill: what is Eni Ghana's first line of action before an extensive contingency plan is executed.
- Environmental Monitoring: Monitoring programs should be developed to regularly check the status of the marine ecosystem during exploration, drilling and actual operations.
- Standard Operating Protocols: Eni Ghana should make available their Standard Operating Protocols/procedures (SOPs) especially for drilling operations, offloading, maintenance and also operations on the FPSO.

GHANA NATIONAL PETROLEUM CORPORATION (GNPC)

GNPC comments on stakeholder consultation for the Ghana eni Ghana OCTP Phase 1 Development

ENVIRONMENTAL IMPACTS

- Modelling of oil spills potentially resulting from accidental events (i.e. collisions, blowouts, ruptures, loss of containment during offloading from FPSO) should be undertaken
- Atmospheric dispersion modelling of project emissions to air should be undertaken to determine the extent of possible impacts on air quality
- Aquatic dispersion modelling of operational discharges, including drill cuttings discharges and produced water discharges should be conducted.
- An assessment of waste treatment and disposal options for priority waste streams should be conducted on all identified potential wastes identified and also on waste management options chosen to mitigate them.
- A Best Practicable Environmental Option study should be carried out to evaluate options for the treatment and disposal of drill cuttings and all identified operational discharges, considering environmental, financial, health and safety and technical criteria. These should be based on industry guidelines as provided by international bodies such as the International Association of Oil & Gas Producers (OGP) and International Petroleum Industry Environmental Conservation Association (IPIECA).
- A study on the likelihood of collision of support vessels with other fishing vessels should be conducted along with its appropriate mitigation measures. Air/marine operational transportation routes and corridors between the FPSO and Takoradi Port should be determined. These routes and corridors are necessary to avoid or minimise the perceived environmental (and safety) impacts on shoreline communities, collision with other marine vessels, offshore fishing activities, the Amansuri Wetlands and other Gazetted areas and areas of natural conservation interest.
- Increased vessel presence during installation of gas export pipeline that could affect fish populations and indirectly affect artisanal fishing communities reliant on the availability of fish for their livelihood.
- Possible gas leakage that could affect coastal communities directly and indirectly; and creation of employment opportunities and associated indirect economic benefits for local people, especially during installation of gas export pipeline.

SOCIO – ECONOMIC AND HEALTH IMPACTS

STAKEHOLDER ENGAGEMENT

- This should include consultations with health facilities in the coastal towns to acquire factual data on prevalent diseases in such areas.
- For quantitative studies on waste generation in such districts, the appropriate metropolitan assemblies should be consulted.
- Data on fishing methods, gear, fishing locations in the vicinity of the OCTP block, and vessel movement lanes during gas export pipeline installation from Ministry of Fisheries.

SCOPE

The main potential causes of social impacts should cover:
- increased government revenue
- employment and skills development

- procurement of goods and services
- influx of job seekers into the Region
- issues with heightened and unmet expectations
- impacts on commercial shipping
- impacts from onshore bases

REFERENCES

1. EPA GHANA Guidelines for Environmental Assessment and Management in the Offshore Oil and Gas Development
2. Tullow Ghana Limited TEN field EIS
3. Tullow Ghana Limited Jubilee Field EIS
4. Scoping Document for the Preparation of Environmental Impact Statement and Environmental Management Plan for Ghana National Petroleum Corporation Gas Infrastructure Project

GHANA PORTS AND HARBOURS AUTHORITY (GPHA) – WESTERN REGION

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STAKEHOLDER COMMENT SHEET

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If you wish to make any comments, please use this form. Alternatively, please do not hesitate to send an email or write separately.

To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

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Stakeholder Comment Sheet

It would be useful if you could answer the questions below but please feel free to provide any comments you would like to raise. Please continue on additional paper if required.

1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

1- Increased Swip cell
2- Increased revenue from oil related services
3- Increased demand for water supply

2. In your opinion, what are the positive and negative aspects of the proposed project?

1- Pricing of certain services
2- Increased rent
3- Increment Conjestion

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

① Increased operational waste from oil fields- How is this going to be managed in the past

Thank You for Your Participation

Summary of issues raised:

- More revenue for GPHA since ship calls would increase
- The current water supply at the port is woefully inadequate to support the new vessels.
- There is limited port space which is not sufficient to handle additional oil service providers.
- Escalating prices of the cargo storage/ warehouse which are as a result of the oil companies pricing out other commercial ships.
- The issue of discharge of ballast water into the marine environment and introduction of alien species in our ecosystem.
- Influx of foreigners/expatriate workers and its effect on the culture of the indigenes.
- Increase in social vices such as prostitution is now on an increase as well as other crimes.

GHANA MARINE POLICE

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1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

① Provision of necessary logistics to the Marine Police like gadgets, improvement in their fleet etc, Crafts to intensify patrols on the sea to ward off fishermen from going close to the exploration rigs.

2. In your opinion, what are the positive and negative aspects of the proposed project?

① Improve the performance of drilling companies.
② Assist the oil companies to do a better job.
③ Concentration of the oil companies comes with purchasing suspicion which put a drop of challenges on the economy.

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

① Provision of the necessary logistics to fishermen to deter them from going close to the rig.
② Intensify education to the fishermen on the dangers of fishing close to the rig.
③ Government support in the form of loans to the fishermen to help them to do a better fishing work and avoiding the rig.

Thank You for Your Participation

Summary of issues raised:

- Clear demarcation of the safety zone around the FPSO to ward off fishermen
- Subsidize the cost of fishing gears and pre-mix fuel
- Continuous consultation with community members especially fishermen would ensure peace and a successful development.
- Requested that ENI Ghana could help provide logistical support to the Marine Police.

CHIEF AND ELDERS OF SANZULE

ENVIRONMENTAL IMPACT ASSESSMENT
ON
GAS AND OIL EXPLOITATION
AT
SANZULE - WESTERN REGION

1. PRIMARY CONCERN:
The probable threat of resettlement. The community is not ready to accept this unless prior notification is given and all satisfactory negotiations agreed upon.

2. NEGATIVE IMPACT OF THE PROJECT.

ENVIRONMENTAL HAZARDS

Sea:

- Pollution of air and water and its attendant health hazards to humans as well as fish species in the sea.
- Spillage-This will kill a lot of fish stocks.
- Explosion Disaster with grave consequences on humans and fish.

I. Land:

- Reduction of arable lands due to leases. Disposal of domestic and industrial waste that can affect the fertility of the soil and the ecosystem at large.

iii. Other

Possible climate change in the long term- KYOTO Protocol.

ECONOMIC HAZARDS

I. Sea:

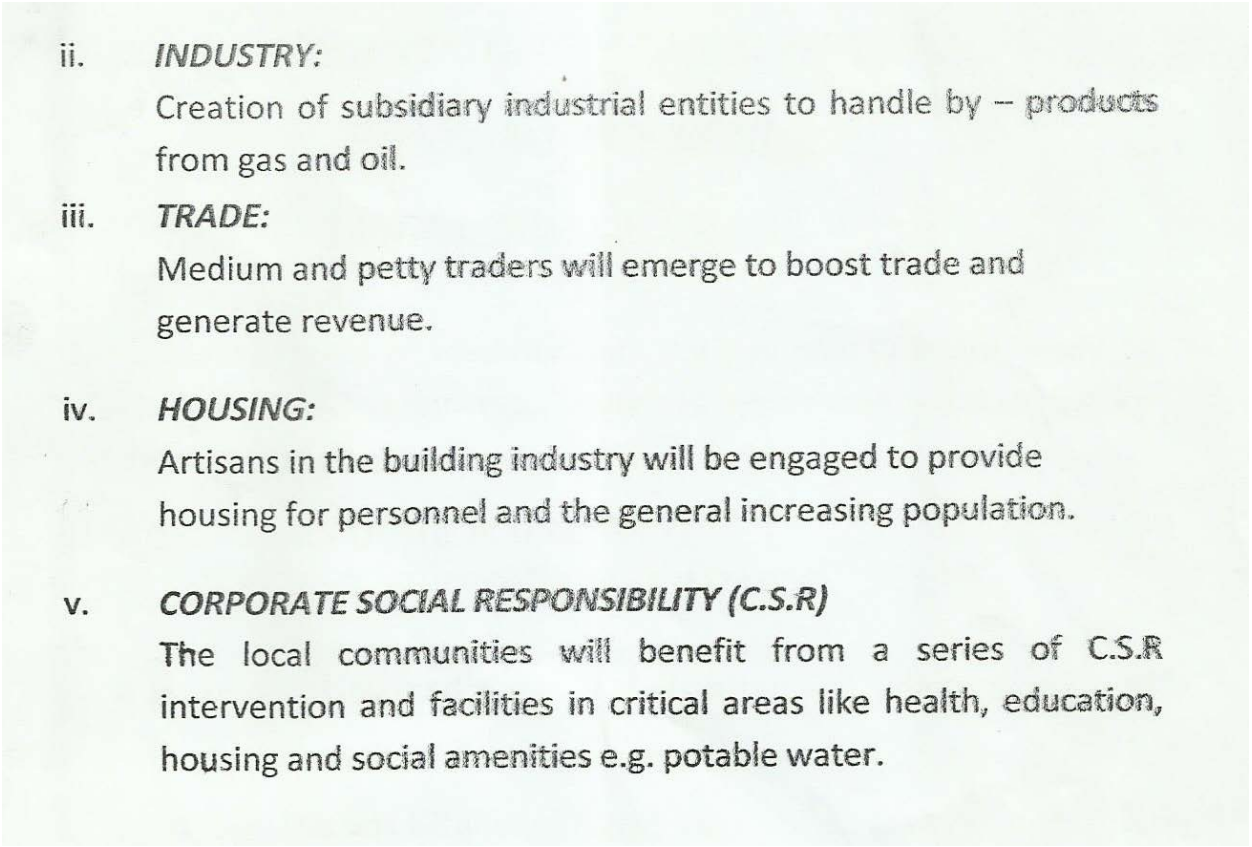
- Dwindling of the fishing industry in the area due to disappearance of fish stocks in the long run.

ii. Land:

- Less farming land coupled with less soil fertility will result in low food production and consequently less income.

3. POSITIVE IMPACT OF THE PROJECT

i. *EMPLOYMENT:*
The project will boost the employment rate especially for the youth in the area.



ii. ***INDUSTRY:***
Creation of subsidiary industrial entities to handle by – products from gas and oil.

iii. ***TRADE:***
Medium and petty traders will emerge to boost trade and generate revenue.

iv. ***HOUSING:***
Artisans in the building industry will be engaged to provide housing for personnel and the general increasing population.

v. ***CORPORATE SOCIAL RESPONSIBILITY (C.S.R)***
The local communities will benefit from a series of C.S.R intervention and facilities in critical areas like health, education, housing and social amenities e.g. potable water.

Summary of issues raised:

- Decline if fish catch due to oil activities
- Destruction of fishing nets by support vessels/oil tanker
- Harassments by Ghana Navy
- Shoreline invasion by sea weed caused by oil activities
- Occurrence of tar balls on the beaches
- Alternative livelihood projects need to be instituted to compensate the fishermen
- Some oil and gas companies do not respect the traditions and culture of local communities in which they operate in, thus Eni Ghana should take note and not repeat the same
- In the event of relocation, Eni Ghana should adequately compensate the community
- Local employment opportunities especially for women

CHIEF FISHERMAN & FISHERMEN OF SEKONDI

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STAKEHOLDER COMMENT SHEET

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To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

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Stakeholder Comment Sheet

It would be useful if you could answer the questions below but please feel free to provide any comments you would like to raise. Please continue on additional paper if required.

1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

Our concern is that our fishing grounds will be reduced.

Subsea materials entangle our nets and shore as a result of oil exploration. Eventually the entangled nets get destroyed.

2. In your opinion, what are the positive and negative aspects of the proposed project?

Positive impact is that production of gas will reduce the cost of power generation, bring about industrialization and eventually employment for the populace.
Negatively, it will limit our expedition around that area thus reduce our catch.

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

The company should try as much as possible to prevent spillage so as not to affect the community. They must subsidize fishing inputs ie nets, outboard motors etc for the fishermen

Thank You for Your Participation

Summary of issues raised:

- Issues and concerns expressed by fishermen during previous consultations have not been addressed.
- No compensation have been giving to fishermen since the oil activities begun
- Oil companies and government need to fulfil promises made to them.
- Eni Ghana could subsidize fishing gears and pre-mix fuel for fishermen
- Employment opportunities for local fishermen.
- Pair trawling problem faced by fishermen as well as selling of bycatch cheaply to market women.
- The oil companies (Eni Ghana) should help support the government in the implementation and enforcement of the fisheries regulations to preserve the fishing industry.
- Transparency in the award of scholarships and other benefits
- Eni Ghana should investigate the cause of the green algae outbreak that turn to hamper beach seining during certain times of the year.
- Eni Ghana should clearly demarcate the safety zone around the FPSO with moored buoys/reflectors so that fishermen can see and stay off the zone.
- Eni Ghana should do everything possible to prevent oil spills/leaks.

NZEMA YOUTH ASSOCIATION

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To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

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1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

Our primary concerns are that most often those of us who live in close proximity to these oil wells do not have access to the jobs they provide and it would be very beneficial to us if the opening like field workers would be published locally so we can have access.

2. In your opinion, what are the positive and negative aspects of the proposed project?

In our opinion harnessing our oil would bring in the needed revenue to fuel our economy and if oil companies should abide by layed down principles the positives would outweigh the negative.

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

We have been conducting EIA's but what about fisheries impact accessment Our hospitals are very ill equiped to the extent that if there should be a disaster they would not be able to cope.

Thank You for Your Participation

JOMORO DISTRICT ASSEMBLY

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To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

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1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

1. ~~Constituency~~ where projects are sited
1. Districts where projects are sited seem to be recognised better than communities lying in adjoining Districts but are affected by the projects environmentally.
2. Alternative source of livelihood
3. Marginalisation of host communities.
4. Restriction of Marine fishing areas.

2. In your opinion, what are the positive and negative aspects of the proposed project?

Positives: 1. Open up the area ② Improved infrastructure
3. Open up other opportunities

Negatives: Segregation; Marginalisation; Pressure on existing infrastructure; Increased social vices;

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

1. Encroachment of precious community lands;
2. Land litigation
3. Increased tension and unwarranted suspicions
4. Encroachment of wetlands
5. Cultural shocks and other vices
6. Youth restiveness
7. Increased in cost of living
8. Alternative livelihood for fisherfolks.
9. Restriction of Marine fishing areas
10. Pollution & Spillages

Thank You for Your Participation

Summary of issues raised:

- Recommendations in previous EIA done for Jubilee production has not been adhered to and now the host communities are disadvantaged, fishermen are suffering and benefits are not getting to the right people.
- Uncoordinated approach to executing CSR projects in the districts by the Jubilee Partners.
- Eni Ghana should merge their CSR activities to fit into the developmental goals/plans of the district.
- Cumulative effect of the now two FPSO on fishing grounds and fishing in general
- Why are oil companies reluctant to send community members to the rigs/FPSO?
- Eni Ghana needs to have a Fisheries Impact Assessment done as it is stipulated in the Fisheries Act 625.
- Eni Ghana should not to just put up CHIP compounds but furnish and equip the place.
- Eni Ghana should pursue alternative livelihood projects to make the lives of fishermen including fishmongers better such as aquaculture in the Abby lagoon and microfinance schemes for fishmongers and market women.
- Eni Ghana could begin climate change adaptation programmes as part of its CSR activities.
- The need for extensive consultation before any project is started.

SHAMA DISTRICT ASSEMBLY

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To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

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1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

Oil spillage
Ship lekages
Sea weeds
Fish spices dying
Barakading of the area reducing fishing area
fleeing of species

2. In your opinion, what are the positive and negative aspects of the proposed project?

Hope the project brings employment
Community intervention or support

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

The drilling of wells affecting the chemistry of the water there by causing the dying of fish species

Thank You for Your Participation

Summary of issues raised:

- Oil find will increase revenue to the government which will in turn use it to develop social infrastructure.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish
- Eni Ghana should consider alternative livelihood for the fishermen
- Eni Ghana's preparedness to handle an oil spill
- The issue of Ballast water discharge at sea would be important with more support vessels/oil tanker vessels.
- Flaring of excess gas is occurring at the Jubilee field, is Eni Ghana also going to flare excess gas.
- There will be an increase in vessel traffic as more support vessels would use our waters thus can result in accidents, ship grounding/wrecking.
- Extensive consultations need to be done especially with local community members and fishermen
- Eni Ghana to establish scholarship schemes for children of fishermen.
- Employment of local community members will go a long way to foster cordial relationship between oil companies and communities.
- Eni Ghana to establish an oil and gas training facility at an affordable fee and or offer scholarships to student to receive training at the already existing facility at Takoradi Polytechnic.
- Build the capacity of fishermen in oil and gas activities since fishermen are the first point of contact in the event of an accident.
- ENI Ghana to incorporate a periodic health check programme into their CSR programmes.
- Incorporate CSR projects in District Assembly's development plan.

SHAMA DISTRICT ASSEMBLY – PLANNING DEPARTMENT

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OCTP : Oil Project
Background Information Document (B.I.D)

STAKEHOLDER COMMENT SHEET

You are invited to participate in the E(SH)IA process and to raise any issues and concerns you may have about the proposed project.

Your comments are a key part of the assessment process and it is important that ENI E&P Ghana Limited understands your support or concerns so that they can be responded to and assessed through the E(SH)IA process.

If you wish to make any comments, please use this form. Alternatively, please do not hesitate to send an email or write separately.

To be kept informed throughout the E(SH)IA process please register as an Interested and Affected Party. To register, please send this form or provide your details to the addresses given below.

Name: Eugene Nyansafo

Organization: SDA, Physical Planning Dept.

Position: Dist. Town Plg. Officer

Address: P. O. Box 37 Shama

Telephone:

Cell Phone: 0203568526

Email: nyansafo2007@gmail.com

Please post or fax or email this form to the following address:

ESL Consulting Limited

Tel: +233-302-683206/514614
Email:tbentil@eslghana.com/
info@eslghana.com

Address: ESL Consulting Ltd,
P.O. Box LG 239
Legon, Ghana

eni Ghana Exploration and Production Limited
Contact: Mr. Juan Deffis

Tel: +233-302 761 790 ext 227
Email:
juan.Deffis@enighana.eni.com

Address: 1st Floor Una Home Building, No.12 Airport Bypass Airport City. PMB KA 185 Accra, Ghana

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OCTP : Oil Project
Background Information Document (B.I.D)

Stakeholder Comment Sheet

It would be useful if you could answer the questions below but please feel free to provide any comments you would like to raise. Please continue on additional paper if required.

1. What are the primary concerns and or benefits faced by you/your community/your organization with regards to this development?

* The issue of oil spillage or any form of pollution to the marine environment that would affect livelihood of fishermen and the marine ecosystem as a whole
* Probable employment opportunities for qualified youth

2. In your opinion, what are the positive and negative aspects of the proposed project?

* Contribution to the national income, and employment and corporate social Responsibility projects in the coastal districts
* Reduction of fishing area for fishermen and possible adverse impacts on the marine ecosystem

3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

→ Socio-economic data on Shama District
→ Shoreline categorisation of Shama District

Thank You for Your Participation

NZEMA EAST DISTRICT ASSEMBLY

Summary of issues raised:

- Deterioration of roads within the district by the constant usage of heavy duty vehicles
- Oil activities affecting livelihood of fishermen also harassment by the Ghana Navy
- In the event of the incompletion of the Ghana Gas project, would the excess gas be flared?
- Alternative livelihood projects for fishermen such as aquaculture.
- How would Eni Ghana handle an oil spill when it occurs?
- The number of whales dying in recent times has increased and attributed to oil activities, Eni Ghana should in collaboration with a research institution investigate the cause.
- Continuous consultation with District Assembly in the implementation of any project in the community is paramount to it success.
- Incorporate CSR projects in District Assembly's development plan.

AHANTA WEST DISTRICT ASSEMBLY

Summary of issues raised:

- Specific impacts on environment such as disease to human need to be stated in BID
- Negative impact of oil activities affecting fish catch and livelihood of fishermen
- Consultations should be extended to community members.
- BID did not state impacts on health, socioeconomics and cultural but only on marine environment
- Oil activities causing an increase in social vices and high cost living
- Eni Ghana should always engage district assembly in all activities in the communities
- CSR projects should be aligned with development goats of the district assemblies
- Preparedness of Eni to handle oil spill if it occurs and also effective ways of disposing off wastes generated offshore
- Cumulative impacts of all oil activities need to be addressed in ESHIS
- Local Content need to be improved by the use of local goods and services and also employment of locals.

ELLEMBELLE DISTRICT ASSEMBLY

Summary of issues raised:

- Alternative livelihood projects need to set up to compensate fishermen
- Eni Ghana should commission a scientific investigation into the deaths of whales.
- Public transparency in royalty payment
- Employment opportunities of locals. Quota can be given to district assembly to select best youth for such jobs
- Training schemes for the youth of the communities to be able to work in the oil industry
- Community sensitization programme aimed at educating the community to be receptive to alternative livelihood projects such as aquaculture, snail rearing, piggery etc
- Allocation of CSR programmes to dealt to HIV/AIDS situation in the district
- Measures to handle an oil spill and also offshore wastes need ot be stated in the EHSIS
- Climate change adaption programmes can also be included in Eni CSR programmes
- Request to upgrade district hospital

SEKONDI-TAKORADI MUNICIPAL ASSEMBLY

Summary of issues raised:

- Preparedness of Eni Ghana to handle wastes generated offshore.
- The standard of facilities and level of operation of ZEAL technologies to handle offshore wastes
- The safety and protection of the coastline , marine life and fishermen livelihood is of much concern to STMA
- Eni Ghana should handle their operation in such a manner to prevent conflict with local community members
- Eni Ghana should investigate the cause of whales dying.
- Manage high expectation of people to prevent agitation.
- Eni Ghana could support the agriculture sector to produce foodstuff to be used on the rigs/FPSO
- Eni Ghana should merge their CSR projects into the development plans of STMA so that the genuine needs of the people at large are met.
- The adequacy of Eni Ghana's health care system to handle health impacts on workers and community members.

- Capacity building on oil and gas activities for district assembly members.

CHIEF FISHERMAN AND FISHERMEN OF UPPER AXIM

Summary of issues raised:

- Promises made by the Jubilee partners and recommendations made during the Jubilee EIA have not been implemented.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.
- Conflicts between fishermen and security personnel/Ghana Navy at the FPSO/rigs.
- NO government official (Petroleum Commission, Ministry of Energy, EPA, GNPC etc) had consulted with the fishermen. Government need to consult with fishermen to know their plight and act to make their lives better.
- Subsidies on fishing gears and pre-mix fuel to make lives of fishermen comfortable
- No transparency in the award of benefits such as scholarships
- There is NO physical demarcation around the FPSO to prompt fishermen when they go beyond bounds. Eni Ghana should clearly demarcate the safety zone around the FPSO with moored buoys/reflectors so that fishermen can see and stay off the zone.
- Eni Ghana should enhance local content by employing local community members, also local goods and services should be used by the company thus boosting the local economy.

CHIEF FISHERMAN AND FISHERMEN OF UPPER DIXCOVE

Summary of issues raised:

- Ghana is really blessed to find oil in its waters and he hoped this would bring about lots of economic development in the country.
- The issue of an oil spill occurring was raised and can destroy the fishing stock.
- The issue of support vessels/oil tankers discharging of ballast water into our seas. If not checked can gradually lead to decline in fish/marine life
- Request for Eni Ghana to compete a sea defence wall which was started some years back to prevent the town from eroding off.
- Another request was made to get the only primary school in the community renovated since the building is in such a deplorable state.
- Institute a scholarship scheme for brilliant children of fishermen to pursue higher education.

CHIEF FISHERMAN AND FISHERMEN OF SHAMA APO

- The oil find will increase government revenue to continue infrastructural development.
- There has NOT been any consultation between the community and government officials (EPA, Petroleum Commission, GNPC) regarding the impacts of the oil.
- Oil companies particular Jubilee partners have not fulfilled promises made to fishermen and not implemented recommendations made during the Jubilee EIA.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.
- An appeal was made for the wanted the hospital at Shama to be rehabilitated and adequately equipped.

CHIEF FISHERMAN AND FISHERMEN OF SHAMA BENTSIR

Summary of issues raised:

- The OCTP development would bring economic benefits to the nation but not the fishermen as it has been the case with the Jubilee field development.
- Promises made by the Jubilee partners and recommendations made during the Jubilee EIA have not been implemented.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.
- Conflicts between fishermen and security personnel/Ghana Navy at the FPSO/rigs.
- High cost of living in recent times attributed to the oil find
- Employment of local community members in the oil and gas activities
- Dealings with fishermen should be made transparent as much as possible
- Eni Ghana should help subsidize cost of fishing gears and premix fuel.

CHIEF FISHERMAN AND FISHERMEN OF HALF ASSINI

Summary of issues raised:

- Promises, pledge and recommendations from Jubilee ESIS to make the lives of fishermen comfortable have not be fulfilled so fishermen are now in extreme hardship
- Decline in fish catch due to attraction of fish to the light on FPSO.
- Flaring gas causing skin diseases and other health issues
- Harassments by Ghana Navy
- Destruction of fishing nets by supply/support vessels

- Support vessels colliding with fishing canoes leading to death of fishermen
- Occurrance of green algae/grass along the shores hindering fishing.
- Request for clinic to cater of only fisherfolks and or a health insurance scheme for fisherfolks
- Build schools for the children and awards scholarship to children of fisherfolks,
- Subsidizing fishing implements including pre-mix fuel.
- Provide credit facilities to fishermen and
- Providing an alternative livelihood support for the fisherfolk
- Benefits due to fishermen should be given directly to the chief fisherman in a public presentation since benefits given to fishermen over the years did not get to the intended target.

CHIEF FISHERMAN AND FISHERMEN OF LOWER AXIM

Summary of issues raised:

- EPA of Ghana should educate fishermen on the impacts of oil activities on their livelihood
- Ever since the oil activities begun no government agency including EPA, Petroleum Commission etc has interacted with them to find out their concerns, which is very bad
- The livelihoods of fishermen have been greatly affected since the inception of the oil business. Fishermen spend so much just to go fishing and encounter harassment by the Ghana Navy, destruction of nets, collision with supply vessels and in addition less catch which is so inadequate to defray the expenses made.
- Death of whales is negatively affecting the whale watching tourism in the region.
- Flaring of gases from the Jubilee causing skin disease
- Eni Ghana should have an oil spill contingency plan to deal with any oil spill
- Government and oil companies to subsidize fishing implement
- Government to reduce the cost of premix fuel
- Government should stop the Ghana Navy from harassing the fishermen and return all seized nets
- Oil companies should compensate the fishermen before oil production begins i.e., cash compensation
- Oil companies should roll out education scholarship purposely for children of fisherfolks
- Employment of community members as well as use of local goods and services will enhance the local content of the development.

- The fishing community of Axim is in dying need of a hospital and would be happy if one is provided.
- All the oil companies should unite in dealing with issues affecting the communities instead of pursing haphazard interests.

CHIEF FISHERMAN AND FISHERMEN OF LOWER DIXCOVE

Summary of issues raised:

- The oil find is beneficial to the government since revenue from the development will go a long way to support the government but not fishermen
- Light on the FPSO attract fishes thus depriving the fishermen of adequate catch.
- Harassment of fishermen by the Ghana Navy.
- Employment opportunities for community members
- Eni Ghana should ensure transparency in the award of education scholarship or any other social venture.

GHANA MARITIME AUTHORITY

Summary of issues raised:

- Eni Ghana should obtain permit for GMA for the FPSO and any support vessel
- Three (3) main concerns are Marine Pollution, Safety at sea including occupational safety and Maritime Security.
- In terms of marine pollution, ballast water discharge and garbage disposal as well as other water emissions including anti-fouling chemicals, domestic waste are also of concern to the GMA.
- In terms of safety at sea, GMA will be much more concerned about the sea worthiness of the support vessels and the FPSO. Also hazards from fishermen to navigation.
- Air emissions as a result of operations should be addressed well so as to minimize its impact on workers on the FPSO or rigs and also on marine birds.
- In terms of marine security, Capt. stated that GMA is concern about issues relating with piracy, armed robbery at sea, illegal bunkering, narcotic trafficking and terrorism.

ENVIRONMENTAL PROTECTION AGENCY – WESTERN REGION

Summary of issues raised:

- Complete assessment of all tourist/beach business such as hotel, resort etc need to be done
- Fisheries impact Assessment (FIA) which is a legal requirement for the Fisheries Commission of Ghana need to be done.
- Eni Ghana should have a comprehensive health baseline data collection done.
- A comprehensive socio-cultural baseline data is also needed
- Baseline data is also needed on the Road transport System in the region
- The adequacy/efficiency of waste management firms to handle offshore waste need to be verified before contracts is giving out.
- Flagging of wells. Eni Ghana should ensure that unproductive wells are properly sealed to prevent future leakages.
- Oil spill contingency plans including modelling need to be done.
- Increase in vessel traffic in our waters would put pressure on GPHA, Eni Ghana should show how the situation would be managed.
- Eni Ghana should use floaters/buoys to clearly demarcate the extent of the safety zone around the FPSO.
- Eni Ghana should always get a chemical clearance certificate for EPA before any chemical is brought into the country
- The ESHIS should include a well laid out decommission plan
- Eni Ghana should provide in the ESHIS information about the composition of the produced water, the toxicology done on the water and all information pertaining to hydro testing.
- Eni Ghana should have a local district/community liaison representative in all the 6 districts.
- Consultation evidence should include videos
- Eni Ghana should show how cumulative impacts of their operations and other operations in Ghana would be dealt with in the ESHIS.
- Local content policy should be taken serious, thus the use of local personnel, goods and services should be paramount in the operations
- Eni Ghana should apply recognised international procedure or standards when dealing with service providers and or contractors.
- ESHIS should provide for security issues such as sabotage, terrorism, armed robbery, piracy etc.

FISHERIES COMMISSION – WESTERN REGION

Summary of issues raised:

- The main concern of Fisheries Commission is that Eni Ghana should submit a Fisheries Impact Assessment (FIA) which is legally stipulated in the Fisheries ACT 625.
- Harassment of fishermen by Ghana Navy
- Demarcation of safety zone around the FPSO/rigs
- ENI Ghana should actively engage with the fishermen and design social interventions to ease their predicaments.
- Increasing cases of support vessels colliding with fishing canoes, how would Eni Ghana help curb the situation
- Request for logistical support and training for the Fisheries Commission
- Eni Ghana should conduct an investigation into why the whales are dying.

FRIENDS OF THE NATION/CRC

Summary of issues raised:

- Suggested that ENI Ghana conduct a health impact assessment as part of the ESIA.
- Conflict between fishermen and (Ghana navy) security apparatus of oil companies operating in the waters of western region.
- ENI Ghana should design measures to prevent this occurrence and foster a good relationship with the fishermen.
- Suggested that the oil companies together with Government could declare a marine protected /no go zone area in our marine environment where no oil activities will take place.
- Death of whales, ENI Ghana should ensure that marine mammals are avoided, and make available data on the population and movement of the mammals in our waters.
- Oil companies use social projects to gain community approval of projects
- The ESHIA process itself need to be reviewed properly as in some of the assessments in previous report were wrong.
- An extensive stakeholder consultations need to be done so that all relevant stakeholders are contacted especially fishermen along the 6 coastal districts.
- A Fisheries impact Assessment needs to be done, thus contact Fisheries Commission for the modalities.
- ENI Ghana needs to be very careful with making promises to the communities as the communities will not be pleased if promises are not redeemed.
- The cumulative impacts of the oil development need to be addressed in the ESIA.

RICERCA E COOPERAZIONE

Summary of issues raised:

- No information was giving on impacts on health, livelihood of the people, archeological, cultural and historical sites
- Eni Ghana should mention how to handle a worst case oil spill which can destroy a lot of these archeological, cultural and historical sites scattered on the west coast of Ghana.
- Impacts to tourism should also be dealt with
- The rampant clearing of vegetation to build onshore bases for some oil companies is making the landscape aesthetically poor at the same time losing ecological significance of the vegetation.
- Positively, more jobs will be created, revenue to government will increase and communities will get social projects (CHIP compounds, hospital, schools, KVIP, etc).
- Government in partnership with the oil companies should set up a fund sourced from the oil revenue to improve tourism and maintain our archaeological, cultural and historical sites.
- No disposal of waste at sea thus effective management of offshore waste is critical.
- Eni Ghana in partnership with government agencies such as district assemblies should develop and maintain a sound building/development master plan for the districts.

Ghana OCTP Block Phase 1 ESHIA

Attachment B

B.1 Additional Biophysical Baseline Data

B. 2 Baseline Reports and Results

ABSTRACT

This Annex provides a detailed description of the baseline reports for the E(SH)IA and the methodology adopted for the E(SH)IA of the Ghana OCTP Block Phase 1 Development Project.

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ANNEX B1: BIOPHYSICAL BASELINE DATA

1.1 GEOPHYSICAL AND ENVIRONMENTAL SURVEY

The environmental baseline survey was conducted along the intrafield flowlines of the proposed OCTP offshore site of Sanzule, Ghana. The survey was conducted to determine the physico-chemical and biological status of the seabed and water column prior to development.

Geophysical Survey

The survey (Phase 1) comprised acquisition of a suite of geophysical data via an AUV (Autonomous Underwater Vehicle) to provide regional acoustic characterization of seabed and sub-seabed conditions to inform the selection of infield pipe routes. Analysis of AUV data was supported by a range of reference information, largely supplied by ENI, and a limited amount of geological and geotechnical data. The survey area comprised an irregular 29 km by 23 km study area, covering 630 km2, ranging in depth from 82 m (to the north) to 1390 m (to the south-west).

In the paragraph 4.4 the results will be explained as Bathymetry, Seabed features in continental shelf and slope, seabed feature as manmade features, seabed sediments and shallow geology of continental shelf and slope.

Environmental Survey

The environmental survey comprised acquisition of seabed grab samples, water column profiles and water column samples. Sampling stations largely coincided with geotechnical survey locations. The total number of stations was pre-determined as 13 (12 for sediment sampling, three for water sampling). Stations were located along the flowline corridors with equal spacing for site coverage. The locations of all sampling stations are presented in Figure 1. Environmental Sampling Locations

Benthic samples were obtained using a 0.1 m2 dual van Veen grab at 12 stations. Three samples were collected at each station, two for macrofaunal analysis (FA and FB) and one sub-sampled for physico-chemical analysis (PC). Water sampling (WS) and profiling (WP) was undertaken at three stations, including two of the 12 stations sampled for macrofauna / PC, as well as at an additional station. Water samples were collected at three depths; the first at 1 m, the second at 100 m and the third at 200 m. Sampling locations are provided in Annex B2.

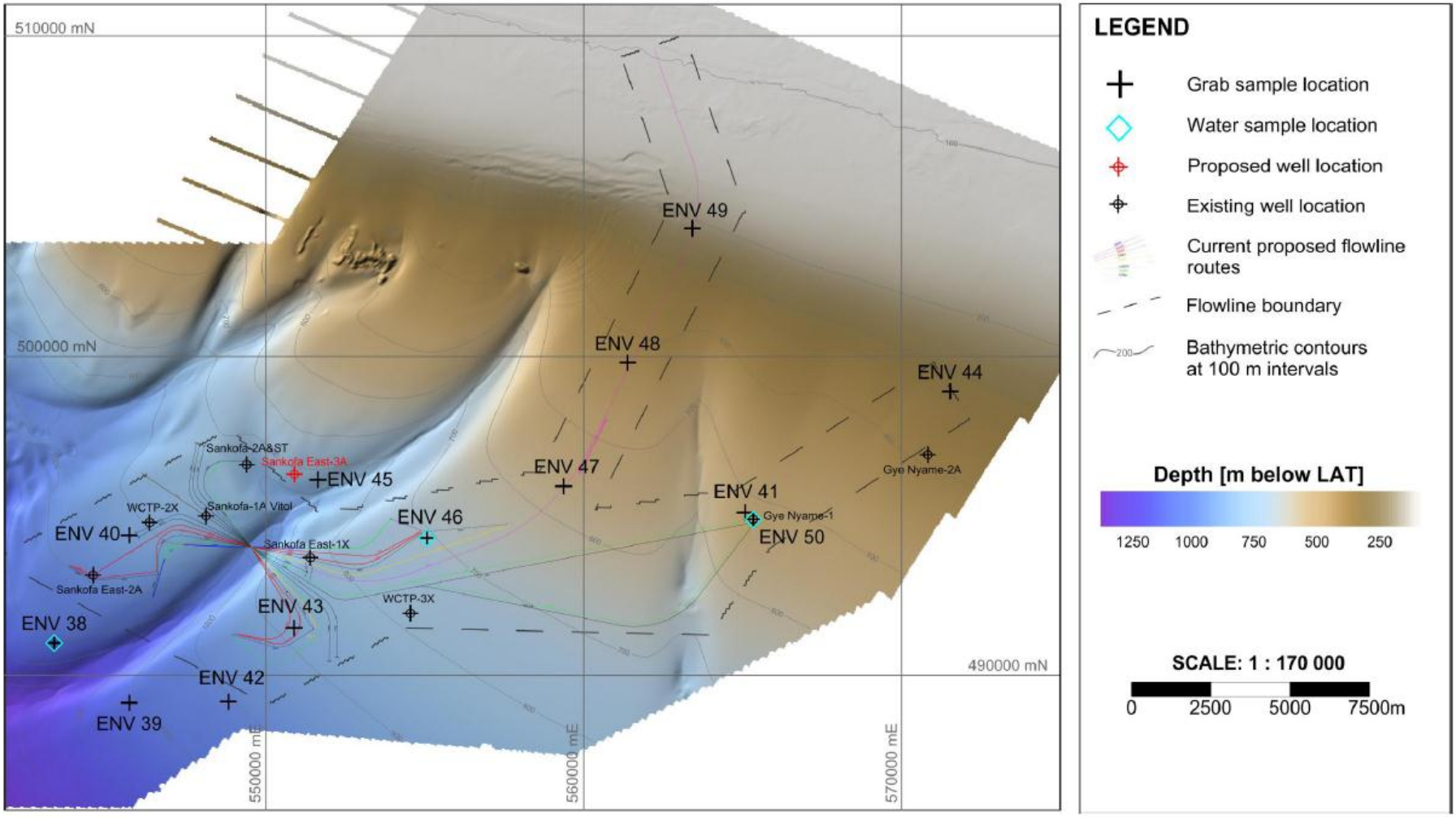


Figure 1 Seabed bathymetry showing environmental sampling locations in the wells area

The following paragraphs will explain the results of environmental survey carried out between 24 and 27 April 2013 by Fugro.

The results data for each environmental component will be compare, where possible, to the nearby EBS survey carried out by TDI-Brooks International in 2008 (TDI Brooks, 2008). This data is summarized in the Environmental Impact Assessment (EIA) for the Jubilee Field, prepared by Environmental Resources Management (ERM) and Tullow Ghana Limited (ERM, 2009).

Results from this survey will be referenced throughout the report as TDI Brooks (2008).

Furthermore secondary baseline analysis data will also be compared, where possible, to Environmental Baseline results summarized in the Environmental Impact Assessment (EIA) for the Jubilee Field, prepared by Environmental Resources Management (ERM) and Tullow Ghana Limited (ERM, 2009).

In particular considering sediment and water results of the current survey, they will be compare, where possible, to the results from the Phase 2 and 4 study although differences in water depths are considered when drawing comparisons (see Annex B1). In addition, comparisons will also made with data from a previous environmental survey carried out in 2009 as part of the EAF Nansen project (a joint effort between the Ghana Environmental Protection Agency (EPA), University of Ghana, University of Cape Coast, Survey Department, Marine Fisheries Research Division and Tullow Oil) (EAF Nansen, 2010).

Results from this survey will be referenced throughout the report as EAF Nansen (2010).

Sampling stations in the EAF Nansen (2010) survey ranged from 28 m to 1300 m, however only data from stations at similar depths to those surveyed in the current survey, i.e. 250 m to 1300 m, were used for comparative purposes. This included data from the following EAF Nansen survey stations: GE4, GE5, GE6, GW4, GW5, GW6, GP4, GP5, J7-1, J7-2, J7-3 and J7-4 (refer to Annex B2). Analytical methodologies between this previous survey and the current survey were assessed and generally were thought to be comparable.

Considering benthic data results reported in TDI Brooks (2008), only benthic stations in water depths ranging from 942.5 m to 1264.3 m at the Jubilee Field have been selected for benthic comparative purposes (Stations EBS001, EBS002, EBS004, EBS006 and EBS007) (see Annex B1). Figure 2 illustrates the different sampling positions of benthic water stations off the coast of Ghana recorded in the TDI Brooks Report.

In general the discussion will be organized considering each environmental component and for each one the comparison among secondary and primary data.

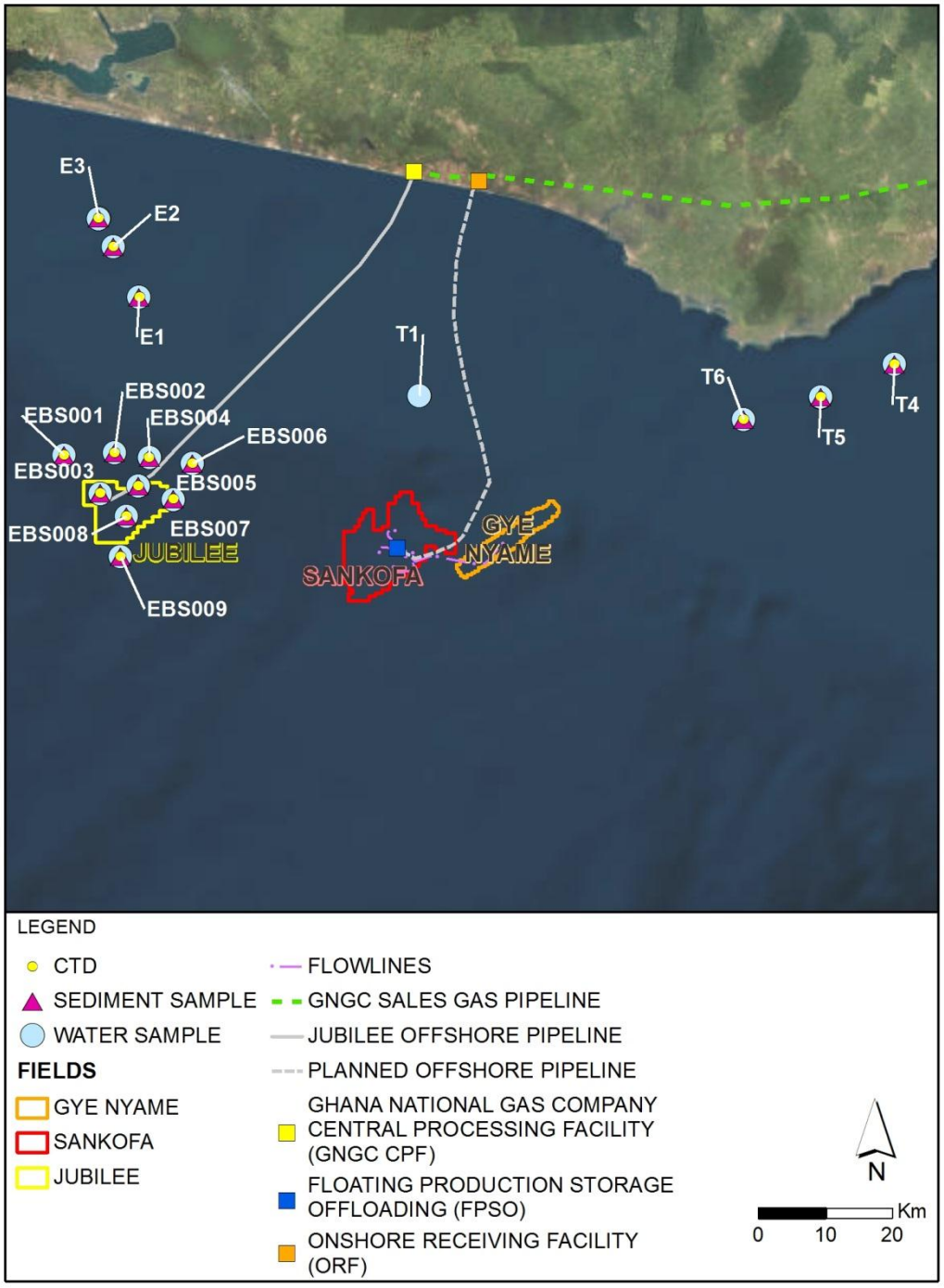


Figure 2 TDI Brooks (2008) - Map of Sampling Locations

Table 1 Environmental sampling Locations (FA/FB = Fauna sample A or B. PC = Physico-chemical sample. W/S= Water sample. W/P = Water profile. Zoo = vertical zooplankton tow)

Datum: WGS84, Projection: UTM Zone 30 N, CM 03° W					
Station	Easting [mE]	Northing [mN]	Rationale	Sampling	
				Grabs	Water
38	543343.32	491020.63	Client supplied, coverage over intrafield flowlines	FA, FB, PC	W/P, W/S (1, 100, 200 m), Zoo
39	545701.52	489148.22	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
40	545700.15	494399.35	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
41	565070.00	495100.00	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
42	548811.19	489176.57	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
43	550892.00	491486.99	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
44	571549.00	498903.00	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
45	551632.27	496142.19	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
46	555057.98	494308.72	Client supplied, coverage over intrafield flowlines	FA, FB, PC	W/P, W/S (1, 100, 200 m), Zoo
47	559368.96	495933.43	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
48	561383.04	499794.15	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
49	563419.20	504012.95	Client supplied, coverage over intrafield flowlines	FA, FB, PC	-
50	565340.77	494894.25	Client supplied, coverage over intrafield flowlines	-	W/P, W/S (1, 100, 200 m), Zoo

Table 2 TDI Brooks (2008) - Location and depth of EIA stations (SS=sediment sample, SWS=surface water sample, BWS=bottom water sample, SSR=sediment sample re-take. Blue cells were sites not successfully sampled)

Locations	Date	Time	Lat.	Long.	Depth (m)
EBS:T3	09/09/2008	08:54:34	N04 55.9778	W001 38.3939	16.6
EBS:T3_CTD	09/09/2008	09:22:28	N04 55.9825	W001 38.3912	17.3
EBS:T3 ALT_SS	09/09/2008	10:04:41	N04 52.6817	W001 36.8161	28.1
EBS:T2_SS	09/09/2008	11:19:42	N04 47.6608	W001 42.5213	33.3
EBS:T2_CTD	09/09/2008	11:33:02	N04 47.6612	W001 42.5264	34.4
EBS:T1_CTD	09/09/2008	18:51:36	N04 40.5986	W002 31.3688	73.6
EBS:T1_SS	09/09/2008	18:57:59	N04 40.5979	W002 31.3806	73.3
Jub_EBS006_SS	09/09/2008	23:05:02	N04 35.0791	W002 49.7665	942.5
Jub_EBS006_CTD	09/10/2008	00:20:51	N04 35.0795	W002 49.77	947.5
Jub_EBS007_SS	09/10/2008	01:36:19	N04 32.1627	W002 51.329	1180
Jub_EBS007_CTD	09/10/2008	01:36:55	N04 32.1621	W002 51.3283	1180

Locations	Date	Time	Lat.	Long.	Depth (m)
Jub_EBS007_SSR	09/10/2008	07:28:48	N04 32.1616	W002 51.3295	1180
Jub_EBS009_CTD	09/10/2008	09:25:36	N04 27.4913	W002 55.6064	1741.7
Jub_EBS009_SS	09/10/2008	09:33:42	N04 27.4861	W002 55.6122	1745.8
Jub_EBS009_SSR	09/10/2008	10:41:07	N04 27.4902	W002 55.6085	1766.7
Jub_EBS008_CTD	09/10/2008	12:18:45	N04 30.794	W002 55.1232	1441.7
Jub_EBS008_SS	09/10/2008	12:19:07	N04 30.7939	W002 55.1238	1441.7
Jub_EBS005_SS	09/10/2008	13:40:55	N04 33.2307	W002 54.1438	1341.7
Jub_EBS005_CTD	09/10/2008	13:41:11	N04 33.2303	W002 54.1463	1341.7
Jub_EBS005_SSR	09/10/2008	14:17:50	N04 33.2375	W002 54.1485	1345.8
Jub_EBS004_CTD	09/10/2008	15:32:48	N04 35.5703	W002 53.276	985.7
Jub_EBS004_SS	09/10/2008	15:33:08	N04 35.5699	W002 53.2754	985.7
Jub_EBS002_CTD	09/10/2008	16:44:46	N04 35.9511	W002 56.094	992.9
Jub_EBS002_SS	09/10/2008	16:45:10	N04 35.9526	W002 56.096	996.4
Jub_EBS003_CTD	09/10/2008	17:59:21	N04 32.6502	W002 57.2635	1382.1
Jub_EBS003_SS	09/10/2008	17:59:50	N04 32.6484	W002 57.2649	1378.6
Jub_EBS003_SSR	09/10/2008	18:45:29	N04 32.6479	W002 57.2523	1385.7
Jub_EBS001_SS	09/10/2008	20:11:04	N04 35.7645	W003 0.1693	1264.3
Jub_EBS001_CTD	09/10/2008	20:11:17	N04 35.7623	W003 0.1697	1267.8
EBS:E1_SS	09/11/2008	06:48:48	N04 48.6119	W002 54.1051	74.5
EBS:E1_CTD	09/11/2008	07:14:55	N04 48.6048	W002 54.0901	75
EBS:E2_CTD	09/11/2008	08:00:50	N04 52.7208	W002 56.1984	64
EBS:E2_SS	09/11/2008	08:08:57	N04 52.7146	W002 56.2021	64.5
EBS:E3 ALT_SS	09/09/2008	09:15:20	N04 59.1209	W002 59.477	40
EBS:E3ALT_CTD	09/09/2008	09:44:24	N04 59.121	W002 59.4679	40
EBS:E3ALT_BWS	09/09/2008	12:49:04	N04 59.127	W002 59.4796	41.5
EBS:E3ALT_SWS	09/09/2008	12:49:31	N04 59.1264	W002 59.4778	41
EBS:E2_SWS	09/11/2008	13:51:49	N04 52.7187	W002 56.2057	65
EBS:E2_BWS	09/11/2008	13:52:30	N04 52.7186	W002 56.2068	64.7
EBS:E1_BWS	09/11/2008	15:03:43	N04 48.6058	W002 54.1054	74.7

Locations	Date	Time	Lat.	Long.	Depth (m)
Jub_EBS001_BWS	09/11/2008	17:25:30	N04 35.7604	W003 0.177	1264.3
Jub_EBS003_BWS	09/12/2008	08:42:27	N04 32.6422	W002 57.2571	1385.7
Jub_EBS003_SWS	09/12/2008	08:43:09	N04 32.6418	W002 57.2586	1385.7
Jub_EBS002_BWS	09/12/2008	09:40:13	N04 35.9558	W002 56.0827	992.9
Jub_EBS002_SWS	09/12/2008	09:40:33	N04 35.9534	W002 56.0837	996.4
Jub_EBS004_BWS	09/12/2008	10:33:41	N04 35.5656	W002 53.2608	985.7
Jub_EBS004_SWS	09/12/2008	10:33:52	N04 35.5652	W002 53.2631	985.7
Jub_EBS005_SWS	09/12/2008	11:11:56	N04 33.2326	W002 54.1396	1346.4
Jub_EBS005_BWS	09/12/2008	11:27:21	N04 33.2357	W002 54.1425	1346.4
Jub_EBS008_SWS	09/12/2008	12:14:41	N04 30.7959	W002 55.1206	1435.7
Jub_EBS008_BWS	09/12/2008	12:24:44	N04 30.7965	W002 55.1183	1435.7
Jub_EBS009_SWS	09/12/2008	13:07:22	N04 27.5013	W002 55.6101	517.8
Jub_EBS009_BWS	09/12/2008	13:15:17	N04 27.4933	W002 55.6082	92.9
Jub_EBS007_SWS	09/12/2008	14:10:38	N04 32.1587	W002 51.3165	521.4
Jub_EBS007_BWS	09/12/2008	14:19:54	N04 32.156	W002 51.3265	1178.6
Jub_EBS006_SWS	09/12/2008	14:57:03	N04 35.0784	W002 49.7678	942.9
Jub_EBS006_BWS	09/12/2008	15:09:02	N04 35.0769	W002 49.7658	942.9
EBS:E3 R_BWS	09/12/2008	20:37:10	N04 55.0104	W002 57.3632	50
EBS:E3 R_SS	09/12/2008	22:08:07	N04 55.0121	W002 57.3743	50
EBS:E3 R_SWS	09/12/2008	22:25:17	N04 55.0046	W002 57.381	50
EBS:E3 R_CTD	09/12/2008	22:51:45	N04 55.022	W002 57.3748	50
EBS:T1_BWS	9/13/2008	06:35:59	N04 40.5954	W002 31.3866	73.3
EBS:T1_SWS	9/13/2008	06:42:46	N04 40.5964	W002 31.3789	73.3
EBS:T6_SWS	9/13/2008	10:48:16	N04 38.6372	W002 5.0963	52.5
EBS:T6_BWS	9/13/2008	10:53:11	N04 38.6428	W002 5.0989	53.1
EBS:T6_CTD	9/13/2008	11:12:55	N04 38.6369	W002 5.103	53.1
EBS:T6_SS	9/13/2008	11:23:01	N04 38.6367	W002 5.1029	51.9
EBS:T6_SSR	9/13/2008	11:53:23	N04 38.6394	W002 5.1046	52.5
EBS:T5_SWS	9/13/2008	13:23:36	N04 40.4249	W001 58.8556	45

Locations	Date	Time	Lat.	Long.	Depth (m)
EBS:T5_BWS	9/13/2008	13:32:23	N04 40.4351	W001 58.8604	45
EBS:T5_CTD	9/13/2008	13:46:10	N04 40.4357	W001 58.8554	44.7
EBS:T5_SS	9/13/2008	13:52:42	N04 40.4334	W001 58.8589	45.3
EBS:T4_SWS	9/13/2008	16:08:51	N04 43.0769	W001 52.8862	38.9
EBS:T4_BWS	9/13/2008	16:11:08	N04 43.0778	W001 52.889	38.9
EBS:T4_CTD	9/13/2008	16:23:38	N04 43.0776	W001 52.887	38.7
EBS:T4_SS	9/13/2008	16:32:05	N04 43.0827	W001 52.8965	39.4

Table 3 Seabed Sediment Sampling Locations

Sampling station name	Coordinates		Depth (m)	Description
	Easting (m)	Northing (m)		
1	562,187	509,492	99	Offshore pipeline
2	561,683	511,424	88	Offshore pipeline
3	561,172	513,358	84	Offshore pipeline
4	560,159	517,224	77	Offshore pipeline
5	559,668	519,164	75	Offshore pipeline
6	559,275	521,131	72	Offshore pipeline
7	558,499	525,051	65	Offshore pipeline
8	557,952	529,003	56	Offshore pipeline
9	558,164	532,999	51	Offshore pipeline
10	582,85	534,993	47	Offshore pipeline
11	558,399	536,994	44	Offshore pipeline
12	559,139	540,911	33	Offshore pipeline
13	559,634	542,846	27	Offshore pipeline
14	560,126	544,799	22	Offshore pipeline
15	560,191	545,082	20	Nearshore
16	560,257	545,318	20	Nearshore
17	560,321	545,564	19	Nearshore
18	560,369	545,760	18	Nearshore
19	560,440	546,057	17	Nearshore

Sampling station name	Coordinates		Depth (m)	Description
	Easting (m)	Northing (m)		
20	560,509	546,294	16	Nearshore
21	560,574	546,540	15	Nearshore
22	560,628	546,786	13	Nearshore
23	560,686	547,035	13	Nearshore
24	560,755	547,268	9	Nearshore
25	560,806	547,507	7	Nearshore
26	560,692	544,963	20	Nearshore
27	560,814	545,443	19	Nearshore
28	560,936	545,943	17	Nearshore
29	561,070	546,417	15	Nearshore
30	561,172	546,910	12	Nearshore
31	561,313	547,354	6	Nearshore
32	559,723	545,203	20	Nearshore
33	559,844	545,687	18	Nearshore
34	559,961	546,178	17	Nearshore
35	560,086	546,662	15	Nearshore
36	560,214	547,138	12	Nearshore
38	543,343	491,021	1122	Wells and intrafield flowlines
39	545,701	489,148	1112	Wells and intrafield flowlines
40	545,700	494,399	922	Wells and intrafield flowlines
41	565,070	495,100	519	Wells and intrafield flowlines
42	548,811	489,177	1007	Wells and intrafield flowlines
43	550,892	491,487	883	Wells and intrafield flowlines
44	571,549	498,903	327	Wells and intrafield flowlines
45	551,632	496,142	834	Wells and intrafield flowlines
46	555,058	494,309	708	Wells and intrafield flowlines
47	559,369	495,933	561	Wells and intrafield flowlines
48	561,383	499,794	427	Wells and intrafield flowlines
49	563,419	504,013	219	Wells and intrafield flowlines

Source: Fugro (2013)

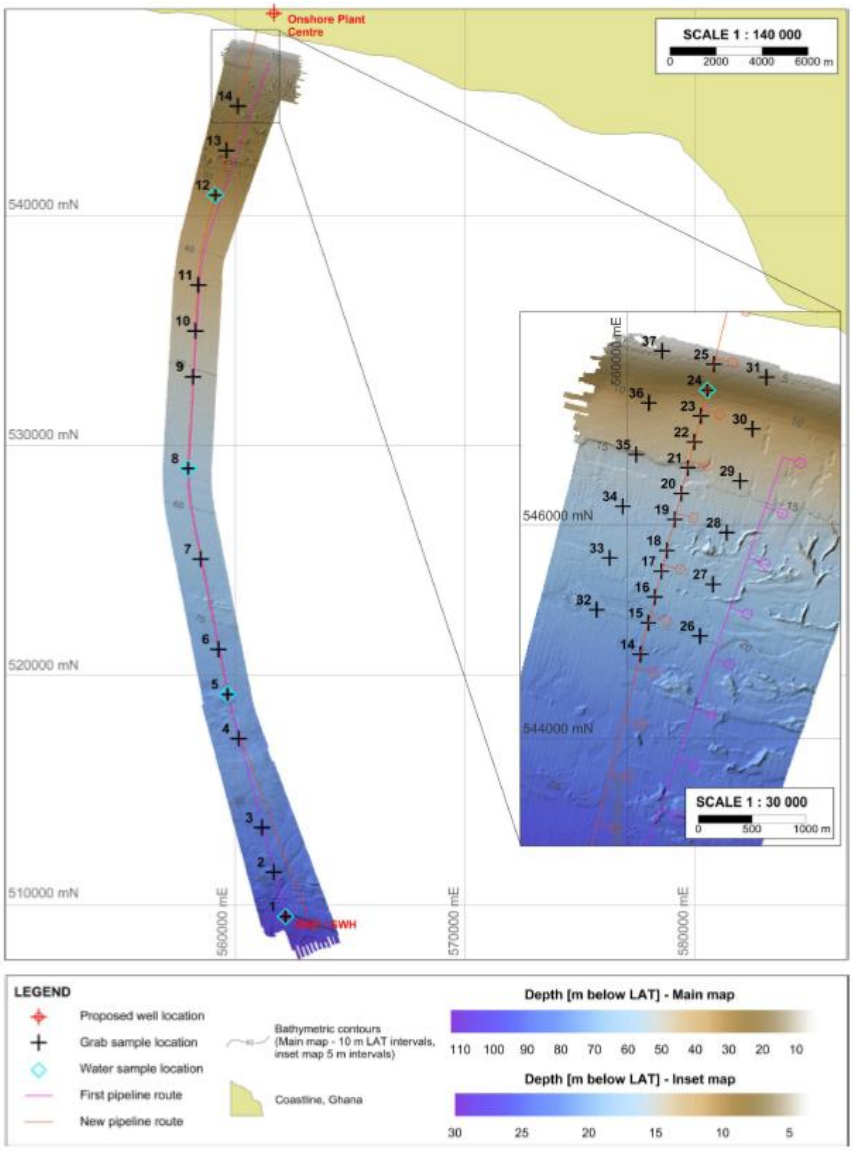


Figure 3 Seabed bathymetry showing environmental sampling locations (PHASE 2 & 4 SURVEY)

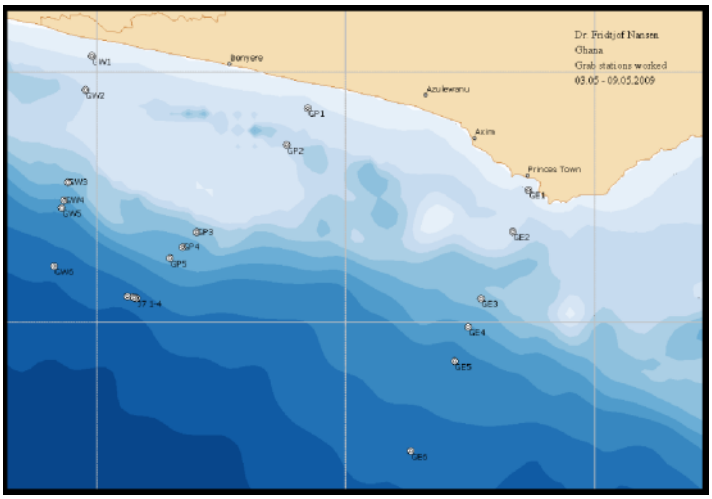


Figure 4 **EAF Nansen (2010) - Map showing the investigated sites**

Table 4 **EAF Nansen (2010)- Information about Sampling sites**

Grab Station Nr	CTD Station Nr,	Date	Time UTC	Longitude WGS 84	Latitude WGS 84	Depth (m)	Sediment Description
GE1	477	04.05.2009	13:15:32	-2.13267	4.764733	28	Silt and sand. Broken shells
GE2	476	04.05.2009	09:46:42	-2.16448	4.681167	50	Clay and silt
GE3	478	04.05.2009	16:21:58	-2.22888	4.547150	101	Sand and silt
GE4	479	04.05.2009	19:36:36	-2.25403	4.490267	250	Sand and silt
GE5	480	05.05.2009	00:01:23	-2.28167	4.421583	503	Clay and silt
GE6	481	05.05.2009	05:54:40	-2.36910	4.242100	1201	Clay and silt
GW1	488	06.05.2009	15:42:55	-3.00923	5.032833	28	Sand
GW2	487	06.05.2009	13:42:23	-3.02270	4.964233	52	Silt
GW3	486	06.05.2009	11:14:52	-3.05775	4.779500	104	Sand and silt
GW4	485	06.05.2009	07:12:34	-3.06473	4.743967	252	Sand and silt
GW5	484	06.05.2009	03:33:52	-3.06982	4.728583	501	Clay and silt

Grab Station Nr	CTD Station Nr,	Date	Time UTC	Longitude WGS 84	Latitude WGS 84	Depth (m)	Sediment Description
GW6	482	06.05.2009	22:36:37	-3.08517	4.611617	1200	Clay and silt
GP1	492	07.05.2009	12:20:57	-2.57592	4.928033	28	Sand
GP2	491	07.05.2009	10:21:52	-2.61877	4.854317	51	Sand,broken shells
GP3	490	07.05.2009	06:48:08	-2.79882	4.679933	102	Sand,broken shells
GP4	483	05.05.2009	22:49:24	-2.82733	4.650300	250	Sand
GP5	482	05.05.2009	18:49:39	-2.85302	4.628283	508	Clay and silt
J7-1	493	07.05.2009	18:35:03	-2.92807	4.550033	1273	Clay and silt
J7-2	-	08.05.2009	02:09:48	-2.91933	4.547633	1300	Clay and silt
J7-3	-	08.05.2009	10:59:28	-2.93790	4.551667	1271	Clay and silt
J7-4	-	08.05.2009	15:52:16	-2.92442	4.548900	1280	Clay and silt

1.2 BENTHIC ORGANISMS

1.2.1 Data treatment

A total of 12 stations are sampled for macrofauna using a 0.1 m2 dual van Veen grab (see Figure 6). Two replicate grab samples are obtained for macrofaunal analysis (denoted FA and FB) at all stations, resulting in a total of 24 grab samples for macrofaunal analysis. All macrofauna (>1 mm) are analyzed, identified, and enumerated. Abundances are expressed as numbers of individuals per 0.1 m2.

To prevent spurious results, data underwent a rationalisation process. This involved combining juvenile taxa with the parent taxon so as to prevent artificial inflation of taxon numbers. A total of 269 adults, 35 juveniles and 7 damaged individuals are recorded. Twelve individuals of juvenile Maldanidae are recorded; this family is ranked seventh in abundance. Newly settled juveniles of benthic species may at times dominate the macrofauna, but due to heavy post-settlement mortality, in many cases they should be considered an ephemeral component and not representative of prevailing bottom conditions (OSPAR Commission, 2004). When juveniles are ranked in abundance in the top 10 taxa, OSPAR (2004) recommends that statistical analysis is conducted both with and without juveniles in order to evaluate their ecological importance to the dataset and hence their need for inclusion/exclusion. However, the juveniles are identified to a low level of taxonomic resolution.

Since the number of adult species and individuals in the dataset is also low, the inclusion of juveniles would potentially result in spurious results due to a doubling up of taxa identified to different levels of taxonomic resolution. It is therefore considered appropriate to exclude the juveniles. In addition, based on the same rationale, the seven damaged individuals are also excluded.

Meiofaunal taxa were also recorded, however they are under recorded on a 1 mm sieve size. In addition, they are not considered part of the macrobenthos and were removed from the calculation of macrobenthic community indices and multivariate analysis of community structure (OSPAR, 2004).

1.2.2 Phyletic Composition

A total of 91 macrofaunal taxa from 8 phyla are recorded during the course of the survey, excluding the 18 juvenile, 7 damaged, 3 meiofaunal and 1 pelagic taxon removed from the data set for taxonomic rationalisation (annex B2.9 Benthic Organisms- Macrofauna Analysis). Of these 91 taxa, 54 (59.3%) were annelids, 14 (15.4%) were arthropods, 13 (14.3%) were molluscs, 4 (4.4%) were sipunculids, and 3 (3.3%) were echinoderms (Table 5 and Figure 5). *Cnidarians*, nemerteans and echiura comprised the remaining 3 taxa and are included in the 'Other' group (3.3% of the total).

In terms of abundance, annelids are dominant, representing half (50.9%) of the 269 individuals recorded. Arthropods, molluscs and echinoderms represent 10.4%, 13.4%, and 1.1% of the total abundance, respectively. Other taxa make up 10.0% of the total abundance, of which *echiura sp. A*. contributed 6.7%. Mean macrofaunal density per sample is 11.2 individuals per 0.1 m2 ±10.4 (S.D.), indicating that abundance is highly variable between samples.

Table 5 Abundance of Major Taxonomic Groups

Group	Number of Taxa	Total Taxa [%]	Abundance	Total Abundance [%]
Annelida	54	59.3	137	50.9
Arthropoda	14	15.4	28	10.4
Mollusca	13	14.3	36	13.4
Sipuncula	4	4.4	38	14.1
Echinodermata	3	3.3	3	1.1
Others	3	3.3	27	10.0
Total	91	100.0	269	100.0

Note: Others = Echiura, Cnidaria and Nemertea.

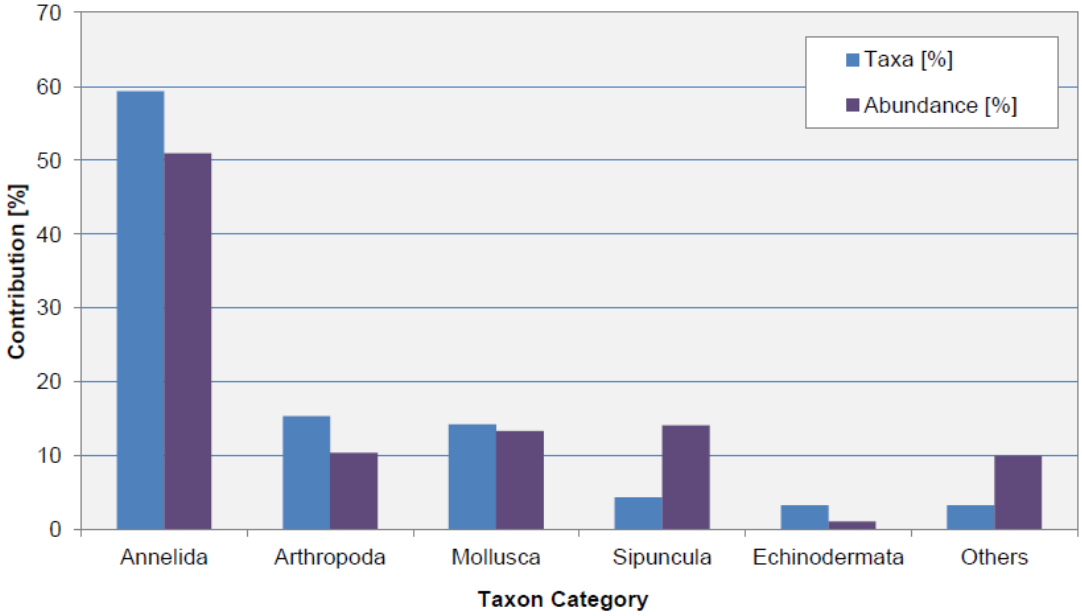


Figure 5 Abundance of major taxonomic groups

1.2.3 Rank Abundance and Dominance

The ten most abundant taxa recorded from the grab sampling survey are presented in Table 6, alongside mean abundance, frequency of occurrence and rank dominance. By ranking the taxa recorded for each sample in terms of abundance and summing the rank scores for all samples to give the overall rank dominance for each taxon, it is possible to examine which species are consistently dominant throughout the survey route. This method is less susceptible to bias toward species which may occur in higher densities at a smaller proportion of stations. In an area from which a single community is found, few notable disparities would be expected between dominance and abundance ranks.

In general, the abundance of macrofauna is low, a maximum of 18 individuals in total recorded for any single species/taxon from the 22 samples obtained across 11 stations. The most abundant species are the sipunculid *Onchnesoma steenstrupii* and *ECHIURA sp. A*. (18 individuals, ranked joint first in abundance), both occurring at 9.5% of stations surveyed (Table 6). All individuals of *O. steenstrupii* are recorded from two samples obtained from a single station (49FA: ten individuals; 49FB: eight individuals). Similarly, all individuals of *echiura sp. A.* are also obtained from a single station (47FA: 3 individuals; 47FB: 15 individuals). Ranked joint third in abundance are the sipunculid *Apionsoma sp.* and the bivalve *Medicula ferrigunosa*. These two species contain a similar number of individuals (17 individuals) but are more widely distributed at approximately 24% and 33% of all stations, respectively. Other species which are relatively abundant include the eunicid polychaete *Aponuphis sp. A*., and the terebellid polychaete *Monticellina sp.* (14 individuals each, ranked joint fifth in abundance). In terms of rank dominance, *Monticellina sp.* is ranked first, due to relatively high number of individuals and the high frequency of occurrence (38%). Ranked second and third are *M. ferrigunosa* and *Aponuphis sp. A*., respectively. The most abundant species, O. steenstrupii and *echiura sp. A*., are ranked fifth and tenth in dominance, respectively, the difference in rank caused by the greater between sample (within station) variability in the abundance for echiura sp. A. (3 and 15 individuals: Station 49), compared to O. steenstrupii (10 and 8 individuals: Station 47). In addition to the taxa already mentioned, *Aricidea sp.* is the most observed taxon, occurring at 38% of the stations surveyed, with 10 individuals recorded.

The marked difference between the abundance ranks and dominance ranks, and low frequency of occurrence of relatively abundant taxa indicates that the benthic community is spatially variable. This is possibly a function of differing community assemblages between stations or possibly a result of the very low abundance, resulting in very few characterising taxa per station making it difficult to resolve similarities or differences in the community structure.

Table 6 Dominant Taxa and Dominance Rank for All Samples [0.1 m2]

Taxon	Rank Abundance	Mean Abundance	Frequency [%]	Rank Dominance
Onchnesoma steenstrupii	1	0.86	9.52	5
ECHIURA sp. A	1	0.86	9.52	10
Apionsoma sp.	3	0.81	23.81	4
Mendicula ferruginosa	3	0.81	33.33	2
Aponuphis sp. A	5	0.67	14.29	3
Monticellina sp.	5	0.67	38.10	1
Aricidea sp.	7	0.48	38.10	7
NEMERTEA	8	0.38	28.57	15
Notomastus sp.	9	0.29	19.05	6
Ampeliscidae	9	0.29	9.52	10

1.2.4 Primary Variables and Univariate Analysis

The primary variables, numbers of taxa (S) and abundance (N), have been calculated together with the univariate measures richness (D), evenness (J′), dominance (1-λ) and Shannon-Wiener diversity using the PRIMER v6.1.15 DIVERSE procedure (Clarke and Gorley, 2006). Margalef's richness (D) is a simple measure calculated from the number of taxa and abundance. Pielou's evenness (J′) and the reciprocal of Simpson's dominance (1-λ) are measures of equitability (i.e. how evenly the individuals are distributed among different species); low evenness indicates that a sample is dominated by one or a few highly abundant species whereas high evenness means that total abundance is spread more evenly among the constituent species. The Shannon-Wiener index (H′) (Shannon and Weaver, 1949) combines both the components of species richness and evenness to calculate a measure of diversity. See Magurran (1988) for further discussion of these indices. Further details on the univariate measures analysed are available in Annex B1.8.

1.2.5 Sample Data [0.1m2]

The mean number of taxa per sample is 7.1 per 0.1 m2 ±5.4 (S.D.), and ranged from 0 in samples 40FA, 40FB and 41FB, to 23 in sample 44FA. The mean number of individuals per sample is 12.2 ±10.3 (S.D.), ranging from 0 individuals in samples 40FA, 40FB and 41FB to 37 individuals in sample 44FA. The number of taxa is significantly positively correlated with the number of species ($P<0.001$); stations with a relatively high number of taxa have a relatively high number of individuals, and conversely, those with a low number of taxa have a low number of individuals. Stations with low numbers of both taxa and individuals included 38FA, 38FB, 41FA, and 42FA,

whereas stations with high numbers of both taxa and individuals included 44FA, 44FB, 49FA, and 49FB. Stations where no individuals are recorded included 40FA, 40FB, and 41FB. Coefficients of variation (standard deviation expressed as percentage) reveal that abundance is slightly more variable than the number of taxa (92.72 and 75.33, respectively). The average number of taxa per station and average abundance per station are illustrated on Figure 6 and Figure 7.

Both the sum of the taxa and the total number of species at each station are negatively correlated with depth and the proportion of sediment fines ($P<0.05$) (annex B2.10 Benthic Organisms-Correlations). This suggests benthic communities may be richer in shallower waters; however it should be noted that this may be a function of sediment differences in shallower water and not directly related to water depth.

Mean Margalef's species richness is 3.0 ±1.0 (S.D.), ranging from 1.2 to 6.1. Mean Shannon-Wiener diversity is 1.5 ±0.8 (S.D.), but ranged from 0 to 2.9, suggesting that at some stations diversity is low (e.g. 38FA, 38FB, 40FA, 40FB, 41FA, 41FB and 42FA) whereas at other stations it is relatively high (e.g. 44FB, 49FB and 44FA).

Pielou's evenness ranged from 0.6 to 1.0, revealing that at some stations the abundance is dominated by only a few species (e.g. 47FB), whilst at other stations the abundance is evenly spread across the species (e.g. 39FB, 41FA, 42FA, 43FA and 46FA). However, evenness averaged 0.9 ±0.1 (S.D.) revealing that the predominant trend is for abundance to be evenly spread between the occurring taxa; this is largely due to a low number of individuals spread across a limited number of taxa at several stations. Simpson's dominance index ranged from 0.0 to 0.9 and averaged 0.8 ±0.2 (S.D.), again demonstrating the general evenness of the community and relatively low dominance.

Table 7 Primary and Univariate Parameters by Sample [0.1 m2]

Sample		No of Taxa (S)	Abundance (N)	Richness (D_{MG})	Evenness (J')	Simpson's (1-λ)	Shannon-Wiener (H')
38 FA		1	1	n/a	n/a	0.0	0.0
38 FB		3	5	1.2	0.9	0.6	1.0
39 FA		8	11	2.9	0.9	0.8	2.0
39 FB		6	6	2.8	1.0	0.8	1.8
40 FA		0	0	n/a	n/a	n/a	0.0
40 FB		0	0	n/a	n/a	n/a	0.0
41 FA		4	4	2.2	1.0	0.8	1.4
41 FB		0	0	n/a	n/a	n/a	0.0
42 FA		4	4	2.2	1.0	0.8	1.4
42 FB		5	5	2.5	1.0	0.8	1.6
43 FA		6	6	2.8	1.0	0.8	1.8
43 FB		7	10	2.6	0.9	0.8	1.8
44 FA		23	37	6.1	0.9	0.9	2.9
44 FB		13	22	3.9	0.9	0.9	2.3
45 FA		7	9	2.7	1.0	0.8	1.9
45 FB		7	9	2.7	0.9	0.8	1.8
46 FA		5	5	2.5	1.0	0.8	1.6
46 FB		8	9	3.2	1.0	0.9	2.0
47 FA		9	12	3.2	1.0	0.9	2.1
47 FB		7	21	2.0	0.6	0.5	1.1
48 FA		9	17	2.8	0.9	0.8	1.9
48 FB		9	16	2.9	0.9	0.8	1.9
49 FA		14	24	4.1	0.8	0.8	2.2
49 FB		16	36	4.2	0.9	0.9	2.5
Current Survey	Min	0.0	0.0	1.2	0.6	0.0	0.0
	Mean	7.1	11.2	3.0	0.9	0.8	1.5
	Max	23.0	37.0	6.1	1.0	0.9	2.9
	SD	5.4	10.4	1.0	0.1	0.2	0.8

Note: SD = 1 standard deviation; Min = minimum; Max = maximum; n/a = not applicable.

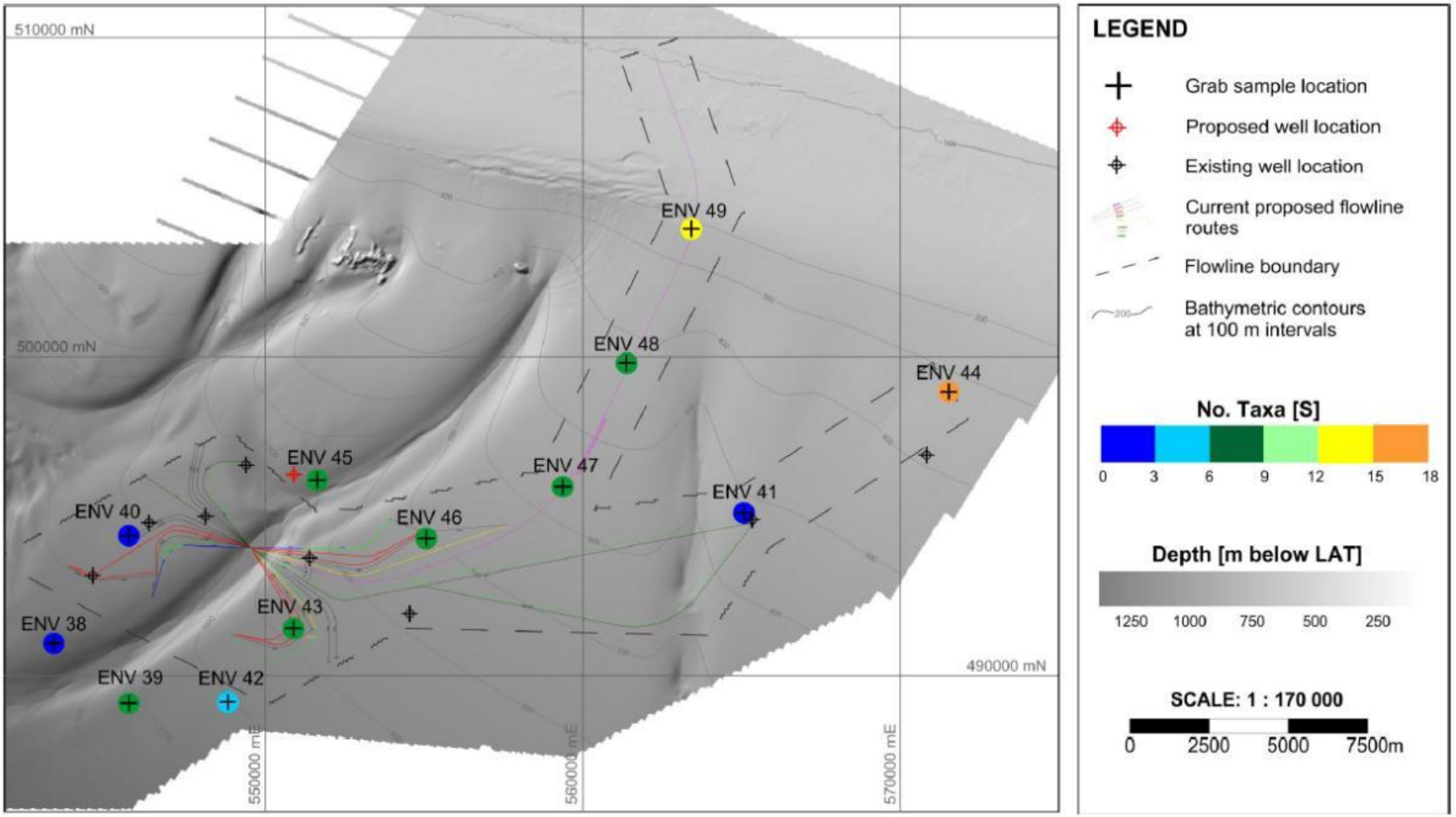


Figure 6 Spatial distribution of average number of taxa (S) [per 0.1 m2]

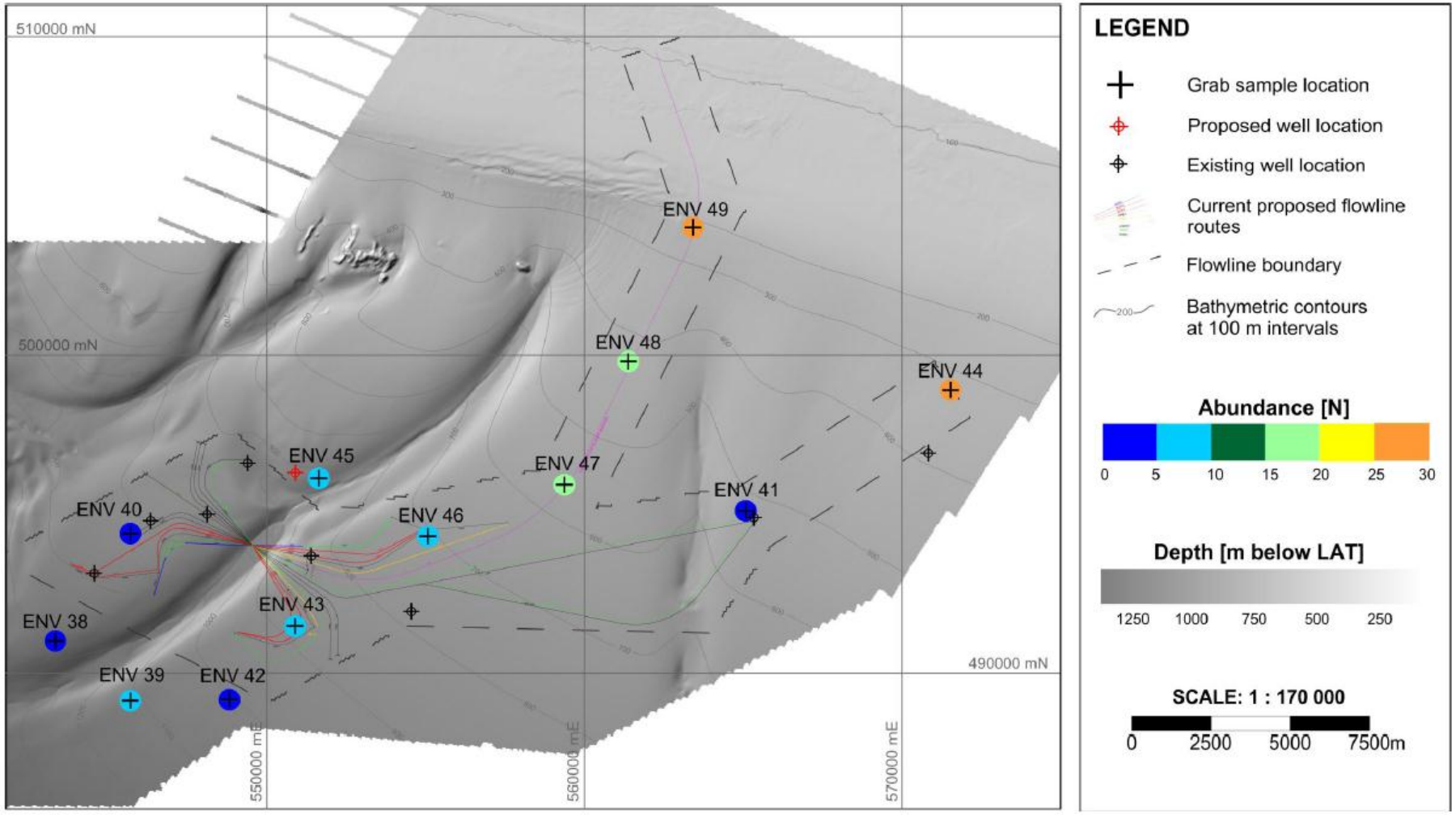


Figure 7 Spatial distribution of abundance (N) [per 0.1 m^2]

1.2.6 Species Accumulation and Richness Estimation

The species accumulation plot displayed in Figure 8 is generated using untransformed sample data (0.1 m2) in PRIMER v6.1.15. The observed number of taxa obtained through repeated sampling (Sobs) are cumulatively plotted, as are richness estimates from repeated sampling as calculated by the Chao1, Chao2, Jacknife1 and Jacknife2 formulae (see Chao (2005) for further discussion of these indices). All of the displayed curves are smoothed (by random permutation of the data points) to aid interpretation.

The observed species accumulation curve (Sobs) is of reasonably constant slope and appeared unlikely to be close to reaching its asymptote; this suggests that a number of taxa present in the survey area has not been detected by the sampling undertaken. The richness estimators also suggested that the survey area has not been fully described, with estimates for the total macrofaunal diversity of the area ranging from 140 taxa (Jacknife 1) to 165 taxa (Jacknife 2), in comparison to the 91 taxa observed. These estimates suggest that only a moderate proportion (55% to 65%) of the area's total faunal diversity had been detected by the sampling undertaken. Nevertheless, the main keystone species should have been captured by the sampling campaign, although increased replication at each station would have captured a greater proportion of the diversity at each station.

Similarly, more stations would have facilitated an enhanced analysis of spatial differences in benthic community structure within the survey area.

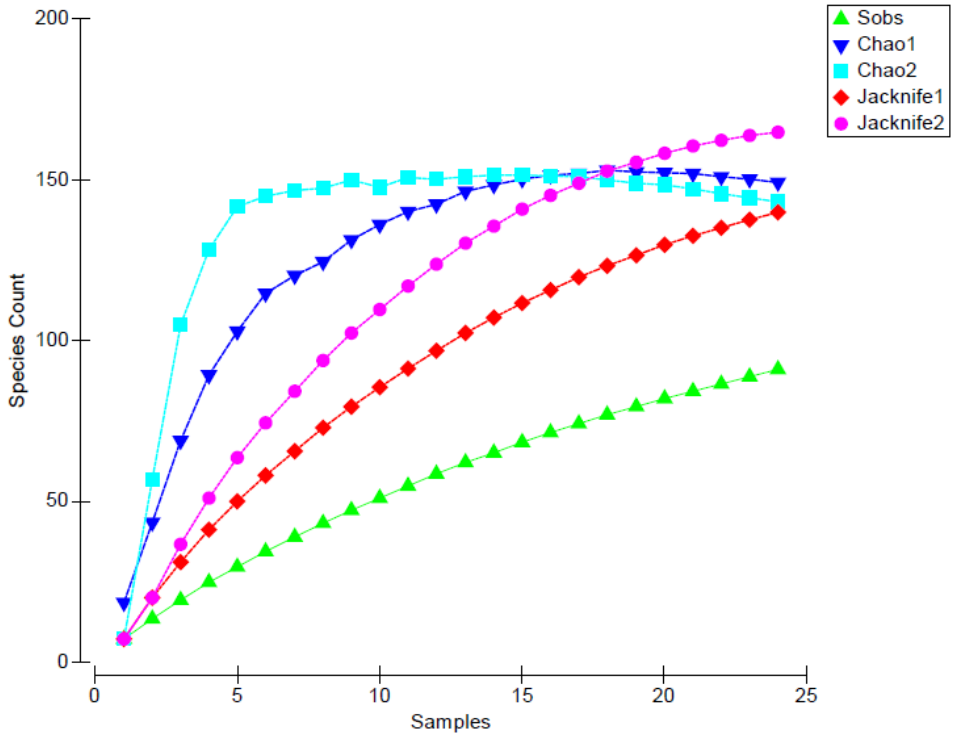


Figure 8 Species accumulation plot

1.2.7 Multivariate Analysis

Multivariate analysis of data allows a more thorough examination of differences between samples that cannot be achieved by examination of univariate measures alone. Multivariate analysis preserves the identity of species when calculating similarities between sample data, whereas this information is lost when computing univariate measures.

Analyses are undertaken using the PRIMER v6.1.15 statistical package (Clarke and Gorley, 2006).

Two techniques have been used to illustrate and identify differences in the data; cluster analysis, which outputs a dendrogram displaying the relationship between data based on the Bray-Curtis Similarity measure; and non-metric multi-dimensional scaling (nMDS) in which station data are ordinated as a 2-dimensional map. No transformation is applied to the data before analyses, due to the low abundances of taxa at all survey stations. This low abundance or lack of fauna at each station is considered to be for the same reasons (i.e. no location is identified a likely to be depurate because of disturbance or contamination), and therefore Bray-Curtis similarity coefficients are constructed with a dummy variable (see Clarke and Gorley, 2006; Clarke *et al*., 2006). The insertion of a dummy variable enables samples with denuded communities to be placed near to one another in multivariate space, under the assumption that the lack of individuals between two statistically similar samples is for the same reason.

The dendrogram (Figure 9) shows patterns in sample data similarities. The similarity profiling (SIMPROF) algorithm is used to identify statistically significant (P=0.01) differences between samples, with significant splits shown as black lines and non-significant splits as red lines.

The probability level is set at 1% (P=0.01) since at the lower probability of 5% (P=0.05) an increased number of groups are differentiated which are considered to be artefacts of the clustering of data with very low internal variability. Using a higher significance level increases the likelihood that observed clusters represent genuine differences in the data.

A key characteristic of the data is the low level of similarity in community structure between replicate samples obtained from the same station, such as Station 49, where the similarity between replicates is approximately 39% (Figure 9). In addition, several sample replicates from the same station are placed in different clusters, such as samples 45FA and 45FB (Figure 9). This indicates that the macrofaunal communities are patchy over the relatively small spatial scales between replicate samples taken within the survey area. (Note, however, that several stations in Cluster F display high similarity due to a complete lack of fauna, and hence are classified as 100% similar to one another).

In total, seven cluster groups are identified. A 2-dimensional nMDS plot is presented in Figure 10.

The grouping of stations into clusters in part reflects variations in community structure according to station depth. Cluster A represents the shallowest stations occurring at depths of 219 m and 220 m, while Cluster C includes stations at a deeper depth of 327 m and 427 m. The remaining clusters occur at depths of between 519 m and 1122 m.

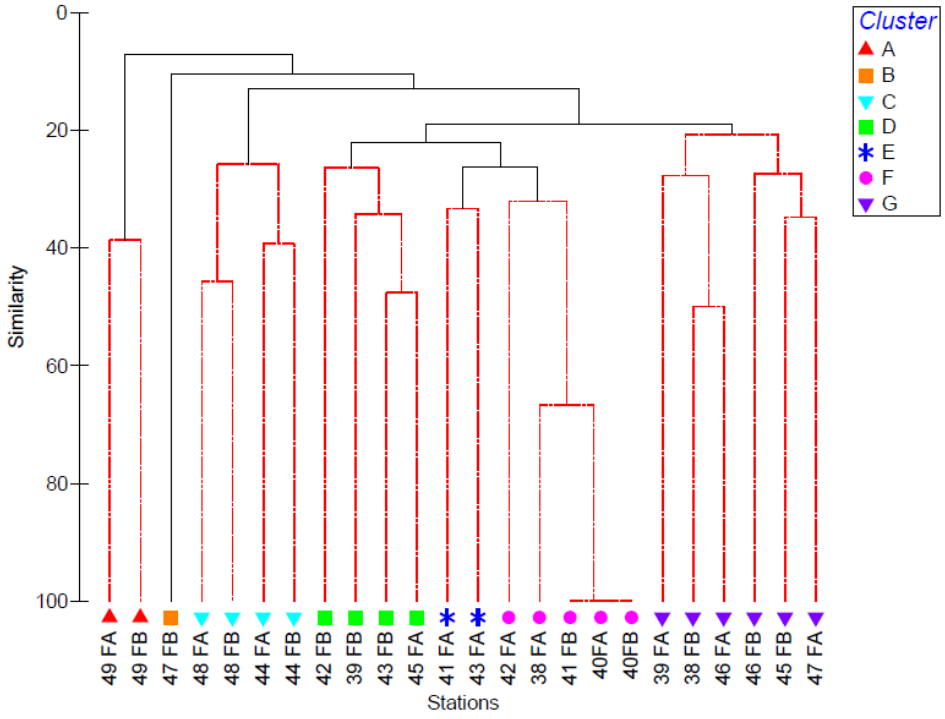


Figure 9 Dendrogram of benthic macrofaunal data (Bray Curtis similarity) with SIMPROF testing (P=0.01)

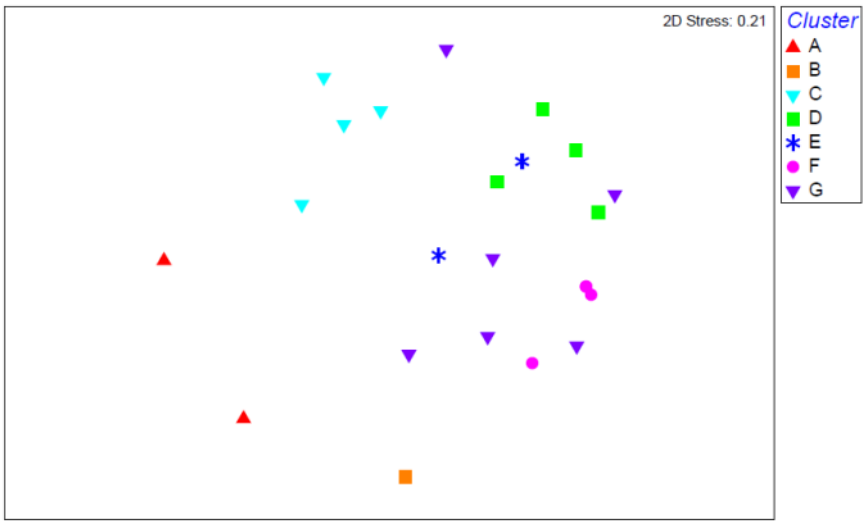


Figure 10 nMDS ordination Bray Curtis similarity of benthic macrofaunal data

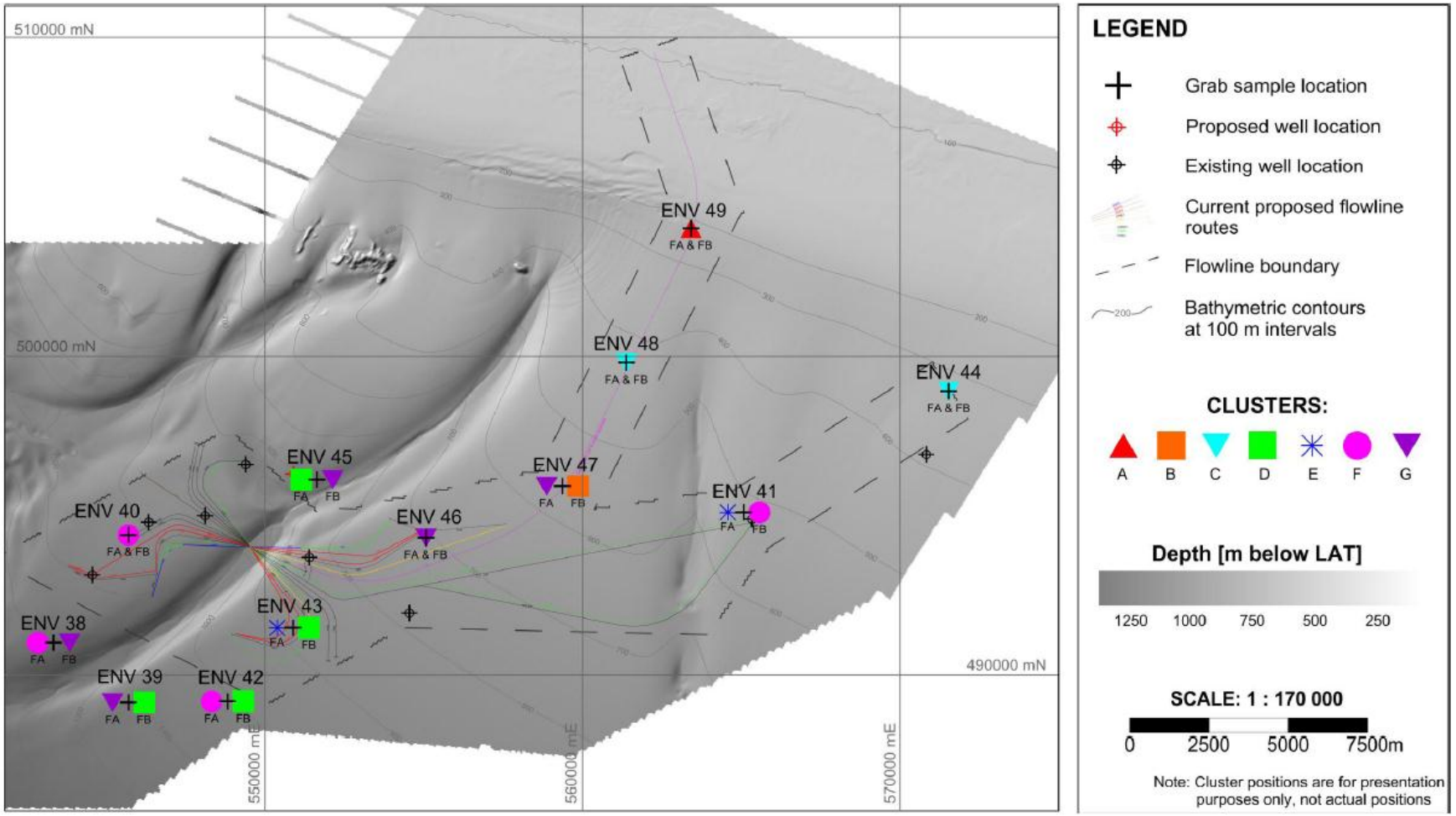


Figure 11 Spatial distribution of macrofaunal multivariate clusters

The PRIMER similarity percentage analysis (SIMPER) routine is run on the benthic macrofaunal dataset to identify the taxa which contribute to the top 90% of within group similarity (Table 8).

Within group similarity is consistently low, ranging from 16.46% for Cluster G to 36.67% for Cluster A. This demonstrates that the grouping of samples together is achieved with only limited similarities. As already discussed each sample has only a small number of taxa and low abundance so and number of individuals from which to draw similarities between is low limiting the ability of the tests to resolve assemblage differences.

In Clusters A, D and E, a maximum of three taxa contribute the bulk of the contributions to the within cluster similarity, suggesting that these clusters are characterised by the share occurrence of a small number of individual taxa between the samples. In Cluster C, the number of taxa comprising the bulk of the within-group contributions is increased to five, although the top two taxa (*Apionodma sp*. and *Monticellina sp*.) still contribute over 60% to the group's similarity Table 8).

Cluster A is located at a depth of 219 m. Sediments at stations in this cluster had the largest mean grain size (221 µm). This cluster is characterised predominantly by the *sipunculid Onchnesoma steenstrupii*, which contribute more than 70% to within cluster similarity. Other characteristic taxa included the *phylodocid polychaete Goniada sp*. and the *eunicid polychaete Lumbrineris sp. C.*

Cluster B is located at 561 m in very poorly sorted very fine sand. This cluster containes only

Station 47FB and is typified by Echiura sp. A.

Cluster C is found at stations at 327 m and 427 m (Stations 44FA, 44FB, 48FA, and 48FB).

Sediments vary between these stations, including very poorly sorted very fine sand at Station 44 and very poorly sorted medium silt at Station 48. The main characterising taxa are the *sipunculid Apionsoma sp.*, the *cirratulid polychaete Monticellina sp*., and the *eunicid polychaete Aponuphis sp. A*.

Cluster D is located at depths ranging from 833 m to 1111 m (Stations 39FB, 42FB, 43FB, and 45FA). Sediments contain a high proportion of fine material and are classified as very poorly sorted fine or medium silts. Over 90% of within group similarity is contributed by two polychaete taxa, *Aricidea sp.* and *Prionospio sp.*

Cluster F is found at five stations (38FA, 40FA, 40FB, 41FB, and 42FA), ranging from 519 m to 1122 m deep, and represents impoverished or denuded samples. Stations 38FA and 42FA contain only a single individual and four individuals, respectively, while all other samples are devoid of fauna, and consequently no taxa characterizes this cluster.

Cluster G is found at six stations (38FB, 39FA, 45FB, 46FA, 46FB and 47FA) ranging from 561 m to 1122 m deep. Station sediments are all very poorly sorted and ranged from fine silt, to medium silt to very fine sand. A high degree of variability in community structure between stations in this cluster is apparent, as evident by the between station distances on the MDS plot (Figure 10) and low within cluster similarity (Table 8). The predominant taxa which typified this cluster includes *Nemertea* and the bivalve *Mendicula ferruginosa*.

Table 8 SIMPER Analysis Showing Characterising Taxa for Clusters

Taxon	Average Abundance (non-transformed)	Contribution to Similarity [%]	Cumulative Contribution [%]
Cluster A: Average similarity = 36.67			
Onchnesoma steenstrupii	9.00	72.73	72.73
Goniada sp.	1.50	9.09	81.82
Lumbrineris sp. *C.*	1.50	9.09	90.91
Cluster B: Less than 2 samples in group			
ECHIURA sp. *A.*	15.00	n/a	n/a
Paradiopatra sp.	1.00	n/a	n/a
Magelona sp.	1.00	n/a	n/a
Spiochaetopterus sp.	1.00	n/a	n/a
Maldane sp.	1.00	n/a	n/a
Harpinia sp.	1.00	n/a	n/a
Abra sp.	1.00	n/a	n/a
Cluster C: Average similarity = 28.27			
Apionsoma sp.	4.00	38.37	38.37
Monticellina sp.	2.00	23.43	61.8
Aponuphis sp. *A.*	3.50	18.41	80.21
Mendicula ferruginosa	2.25	9.20	89.41
Ledella orstomi	0.50	2.22	91.64
Cluster D: Average similarity = 23.26			
Aricidea sp.	1.50	66.41	66.41
Prionospio sp.	0.75	26.05	92.46
Cluster E: Average similarity = 20.00			
Monticellina sp. *1*	1.00	100.00	100.00
Cluster F: All similarities are zero (afaunal samples)			
Cluster G: Average similarity = 16.46			
NEMERTEA	1.17	52.99	52.99
Mendicula ferruginosa	1.17	23.48	76.47
Leucon sp. *B.*	0.33	8.10	84.57
Paradiopatra sp.	0.33	3.86	88.43
Abyssoninoe sp.	0.33	3.86	92.28

The abundance in each sample from each individual station is also summed by station to remove within station heterogeneity (see Somerfield *et al*., 1995), thus potentially enabling any spatial trends to be more easily observed. However, no spatial differences can be resolved because of the very low numbers of taxa and individuals observed (Figure 10). Although it may be true that a single benthic community is apparent across the whole survey area, the clustering of a single group at very low similarity levels (Figure 10) indicates that there is limited data from which to draw statistical conclusions from. Increased replication or additional stations may have identified more taxa, potentially enabling any apparent spatial trends identified.

Since no structure in the macrofaunal assemblages across the survey area is able to be assessed, it is deemed inappropriate to try to find the best explanatory variables which match the (nonexistent) structure of the macrofauna to the patterns in the abiotic data (i.e BIOENV algorithm). For this reason the PRIMER BEST routine has not been utilised to calculate correlations between environmental variables, and any observed patterns in community structure.

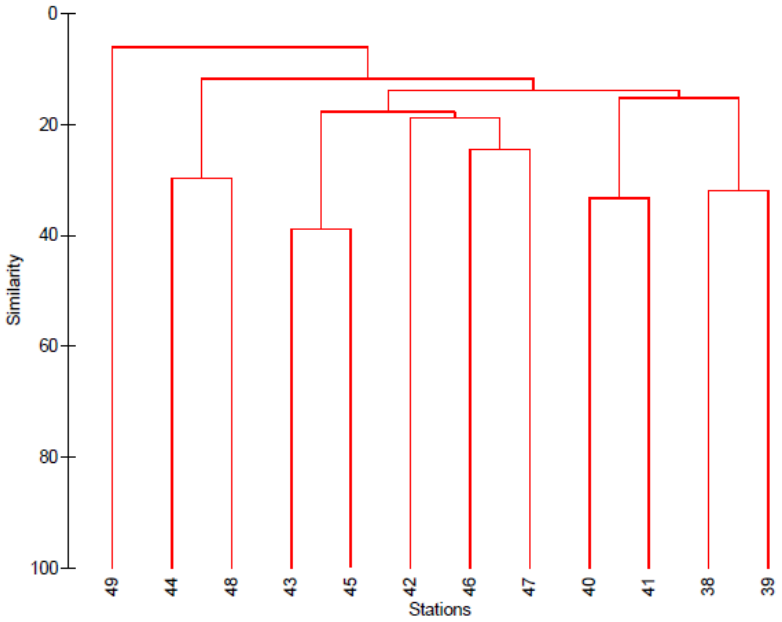


Figure 12 Dendrogram of Bray Curtis similarity of benthic macrofauna with SIMPROF testing (P=0.05).

1.3 SEDIMENT AND WATER QUALITY

Sediment granulometry in the survey area is very poorly sorted and ranged from fine sand to fine silt. Silt is the dominant sediment component at the majority of stations. In general, the proportion of silt increases and the proportion of sand decreases with increasing water depth.

Considering chemistry there are some salient issues.

Total hydrocarbons are low at most stations but are considerably elevated at Station 41. Station 41 is located approximately 340 m west-northwest of the ENI Ghana Gye Nyame-1 well where new hydrocarbon resources were discovered in July 2011. Side scan sonar of drill spoil at the Sankofa 2A/2AST well, located approximately 16 km west-northwest of Gye Nyame-1, is observed to extend approximately 500 m west-northwest of the well. Thus it is likely that the high readings at Station 41 are related to local anthropogenic activities, and petrogenic contamination.

Total PAHs are low at all stations apart from Station 41. At Station 41 they are considerably elevated, with a dominance of NPD 2-3 ring PAHs. Elevated PAHs at station 41 support the assertion of drilling related sediment contamination from the nearby Gye Nyame-1 well.

CPI ratios at most stations suggest a dominance of biogenic/terrestrial n-alkanes. In contrast, the signature at Station 41 indicates that the n-alkanes within the sediments are probably of anthropogenic sources. Station 41 is dominated by short chain alkanes, indicating petrogenic contamination. The GC trace at Station 41 is indicative of well weathered low-toxicity based drilling muds. Pristane and phytane concentrations are also markedly elevated at Station 41.

Metal concentrations are generally low, although arsenic, chromium and nickel are found to exceed respective NOAA ERL values at Stations 41, 44 and 48. Barium, used as a weighting agent in

drilling muds, has marginally elevated levels due to general drilling activities in the region, and higher level at station 41 that indicates direct drilling related contamination.

1.3.1 Sediment quality

Particle Size Distribution

Particle size analysis are performed using wet and dry sieving and laser diffraction techniques. Summarized results and sediment descriptions based on the Wentworth Classification (Buchanan, 1984) are given in Table 9. The proportion of fines (<63 µm) are displayed spatially in Figure 13.

Table 9 Summary of Particle Size Distribution

Station	Depth [m]	Mean [µm]	Mean [phi]	Sorting	Fines [%]	Sand [%]	Coarse [%]	Graphical Mean (Wentworth Classification)
38	1122	11.57	6.43	2.22	90.6	9.4	0.0	Very Poorly Sorted, Fine Silt
39	1112	14.55	6.10	2.22	86.7	13.2	0.1	Very Poorly Sorted, Fine Silt
40	922	14.12	6.15	2.15	88.6	11.4	0.1	Very Poorly Sorted, Fine Silt
41	518	39.35	4.67	2.66	57.8	42.2	0.1	Very Poorly Sorted, Coarse Silt
42	1007	14.34	6.12	2.24	86.9	13.1	0.0	Very Poorly Sorted, Fine Silt
43	883	16.04	5.96	2.20	85.4	14.6	0.0	Very Poorly Sorted, Medium Silt
44	327	79.14	3.66	2.56	36.2	63.6	0.1	Very Poorly Sorted, Very Fine Sand
45	834	18.34	5.77	2.23	81.4	18.6	0.0	Very Poorly Sorted, Medium Silt
46	708	18.94	5.72	2.33	79.9	20.1	0.0	Very Poorly Sorted, Medium Silt
47	561	72.14	3.79	2.67	38.7	61.2	0.0	Very Poorly Sorted, Very Fine Sand
48	427	22.18	5.49	2.36	75.4	24.6	0.0	Very Poorly Sorted, Medium Silt
49	219	221.14	2.18	2.01	14.4	84.7	0.9	Very Poorly Sorted, Fine Sand
Current survey	Min	11.57	2.18	2.01	14.4	9.4	0.0	Very Poorly Sorted, Fine Silt
	Mean	45.15	5.17	2.32	68.5	31.4	0.1	
	Max	221.14	6.43	2.67	90.6	84.7	0.9	
	SD	60.04	1.32	0.21	25.5	25.3	0.3	
Comparison surveys*	Mean				76.0	23.8	0.3	N/A
	SD				30.9	30.4	0.7	

Note: fines: <63 µm; sand: 63 µm to 2 mm; coarse material: >2 mm. SD = 1 standard deviation.

*Comparison surveys: EAF Nansen (Stations GE4, GE5, GE6, GW4, GW5, GW6, GP4, GP5, J7-1, J7-2, J7-3, J7-4) and TDI Brooks (Stations EBS001, EBS002, EBS004, EBS006, EBS007).

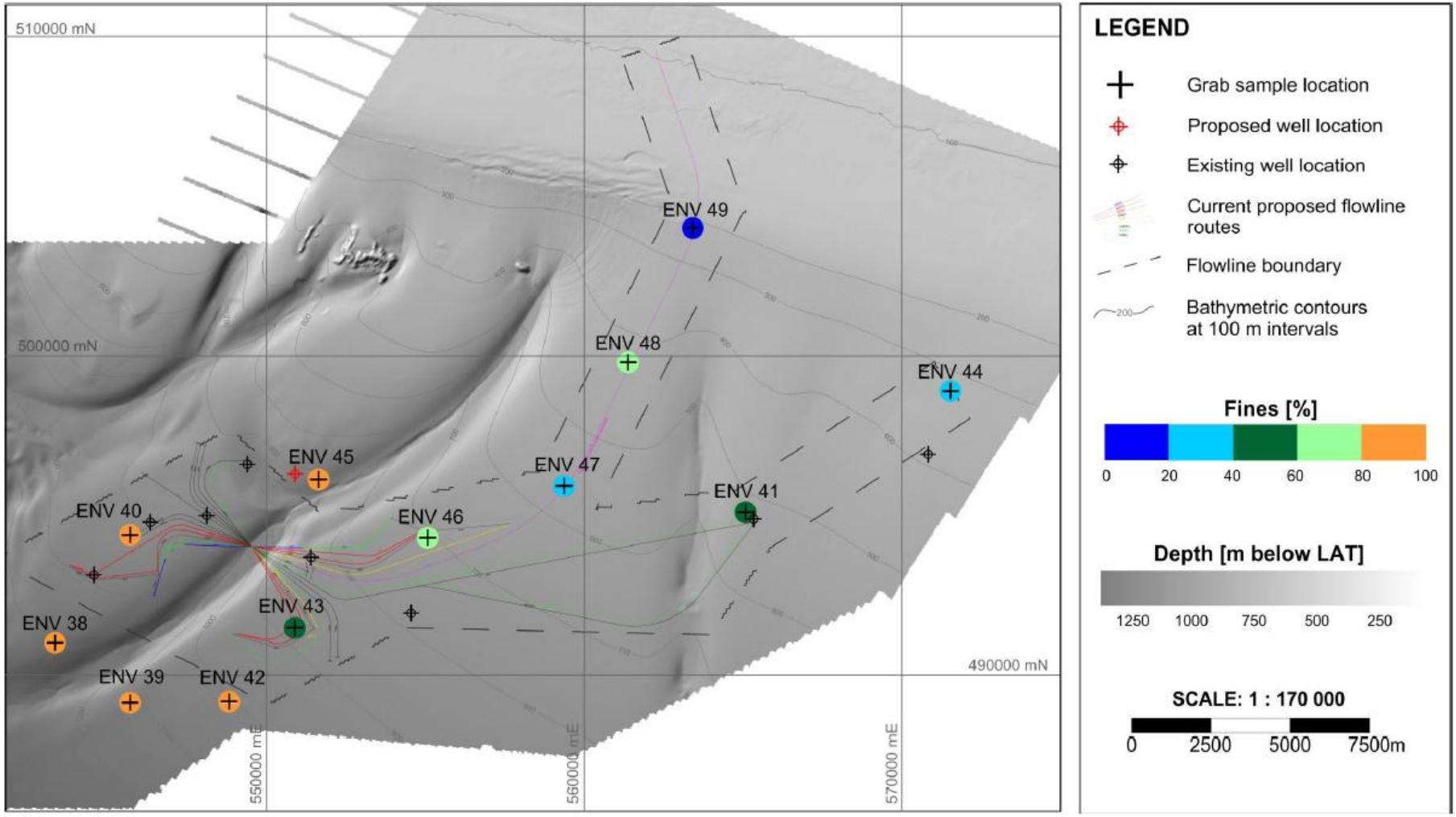


Figure 13 Spatial distribution of percentage fines (<63 µm)

Sediments within the survey area are all very poorly sorted and ranged from fine sand/coarse silt at most of the shallowest stations (Station 49, 44, 47 and 41), to medium silt at the intermediate depth stations (Stations 46, 45 and 43), to fine silts at the deepest stations (Station 40, 42, 39 and 38). At all stations less than 600 m deep, excluding Station 48, the proportion of sand is relatively high (42% to 85%) and the proportion of silt relatively low (14% to 39%). This trend is reversed at stations in water depths greater than 600 m, where sediments all consist of more than 79% silt and less than 21% sand. The amount of coarse sediment material is less than 1% at all stations. These results are consistent with the seabed features interpretation, which suggests sediments on the outer shelf comprise silty sand, while slope sediments largely consist of slightly silty sandy clay. Proportions of fine sediment show a positive correlation with depth ($P<0.001$), whereas the proportion of sand show a negative correlation with depth ($P<0.001$).

The results of the granulometric analysis for the current survey appear to be consistent with previous literature describing this region that suggest the presence of a range of sediment types, varying between soft sediments (mud and sandy mud), sandy sediments and hard substrate (Martos *et al*., 1991).

Comparable data for fines, sand and coarse sediment percentages from the EAF Nansen (EAF Nansen, 2010) and the TDI-Brooks surveys (TDI Brooks, 2008) are presented in Table 9.

Data are averaged from stations located within the depth range 200 m to 1300 m. Results from the current survey compare well with the previous EAF Nansen and TDI Brooks surveys, although variability is slightly greater in the data from these previous surveys. This is most likely due to the larger spatial area from which data are selected for comparison. Sediments are also in line with the data collected from the Phase 2&4 surveys from the current program which demonstrate that sediments towards the end of the proposed pipeline route, in water depths approaching 100 m are dominated by sand and fine sediments with limited or no coarse components, concurrent with the predominantly sandy sediments described from the shelf sediments in the current survey area.

Multivariate Analysis

Patterns in the distribution of seabed sediments are also examined by multivariate statistical analysis, in order to identify clusters of stations with similar granulometry. The influence of sediment granulometry on other environmental variables means that clusters of stations with similar granulometry may also exhibit similar chemical and biological characteristics.

Multivariate analyses are undertaken using the Plymouth Routines in Multivariate Ecological Research (PRIMER) v6.0 statistical package (Clarke and Gorley, 2006). Data for the percentage composition within one phi unit sieve size classes are analysed using the Bray-Curtis similarity measure. A cluster analysis, which outputs a dendrogram displaying the relationships between data based on this similarity measure, is displayed in Figure 14. Ordination of samples by non-metric multi-dimensional scaling (nMDS), which outputs a map or configuration of the samples based on the similarity matrix, is displayed in Figure 15.

The similarity profiling (SIMPROF) algorithm is used to identify statistically significant groupings in the data ($P=0.05$), with statistically significant splits shown as black lines and non-significant splits as red lines. The SIMPROF analysis formed nine clusters. This clustering is considered to be an over-differentiation of the dataset due to the low variability between samples. Consequently the dendrogram is divided into two predominant groups which split from one another at a similarity level of approximately 53% and had over 70% within group similarity (Figure 15). The resulting cluster groups, Clusters A and B, correspond to logical divisions in the dendrogram, thus demonstrating broader scale changes in sediment type. The partitioning of the stations into these two groups is consistent with their relative proportions of sand and silt, as described in Section Particle Size Distribution.

The mean proportion of sediment in each size class is calculated for each cluster (Table 10) and displayed with example seabed and grab sample photographs (Figure 16).

Cluster A shows a bimodal distribution, the main peak at 2 to 3 phi and a second smaller peak at 7 to 8 phi. This cluster contains stations with relatively high proportions of fine sand (2 phi, ~19%) and very fine sand (3 phi, ~18%), the second peak corresponding to very fine silt (7 phi, ~9%) and clay material (8 phi, ~8%). Cluster B exhibits a unimodal distribution, peaking at 7 phi. This cluster contains finer sediments than the stations in Cluster B, with higher proportions of fine silt (6 phi, ~18%), very fine silt (7 phi, ~20%) and clay material (8 phi, ~18%).

The spatial distribution of the sediment clusters within the survey area is displayed in Figure 17.

Cluster A contains stations located on the continental shelf and upper slope at relatively shallow depths (219 m to 561 m). With the exception of Station 48 (427 m), Cluster B contains stations on the lower slope at depths greater than 600 m.

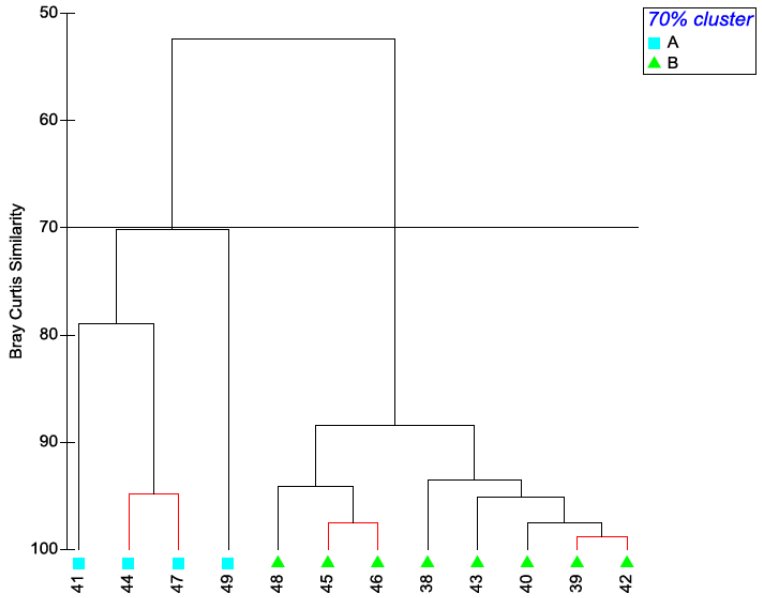


Figure 14 Dendrogram of Bray Curtis similarity of sediment PSD data

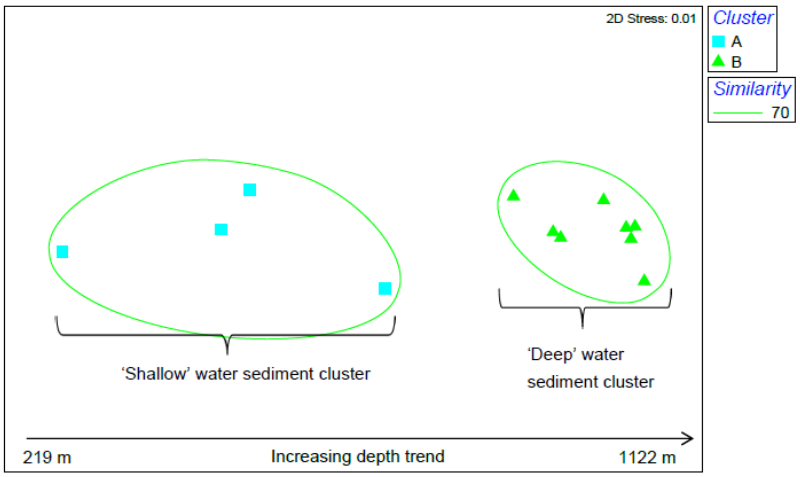


Figure 15 nMDS ordination of Bray Curtis similarity of sediment PSD data

Table 10 Summary of Sediment PSD Multivariate Clusters

Cluster		Sieve Size [Phi Units]											
		-2	-1	0	1	2	3	4	5	6	7	8	>8
A	Mean	0.05	0.22	1.70	9.86	19.23	18.42	13.71	7.69	6.81	8.55	8.20	5.56
	SD	0.09	0.33	2.90	5.55	5.49	3.53	2.03	3.26	4.58	4.35	3.70	2.00
B	Mean	0.00	0.02	0.02	0.34	1.83	4.48	8.94	14.60	18.37	20.11	18.43	12.87
	SD	0.00	0.00	0.01	0.29	0.82	1.07	1.09	0.38	0.81	1.30	1.03	0.67

Note: SD = 1 standard deviation

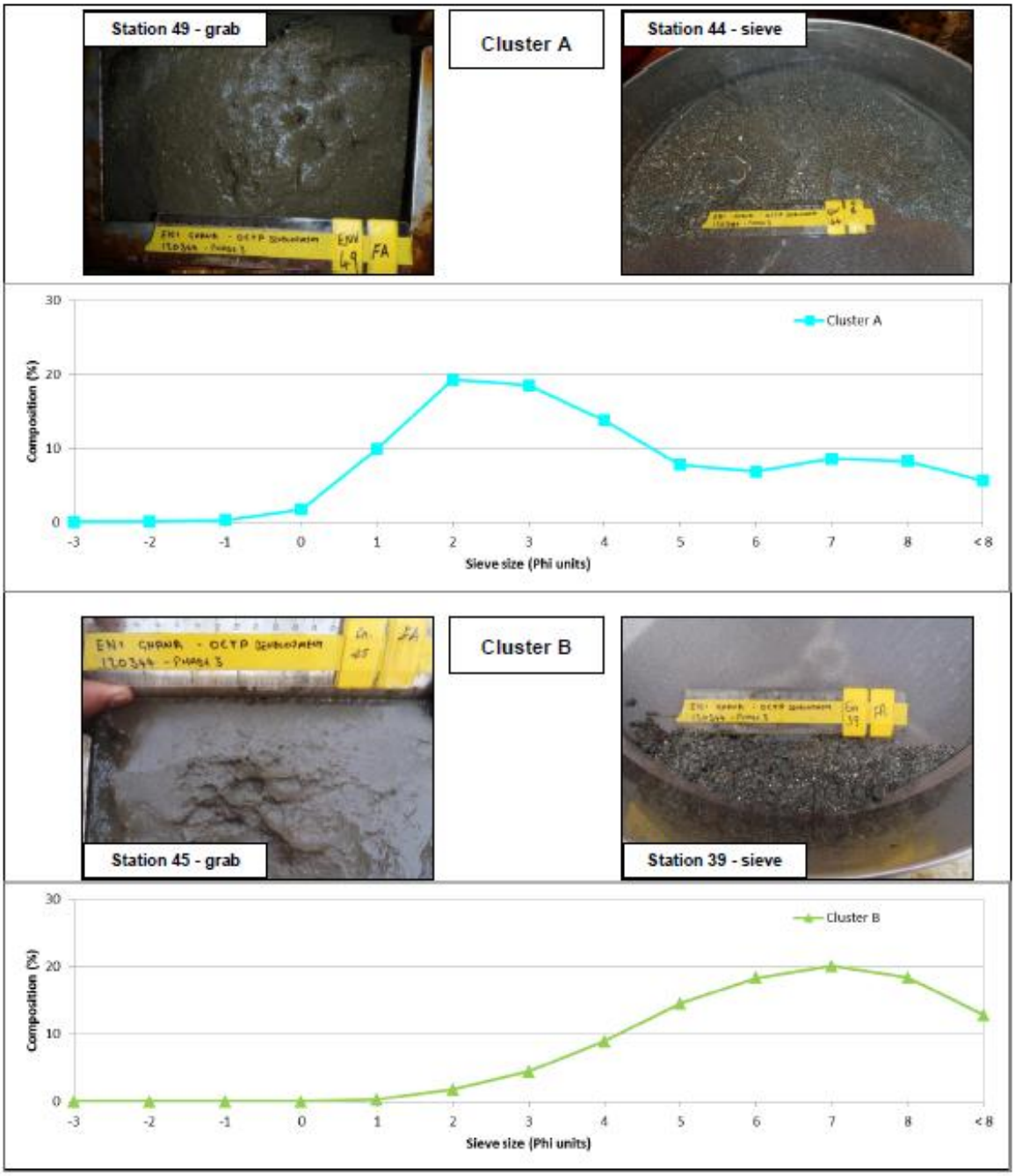


Figure 16 Example photographs and PSD for each sediment cluster

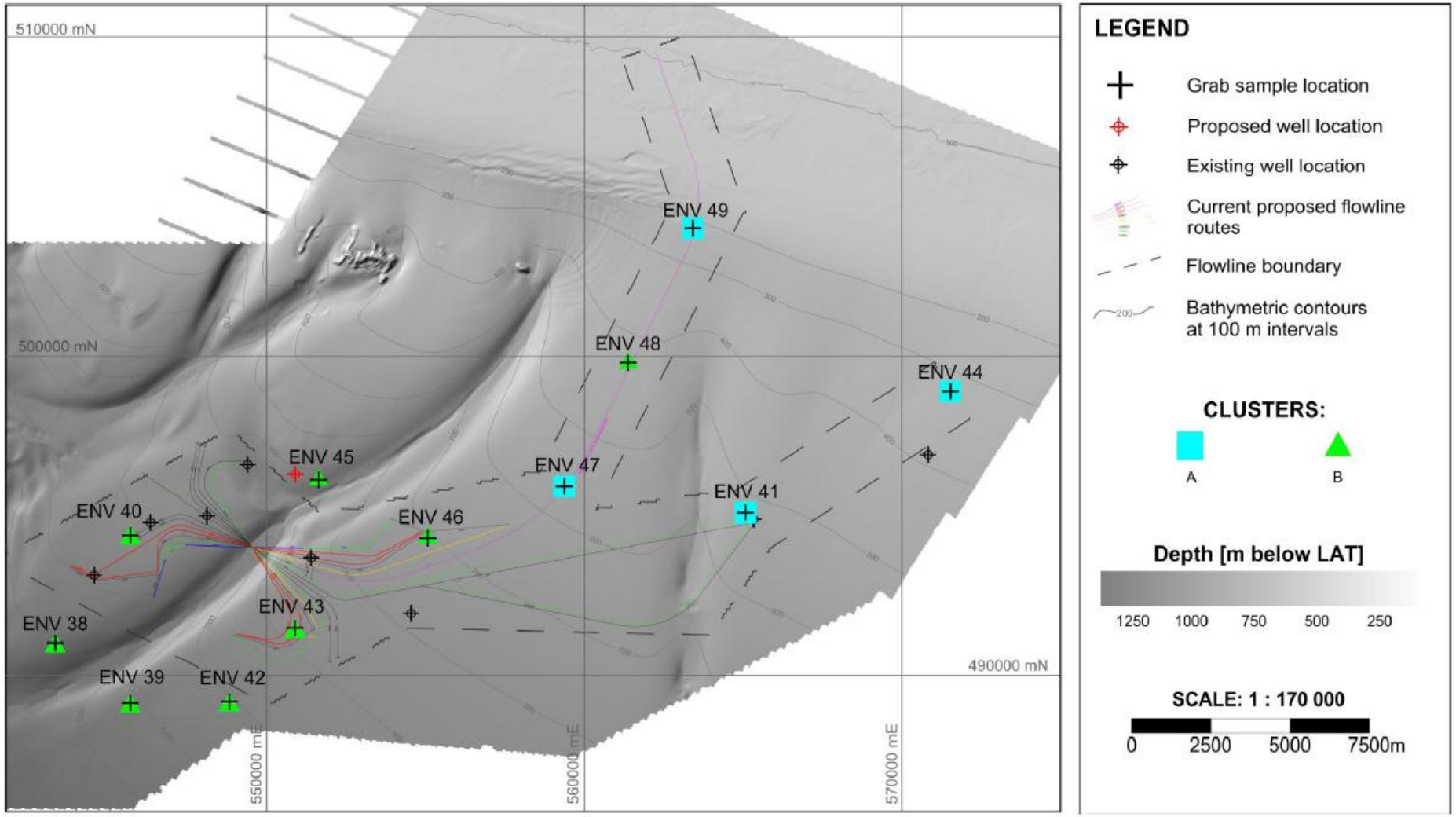


Figure 17 Spatial distribution of multivariate sediment clusters

Microbiological Analysis

In the field, physico-chemical subsamples are analysed for sulphate-reducing bacteria (SRB) content, using a SRB rapid check kit. High levels of sulphate-reducing bacteria present in a sample can be indicative of nutrient enrichment and anoxia; however, a key role can be played by SRB consortia in the anaerobic biodegradation of hydrocarbons in sediments (Perez-Jimenez *et al*., 2001).

The SRB rapid check kit results showed SRB levels to range from 10^3 to 10^6 cells per ml (see Table 11). From these results, there don't appear to be any spatial trends in the data. The data range is similar to that in volume 1, which showed levels of SRB at between 10^3 and 10^6 cells per ml at the deeper stations.

Table 11 Summary of Microbiological Analysis (SRB)

Station	SRB (cells per ml)
38	10^6
39	10^6
40	10^5
41	10^4
42	10^6
43	10^3
44*	10^4
44	10^5
45	10^4
46	10^6
47	10^5
48	10^3
49	10^4

Note: SRB = sulphate-reducing bacteria.
*Samples taken in wrong location due to positioning error.

Organic Carbon Analysis

Organic matter, primarily comprising detrital matter and naphthenic materials, i.e. carboxylic acids and humic substances, performs an important role in marine ecosystems providing a source of food for suspension and deposit feeders, which may then be preyed upon by carnivores. This has led to the suggestion that variation in benthic communities can be influenced to some extent by the availability of organic carbon (Snelgrove and Butman, 1994).

Organic carbon is also an important absorber (scavenger) of heavy metals and may be of use in

interpreting the distribution of metals (McDougall, 2000). Total organic carbon (TOC) measurements are made by pre-treating samples with strong acid prior to quantitation, which liberates inorganic carbonates. Dried samples are analysed for total organic carbon content using an induction furnace.

The results of the total organic carbon analysis are presented in Table 12 and the spatial distribution of the concentrations of TOC is displayed in Figure 18. TOC concentrations across the survey area ranged from 0.86% to 3.02% (Stations 49 and 40, respectively). These values compare well with results from the TDI Brooks (2008) survey, which ranged from 1.41% to 2.99%, although the proportions of fines at the comparison stations are increased (Table 12). Organic carbon content is higher than that reported form the phase 2&4 surveys in shallower water, which

ranged from 0.07% to 1.43%. Higher organics in the deeper water of the current survey area is likely due to a more depositional environment with higher fine content. Sediment samples are not analysed for TOC in the EAF Nansen (2010) study and therefore only results from the TDI Brooks survey are reported. Note that for comparative purposes only those TOC samples (or samples for sediment PSD analysis) from the TDI Brooks (2008) survey which were obtained within the depth range surveyed in the current study are compared to. This included TDI Brooks stations EBS001, EBS002, EBS004, EBS006 and EBS007.

Table 12 Summary of Organic Carbon Analysis

Station		Fines (%)	Total Organic Carbon (%)
38		90.62	2.57
39		86.71	2.43
40		88.57	3.02
41		57.81	2.47
42		86.92	2.58
43		85.40	2.90
44		36.24	1.59
45		81.42	2.39
46		79.89	2.96
47		38.75	2.78
48		75.38	1.38
49		14.43	0.86
Current Survey	Min	14.43	0.86
	Mean	68.51	2.33
	Max	90.62	3.02
	SO	25.51	0.69
TDI Brooks (2008)	Min	67.42	1.41
	Mean	87.41	2.34
	Max	97.18	2.99
	SO	12.73	0.62

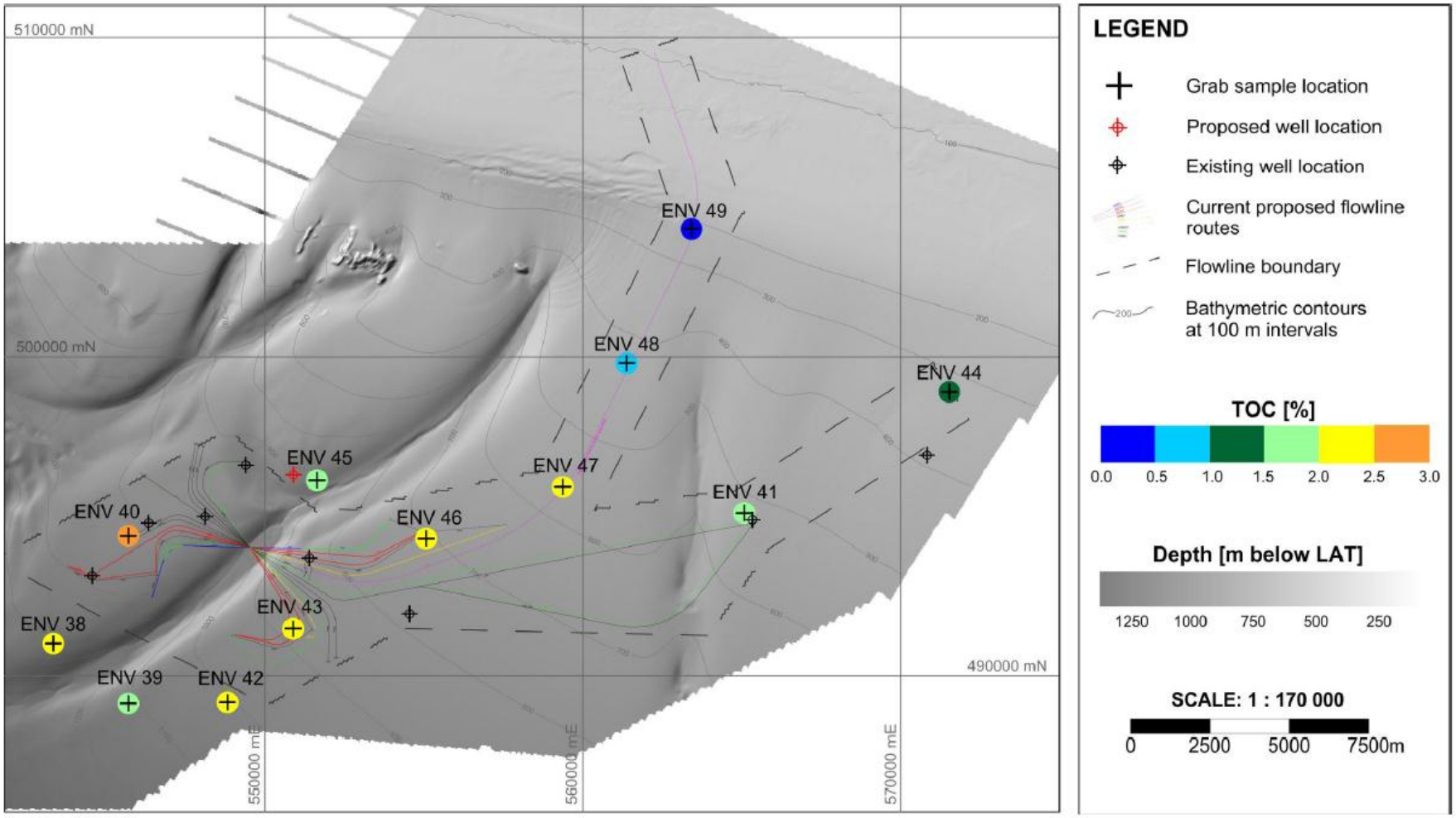


Figure 18 Spatial distribution of Total Organic Carbon (TOC) [%]

Nutrient Analysis

Sediment samples were analysed for nitrogen, ammonium, nitrate, total phosphorus and available phosphate. The results of these analyses are provided in Table 13, with the spatial distribution of total phosphorus displayed in Figure 19.Nitrogen and phosphorous are essential nutrients for primary production and the supply of these elements is the most frequent rate-limiting process for marine production. Marine sediments act as a sink for these elements and benthic fauna play an important role in releasing nutrients from their organic binding during metabolism, so that they are once again made available to bacteria, algae (macro and micro), phytoplankton etc. (Barnes and Hughes, 1999).

Nitrogen concentrations are ranged from 0.09% (Station 49) to 0.39% (Station 46). Nitrate is below the detection limit (<1.5 µg.g-1) at all stations. Available phosphate concentrations range from 19.3 µg.ml-1 (Station 38) to 37.6 µg.ml-1 (Station 49). Concentrations of available phosphate tend to be lower at the deeper stations, especially those located at depths greater than 800 m. Total phosphorous concentrations range from 805 µg.g-1 (Station 42) to 1370 µg.g-1 (Station 49) and are generally similar at all stations (average 889 ug.g-1), apart from at the shallowest station (Station 49, 219 m), where values are much higher (1370 ug.g-1). Available phosphate and total phosphorous are both negatively correlated with depth and percentage fines ($P<0.05$), although these trends are not clear cut. For example, considering Stations 41, 44, 46 and 48 only, available phosphate increase with increasing depth which contrast with the trend when all data are considered. In addition, removal of Station 38 from the correlation between total phosphorous and depth resulted in the correlation being not significant.

Total phosphorus concentrations in the present study are higher than recorded in the previous Jubilee Field survey, which ranged from 400 µg.g-1 to 690 µg.g-1 (TDI Brooks, 2008). Other comparable nutrients are not measured in previous comparable surveys from the region.

Table 13 Summary of Nutrient Analysis

Station	Depth [m]	Fines [%]	Nitrogen [%]	Ammonium [µg.g^{-1}]	Nitrate [µg.g^{-1}]	Total Phosphorus [µg.g^{-1}]	Available phosphate [µg.ml^{-1}]
38	1122	90.62	0.33	3.9	<1.5	852	19.3
39	1112	86.71	0.34	4.9	<1.5	852	23.6
40	922	88.57	0.35	3.2	<1.5	893	26.8
41	519	57.81	0.32	0.9	<1.5	863	30.1
42	1007	86.92	0.32	<0.5	<1.5	805	25.1
43	883	85.40	0.39	0.8	<1.5	955	27.0
44	327	36.24	0.19	0.9	<1.5	933	26.6
45	834	81.42	0.30	1.0	<1.5	883	27.3
46	708	79.89	0.39	1.2	<1.5	932	32.4
47	561	38.75	0.35	0.8	<1.5	920	34.7
48	427	75.38	0.16	0.7	<1.5	891	28.5
49	219	14.43	0.09	0.7	<1.5	1370	37.6
Current Survey	Min	14.43	0.09	<0.5	<1.5	805	19.3
	Mean	68.51	0.29	-	-	929	28.3
	Max	90.62	0.39	4.9	<1.5	1370	37.6
	SD	25.51	0.10	-	-	145	4.9

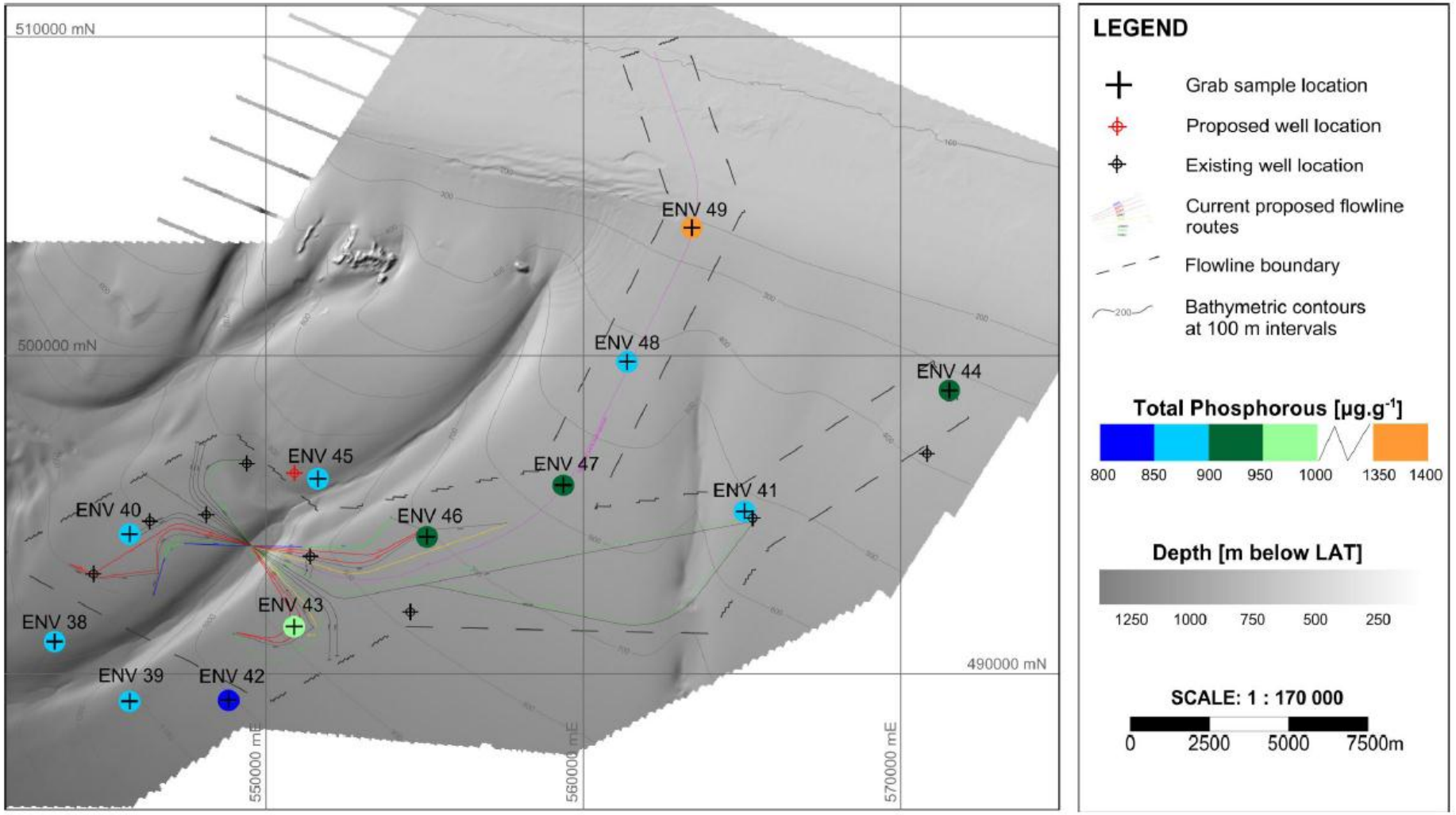


Figure 19 Spatial distribution of total phosphorus [µg.g-1]

Hydrocarbon Analysis

The extraction of hydrocarbons is undertaken on wet sediment samples. This technique is considered to extract a greater proportion of the target analytes than dry extraction methods; Wong and Williams (1980) estimated that around 16% of hydrocarbons determined by wet extraction procedures were lost as a consequence of the drying process. Comparison with baseline values from previous surveys or published literature should be undertaken with caution as it is often not clear whether wet or dry extraction has been employed.

Total Hydrocarbons Concentrations

Total hydrocarbon concentrations (THC), total n-alkanes and carbon preference index (CPI) are summarized for each station in Table 14. The spatial distribution of THC is displayed in Figure 20.

Total hydrocarbon concentrations are low at most stations, ranging from 1.5 µg.g-1 to 15.2 µg.g-1 (Stations 49 and 47, respectively), but are considerably elevated at Station 41 (787 µg.g-1).

Excluding Station 41, levels of THC in the current survey are comparable to those recorded in the previous EAF Nansen survey, where concentrations ranged from less than 1 µg.g-1 to 14.7 µg.g-1 at stations from comparable depths (EAF Nansen, 2010). Background levels of THC (all stations excluding station 41) are comparable to levels recorded during the phase 2&4 pipeline survey demonstrating typical THC levels below 10 µg.g-1.

Elevated THC at station 41 is strongly indicative of contamination. Station 41 is located 340 m from the Gye Nyame-1 exploration well, which is considered to be the source of the contamination. Further details on the hydrocarbons found at this location are discussed in the sections below.

Table 14 Summary of Hydrocarbon Concentration [µg.g-1 dry weight]

Station		THC	n-alkanes (nC_{12-36})	UCM	CPI			Pr	Ph
					nC_{12-20}	nC_{21-36}	nC_{12-36}		
38		7.1	1.59	3.3	1.34	1.38	1.38	0.001	0.001
39		7.8	1.50	4.0	1.27	1.01	1.01	0.001	<0.001
40		8.4	1.76	3.7	1.23	0.99	1.00	0.001	0.001
41		787.0	16.80	643.0	0.82	5.80	0.95	0.622	0.229
42		5.9	1.19	3.1	1.14	2.48	2.39	0.001	0.001
43		4.0	0.81	1.9	1.13	2.54	2.42	0.002	0.001
44		2.9	0.33	1.6	0.83	0.88	0.87	0.001	<0.001
45		7.2	1.28	3.7	1.13	1.08	1.08	0.002	0.001
46		7.7	1.37	4.1	1.29	1.12	1.13	0.002	0.001
47		15.2	2.99	12.0	1.36	1.28	1.28	0.003	0.001
48		2.2	0.33	1.1	0.86	2.35	2.17	0.001	<0.001
49		1.5	0.16	0.8	0.79	1.68	1.54	0.001	0.001
Current Survey	Min	1.5	0.16	0.8	0.79	0.88	0.87	0.001	0.001
	Mean	71.4	2.51	56.9	1.10	1.88	1.44	0.053	0.026
	Max	787.0	16.80	643.0	1.36	5.80	2.42	0.622	0.229
	SD	225.4	4.57	184.6	0.22	1.38	0.57	0.179	0.076

Note: THC = total hydrocarbon concentration; UCM = unresolved complex mixture; CPI = carbon preference index (ratio of the sum of odd- to the sum of even-carbon alkanes); Pr = pristane; Ph = phytane; Min = minimum; Max = maximum SD = 1 standard deviation.

n-Alkanes - Total n-alkanes

Excluding Station 41, total n-alkane (nC12-36) concentrations measured during the current survey are low, ranging from 0.16 µg.g-1 (Station 49) to 2.99 µg.g-1 (Station 47). At Station 41, total n-alkane (nC12-36) concentrations are markedly increased (16.8 µg.g-1). The concentration of total n-alkane (nC12-36) is positively correlated with THC ($P<0.001$).

Levels of unresolved complex mixture (UCM), which are made up of hydrocarbons of various origins that cannot be resolved by GC analysis, is also positively significantly with THC and total n-alkanes (nC12-36) ($P<0.001$). UMC is typically low at most station (0.8 µg.g-1 to 12.0 µg.g-1), although is considerably elevated at station 41 (643.0 µg.g-1).

n-Alkanes - Carbon Preference Index

The carbon preference index (CPI) is used to assess the relative contribution from petrogenic and biogenic sources in hydrocarbon samples and is determined by calculating the ratio of the sum of odd to the sum of even-carbon alkanes. The range of alkanes from nC21-36 is of particular interest as odd carbon n-alkanes from terrestrial plants elute in this region. Pristine sediments exhibiting a predominance of odd number biogenic alkanes would be expected to have a CPI value of greater than 1.0, while crude oil or refined products show no preference for odd or even n-alkanes and achieve a CPI close to unity (1.0) (McDougall, 2000).

The CPI ratios for nC12-36 range between 0.87 and 2.42 (Tab. 7.16). At most stations values are greater than 1, suggesting a dominance of biogenic/terrestrial n-alkanes. These stations also has a dominance of odd number, longer chained alkanes (nC21-36), indicating that the major source of n-alkanes is from terrestrial plants. Notably the CPI ratio for nC21-36 at station 41 is 5.80, which may, on the face of it, be interpreted as a biogenic signature; this however is not the case as the actual n-alkane values for the nC21-36 range are very low at station 41 (Table 15), dwarfed by the highly elevated n-alkanes in the nC12-20 range. The CPI for the nC21-20 range at station 41 is 0.82 further indicating that this station is contaminated with petrogenic hydrocarbons.

Several stations has nC12-36 CPI ratios of approximately 1 (Stations 39, 40, 44, 45). These stations show a dominance of longer chained alkanes (nC21-36). The relatively low CPI ratios at these stations are not interpreted as petrogenic contamination and are a function of low overall n-alkanes values.

Pristane and Phytane

Pristane and phytane are isoprenoidal alkanes which are common constituents of crude oils. However, phytane is generally absent or only present at low levels in uncontaminated natural systems (Blumer and Snyder, 1965).

Concentrations of these isoprenoids mirrored THC and n-alkanes, with low levels recorded at all stations apart from Station 41. Excluding Station 41, pristane concentrations range from 0.001 µg.g-1 to 0.003 µg.g-1 and phytane concentrations range from less than the detection limit (0.001 µg.g-1) to 0.001 µg.g-1. This indicates that sediments at these stations are not contaminated. In contrast, pristane and phytane concentrations of 0.622 µg.g-1 and 0.229 µg.g-1 are recorded at Station 41, respectively, indicating petrochemical contamination of sediments at this station.

Table 15 Individual Aliphatic Concentrations [ng.g-1 dry weight]

n-Alkane	Station 38	39	40	41	42	43	44	45	46	47	48	49
nC12	8.1	6.8	8.3	1066.0	8.2	8.3	7.7	10.5	7.4	10.0	6.8	4.2
nC13	4.7	4.8	5.5	709.0	4.9	4.8	3.8	6.3	5.1	9.3	3.7	2.3
nC14	2.8	1.9	2.9	5140.0	2.2	2.1	1.5	3.4	2.1	5.5	1.7	0.9
nC15	7.8	5.6	7.1	5250.0	5.3	4.0	2.0	5.6	5.1	13.4	2.5	1.1
nC16	1.8	1.8	1.7	1680.0	1.6	1.5	0.9	1.6	1.6	4.2	0.8	1.7
nC17	10.0	6.7	7.5	666.0	7.6	5.8	2.6	8.5	8.0	15.2	2.1	1.8
nC18	5.6	5.4	6.3	368.0	6.0	3.4	1.9	5.8	5.1	13.8	2.0	1.7
nC19	10.1	9.1	11.2	277.0	9.7	7.7	3.0	8.6	8.8	19.8	2.6	2.2
nC20	6.0	4.8	6.2	161.0	6.2	4.5	1.7	4.5	4.7	8.9	1.2	0.9
nC21	9.9	8.8	11.0	988.0	9.2	6.8	1.4	6.9	7.6	17.9	1.4	0.9
nC22	10.2	9.5	10.2	67.1	10.5	6.9	1.6	7.7	7.5	23.6	2.0	1.4
nC23	20.4	18.1	23.1	47.9	20.9	13.7	2.9	14.4	15.8	48.2	4.1	2.3
nC24	16.1	15.3	15.4	29.1	15.3	11.5	2.9	10.4	11.7	48.0	3.1	2.2
nC25	40.8	39.7	44.4	45.0	34.1	25.7	6.7	27.3	29.6	88.9	7.3	4.2
nC26	453.0	572.0	675.0	57.3	141.0	85.4	128.0	445.0	470.0	840.0	43.9	33.2
nC27	90.5	79.8	89.3	40.9	84.2	59.5	13.0	62.9	69.1	172.0	17.6	7.8
nC28	45.9	46.0	47.0	33.0	44.9	32.5	8.3	35.0	36.8	109.0	9.6	4.7
nC29	287.0	236.0	266.0	87.8	257.0	176.0	41.6	205.0	217.0	486.0	63.4	25.7
nC30	41.0	33.4	38.4	21.5	41.8	27.9	5.9	29.4	30.9	86.9	9.4	3.1
nC31	277.0	230.0	273.0	65.3	253.0	169.0	50.2	204.0	228.0	502.0	73.3	32.0
nC32	51.2	35.7	53.6	5.3	46.9	35.9	12.3	39.6	44.6	104.0	14.3	5.1
nC33	134.0	96.8	114.0	16.3	117.0	77.6	20.6	89.1	105.0	238.0	36.3	11.2
nC34	13.4	6.5	7.5	4.5	13.5	8.6	2.0	9.4	9.8	30.2	5.0	1.1
nC35	30.4	20.7	28.6	5.8	34.5	20.5	6.6	24.2	24.7	67.9	13.3	3.4
nC36	11.6	7.0	10.0	6.0	11.7	7.1	2.2	9.2	10.9	29.7	4.9	1.3
Total [µg.g-1]	1.6	1.5	1.8	16.8	1.2	0.8	0.3	1.3	1.4	3.0	0.3	0.2
Pristane	1.1	0.9	1.3	622.0	1.2	1.5	0.8	1.6	1.6	2.8	0.5	0.8
Phytane	0.5	0.5	0.6	229.0	0.6	0.6	0.4	0.5	0.6	0.9	0.3	0.5

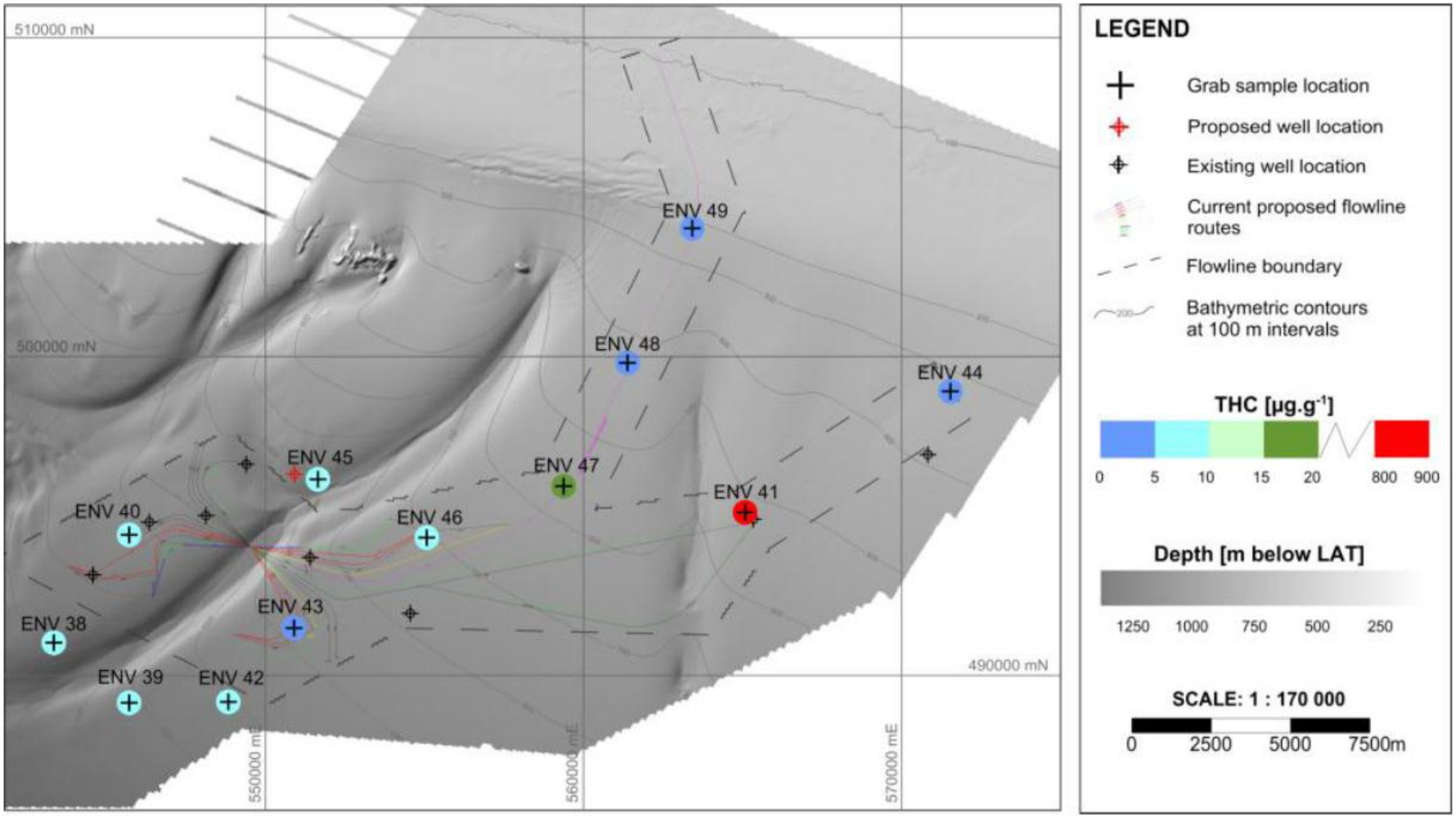


Figure 20 Spatial distribution of total hydrocarbon concentration [µg.g-1]

Gas Chromatography Traces

The gas chromatography traces are generally similar at the majority of stations (i.e. Stations 38, 39, 40, 42, 43, 44, 45, 46, 48 and 49) with only minimal variation observed between them. At Station 41, however, differences in the GC trace are readily apparent

Example GC traces from Station 42 and 41 are displayed in Figure 21 and Figure 22, respectively, while all traces are provided in the annex B2.2 Sediment-Hydrocarbon Analysis- Gas Chromatography Traces. Examination of the traces shows a slight 'hump' of UCM at the majority of stations with an associated homologous series of odd-carbon dominated n-alkanes in the higher boiling point range nC23-36 (Figure 21). In particular, most traces show peaks eluting at nC29, nC31 and nC33 (e.g. Station 40 and 47), as evident from review of the individual aliphatic concentrations (Table 15). This signature is thought to be indicative of an input of terrestrial organic matter into the sediments.

A weak signature is observed around nC21 at all stations that is thought to be of biogenic origin. As this slight peak is seen on all traces (including those from the phase 2&4 study) it is considered to be representative of background conditions. Variation in the UCM 'hump' is apparent, independent of depth range, with some stations showing a smaller hump (e.g. Stations 43 and 44) compared to others. A high peak eluting at the even numbered nC26 alkane is also observed at many stations (e.g. Station 42, Figure 21), again this is not considered to be indicative of contamination, however the source is not identified.

The GC trace at Station 41 is very different to the rest of the traces (Figure 22), higher peaks being observed in the shorter chain alkanes. Individual aliphatic concentrations for n-alkanes measured in the range C12 to C21 (and to a certain extent C22 and C23) are highly elevated compared to all other stations (Table 15), however the GC trace shows that relative to the UCM these peaks are not well resolved, this suggests that the inputs are well weathered and not current. The GC trace profile suggests that the hydrocarbon contamination at station 41 is likely to be from drilling muds (probable well weathered low-toxicity mud). It is highly likely this this drilling related contamination is from past drilling activities at the Gye Nyame-1 exploration well located 340 m to the south-east of station 41.

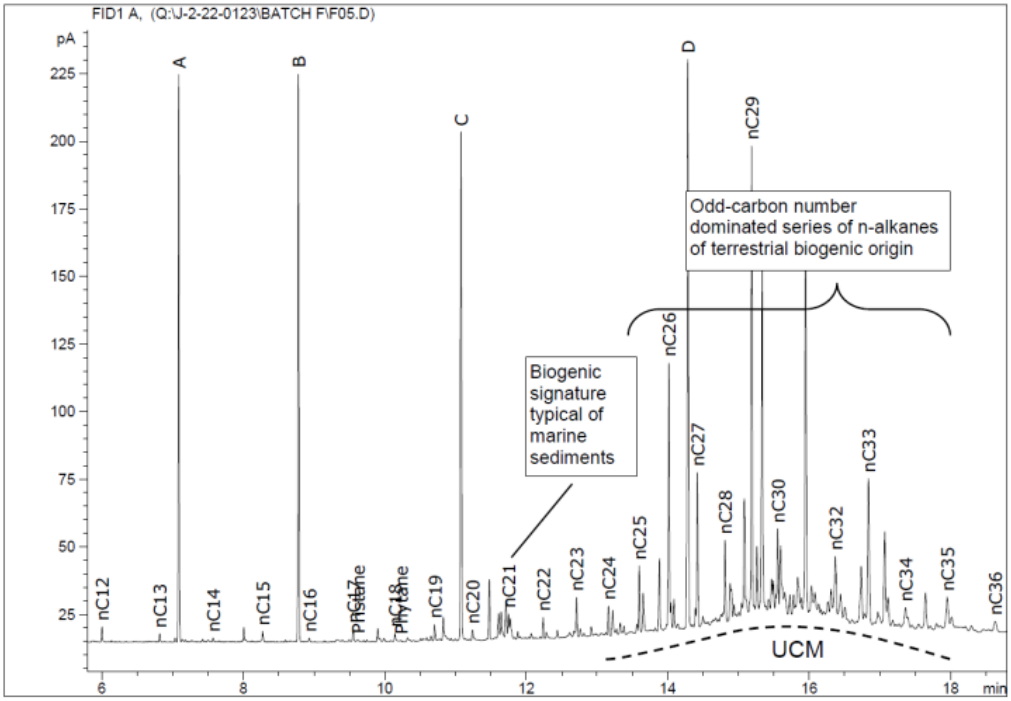


Figure 21 **Example gas chromatography trace (simple from Station 42)**

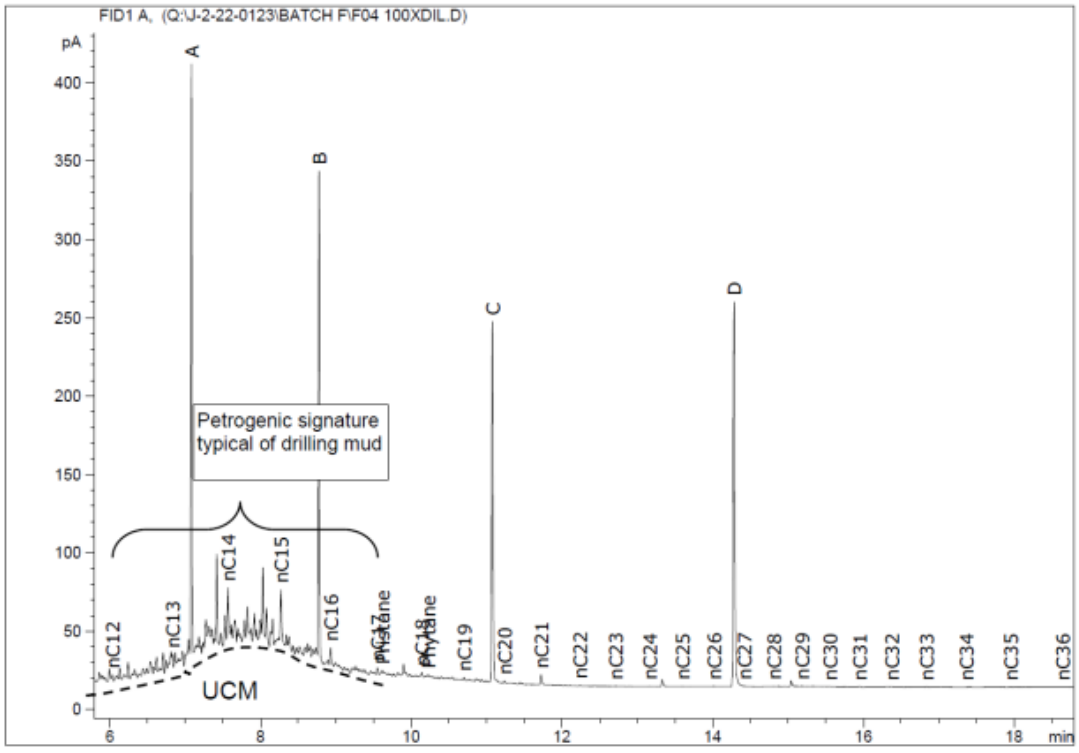


Figure 22 **Example gas chromatography trace (sample fromStation 41)**

Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are evident throughout the marine environment (Laflamme and Hites, 1978), with natural sources including plant synthesis and natural petroleum seepage.

However, these natural inputs are dwarfed in comparison to the volume of PAHs arising from the combustion of organic material such as forest fires and the burning of fossil fuels (Youngblood and Blumer, 1975). These pyrolytic sources tend to result in the production of heavier weight 4 to 6 ring aromatics (but not their alkyl derivatives) (Nelson-Smith, 1972).

Another PAH source is petroleum hydrocarbons, often associated with localised drilling activities. These are rich in the lighter, more volatile 2 to 3 ring aromatics (NPD; naphthalene, phenanthrene, anthracene and dibenzothiophene (DBT) with their alkyl derivatives). As the lightest and most volatile fraction, the NPD is the dominant PAH in petrogenic hydrocarbons but is quickest to degrade and weather over time.

Many different PAHs exist, however certain ones are particularly toxic, prevalent or indicative of anthropogenic contamination. To assess the level of the most significant PAHs from the collected sediment samples two sets of PAHs are analyzed, the UK Department of Trade and Industry (DTI) specified PAHs (now part of the Department of Energy and Climate Change (DECC)), and the US environmental protection agency (EPA) priority 16 PAHs. A summary of the DTI/DECC specified PAHs is provided in Table 16 and discussed in paragraph Polycyclic Aromatic Hydrocarbons (PAHs) - Total PAH and the US EPA PAHs are given in Table 18 and discussed in paragraph Polycyclic Aromatic Hydrocarbons (PAHs) - USEPA 16 PAH. Total 2-6 ring PAHs at each station are displayed on Figure 25.

Table 16 Summary of DECC Specified PAH Concentrations [ng.g-1 dry weight]

Station		Sum All PAH (2 to 6 Ring)	Sum NPD	Sum 4-6 Ring	NPD / 4-6 Ring Ratio
38		34	9	25	0.4
39		30	8	22	0.4
40		36	11	25	0.4
41		180	161	19	8.5
42		26	8	18	0.4
43		21	8	13	0.6
44		25	9	16	0.6
45		28	10	18	0.6
46		31	11	20	0.6
47		58	22	36	0.6
48		8	2	6	0.3
49		3	2	1	2.0
Current Survey	Min	3	2	1.0	0.3
	Mean	40	22	18.3	1.3
	Max	180	161	36.0	8.5
	SD	46	44	9.1	2.3

Note: NPD = naphthalene, phenanthrene, anthracene and dibenzothiophene (DBT) with their alkyl derivatives; SD = Standard deviation

Polycyclic Aromatic Hydrocarbons (PAHs) - Total PAH

Apart from Station 41, the sum of all 2-6 ring PAHs are low at all stations, ranging from 3 ng.g-1 at Station 49 to 58 ng.g-1 at Station 47. At Station 41, however, the sum of all 2-6 ring PAHs is elevated to 161 ng.g-1.

Total PAH concentrations correlate with both THC and UCM ($P<0.001$) and show a similar spatial distribution, with maximum concentrations of all analytes find to be highest at Station 41. PAH concentrations are considerably lower at all other stations, although slightly elevated concentrations of the alkylated C2 178 phenanthrene / anthracene group, and to a lesser extent naphthalene parent and alkylated species, are noted at Station 47.

Excluding Station 41, total PAH concentrations at the Jubilee Field are slightly higher than in the current survey, ranging from 116 ng.g-1 to 176 ng.g-1, at stations at depths comparable to those in the current study (i.e. between 942 m to 1264 m). However, no data from stations at shallower depths similar to those recorded in the current study (i.e. between 200 m and 900 m) are available for comparison (TDI Brooks, 2008). Levels of total PAHs from the phase 2&4 survey are comparable to the current survey with values ranging from 1 ng.g-1 to 56 ng.g-1, and not considered indicative of contaminated sediments.

Polycyclic Aromatic Hydrocarbons (PAHs) - NPD and 4-6 Ring PAH

The ratio of NPD PAH to 4-6 ring PAH is low at the majority of stations, ranging from 0.3 (Station 48) to 0.6 at a number of stations, the exception to this is a ratio of 2.0 and 8.5 at Stations 49 and 41, respectively. Overall levels of 4-6 ring PAHs are generally higher than NPD PAHs indicating a predominance of pyrolytic sources at station 49 higher NPD : 4-6 ring ratios at the station 49 is a function of the very low concentrations and should not be interpreted as a sign of petrochemical contamination. The higher ratio at station 41 however shows a strong dominance of NPD PAHs which is indicative of petrochemical contamination at this station.

Polycyclic Aromatic Hydrocarbons (PAHs) - Parent / Alkyl Distribution

PAH distribution plots (Figure 23 and annex B2.3 Sediment-Hydrocarbon Analysis- Parent Alkyl Pah Graphs) typically show a slight dominance of 4 to 6 ring (pyrolytically derived) PAHs at the majority of stations. The higher molecular weight (and therefore more persistent) 4 to 6 ring PAHs generally show a preference for parent compounds over alkyl groups, whereas the lighter, more easily degraded NPD PAHs tend to show a dominance of alkylated compounds. Parent NPD PAHs are observed, however these tend to be at low values and therefore are not thought to be indicative of any significant contamination. In contrast, the NPD 2-3 ring PAHs dominate Station 41 (Figure 24). Specifically, alkylated C2, C3 and C4 naphthalene groups are found at highly elevated concentrations at Station 41, indicating significant petrogenic contamination.

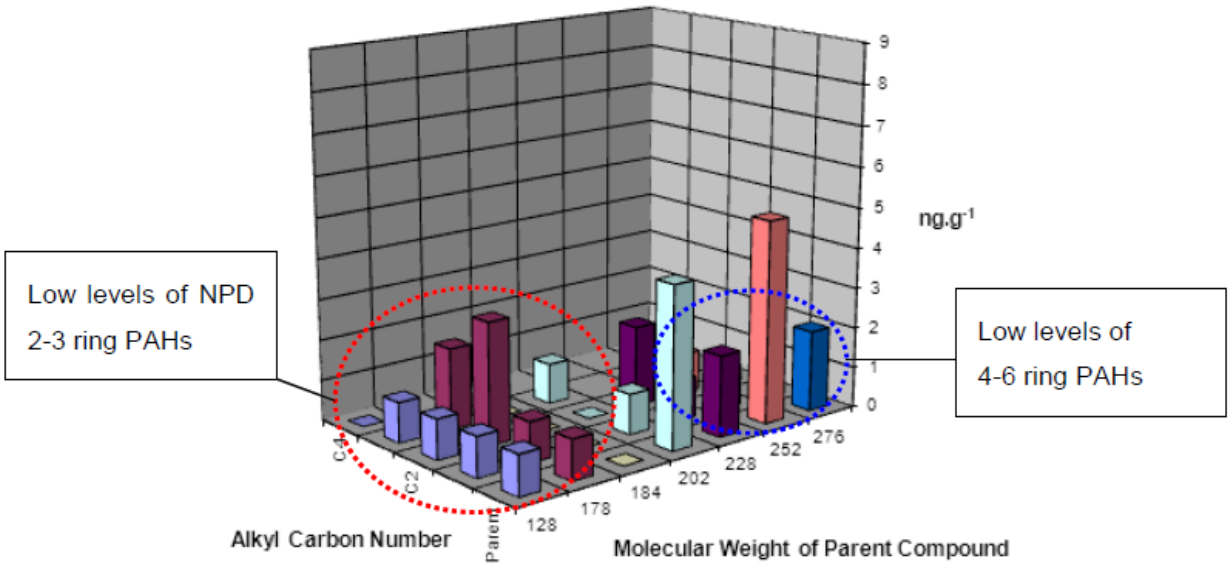


Figure 23 Total PAH parent alkyl distribution (sample from Station 46)

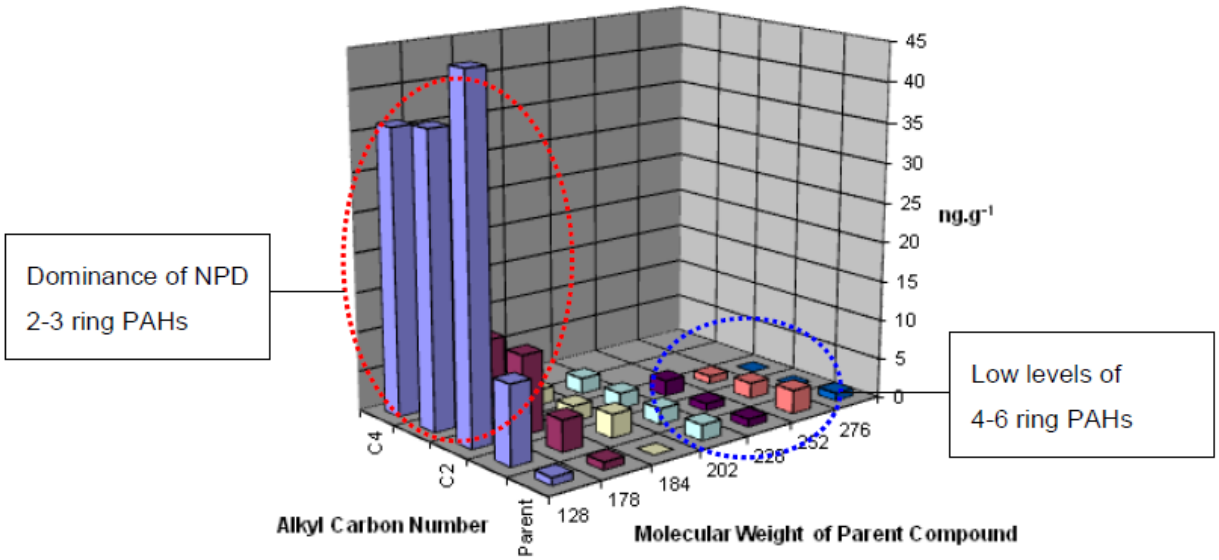


Figure 24 Total PAH parent alkyl distribution (sample from Station 41; note difference in scale to Figure 4-48).

Table 17 Individual DTI Specified PAH Concentrations [ng.g-1 dry weight]

	Stations											
PAH [ng.g^{-1}]	38	39	40	41	42	43	44	45	46	47	48	49
Naphthalene (128)	1	1	1	1	1	1	1	1	1	2	<1	<1
C1 128	1	1	1	10	1	1	<1	1	1	1	<1	<1
C2 128	1	1	1	45	1	1	1	1	1	2	<1	<1
C3 128	<1	<1	1	37	<1	<1	<1	1	1	2	<1	<1
C4 128	<1	<1	<1	36	<1	<1	<1	<1	<1	1	<1	<1
TOTAL 128	**3**	**3**	**4**	**129**	**3**	**3**	**2**	**4**	**4**	**8**	**<1**	**<1**
Phenanthrene / Anthracene (178)	1	1	1	1	1	1	2	1	1	2	<1	<1
C1 178	1	1	1	4	1	1	1	1	1	2	<1	<1
C2 178	3	2	3	10	2	2	2	3	3	5	1	1
C3 178	1	1	2	10	1	1	2	1	2	3	1	1
TOTAL 178	**6**	**5**	**7**	**25**	**5**	**5**	**7**	**6**	**7**	**12**	**2**	**2**
Dibenzothiophene (DBT)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
C1 184	<1	<1	<1	3	<1	<1	<1	<1	<1	<1	<1	<1
C2 184	<1	<1	<1	2	<1	<1	<1	<1	<1	1	<1	<1
C3 184	<1	<1	<1	2	<1	<1	<1	<1	<1	1	<1	<1
TOTAL 184	**<1**	**<1**	**<1**	**7**	**<1**	**<1**	**<1**	**<1**	**<1**	**2**	**<1**	**<1**
Fluoranthene / Pyrene (202)	4	4	5	2	3	2	4	2	4	5	<1	<1
C1 202	1	1	1	2	1	<1	1	1	1	1	<1	<1
C2 202	<1	<1	<1	2	<1	<1	<1	<1	<1	1	<1	<1
C3 202	1	1	1	2	<1	<1	<1	1	1	1	<1	<1
TOTAL 202	**6**	**6**	**7**	**8**	**4**	**2**	**5**	**4**	**6**	**8**	**<1**	**<1**
Benzanthracenes / Benzphenanthrenes (228)	3	2	2	1	2	1	2	2	2	3	1	<1
C1 228	1	1	1	1	1	1	1	1	1	1	<1	<1
C2 228	2	2	2	2	1	1	1	2	2	4	1	<1
TOTAL 228	**6**	**5**	**5**	**4**	**4**	**3**	**4**	**5**	**5**	**8**	**2**	**<1**
m/z 252	7	6	7	3	6	4	4	5	5	9	2	1
C1 252	2	1	2	2	1	1	1	1	1	3	1	<1
C2 252	1	1	1	1	1	1	<1	1	1	2	<1	<1
TOTAL 252	**10**	**8**	**10**	**6**	**8**	**6**	**5**	**7**	**7**	**14**	**3**	**1**
m/z 276	3	3	3	1	2	2	2	2	2	4	1	<1
C1 276	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1
C2 276	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1
TOTAL 276	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**6**	**1**	**<1**

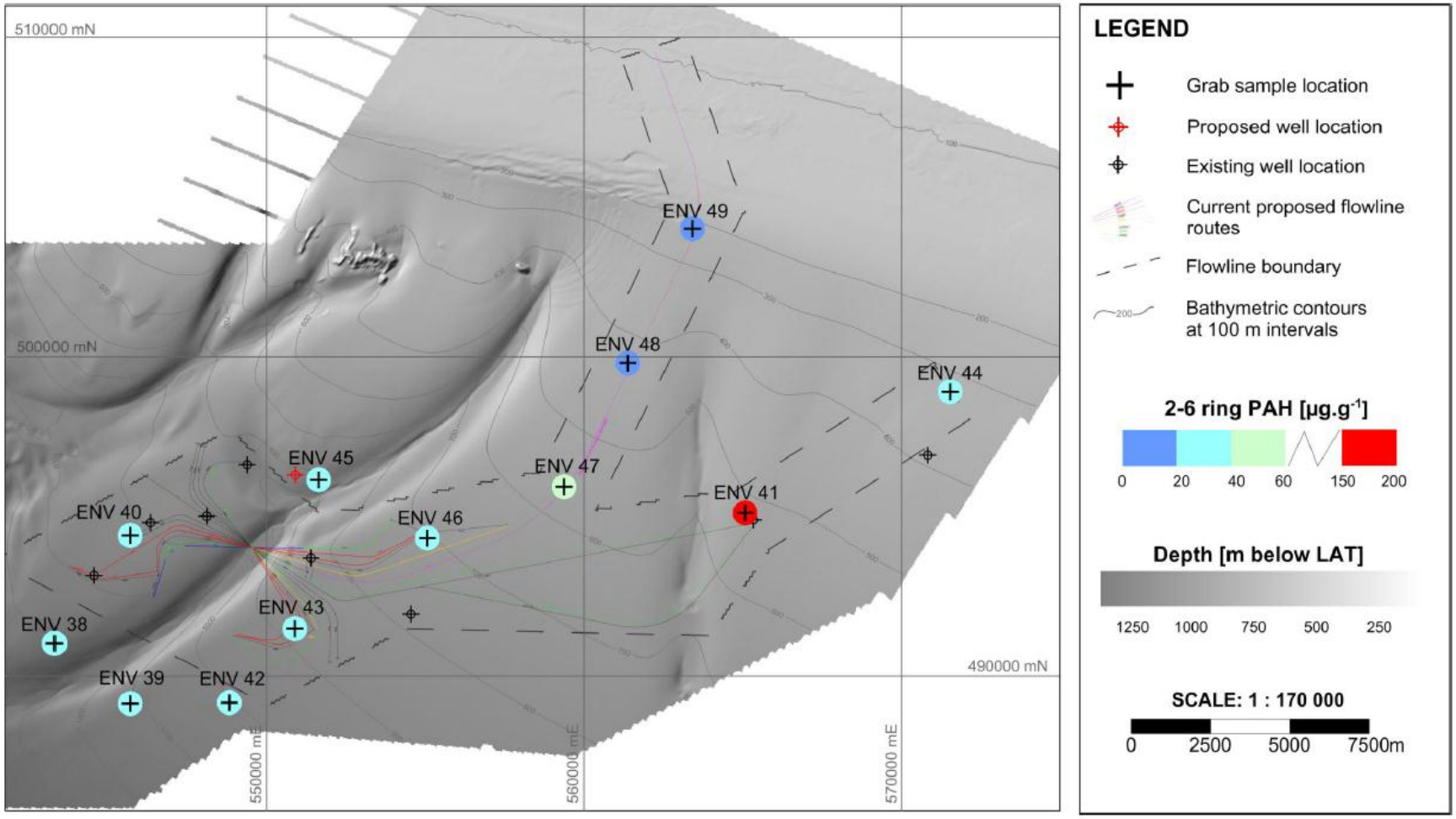


Figure 25 Spatial distribution of total (2-6 ring) PAH concentrations [ng.g-1]

Polycyclic Aromatic Hydrocarbons (PAHs) - USEPA 16 PAH

Concentrations of United States Environmental Protection Agency (USEPA) specified PAHs (USEPA 16 PAH) are provided in Table 18, where they are compared to National Oceanographic and Atmospheric Administration (NOAA) Effects Range Low (ERL) concentrations. ERLs are defined as minimal concentrations over a range at which adverse biological effects have been observed from ecotoxicological studies. ERLs are not available for benzo(b)fluoranthene and benzo(k)fluoranthene, and therefore values for these PAHs have been compared against OSPAR sediment quality guideline action levels (CEFAS, 2003).

Levels of USEPA 16 PAH concentrations were low throughout the survey area. All PAH concentrations are considerably lower than NOAA specified ERL concentrations or, where applicable, OSPAR action levels.

Table 18 USEPA 16 PAH Concentrations [ng.g-1 dry weight]

PAH [ng.g^{-1}]	Stations													
	38	39	40	41	42	43	44	45	46	47	48	49	NOAA	OSPAR
Naphthalene	1.3	1.1	1.1	1.0	1.0	0.8	0.6	1.0	0.9	1.7	0.4	0.3	160	
Acenaphthylene	0.1	0.1	0.1	7.6	0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	<0.1	44	
Acenaphthene	0.1	<0.1	0.1	10.8	0.1	<0.1	0.3	<0.1	0.1	0.1	0.1	<0.1	16	
Fluorene	0.2	0.1	0.2	1.5	0.1	0.1	0.3	0.1	0.2	0.3	0.1	<0.1	19	
Phenanthrene	1.3	1.0	1.1	1.4	0.9	0.7	1.6	0.9	1.1	1.7	0.3	0.1	240	
Anthracene	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.2	0.3	<0.1	<0.1	85.3	
Fluoranthene	2.1	1.8	2.1	0.6	1.4	1.1	1.8	1.4	1.7	2.5	0.4	0.2	600	
Pyrene	2.4	2.2	2.5	1.3	1.6	1.4	1.6	1.5	1.8	2.7	0.5	0.2	665	
Benzo(a)anthracene	0.8	0.5	0.7	0.4	0.5	0.4	0.9	0.5	0.6	0.9	0.2	0.1	261	
Chrysene	1.6	1.3	1.4	0.7	1.2	0.9	1.1	1.1	1.2	2.0	0.4	0.1	384	
Benzo(b)-fluoranthene	1.6	1.3	1.4	0.4	1.2	0.9	0.9	1.1	1.3	2.2	0.4	0.2		75,000
Benzo(k)-fluoranthene	1.0	0.8	0.9	0.1	0.7	0.5	0.7	0.7	0.7	1.3	0.3	0.1		94,600
Benzo(a)pyrene	0.5	0.3	0.3	0.1	0.2	0.2	0.8	0.3	0.4	0.6	0.2	0.1	430	
Indeno(123cd)-pyrene	1.1	1.0	1.0	0.2	0.7	0.5	0.7	0.8	0.8	1.3	0.2	0.1	240	
Benzo(ghi)perylene	0.7	0.6	0.6	0.2	0.4	0.3	0.6	0.6	0.6	0.9	0.2	0.1	85	
Dibenzo(ah)-anthracene	0.2	0.1	0.1	<0.1	0.1	0.1	0.1	0.1	0.1	0.2	<0.1	<0.1	63.4	
Total EPA 16	**15.2**	**12.4**	**13.8**	**26.5**	**10.3**	**8.0**	**12.2**	**10.3**	**11.8**	**18.8**	**3.7**	**1.6**		

Note: ERLs were developed by the United States Environmental Protection Agency for assessing the ecological significance of sediment concentrations. Concentrations below the ERL rarely cause adverse effects in marine organisms.

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are synthetic organic compounds with a biphenyl group base unit. They may be introduced into the marine environment as a component of industrial effluent and by the dumping of electrical components (Libes, 1992). PCBs are likely to be sequestered in sediments close to the point where they are introduced due to adsorption and incorporation into biogenic matter (Libes, 1992).

In the current survey, sediment data are analyzed for PCB28, PCB52, PCB101, PCB118, PCB153, PCB138 and PCB 180. PCB concentrations are below the detection limit (<5 ng.g-1) at all stations.

Organochlorine Pesticides

Organochlorine pesticides are chlorinated hydrocarbons which were mainly used in agriculture and mosquito control in the mid 20th century. Pesticides can be transported into the marine environment by ground-water runoff from adjacent landmasses; these compounds may then enter the marine food chain via adsorption onto organisms or active uptake by phytoplankton. Removal of pesticides from seawater is enhanced by biological activity as these compounds are degraded by metabolic processes. Biomagnification and bioaccumulation may occur causing organochlorine pesticides such as DDT to reach very high levels in organisms at the top of the food chain (Libes, 1992).

Sediment data was analyzed for a number of different organochlorine pesticides (see Annex B1.7 for details). Concentrations of all organochlorine pesticides were below their respective limits of detection at all stations in the survey area.

Heavy and Trace Metal Analysis

Heavy and trace metals (aluminium, arsenic, barium, cadmium, cobalt, chromium, copper, lead, iron, nickel, vanadium, selenium, and zinc) are analyzed following near total metal digestion using hydrofluoric acid. Samples are heated at approximately 105°C in hydrofluoric acid, allowed to cool and then neutralised by addition of boric acid prior to dilution for testing. Concentrations of metals in the digest are determined by ICPOES (aluminium, barium and iron) or by ICP-MS. Mercury is determined following nitric acid and hydrogen peroxide digestion, followed by ICP-MS detection. Full details of the analytical techniques used are provided in Annex B1.7.

Samples acquired from the previous EAF Nansen and Jubilee surveys underwent a strong partial digestion using nitric acid, followed by detection by ICP MS/ICP-AES (TDI Brooks, 2008; EAF Nansen, 2010). NOAA ERL concentrations were also derived using the less stringent strong partial digest. As this methodology will tend to liberate lower concentrations of metals than the hydrofluoric acid digest used in the current survey, only broad comparisons between the surveys and ERL values could be made.

Results for the heavy and trace metal analyses is provided in Table 19, alongside NOAA ERLs which indicate the lower threshold at which adverse biological effects have been identified from ecotoxicological studies (Buchman, 2008). The spatial distribution of chromium, nickel and barium concentrations are presented in Figure 26, Figure 27 and Figure 28.

Concentrations of the majority of metals (excluding arsenic, chromium and iron) are significantly positively correlated with the proportion of fine sediment at each station ($P<0.05$: barium, cadmium, cobalt, vanadium, zinc; $P<0.001$: aluminium, mercury, copper, nickel and lead). In addition, several metals are positively correlated with depth ($P<0.05$: barium, cadmium, cobalt, vanadium and zinc; $P<0.001$: aluminium, mercury, copper, nickel and lead) or negatively correlated with depth ($P<0.05$: arsenic).

Metal concentrations are generally low, although arsenic, chromium (Figure 26) and nickel (Figure 27) are found to exceed their respective NOAA ERL concentrations at four, ten and eleven stations, respectively (Table 19). Arsenic concentrations range from below the detection limit (1.0 µg.g-1; Stations 43 and 47) to 32.3 µg.g-1 (Station 49), with four stations exceeding the ERL value as previously mentioned. This may be the result of the more stringent analytical method used in the current survey or it may be indicative of the local geochemistry. Notably the highest arsenic concentrations are found at the station with the highest proportion of sand and coarse grained

sediments (station 49), suggesting a possible influence of local geology rather than anthropogenic contamination. Arsenic levels are also found to be elevated above the NOAA ELR at many of the locations in the Phase 2&4 surveys further indicating that these levels are representative of background conditions of not necessarily indicative of anthropogenic or drilling related contamination.

A relatively high iron concentration is observed at Station 48 (79500 µg.g-1), however it is difficult to define this signal elevated analyte to a source, and it is possible it may be from sample contamination during collection. Barium, in the form of barite, is used as a weighting material to increase the density of drilling muds and can be present in concentrations ranging from 720 µg.g-1 to 449,000 µg.g-1 (Neff, 2005). Barium concentrations are highly elevated at station 41 (1890 µg.g-1), but generally lower throughout the rest of the survey area, ranging from 64.6 µg.g-1 (Station 49) to 562.0 µg.g-1 (Station 42). However, background barium levels in the current survey area (i.e. all stations excluding station 41) are generally higher than those recorded in the EAF Nansen (2010) survey (average of 94.23 µg.g-1) and the previous Jubilee survey, where concentrations ranged from 23 µg.g-1 nearshore to 291 µg.g-1 further offshore (ERM, 2009). The phase 2&4 survey also found levels of barium below that of the current survey (69.7 µg.g-1 to 189 µg.g-1). As barium is persistent in marine sediments it is possible that the barium levels in sediments in the current survey may indicate a highly dispersed very low level barium contamination from the numerous well in the local area.

Barium levels at station 41 are highly indicative of past drilling related contamination, however it is notable that other metals are not equally elevated at this location suggesting drilling muds are not heavy contaminated with impurities Station 41 is located 340 m from the Gye Nyame-1 exploration well (Figure 28) drilled in 2011 (SUBSEAIQ, 2013) which is the presumed source of the contamination.

Mean and maximum concentrations of cadmium, chromium, lead and zinc are higher than those recorded in the previous EAF Nansen (2010) survey (Table 19). Values in the current study would be expected to be slightly higher due to the stronger analytical method used. Of these cadmium, lead and zinc are all below their respective NOAA ERL levels. Concentrations of copper and mercury recorded in the current survey compare well with those from the EAF Nansen (2010) survey.

Table 19 Heavy and Trace Metal Concentrations [µg.g-1 dry weight]

Station		Fines [%]	Al	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Ni	Pb	Se	V	Zn
38		90.62	93100	6.6	406.0	0.6	11.1	109.6	18.4	35070	0.05	57.4	13.6	<0.5	103.1	92.8
39		86.71	93500	7.0	410.0	0.7	10.9	109.1	19.9	35900	0.05	57.3	13.8	<0.5	105.7	92.8
40		88.57	92600	6.3	393.0	0.6	10.3	108.0	17.9	34400	0.03	57.1	13.5	<0.5	99.1	93.0
41		57.81	56200	8.7	1890.0	0.5	8.4	102.6	9.3	35800	0.03	44.4	10.7	<0.5	82.9	71.3
42		86.92	91100	6.8	562.0	0.5	10.8	108.8	16.4	35100	0.03	54.4	13.5	<0.5	98.4	88.9
43		85.40	90700	<1.0	406.0	0.4	5.7	62.3	8.0	34800	0.04	32.6	7.5	<0.5	64.9	47.2
44		36.24	36020	13.3	111.0	0.3	7.8	98.5	10.0	43300	0.01	32.0	7.5	<0.5	66.7	72.6
45		81.42	60200	7.5	290.0	1.1	9.0	99.4	15.7	33300	0.02	47.0	11.1	<0.5	86.4	80.1
46		79.89	64300	6.9	284.0	0.6	9.4	99.0	15.5	31300	0.03	51.4	11.7	<0.5	89.6	80.2
47		38.75	61200	<1.0	231.0	0.4	4.9	54.0	7.2	30000	0.02	27.2	5.7	<0.5	51.5	37.6
48		75.38	37500	21.8	109.0	0.3	7.2	138.3	10.1	79500	0.01	28.6	7.2	<0.5	80.5	64.2
49		14.43	18900	32.3	64.6	0.3	9.3	71.5	3.4	44600	<0.01	19.6	5.6	<0.5	69.2	71.5
Current Survey	Min	14.43	18900	<1.0	64.6	0.3	4.9	54.0	3.4	30000	<0.01	19.6	5.6	<0.5	51.5	37.6
	Mean	68.51	66277	11.7	429.7	0.5	8.7	96.8	12.7	39423	0.03	42.4	10.1	-	83.2	74.4
	Max	90.62	93500	32.3	1890.0	1.1	11.1	138.3	19.9	79500	0.05	57.4	13.8	<0.5	105.7	93.0
	SD	25.51	26151	8.7	483.4	0.2	2.0	23.4	5.3	13315	0.01	13.7	3.2	-	17.2	17.9
EAF Nansen, 2010	Min				7.9	0.1		34.1	2.1		0.01		2.1			35.8
	Mean				94.2	0.1		42.5	11.4		0.03		4.0			46.3
	Max				176.0	0.2		58.6	18.8		0.05		5.3			59.2
	SD				73.5	0.1		7.3	6.1		0.02		1.2			6.6
NOAA ERL		-	-	8.2	-	1.2	-	81.0	34.0	-	0.15	20.9	46.7	-	-	150.0

Note: SD = 1 standard deviation; Min = minimum; Max = maximum. Cells shaded red exceed NOAA ERL. Where values have been reported as less than a particular value, i.e. less than the detection limits, the calculation of the mean and standard deviation has excluded these values.

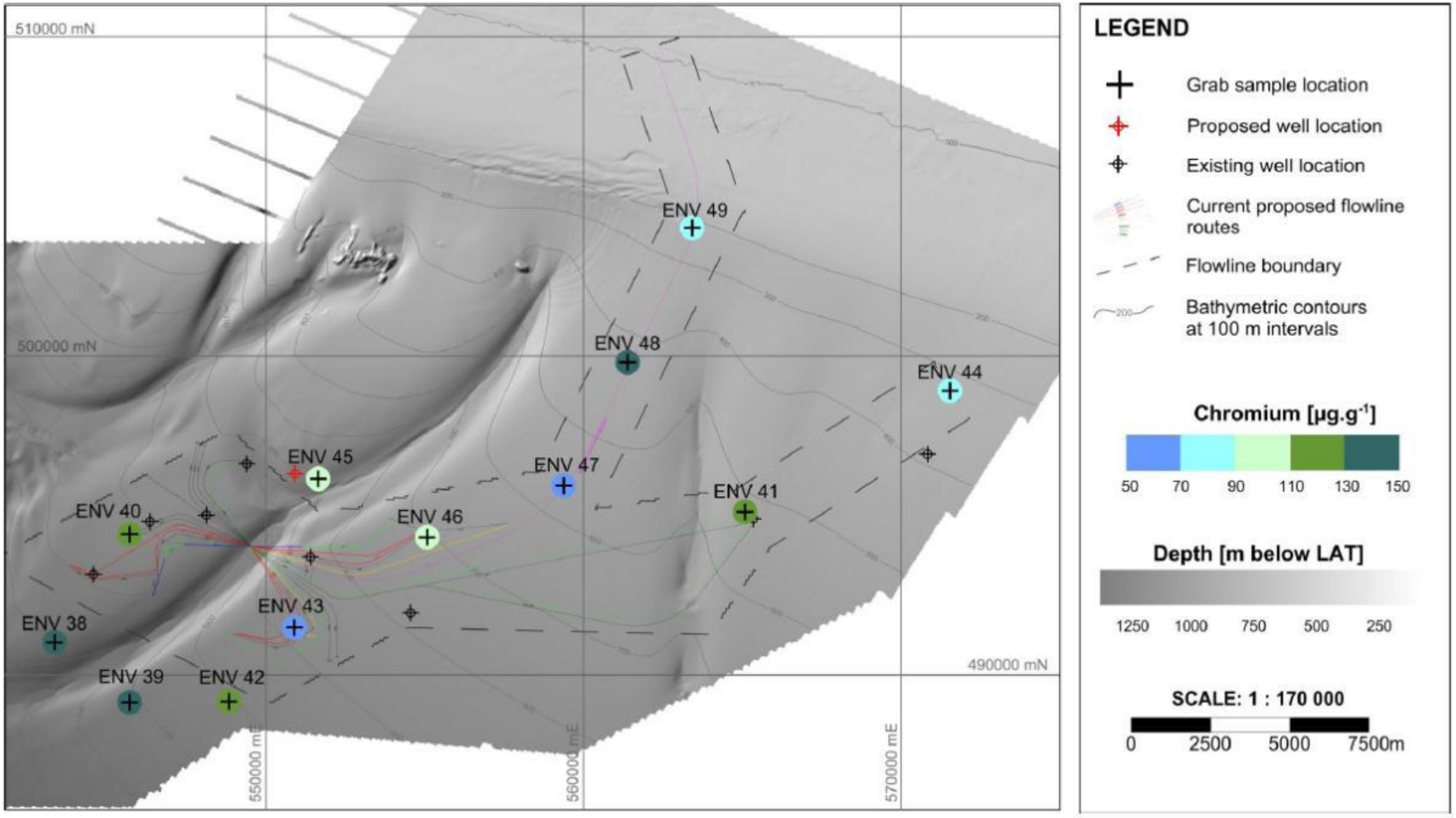


Figure 26 Spatial distribution of chromium concentrations [µg.g-1]

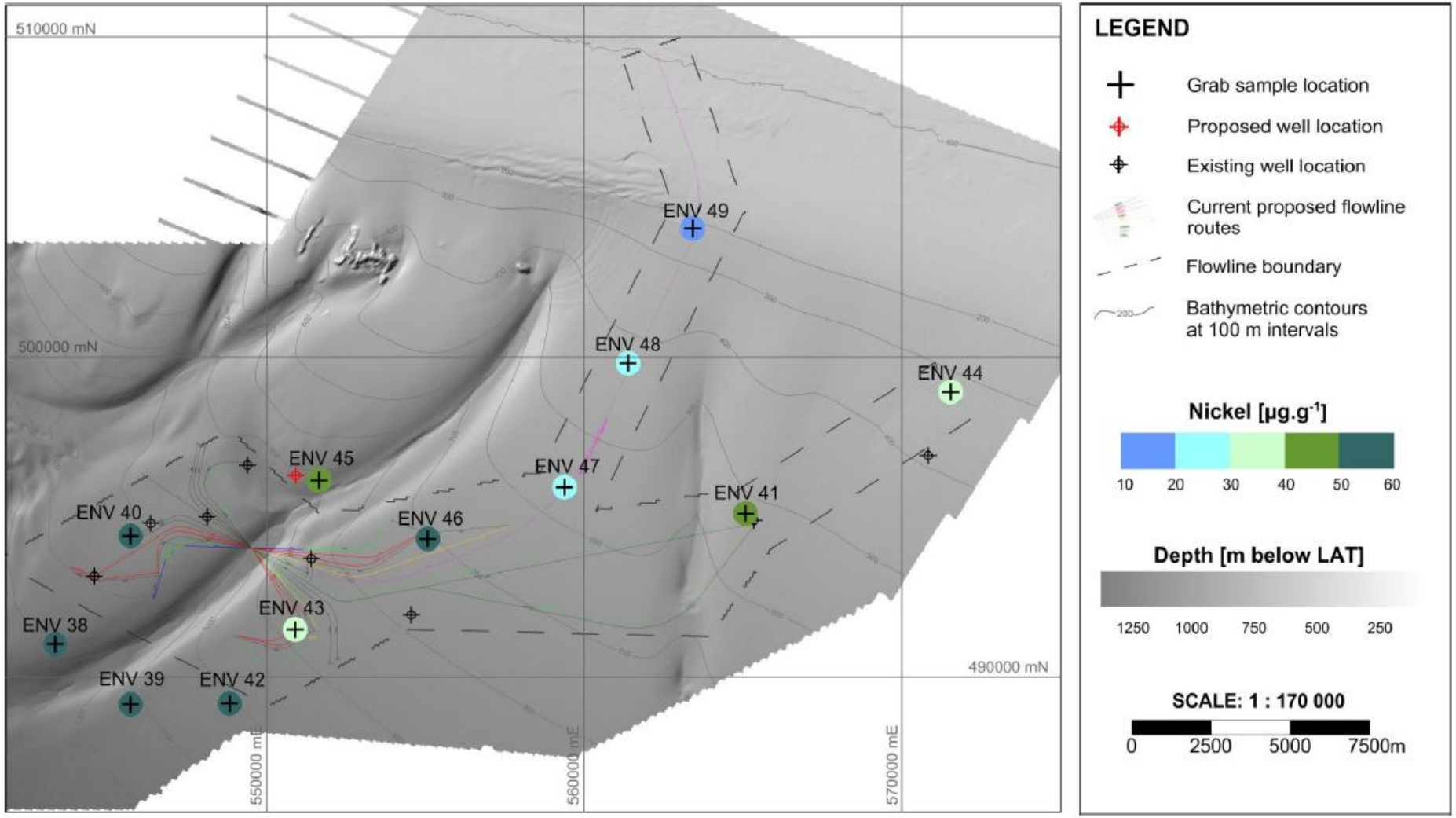


Figure 27 Spatial distribution of nickel concentrations [µg.g-1]

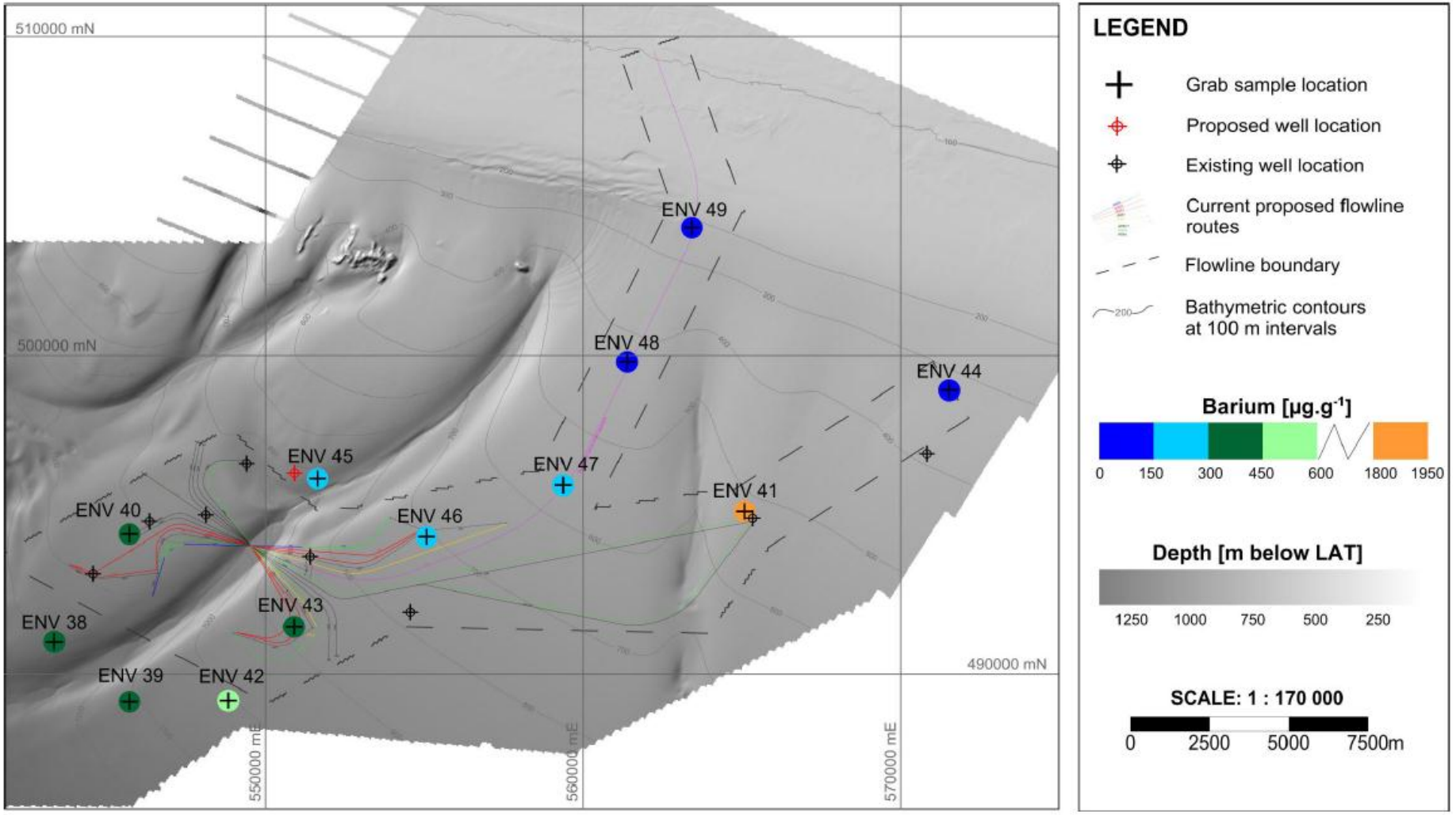


Figure 28 Spatial distribution of barium concentrations [µg.g-1]

1.4 CORAL REEF

1.4.1 Coral reef location

Generally corals exist both in temperate and tropical waters but shallow-water corals that form reefs occur only in a zone extending from 30° N to 30° S of the equator. Tropical corals (the ones forming coral reefs) do not grow at depths of over 50 meters. The optimum temperature for most coral reefs is 26–27 °C, and few reefs exist in waters below 18 °C (Achituv, Y. and Dubinsky, Z. 1990. Evolution and Zoogeography of Coral Reefs Ecosystems of the World. Vol. 25:1–8).

However, reefs in the Persian Gulf have adapted to temperatures of 13 °C in winter and 38 °C (100 °F) in summer (Wells, Sue; Hanna, Nick (1992). Greenpeace Book of Coral Reefs. Sterling Publishing Company. ISBN 0-8069-8795-2)

There are 37 species of scleractinian corals identified in such harsh environment around Larak Island (island off the coast of Iran in the Persian Gulf). (Vajed Samiei, J.; Dab K.; Ghezellou P.; Shirvani A. (3). "Some Scleractinian Corals (Class: Anthozoa) of Larak Island, Persian Gulf". Zootaxa 3636 (1): 101–143.)

Coral reefs are rare along the west coasts of the Americas and Africa, due primarily to upwelling and strong cold coastal currents that reduce water temperatures in these areas (respectively the Peru, Benguela and Canary streams) (Nybakken, James. 1997. Marine Biology: An Ecological Approach. 4th ed. Menlo Park, CA) (Figure 29, Figure 30).

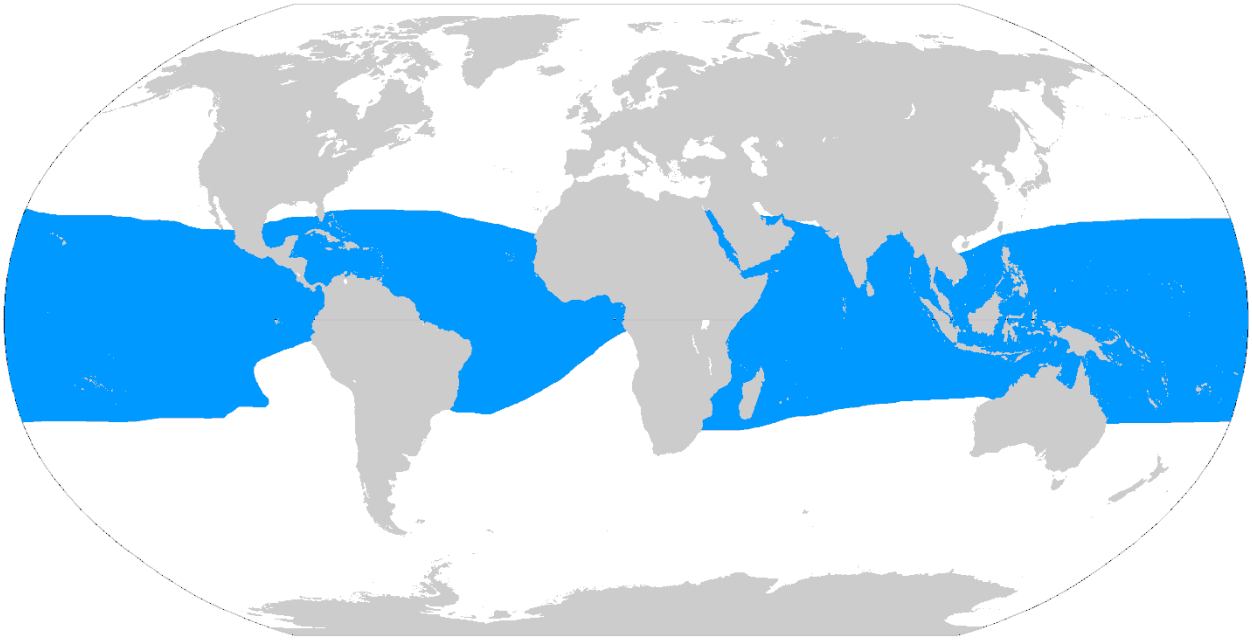


Figure 29 Boundary for 20 °C isotherms. Most corals live within this boundary. Note the cooler waters caused by upwelling on the southwest coast of Africa and off the coast of Peru. (map adapted from PDF world map at CIA World Fact Book)

Corals are seldom found along the coastline of South Asia—from the eastern tip of India (Madras) to the Bangladesh and Myanmar borders (Spalding, Mark, Corinna Ravilious, and Edmund Green (2001). World Atlas of Coral Reefs. Berkeley, CA: University of California Press and UNEP/WCMC

ISBN 0520232550)—as well as along the coasts of northeastern South America and Bangladesh, due to the freshwater release from the Amazon and Ganges Rivers respectively.

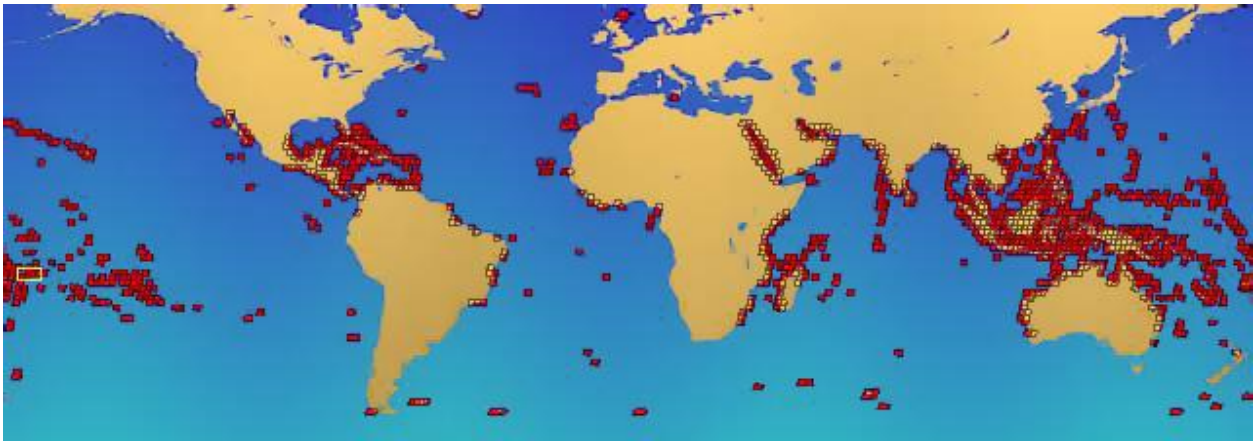


Figure 30 Locations of Available Coral Reef Data -- This image depicts all of the areas that the Millenium Coral Reef Landsat Archive covers. Red dots indicate coral reef data at the website: http://seawifs.gsfc.nasa.gov/cgi/landsat.pl

1.4.2 Coral Reef nearshore

The continental shelf of Ghana's western region is traversed by a belt of dead madreporarian coral up to a 75 m depth. Beyond this coral belt, the bottom falls sharply, marking the transition from the continental shelf to the slope (**Figure 31**). This dead coral reef is located mainly east of the Cape Three Points.

Soft sediment (mud and sandy mud) predominates along the coast and offshore of the coral belt. The central part of the continental shelf has extensive hard bottom areas, which are widest off Takoradi and Cape Coast and extend eastward. They consist of flat rocks and shoals and are covered by gorgonians, branched corals, and bryozoans (Rijavec, 1980). Mixed gravel and pebble bottoms, on the other hand, are usually covered with *corallinaceous algae* (Figure 32)

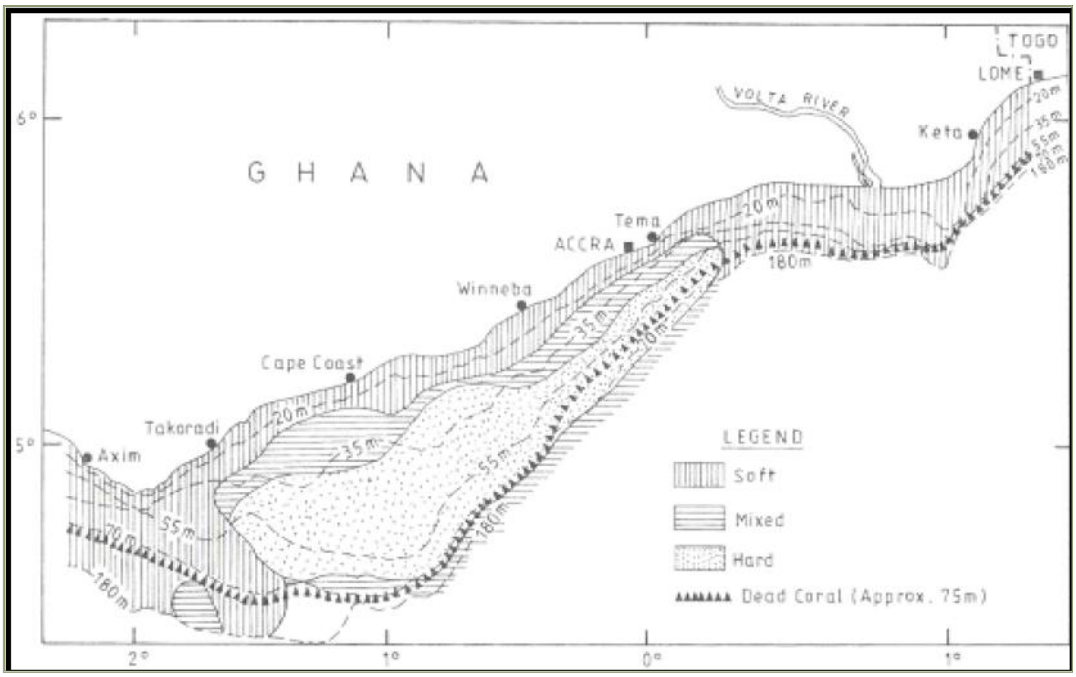


Figure 31 **Map of southern Ghana showing the location of dead madreporian corals**

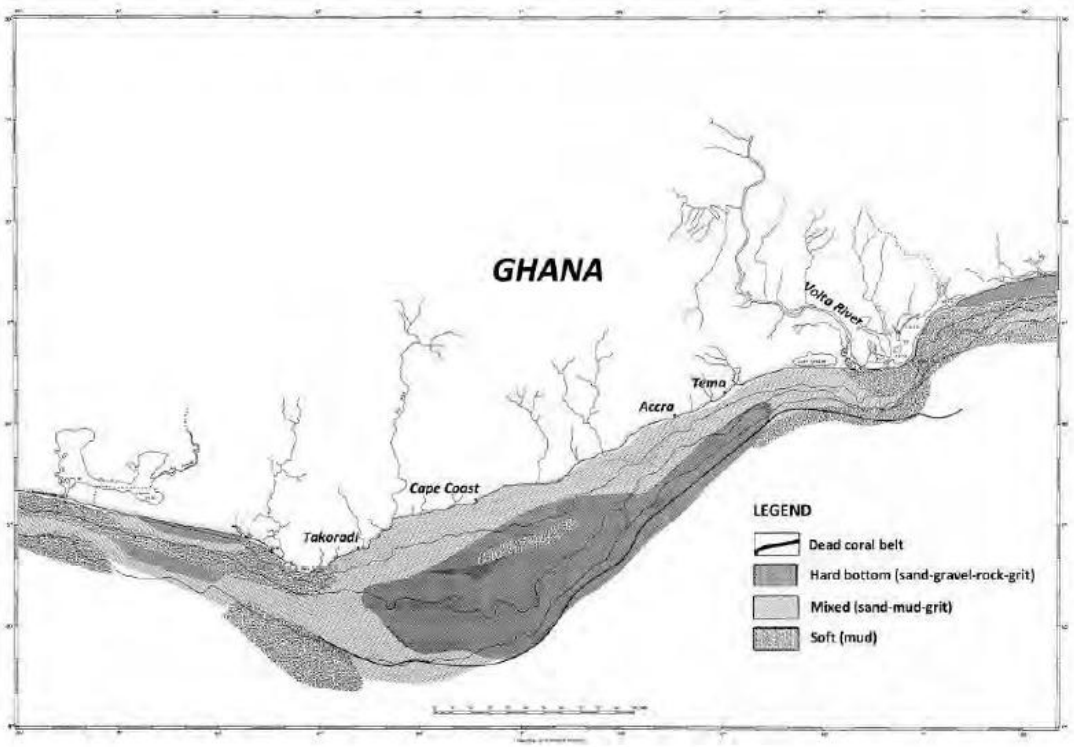


Figure 32 **Distribution of seafloor types offshore Ghana, West Africa (From: Martos *et al*., 1991)**

According to Ghana Environmental Protection Agency there is the evidence of the existence of live coral reef s along Ghanaian coastline.

The Ghana's EPA published on its website an article explaining the outcome of the marine environmental survey undertaken by the Norwegian research vessel Dr Fridtjof Nansen and officers of the Agency along the entire coastline of Ghana indicating that 'during the survey of the marine ecosystem along the Ghanaian coastline live coral reefs were discovered. These discoveries are interesting and the reefs should be protected because it has immense ecological benefits for the country'".

The cruise report (in this report cited as EAF Nansen, 2010) "2009 MARINE ENVIRONMENTAL SURVEY OF BOTTOM SEDIMENTS IN GHANA"- Cruise report No 5/2009 – May 2009" that involved Institute of Marine Research – IMR (Norway), Uni Research AS, SAM-Marin Norway, Environmental Protection Agency (EPA Ghana), University of Ghana Legon, Ghana, University of Cape Coast (UCC) Ghana, Survey Department Ghana, Tullow Oil Ghana, put in evidence the presence of two individuals of *Hexacorallia* Class at GP1 station (28 meters depth). These individuals, being isolated, do not to form a reef.

Analyzing TDI-Brooks surveys (TDI Brooks, 2008) individuals of *Anthozoa* Order (Phylum: *Cnidaria*-Class: *Anthozoa*-Order: *Actiniaria* and Phylum: *Cnidaria*-Class: *Anthozoa*-Order: *Pennatulacea*) occur in three sapling points EBS:E2_SS, EBS:E3 R_SS, EBS:T6_SS (respectively at 64.5 m, 50 m, 51.9 m depth), while considering Fugro report on Phase 2&4 surveys individuals of Actiniaria Order occur in two sapling points ENV09 and ENV29 (respectively at 51 m, 15 m depth).

Figure 33 shows the localizations of sampling point GP1 of the EAF Nansen 2010 (red dots), the environmental sampling points realized by Fugro during the survey offshore for the phase 1 (green square with black text on white background labels), the sampling points ENV09 and ENV29 realized by Fugro during the survey for the phases 2 and 4 (violet rhombus with violet txt on white background labels) and the sampling points EBS:E2_SS, EBS:E3 R_SS, EBS:T6_SS realized by TDI-Brooks surveys of 2008 year (yellow square with black text on yellow background labels)..



Figure 33 Localization of sampling points

Overall considering the 4 surveys cited above, an evidence of coral along Ghanaian coastline is found only in the nearshore sampling points mentioned above.

The ReefBase database (accessed on 25 February 2014 http://www.reefbase.org/main.aspx) shows the offshore band of dead coral, but does not identify any active coral reefs offshore Ghana. In fact querying reef locations dataset, that are taken from the original ReefBase database, that provides point data on the approximate location of coral reefs environments, no data are found about Ghana (

Table 20).

Table 20 Table extracts from ReefBase database (accessed on 25 February 2014 http://www.reefbase.org/main.aspx)

ID	REGION	SUBREGION	COUNTRY	LOCATION	LAT	LON	REEF_SYSTEM	REEF_TYPE	REEF_NAME	WATER_DEPTH	ISLAND_NAME	PROTECTED	TOURISM	COUNTRY_CODE
8344	Africa	West Africa	Ghana		4.43333	-1.71667	Cape Three Points	Non-reef coral community	Cape Three Points			0	0	GHA
8343	Africa	West Africa	Ghana		7.13333	-1.18333	Ghana	Non-reef coral community	Ghana			0	0	GHA

Table 20 Attribute Data:

Records in the Place Name dataset include the following attribute data:

Field name	Description
ID	- ReefBase GIS ID
Region	- Regional name
Subregion	- Sub regional name
Country	- Country name
Location	- Name of place
Lat	- Latitude of reef
Lon	- Longitude of reef
Reef_system	- Reef system name (larger system where reef is part of)
Reef_type	- Type of reef
Reef_name	- Reef name
Water_depth	- Sea water depth level
Island_name	- Name of Island where reef is located
Protected	- Is protected area
	0 - No
	1 - Yes
Tourism	- Is tourism area
	0 - No
	1 - Yes
Country_code	- ReefBase country code

An internet search indicates several named reefs in nearshore waters (e.g., Bosum Accra reef, Kassa reef, Pompendi reef, Roani bank, Suchu reef, and Takoradi reef [SatelliteViews, 2009] http://www.satelliteviews.net/cgi-bin/w.cgi/?c=gh&DG=RF).

This last two considerations are reported also in the “Preliminary Environmental Report – West Cape Three Points, 2011 Exploration and Appraisal Program Offshore Ghana”.

1.4.3 Deep Water Corals

According to NOAA's Coral Reef Information System (CoRIS) updated in 2004 (http://www.coris.noaa.gov/about/deep/) in addition to coral reefs that thrive in shallow, well lighted, clear, warm tropical waters, corals also grow in the deep, cold sea. Although the existence of some

of these deep-sea coral thickets has been known for several centuries, initially from pieces of broken corals brought up with fishing gear, scientists know little about their distribution, biology, behavior, and function as essential habitats for fishes and invertebrates.

Some deep-water corals (also called cold-water corals) do not form reefs exactly like those in tropical waters. Often, they form colonial aggregations called patches, mounds, banks, bioherms, massifs, thickets or groves. These aggregations are often still referred to as “reefs.” While there are nearly as many species of deep–water corals as there are shallow-water species, only a few deep-water species develop these so called “reefs.”

Three main groups of corals make up deep-water coral communities: hard (stony) corals of the Order *Scleractinia*, which form hard, ahermatypic reefs; black and horny corals of the Order *Antipatharia*; and soft corals of the order *Alcyonacea*, which includes the gorgonians (sea fans) (Williams, 2001). Deep-water corals are similar in some ways to the more familiar corals of shallow, tropical seas. Like their tropical equivalents, the hard corals develop sizeable reef structures that host rich and varied invertebrate and fish fauna. However, unlike the tropical ones, which are typically found in waters above 70m depth and at temperatures between 23° and 29° C, deep-water corals live at depths just beneath the surface to the abyss (2000 m), where water temperatures may be as cold as 4° C and utter darkness prevails.

At these depths, corals lack *zooxanthellae*. These symbiotic algae provide food for many shallow-water corals through photosynthesis. They also assist in the formation of the calcareous skeleton, and give most tropical corals their coloration. By contrast, the polyps of deep-water corals appear to be suspension feeders. They capture and consume organic detritus and plankton that are transported by strong, deep-sea currents. These corals are commonly found along bathymetric highs such as seamounts, ridges, pinnacles and mounds.

Deep-water corals are found globally, from coastal Antarctica to the Arctic Circle. In northern Atlantic waters, the principal coral species that contribute to reef formation are *Lophelia pertusa*, *Oculina varicosa*, *Madrepora oculata*, *Desmophyllum cristagalli*, *Enallopsammia rostrata*, *Solenosmilia variabilis*, and *Goniocorella dumosa*. Four of those genera (*Lophelia*, *Desmophyllum*, *Solenosmilia*, and *Goniocorella*) constitute the majority of known deep-water coral banks at depths of 400 to 700 m (Cairns and Stanley, 1982).

Two of the more significant deep-sea coral species are *Lophelia pertusa* and *Oculina varicosa*. These species form extensive deep-water communities that attract commercially important species of fishes, making them susceptible to destructive bottom trawling practices (Reed, 2002a).

Lophelia pertusa is the most common aggregate-forming deep-water coral. Typically, it is found at depths between 200 and 1,000 m in the northeast Atlantic, the Mediterranean Sea, along the mid-Atlantic Ridge, the West African and Brazilian coasts, and along the eastern shores of North America (e.g., Nova Scotia, Blake Plateau, Florida Straits, Gulf of Mexico) as well as in parts of the Indian and Pacific Oceans (**Figure 34 Global distribution of *Lophelia pertusa*. Image: Southampton Oceanography Centre, UK**)

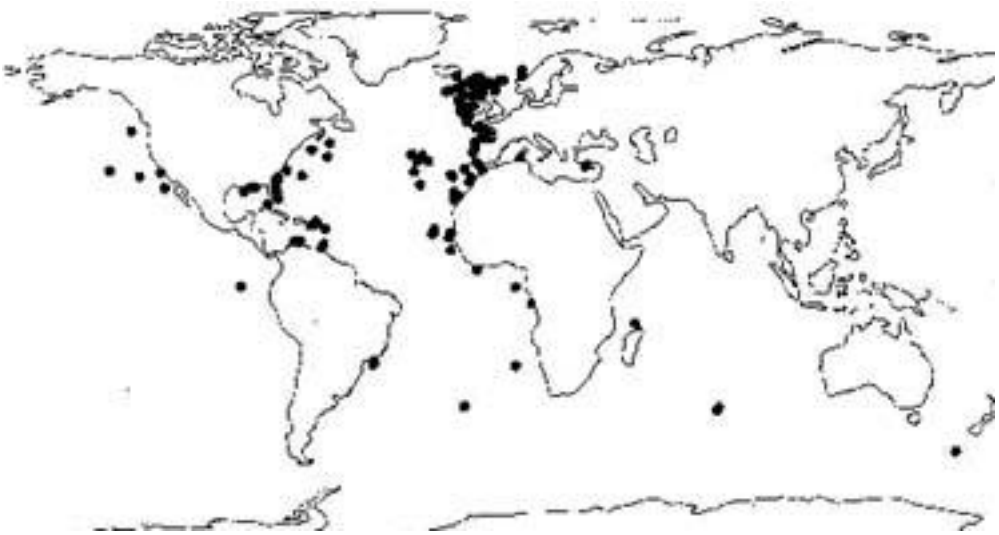


Figure 34 Global distribution of *Lophelia pertusa*. Image: Southampton Oceanography Centre, UK

Oculina varicosa is a branching ivory coral that forms giant but slow-growing, bushy thickets on pinnacles up to 30 m in height. The *Oculina Banks*, so named because they consist mostly of *Oculina varicosa*, exist in 50 to 100 m of water along the continental shelf edge about 26 to 50 km off of Florida's central east coast.

In summary NOAA's Coral Reef Information System and other document as the report “Cold-water coral reefs - Out of sight – no longer out of mind” supported by the Governments of Ireland, Norway and the United Kingdom, as well as the World Wide Fund for Nature (WWF) and the United Nations Environment Programme (UNEP) confirm the potential presence of deep water corals also in the project area.

The environmental surveys performed by Fugro for the current Project did not record the presence of deep water corals in the sites surveyed along the Study Area of the Project.

However, a survey conducted in 2013 by the R/V Dr Fridtjof Nansen of the Institute of Marine Research of Norway with the collaboration of the EPA along the Tano Basin, south west of the Project Area, revealed the presence of a deep coral reef-like structure at approximately 500 m of depth.

1.5 CHEMOSYNTHETIC ORGANISMS

Chemosynthesis is the biological conversion of one or more carbon molecules and nutrients into organic matter using the oxidation of inorganic molecules (eg hydrogen sulphide) or methane as a source of energy, rather than sunlight, as used in photosynthesis. In water depths where there is no light penetration and where seepage of hydrocarbons, venting of hydrothermal fluids or other geological processes supply abundant reduced compounds, microorganisms can use chemosynthesis to produce biomass and can become the dominant component of the ecosystem. Chemosynthetic communities can have unusually high biomass (MacDonald, 2002).

The three main sources of energy and nutrients for deep sea communities are marine snow, whale falls, and chemosynthesis at hydrothermal vents and cold seeps.

The first type of organism to take advantage of this deep-sea energy source is bacteria that metabolize methane and hydrogen sulfide. Other organisms that rely with this type of bacteria are bivalves, mussels and tubeworms.

Recently seep communities have been discovered in the eastern Atlantic, on a giant pockmark cluster in the Gulf of Guinea near the Congo deep channel, also on other pockmarks of the Congo margin, Gabon margin and Nigeria margin (Olu K., Cordes E. E., Fisher C. R., Brooks J. M., Sibuet M. & Desbruyères D. (2010). "Biogeography and Potential Exchanges Among the Atlantic Equatorial Belt Cold-Seep Faunas". PLoS ONE 5(8): e11967. doi:10.1371/journal.pone.0011967). These cold seeps are within the Atlantic Equatorial Belt (AEB), that extends from the Gulf of Mexico to the Gulf of Guinea, that was one focus of the Census of Marine Life ChEss (Chemosynthetic Ecosystems) program to study biogeography of seep and vent fauna (Figure 35).

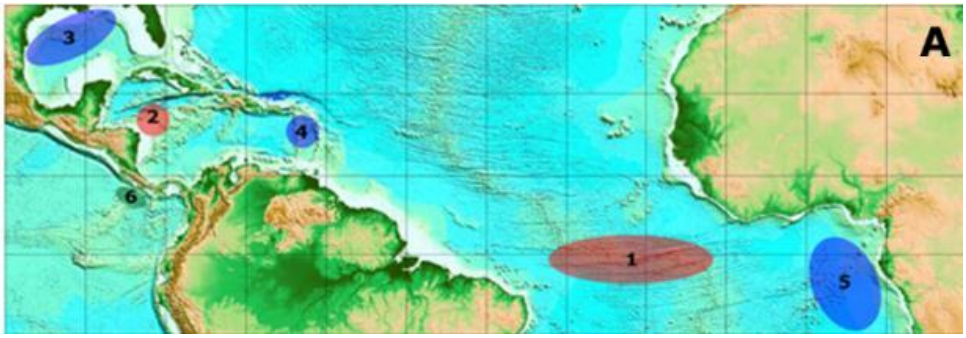


Figure 35 Atlantic Equatorial Belt- Priority field program area. A) AEB: (1) Equatorial MAR and fracture zones; (2) Mid-Cayman Rise; (3) Gulf of Mexico; (4) Barbados Accretionary Prism; (5) NW African margin; (6), Costa Rica margin

The Figure 36, and the Table 21 show the sampling sites and the list for deep-sea Bathymodiolus mussels evidencing the presence of these species in the proximity of the project area.

(Jun-Ichi Miyazaki, Leonardo de Oliveira Martins, Yuko Fujita, Hiroto Matsumoto, Yoshihiro Fujiwara (2010) “Evolutionary Process of Deep-Sea Bathymodiolus Mussels” http://www.plosone.org/article/info:doi/10.1371/journal.pone.0010363)

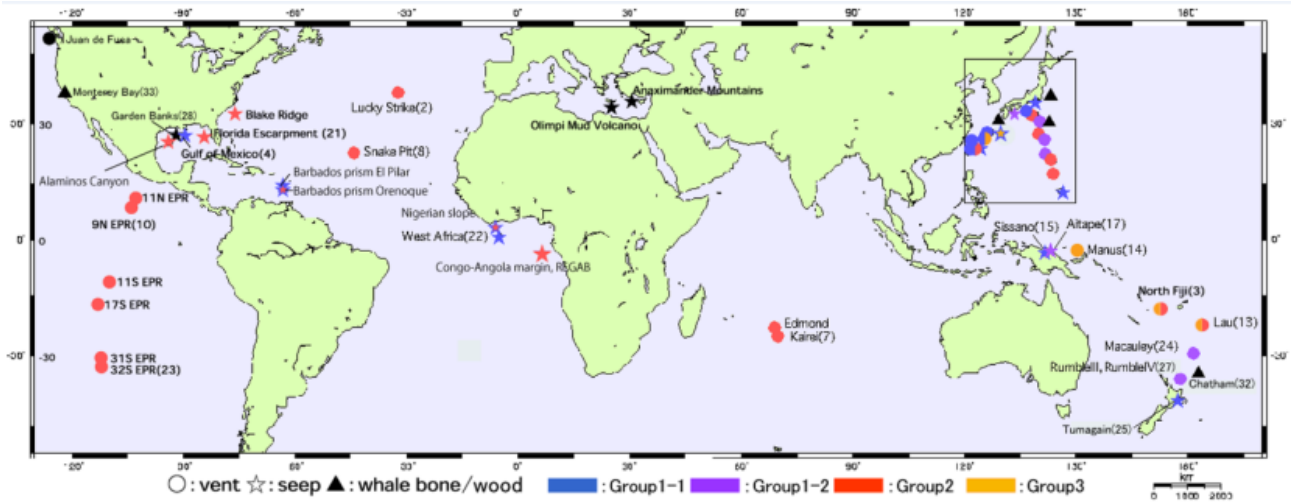


Figure 36 Sampling sites for deep-sea Bathymodiolus mussels

Table 21 Sample list for deep-sea Bathymodiolus mussels

Species	Sample abbreviation	Sampling site (locality number in Fig. 1)	Depth (m)	Habitat type
Bathymodiolinae				
Bathymodiolus aduloides	AK1	Off Kikaijima Island (1)	1 451	Seep
B. azoricus	AZL1	Lucky Strike, Mid-Atlantic Ridge (2)	Unknown	Vent
B. brevior NF	BN	Mussele Valley, North Fiji Basin (3)	Unknown	Vent
B. childressi	ChlG1	Gulf of Mexico(4)	1 859	Seep
B. hirtus	HK1	Kuroshima Knoll, Off Yaeyama Islands (5)	637	Seep
B. japonicus	JH1	Off Hatsushima, Sagami Bay (6)	1 170–1 180	Seep
B. marisindicus	MK1	Kairei Field, Southern Central Indian Ridge (7)	2 443–2 454	Vent
B. platifrons	PH1	Off Hatsushima, Sagami Bay (6)	1 170–1 180	Seep
B. puteoserpentis	PUS1	Snake Pit, Mid-Atlantic Ridge (8)	3 023–3 510	Vent
B. securiformis	LK1	Kuroshima Knoll, Off Yaeyama Islands (5)	641	Seep
B. septemdierum	SM1	Myojin Knoll, Izu-Ogasawara Island-arc (9)	1 288–1 290	Vent
B. thermophilus	ThE1	9N East Pacific Rise (10)	2 524	Vent
Chamorro *B.* sp.	C1	South Chamorro Seamount, Mariana (11)	2 899	Seep
Eifuku *B.* sp.	EF1	Northwest Eifuku Seamount (12)	1 625	Vent
Kikaijima *B.* sp.	Kikaijima	Off Kikaijima Island (1)	1 430	Seep
Lau *B.* sp. 1	Lau1	Hine Hina, Lau Basin (13)	1 818	vent
Lau *B.* sp. 2	BR1	Hine Hina, Lau Basin (13)	1 818	Vent
B. manusensis	BE1	PACKMANUS Field E, Manus Basin (14)	1 627–1 629	Vent
NZ *B.* sp.	Ne1	Off New Zea land (unknown)	Unknown	Vent
Sissano *B.* sp. 1	Si2-1	Sissano, Papua New Guinea (15)	1 646	Seep
Sissano *B.* sp. 2	Si1-1	Sissano, Papua New Guinea (15)	1 881	Seep
Sissano *B.* sp. 3	Si3-3	Sissano, Papua New Guinea (15)	1 881	Seep
Gigantidas horikoshii	Kaikata	Kaikata Seamount (16)	486	Vent
Aitape *G.* sp.	Aitape1	Aitape, Papua New Guinea (17)	470	Seep
Ashizuri *G.* sp.	Ashizuri	Off Ashizuri Cape (18)	575	Seep
Nikko *G.* sp.	NK1	Nikko Seamount (19)	485	Vent
Sumisu *G.* sp.	Su1	Sumisu Caldera (20)	676–686	Vent
Database				
B. brooksi	*B. brooksi*WFE(DB)	West Florida Escarpment (21)	3 314	Seep
B. heckerae	*B. heckerae*WFE(DB)	West Florida Escarpment (21)	3 314	Seep
B. mauritanicus	*B. mauritanicus*(DB)	West Africa (22)	1 000–1 267	Seep
B. sp. East Pacific	*B. aff. thermophilus*(DB)	325 East Pacific Rise (23)	2 331	Vent
B. sp. NZ3	*B.* sp. NZ3(DB)	Macauley Cone (24)	200	Vent
B. tangaroa	*B. tangaroa*(DB)	Off Turnagain Cape, New Zea land (25)	920–1 205	Seep
B. brevior MT	*B. brevior*MT(DB)	Mariana Trough (26)	3 589	Vent
Gigantidas gladius	*Gigantidas gladius*(DB)	Rumble III (27)	300–460	Vent
Tamu fisheri	*Tamu fisheri*(DB)	Garden Banks (28)	546–650	Seep
Modiolinae & Mytilinae				
Adipicola crypta	ACN1	Off Noma Cape, Kagoshima (29)	225–229	Whale bone
Adipicola iwaotakii	AIH1	Off Nakaminato, Ibaraki (30)	490	Wood
Adipicola pacifica	APN1	Off Noma Cape, Kagoshima (29)	225–229	Whale bone
Idasola japonica	IJN1	Off Noma Cape, Kagoshima (29)	400–425	Wood
Benthomodiolus geikotsucola	Tori1-1	Torishima Seamount (31)	4 051	Whale bone
Modiolus nipponicus	*Modiolus nipponicus*	Off Oura Harbor, Shizuika	-	Shallow
Database				
Benthomodiolus lignicola	*Benthomodiolus lignicola*(DB)	Chatham Rise (32)	826–1 174	Whale bone, Wood
Idas macdonaldi	*Idas macdonaldi*(DB)	Garden Banks (28)	650	Seep
Idas washingtonia	*Idas washingtonia*(DB)	Monterey Bay (33)	960–1 910	Whale bone, Wood, Vent

Other research program and studies put in evidence results that could confirm the presence of chemosynthetic communities in the proximity of the project area.

The Environmental Baseline Survey explained in GHANA JUBILEE FIELD PHASE 1 DEVELOPMENT reports two examples of research with some findings:

-Brooks and Bernard (2006) found two sites with chemosynthetic communities using coring samplers over small mounds associated with presumed deeper faulting in water depths of between 1,600 and 2,200 m offshore Nigeria. The communities comprised a high density of mussels and associated tubeworms, clams, shrimps, limpets, crabs, brittle stars, heart urchins and sponges.

-Nibbelink and Huggard (2002) in a study of submarine canyons offshore the Volta River Delta in Ghana, noted evidence of gas seeps on seismic data and oil slicks on radar images. They interpreted the flat floors of the canyons as carbonate formed by chemosynthetic communities that feed on hydrocarbons seeping from the depleted free gas zones below the canyons.

Regarding the results and the research programs cited above in the project area potentially exist chemosynthetic communities but neither Fugro survey nor The Environmental Baseline Survey of GHANA JUBILEE FIELD PHASE 1 DEVELOPMENT, indicate the presence of any chemosynthetic communities in their survey area

1.6 MARINE MAMMALS

The following paragraphs show the results of our desktop studies about the populations of marine mammals which pass through or live permanently/seasonally in the area of the project.

Considering the physiological and ecological characteristics of these animals, data for distribution of the mammals and their use of habitats has not always been available. Many aspects of their life are still relatively undocumented and our knowledge of their geographical distribution, behaviour and other characteristics is constantly evolving. Descriptions of marine mammals derive almost exclusively from dead specimens, beached or killed by whalers and fishermen.

Towards the end of the century Jefferson *et al*. have already undertaken a census of sightings of odontoceti (toothed whales) and pinnipeds (seals and sea-lions) in the area between the Straits of Gibraltar and the mouth of the river Congo. Since the year 2000 studies have been carried out on the presence and distribution of marine mammals in the Gulf of Guinea area.

The ecological significance of Ghana's coastal waters for dolphins and whales has only recently become the subject of scientific studies, which partially explains the lack of population abundance estimates and why their natural history remains largely unknown. The conditions created by the seasonal upwelling in the northern Gulf of Guinea is likely to create conditions favourable for marine mammals as well as for fisheries.

Small cetaceans of Ghana are documented to suffer considerable pressure from frequent by-catches in mostly drift gillnet fisheries and perhaps also in industrial purse-seine fisheries although the latter remain largely unmonitored. While total mortality is unknown, it is significant and potentially increasing with intensifying fishing effort. Monitoring of landings over a few years has shown the presence of at least 17 different species of dolphins and small whales and all are affected to varying degrees.

Researchers at the University of Ghana at Legon and the Wildlife Department have pressed for the adoption of conservation strategies for marine mammals offshore Ghana.

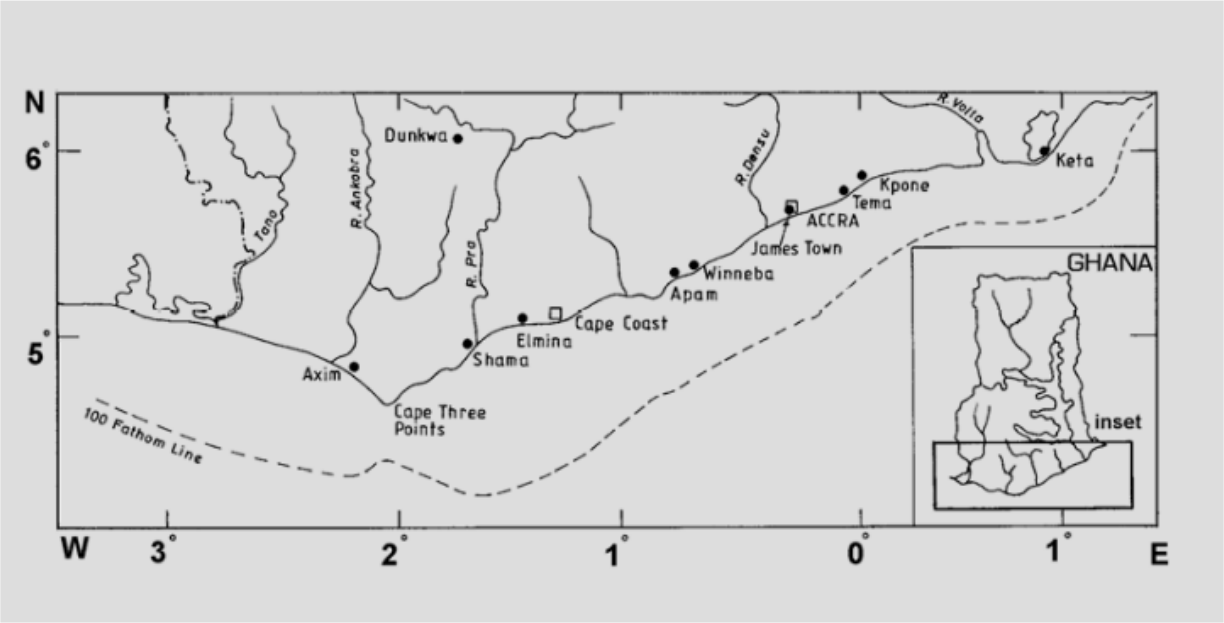
In 2008, the Conference of the Parties of the Convention for the Conservation of Migratory Species (CMS/UNEP) included the West African population of *Clymene dolphin* (*Stenella clymene*) (Ghana's principal dolphin species) on its Appendix II (http://www.cms.int/bodies/COP/cop9/Proposals/Appendix_I_&_II_Proposals.pdf), thus formally recognising its vulnerable status. The Atlantic humpback dolphin, a species endemic to West Africa, has not yet been found in Ghana even though good habitat exists. Rudimentary knowledge of the presence of large whales in Ghana waters may result equally problematic as potential conservation issues may also go unrecognised. For instance, the Gulf of Guinea humpback whale population occupies Ghana's shelf zone as a calving and breeding area, i.e. during a period when they are most vulnerable to disturbance. The global threat of large ships colliding with whales and killing or injuring them is well-documented. Shipping is known to affect at least humpback whales and Bryde's whales worldwide but also in West Africa and especially near large ports. In West Africa, a number of unexplained whale deaths are suspected to be due to ship strikes.

Together with these deaths is important to consider the washing ashore of whales carcass. A total of 20 dead whales have been discovered along Ghana's coastline in the last four years (starting from 2009) including at least eight since September 2013.

Current knowledge of the distribution, natural history, population structure and ecology of dolphins and whales in the Gulf of Guinea is rudimentary and fragmentary in the scientific literature. All information on cetaceans in Ghana is the result of land-based field research, mainly monitoring of fishing port for landings of small cetacean by-catches as well as the study of stranded animals.

Capture locations and thus habitat (neritic, slope, pelagic) are unknown, as fishermen may operate both shorewards and offshore of Ghana's continental shelf and operate at considerable distances to the east or west of the ports where they landed catches. No shipboard surveys for marine mammals have been implemented so far, therefore it is not presently possible to provide distribution maps for Ghana or adjacent states. Scientists who study aquatic mammals are based at the University of Ghana at Legon and the Faculty of Sciences at the University of Cape Coast.

Figure 37 shows artisanal fishing ports and fish landing beaches where cetaceans have been landed (Van Waerebeek *et al*, 2009). Specimens derived from by-catches and stranding shows that the cetacean fauna of Ghana is moderately diverse, essentially tropical and predominantly pelagic. It comprises 18 species belonging to 5 families: 14 species of *Delphinidae* (dolphins) and one species each of families *Ziphiidae* (beaked whales), *Physeteridae* (sperm whales), *Kogiidae* (pygmy sperm whales) and *Balaenopteridae* (rorquals).



Source: Van Waerebeek *et al*, 2009

Figure 37 Fishing Ports on the Ghanaian Coast

References to cetaceans in West Africa include Wilson *et al* (1987) for a striped dolphin *Stenella coeruleoalba* record from Côte d'Ivoire, but no voucher material is identifiable. However, striped dolphins are not uncommon offshore Angola (Weir, 2007) and this delphinid and the short-snouted common dolphin *Delphinus delphis* are expected to occur in the Gulf in deep waters. Among beaked whales, the Gervais' beaked whale *Mesoplodon europaeus* has been documented from Ascension and Guinea-Bissau (Rice, 1998), so may also be present offshore, as well as Blainville's beaked whale *Mesoplodon densirostris* which is a pantropical cetacean. Another widely distributed (sub)tropical cetacean that may be present within the survey area is the pygmy sperm whale *Kogia breviceps*. All these species have a pelagic distribution in common and may be present in the Gulf. The presence of long- snouted common dolphin in Ghana, Côte d'Ivoire (Cadenat, 1959) and Gabon (Van Waerebeek, 1997) puts in evidence a wide distribution in the Gulf, perhaps partly related to the seasonal upwelling over the continental shelf (Adamec and O'Brien, 1978). The listing of *D. delphis* in Ofori-Danson *et al* (2003) was premature, but the species may be present offshore. The skull of a confirmed *D. delphis* was collected in Mayoumba, Gabon (van Bree and Purves, 1972; Van Waerebeek, 1997).

Among baleen whales, pictures of Bryde's whales *Balaenoptera brydei/edeni* were taken as far north as Gabon (Ruud,1952) and it is likely that Bryde's whale occurs in Ghana's Exclusive Economic Zone (EEZ) waters. *B. brydei* was originally described from South Africa (Olsen 1913) and is the most likely species involved. Other rorquals (*Balaenoptera spp*.) could also occur. No Atlantic humpback dolphins (*Sousa teuszii*) have so far been confirmed in Côte d'Ivoire, Ghana, Togo, Benin or Nigeria (Debrah, 2000; Ofori-Danson *et al*, 2003; Van Waerebeek *et al*, 2004, 2009; Perrin and Van Waerebeek, 2007), despite suitable coastal habitat. Also, since the holotype was collected in the port of Douala (Kükenthal, 1892), it has not been reported again from Cameroon. Possible explanations may include local extirpation through intense pressure from

coastal fisheries (by-catch), disturbance and other habitat encroachment or insufficient research effort.

There are unconfirmed fishermen's reports that humpback dolphins may occasionally be seen between the Volta River delta and Lomé, Togo. In recent years, Atlantic humpback dolphins have been encountered with some regularity in Gabon (Schepers and Marteijn, 1993; Collins *et al*, 2004; Van Waerebeek *et al*, 2004). In 2008, the species was listed on Appendix I of CMS reflecting mounting international concern about its population status. Other rorquals such as minke whales (*Balaenoptera acutorostrata*), sei whales (*Balaenoptera borealis*), blue whales (*Balaenoptera musculus*) and fin whales (*Balaenoptera physalus*) have very wide distributions globally. Of these, the blue, fin and sei whales are classified as Endangered on the IUCN's Red Data List. The primary and secondary ranges of blue whales and the secondary ranges of fin whales potentially extend into the Gulf of Guinea, although there are no records of blue whales in Ghanaian waters. Sei whale are not generally found in equatorial waters as they occupy areas northern and southern oceans (Jefferson *et al*, 2008).

Regular landings in several Ghana ports of Clymene dolphin, pantropical spotted dolphin, common bottlenose dolphin and, to a lesser degree, short- finned pilot whale, Risso's dolphin, Atlantic spotted dolphin, rough-toothed dolphin and melon-headed whale suggest that these species are not rare in the northern Gulf of Guinea, although any estimate of population abundance is lacking. Rarely captured species may be characterised by a lower abundance in the areas that are near the continental shelf and slope. Landed cetaceans are often used as 'marine bush meat (Clapham and Van Waerebeek 2007), which is defined as meat and other edible parts derived from wild-caught marine mammals, sea turtles and seabirds.

1.6.1 Common bottlenose dolphin (*Tursiops truncatus*)

The bottlenose dolphin (family *Delphinidae*) is one of the best documented species of marine mammals. It is found in all temperate and tropical oceans and seas. Its distribution seems to be correlated to temperature, directly or indirectly, via availability of prey (Wells & Scott, 2002). Areal distribution varies as there is a wide range of behaviour patterns: seasonal migration, annual changes of the area of residence, periodic residence, combinations of long range migrations and residence in the same area. The species therefore has a large variety of marine habitats, also including estuary areas, although it does favour shallow coastal waters. It is thought that this species includes two types (ecotypes), one coastal, which is smaller in size, and one pelagic, with a more robust body. The coastal ecotype is migratory, the open sea type is generally sedentary. The bottlenose is highly social, it congregates in schools formed by females and their young, the males form associations, also with other species (IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Bottlenose dolphins have been recorded landed at Jamestown, Senya Beraku (05°23'N,00°29'W) and Tema. A small group has been recorded foraging around artisanal encircling gillnets set in nearshore waters west of Cotonou, Benin. Four bottlenose dolphins of an undetermined population, possibly offshore, were taken 10-16nm south of Vridi (ca. 05°14.5'N, 04°02.3'W), Ivory Coast, in 1957-1958 (Cadenat and Lassarat, 1959a). Both inshore and offshore populations occur off Angola year-round (Weir, 2007), as well as off western South Africa and Namibia (Ross,1977; Findlay *et al*, 1992).

Bottlenose dolphin is the third-most frequently (15.5%) landed small cetacean in Ghana (Ofori-Danson *et al*, 2003). The location of the usual drift-gillnetting grounds suggests an offshore

population, although this has not been confirmed. A total of 11 live-capture attempts were made in Walvis Bay, Namibia, in 1975, 1976 and 1983 (Findlay *et al*, 1992). Best and Ross (1984) warned against capture operations on small coastal populations on South Africa's west coast as 'potentially of more consequence'.



Figure 38 Spatial distribution of Tursiops truncates

Source: http://maps.iucnredlist.org/map.html?id=22563 accessed on 20 November 2013

1.6.2 Clymene dolphin (*Stenella clymene*)

The clymene dolphin is highly similar to the spinner, so much so that for many years it was considered a variant type, until 1981 when it was reclassified as a separate species. It is very commonly found in deep tropical and subtropical waters of the Atlantic. It is thought to frequent the entire tropical coastline of western Africa (Perrin & Mead, 1994). It is pelagic, favouring deep waters, including depths of over 5000m. It is gregarious and forms schools ranging from some individuals to thousands, and is often found in association with the spinner dolphin *S. longirostris* and short-beaked common dolphin *Delphinus delphis* (Perrin & Mead, 1994).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Robineau *et al* (1994) provided a first review of the presence of Clymene dolphin in West Africa, but did not indicate records for Ghana. Ghanaian fishermen however are most familiar with the Clymene dolphin, some calling it 'true dolphin' or 'Etsui Papa' because the species is so frequently found entangled in fishing gear. Many specimens have been landed at Keta (05°55' N, 00°59' E), Winneba, Apam and Dixcove (Debrah, 2000; Ofori-Danson *et al*, 2003). A sighting was registered in deep oceanic water at 02°10'N,02°30'W, some 160nm south of the Ghana coast (Perrin *et al*, 1981). From temporal distribution of captures, Clymene dolphins seem to be present year-round in Ghanaian waters. South of the Gulf, credible sightings were reported from Congo and Angola (Weir, 2006a, 2007). Being a tropical species, it is absent from the cool Benguela system off southwestern Africa (Findlay *et al*, 1992).

Some 34.5 percent of captured cetaceans have been Clymene dolphins, more than of any other species (Ofori-Danson *et al*, 2003). Most catches were by drift-gillnet fishermen operating out of Apam and Dixcove. The COREWAM-Ghana database holds photographic evidence for at least 35 net-entangled specimens. In 2007, concern about the observed take led the CMS Scientific

Council to unanimously endorse an Appendix II listing proposal for the West African population (Van Waerebeek, 2007). The population was added to Appendix II by the Conference of the Parties in December 2008.

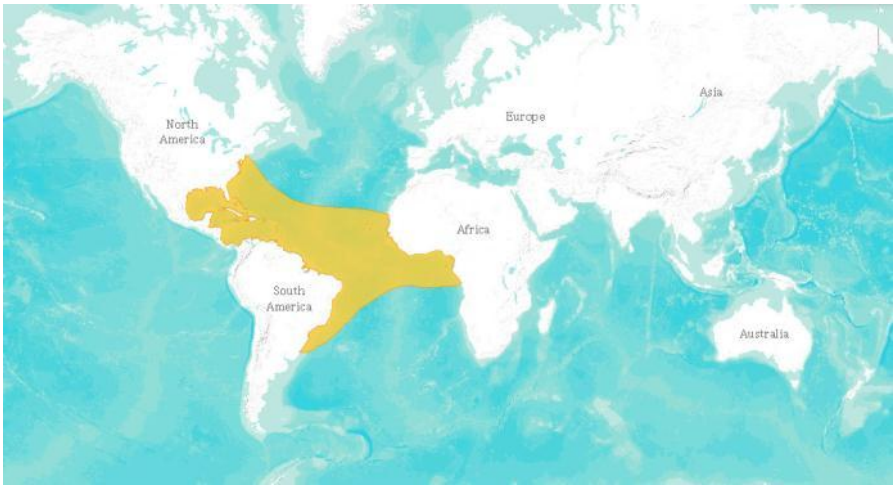


Figure 39 Spatial distribution of Stenella clymene

Source: http://maps.iucnredlist.org/map.html?id=20730 accessed on 20 November 2013

1.6.3 Spinner dolphin (*Stenella longirostris*)

The spinner dolphin is a small, toothed mammal of the *Delphinidae* family. It is commonly found in tropical and temperate warm waters all over the world, its presence in the African Atlantic offshore is poorly documented. Although it generally prefers the open seas it does at times frequent coastal waters. The spinner is a social animal, forming pods ranging from just a few individuals to some thousands.

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Spinner dolphins have been offloaded at Dixcove and Axim in 2000. Skulls exist from specimens collected at Abidjan, Côte d'Ivoire (van Bree, 1971) and in Liberia. (Broekema, 1983).

Weir (2007) reported sightings in deep pelagic areas off Angola. Spinner dolphins, typically wide-ranging and oceanic, are likely to occur throughout the deeper waters of the study area and the entire eastern tropical Atlantic.

Morphology points to the pantropical subspecies *S. longirostris longirostris* (see Perrin, 1990).

Conservation status is unknown. Spinner dolphins are only infrequently captured (3.5% of dolphin takes) by Ghana's artisanal fishermen (Ofori-Danson *et al*, 2003). The claim that tuna- dolphin associations are rare in this ocean province and tuna purse-seiners rarely set upon dolphins is not properly supported and stands in sharp contrast with the situation in the eastern tropical Pacific (e.g. Perrin, 2004). If the captures by small-scale drift-gillnet boats in Ghana are any indication, several species of tuna, billfish and sharks are habitually taken with dolphins in the same nets (Debrah, 2000; Ofori-Danson *et al*, 2003).

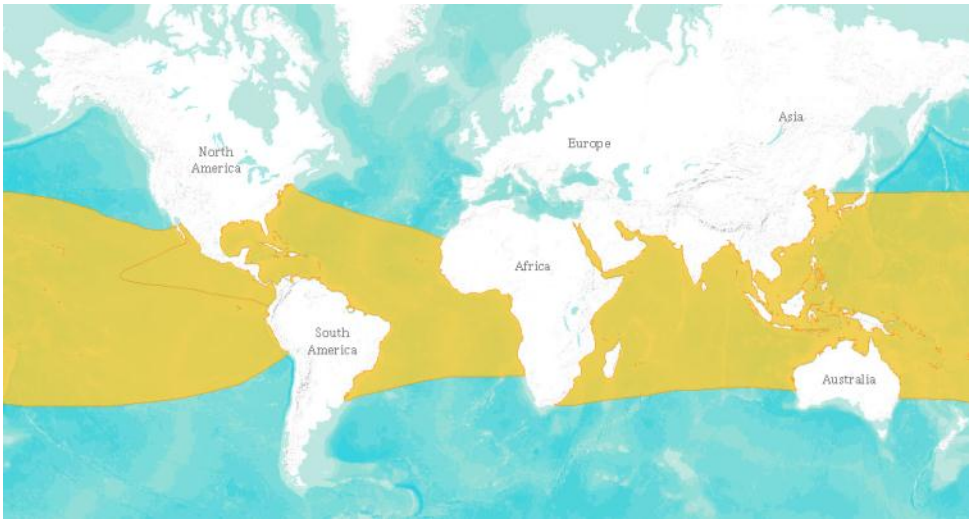


Figure 40 Spatial distribution of *Stenella longirostris*

Source: http://maps.iucnredlist.org/map.html?id=20733 accessed on 20 November 2013

1.6.4 Pantropical spotted dolphin (Stenella attenuata)

The pantropical spotted dolphin is found in tropical and subtropical seas and oceans and temperate warm waters all over the world, although sightings along the western coasts of Africa are rare. Weir (2007a) reports 5 sightings in Angola bertween 2003 and 2006, in deep waters beyond the continental slope, all located in northern Angolan waters in July.

The first supported record in Ghana was a juvenile examined at Apam in 1998; since then many more have been collected from the main study sites. The species has been documented from Côte d'Ivoire (Cadenat and Lassarat, 1959b; van Bree, 1971), Gabon (Fraser, 1950a) and offshore waters of the eastern tropical Atlantic (Perrin *et al*, 1987). No records exist from the Atlantic coast of South Africa (Findlay *et al*, 1992). A group was encountered off Pointe Pongara, southern shore of the Gabon River estuary (Fraser, 1950a).

An high percentage (17.2%) of small cetaceans offloaded in Ghana ports were pantropical spotted dolphins, making it the second-most frequently captured species (Ofori-Danson *et al*, 2003). Spinner and pantropical spotted dolphins are the main marine mammal indicator species for the presence of tuna in the eastern tropical Pacific (Perrin, 2004). For tuna fisheries in the eastern Atlantic such associations have not yet been studied. Information on levels of incidental dolphin mortality in these fisheries is scarce and of questionable credibility.

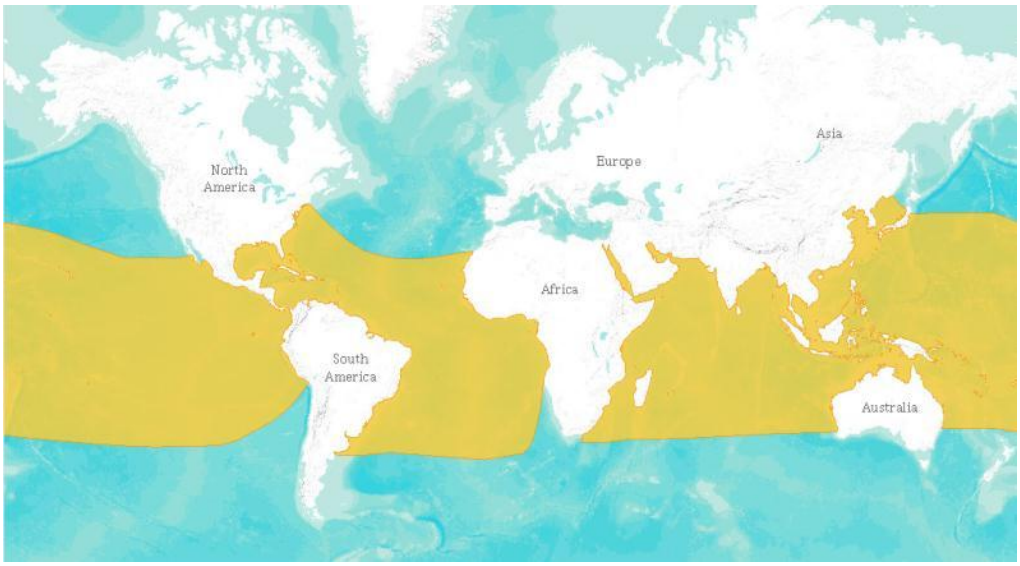


Figure 41 Spatial distribution of *Stenella attenuata*

Source: http://maps.iucnredlist.org/map.html?id=20729 accessed on 20 November 2013

1.6.5 Atlantic spotted dolphin (*Stenella frontalis*)

The Atlantic spotted dolphin is commonly found in tropical and warm temperate waters of the Atlantic ocean. Its presence is well documented at equatorial African latitudes (Guinea and Ivory Coast; Perrin *et al*., 1994a) but there is little detailed information on distribution along the entire western coast of Africa. The species is thought to include two ecotypes, a coastal type, more spotted and larger in size, and a pelagic type, less spotted and smaller (Perrin *et al*., 1994b). The former populates continental shelf areas (<200m), the latter deeper waters near the continental slope.

Atlantic spotted dolphin is endemic to the eastern and western tropical Atlantic (Perrin *et al*, 1987). The earliest reports of Atlantic spotted dolphin in Ghana refer to two bycatch victims at Dixcove, one in 2000 and another in 2003. Two specimens were captured off Vridi, Côte d'Ivoire, in 1958 (Cadenat and Lassarat, 1959b). Off Benin, a group of 10 individuals was sighted in coastal waters (Van Waerebeek, 2003). Gabon has also been cited as a range state (Perrin and Van Waerebeek, 2007). Atlantic spotted dolphin is reported from Angola (Weir, 2008), but the species avoids the cold Benguela Current off Namibia and western South Africa (Findlay *et al*, 1992). As noted above, the spotted dolphin collected off Gabon and reported by Fraser (1950a) as *Stenella frontalis* was actually a pantropical spotted dolphin.

In Ghana in 1998-2000, Atlantic spotted dolphins accounted for 5.2 percent of the small cetacean bycatch (Ofori-Danson *et al*, 2003). Two specimens were captured for research in Côte d'Ivoire (Cadenat, 1959). The largest recorded mortality was attributed to fisheries in Mauritania involving 140 stranded dolphins of which at least 125 died (Nieri *et al*, 1999). Off Angola, Weir (2008) detected negative responses in Atlantic spotted dolphins to seismic surveying off Angola.

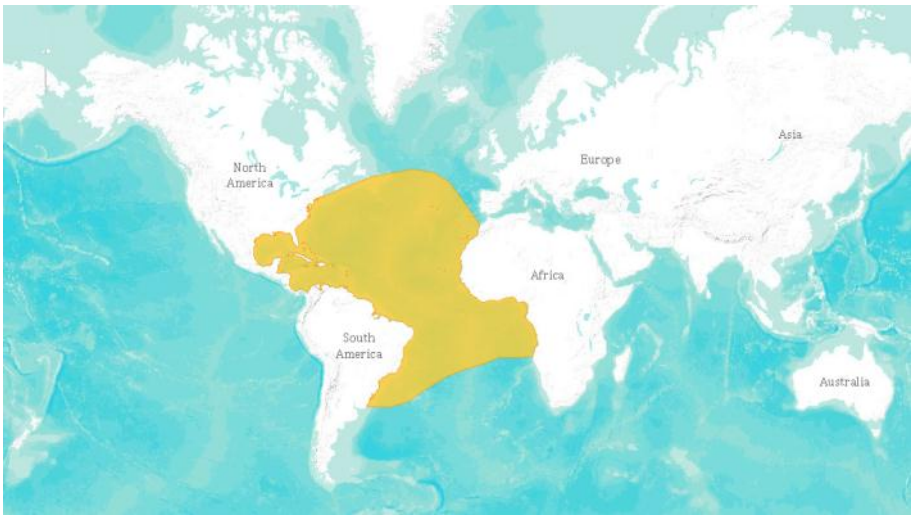


Figure 42 Spatial distribution of *Stenella frontalis*

Source: http://maps.iucnredlist.org/map.html?id=20732 accessed on 20 November 2013

1.6.6 Long-beaked common dolphin (*Delphinus capensis*)

Long-beaked common dolphins inhabit tropical and warm-temperate waters of all three major oceans. *D. capensis* seems to prefer shallower and warmer water and occurs generally closer to the coast than does *D. delphis* (Perrin 2002). It is found mostly over continental shelf water depths (< 180 m), and generally does not occur around oceanic islands far from mainland coasts (Jefferson and Van Waerebeek 2002). It sometimes associate with other species of cetaceans.

Long-beaked common dolphins generally occur within about 180 km of the coast. The overall distribution of this species remains imperfectly known, because until 1994, all common dolphins around the world were classified as a single species: *D. delphis* (Heyning and Perrin 1994).

There are two subspecies recognized:

- *D. c. capensis* – This subspecies appears to be found in distinct areas and apparently-disjunct subpopulations are known from the east coast of South America, West Africa, southern Japan, Korea and northern Taiwan (and possibly China), central California to southern Mexico, Peru, and South Africa.
- *D. c. tropicalis* – This subspecies ranges in the Indo-Pacific from at least the Red Sea/Somalia to western Taiwan/southern China and Indonesia, and including the Persian Gulf and Gulf of Thailand (Jefferson and Van Waerebeek 2002).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

This species is often confused with the short-beaked common dolphin *D. delphis*. Fishermen landed two long-beaked common dolphins at Dixcove in 1999 and a third was landed at Axim in 2000. For the Gulf, Cadenat (1959) provided body measurements for 24 long-beaked common dolphins from Côte d'Ivoire. Van Waerebeek (1997) re-examined nine West African dolphin skulls considered *D. delphis* (van Bree and Purves, 1972) but assigned only two specimens to *D. delphis*, one from Mayoumba, Gabon and another from Angola. Four skulls from Gabon, two from Angola and one from Congo were assigned to *D. capensis*. Most common dolphins occurring within the 200-m isobath shelf in South African waters are *D. capensis*.

Common dolphin records, perhaps of both species, exist as far north as Walvis Bay, Namibia (Findlay *et al*, 1992). Photographs off Gabon (in Rosenbaum and Collins, 2004) show a colouration pattern consistent with that of *D. capensis*. It supports an earlier claim that long- beaked common dolphins are widely distributed in the Gulf of Guinea as well as off central Africa (Van Waerebeek, 1997).

Long-beaked common dolphins are avid bowriders and can easily be targeted with hand-held harpoons. However, so far only a few have been recorded landed in Ghana ports. Simmons (1968) reported the take of 'common dolphins' with tuna in the Gulf of Guinea.

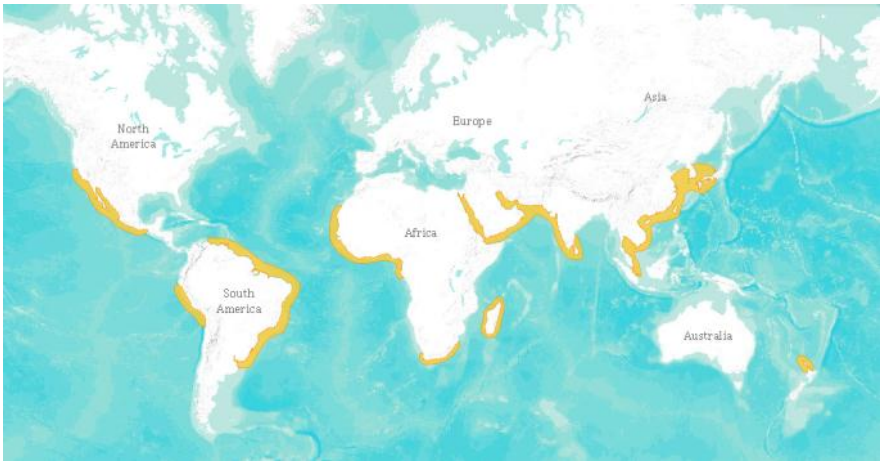


Figure 43 Spatial distribution of *Delphinus capensis*

Source: http://maps.iucnredlist.org/map.html?id=6337 accessed on 20 November 2013

1.6.7 Fraser's dolphin (*Lagenodelphis hosei*)

It is an oceanic species that prefers deep offshore waters, but it can be seen near shore in some areas where deep water approaches the coast (such as the Philippines, Taiwan, and some islands of the Caribbean and the Indo-Malay archipelago) (Perrin *et al*. 1994).

In the eastern tropical Pacific, it occurs more often in Equatorial - southern subtropical surface water and other waters typified by upwelling and generally more variable conditions (Au and Perryman 1985). Off South Africa, records are associated with the warm Agulhas Current that moves south in the summer (Perrin *et al*. 1994).

Fraser's Dolphins feed on midwater fish (especially myctophids), squid, and crustaceans (Dolar *et al*. 2003). Physiological studies indicate that Fraser's are capable of quite deep diving (and it is thought that they do most of their feeding deep in the water column – in waters up to 600 m deep), but they have been observed to feed near the surface as well (Watkins *et al*. 1994).

The exact distribution of this species is poorly known. Fraser's Dolphin has a pantropical distribution, largely between 30°N and 30°S in all three major oceans (Jefferson and Leatherwood 1994, Dolar 2002). Strandings in temperate areas (Victoria in Australia, Brittany and Uruguay) may represent extralimital forays connected with temporary oceanographic anomalies such as the world-wide El Niño phenomenon in 1983–84, during which a mass stranding occurred in France (Perrin *et al*. 1994). Bones *et al*. (1998) reported on a stranding on the coast of Scotland.

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Records of Fraser's dolphin in West Africa were recently reviewed (Weir *et al*, 2008). For Ghana, only bycatch specimens are known: one in Axim in 2000 (Ofori-Danson *et al*, 2003), three at Dixcove and Axim in 2000 (Debrah, 2000). One probable sighting is known from Nigeria and two confirmed sightings from Angola (Weir *et al*, 2008). To the west, the closest record is Ile de Sangomar (13°50'N, 16°46'W), Senegal (Van Waerebeek *et al*, 2000). However, Fraser's dolphin may be widely distributed in deep waters of the Gulf and the tropical SE Atlantic Ocean. In South Africa all records are from the warm Agulhas Current-influenced SE coast (Ross, 1984; Findlay *et al*, 1992).

Of unknown status, Fraser's dolphin is only occasionally taken in Ghana's artisanal fisheries, explainable by its preference for far offshore waters. The potential of bycatches by large pelagic or foreign fishing vessels remains to be assessed.

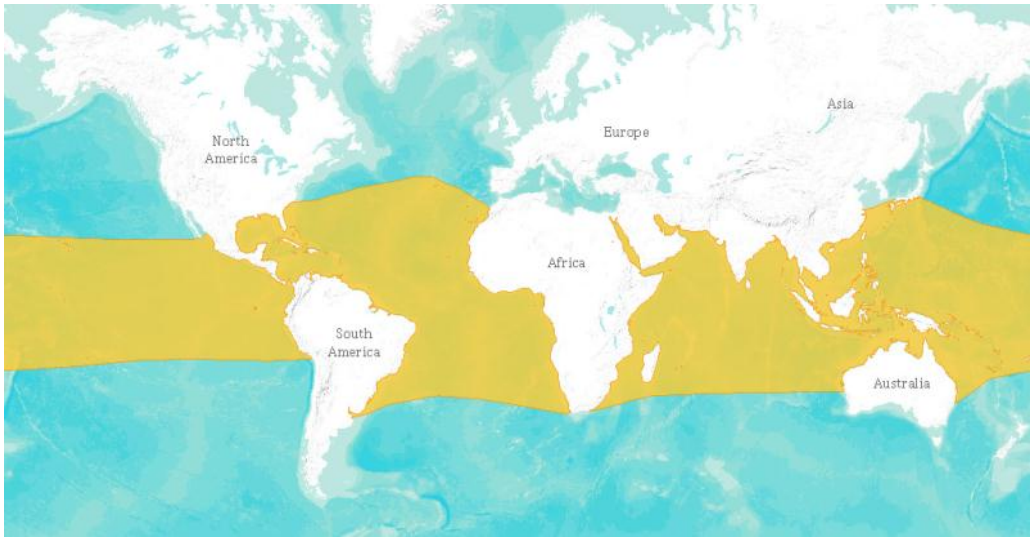


Figure 44 Spatial distribution of *Lagenodelphis hosei*

Source: http://maps.iucnredlist.org/map.html?id=11140 accessed on 20 November 2013

1.6.8 Rough-toothed dolphin (*Steno bredanensis*)

The rough-toothed dolphin is a large mammal found in warm waters all over the world, although with low abundance. It is typically an open sea mammal, preferring tropical and subtropical waters of considerable depth. It is gregarious, often forming schools of some tens of individuals and has been observed in association with the bottlenose dolphin *Tursiops truncatus* (in Gabon) and pilot whale *Globicephala macrorhynchus* (in Angola).

Jefferson *et al* (1997) reported two undocumented sightings 'off Ghana' in 1972. At least four catches are recorded in Ghana at Apam: one in 1999, two in 1998, and another one in 2002 (Debrah, 2000; Van Waerebeek *et al*, 1999). Rough-toothed dolphins are confirmed from Côte d'Ivoire when 3 were taken 15-18nm south of Vridi in 1958 (Cadenat, 1959), a fourth (a skull) with reported origin 'Abidjan' is at the US National Museum of Natural History. Only one specimen

record exists for Namibia (Möwe Bay, 19°20S,12°35'E) in 1986 (Findlay *et al*, 1992). Rough-toothed dolphins plausibly range in deep waters throughout the eastern tropical Atlantic.

In Ghana, rough-toothed dolphins are occasional victims of gillnet entanglement (3.5% of cetacean catches). Apparently the Vridi specimens (Cadenat, 1959) were taken for research purposes. Little else is known on the species' status in the eastern tropical Atlantic.

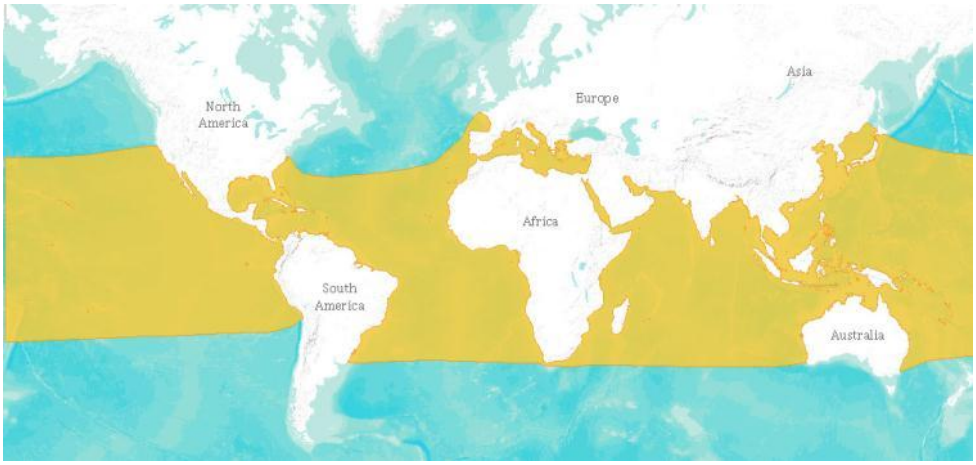


Figure 45 Spatial distribution of *Steno bredanensis*

Source: http://maps.iucnredlist.org/map.html?id=20738 accessed on 20 November 2013

1.6.9 Risso's dolphin (*Grampus griseus*)

Risso's dolphin is a cosmopolitan species of the *Delphinidae* family, absent only from high latitude seas. It frequents all temperate and tropical waters with temperatures above 10°C (Notarbartolo di Sciara, 2002). It favours the deep waters near continental escarpments and particularly zones where the slope is most steep, as well as submarine canyons, also approaching the coast if the seabed is sufficiently deep. However it is not uncommon to find it also near coasts (sightings in platform zones in Gabon in 2004). It is usually observed in groups comprising 1 to 15-18 individuals (Weir, 2007a).

Ghana's Fante fishermen have long been familiar with the Risso's dolphin and call it 'Eko tui', the parrot dolphin, in reference to its peculiar head shape. Confirmed landings are known at Apam in 1999, at Dixcove in 2000, and one at Axim in 2000 (Ofori-Danson *et al* , 2003). A crew chased a small group of Risso's dolphins ca. 25nm off Côte d'Ivoire in 1958, in a failed harpooning attempt (Cadenat, 1959). The species almost certainly occurs throughout the Gulf, but Ghana and Côte d'Ivoire are the only confirmed range states.

The Risso's dolphin inhabits tropical to cool-temperate waters which is in concordance with its presence off Angola (Weir, 2007), Namibia and South Africa where it is associated with the shelf edge and pelagic waters (Findlay *et al*, 1992).

Risso's dolphins are regularly captured (6.9% of catches) in Ghana's artisanal fisheries (Ofori-Danson *et al*, 2003), but we know little else on the species' status.

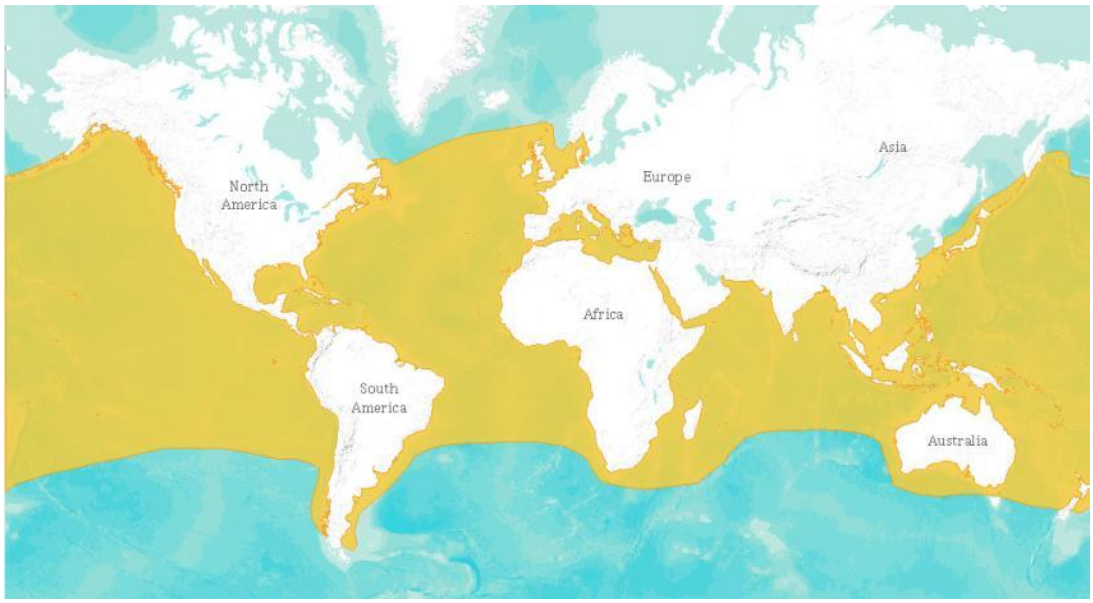


Figure 46 Spatial distribution of *Grampus griseus*

Source: http://maps.iucnredlist.org/map.html?id=9461 accessed on 20 November 2013

1.6.10 Melon-headed whale (*Peponocephala electra*)

Most sightings are from the continental shelf seaward, and around oceanic islands; they are rarely found in temperate waters. However, they do occur in some nearshore areas where deep water approaches the coast (see Watkins *et al*. 1997; Wang *et al*. 2001a, b). In the eastern tropical Pacific, the distribution of reported sightings suggests that the oceanic habitat of this species is primarily in the upwelling modified and equatorial waters (Perryman *et al*. 1994).

Little is known of the diet of this species, though they are known to feed on several species of squid, shrimp and small fish.

Melon-headed whales have a pantropical distribution (Perryman 2002). The distribution coincides almost exactly with that of the pygmy killer whale in tropical/subtropical oceanic waters between about 40°N and 35°S (Jefferson and Barros 1997). A few high-latitude strandings are thought to be extralimital records, and are generally associated with incursions of warm water. These include specimens from Cornwall in England, Cape Province in South Africa, and Maryland, USA (Perryman *et al*. 1994; Rice 1998).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

The melon-headed whale is known in the Gulf solely from bycatches in Ghana. Geographically most adjacent records are, to the northwest, a skull from Guinea-Bissau (van Bree and Cadenat, 1968) and, to the south, three sightings in deep oceanic waters off Angola (Weir, 2007) plus a stranding at Hout Bay (34°03' S,18°21'E), South Africa (Best and Shaughnessy, 1981).

Nonetheless, melon-headed whale may be widely distributed in the eastern tropical Atlantic but it is probably fairly rare.

Melon-headed whales are accidentally netted with some regularity in Ghana waters. Specimens have been landed in Shama in 1994 and at least four in Dixcove in 2000 and 2002. No other information is available.

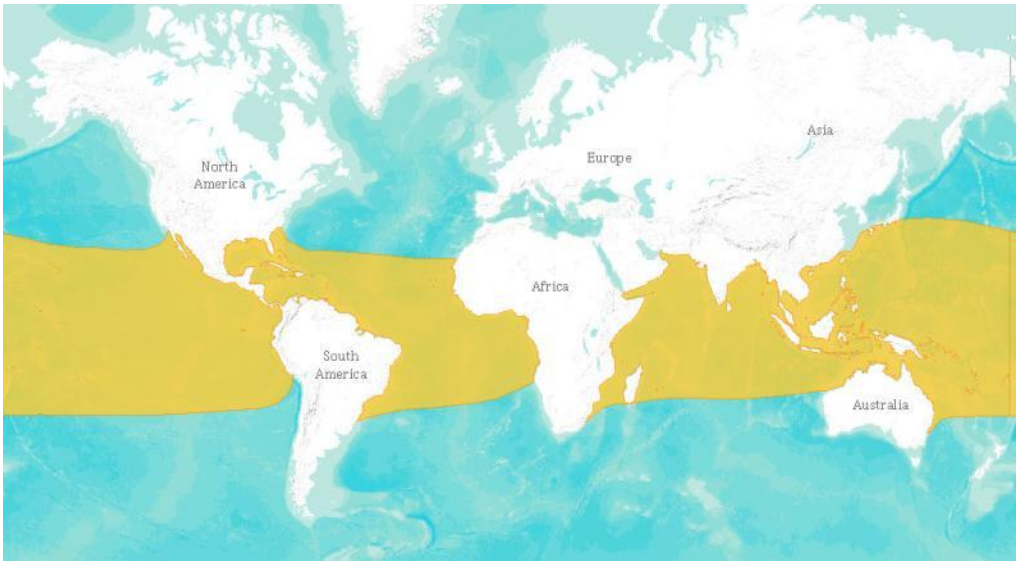


Figure 47 Spatial distribution of *Peponocephala electra*

Source: http://maps.iucnredlist.org/map.html?id=16564 accessed on 20 November 2013

1.6.11 Pygmy killer whale (*Feresa attenuata*)

The pygmy killer whale occurs in deep, warm waters, generally beyond the edge of the continental shelf, and rarely close to shore (except near some oceanic island groups where the water is deep and clear). This species is mainly tropical, but occasionally strays into warm temperate regions.

Little is known of the diet of this species, although it is known to eat fish and squid. It has occasionally been recorded attacking dolphins, at least those involved in tuna fishery interactions in the eastern tropical Pacific (Perryman and Foster 1980).

This is a tropical/subtropical species that inhabits oceanic waters around the globe generally between 40°N and 35°S. It does not generally approach close to shore, except in some areas where deep, clear waters are very close to the coast (such as around oceanic archipelagos like Hawaii). Reports of its occurrence in the Mediterranean Sea, while common in the literature, are not supported by authenticated records. It is also doubtful whether it occurs regularly in the Red Sea or Persian Gulf (Leatherwood *et al*. 1991). A few high-latitude strandings and sightings are thought to be extralimital records, and are generally associated with incursions of warm water (Ross and Leatherwood 1994; Donohue and Perryman 2002; Williams *et al*. 2002).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

An adult-sized pygmy killer whale landed at Dixcove in 2007 is the first and only documented record in the Gulf of Guinea. Records to the south from Annobon Island (01°24.2'S,05°36.8' E) were reported by Tormosov *et al* (1980) however there is no voucher information and the records cannot be verified. Indeed, confusion with melon-headed whales is very common. Off southwestern Africa, pygmy killer whales have stranded in Cape Town and as far north as 23°S, Namibia (Best, 1970; Findlay *et al*, 1992). Best (1970) documented in great detail four animals stranded at Lüderitz Lagoon, but little other information is published.

An adult-sized pygmy killer whale was landed at Dixcove in December 2007, the only case detected during our port monitoring (Van Waerebeek *et al*, 2009). Status is unknown but, as elsewhere, pygmy killer whales are probably rare.

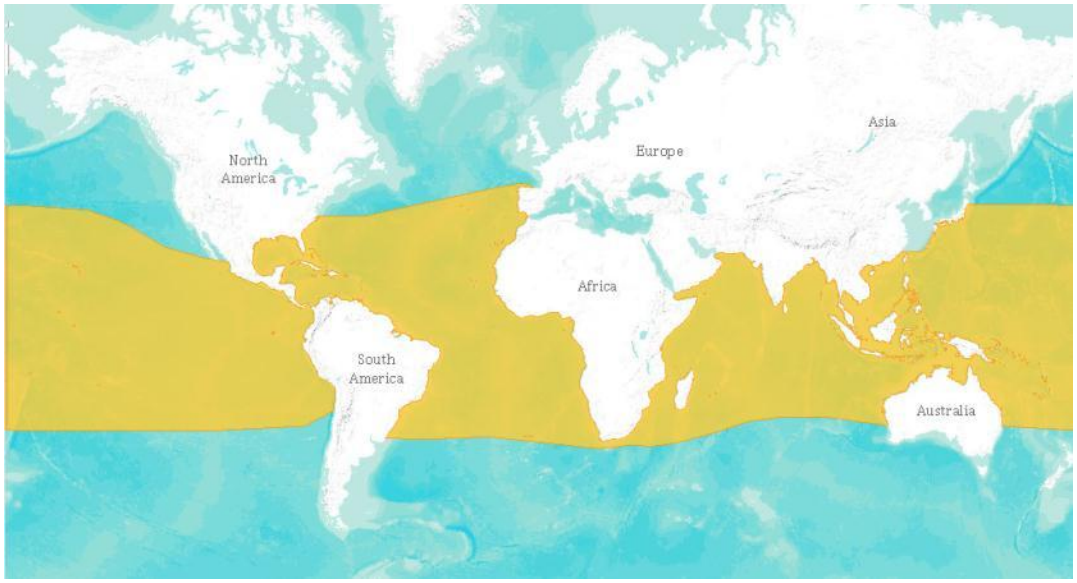


Figure 48 Spatial distribution of *Feresa attenuata*

Source: http://maps.iucnredlist.org/map.html?id=8551 accessed on 20 November 2013

1.6.12 Short-finned pilot whale (*Globicephala macrorhynchus*)

The short-finned pilot whale *Globicephala macrorhynchus* is one of the two species of marine mammals of the genus *Globicephala*, family *Delphinidae*. It is widely distributed in all seas but mainly found in warm waters. It is a gregarious species and forms pods of tens or even hundreds of individuals. Weir (2007a) reports that between 2003 and 2006 there were twenty two sightings of pods, with from 4 to 200 animals. The sightings were made in open seas beyond the continental shelf, in waters of average depth of 2000m, and throughout the entire year.

The other species in the genus is *Globicephala melas* (long-finned pilot whale). It is commonly found in sub-polar temperate waters of oceans and seas that have a temperature range between 0°C and 25°C (Martin 1994). An open sea mammal with a gregarious temperament, it favours deep waters, far from the coast. The species forms pods of large numbers.

Differentiating between the two species of the genus is difficult at sea. They are distinguished by the length of the fins, *G. macrorhynchus* has short fins, *G. melas* long

Short-finned pilot whales seem to be fairly common in Ghana waters, and also occur off Côte d'Ivoire (Cadenat, 1959). Pilot whales are also reported off Cap López, Gabon (Walsh *et al*, 2000). Fraser (1950b) summarized the morphology of pilot whales in NW Africa. Distribution boundaries to the south and SE are unclear. On South Africa's Atlantic coast the cool-water- adapted long-finned pilot whale *G. melas edwardii* is found but no short-finned pilot whales have been recorded (van Bree *et al*, 1978; Findlay *et al*, 1992).

Short-finned pilot whales are irregular bycatch victims in drift gillnets off Ghana (3.5% of cetacean catches, Ofori-Danson *et al*, 2003) and have been landed at Shama, Axim and Dixcove.

Most specimens are too big to haul onboard artisanal fishing boats and are towed to port. The Vridi specimen was harpooned for research purposes (Cadenat, 1959). A significant conservation problem exists around the Canary Islands where animals are frequently hit by small boat propellers during whale-watching (Heimlich-Boran,1990; Carwardine, 1994; Van Waerebeek *et al*, 2007).

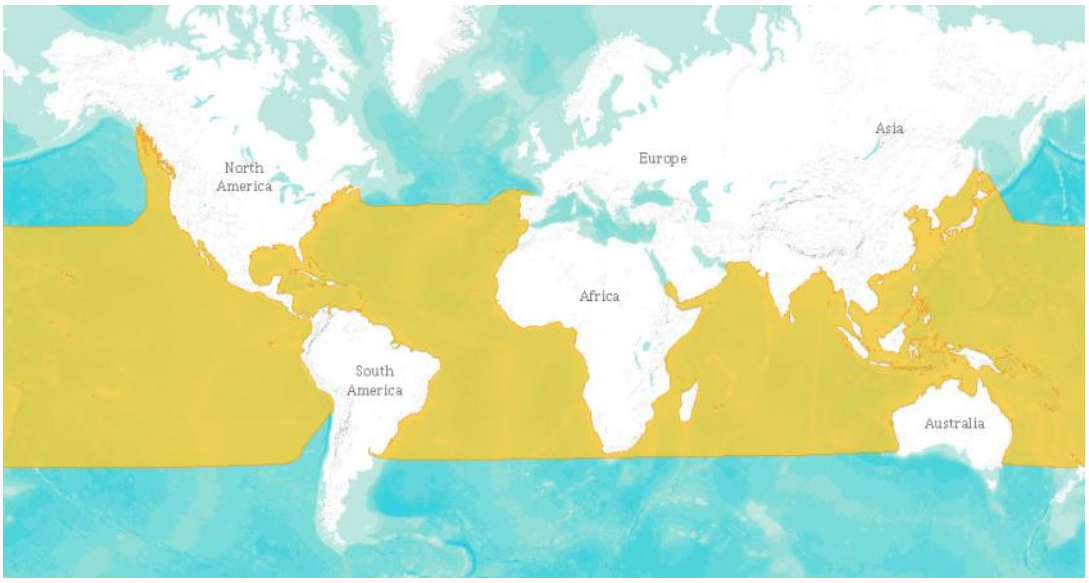


Figure 49 Spatial distribution of *Globicephala macrorhynchus*

Source: http://maps.iucnredlist.org/map.html?id=9249 accessed on 20 November 2013

1.6.13 Killer whale (*Orcinus orca*)

The orca or killer whale is a marine mammal belonging to the *Delphinidae* family, suborder *Odontoceti.* It is extremely common in all oceans, from polar to tropical waters, although as a general rule it prefers the cold waters of the poles, at times migrating to the equator. Its habitats are highly varied, from open seas to shallow waters, including very low depths and sometimes even the mouths of rivers. It is a highly social animal, typically congregating in pods with an average of 15 individuals, usually composed of a female, her young, older females and one adult male.

A single skeletal specimen is known for Ghana, possibly collected in 1956. A killer whale was harpooned some 15-20nm south of Abidjan in 1958 but the animal sank. Cadenat (1959) claimed that killer whales are regularly present in the region. Observers on industrial tuna purse-seiners reported a few sightings off the coast of Liberia, Ivory Coast and Ghana (Hammond and Lockyer, 1988). Other sighting reports exist for Gabon (Reeves and Mitchell, 1988; Jefferson *et al*, 1997; Rosenbaum and Collins, 2004). The presence of humpback whales with calves in many areas of the Gulf may attract killer whales to prey on them.

The status in the region is unknown but no conservation problems have been identified. The only killer whale reported taken in the Gulf was in 1958 (Cadenat, 1959).



Figure 50 Spatial distribution of *Orcinus orca*

Source: http://maps.iucnredlist.org/map.html?id=15421 accessed on 20 November 2013

1.6.14 False killer whale (*Pseudorca crassidens*)

False killer whales occur in tropical and temperate waters worldwide (Stacey *et al*. 1994; Odell and McClune 1999), generally in relatively deep, offshore waters. However, some animals may move into shallow and higher latitude waters, on occasion (including some semi-enclosed seas such as the Red Sea and the Mediterranean). The species seems to prefer warmer water temperatures. Off Hawaii, this species is found in both shallow (less than 200 m) and deep water (greater than 2000 m) habitats (Baird *et al*. 2008).

Although false killer whales eat primarily fish and cephalopods, they also have been known to attack small cetaceans, humpback whales, and sperm whales. They eat some large species of fish, such as mahi-mahi (also called dorado or dolphinfish), tunas (Alonso *et al*. 1999) and sailfish. In Hawaiian waters observational studies suggest that large game fish (mahi-mahi, tunas, billfish) may form the majority of their diet (Baird *et al*. 2008).

False killer whales are found in tropical to warm temperate zones, generally in relatively deep, offshore waters of all three major oceans. They do not generally range into latitudes higher than 50° in either hemisphere. However, some animals occasionally move into higher latitude waters. They are found in many semi-enclosed seas and bays (including the Sea of Japan, Bohai/Yellow Sea, Red Sea, and Persian Gulf), but they only occasionally occur in the Mediterranean Sea (Leatherwood *et al*. 1989). There are a few records for the Baltic Sea, which are considered extralimital. There are also records of false killer whales being found far into large rivers in China.

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

The first record in Ghana comprises three false killer whales landed at Apam in 2003. Skulls were collected from a false killer whale stranded near Assini (05°07'25"N, 03°06'40"W), Côte d'Ivoire, in 1970 (van Bree, 1972) and from a specimen in Benin (Van Waerebeek *et al*, 2001; Tchibozo and Van Waerebeek, 2007). An animal live-stranded at Cap Esterias (00°37'N, 09°29'E), Gabon, in 1992 (Van Waerebeek and De Smet, 1996). Mörzer-Bruyns (1969) described a group of 30 off Liberia at 04°48'N,11°24'W in 1961.

Nine sightings off Angola, in eight months of the year, were all located over deep-water areas seaward of 1467m (Weir, 2007) in accordance with the species' usual habitat elsewhere. Findlay *et al* (1992) reported a mass stranding near Lüderitz, Namibia.

The conservation status of false killer whale in the Gulf is unknown. In Ghana, the species is infrequently captured in drift gillnets. The animal that live-stranded in Gabon was butchered for food (Van Waerebeek and De Smet, 1996).

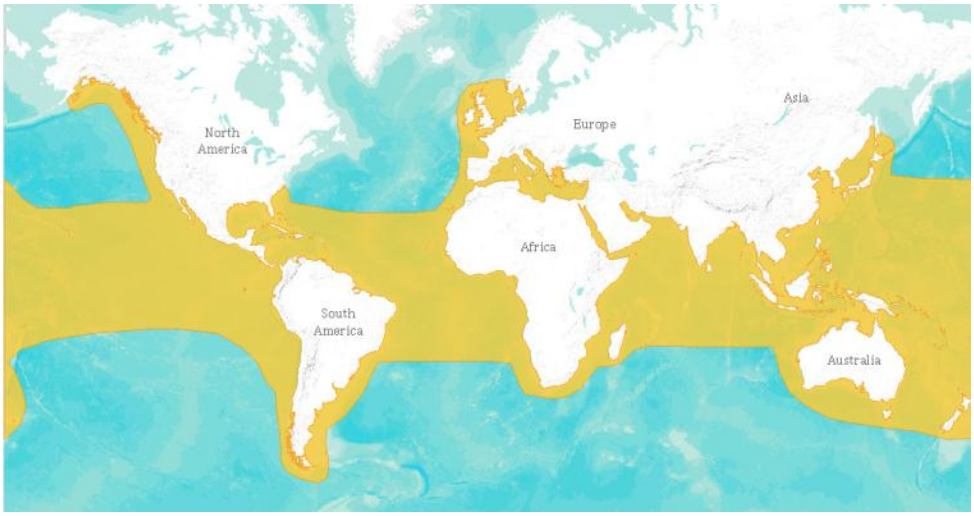


Figure 51 Spatial distribution of *Pseudorca crassidens*

Source: http://maps.iucnredlist.org/map.html?id=18596 accessed on 20 November 2013

1.6.15 Cuvier's beaked whale (*Ziphius cavirostris*)

A toothed whale belonging to the family *Ziphiidae*, the beaked whale is named for its elongated beak, typical of the family. It is commonly found in all oceans, in temperate and tropical waters. It is typically an open sea mammal, rarely found near coastal and continental shelf waters. It favours deep waters beyond continental slopes, with a marked preference for zones over submarine canyons. In general it is solitary or congregates in small pods (2-4 individuals). Although present in practically all seas, it seems to have a low abundance and is also poorly documented.

Cuvier's beaked whale is a cosmopolitan ziphiid found in pelagic tropical to warm temperate waters. A juvenile landed at Axim in 1994 is the first documented beaked whale in the Gulf of Guinea. Weir (2006b) described a group of 3 Cuvier's beaked whales SW of Luanda, Angola, at 07°15.84'S,11°07.79'E, and reported a group of 3-4 'likely Cuvier's beaked whales' NW of Luanda. Four other beaked whale sightings off Angola were not identified, but Cuvier's beaked whale was possible in three cases. The fourth was a *Mesoplodon sp*.

All encounters were over deep water seaward of the continental shelf (Weir, 2006b). Three stranded Cuvier's beaked whales are known from Namibia (21°-23°S) and another two from the Atlantic coast of South Africa (Findlay *et al*, 1992).

The status of Cuvier's beaked whale is unknown, but no threats are identified. The single capture in Ghana among hundreds of other small cetaceans (Debrah, 2000; Ofori-Danson *et al*, 2003) suggests that impact from bycatch is probably negligible.

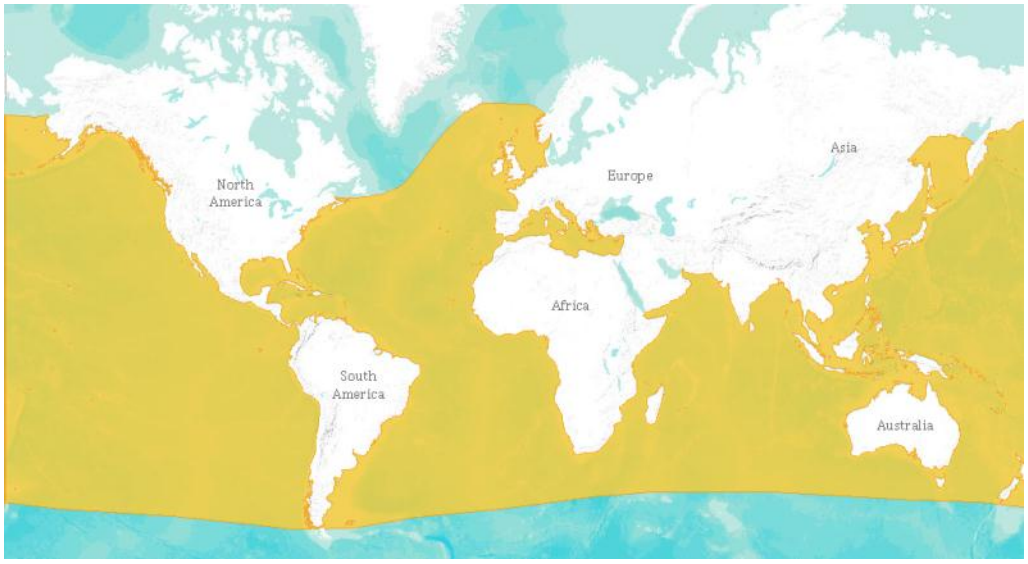


Figure 52 Spatial distribution of *Ziphius cavirostris*

Source: http://maps.iucnredlist.org/map.html?id=23211 accessed on 20 November 2013

1.6.16 Dwarf sperm whale (*Kogia sima*)

A relative of the sperm whale, this species is also known as the dwarf sperm whale due to its much smaller size. It is one of the three species of *Odontoceti* of the family *Physeteridae*. Commonly found in tropical and subtropical ocean waters, it seems to favour deep waters beyond the continental shelf. The dwarf sperm whale is usually solitary but has occasionally been seen in small pods.

In Ghana, a dwarf sperm whale was taken by fishermen from Apam in 1998. Two unidentified *Kogia sp*. were landed, one at Shama in 1994 and another at Apam in 2003. No sightings exist for the Gulf. In South Africa dwarf sperm whale distribution is limited to the South Coast between Cape Columbine and c. 28°E. Stranded dwarf sperm whale specimens are recorded north to at least 22°S at Cape Cross, Namibia (Ross 1984, Findlay *et al* 1992). Maigret and Robineau (1981) reviewed the genus *Kogia* in Senegal and West Africa.

Although all three *kogiid* specimens, one *K. sima* and two *Kogia sp*. were captured in drift gillnets, impact of fisheries cannot yet be evaluated. While entanglement rate seems low, populations may also be small.

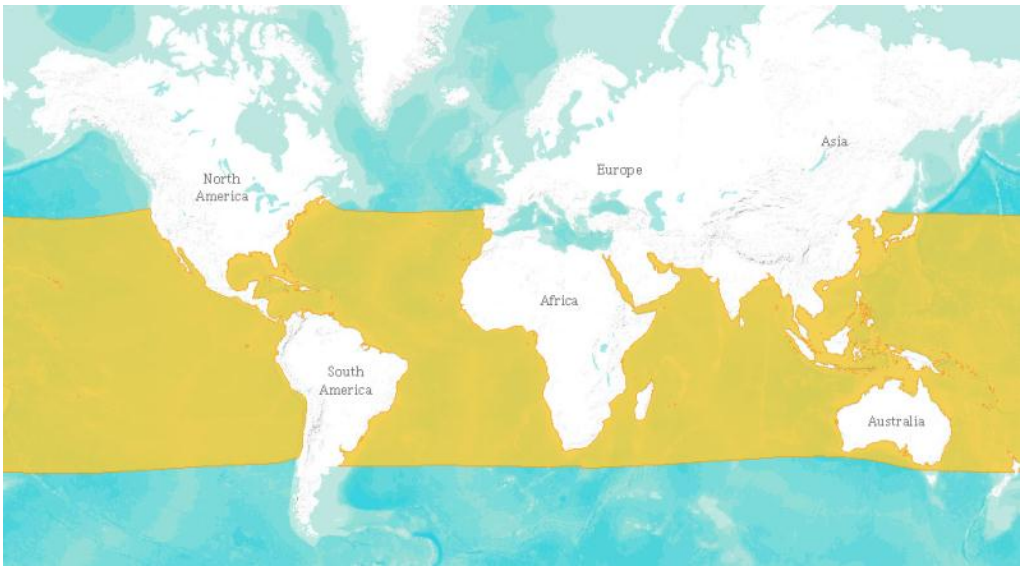


Figure 53 Spatial distribution of *Kogia sima*

Source: http://maps.iucnredlist.org/map.html?id=11048 accessed on 20 November 2013

1.6.17 Sperm whale (*Physeter macrocephalus*)

Belonging to the suborder of *Odontoceti*, family *Physeteridae*, the sperm whale is found in oceans worldwide, from the equator to cold water seas, with a marked preference for deep waters. It is a typical open sea mammal, capable of diving to over 2500m. It prefers continental slope and canyon areas, approaching the coast only where the seabed is particularly steep. Spatial distribution varies according to age and gender: females and their young frequent temperate and tropical waters, while males leave these nurseries in puberty and migrate to higher latitudes or even as far as polar waters (Best, 1974). The social structure of the sperm whale is also determined by gender: females are highly social, they congregate in pods of about a dozen individuals and their young; males, once they have left the nursery, form pods of bachelors with other males of similar age and size, becoming solitary in later life.

Hardly any information is available on sperm whales in the Gulf of Guinea, however at least females and juveniles are thought to be present year-round beyond the continental shelf. In Ghana, two dead sperm whales washed ashore, one near Accra in 1994 and a second at Dixcove in 2002. Off Gabon, sperm whales were hunted from August till October (Slijper *et al*, 1964). Off Angola, their density peaked between January and May (Weir, 2007a). As expected, sperm whales were sighted exclusively seaward of the shelf break.

A notable cluster occurred west of the Congo River mouth. Natural history information is available only for sperm whales off the southwest coast of South Africa (e.g. Best 1967, 1969, 1970). Sperm whales are ‘Vulnerable’ according to the 2008 IUCN Red List and are listed in Appendix I of CMS. Long-line fishermen targeting tuna and sharks in equatorial waters of the Gulf and farther south complain about regular predation of hooked fish by sperm whales.



Figure 54 Spatial distribution of *Physeter macrocephalus*

Source: http://maps.iucnredlist.org/map.html?id=41755 accessed on 20 November 2013

1.6.18 Humpback whale (*Megaptera novaeangliae*)

With few exceptions, such as the Arabian Sea population, humpback whales undertake long migrations between breeding grounds in tropical coastal waters in winter to feeding grounds in middle and high latitudes, mainly in continental shelf waters (Clapham 2002).

In the Southern Hemisphere, humpbacks appear to feed mainly in the Antarctic, where the diet consists almost exclusively of krill (*Euphausia superba*) (Mackintosh 1970), although some feeding in the Benguela Current ecosystem on the migration route west of South Africa has been observed (Best *et al*. 1995; suspected prey species are: *E. lucens* and *Themisto gaudichaudii*).

The Humpback Whale is a cosmopolitan species found in all the major ocean basins (Clapham and Mead 1999), and all but one of the subpopulations (that of the Arabian Sea) migrate between mating and calving grounds in tropical waters, usually near continental coastlines or island groups, and productive colder waters in temperate and high latitudes.

Humpbacks in the North Atlantic range in summer from the Gulf of Maine in the west and Ireland in the east, and up to but not into the pack ice in the north; the northern extent of the humpback's range includes the Barents Sea, Greenland Sea and Davis Strait, but not the Canadian Arctic. They occur mainly in specific feeding areas, as noted below. In the winter the great majority of whales migrate to wintering grounds in the West Indies, and an apparently small number use breeding areas around the Cape Verde Islands.

In the North Pacific their summer range covers shelf waters from southern California, to the Gulf of Alaska, Bering Sea and southern Chukchi Sea, the Aleutian chain and Kamchatka, Kurile Islands,

Okhotsk Sea and northeastern Japan. Wintering grounds are off the coasts of Mexico and Central America, around the Hawaiian Islands, the Bonin Islands, Ryukyu Islands and the northern Philippines, and possibly around additional island groups in the western North Pacific.

Humpbacks are abundant throughout the Antarctic in summer south to the ice edge, but not within the pack ice zone. In the winter, Southern Hemisphere whales aggregate into specific nearshore breeding areas in the Atlantic, Indian Ocean and Pacific, two of which extend north of the equator, i.e. off Colombia in the eastern Pacific and in the Bight of Benin in the Atlantic. Some wintering grounds are fairly localized, e.g. around island groups, and some are more diffuse, e.g. along the western coast of southern Africa and the southern coast of West Africa.

There is a resident year-round population in the Arabian Sea, which is genetically distinct from that of the southern Indian Ocean.

Humpbacks rarely enter the Mediterranean and are considered only visitors there (Reeves and Notarbartolo di Sciara 2006).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Irvine (1947) recorded a possible humpback whale at Prampram in September 1938. Van Waerebeek and Ofori-Danson (1999) first confirmed the species from Ghana based on a fresh neonate stranded at Ada (05°48.5'N,00°38'E) in September 1997. An adult-sized humpback whale stranded at Ada Foah (05°46'33"N,0°36'58"E) in October 2006. Humpback whales are regularly sighted inshore, e.g. from the Dixcove castle, from September till December. A neonate stranded in Lomé, Togo, in August 2005 (Tchibozo and Van Waerebeek, 2007). Rasmussen *et al* (2007) encountered several pods including a mother and possible newborn calf in Ghanaian waters in October 2006.

From the presence of humpback whales exclusively from early August till late November, and the frequent observations of neonates and 'competitive groups', it is evident that the continental shelf of Benin, Togo, Ghana, and western Nigeria hosts a breeding/calving population with a Southern Hemisphere seasonality (Van Waerebeek *et al*, 2001; Van Waerebeek, 2003), referred to as the 'Gulf of Guinea stock'. Its parapatric distribution suggests it may be related to the IWC- defined breeding stock 'B' from central-west Africa (IWC, 1997, 2006). Mother/calf pairs have been sighted exclusively nearshore in Benin, sometimes just beyond the surf-zone. The westernmost authenticated record is a stranding at Assini Mafia (05°7'25"N, 03°16'40"W), eastern Côte d'Ivoire in August 2007 (Van Waerebeek *et al*, 2007). For many years, small-scale, seasonal humpback whale-watching sorties have been conducted from the ports of Sekondi- Takoradi, Lomé and Cotonou (Van Waerebeek *et al*, 2001). The breeding stock off Gabon and Angola is the subject of long-tem dedicated studies (e.g. Best *et al*, 1999; Walsh *et al* 2000; Rosenbaum and Collins, 2004).

No abundance estimate is available for the Bight of Benin population, but encounter rate in October 2000 was 0.109 humpback whales/nautical mile surveyed (Van Waerebeek *et al*, 2001).

The reported neonates stranded in unknown circumstances, both natural and anthropogenic causes are possible. At least some humpback whale strandings in the area are thought to be animals killed in vessel collisions, which may be far more common in African waters than scarce reports suggest (Félix and Van Waerebeek, 2005; Van Waerebeek *et al*, 2007). Humpback whales near Cotonou's harbour entrance and crossing the main shipping lanes, incur obvious risk. The individual that stranded at Assini Mafia was reported with external trauma consistent with a propeller hit (see Van Waerebeek *et al*, 2007).

Table 22 Threatened Marine Mammals Species in Ghanaian Waters (IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org) (IUCN Red List Status CR=Critically Endagered; EN=Endagered; DD=Data deficient; LC=Least Concern; NT=Near Threatened; VU=Vulnerable)

Scientific name	Common name	Red List Category	Population trend
Globicephala macrorhynchus	Short-finned Pilot Whale	DD	Unknown
Grampus griseus	Risso's Dolphin	LC	Unknown
Kogia breviceps	Pygmy Sperm Whale	DD	Unknown
Kogia sima	Dwarf Sperm Whale	DD	Unknown
Lagenodelphis hosei	Fraser's Dolphin	LC	Unknown
Orcinus orca	Killer Whale	DD	Unknown
Stenella attenuata	Pantropical Spotted Dolphin	LC	Unknown
Stenella clymene	Clymene Dolphin	DD	Unknown
Stenella frontalis	Atlantic Spotted Dolphin	DD	Unknown
Stenella longirostris	Spinner Dolphin	DD	Unknown
Steno bredanensis	Rough-toothed Dolphin	LC	Unknown
Tursiops truncatus	Common Bottlenose Dolphin	LC	Unknown
Delphinus capensis	Long-beaked common dolphin	DD	Unknown
Peponocephala electra	Melon-headed whale	LC	Unknown
Pseudorca crassidens	False killer whale	DD	Unknown
Zipihius cavirostris	Cuvier's beaked whale	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	N.A.
Physeter macrocephalus	Sperm whale	VU	Unknown
Megaptera novaengliae	Humpback whale	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	N.A.

1.7 SEA TURTLES

The Gulf of Guinea serves as an important migration route, feeding ground, and nesting site for sea turtles. Five species of sea turtles have been confirmed for Ghana, namely the loggerhead (*Caretta caretta*), the olive ridley (*Lepidochelys olivacea*), the hawksbill (*Erectmochelys imbricata*), the green turtle (*Chelonia mydas*), and the leatherback (*Dermochelys coriacea*) (Armah *et al*, 1997, Fretey, 2001). All five species of sea turtles are listed by the CITES and National Wildlife Conservation Regulations under Schedule I. The olive ridley is listed by the World Conservation

Union (IUCN) as vulnerable while the loggerhead and green turtles are listed as endangered. The hawksbill and the leatherback are listed as critically endangered.

All species except the hawksbill are captured with some regularity in fishing nets set off Ghana. Although fully protected by national and international legislation, sea turtles that are landed are sold locally for human consumption.

The EEZ waters of Ghana constitute a known feeding area for at least the green turtle. However, there is no published information on the spatial and temporal distribution of turtles in both nearshore and offshore waters. Recent sea turtle telemetry tagging undertaken by a team from the Department of Oceanography and Fisheries, University of Ghana and Galathea II team from Denmark indicated that sea turtles from Ghana migrate as far west as the inshore areas of Liberia.

Marine turtles spend most of their life at sea, but during the breeding season they go ashore and lay their eggs on sandy beaches. The beaches of Ghana from Keta to Half-Assini are important nesting areas for sea turtle species.

Approximately 70 percent of Ghana's coastline is found suitable as nesting habitat for sea turtles, and three species; the green turtle, olive ridley and leatherback turtles are actually known to nest (Armah *et al*, 1997; Amiteye, 2002). The olive ridley is the most abundant turtle species in Ghana.

Population estimates from four previous surveys of these turtle species are provided in Table 23. The nesting period stretches from July to December, with a peak in November (Armah *et al*, 1997). In Ghana, the majority nests observed (86.3 percent) are those of the olive ridley.

Table 23 Population of the three sea turtle species that nest on the beaches of Ghana

Author, year	Leatherback	Olive ridley	Green Turtle
Amiteye, 2002	46	412	32
Agyemang, 2005	30	190	10
Allman, 2007	418	134	0
Agyekumhene, 2009	74	103	0
Average	**142**	**210**	**21**

Source: Armah *et al*, 1997

The Gulf of Guinea serves as an important migration route, feeding ground, and nesting site for sea turtles, approximately 70 percent of Ghana's coastline is found suitable as nesting habitat for sea turtles and in particular In the Western region, the beaches at Kengen, Metika Lagoon, Elonyi, Anochi, Atuabo and Benyin are important nesting sites.

In general but also considering the area of interest of the project, the principal threats must be underlined:

- Unsustainable harvest of Sea Turtles and their eggs for human consumption
- Unsustainable harvest of fish stocks and improper management of by-catch
- Loss of habitats
- Deteriorating water quality and increased sea debris

("Sea Turtle Conservation on the West Coast of Ghana A Background Report" 2009)

The first two points are related because the depleting of fish stock is negative for sea turtle (considering fish as their food) and because induces the changing of human opportunistic consumption of sea turtles meat and eggs, in something more frequent.

Considering the habitats is important to consider all five different habitat types that Sea turtles use at different stages of their lives. These are: the natal beach; mating areas; inter-nesting habitat; feeding areas; and pelagic waters (Environment Australia, 2003).

Considering the deteriorating of water quality, the report puts in evidence that the presence of oil based pollutants such as coal tar and engine fuel were frequent. These pollutants can originate from test extractions at oil deposits only 70 km off the west coast of Ghana but are more likely spills from local and commercial fishing vessels or the flushing of cargo ship bilge tanks ("Sea Turtle Conservation on the West Coast of Ghana A Background Report" 2009).

In the Western region, the beaches at Kengen, Metika Lagoon, Elonyi, Anochi, Atuabo and Benyin are important nesting sites for sea turtles. The prime nesting sites have been identified as the coastline from Prampram (about 10 to 15 km east of Tema) to Ada and the areas beyond the Volta estuary to Denu, in the Volta region. It is also evident that moderate nesting occurs from Winneba through Bortianor and on some beaches around Accra such as Gbegbeyise and Sakumono (Amiteye, 2002). These nesting sites are located along the eastern coast of Ghana.

Despite their protected status, marine turtles continue to face various forms of threat on Ghanaian beaches. The major threat to marine turtle population in Ghana is predation on eggs and juveniles by domestic animals especially pigs and dogs (Billes, 2003). Human exploitation also contributes significantly to the decline in turtle population in Ghana. Female turtles which come to the beaches to lay eggs are normally ambushed and killed as soon as they start laying because they become weak and hence easy to capture. Where the female succeeds to complete laying the eggs, the local people walk the beaches at dawn to look for the tracks and dig up the eggs. Special fishing nets are used by local fishermen for capturing the turtles. The turtle meat and eggs obtained by the above methods are eaten or traded for cash income.

The Ghana Wildlife Society has been carrying out sea turtle research and monitoring activities, conservation education and enforcement of legislation since 1995. The marine turtle conservation project is a contribution towards the achievement of Ghana's national goal of sustainable management of coastal resources and wetland habitats. The objective of the project is to promote the socio-economic development of coastal communities through marine turtle conservation.

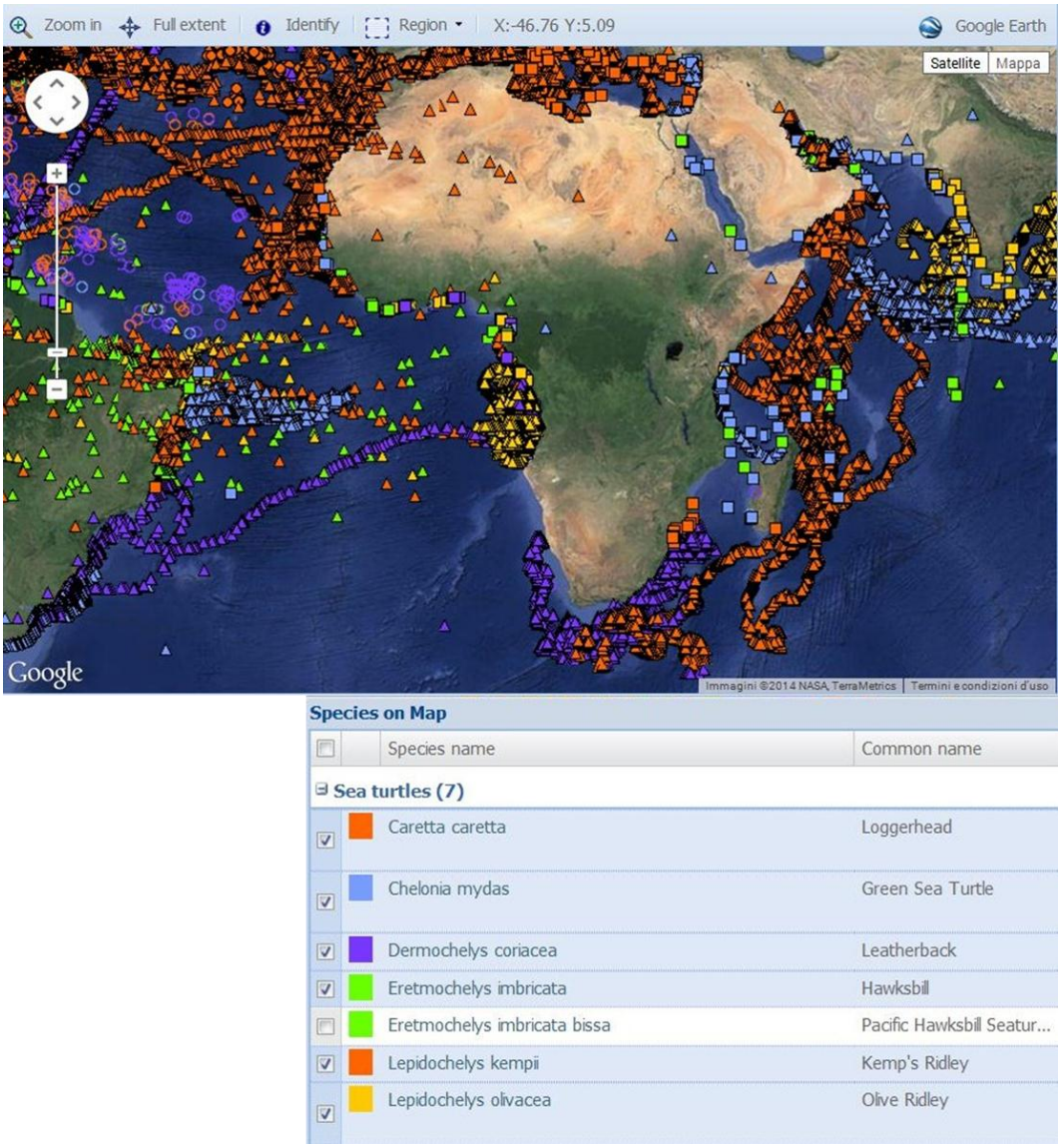


Figure 55 Sea turtle habitats/sites/nesting, Africa (Source: Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) website)

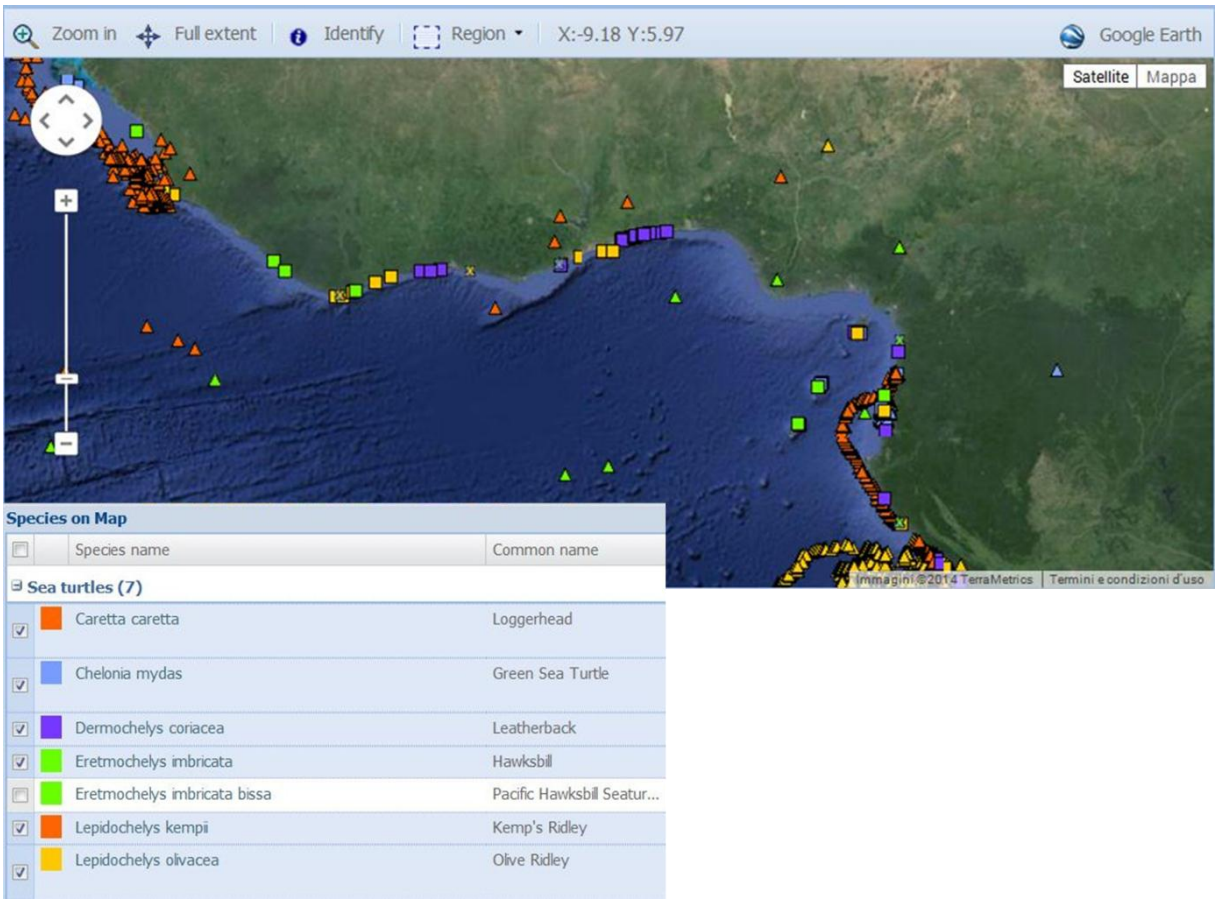


Figure 56 Sea turtle habitats/sites/nesting, Gulf of Guinea (Source: Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) website)

1.7.1 Olive Ridley (*Lepidochelys olivacea*)

The Olive Ridley sea turtle has a circumtropical distribution, with nesting occurring throughout tropical waters (except the Gulf of Mexico) and migratory circuits in tropical and some subtropical areas (Atlantic Ocean – eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Pacific Ocean – eastern central, northwest, southwest, western central) (Pritchard 1969). Nesting occurs in nearly 60 countries worldwide. Migratory movements are less well studied than other marine turtle species but are known to involve coastal waters of over 80 countries. With very few exceptions they are not known to move between ocean basins or to cross from one ocean border to the other. Within a region, Olive Ridleys may move between the oceanic and neritic zones (Plotkin *et al*. 1995, Shanker *et al*. 2003) or just occupy neritic waters (Pritchard 1976, Reichart 1993).

Like most other sea turtles, Olive Ridleys display a complex life cycle, which requires a range of geographically separated localities and multiple habitats (Márquez 1990). Females lay their nests on coastal sandy beaches from which neonates emerge and enter the marine environment to continue their development. They remain in a pelagic phase, drifting passively with major currents that disperse far from their natal sites, with juveniles sharing some of the adults' habitats (Kopitsky *et al*. 2000) until sexual maturity is reached (Musick and Limpus 1997). Reproductively active males and females migrate toward coastal zones and concentrate near nesting beaches. However,

some males appear to remain in oceanic waters and mate with females en route to their nesting beaches (Plotkin *et al*. 1996, Kopitsky *et al*. 2000). Their post-breeding migrations are complex, with pathways varying annually (Plotkin 1994) and with no apparent migratory corridors, swimming hundreds or thousands of kilometers over large ocean expanses (Morreale *et al*. 2007), commonly within the 20°C isotherms (Márquez 1990). In the East Pacific, they are present from 30°N to 15°S and often seen within 1,200 nautical miles from shore although they have been sighted as far as 140°W (IATTC 2004). Western Atlantic Olive Ridleys appear to remain in neritic waters after breeding (Pritchard 1976, Reichart 1993).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Size: Adult Length 60-70 cm Mass up to 70 kg/ Hatchlings Length 25 mm. Mass 15-20 g

Distribution: Circumglobal.Nesting areas in tropical to sub-tropical regions.Non-nesting range extends to temperate regions.

Reproduction: Reproduce every 1-3 years. Lay 1-3 clutches of eggs per season. Lay 90-130 eggs per clutch. Ping-pong ball size eggs weigh approximately 30 grams each. Incubation period approximately 60 days long.

(IUCN Marine Turtle Specialist Group accessed on 20 November 2013 http://iucn-mtsg.org)

1.7.2 Green Turtle (*Chelonia mydas*)

The Green Turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Atlantic Ocean – eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Mediterranean Sea; Pacific Ocean – eastern central, northwest, southwest, western central). Green turtles are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. Nesting occurs in more than 80 countries worldwide (Hirth 1997). Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).

Like most sea turtles, green turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (for review see Hirth 1997). Upon leaving the nesting beach, it has been hypothesized that hatchlings begin an oceanic phase (Carr 1987), perhaps floating passively in major current systems (gyres) that serve as open-ocean developmental grounds (Carr and Meylan 1980, Witham 1991). After a number of years in the oceanic zone, these turtles recruit to neritic developmental areas rich in seagrass and/or marine algae where they forage and grow until maturity (Musick and Limpus 1997). Upon attaining sexual maturity green turtles commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years (Hirth 1997). Migrations are carried out by both males and females and may traverse oceanic zones, often spanning thousands of kilometers (Carr 1986, Mortimer and Portier 1989). During non-breeding periods adults reside at coastal neritic feeding areas that sometimes coincide with juvenile developmental habitats (e.g., Limpus *et al*. 1994, Seminoff *et al*. 2003).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Size: Adult Length 80-120 cm. Mass up to 300 kg/ Hatchlings Length 30-40 mm. Mass 25-30 g

Distribution: Nesting areas throughout tropical regions are often on islands and coral atolls in addition to mainland beaches. Non-nesting range extends to temperate regions during immature stages.

Reproduction: Reproduce every 2-4 years. Lay 2-5 clutches of eggs per season. Lay 80-120 eggs per clutch. Large ball size eggs weigh approximately 40-50 grams. Incubation period approximately 60 days long. Can take 20-40 years to reach sexual maturity

(IUCN Marine Turtle Specialist Group accessed on 20 November 2013 http://iucn-mtsg.org)

1.7.3 Leatherback Turtle (*Dermochelys coriacea*)

The Leatherback turtle has a worldwide distribution. It is found from tropical to sub-polar oceans; nests on tropical (rarely subtropical) beaches. Very little is known about the distribution of post-hatchlings and juveniles. Leatherbacks smaller than 100 cm curved carapace length seem limited to regions warmer than 26°C. Sightings of turtles less than 145 cm show that some juveniles remain near to the coast in St. Lucia, E. Trop. Pacific, Mexico, Barbados, USA (east and west coast-Georgia, S. Carolina, Texas, Rhode Island, California) Puerto Rico, Amer. Samoa, Bonaire, Chile, Spain, Venezuela, Scotland, and England (Eckert 1999).

Main Habitats are nest on sandy beaches. The juveniles may remain in tropical waters warmer than 26°C, near the coast, until they exceed 100 cm in curved carapace length. When adults, they are pelagic and live in open ocean, sometimes in temperatures below 10°C. There are very few sighting of males near the coast during the breeding season, only the females are near to the coast during the breeding season and go to the beach to nest.

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Size: Adult Length 140-160 cm Mass 300-1000 kg/ Hatchlings Length 50 mm Mass 40-50 g

Distribution: Present in all world's oceans except Arctic and Antarctic. Nesting areas in tropics. Non-nesting range extends to sub-polar regions

Reproduction: Reproduce every 2-4 years. Lay 4-7 clutches of eggs per season. Lay 50-90 eggs per clutch. Billiard ball size eggs weigh roughly 80 grams. Incubation period is approximately 60 days long.

(IUCN Marine Turtle Specialist Group accessed on 20 November 2013 http://iucn-mtsg.org)

1.7.4 Hawksbill Turtle (*Eretmochelys imbricate*)

The Hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic Ocean, Indian Ocean, and Pacific Ocean. Hawksbills are migratory and individuals undertake complex movements through geographically disparate habitats during their lifetimes. Hawksbill nesting occurs in at least 70 countries, although much of it now only at low densities. Their movements within the marine environment are less understood, but Hawksbills are believed to inhabit coastal waters in more than 108 countries (Groombridge and Luxmoore 1989, Baillie and Groombridge 1996).

Hawksbills nest on insular and mainland sandy beaches throughout the tropics and subtropics. They are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (for review see Witzell 1983). Available data indicate that newly emerged hatchlings enter the sea and are carried by offshore currents into major gyre systems where they remain until reaching a carapace length of some 20 to 30 cm. At that point they recruit into a neritic developmental foraging habitat that may comprise coral reefs or other hard bottom habitats, sea

grass, algal beds, or mangrove bays and creeks (Musick and Limpus 1997) or mud flats (R. von Brandis unpubl. data). As they increase in size, immature Hawksbills typically inhabit a series of developmental habitats, with some tendency for larger turtles to inhabit deeper sites (van Dam and Diez 1997, Bowen *et al*. 2007). Once sexually mature, they undertake breeding migrations between foraging grounds and breeding areas at intervals of several years (Witzell 1983, Dobbs *et al*. 1999, Mortimer and Bresson 1999). Global population genetic studies have demonstrated the tendency of female sea turtles to return to breed at their natal rookery (Bowen and Karl 1997), even though as juveniles they may have foraged at developmental habitats located hundreds or thousands of kilometers from the natal beach. While Hawksbills undertake long migrations, some portion of immature animals may settle into foraging habitats near their beaches of origin (Bowen *et al*. 2007).

(IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org).

Size: Adult Length 75-90 cm. Mass up to 150 kg/ Hatchlings: Length 30 mm. Mass 5 g

Distribution: Nesting areas in tropics. Non-nesting range is generally restricted to tropical regions, although during immature stages it extends to sub-tropical regions.

Reproduction: Reproduce every 2-4 years. Lay 2-5 clutches of eggs per season. Lay 120-200 eggs per clutch. Ping-pong ball size eggs with approximately 25-30. Incubation period is approximately 60 days long.

(IUCN Marine Turtle Specialist Group accessed on 20 November 2013 http://iucn-mtsg.org).

1.7.5 Loggerhead Turtle (*Caretta caretta*)

Loggerhead sea turtles are found in coastal tropical and subtropical waters often extending to temperate waters in search of food. Found in the Atlantic Ocean from Argentina to Nova Scotia. The highest populations in North America are found on barrier islands from North Carolina to the Florida Keys. These Florida loggerheads migrate to the Bahamas in the winter. Small populations of the Atlantic loggerhead are also found on barrier islands off of the Texas coast. Primary habitat is in southeastern United States ranging southward to South America and extending eastward to Africa and the Mediterranean as well as areas of the western Pacific and Indian Oceans.

Hatchling habitat is primarily in warm ocean currents among flotsam such as sargassum mats. Adult habitat includes rock outcroppings and reefs near shore as well as in brackish lagoons and the mouths of inlets. Long migrations often occur, especially to return to nesting beaches.

(MarineBio accessed on 20 November 2013 http://marinebio.org)

Size: Adult Length 70-100 cm. Mass up to 200 kg/ Hatchlings: Length 25 mm. Mass 15-20 g

Distribution: Nesting areas in tropical to sub-tropical regions; Non-nesting range extends to temperate regions. Loggerheads exhibit trans-oceanic developmental migrations from nesting beaches to immature foraging areas on opposite sides of ocean basins.

Reproduction: Reproduce every 2-4 years. Lay 2-5 clutches of eggs per season. Lay 80-120 eggs per clutch. Large ping-pong ball size eggs weigh 30-40 grams. Can take 20-30 years to reach sexual maturity.

(IUCN Marine Turtle Specialist Group accessed on 20 November 2013 http://iucn-mtsg.org).

1.7.6 Kemp's ridley sea turtle (*Lepidochelys kempii*)

Kemp's ridley turtles have an extremely restricted range; found mainly in the Gulf of Mexico and some way up the eastern seaboard of the United States. The epicenter of nesting is a 20 kilometre beach at Rancho Nuevo in Northeast Mexico, with most nesting in the Mexican state of Tamaulipas. Nesting has also been documented in Veracruz and Campeche, Mexico, as well as in various U.S. states. Most U.S. nesting occurs in Texas, with nesting coastwide, but concentrated in the southern part of the state.

Adults inhabit crab-rich shallow inshore waters near the coast. Juveniles are also found in shallow waters, often where there are eelgrass beds and areas of sand, gravel and mud.

(Arkive accessed on 20 November 2013 http://www.arkive.org)

Size: Adults: Length 60-70 cm; mass up to 60 kg/ Hatchlings: Length 25 mm. Mass 15 to 20 g.

Distribution: Most restricted geographic range of all sea turtle species. Only nesting areas in Rancho Nuevo, Tamaulipas, Mexico, and in Texas, U.S. Non-nesting range extends between the Northwest Atlantic Ocean, the Gulf of Mexico, and the Caribbean.

Reproduction: Reproduce every 1-3 years. Lay 1-3 clutches of eggs per season. Lay 90-130 eggs per clutch. Ping-pong ball size eggs weigh approximately 30 grams each. Incubation period is approximately 60 days long. Takes 10-15 years to reach sexual maturity.

(IUCN Marine Turtle Specialist Group accessed on 20 November 2013 http://iucn-mtsg.org).

On the 15th June 2009 the Nature Conservation Research Centre (NCRC) and Beyin Beach Resort commissioned a back ground study on the Sea Turtle on the West Coast of Ghana. This study (due for completion on 1st November 2009) has identified a strong interest from resorts and fishing village communities to better understand sea turtle populations and ecology and build on efforts already seen at the local scale by Green Turtle Lodge and Beyin Beach Resort.



Figure 57 Beyin Beach Sea Turtle Conservation Program Area (Red square area - from interviews during eni OCTP Block Site Selection June 2012 survey)

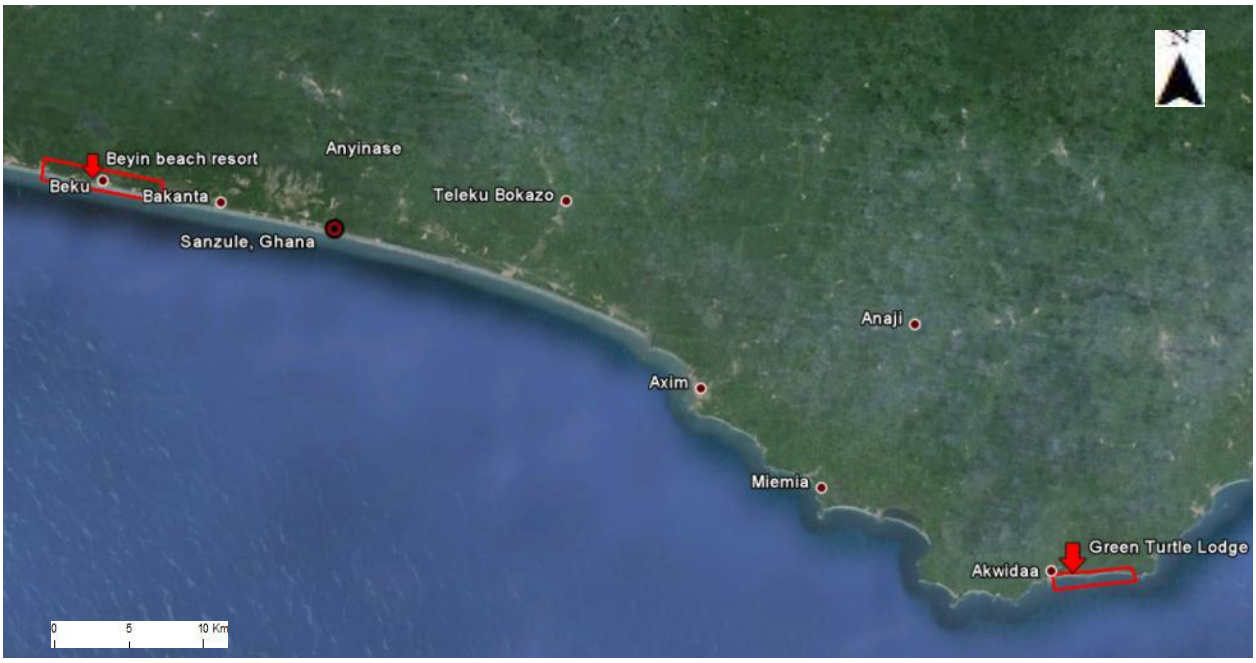


Figure 58 Beyin Beach and Green Turtle Lodge Sea Turtle Conservation Program Areas (red square areas - from interviews during eni OCTP Block Site Selection June 2012 survey)

According to the Sea Turtle Conservation on the West Coast of Ghana - A Background Report (October 2009) the population of sea turtles on Ghana's West Coast is without a doubt declining.

All coastal communities consistently reported observing less of all species of sea turtles now than ever before.

Sea turtles move into Ghanaian West Coast water to mate and prepare for nesting primarily between the months of August and April, with a peak in activity during October, November and December.

Most sea turtles prefer to nest near where the vegetation line meets the first sand dune. Lights, noise and physical obstacles that are usually associated with West Coast development prevent nesting in this area.

The list of sea turtle species and their possible observation is reported in the Table 24.

Table 24 Sea turtle species and likelihood of being observed on west coast of Ghana

Common Name	Genus	Possibility of being Observed
Olive Ridley Turtle	*Lepidochelys olivacea*	**Most common**
Green Turtle	*Chelonia mydas*	**Common**
Leatherback Turtle	*Dermochelys coriacea*	**Common**
Hawksbill Turtle	*Eretmochelys imbricate*	**Rarely**
Loggerhead Turtle	*Caretta caretta*	**Not in recent years**
Kemps Ridley Turtle	*Lepidochelys kempii*	**Yet to be recorded**

Since 2007 Beyin Beach Resort in collaboration with local villagers have been collecting data for both the Olive Ridley and Green turtles nesting.

Where nests were discovered, the clutches were transferred to the Beyin Beach Turtle Hatchery, because of the threats, primarily due to human predation. The percentage of relocated clutches that hatched within the hatchery at Beyin Beach Resort since August 2008 was 79 percent. Other results such as hatchling success, incubation period and clutch size are summarised in the Table 25 below

Table 25 Results of Beyin Beach Sea Turtle Conservation Program

Activity	Data for Aug 08 to April 09
No. of relocated clutches	53
No. of relocated clutches that hatched*	42
Mean clutch size (all species combined)	108 eggs
Success rate of relocated clutches	79.25%
Mean incubation period	50.38 days
Hatchling success rate	61.46%

*Missing hatchling data for 11 clutches, therefore it was assumed the clutch did not hatch.

The data also indicates that the most active months that the Olive Ridley and Green Turtles nest at Beyin are September, October and November and also between the months of August to April.

The total number of eggs relocated along the 10kms of beach at Beyin for the period of August 2008 to May 2009 was 5998.

Table 26 Threatened Sea Turtles Species (IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org) (IUCN Red List Status CR=Critically Endagered; EN=Endagered; DD=Data deficient; LC=Least Concern; NT=Near Threatened; VU=Vulnerable)

Scientific name	Common name	Red List Category	Population trend	criteria
Lepidochelys olivacea	Olive Ridley	VU	Decreasing	Atlantic easter and central/Terrestrial Marine system/Oceanic habitat/assessment year 2008
Chelonia mydas	Green Turtle	EN	Decreasing	Atlantic easter and central/Terrestrial Marine system/Oceanic habitat/assessment year 2004
Dermochelys coriacea	Leatherback Turtle	CR	Decreasing	Atlantic easter and central/Terrestrial Marine system/Oceanic habitat/assessment year 2004
Eretmochelys imbricate	Hawksbill Turtle	CR	Decreasing	Atlantic easter and central/Terrestrial Marine system/Oceanic habitat/assessment year 2004
Caretta caretta	Loggerhead	EN		Atlantic easter and central/Terrestrial Marine system/Oceanic habitat/assessment year 1996
Lepidochelys kempii	Kemps Ridley Turtle	CR		Atlantic easter and central/Terrestrial Marine system/Oceanic habitat/assessment year 1996

1.8 FISH ECOLOGY

The composition and distribution of fish species found in Ghanaian waters, and the wider Gulf of Guinea, is influenced by the seasonal upwelling that occurs between Nigeria and the Ivory Coast mainly in July to September and to a lesser extent in December to February.The rising of colder, dense and nutrient-rich deep waters stimulate high levels of primary production (phytoplankton) and consequently this will increases the production of zooplankton and fish.

The fish species find in Ghanaian waters belong to four groups:

- small pelagic species;
- large pelagic species (tuna and billfish);
- demersal (bottom dwelling) species; and
- deep sea species

1.8.1 Small pelagic species

The pelagic fish assemblage consists of a number of species that are exploited commercially but are also important members of the pelagic ecosystem, providing food for a number of large predators, particularly large pelagic fish such as tuna, billfish and sharks. The most important pelagic fish species find in the coastal and offshore waters of Ghana are:

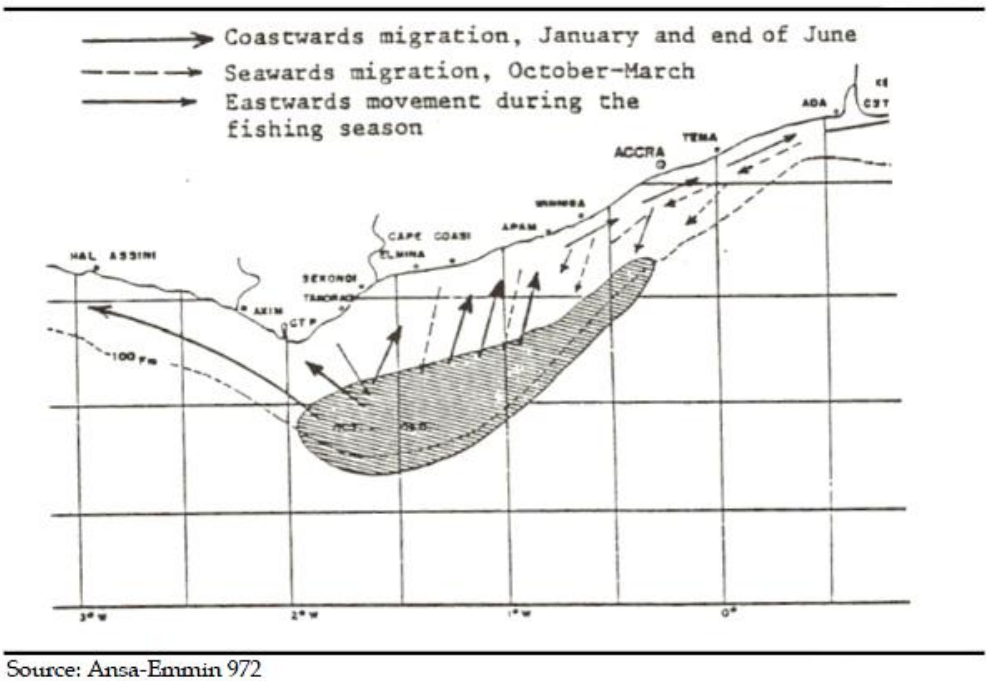
- round sardinella (*Sardinella aurita*);
- flat sardinella (*S. maderensis*);
- European anchovy (*Engraulis encrasicolus*); and
- chub mackerel (*Scomber japonicus*).

These species are important commercially as they represent approximately 80 percent of the total catch landed in the country.

Acoustic surveys have shown that the two sardinella species and the European anchovy represent almost 60percent of the total biomass in Ghanaian waters (FAO & UNDP, 2006).

Sardinella

Both sardinella species are found throughout Ghanaian coastal waters and the local population is part of the Central Upwelling Zone stock which is one of three stocks along the West African coast. The eggs and larvae of the sardinellas are found all year but distinct peaks in spawning are seen between July and August during the upwelling periods. The eggs are planktonic and found in the upper mixed layer and upon hatching the larvae feed on plankton in the upper layers. Adults exhibit seasonal migration towards the shore (see Figure 59). Juveniles remain in shallow water until maturation when they migrate into deeper shelf waters to join the adult stock.



Source: Ansa-Emmin 972

Figure 59 Migratory Pattern of the Sardinellas

European Anchovy

The *European anchovy* is found throughout European waters and all along the West African coast as far as Angola. European anchovy are mainly a coastal marine species but they can tolerates a wide range of salinities and may be found in lagoons, estuaries and lakes, especially during spawning. This species shows a tendency to extend into more waters further north in summer where it moves into the surface water layers. During the winter the populations retreat and descend to deeper water where they can be found as deep as 400 m in West Africa and deeper in more northerly areas. This species forms large schools and feeds on planktonic organisms, especially copepods and mollusc larvae and the eggs and larvae of fish. Spawning takes place over an extended period from April to November with peaks usually in the warmest months.

Chub Mackerel

Chub mackerel are a cosmopolitan species and inhabit the warm and temperate transition waters of the Atlantic, Indian and Pacific oceans and adjacent seas. They are primarily coastal pelagic species and are found from the surface down to depths of 300 m. However, they may extend into the epipelagic(1) (to 200 m) or mesopelagic (200 to 1,000 m) waters over the continental slope. Seasonal migrations may be very extended, with entire populations in the northern hemisphere moving further northward with increased summer temperatures and southwards for overwintering and spawning. In Ghanaian waters spawning, in common with most pelagic species, coincides with the seasonal upwelling. The chub mackerel is an opportunistic and non-selective predator, feeding on copepods and other crustaceans, fish and squid. Its predators include tuna, billfish and other fishes, as well as sharks and pelicans.

Other Pelagic Species

Other pelagic species found in Ghanaian water:

- horse mackerel (*Trachurus sp*.);
- little tunny (*Euthynnus alletteratus*);
- bonga shad (*Ethmalosa fimbriata*);
- African moonfish (*Selene dorsalis*);
- West African Ilisha (*Ilisha africana*);
- largehead hairtail (*Triciurus lepturus*);
- crevalle jack (*Caranx hippos*);
- Atlantic bumper (*Chloroscombrus chrysurus*); and
- Barracuda (*Sphyraena sp*.).

1.8.2 Large Pelagic Species

Large pelagic fish stocks off the coast of Ghana include tuna and billfish. These species are highly migratory and occupy the surface waters of the entire tropical and sub-tropical Atlantic Ocean. They are important species in the ecosystem as both predators and prey for sharks, other tuna and cetaceans as well as providing an important commercial resource for industrial fisheries.

The tuna species are:

- skipjack tuna (*Katsuwonus pelamis*);
- yellowfin tuna (*Thunnus albacares*); and
- bigeye tuna (*Thunnus obesus*).

Billfish species occur in much lower numbers and comprise:

- swordfish (*Xiphias gladius*);
- Atlantic blue marlin (*Makaira nigricans*); and
- Atlantic sailfish (*Istiophorus albicans*).

Skipjack Tuna

Skipjack tuna is a cosmopolitan species found in schools in tropical and subtropical waters. This wide distribution accounts for the number and variety of fisheries that have developed all around the world.

The species is epipelagic generally inhabiting open waters with aggregations associated with convergences, boundaries between cold and warm water masses, and other hydrographic discontinuities. Depth distribution ranges from the surface to about 260 m during the day, however, they remain close to the surface during the night.

In the Eastern Atlantic skipjack tuna spawn over a wide area on either side of the equator, from the Gulf of Guinea to 20º to 30ºW. Spawning seasons differ according to the zone, in the southern part of their range (Liberia, Ivory Coast, Ghana and Cape Lopez) spawning mainly takes place during the first and fourth quarters of the year (Cayré and Farrugio, 1986).

In common with other tuna species, skipjack tuna is an opportunistic predator with the principal prey being fish (mainly mackerels and pilchards), cephalopods and crustaceans.

Yellowfin Tuna. Yellowfin are found in open waters of tropical and subtropical seas worldwide where they are generally confined to the upper 100 m of the water column with their vertical distribution being influenced by the thermal structure of the water column.

Yellowfin tuna found in Ghana form part of an Atlantic population which spawns off Brazil and in the Gulf of Guinea and migrates to the Equatorial East Atlantic in the austral summer. The Gulf of Guinea is one of the most important areas for yellowfin tuna in the Atlantic population and large aggregations are found in near-surface waters, often associated with floating debris. Yellowfin tuna feed near the surface, mainly on epipelagic fish.

Bigeye Tuna

Bigeye tuna form part of an Eastern Atlantic population whose core distribution extends from north-west Africa to southern Angola.

Generally this species is epipelagic and mesopelagic in oceanic waters, occurring from the surface to about 250 m in depth. Vertical distribution is influenced by water temperature and thermocline depth, although their range differs from yellowfin tuna.

Spawning takes place throughout the year in a vast zone in the vicinity of the equator with temperatures above 24ºC. The Gulf of Guinea is one of the most important spawning areas for this species.

The diet of bigeye tuna includes a variety of fish species, cephalopods and crustaceans, however, they forage over a greater vertical range and feed on a wider range of fish and cephalopod species than yellowfin tuna, due to the latter's more narrow temperature range.

Atlantic Blue Marlin

Atlantic blue marlin is an epipelagic oceanic species, found in wide open waters. Adults spends over 80% of their time in the surface water, however, they undergo frequent, short duration dives to depths of between 100 and 200 m. Blue marlin display extensive migratory patterns, making trans-equatorial movements between the eastern and western Atlantic, although they are less abundant in the eastern Atlantic than the western Atlantic. Off the west coast of Africa they mostly occur between 25°N and 25°S, with important concentrations being found within the Gulf of Guinea. Spawning takes place during austral spring-summer and boreal summer. Most spawning takes place in the western Atlantic. Blue marlin feed near the surface and in deep water where they feed

opportunistically on schooling stocks of flyingfish, small tunas, dolphinfish and squid.

Swordfish

Swordfish are a cosmopolitan species found in tropical, temperate and sometimes cold waters of all oceans, including the Mediterranean Sea.

They are mainly found in open oceanic waters but may occasionally be found in coastal waters, generally above the thermocline (Colette, 1995). Migrations consist of movements toward temperate or cold waters for feeding in summer, and back to warm waters in autumn for spawning and overwintering.

Swordfish spawning grounds are known to be present in the western Atlantic and the Mediterranean and spawning takes place throughout the year in the western Atlantic with a peak from April to September.

Adult swordfish are opportunistic feeders. Over deep water, they feed primarily on pelagic fish, including tuna, dolphinfish, flyingfish, barracuda and pelagic squid. In shallower waters their diet consists mainly of mackerel, herring, anchovy, sardines and needlefish. Large adults often make feeding trips to the bottom to feed on demersal fish including hake, redfish and lanternfish.

Sailfish

Sailfish are found throughout the tropical and temperate Atlantic Ocean. In the eastern Atlantic its distribution extends from the Bay of Biscay to the Cape of Good Hope. It is an epipelagic and coastal to oceanic species, often found above the thermocline, although it is known to frequently make short dives to depths of up to 250 m.

Sailfish spawning areas in the Atlantic are mainly found in the tropical areas of both hemispheres. In the eastern Atlantic, spawning has been observed in West African shelf waters throughout the year. Sailfish migration routes are not fully understood, however, it is thought that most adults remain in the same location and there are few, if any, trans-Atlantic migrations. Adult sailfish feed opportunistically on schooling stocks of halfbeaks, jacks, small tunas, and cephalopods. Larvae sailfish feed on copepods.

Juveniles and small adults of skipjack, yellowfin and bigeye tuna school at the surface either in mono-species groups or together and these schools are often associated with floating objects such as floating seaweed, pieces of wood and stationary, anchored or drifting vessels (Røstad, Kaartvedt, Klevjer and Melle, 2006). The attraction is likely to be linked to predator avoidance and a focus of aggregation behaviour. Marlin, swordfish and sailfish are also attracted to floating objects probably for the same reason as tuna but also to feed on readily available prey that is attracted to floating objects. Fishermen exploit this by using floating aggregation devices (FADs) to attract schools of tuna.

1.8.3 Demersal Species

Demersal fish are widespread on the continental shelf along the entire length of the Ghanaian coastline. Species composition is a typical tropical assemblage including the following families:

- Three Porgies or seabreams (*Sparidae*), eg *Pagellus bellottii*, *Pagrus caeruleostictus*, *Dentex canariensis*, *Dentex gibbosus*, *Dentex angolensis* and *Dentex congoensis*;
- Two Grunts (*Haemulidae*), eg *Pomadasys incisus*, *P. jubelini* and *Brachydeuterus auritus*;
- One Croakers or drums (*Sciaenidae*), eg *Pseudotolithus senegalensis*;
- Goatfishes (*Mullidae*), eg *Pseudupeneus prayensis*;
- Snappers (*Lutjanidae*), eg *Lutjanus fulgens* and *L. goreensis*;
- Groupers (*Serranidae*), eg *Epinephelus aeneus*;
- Threadfins (*Polynemidae*), eg *Galeoides decadactylus*; and
- Emperors (*Lethrinidae*), eg *Lethrinus atlanticus*.

The seasonal upwelling of cold and saline waters over the Ghanaian shelf provokes changes in the geographical distribution of many of the demersal fish species. During the upwelling season, the bathymetric extension of the croakers is reduced to a minimum, while the deep water porgies are found nearer the coast than at other times of the year.

The demersal species that are most important commercially are cassava croaker (*Pseudotolithus senegalensis*), bigeye grunt (*Brachydeuterus auritus*), red pandora (*Pellagus bellottii*), Angola dentex (*Dentex angolensis*), Congo dentex (*Dentex congoensis*) and West African Goatfish

(*Pseudupeneus prayensis*).

Cassava croaker (Pseudotolithus senegalensis)

Cassava croaker is considered to be the most economically important demersal fish in West African waters, although it is reported (Froese and Pauly, 2009) that in recent years in Ghana their importance has declined. They are distributed along the west coast of Africa as far south as Namibia and as far north as Morocco. They are a demersal species occupying both marine and brackish water down to a depth of 70 m.

They are mainly found in coastal waters over muddy, sandy or rocky bottoms. Smaller individuals are found in shallow waters, occasionally entering estuaries. Their diet includes fish, shrimps and crabs. Spawning in the Gulf of Guinea takes place between November and March in waters of 22 to 25°C.

Big eye grunt (Brachydeuterus auritus)

Big eye grunt are common along the coast of West Africa and may also extend into the waters of Morocco. In Ghana, big eye grunt inhabit coastal waters with sandy and / or muddy bottoms at depths of between 10 and 100 m, but are mostly found between 30 and 50 m. This species remains near the bottom during the day and migrates vertically at night, feeding on invertebrates and small fishes. Other important grunt species of this group include sompat grunt (Pomadasys jubelini) and the bastard grunt (Pomadasys incisus).

Red pandora (Pellagus bellottii)

Red pandora are found along the west African coast from the Canaries to Angola. They are mainly benthopelagic (they usually live just above seabed) but demonstrate demersal behaviour. Red Pandora inhabit inshore waters, with hard or sandy bottoms, to a depth of 250 m, with their

preferred depth being greater than 120 m. Their diet is omnivorous, with benthic invertebrates, cephalopods, small fish, amphioxus (lancelets) and worms dominating. Once fish are mature (at 1 to 4 years) they migrate to the coast and intermittent spawning occurs between May and November.

Angola dentex (Dentex angolensis)

Angola dentex occur along the West Coast of Africa from Morocco to Angola. In common with the large eye dentex, this species is benthopelagic with a predominantly demersal behaviour. They are found on varied substrates but mainly occupy sandy mud substrates on the shelf and upper slope between 15 and 700 m. Adults feed predominantly on crustaceans, but fish, molluscs and worms also form part of their diet.

Congo dentex (Dentex congoensis)

Congo dentex are distributed along the West African coastline from Senegal to Angola. Congo dentex is a benthopelagic species that inhabits various bottoms types on the continental shelf and upper slope, to a depth of at least 200 m. The species is carnivorous feeding chiefly on fish, and to a lesser extent on tunicates and molluscs.

West African goatfish

West African goatfish are distributed along the West African coast between Morocco and Angola. They inhabit the coastal waters of the continental shelf, over sandy and muddy bottoms, where they feed on benthic invertebrates such as amphipods and polychaetes.

1.8.4 Deep Sea Species

Froese and Pauly (2009) lists over 180 species of deep-sea fish, including 51 bathydemersal species that are associated with the bottom and a further 106 are listed as bathypelagic (1000 to 4000 m). The remaining species are generally considered to occupy depths to 1000 m (ie epipelagic or mesopelagic) but may venture into deeper water during part of their lifecycle.

Froese and Pauly (2009) lists 89 species from 28 families that are likely to be found in Ghanaian waters within the depth range 1,100 and 1,700 m.

Table 27 provides a list of the families and representative species that potentially occur on the seabed in the project area.

Table 27 Deep Water Fish Families Potentially Present in the Project Area

Family	Species
Alepocephalidae	*Asquamiceps caeruleus, Bathytroctes microlepis, Xenodermichthys copei, Herwigia kreffti, Einara macrolepis, Alepocephalus rostratus, Talismania antillarum, Leptoderma macrops, Talismania homoptera, Talismania mekistonema, Talismania longifilis*
Bathysauridae	*Bathysaurus mollis*
Carapidae	*Snyderidia canina*
Centrophoridae	*Centrophorus lusitanicus*
Congridae	*Bathyuroconger vicinus*
Dalatiidae	*Dalatias licha*
Gempylidae	*Lepidocybium flavobrunneum, Nesiarchus nasutus, Nealotus tripes*
Gonostomatidae	*Diplophos taenia, Cyclothone braueri, Bonapartia pedaliota, Cyclothone pallida, Cyclothone microdon, Cyclothone alba, Cyclothone livida, Gonostoma atlanticum, Sigmops bathyphilus, Cyclothone obscura*
Halosauridae	*Halosaurus ovenii*
Ipnopidae	*Bathymicrops regis, Bathytyphlops sewelli, Bathypterois atricolor , Bathypterois quadrifilis, Bathypterois grallator*
Macrouridae	*Malacocephalus occidentalis, Malacocephalus laevis, Nezumia aequalis, Nezumia duodecim, Nezumia micronychodon, Bathygadus melanobranchus*
Myctophidae	*Diaphus perspicillatus, Ceratoscopelus warmingii, Notoscopelus resplendens, Diaphus lucidus, Lobianchia dofleini, Diaphus splendidus, Lampadena anomala, Lampanyctus alatus, Benthosema suborbitale*
Nemichthyidae	*Nemichthys scolopaceus, Nemichthys curvirostris*
Neoscopelidae	*Scopelengys tristis*
Nettastomatidae	*Nettastoma melanurum, Venefica proboscidea*
Notosudidae	*Ahliesaurus berryi*
Ogcocephalidae	*Dibranchus atlanticus*
Ophidiidae	*Monomitopus metriostoma*
Opisthoproctidae	*Dolichopteryx binocularis, Winteria telescopa*
Paralepididae	*Dolichosudis fuliginosa*
Phosichthyidae	*Vinciguerria nimbaria*
Platytroctidae	*Barbantus curvifrons, Holtbyrnia innesi, Sagamichthys schnakenbecki, Platytroctes apus, Maulisia mauli, Searsia koefoedi*
Rajidae	*Bathyraja hesperafricana, Rajella barnardi, Dipturus doutrei*
Serrivomeridae	*Serrivomer beanie*
Squalidae	*Squalus uyato*
Sternoptychidae	*Sternoptyx pseudobscura, Argyropelecus hemigymnus, Argyropelecus sladeni, Argyropelecus affinis, Sternoptyx diaphana*
Stomiidae	*Astronesthes macropogon, Flagellostomias boureei, Stomias affinis, Stomias longibarbatus, Borostomias elucens, Malacosteus niger, Pachystomias microdon, Bathophilus brevis, Heterophotus ophistoma*

Source: Froese and Pauly (2009)

Maintenance of deep-sea fish communities depends on the presence of large fish to break up the bulk of the carrion falls, allowing the majority of fish species to access a vital food source and the presence of small amphipods (small crustaceans) at the basis of the food chain that support many of the larger fish.

1.8.5 Protected or Endangered Species

The sensitive species in Ghanaian waters according to the IUCN red list (IUCN, 2013) are presented in Table 28. Of these only the tuna and swordfish species are likely to occur in the water depths found in the project field area.

A number of these species are commercially important and are subjected to heavy exploitation, particularly Albacore tuna and swordfish. It should be noted that Albacore catches in Ghanaian waters are not currently recorded (ICCAT Fishstat data). Of the listed species, bigeye tuna, yellowfin tuna and swordfish are recorded as being present in the project area. These species are

all found within the surface waters of the area (the first 100 m below the surface). Swordfish and bigeye may also be found at depths up to 250 m.

In the global context there is concern about the bigeye tuna stocks. The International Commission for the Conservation of Atlantic Tunas (ICCAT) has listed it as the species of greatest concern, after the bluefin, in terms of its population status and the unsustainable levels of exploitation exacted on this species.

Table 28 Threatened Fish Species in Ghanaian Waters (IUCN Red List of Threatened Species accessed on 20 November 2013 from www.iucnredlist.org) (IUCN Red List Status CR=Critically Endagered; EN=Endagered; DD=Data deficient; LC=Least Concern; NT=Near Threatened; VU=Vulnerable)

Scientific name	Common name	Red List Category	Population trend	criteria
Epinephelus itajara	Atlantic Goliath Grouper	CR	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2011
Squatina aculeata	Sawback Angelshark	CR	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2007
Squatina oculata	Smoothback Angel Shark	CR	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2007
Epinephelus marginatus	Dusky Grouper	EN	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2004
Rostroraja alba	Bottlenose Skate	EN	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2006
Sphyrna lewini	Scalloped Hammerhead	EN	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2007
Sphyrna mokarran	Squat-headed Hammerhead Shark	EN	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2007

Scientific name	Common name	Red List Category	Population trend	criteria
Bathyplotes natans		LC	stable	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Bathyplotes pourtalesii		LC	stable	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Grampus griseus	Risso's Dolphin	LC	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2012
Holothuria lentiginosa		LC	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Lagenodelphis hosei	Fraser's Dolphin	LC	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2012
Mesothuria lactea		LC	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Mesothuria rugosa		LC	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Molpadiodemas villosus		LC	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Parastichopus regalis		LC	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Spirula spirula	Ram's Horn Squid	LC	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2012
Stenella attenuata	Pantropical Spotted Dolphin	LC	unknown	Atlantic easter and central/marine

Scientific name	Common name	Red List Category	Population trend	criteria
				system/Oceanic habitat/assessment year 2012
Steno bredanensis	Common Bottlenose Dolphin	LC	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2012
Synallactes crucifera		LC	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2013
Tursiops truncatus	Common Bottlenose Dolphin	LC	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2012
Carcharhinus falciformis	Silky Shark	NT	Decreasing	Atlantic easter and central/marine system/Oceanic and deep benthic habitat/assessment year 2009
Dalatias licha	Kitefin Shark	NT	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2009
Galeocerdo cuvier	Tiger Shark	NT	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Negaprion brevirostris	Lemon Shark	NT	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Prionace glauca	Blue Shark	NT	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Raja clavata	Thornback Skate	NT	Decreasing	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2005
Thunnus alalunga	Albacore Tuna	NT	Decreasing	Atlantic easter and central/marine system/Oceanic

Scientific name	Common name	Red List Category	Population trend	criteria
				habitat/assessment year 2011
Thunnus albacares	Yellowfin Tuna	NT	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2011
Alopias superciliosus	Bigeye Thresher Shark	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2006
Alopias vulpinus	Common Thresher Shark	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Carcharhinus longimanus	Whitetip Oceanic Shark	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2006
Carcharias taurus	Sand Tiger	VU	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Carcharodon carcharias	Great White Shark	VU	unknown	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Centrophorus lusitanicus	Lowfin Gulper Shark	VU	unknown	Atlantic easter and central/marine system/deep benthic habitat/assessment year 2009
Galeorhinus galeus	Whithound	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Isurus oxyrinchus	Shortfin Mako	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Isurus paucus	Longfin Mako	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2006

Scientific name	Common name	Red List Category	Population trend	criteria
Kajikia albida	White Marlin	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2011
Lepidochelys olivacea	Olive Ridley	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2008
Makaira nigricans	Blue Marlin	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2011
Manta alfredi	Reef Manta Ray	VU	Decreasing	Atlantic easter and central/marine system/Oceanic and deep benthic habitat/assessment year 2011
Manta birostris	Giant Manta Ray	VU	Decreasing	Atlantic easter and central/marine system/Oceanic and deep benthic habitat/assessment year 2011
Mobula rochebrunei	Lesser Guinean Devil Ray	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2009
Thunnus obesus	Bigeye Tuna	VU	Decreasing	Atlantic easter and central/marine system/Oceanic habitat/assessment year 2011

ANNEX B2: BASELINE RESULTS

BASELINE METHODOLOGY

The following paragraphs will describe the EIA baseline methodology. The EIA team will analyze existing studies and bibliographic data as secondary data resources. A field survey will be performed to complete and update the available datasets.

Considering similarities between Ghana OCTP block project and Ghana Jubilee Field Phase 1 Oil and Gas Development project, in terms of (i) distance from coast, (ii) comparable water depth, (iii) short distance between the two blocks, (iv) substantial uniformity of the seabed in the pelagic zones at greater depths, and (v) the hydrodynamism of pelagic areas that makes the water column a single receptor body uninfluenced by contributions from terrigens (considering the distance from the coast), EIA team has decided to take into consideration the environmental data collected by Tullow during an EBS undertaken by TDI Brooks in September 2008.

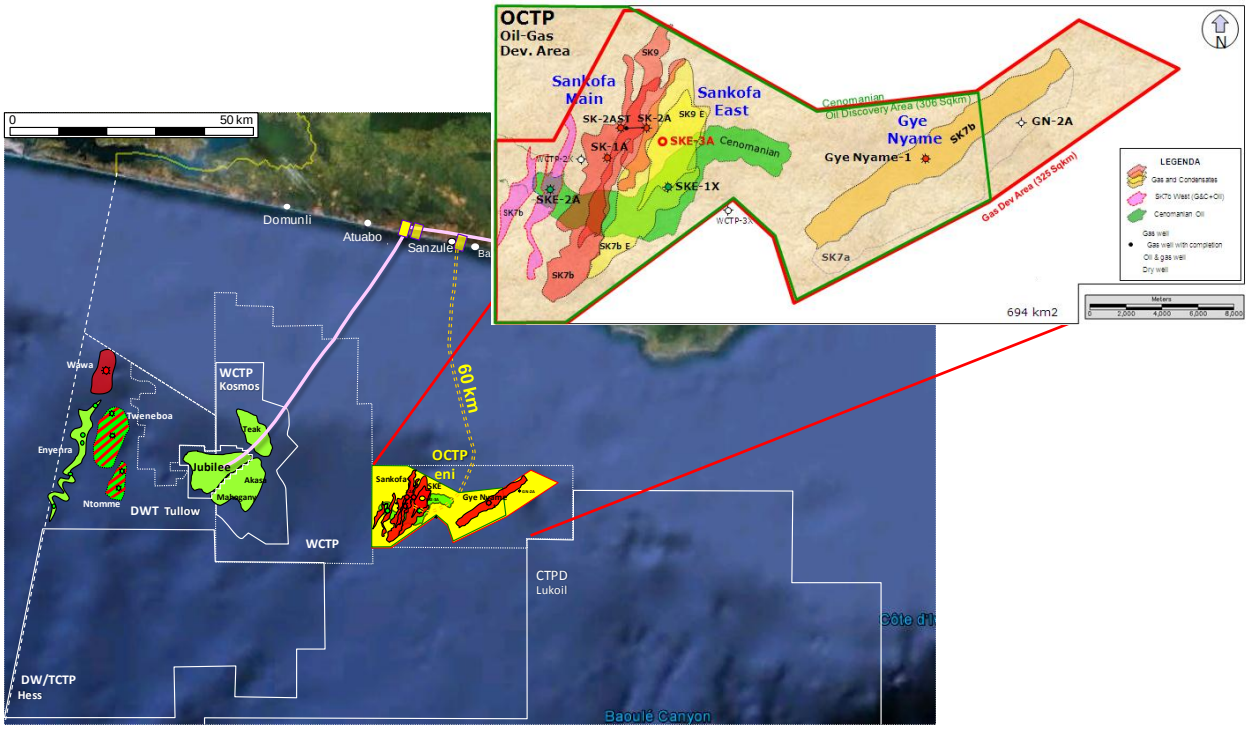


Figure 60: Jubilee field in relation to license OCTP block location

2.1 Secondary data

The EIA team will obtain and review existing data and primary data collected in the study area and surroundings. In particular results from the following studies will be used to update secondary datasets.

The project is based on the extraction of hydrocarbons from an underground reservoir in deep water offshore Ghana (approximately 1100-1700 m depth). The Jubilee field is located at about 60 km from nearest west coast.

The jubilee field covers a part of Deepwater Tano and West Cape Three Points license areas.

The phase 1 development involve the completion of 17 wells, 9 production wells used to bring oil and gas from the underground reservoir to the surface, 6 water and 2 gas injection wells used to re-inject water and gas back into the reservoir for pressure maintenance and enhancing oil recovery.

The wells will be connected through a network of valves and pipelines to a Floating Production Storage and Offloading vessel (FPSO) permanently moored at the north of the Jubilee field. On the FPSO the crude oil will be separated from natural gas and water. The processed crude oil will be stored in the FPSO storage tanks and offloaded to oil tanker vessels approximately once a week for delivery to international markets. Separated natural gas will be re-injected into the reservoir to maintain pressure with a small proportion (15%) of the gas being used for power generation to run the FPSO

Tullow considered the Noble-Denton (2008) metocean report and Ghana meteorological recording stations placed in Takoradi and Axim in the western coast to characterize climate and weather of the Jubilee field.

Concerning bathymetric, seabed topographic and geohazard data Tullow considered the seabed survey undertaken by Gardline Surveys (2008).

An Environmental Baseline Survey commissioned by Tullow and undertaken by TDI Brooks was conducted during September 2008. The survey collected data about seabed sediment, water quality and biological community composition.

Water and sediment samples were collected on and in the vicinity of jubilee field, other samples were collected along the two principal pipelines routes from the field to Effasu and Takoradi. The sampling depth varied between about 950 m and 1750 m in the vicinity of the field.

Information on Plankton (phytoplankton and zooplankton), characterizing the Gulf of Guinea, were obtained from EIAs for West Africa Gas Pipeline Project (WAPC 2004) other research programs and other available sources.

The socio-economic context of the target area will be described via qualitative and quantitative indicators gathered from bibliographic sources (i.e. secondary level data) in relation to the data components listed in Annex II of “eni E&P Standard Doc. N° 1.3.1.47, Environmental, Social and Health Impact Assessment, 2010”.

Given the overall socio-economic structure present in the project area and the project type, the description of the socio economic context shall likely dedicate specific focus to the:

- Description of fishing and other human livelihood activities in the area potentially affected by project activities, through the in-depth analysis of local context, based on secondary and primary data collected on the field.
- Identification and analysis of stakeholders involved.
- Description and analysis of national, regional and local development/economic growth policies so as to better align with local Government development strategies.
- Identification of possible points of attention/critical elements as regards the economic and livelihood activities potentially sensitive to project activities’ potential impacts.

Secondary data shall be obtained from a variety of grey literature sources, such as:

- Official records, registries and databases
- Research reports of international, national and regional institutions
- Bibliographic literature review

- Cartographic resources

Other SBA reports carried out for the area of interest

The Social Baseline Analysis shall be conducted in concomitance with the Stakeholder identification and analysis. This shall allow for the identification of social criticalities and hence potential social impacts, correct evaluation of underestimated project risks as well as the identification of opportunities for contributing to social and economic development.

The following Reference Documents will be used:

- Eni E&P Circular N° 498, Community Investment Management System Best Practice, 2008.
- Eni E&P Standard Doc. N° 1.3.1.47, Environmental, Social and Health Impact Assessment, 2010
- IFC Performance Standards on Environmental and Social Sustainability, 2012

2.2 Primary Data

The project will comprise a number of wells in a deepwater block, tied back to either floating production unit (Deepwater Host) or a shallow water platform (Shallow Water Host). An export pipeline will connect either the Deepwater or Shallow Water Host to a landfall.

Geophysical, geotechnical and environmental surveys will be performed in the offshore block for the OCTP development project, offshore Sanzule. Environmental surveys for phase 1 were conducted on board the Fugro Geo Prospector between 24 and 27 April 2013 while the surveys for phase 2 and 4 were conducted on board the Fugro Geo Endeavour between February 26 and March 8 2013.

The environmental survey has the scope to acquire knowledge regarding the physico-chemical and biological features of water column and seafloor sediments, flora and fauna, qualitative and quantitative information on benthos diversity and abundance.

The survey shall cover any significant area that will be utilized during the site development lifecycle. In addition, the sites shall be surveyed over an area sufficient to ensure that the potential for environmental hazards has been thoroughly determined.

In particular, the main different areas to be surveyed are defined:

- Pipeline route corridors (from HOST to shore);
- Offshore HOST location area;
- Flowline route corridors (from HOST to drilling centers);
- Drilling areas.

The survey will comprise:

- Phase 1 Geophysical survey of offshore block
- Phase 2 Geophysical and environmental survey along pipeline corridor
- Phase 3 Detailed geophysical and environmental survey on intrafield flowline corridors
- Phase 4 Geophysical survey at landfall

Sediment and Benthic Fauna

Samples shall be collected in the surface layer of sediments along the flowlines routes with a minimum frequency of one sample every 2 km length of the flowline with a minimum of 1 sample for each flowline in the middle point if the nearest flowline sample collected is more far than 900 m.

At landfall samples shall be collected in the surface layer of sediments at same location of grab sampling.

One sample shall be collected close to each subsea well head/manifold foreseen location if the flowline sample collected is more than 400 m away.

Five more samples will be collected in the HOST area; their location shall be according to these criteria:

- one in correspondence of the HOST foreseen position;
- four along two orthogonal transects, aligned to the cardinal points and crossing each other in correspondence of the HOST foreseen position, at a distance of 500 m, in any case in accordance with the sampling locations chosen for the bottom geophysical survey;
- 6 -10 additional sample points shall be collected , locations will be defined by Company before survey.

Water column

The physicochemical and biological characteristics of the water column shall be measured at the same location of the sediment samples.

Biological characterization

Via visual and deduced (sonar) observations the water column and seafloor shall be characterized biologically with a description of the main faunal and floral components.

Marine organisms (both pelagic and planktonic) should be sampled to assess possible adverse effects to their health. Particular attention has to paid to species inserted in the IUCN Red List of Threatened Species™.

Particular attention shall be given to:

- Presence of key species for local fishery's activities;
- Presence of Cetaceans or marine turtles.

Visual observations will be complemented by a qualified Marine Mammal Observers (MMO).
A high quality Echo-sounder, capable of identifying and recording ichthyic presence, as well as distinguishing between key species should be employed to supplement visual observations.

Bathymetry-morphology

Bathymetric, morphological and stratigraphic survey by MBES (multi-beam echosounder), SSS (Side Scan Sonar) and SBP (Sub-Bottom Profiler) respectively shall be performed in a single pass with all the equipment mounted simultaneously on the vessel.

Seabed

In order to confirm the nature of the seabed soil a series of grab samples shall be collected along the centerline and the two more external wing lines. Samples shall be collected at 250 m intervals on the centerline and 500 m intervals along the two external wing lines.

2.3 Sediment Sampling Methods

Grab Sampling Operations

Seabed samples were acquired using a 0.1 m^2 dual van Veen grab (Figure 62). At each station two deployments were carried out, collecting two samples for macrofaunal analysis and one sub-sampled for physico-chemical analysis.

Operational procedures for sampler deployment and recovery were as follows:

- When steady on location, and permission to deploy from the bridge was given, the sampler was slowly lifted from its frame and manoeuvred outboard using the 'A' frame and winch. Personnel used tag lines to steady the equipment during this process if necessary;
- The sampler was then lowered until it reached the seabed and the cable became slack, the surveyor was then instructed to take a manual fix;
- The sampler was brought up slowly until clear of the seabed;
- When the sampler reached the surface it was recovered to deck using the 'A' frame and winch, deck personnel used tag lines to steady the equipment during this process if necessary. The sample was inspected and accepted or rejected, if accepted it was processed accordingly (see Section 2.3 Sediment Sampling Methods);
- The bridge was informed that the equipment was on deck so that the vessel could be manoeuvred for the next deployment.

Sediment Sample Processing

After recovery of the sampler to deck, the water was drained through a sieve, so that the environmental scientist could examine the sample to accept or reject it accordingly. Rejection criteria were as follows:

- Evidence of surface sediment washout caused by the grab sampler not sealing properly (due to coarse material i.e. stones, shells etc.);
- Inspection hatches open or not closed properly, allowing potential sediment washout and winnowing of surface material;
- Sediment sample was taken at an angle i.e. where the sampler had not struck the seabed true;
- The sample was less than 40% of the samplers volume;
- Sample was more than the accepted range from the target location;
- The presence of a hagfish (Myxine glutinosa agg.) and/or mucous coagulants;
- The sample was too full, with the seabed sample in contact with the inspection hatches of the grab/corer;
- The sample was unacceptable to the Client Representative for any other reason.

If the sample was deemed acceptable, it was photographed with a label showing the job name and number, sample number and a scale bar; additional photograph(s) were also taken after sieving of the macrofaunal samples.

Deck logs were completed for each sample acquired (including no samples), for each sample these showed:

- Date;

- Time;
- Sample no.;
- Fix no.;
- Percentage volume;
- Sediment type;
- Colour of the sediment using Munsell colour codes (Munsell Chart Analysis and **Figure 61**);
- The presence of any smell (i.e. H2S), bioturbation, debris or fauna.

If a no sample was acquired the reason for rejection was logged. The fix numbers recorded for each sample were cross-referenced to the survey logs to give position and water depth.

Macrofauna Processing

Macrofaunal samples were processed as follows:

- Macrofaunal samples were processed in their entirety, by opening the spades of the grab sampler to drop the sample into a container. All supernatant water was processed with the sediment;
- The samples were transferred to a Wilson auto sieve (WAS) and washed through a 0.5 mm sieve to remove excess fines and reduce sample bulk (**Figure 62**);
- Samples were then transferred to containers labelled with the job number, station code and replicate code (FA, FB or FC) and fixed in 10% formal saline (a buffered 4% formaldehyde solution in seawater). The sample containers were then sealed, hazard labelled and stored securely on deck;
- Only the Environmental Scientists were permitted to handle the chemicals used for sample processing (Isopropyl alcohol and formal saline). Additional personal protective equipment (PPE) was used when handling these chemicals.

Physico-Chemical Subsampling

Physico-chemical sub-samples were obtained after photographing the PC sample with a scale bar. Two replicates of each sub-sample type (A and B replicates) were taken and bagged / potted separately. The following sub-samples (labelled with station, job number and replicate) were collected from the surface of the grab:

- Hydrocarbon samples were collected using a metal scoop to a nominal depth of 2 cm. Samples collected were HC A and HC B. The samples were preserved, in pre-cleaned (isopropyl alcohol) metal sample tins, at -20ºC;
- Heavy metal / organics samples were collected using a plastic scoop to a nominal depth of 2 cm. Samples collected were HM A and HM B. The samples were preserved, in polythene bags, at -20ºC;
- Particle size analysis samples were collected using a metal scoop to a nominal depth of 5 cm. Samples collected were PSA A and PSA B. The samples were preserved, in polythene bags, at -20ºC;
- Microbiology samples were collected using a metal scoop to a nominal depth of 5 cm. Samples collected were MicroBio-A and MicroBio-B. The samples were preserved, in polythene bags, at -20ºC;

- Prior to any sub-sampling tins and metal scoops were pre-cleaned using Isopropyl alcohol. The sampler was clean with Isopropyl alcohol between stations;
- Only the Environmental Scientists were permitted to handle the chemicals used for sample processing (Isopropyl alcohol and formal saline). Additional PPE was used when handling these chemicals.

At each station a small quantity of sediment (1 ml) was taken for an immediate sulphur reducing bacteria test which was conducted on board using the modern water rapid check II test kits. Results of the SRB tests can be found in the field logs.
The samples were then shipped back in cool boxes to Fugro EMU Limited's Great Yarmouth office for redelivery to the relevant laboratories.

Munsell Chart Analysis

The Munsell Colour System specifies colour on three colour dimensions: hue, which refers to the pure colour; value, which refers to the lightness of the colour; and chroma, which relates to the purity / intensity of the colour. A colour is fully specified by listing the three numbers for hue, value and chroma. This enables comparisons to be drawn between sediment types and individual sediment layers and helps to standardise individual perspectives of colours.
A small sub-sample is taken from the PC grab sample and held on the finger in a well lit area. The Munsell Soil Colour Chart is then used to determine the best match of the three colour dimensions (**Figure 61**). The results are then recorded on the deck logs.

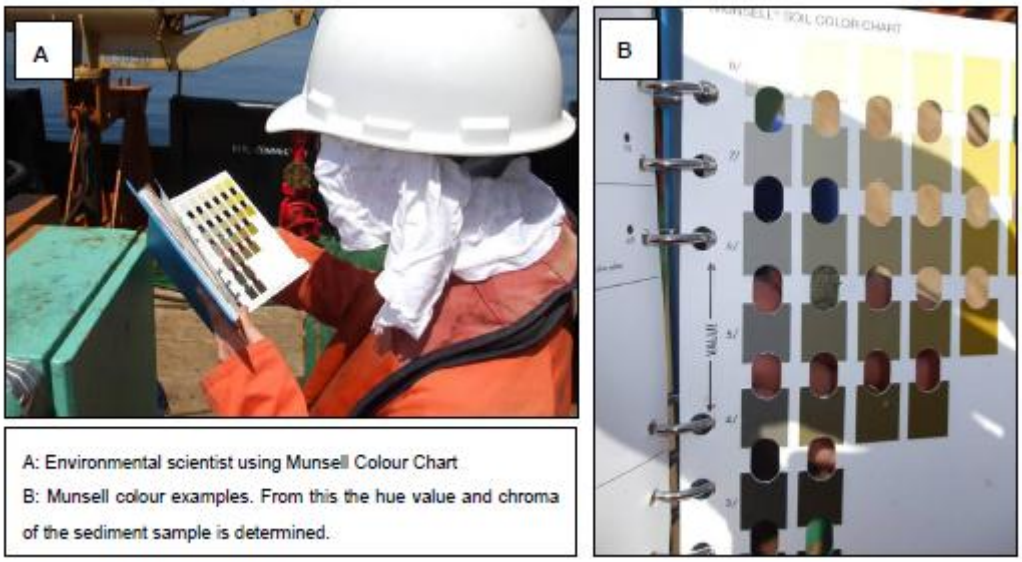


Figure 61 Munsell soil colour chart

2.4 Water Sampling Methods

Water Sampling

Water samples were acquired using 2 x 5 litre Niskin bottles triggered in sequence. At each water station three depths were sampled, the first within a few metres of the surface, the second midway through the water column and the third close to the seabed (approx. 5 m above seabed). In shallow water (<10 m) only top and bottom water samples were collected.

Deployment and Recovery

The Niskin water sampling bottle was attached to the winch wire above a weight, the water profiler (see Section **2.6 Zooplankton Sampling Operations**) and USBL beacon. For the first deployment the Niskin bottle was lowered to 5 m above the seabed and triggered with the messenger weight. The sampler was then recovered and processed (see below). The water sampler was then re-armed and attached to the same point on the wire. The rig was deployed to the middle of the water column and the sampler was triggered. The rig was then lowed to the bottom of the water column to achieve a second water profile (see Section **2.6 Zooplankton Sampling Operations**). The final sample was collected from 1-5 m below the surface and (if the profiler data was acceptable) immediately recovered, if an additional profile was required the rig was lowered to the seabed again.

Sample Processing

Details of the processing of the water samples is given in **Table 29**.

Table 29 Water Sample Processing

Sample	Quantity	Container
Nutrients- Nitrates / Phosphates and other nutrients, suspended solids	1 litre	1 Plastic
Biological oxygen demand / Chemical oxygen demand	1 litre	1 Plastic
Hydrocarbons	1 litre	Glass
Chlorophyll	1 litre	Filtered + frozen
Phenols	500 ml	Glass + fixative
Faecal Coliforms	500 ml	Sterile plastic
Metals	250 ml	Plastic
Phytoplankton	1 litre	1 Plastic – fixed (iodine)
Spare	1 litre	Glass

2.5 Water Profiles

Water column profiles were recorded using a Hydrolab DS5X multi-parameter water profiler. Water profiles were taken simultaneously with the water samples (described above). Two profiles were conducted at each station and both the down cast and up cast from each profile were recorded. Parameters measured were:

- Conductivity (Salinity);
- Temperature (ºC);
- Depth (m);
- Turbidity (NTU);
- Oxygen (percent saturation);
- pH.

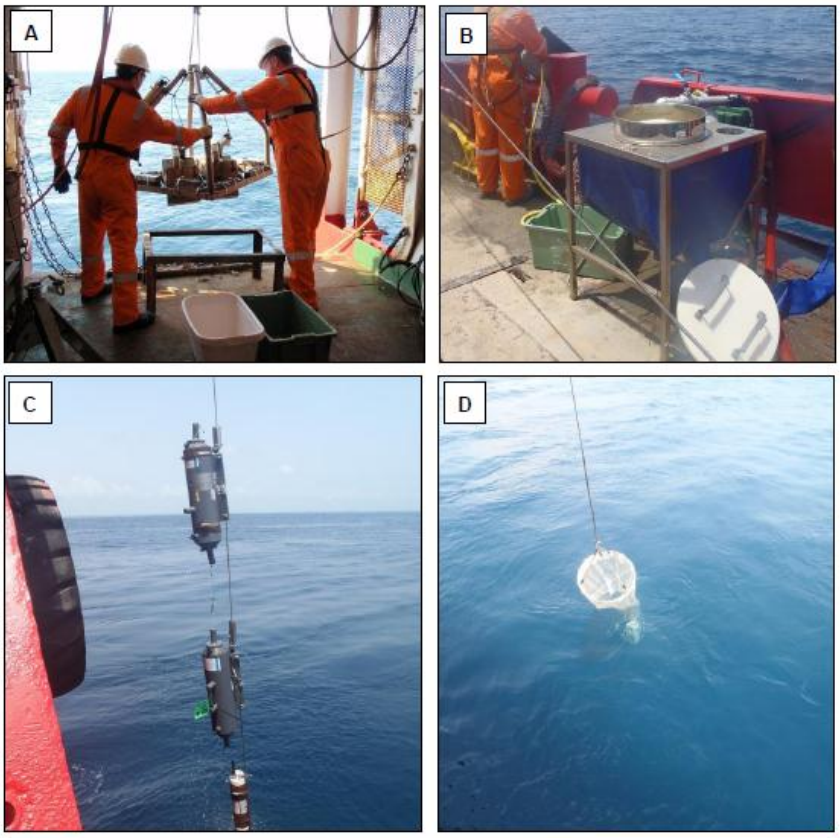
Deployment and Recovery

The water profiler was attached to the winch cable above a clump weight and USBL beacon, below the Niskin water sampler. The profiler was set to record continually before deployment. After the

first deployment the profiler was removed from the wire and the data was downloaded and checked. The profiler was then re-set and attached to the winch for the second deployment. The profiler was not allowed to make contact with the seabed (judged from the USBL beacon) and was stopped 5 m above the seabed.

2.6 Zooplankton Sampling Operations

The zooplankton net, with the weighted cod end, was deployed to just above the seafloor. Then returned to the water surface to collected a zooplankton sample from the entire water column. A seawater hose was then used to wash all the zooplankton down into the cod end of the net. The cod end was then removed and the contents checked for salps and jellyfish. If these were found to be present they were carefully removed from the sample and the rest was fixed in 10% formal saline.



A: Deploying the Dual van Veen grab from the port deployment boom
B: Wilson Auto Sieve (WAS) unit ready for use
C: Niskin water samplers during deployment
D: Zooplankton net during deployment

Figure 62 Equipment Deployment and Recovery Operations

2.7 Laboratory Analysis

Particle Size Analysis (PSA)

Analysis was undertaken via wet, dry sieving and laser diffraction (63000 to < 3.91 µm @ 1 phi intervals) in accordance with Fugro EMU MET/01 based on BS1377: Parts 1-2: 1990, Fugro EMU MET/02 based BS ISO 13320:2009, and Fugro EMU MET/48 based on the NMBAQC PSA SOP for supporting biological data.

Representative material >1 mm was split from the bulk sub-sample and oven dried at 105 ±5°C to constant weight before sieving through a series of sieves with apertures corresponding to 1 phi intervals between 64000-1 mm as described by the Wentworth scale. The weight of the sediment fraction retained on each mesh is measured and recorded.

Representative material <1 mm was removed from the bulk sub-sample for laser analysis, a minimum of three triplicate analyses (mixed samples) or three triplicate analyses (sands) were analysed using the laser sizer at 1 phi intervals between <1 mm-<3.9 µm. Laser diffraction was carried out using a Malvern Mastersizer 2000 using a Hydro 2000G dispersion unit.
Raw data were processed in-house to describe particle size distributions in terms of phi mean, fraction percentages (i.e. coarse sediments, sand and fines – **Table 30**), sorting (range of sediment sizes – **Table 31**) and skewness (weighting of sediment fractions above and below the mean size) (Folk and Ward, 1957). Phi mean uses graphic mean (M):

$$M = \frac{\Phi 16 + \Phi 50 + \Phi 84}{3}$$

Table 30 Phi and Sieve Apertures with Wentworth Classifications

Phi Units	Microns [µm]	Sediment Description
≤-6→ -8	<256000 → 64000	Cobble
≤-2→ -6	<64000 → 4000	Pebble
≤-1→ -2	<4000 → 2000	Granule
>-1 → 0	<2000 → 1000	Very Coarse Sand
>0 → 1	<1000 → 500	Coarse Sand
>1 → 2	<500 → 250	Medium Sand
>2 → 3	<250 → 125	Fine Sand
>3 → 4	<125 → 63	Very Fine Sand
>4 → 5	<63 → 31.5	Coarse Silt
>5 → 6	<31.5 → 15.6	Medium Silt
>6 → 7	<15.6 → 7.8	Fine Silt
>7 → 8	<7.8 → 3.9	Very Fine Silt
>8 → 10	<3.9 → 1	Clay

Sorting (inclusive graphic standard deviation) uses the equation:

$$D = \frac{\Phi 84 - \Phi 16}{4} + \frac{\Phi 95 - \Phi 5}{6.6}$$

Table 31 Sorting Classifications

Sorting Coefficient	Sorting Classifications
≥0 → 0.35	Very well sorted
>0.35 → 0.50	Well sorted
>0.50 → 0.71	Moderately well sorted
>0.71 → 1.00	Moderately sorted
>1.00 → 2.00	Poorly sorted
>2.00 → 4.00	Very poorly sorted
>4.00	Extremely poorly sorted

Sediment Nutrients Analysis

Nutrient analyses including Total Organic Carbon (TOC), nitrate, phosphorus and ammonium analyses were performed by Scientifics Ltd, according to the following method statements.

Sediment Nutrients Analysis-Total Organic Carbon (TOC)

The dry, homogenised sample was treated with acid, in order to remove inorganic carbon. The sample was then introduced into a heated reaction chamber with an oxidative catalyst. Organic carbon was oxidised to CO_2 and measured by non-dispersive infrared analysis. This method does not quantify volatile organic carbon, which should be determined by another technique. The limit of detection for this method was 0.02% w/w.

Sediment Nutrients Analysis-Nitrogen, nitrate and Ammonium

Sample pre-treatment for nitrogen and nitrate is as follows: A 25 g aliquot of the soil sample is extracted in 50 ml of de-ionised water. The mixture is shaken for one hour and the following suspension is then centrifuged. Nitrate is reduced to nitrite with Hydrazine sulphate. The nitrite ions produced (in addition to those already present) are determined by diazotisation with sulphanilamide and coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The absorbance of light by the coloured azo dye is measured at 540 nm, and is proportional to the concentration of TON in the sample. NB: Nitrate may be determined by subtracting the concentration of nitrite from the concentration of TON.

Sample pre-treatment for ammonium is as follows: A 50g aliquot of the soil sample is extracted in 50 ml of 2 M potassium chloride solution (KCl). The mixture is shaken for two hours and the following suspension is then centrifuged. Analysis for Ammonium nitrogen is performed using a Konelab discreet colorimetric analyser.

Sediment Nutrients Analysis-Total Phosphorus and Available Phosphate

For the analysis of available phosphate the sample is mixed with sodium hydrogen carbonate and polyacrylamide then treated with ascorbic acid, antimony potassium tartrate and ammonium molybdate. The optical density is measure 880 nm and compared with a calibration curve to give the concentration of P in the sample.

Pre-treatment of samples for total phosphorus analysis is as follows: Approximately 0.20 g of the sediment sample is accurately weighed out and placed in a PTFE bottle. 2.5 mls of Hydrofluoric acid are added. The bottle is placed in an oven at 105±5°C for approximately 1 hour. The bottle is then allowed to air cool in a fume cupboard. 65 mls of 4% Boric acid is the added to the bottle .The contents are then mixed thoroughly and placed in a polypropylene flask and made up to 100 ml

with deionised water. The sample is then analysed by using Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES).

Sediment Hydrocarbon Analysis-General Precautions

To effectively eliminate all possible sources of hydrocarbon contamination from the analysis the following precautionary measures were taken prior to sample work-up.

- All solvents were purchased as high purity grade. Each batch was checked for purity by concentrating approximately 400 ml down to a small volume (<1 ml) and analysing by gas chromatography (GC);
- All water used was distilled through an all glass still and dichloromethane / pentane extracted to minimise contamination from plasticisers;
- All glassware was cleaned using an acid / base machine wash. The glassware was rinsed with acetone then finally with dichloromethane prior to use;
- Procedural blanks, replicate analyses and laboratory reference material were run with each batch.

Sediment Hydrocarbon Analysis-Ultrasonication Extraction for Hydrocarbons in Sediment

Sediment samples were thawed, homogenised and accurately weighed into a 250 ml conical flask. A solution containing an appropriate amount of the following internal standards was added to each sample using a 100 µl microsyringe.

Aliphatic standards	Aromatic standards
Heptamethylnonane	d8 naphthalene
D_{34} Hexadecane	d8 acenaphthylene
D_{42} Eicosane	d10 phenanthrene
Squalane	d10 pyrene
	d12 chrysene
	d12 perylene

Methanol (50 ml) was added and the solvent mixed with the sediment. Dichloromethane (DCM) (60 ml) was then added and the sample mixed again. The flasks were then capped with solvent cleaned aluminium foil and ultrasonicated for 30 minutes.

After being allowed to settle the solvent was decanted through a GF-C filter paper into a 1 litre separating funnel. The extract was then partitioned with 100 ml of DCM / pentane extracted distilled water and the DCM layer run-off into a clean 500 ml round-bottomed flask. The ultrasonic extraction was repeated a further two times using 50 ml DCM and 15 minutes of ultrasonication, each time the filtered extract was partitioned with the remaining methanol / water in the separating funnel. The DCM extracts were bulked and reduced in volume to approximately 2 ml using a rotary evaporator then further reduced to approximately 1 ml under a gentle stream of nitrogen prior to clean-up.

Correction factors for wet / dry sediments were obtained by drying a sub-sample of the homogenized sediment to constant weight at 110°C.

Sediment Hydrocarbon Analysis-Clean-Up of Extracts by Column Chromatography

Removal of polar material, including lipids was carried out using a silica gel column. The silica gel used was 70 to 230 mesh which was heated at 400°C for at least four hours to remove impurities and residual moisture then stored at 200°C prior to use. The sample extract was added to the silica gel column, containing 5 g of adsorbent and approximately 1 g of activated copper powder (for removal of free sulphur), and eluted with 35 ml of DCM / pentane (1:2). The eluant was reduced in volume using the evaporator to approximately 2 ml before being further reduced under a gentle stream of nitrogen to an appropriate volume and analysed by gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) (see **Table 32**).

Table 32 GC and GC-MS Techniques

	Gas Chromatography (GC)	Gas Chromatography-Mass Spectrometry (GC-MS)
Instrument	HP 6890 Series GC with 7673 autoinjector	ThermoFinnigan Trace GC - DSQ mass selective detector with AS3000 autoinjector
Column	100%-dimethylpolysiloxane bonded fused silica, 60 m, 0.25 µm film thickness, 0.32 mm internal diameter	(5%phenyl)-methylpolysiloxane bonded fused silica, 60 m, 0.25 µm film thickness 0.32 mm internal diameter
Carrier Gas	Hydrogen (constant flow 5 ml / min)	Helium (constant flow 1.4 ml / min)
Injector	On–column (1 µl injection)	Splitless, 250°C, split flow 40 ml / min, vent time 1 min (1 µl injection)
Oven Temperature Programme	80°C - 1 min 80 to 320°C at 15°C / min 320°C – 10 min 320 to 350°C at 10°C / min	60°C - 1 min 60 to 120°C at 15°C / min 120 to 325°C at 5°C / min 325°C – 9 min
Source / Detector Temperature	300°C (FID)	280°C
Electron Energy	-	70 eV
Selected Ion Monitoring (SIM)	-	8 groups - 6 ions per group
Dwell Time (per ion)	-	0.05 second

Sediment Hydrocarbon Analysis-Total Hydrocarbons by Gas Chromatography – Flame Ionisation Detection (GC-FID)

Total hydrocarbons were calculated using an internal standard method. Total hydrocarbon calibration was undertaken using average response factors obtained from the n-alkane standard solutions. The total area of the chromatogram between nC12 and nC36 was quantified.

Limit of Quantification (matrix and oil type dependent) = approximately 0.5 µg.g-1 dry weight.

Sediment Hydrocarbon Analysis-n-Alkanes, Pristane and Phytane

The n-alkanes between nC12 and nC36 were reported, as were the ranges between nC12 and nC20 and nC21 to nC36. Carbon preference index (CPI) values (the ratio of odd to even carbon numbered compounds) for the same ranges were also calculated. Pristane and phytane (and associated ratio) were also quoted.

Calibration was undertaken using a range of n-alkane standard solutions containing the even carbon number compounds between nC12 and nC36 and a range of suitable internal standards. Individual response factors were calculated for each of the n-alkanes present in the calibration solution.

Response factors for the non-calibrated n-alkanes (and pristane and phytane) were taken to be equivalent to closely eluting compounds. Limit of Quantification (matrix dependent) is approximately 1 ng.g-1 dry weight per compound.

Sediment Hydrocarbon Analysis-Polycyclic Aromatic Hydrocarbons

A full range of PAH and alkylated PAH were quantified as specified by Department of Trade and Industry (DTI) PAHs (now part of the Department of Energy and Climate Change (DECC)) regulations.

Calibration was undertaken using a range of PAH standard solutions, a number of alkylated PAH, dibenzothiophene and a range of suitable internal standards. Individual response factors were calculated for each of the compounds present in the calibration solution. Response factors for the noncalibrated alkylated PAH were taken to be equivalent to closely related compounds.
Limit of Quantification (matrix and component dependent) = approximately 1.0 ng.g-1 dry weight per component.

Sediment Hydrocarbon Analysis-Quality Assurance

- An independent standard solution was analysed with each batch of samples to verify instrument calibration;
- Sample blanks were run with each batch;
- At least one laboratory reference sample and one sample duplicate analysis was carried
- out for each study;
- ERT participates in the Quasimeme international laboratory performance scheme.

Sediment Poly Chlorinated Biphenyls (PCBs) Analysis

The following analysis was carried out by Scientifics Ltd. Surrogate is added to an aliquot (5 g) of the supplied As Received Soil, and extracted using ultrasonic enhanced solvent extraction with a 50:50 mixture of hexane/acetone. The extract is dried using anhydrous sodium sulphate and reduced by evaporation to 5 ml. The extract is analysed by GC/ECD. The individual congeners are then quantified against the standard congener reference solution. The Arochlors are then calculated from the individual Congener results.

Sediment Poly Organochlorine Pesticides (OCPs) Analysis

The following analysis was carried out by Scientifics Ltd. Organochlorine Pesticides are extracted from as received (AR), soil using ultrasonic enhanced solvent extraction. Anhydrous sodium sulphate is added to an aliquot of the supplied soil (5 g) and extracted using ultrasonic extraction with a 90:10 mixture of DCM/acetone. The extract is analysed by GC/MS and quantified using the response factors from the continuing calibration. The results for each target compound are tabulated with CAS number, retention time, concentration and library fit. The following OCPs were tested for in the current survey:

1,3,5-Trichlorobenzene	Heptachlorepoxide
1,2,3-Trichlorobenzene	Trans-Chlordane
2,6-Dichlorobenzonitrile	Isodrin
1,2,3,4-Tetrachlorobenzene	O,P'-DDE
Pentachlorobenzene	Cis-Chlordane
Tecnazene	Endosulfan I

Trifluralin	P,P'-DDE
Alpha-HCH	Dieldrin
Hexachlorobenzene	O,P'-DDD
Beta-HCH	Endrin
Gamma-HCH	Endosulfan II
Propyzamide	P,P'-DDD
Chlorthalonil	O,P'-DDT
Triallate	Endosulfan Sulfate
Lindane	P,P'-DDT
Heptachlor	Endrin Ketone
Aldrin	Methoxychlor
Triadimefon	Cis-Permethrin
Pendimethalin	Trans-Permethrin

Sediment Heavy and Trace Metal Analysis

Heavy and trace metal analyses were performed by Scientifics Ltd according to the following method statement. Scientifics are accredited to ISO/IEC 17025:2005 and all analysis meets QA/QC requirements exacted by Fugro Survey Limited's internal procedures (BS/EN/ISO 9001).

Sediment Heavy and Trace Metal Analysis-Sample Digestion Procedure

- Total Metals by ICPOES and ICPMS (Hydrofluoric /Boric acid Extractable Metals).

Approximately 0.20 g of the sediment sample is accurately weighed out and placed in a PTFE bottle. 2.5 mls of Hydrofluoric acid are added. The bottle is placed in an oven at 105±5°C for approximately 1 hour. The bottle is then allowed to air cool in a fume cupboard. 65 mls of 4% Boric acid is the added to the bottle .The contents are then mixed thoroughly and placed in a polypropylene flask and made up to 100 ml with deionised water. The sample is then analysed by using Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES). The digest is diluted 1/10 with 2% Nitric Acid prior to analysis by Inductively Coupled Plasma – Mass Spectrometry (ICPMS).

The above method was used on all metals with the exception of mercury. Copper, lead, cadmium, nickel and zinc were analysed using ICPMS whereas aluminium, barium and iron were analysed using ICP-OES.

- Mercury Digestion Procedure – TMMS1.

Approximately 1 g of the sediment was accurately weighed out and transferred to a beaker. Hydrogen peroxide (10 ml of 30 volumes) was added, and the covered sample left to digest for 0.5 hour in the fume cupboard. Add Nitric acid (10 ml) and place on the hotplate for 1 hour. After digestion, the sample was filtered through a Whatman 542 filter paper into a 100 ml standard flask. The watch-glass and beaker were rinsed thoroughly, transferring the washings to the filter paper. The filter paper was rinsed until the volume was approximately 90 ml. The filter funnel was rinsed into the flask and then the flask was made up to volume and mixed well. The filtrate was the analysed by ICP-MS.

Sediment Heavy and Trace Metal Analysis-Analytical Methodology

Inductively Coupled Plasma Optical Emission Spectrometry - Calibration
The instrument is calibrated using dilutions of the 1 ml = 10 mg spectroscopic solutions. The final calibration solutions arematrix matched with the relevant acids. The calibration line consists of five standards.

Inductively Coupled Plasma- Mass Spectrometry - Calibration
The instrument is calibrated using dilutions of the 1 ml.= 10 mg spectroscopic solutions. The calibration line consists of seven standards. The atomic masses used are as follows:
The analytes are ratioed against internal standards to take account of changes in plasma conditions as a result of matrix differences between standards and samples. Internal standards used should have a similar mass to the analyte ratioed to and should have similar ionisation properties to the analytes.

Quality Control
Quality control consists of running full method blanks together with one in house reference material or certified reference material and one duplicate per batch of 20 samples. Instrument performance is monitored by the use of Instrument Blanks, Continuing Calibration Checks and Independent Calibration Checks.

Macrofauna Analysis-Sorting and Identification

On arrival at the laboratory samples were checked in and their details logged onto the job worksheet.

They were then transferred from their 4% formaldehyde fixative to 70% Industrial Methylated Spirit (IMS) for safe handling and storage.

In order to extract the fauna from the samples they were washed, using a spray head, through a stack of sieves of graduated mesh. The bottom sieve in the stack was of the mesh size specified by the client (0.5 mm). The coarser (>2.0 mm) fractions separated by this process were transferred to trays of water and placed under a freestanding light source; the fauna was then extracted using forceps. To ensure efficient removal of smaller invertebrates from the less coarse (<2.0 mm) fractions, these were poured in small quantities into a Petri dish and examined under a stereo microscope. The animals were stored in labelled jars or vials filled with 70% IMS. At each stage of the extraction process care was taken to ensure that no animals remained on the sieves or in the containers used for sample fraction storage.

Specimens were identified to the lowest practicable taxonomic level (generally species) and enumerated using stereo and compound microscopy and dissection where appropriate. Nonenumerable colonial taxa were identified and their presence in the sample recorded by placing a "P" on the datasheet.

To ensure data quality and consistency various control systems were adhered to. Residues from the finer sample fractions were double-checked to ensure all of the fauna had been removed. The senior taxonomist also checked all of the identifications made. A reference collection of all fauna encountered during the survey was created and used to ensure consistency in identification.

Species data were entered into the environmental database (DES) and an Excel spreadsheet with the appropriate Marine Conservation Society (MCS) codes (Howson and Picton, 1997) was produced.

Macrofauna Analysis-Taxonomic Standardisation

Before undergoing statistical analysis, macrofauna data were reviewed to ensure the dataset was valid for statistical analysis. All taxonomically indistinct taxa were either aggregated to higher taxonomic levels or, if it was felt that this would result in the loss of important discriminatory information, excluded from the dataset.

In accordance with OSPAR Commission (2004) guidelines all juvenile, colonial, planktonic and meiofaunal taxa were excluded from further analysis, ensuring comparability between the data from surveys undertaken in different seasons. Macrofauna were taken to be those animals retained by a 0.5 mm sieve. Meiofauna are those animals retained by a 0.1 mm mesh (Lincoln and Boxshall, 1987).
Taxa such as Nematoda, which may be retained by a 0.5 mm sieve, but will not have been consistently sampled, were also excluded from further statistical analysis.

2.8 Statistical Analysis

The final data derived from the granulometric and macrofaunal samples were analysed using routines in the PRIMER (Plymouth Routines in Multivariate Ecological Research) v.6.0 software package (Clarke and Gorley, 2006). All crude granulometric data (e.g. mean particle size and proportions of coarse, sand and fine sediments) and all chemical data underwent correlation analysis. Purely multivariate methods were utilised to aid the interpretation of fractional granulometric data and a combination of univariate and multivariate methods (as per OSPAR Commission (2004) guidelines) were used to aid identification of any underlying patterns in the benthic communities.

Statistical Analysis-Correlation Analysis

Depth, crude granulometric data, chemical data and univariate indices of community structure (Statistical Analysis-Primary and Univariate Variables) were correlated using the Spearman's Rank Correlation Coefficient. This is calculated as follows:

$$Rs = 1 - \frac{6\,\Sigma d^2}{n(n^2 - n)}$$

Where:
Values for variables x and y are ranked (maximum to minimum) for two samples
d = the difference between the ranks of variables x and y for a given sample
n = the number of samples

The resultant test statistic (RS) will range from -1 to 1, with -1 indicating a very strong negative correlation, 0 no correlation and 1 a very strong positive correlation.

This analysis was undertaken by generating a resemblance matrix in PRIMER V6.0. This was then outputted as a Microsoft Excel file and selectively formatted to highlight significant ($P<0.05$) and highly significant ($P<0.01$) positive and negative correlations.

Statistical Analysis-Primary and Univariate Variables

Diversity is typically thought to comprise two different factors: the number of species (species richness) and the equitability of species abundances (evenness or equitability) (Magurran, 1988). Thus a range of primary and derived univariate indices were calculated which attempt to quantify the species richness, evenness and a combination of both. The primary variables (number of individuals and species) and univariate variables (Shannon-Weiner diversity, Margalef's richness, Simpson's diversity and Pielou's evenness) were calculated for both the samples and the pooled replicates for each station using the PRIMER v6.0 DIVERSE procedure (Clarke and Gorley, 2006) (Table 33).

Table 33 Primary and Univariate Indices

Variable	Dominant Influence/s	Formula	Comment
Number of Species or Species Richness (*S*)	Richness	S Where: S = the total number of species.	The simplest measure of species richness.
Number of Individuals or Abundance (*N*)	-	N Where: N = the total number of individuals.	The simplest measure of abundance.
Shannon Weiner Index (*H'*)	Richness + Evenness	$H' = -\sum_i p_i (\log p_i)$ Where: p_i is the proportion of the total count arising from the *i*th species.	The most widely used diversity index incorporating both species richness and equitability (Shannon and Weaver, 1949).
Margalef's Richness (D_{MG})	Richness	$D_{Mg} = \frac{(S-1)}{\log N}$ Where: S = total number of species; N = total number of individuals.	A simple index derived from a combination of the number of species (S) and total number of individuals (Clifford and Stevenson, 1975).
Pielou's Evenness or Equitability (*J'*)	Evenness	$J' = \frac{H'}{\log S}$ Where: H' = Shannon-Wiener Index; S = total number of species.	A measure of how evenly individuals are distributed between species (Pielou, 1969).
Simpson's Dominance (*1-D*)	Evenness	$D = \sum \left(\frac{n_i (n_i - 1)}{} \right)$ Where: n_i = number of individuals in the *i*th species; N = total individuals.	A measure of dominance weighted to the commonest species (Simpson, 1949). As *D* increases, diversity decreases, so the reciprocal (*1-D*) is more usually expressed.

Statistical Analysis-Species Accumulation and Richness Estimation

A species accumulation plot was generated using PRIMER v6.0. This cumulatively plotted the total number of taxa recorded at each station (Sobs) and can be used to qualitatively assess the efficacy of the macrofaunal sampling operations. The curve of a species accumulation plot for a community that had been fully sampled (i.e. from which all of the taxa present had been detected) would reach its asymptote (point of the curve with no slope), whereas the slope of an accumulation plot for an incompletely sampled community would remain positive throughout. The curves of the species accumulation plot were smoothed by permutation of the data points and calculation of the means of the permuted results.

The number of taxa observed at each station can be extrapolated to estimate the number of taxa present in the community as a whole (Ŝ) using a variety of non-parametric functions. Four richness estimators (Chao1, Chao2, Jacknife1 and Jacknife2) were calculated using PRIMER v6.0 (**Table 34**) and plotted alongside the actual species accumulation (Sobs) curve. All of these richness estimators use the frequency of occurrence of rare taxa to estimate how taxa would accumulate should the community be infinitely sampled. For further discussion of these indices see Chao (2005).

Table 34 Richness Estimators

Variable	Formula	Comment
Chao1 ($\hat{S}_{chao1}$)	$\hat{S}_{chao1} = S_{obs} + \frac{F_1(F_1-1)}{}$ Where: F_1 = number of singletons (taxa of which only single individuals occur at a station) F_2 = number of doubletons (taxa of which two individuals occur at a station)	Bias-corrected estimator which uses the taxa that occur at a frequency of one or two individuals per station to estimate total community richness.
Chao2 ($\hat{S}_{chao2}$)	$\hat{S}_{chao2} = S_{obs} + \left(\frac{m-1}{}\right)\left(\frac{Q_1(Q_1-1)}{}\right)$ Where: m = total number of stations Q_1 = number of uniques (taxa that occur in one sample) Q_2 = number of duplicates (taxa that occur at two stations)	Bias-corrected incidence (presence / absence) estimator which uses the taxa that occur at one or two stations to estimate total community richness.
Jacknife1 ($\hat{S}_{j1}$)	$\hat{S}_{j1} = S_{obs} + Q_1\left(\frac{m-1}{}\right)$ Where: m = total number of stations Q_1 = number of uniques (taxa that occur in one sample)	First order incidence (presence / absence) estimator which uses the taxa that occur at one station to estimate total community richness.
Jacknife2 ($\hat{S}_{j2}$)	$\hat{S}_{j2} = S_{obs} + \left(\frac{Q_1(2m-3)}{} - \frac{Q_2(m-2)}{}\right)$ Where: m = total number of stations Q_1 = number of uniques (taxa that occur in one sample) Q_2 = number of duplicates (taxa that occur at two stations)	Second order incidence (presence / absence) estimator which uses the taxa that occur at one or two stations to estimate total community richness.

Statistical Analysis-Multivariate Analysis

A range of multivariate statistical analyses were conducted on the granulometric and macrofaunal data. These were undertaken with the statistical package Plymouth Routines in Multivariate Ecological Research (PRIMER) v6.0 (Clarke and Gorley, 2006). Multivariate analysis of community data allows a more thorough examination of differences between samples by preserving the identity of species when calculating similarities.

Multivariate Analysis-Non-Parametric Statistical Techniques

Pre-treatment of Data

Prior to analysis data typically undergo transformation to down-weight the effect of dominant data components in determining inter-sample similarities. These transformations vary in their effect through:

no transform; square root (√); fourth root / double square root (√√); logarithmic, and; reduction to presence / absence. At the former end of the spectrum (no transform) all attention is focused on the dominant components of the dataset, and at the latter end (reduction to presence / absence) equal weighting is applied to all components (Clarke and Warwick, 1994).

Granulometric data were aggregated to give percentage composition at 1.0 phi intervals prior to multivariate analysis.

Macrofaunal data underwent a square root transformation so that the analysis took account of all components of the community but retained some quantitative information.

Similarity Matrices
A triangular similarity matrix was then produced from the transformed data, by calculating the similarity between every pair of replicate samples. In this case, the Bray-Curtis similarity coefficient was used for macrofauna data (Bray and Curtis, 1957) and particle size data. This similarity measure is considered to be the most suitable similarity measures for the data being analysed as it maintains independence of joint absence (i.e. will not infer similarity between samples based on the absence of a certain parameter in them).

Hierarchical Agglomerative Clustering (CLUSTER) and Similarity Profile Testing (SIMPROF)
The CLUSTER programme uses the similarity matrix to successively fuse samples into groups and groups into clusters according to their level of similarity. The end point of this process is a single cluster containing all the samples, which is displayed by means of a dendrogram with similarity displayed on one axis and samples on the other.

Similarity profile permutation tests (SIMPROF) were also performed, to look for evidence of genuine statistically significant clusters, in samples which are a-priori unstructured (i.e. with no prior statistical design), as typically seen for a baseline survey such as this. By combining this significance testing with the CLUSTER function, dendrograms are produced indicating those clusters which are statistically significant. Statistically significant splits in dendrograms are illustrated as solid black lines, while non-significant splits are shown as dotted red lines.

Non-Metric Multidimensional Scaling (nMDS)
Non-metric multidimensional scaling (nMDS) use the similarity matrix to ordinate samples in a two dimensional plane. The representation of the multidimensional (multiple variable) dataset in two dimensions will inevitably result in some distortion of the real data relationships and this distortion is expressed as a stress value (**Table 35**).

Table 35 nMDS Stress Values

nMDS Stress	Adequacy of Representation for 2-Dimensional Plot
0.0 → ≤0.05	Excellent representation with no prospect of misinterpretation.
>0.05 → ≤0.1	Good ordination with no real prospect of a misleading interpretation.
>0.1 → ≤0.2	Potentially useful 2-d plot, though for values at the upper end of this range too much reliance should not be placed on plot detail; superimposition of clusters should be undertaken to verify conclusions.
>0.2 → ≤0.3	Ordination should be treated with scepticism. Clusters may be superimposed to verify conclusions, but ordinations with stress values >2.5 should be discarded. A 3-d ordination may be more appropriate.
>0.3	Ordination is unreliable with points close to being arbitrarily placed in the 2-d plot. A 3-d ordination should be examined.

Similarity Percentages Analysis (SIMPER)
This programme calculates the individual contribution of different species to both the similarity of samples within a cluster group and the dissimilarity between different cluster groups. It is therefore possible to identify those species which are characteristic of a particular habitat and those species which act as discriminating species between habitats.

2.9 Field Logs

Survey log

Datum: WGS84, Projection: UTM Zone 30 N, CM 03° W											
Date	Time [GMT]	Transect / Station	Sample Type (Grab / Photo)	Sample Rep / Still No.	Fix No.	Depth [m]	Proposed Location		Actual Location		Range from Target [m]
							Easting [m]	Northing [m]	Easting [m]	Northing [m]	
25/04/2013	13:42	50	WSSurface	WSSurface	1	1	565 364.2	494 905.1	565 340.8	494 894.3	25.8
25/04/2013	14:23	50	WS100	WS100	2	100	565 322.6	494 896.6	565 340.8	494 894.3	18.3
25/04/2013	15:10	50	WS200	WS200	3	200	565 381.0	494 850.8	565 340.8	494 894.3	59.2
25/04/2013	16:00	50	Acclimitising fix	CTD/Zoo	4		565 338.3	494 896.3	565 340.8	494 894.3	3.2
25/04/2013	16:16	50	Bottom fix	CTD/Zoo	5		565 336.9	494 900.9	565 340.8	494 894.3	7.7
25/04/2013	16:39	50	Surface fix	CTD/Zoo	6		565 338.3	494 919.1	565 340.8	494 894.3	25.0
25/04/2013	18:32	46	Acclimitising fix	CTD/Zoo	7		555 040.0	494 339.1	555 058.0	494 308.7	35.3
25/04/2013	19:03	46	Bottom fix	CTD/Zoo	8		555 054.5	494 309.0	555 058.0	494 308.7	3.5
25/04/2013	19:36	46	Surface fix	CTD/Zoo	9		555 060.5	494 319.9	555 058.0	494 308.7	11.5
25/04/2013	20:00	46	WSSurface[1]	WSSurface	10	1	555 057.5	494 311.0	555 058.0	494 308.7	2.3
25/04/2013	20:09	46	WSSurface	WSSurface	11	1	555 059.5	494 308.6	555 058.0	494 308.7	1.5
25/04/2013	20:26	46	WS100	WS100	12	100	555 048.4	494 315.5	555 058.0	494 308.7	11.7
25/04/2013	20:46	46	WS200	WS200	13	200	555 054.7	494 316.8	555 058.0	494 308.7	8.7
25/04/2013	22:22	38	WSSurface	WSSurface	14	1	543 333.0	491 025.0	543 343.3	491 020.6	11.2
25/04/2013	22:42	38	WS100	WS100	15	100	543 334.5	491 023.4	543 343.3	491 020.6	9.2
25/04/2013	23:00	38	WS200	WS200	16	200	543 349.8	491 022.7	543 343.3	491 020.6	6.8
25/04/2013	23:30	38	Acclimitising fix	CTD/Zoo	17		543 343.0	491 021.2	543 343.3	491 020.6	0.7
26/04/2013	00:29	38	Bottom fix	CTD/Zoo	18		543 540.8	490 986.4	543 343.3	491 020.6	200.4
26/04/2013	01:34	38	Surface fix	CTD/Zoo	19		543 797.9	490 824.1	543 343.3	491 020.6	495.2
26/04/2013	02:42	38	PC, FA	Grab	20	1122	543 346.8	491 026.6	543 343.3	491 020.6	6.9
26/04/2013	04:31	38	FB	Grab	22	1122	543 341.5	491 024.8	543 343.3	491 020.6	4.5
26/04/2013	06:14	40	PC, FA	Grab	23	922	545 706.7	494 403.6	545 700.2	494 399.4	7.8
26/04/2013	07:04	40	FB	Grab	24	923	545 700.8	494 404.2	545 700.2	494 399.4	4.9
26/04/2013	08:37	39	No samples	Grab	25	1112	545 703.5	489 148.4	545 701.5	489 148.2	2.0
26/04/2013	09:19	39	PC, FA	Grab	26	1112	545 706.2	489 143.3	545 701.5	489 148.2	6.8

Datum: WGS84, Projection: UTM Zone 30 N, CM 03° W											
Date	Time [GMT]	Transect / Station	Sample Type (Grab / Photo)	Sample Rep / Still No.	Fix No.	Depth [m]	Proposed Location		Actual Location		Range from Target [m]
							Easting [m]	Northing [m]	Easting [m]	Northing [m]	
26/04/2013	10:14	39	FB	Grab	27	1111	545 714.5	489 144.3	545 701.5	489 148.2	13.5
26/04/2013	11:33	42	PC, FA	Grab	28	1007	548 825.2	489 175.8	548 811.2	489 176.6	14.0
26/04/2013	12:29	42	FB	Grab	29	1007	548 818.0	489 172.4	548 811.2	489 176.6	8.0
26/04/2013	13:41	43	PC, FA	Grab	30	883	550 892.2	491 484.4	550 892.0	491 487.0	2.6
26/04/2013	14:27	43	FB	Grab	31	883	550 893.0	491 485.0	550 892.0	491 487.0	2.2
26/04/2013	16:06	45	PC, FA	Grab	32	834	551 643.5	496 140.5	551 632.3	496 142.2	11.4
26/04/2013	16:47	45	FB	Grab	33	833	551 643.2	496 140.5	551 632.3	496 142.2	11.1
26/04/2013	18:18	46	PC, FA	Grab	34	708	555 071.1	494 312.4	555 058.0	494 308.7	13.6
26/04/2013	18:54	46	FB	Grab	35	707	555 068.7	494 313.9	555 058.0	494 308.7	11.9
26/04/2013	20:02	47	PC, FA	Grab	36	561	559 373.0	495 934.0	559 369.0	495 933.4	4.1
26/04/2013	20:37	47	FB	Grab	37	561	559 377.4	495 939.0	559 369.0	495 933.4	10.1
26/04/2013	21:48	41	PC[2]	Grab	38	518	565 080.2	495 108.1	565 070.0	495 100.0	13.0
26/04/2013	22:19	41	FB, FA[2]	Grab	39	519	565 078.3	495 108.3	565 070.0	495 100.0	11.7
26/04/2013	23:42	48	PC, FA	Grab	40	427	561 389.5	499 801.0	561 383.0	499 794.2	9.4
27/04/2013	00:48	48	FB	Grab	41	427	561 388.1	499 792.0	561 383.0	499 794.2	5.5
27/04/2013	02:08	49	PC, FA	Grab	42	219	563 422.3	504 016.9	563 419.2	504 013.0	5.0
27/04/2013	02:41	49	FB	Grab	43	220	563 418.5	504 014.9	563 419.2	504 013.0	2.1
27/04/2013	05:24	44	PC, FA[3]	Grab	45	334	571 053.8	498 962.0	571 052.5	498 963.3	1.9
27/04/2013	05:54	44	FB[3]	Grab	46	334	571 049.1	498 963.9	571 052.5	498 963.3	3.5
27/04/2013	17:21	44 (retaken)	PC, FA[3]	Grab	47	327	571 544.3	498 907.6	571 549.0	498 903.0	6.6
27/04/2013	17:44	44 (retaken)	FB[3]	Grab	48	327	571 552.3	498 899.6	571 549.0	498 903.0	4.7

Grab Sample Log

Datum: WGS84, Projection: UTM Zone 30 N, CM 03° W												
Date	Time [GMT]	Station	Sample Rep	Fix No.	Volume [%]	Sediment Description	Sediment Stratigraphy					Comments (Smell, Bioturbation and Debris)
							Depth [cm]	Hue	Value	Chroma	Colour	
26/04/2013	2:42	38	PC	20	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	2:42	38	FA	20	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	3:46	38	NS/NS	21	-	-	-	-	-	-	-	-
26/04/2013	4:31	38	FB	22	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	6:14	40	PC	23	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	6:14	40	FA	23	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	7:04	40	FB	24	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	8:37	39	NS/NS	25	-	-	-	-	-	-	-	-
26/04/2013	9:19	39	PC	26	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	9:19	39	FA	26	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	10:14	39	FB	27	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	11:33	42	PC	28	95	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	11:33	42	FA	28	95	Silty clay	-	2.5Y	3	1	Very dark grey	Sea Urchin
26/04/2013	12:29	42	FB	29	80	Silty clay	-	2.5Y	3	1	Very dark grey	-
26/04/2013	13:41	43	PC	30	80	Silty clay	-	7.5Y	3	2	-	-
26/04/2013	13:41	43	FA	30	80	Silty clay	-	7.5Y	3	2	-	-
26/04/2013	14:27	43	FB	31	80	Silty clay	-	7.5Y	3	2	-	-
26/04/2013	16:06	45	PC	32	80	Silty clay	-	2.5Y	4	1	Dark grey	-
26/04/2013	16:06	45	FA	32	80	Silty clay	-	2.5Y	4	1	Dark grey	-
26/04/2013	16:47	45	FB	33	80	Silty clay	-	2.5Y	4	1	Dark grey	-

Datum: WGS84, Projection: UTM Zone 30 N, CM 03° W													
Date	Time [GMT]	Station	Sample Rep	Fix No.	Volume [%]	Sediment Description	Sediment Stratigraphy					Comments (Smell, Bioturbation and Debris)
							Depth [cm]	Hue	Value	Chroma	Colour	
26/04/2013	18:18	46	PC	34	80	Silty clay	-	2.5Y	4	1	Dark grey	-
26/04/2013	18:18	46	FA	34	80	Silty clay	-	2.5Y	4	1	Dark grey	-
26/04/2013	18:54	46	FB	35	80	Silty clay	-	2.5Y	4	1	Dark grey	-
26/04/2013	20:02	47	PC	36	80	Silty clay	-	7.5Y	3	2	-	-
26/04/2013	20:02	47	FA	36	80	Silty clay	-	7.5Y	3	2	-	-
26/04/2013	20:37	47	FB	37	95	Silty clay - coarse sand	-	7.5Y	-	-	-	-
26/04/2013	21:48	41	PC	38	95	Silty clay - coarse sand	-	7.5Y	3	2	-	-
26/04/2013	21:48	41	Rejected	38		-	-	-	-	-	-	Rejected - Hagfish present
26/04/2013	22:19	41	FA	39	95	Silty clay - coarse sand	-	7.5Y	3	2	-	-
26/04/2013	22:19	41	FB	39	95	Silty clay - coarse sand	-	7.5Y	3	2	-	-
26/04/2013	23:42	48	PC	40	80	Clayey fine to medium sand	-	2.5Y	4	1	Dark grey	Black sand and large amount of shell fragments in all samples
26/04/2013	23:42	48	FA	40	80	Clayey fine to medium sand	-	2.5Y	4	1	Dark grey	-
27/04/2013	0:48	48	FB	41	80	Clayey fine to medium sand	-	2.5Y	4	1	Dark grey	Smell
27/04/2013	2:08	49	PC	42	80	Silty med - coarse sand	-	2.5Y	4	1	Dark grey	Black sand and large amount of shell fragments in all samples too coarse to sieve fully
27/04/2013	2:08	49	FA	42	90	Silty med - coarse sand	-	2.5Y	4	1	Dark grey	
27/04/2013	2:41	49	FB	43	90	Silty med - coarse sand	-	2.5Y	4	1	Dark grey	
27/04/2013	4:39	44	Rejected	44	-	-	-	-	-	-	-	Incorrect way point inserted into Nav
27/04/2013	5:24	44	PC	45	80	Silty fine - medium sand	-	2.5Y	4	1	Dark grey	Incorrect way point inserted into Nav
27/04/2013	5:24	44	FA	45	80	Silty fine - medium sand	-	2.5Y	4	1	Dark grey	Incorrect way point inserted into Nav
27/04/2013	5:54	44	FB	46	90	Silty fine - medium sand	-	2.5Y	4	1	Dark grey	Incorrect way point inserted into Nav

Datum: WGS84, Projection: UTM Zone 30 N, CM 03° W												
Date	Time [GMT]	Station	Sample Rep	Fix No.	Volume [%]	Sediment Description	Sediment Stratigraphy					Comments (Smell, Bioturbation and Debris)
							Depth [cm]	Hue	Value	Chroma	Colour	
27/04/2013	17:21	44 (retaken)	PC	47	95	Silty fine - medium sand	-	2.5Y	4	1	Dark grey	Original position was incorrect, re-run
27/04/2013	17:21	44 (retaken)	FA	47	95	Silty fine - medium sand	-	2.5Y	4	1	Dark grey	Original position was incorrect, re-run
27/04/2013	17:44	44 (retaken)	FB	48	95	Silty fine - medium sand	-	2.5Y	4	1	Dark grey	Original position was incorrect, re-run

Zooplankton trawl log

Station	Counter		Volume (litres)	Volume (m^3)
	Start	Finish		
38	2272	3693	83554.8	83.5548
46	1353	2268	53802.0	53.8020
50	558	1353	46746.0	46.7460

BASELINE RESULTS

2.1 Sediment-Particle Size Analysis And Grab Photographs

STATION 38



Easting: 543 343.3 m Depth: 1122 m
Northing: 491 020.6 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 543 343.3 m Depth: 1122 m
Northing: 491 020.6 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 543 343.3 m Depth: 1122 m
Northing: 491 020.6 m Sed Type: Very Poorly Sorted, Fine Silt

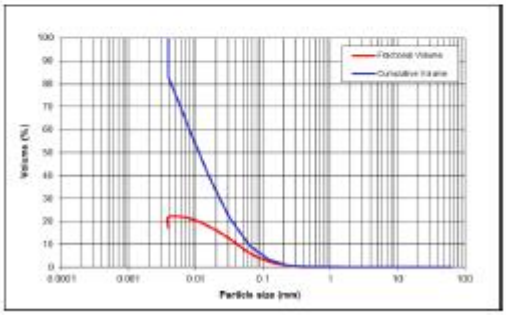
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.02	0.02
0.5	1.00	0.06	0.08
0.250	2.00	0.61	0.69
0.125	3.00	2.44	3.14
0.06250	4.00	6.24	9.38
0.03120	5.00	12.60	21.98
0.01560	6.00	17.77	39.75
0.00780	7.00	21.39	61.14
0.00390	8.00	21.92	83.06
0.00390	< 8.00	16.94	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.219	Very Poorly Sorted	
Skewness	0.104	Fine Skewed	
Kurtosis	1.403	Leptokurtic	
Mean (µm)	11.574	% Coarse	0.00
Median (µm)	11.208	% Sand	9.38
Mean (phi)	6.433	% Fines	90.62
Median (phi)	6.479		

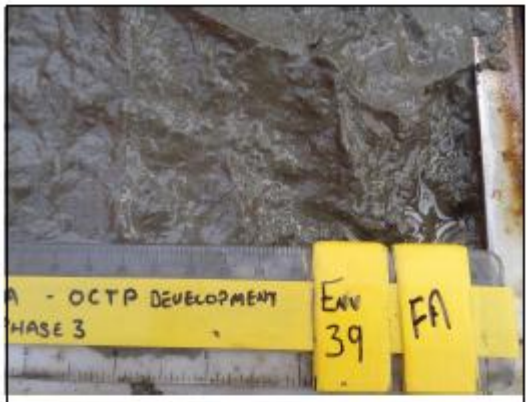
CHART REPRESENTING LASER DATA



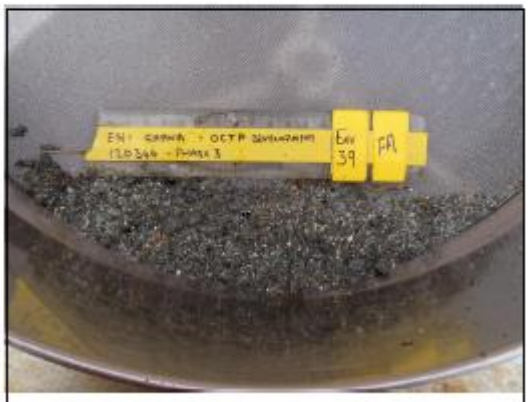
STATION 39



Easting: 545 701.5 m Depth: 1112 m
Northing: 489 148.2 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 545 701.5 m Depth: 1112 m
Northing: 489 148.2 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 545 701.5 m Depth: 1112 m
Northing: 489 148.2 m Sed Type: Very Poorly Sorted, Fine Silt

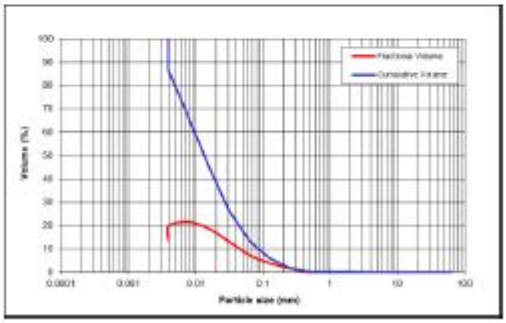
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.08	0.08
1	0.00	0.02	0.10
0.5	1.00	0.15	0.24
0.250	2.00	1.70	1.94
0.125	3.00	4.02	5.96
0.06250	4.00	7.32	13.29
0.03120	5.00	13.17	26.45
0.01560	6.00	18.70	45.16
0.00780	7.00	21.52	66.68
0.00390	8.00	19.76	86.44
0.00390	< 8.00	13.56	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.217	Very Poorly Sorted	
Skewness	0.046	Symmetrical	
Kurtosis	1.389	Leptokurtic	
Mean (µm)	14.554	% Coarse	0.08
Median (µm)	13.368	% Sand	13.20
Mean (phi)	6.102	% Fines	86.71
Median (phi)	6.225		

CHART REPRESENTING LASER DATA



STATION 40



Easting: 545 700.2 m Depth: 922 m
Northing: 494 399.4 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 545 700.2 m Depth: 922 m
Northing: 494 399.4 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 545 700.2 m Depth: 922 m
Northing: 494 399.4 m Sed Type: Very Poorly Sorted, Fine Silt

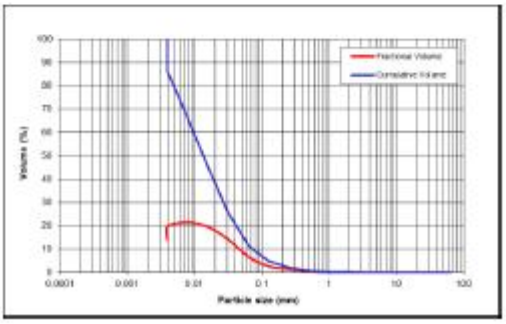
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.07	0.07
1	0.00	0.08	0.15
0.5	1.00	0.53	0.68
0.250	2.00	1.39	2.07
0.125	3.00	2.67	4.75
0.06250	4.00	6.68	11.43
0.03120	5.00	14.20	25.63
0.01560	6.00	19.51	45.14
0.00780	7.00	21.42	66.56
0.00390	8.00	19.63	86.19
0.00390	< 8.00	13.81	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.154	Very Poorly Sorted	
Skewness	0.083	Symmetrical	
Kurtosis	1.381	Leptokurtic	
Mean (µm)	14.124	% Coarse	0.07
Median (µm)	13.351	% Sand	11.36
Mean (phi)	6.146	% Fines	88.57
Median (phi)	6.227		

CHART REPRESENTING LASER DATA



STATION 41



Easting: 565 070.0 m Depth: 519 m
Northing: 495 100.0 m Sed Type: Very Poorly Sorted, Coarse Silt

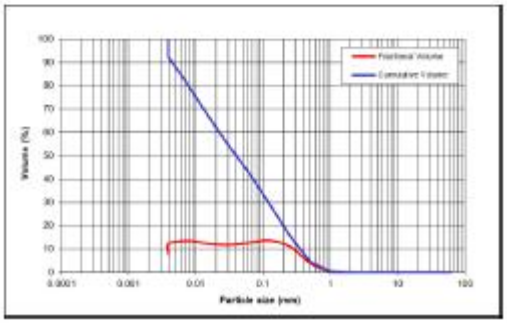
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.03	0.03
1	0.00	0.50	0.53
0.5	1.00	4.03	4.56
0.250	2.00	11.18	15.74
0.125	3.00	13.67	29.42
0.06250	4.00	12.78	42.19
0.03120	5.00	11.91	54.10
0.01560	6.00	12.35	66.45
0.00780	7.00	13.51	79.96
0.00390	8.00	12.31	92.27
0.00390	< 8.00	7.73	100.00
Total	**Total**	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.665	Very Poorly Sorted	
Skewness	0.094	Symmetrical	
Kurtosis	0.915	Mesokurtic	
Mean (µm)	39.350	**% Coarse**	0.03
Median (µm)	39.671	**% Sand**	42.16
Mean (phi)	4.667	**% Fines**	57.81
Median (phi)	4.656		

CHART REPRESENTING LASER DATA



STATION 42



Easting: 548 811.2 m Depth: 1007 m
Northing: 489 176.6 m Sed Type: Very Poorly Sorted, Fine Silt



Easting: 548 811.2 m Depth: 1007 m
Northing: 489 176.6 m Sed Type: Very Poorly Sorted, Fine Silt

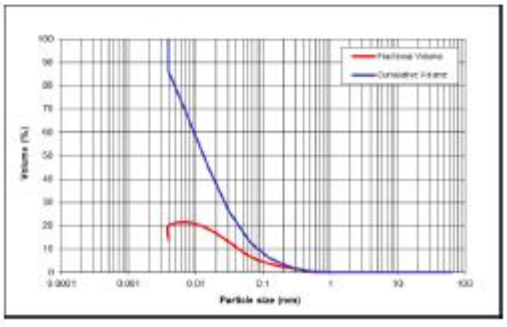
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.05	0.05
0.5	1.00	0.44	0.48
0.250	2.00	1.94	2.42
0.125	3.00	3.75	6.17
0.06250	4.00	6.92	13.08
0.03120	5.00	13.03	26.11
0.01560	6.00	18.50	44.61
0.00780	7.00	21.41	66.02
0.00390	8.00	20.05	86.07
0.00390	< 8.00	13.93	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.237	Very Poorly Sorted	
Skewness	0.038	Symmetrical	
Kurtosis	1.408	Leptokurtic	
Mean (µm)	14.335	% Coarse	0.00
Median (µm)	13.121	% Sand	13.08
Mean (phi)	6.124	% Fines	86.92
Median (phi)	6.252		

CHART REPRESENTING LASER DATA



STATION 43



Easting: 550 892.0 m Depth: 883 m
Northing: 491 487.0 m Sed Type: Very Poorly Sorted, Medium Silt



Easting: 550 892.0 m Depth: 883 m
Northing: 491 487.0 m Sed Type: Very Poorly Sorted, Medium Silt

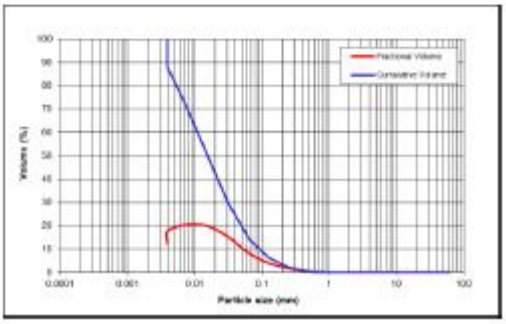
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.00	0.00
0.5	1.00	0.42	0.42
0.250	2.00	1.77	2.19
0.125	3.00	4.05	6.24
0.06250	4.00	8.36	14.60
0.03120	5.00	15.24	29.84
0.01560	6.00	19.82	49.67
0.00780	7.00	20.53	70.20
0.00390	8.00	17.72	87.92
0.00390	< 8.00	12.08	100.00
Total	**Total**	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.195	Very Poorly Sorted	
Skewness	0.083	Symmetrical	
Kurtosis	1.331	Leptokurtic	
Mean (µm)	16.040	**% Coarse**	0.00
Median (µm)	15.452	**% Sand**	14.60
Mean (phi)	5.962	**% Fines**	85.40
Median (phi)	6.016		

CHART REPRESENTING LASER DATA



STATION 44



Easting: 571 549.0 m Depth: 327 m
Northing: 498 903.0 m Sed Type: Very Poorly Sorted, Very Fine Sand



Easting: 571 549.0 m Depth: 327 m
Northing: 498 903.0 m Sed Type: Very Poorly Sorted, Very Fine Sand



Easting: 571 549.0 m Depth: 327 m
Northing: 498 903.0 m Sed Type: Very Poorly Sorted, Very Fine Sand

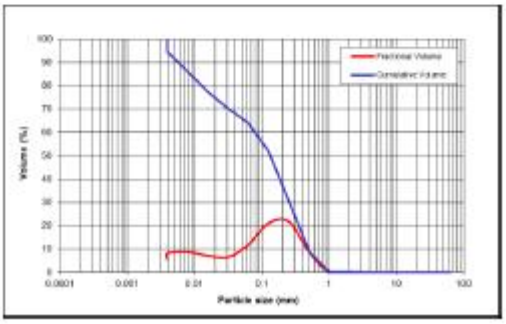
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.13	0.13
1	0.00	0.15	0.28
0.5	1.00	8.74	9.02
0.250	2.00	21.75	30.77
0.125	3.00	21.02	51.79
0.06250	4.00	11.96	63.76
0.03120	5.00	6.55	70.31
0.01560	6.00	7.14	77.45
0.00780	7.00	8.82	86.27
0.00390	8.00	8.22	94.49
0.00390	< 8.00	5.51	100.00
Total	**Total**	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.560	Very Poorly Sorted	
Skewness	0.408	Very Fine Skewed	
Kurtosis	0.831	Platykurtic	
Mean (µm)	79.142	**% Coarse**	0.13
Median (µm)	132.617	**% Sand**	63.63
Mean (phi)	3.659	**% Fines**	36.24
Median (phi)	2.915		

CHART REPRESENTING LASER DATA



STATION 45



Easting: 551 632.3 m Depth: 834 m
Northing: 496 142.2 m Sed Type: Very Poorly Sorted, Medium Silt

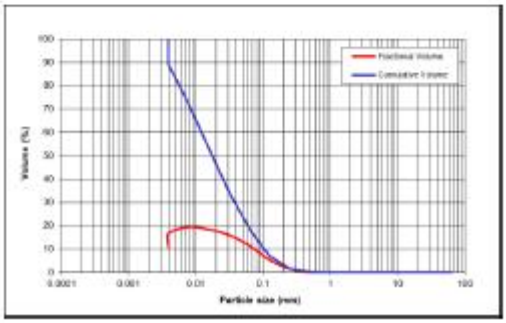
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.00	0.00
0.5	1.00	0.13	0.13
0.250	2.00	1.55	1.68
0.125	3.00	5.37	7.05
0.06250	4.00	11.53	18.58
0.03120	5.00	16.02	34.59
0.01560	6.00	18.41	53.00
0.00780	7.00	19.45	72.45
0.00390	8.00	16.70	89.15
0.00390	< 8.00	10.85	100.00
Total	**Total**	100.00	100.00

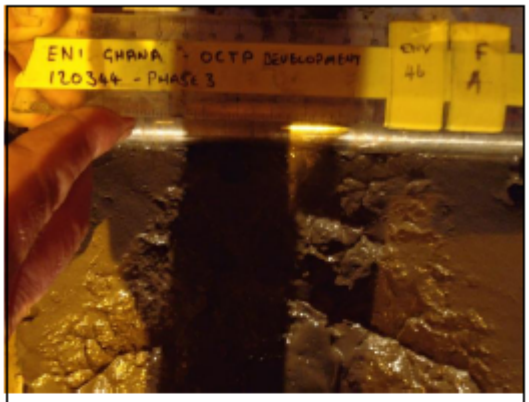
SEDIMENT CHARACTERISTICS

Sorting	2.226	Very Poorly Sorted	
Skewness	0.083	Symmetrical	
Kurtosis	1.226	Leptokurtic	
Mean (µm)	18.345	**% Coarse**	0.00
Median (µm)	17.494	**% Sand**	18.58
Mean (phi)	5.768	**% Fines**	81.42
Median (phi)	5.837		

CHART REPRESENTING LASER DATA



STATION 46



Easting: 555 058.0 m Depth: 708 m
Northing: 494 308.7 m Sed Type: Very Poorly Sorted, Medium Silt

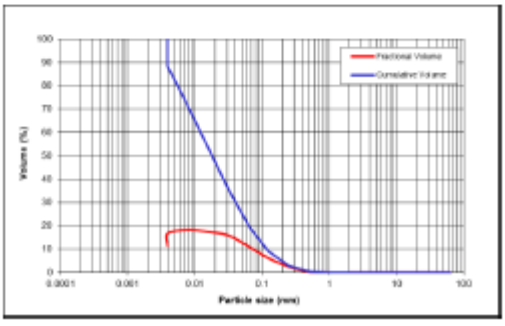
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.00	0.00
0.5	1.00	0.31	0.31
0.250	2.00	2.48	2.80
0.125	3.00	6.09	8.89
0.06250	4.00	11.23	20.11
0.03120	5.00	15.92	36.03
0.01560	6.00	17.43	53.47
0.00780	7.00	18.28	71.75
0.00390	8.00	16.71	88.45
0.00390	< 8.00	11.55	100.00
Total	Total	100.00	100.00

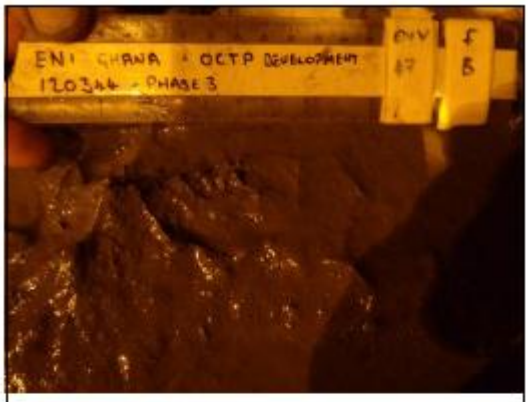
SEDIMENT CHARACTERISTICS

Sorting	2.334	Very Poorly Sorted	
Skewness	0.073	Symmetrical	
Kurtosis	1.226	Leptokurtic	
Mean (µm)	18.935	% Coarse	0.00
Median (µm)	17.934	% Sand	20.11
Mean (phi)	5.723	% Fines	79.89
Median (phi)	5.801		

CHART REPRESENTING LASER DATA



STATION 47



Easting: 559 369.0 m Depth: 561 m
Northing: 495 933.4 m Sed Type: Very Poorly Sorted, Very Fine Sand

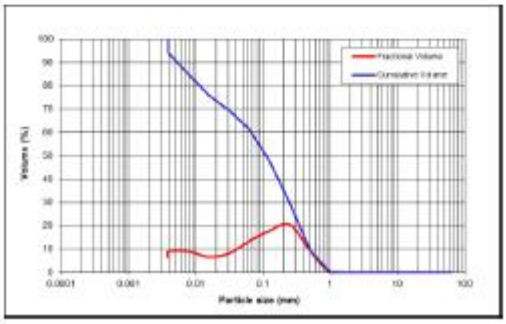
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.13	0.13
0.5	1.00	9.28	9.41
0.250	2.00	20.52	29.94
0.125	3.00	17.82	47.75
0.06250	4.00	13.50	61.25
0.03120	5.00	8.15	69.40
0.01560	6.00	6.58	75.99
0.00780	7.00	8.99	84.97
0.00390	8.00	8.93	93.90
0.00390	< 8.00	6.10	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.669	Very Poorly Sorted	
Skewness	0.355	Very Fine Skewed	
Kurtosis	0.844	Platykurtic	
Mean (µm)	72.140	% Coarse	0.00
Median (µm)	111.369	% Sand	61.25
Mean (phi)	3.793	% Fines	38.75
Median (phi)	3.167		

CHART REPRESENTING LASER DATA



STATION 48



Easting: 561 383.0 m Depth: 427 m
Northing: 499 794.2 m Sed Type: Very Poorly Sorted, Medium Silt



Easting: 561 383.0 m Depth: 427 m
Northing: 499 794.2 m Sed Type: Very Poorly Sorted, Medium Silt



Easting: 561 383.0 m Depth: 427 m
Northing: 499 794.2 m Sed Type: Very Poorly Sorted, Medium Silt

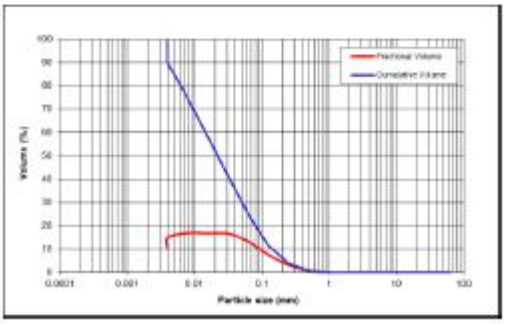
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.00	0.00
2	-1.00	0.00	0.00
1	0.00	0.01	0.01
0.5	1.00	0.70	0.71
0.250	2.00	3.19	3.90
0.125	3.00	7.48	11.38
0.06250	4.00	13.24	24.62
0.03120	5.00	16.62	41.23
0.01560	6.00	16.79	58.03
0.00780	7.00	16.85	74.88
0.00390	8.00	14.91	89.79
0.00390	< 8.00	10.21	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.361	Very Poorly Sorted	
Skewness	0.096	Symmetrical	
Kurtosis	1.174	Leptokurtic	
Mean (µm)	22.184	% Coarse	0.00
Median (µm)	21.763	% Sand	24.62
Mean (phi)	5.494	% Fines	75.38
Median (phi)	5.522		

CHART REPRESENTING LASER DATA



STATION 49



Easting: 563 419.2 m Depth: 219 m
Northing: 504 013.0 m Sed Type: Very Poorly Sorted, Fine Sand



Easting: 563 419.2 m Depth: 219 m
Northing: 504 013.0 m Sed Type: Very Poorly Sorted, Fine Sand



Easting: 563 419.2 m Depth: 219 m
Northing: 504 013.0 m Sed Type: Very Poorly Sorted, Fine Sand

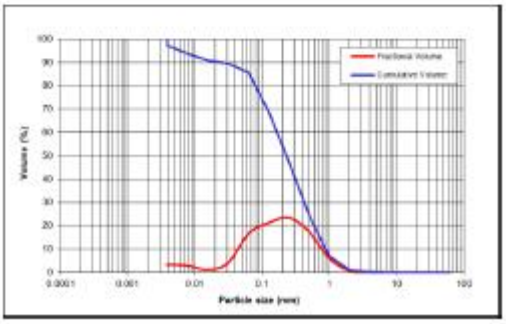
PSD – LASER AND SIEVE DATA

Aperture (mm)	Aperture (phi units)	Percentage	
		Fractional	Cumulative
63	-6.00	0.00	0.00
32	-5.00	0.00	0.00
16	-4.00	0.00	0.00
8	-3.00	0.00	0.00
4	-2.00	0.19	0.19
2	-1.00	0.70	0.89
1	0.00	6.04	6.93
0.5	1.00	17.41	24.34
0.250	2.00	23.44	47.78
0.125	3.00	21.18	68.97
0.06250	4.00	16.60	85.57
0.03120	5.00	4.13	89.70
0.01560	6.00	1.16	90.86
0.00780	7.00	2.90	93.75
0.00390	8.00	3.33	97.09
0.00390	< 8.00	2.91	100.00
Total	Total	100.00	100.00

SEDIMENT CHARACTERISTICS

Sorting	2.012	Very Poorly Sorted	
Skewness	0.217	Fine Skewed	
Kurtosis	1.350	Leptokurtic	
Mean (µm)	221.138	% Coarse	0.89
Median (µm)	232.513	% Sand	84.68
Mean (phi)	2.177	% Fines	14.43
Median (phi)	2.105		

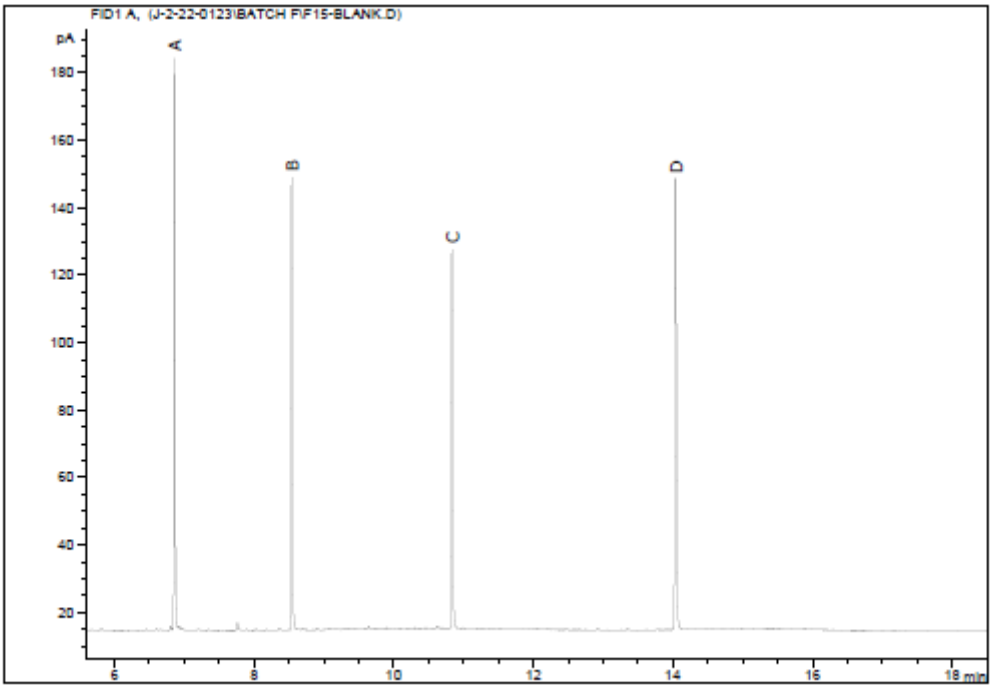
CHART REPRESENTING LASER DATA



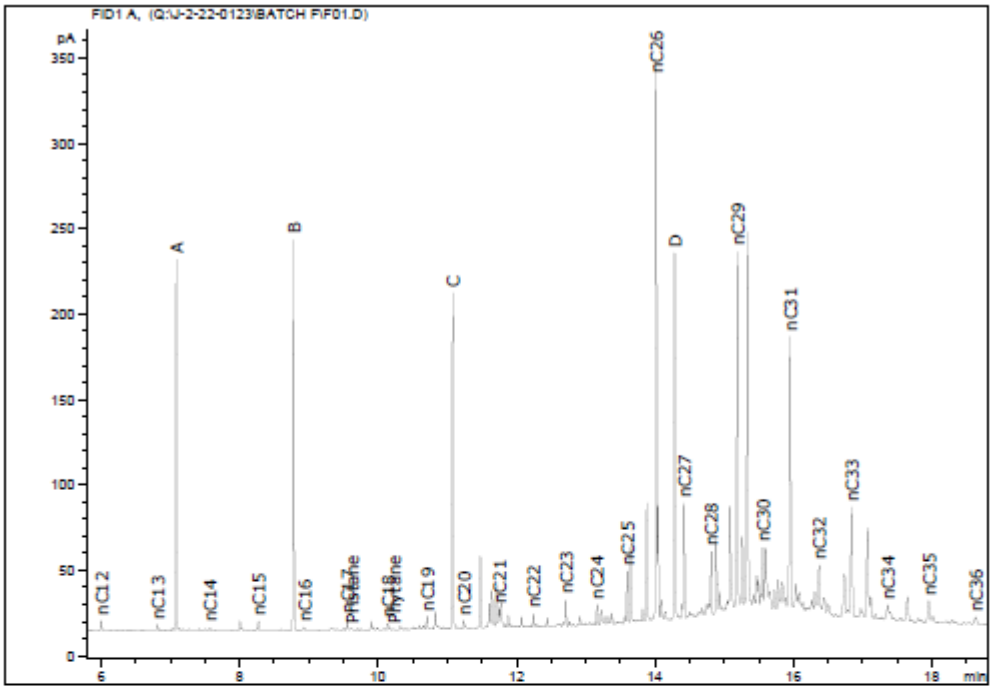
2.2 Sediment-Hydrocarbon Analysis- Gas Chromatography Traces

All Concentrations Expressed as $\mu g g^{-1}$				
Station ID	**Heptamethylnonane (A)**	**D_{34} Hexadecane (B)**	**D_{42} Eicosan (C)**	**Squalane (D)**
ENV 38	0.349	0.350	0.334	0.350
ENV 39	0.286	0.287	0.274	0.287
ENV 40	0.314	0.314	0.300	0.315
ENV 41	50.0	50.1	47.8	50.1
ENV 42	0.365	0.366	0.348	0.366
ENV 43	0.306	0.307	0.293	0.307
ENV 44	0.204	0.204	0.195	0.205
ENV 45	0.276	0.277	0.264	0.277
ENV 46	0.293	0.294	0.280	0.294
ENV 47	0.293	0.294	0.280	0.294
ENV 48	0.199	0.200	0.190	0.200
ENV 49	0.171	0.171	0.163	0.171

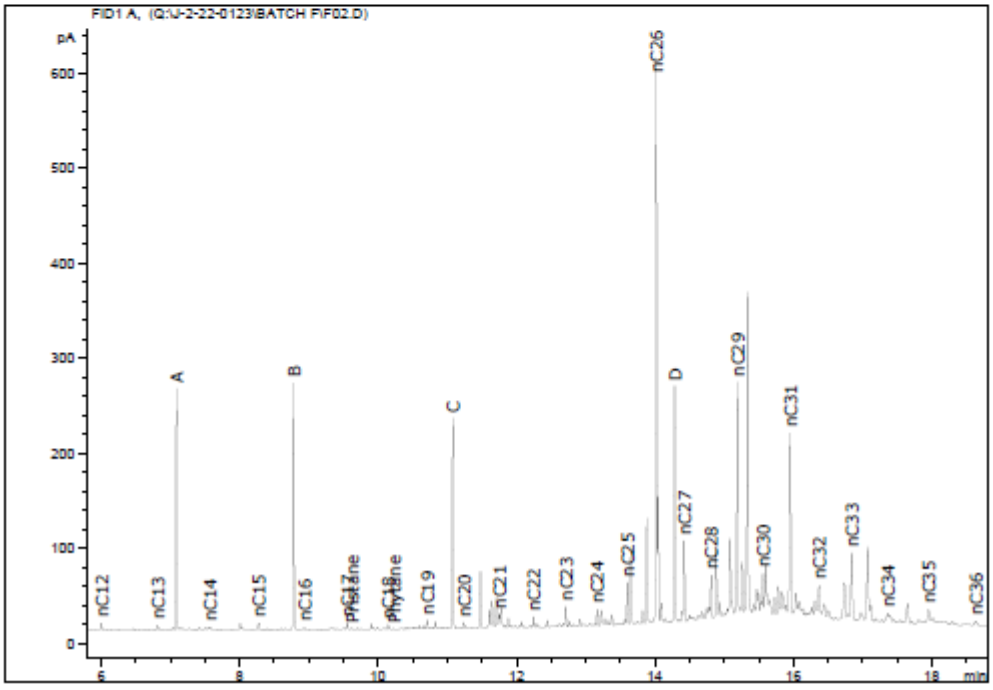
Blank – Sediment GC Trace



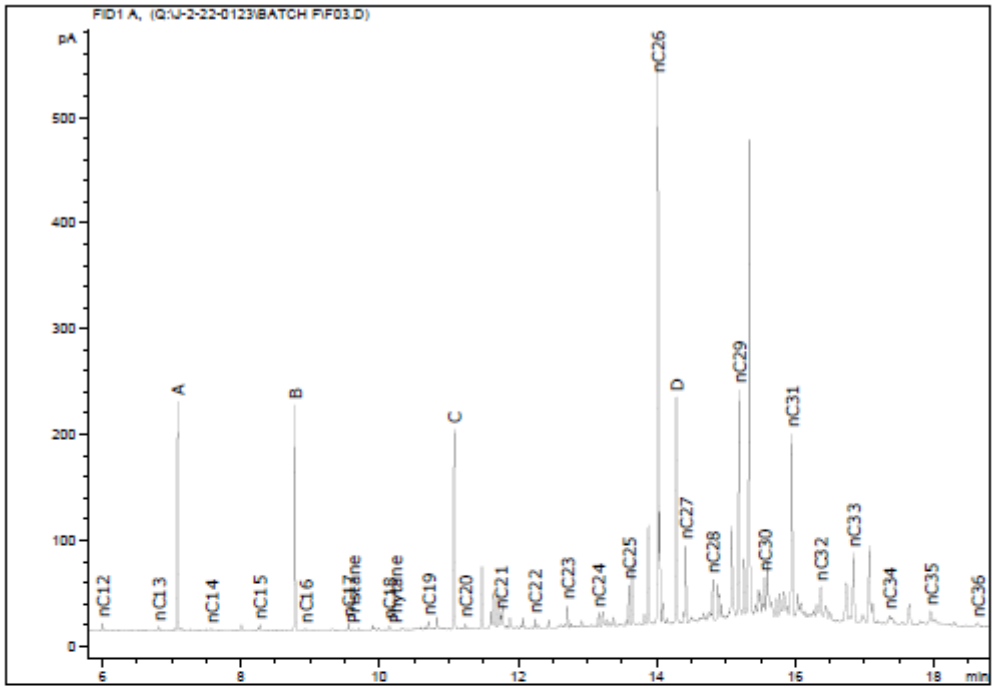
Station 38



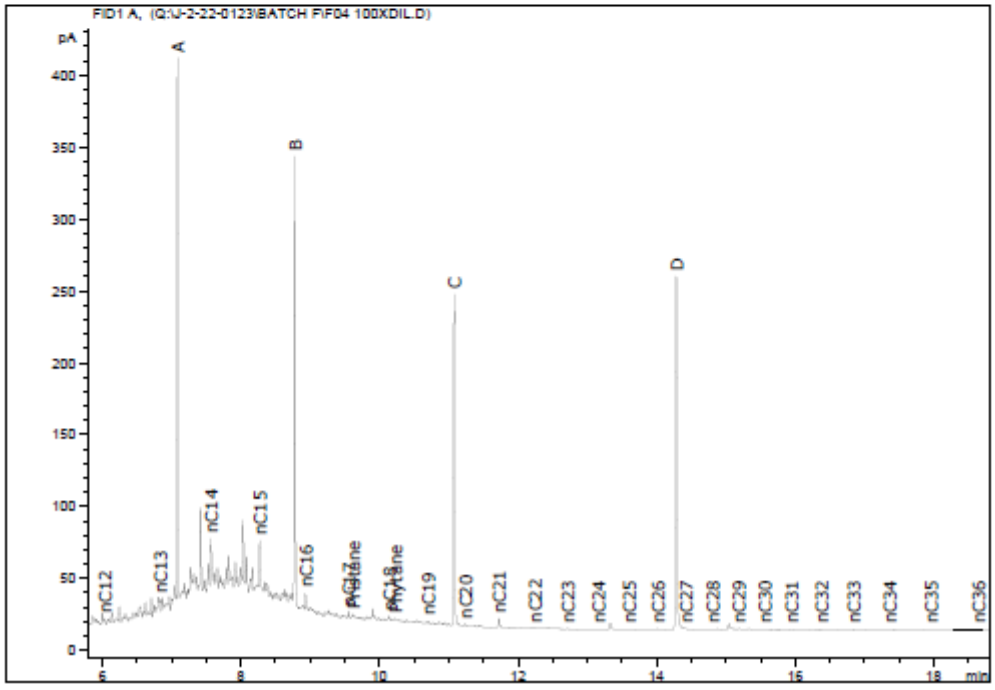
Station 39



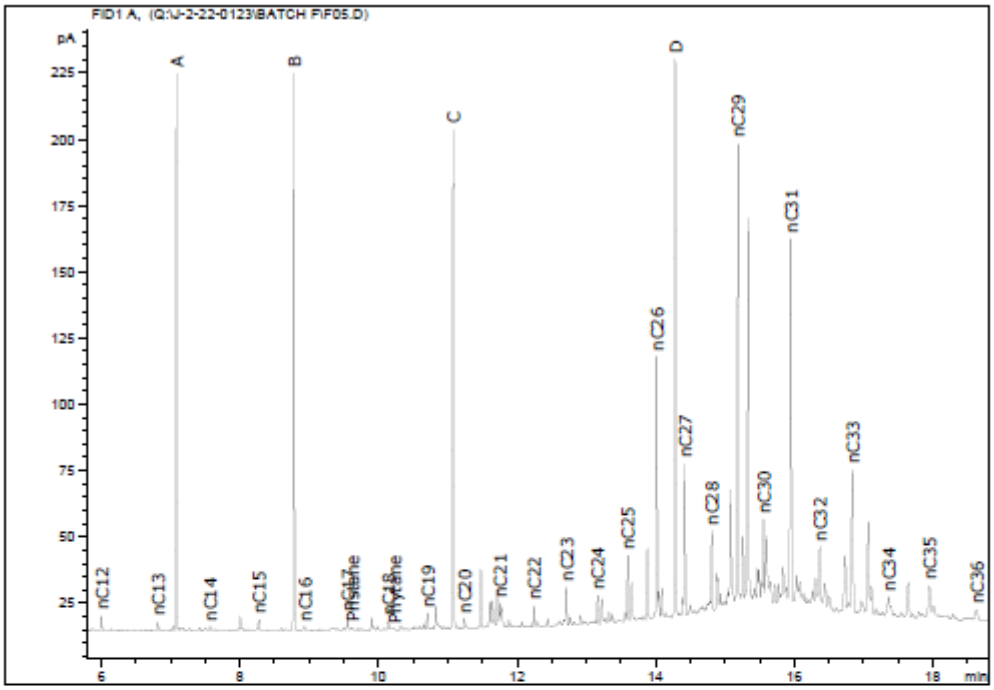
Station 40



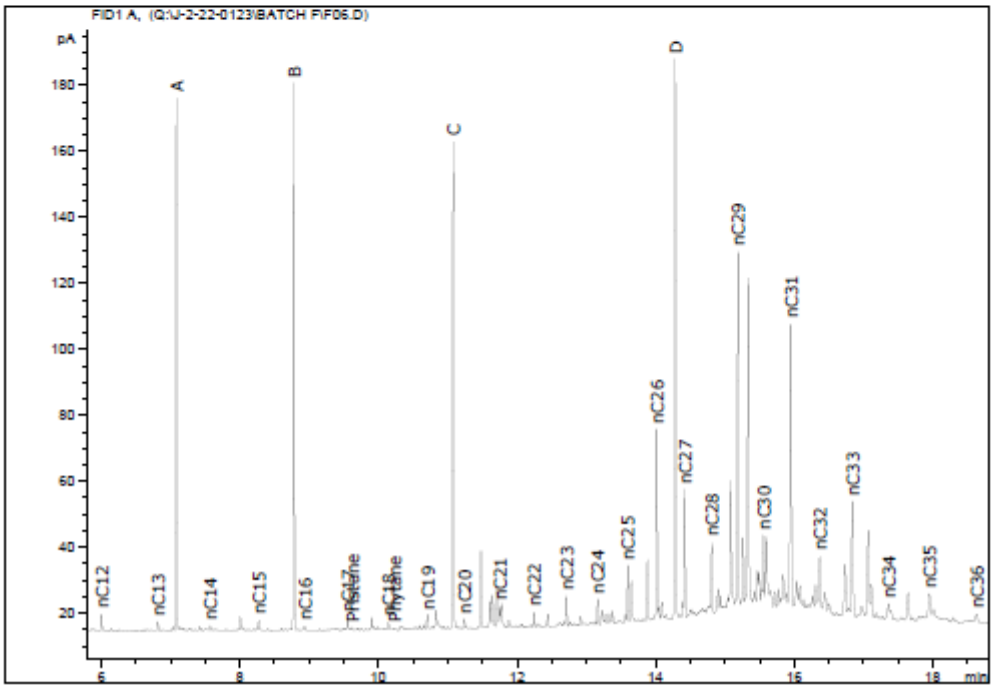
Station 41



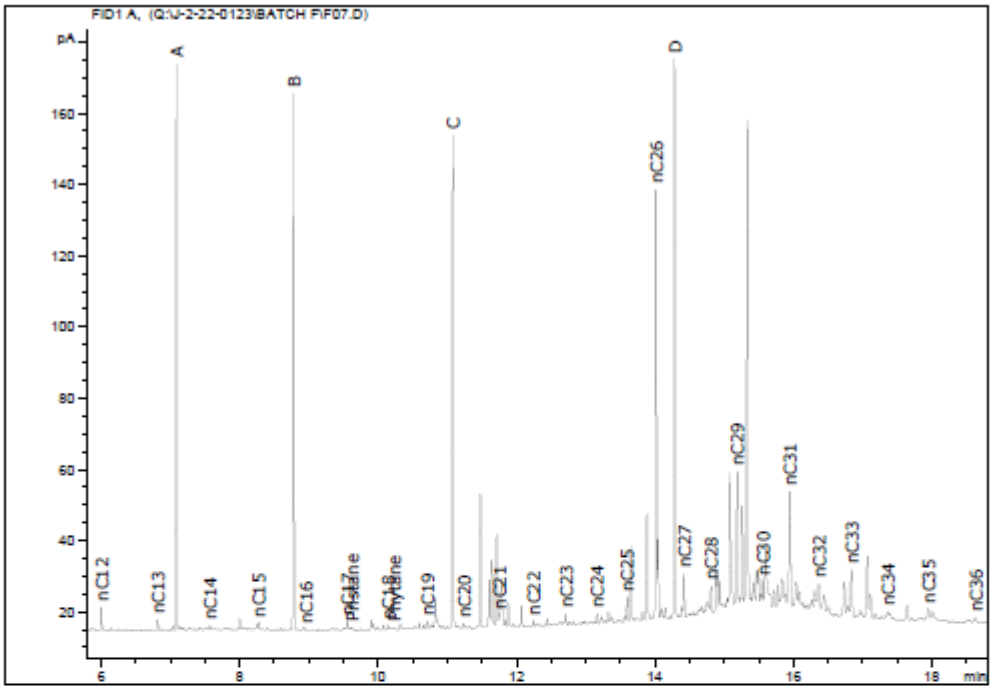
Station 42



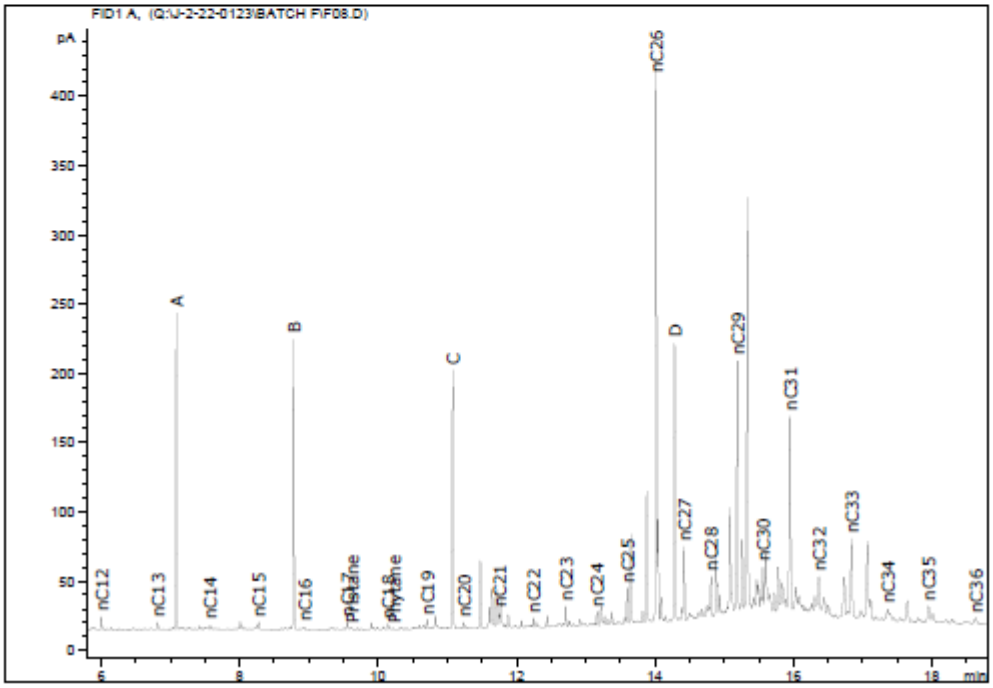
Station 43



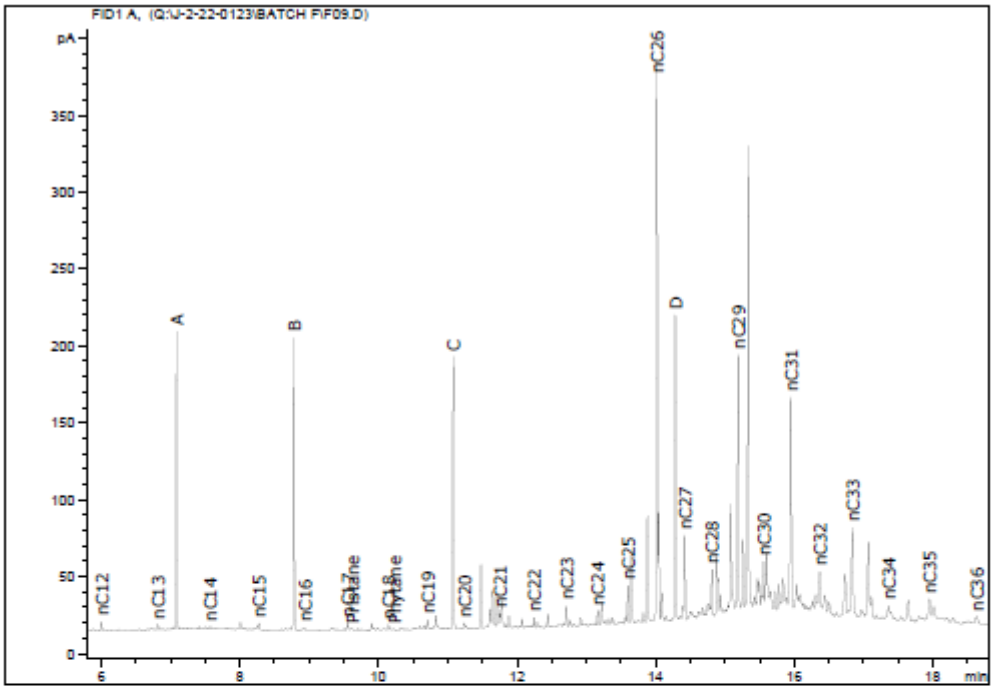
Station 44



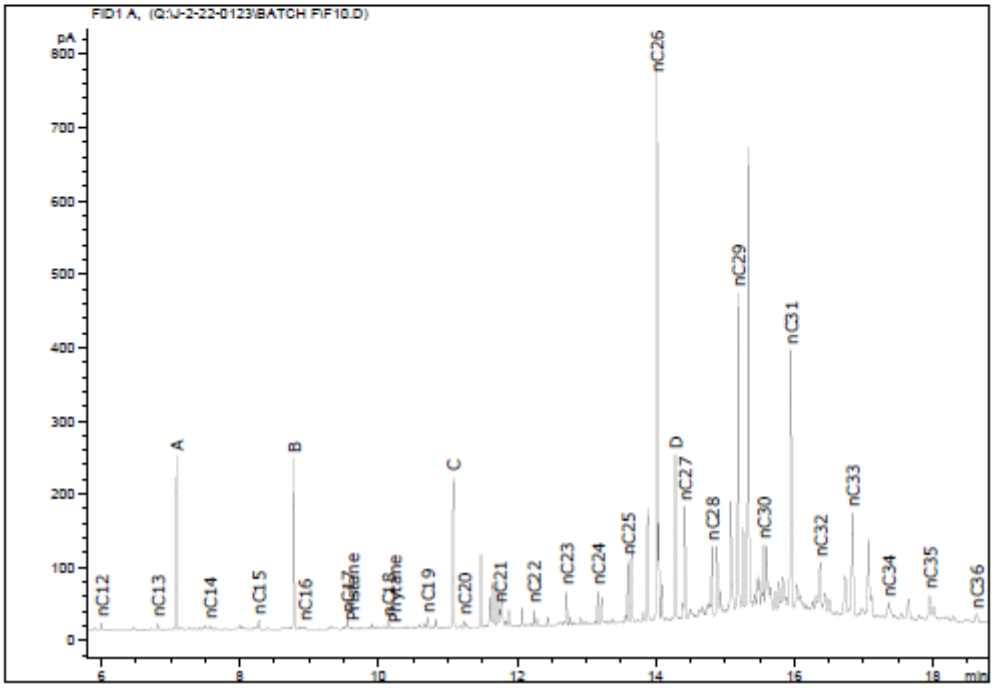
Station 45



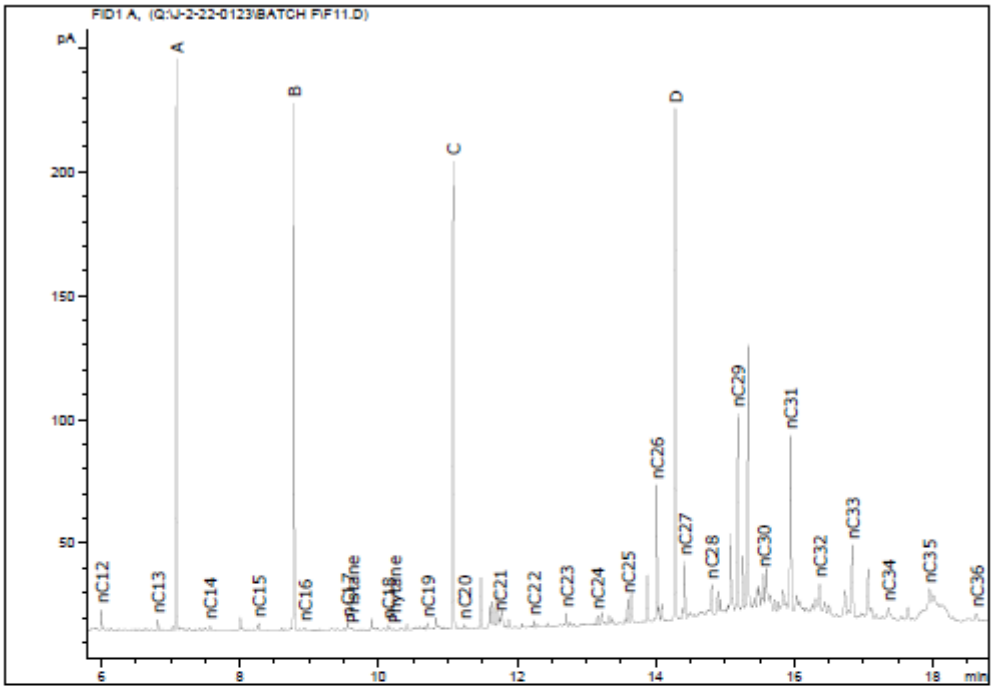
Station 46



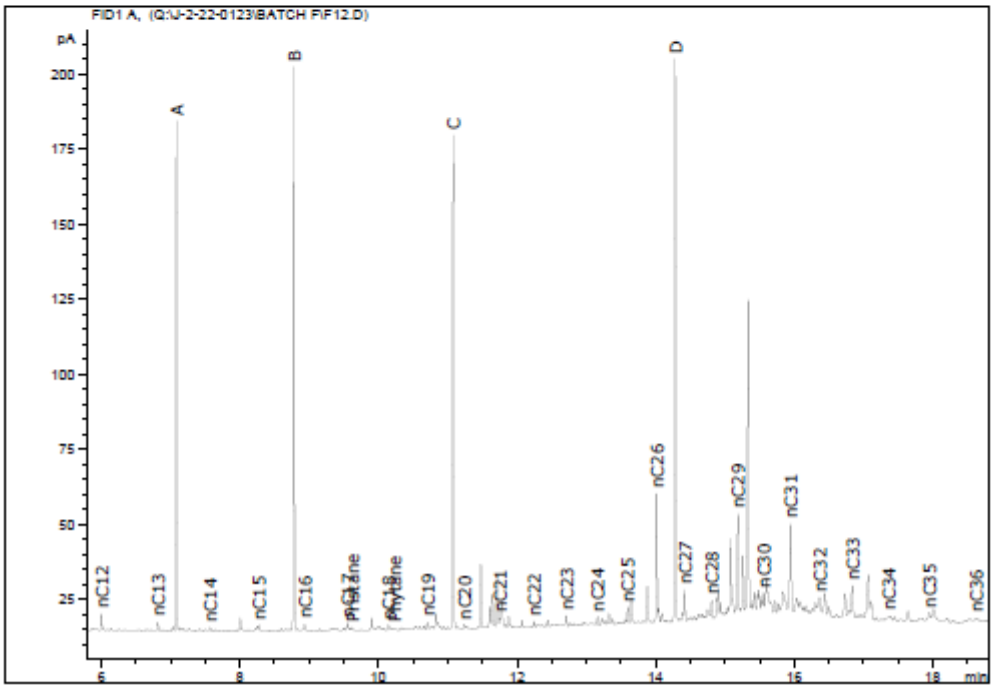
Station 47



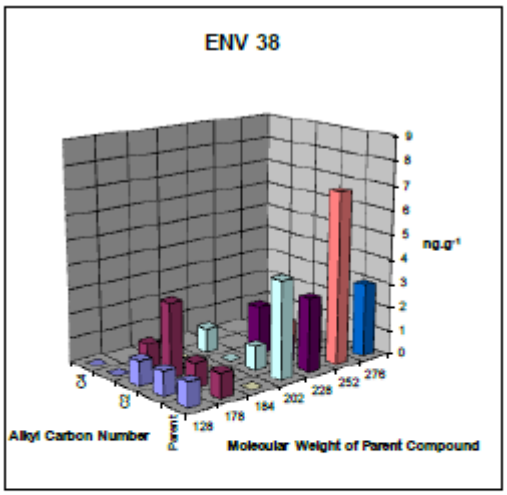
Station 48

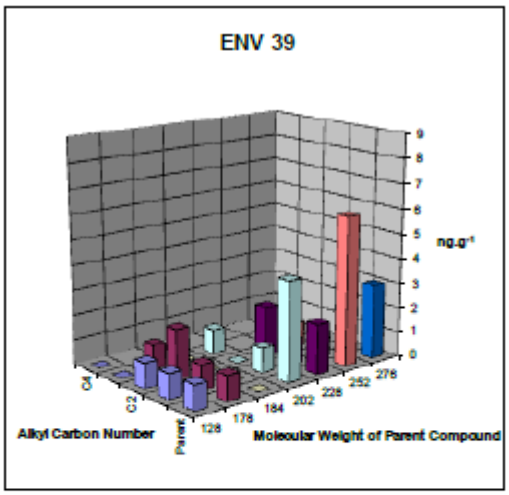


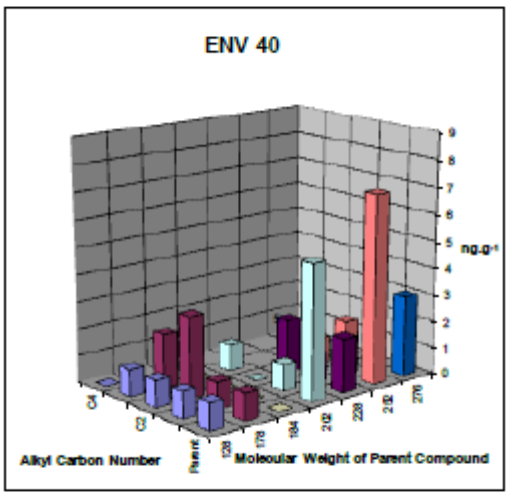
Station 49

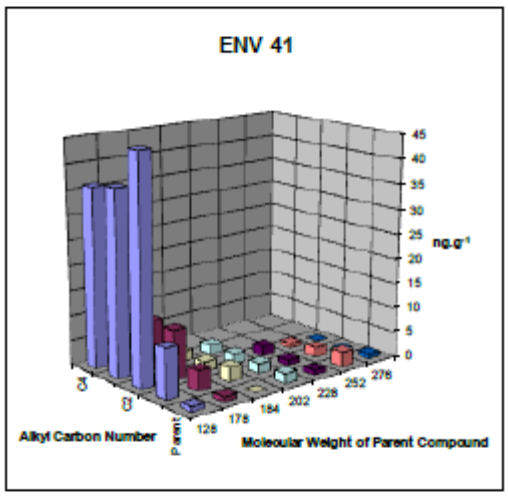


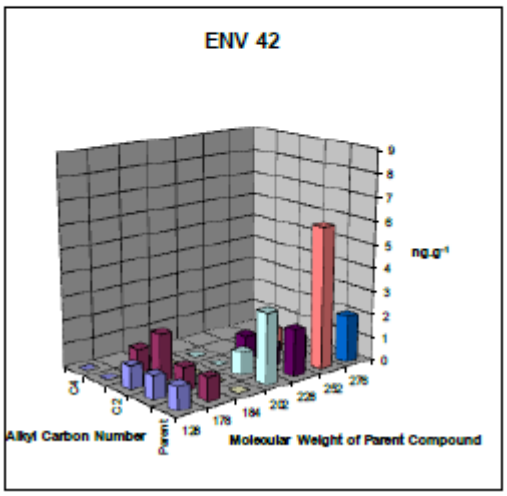
2.3 Sediment-Hydrocarbon Analysis- Parent Alkyl Pah Graphs

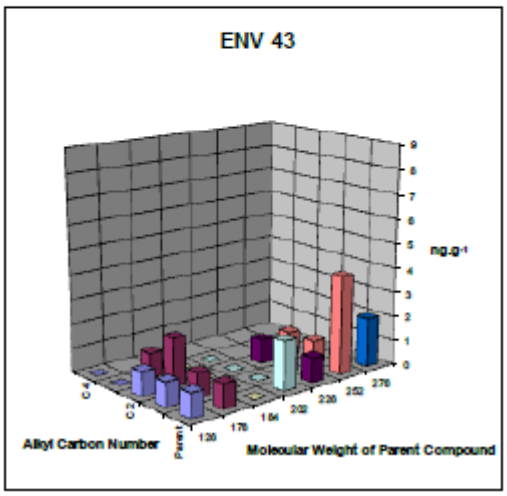


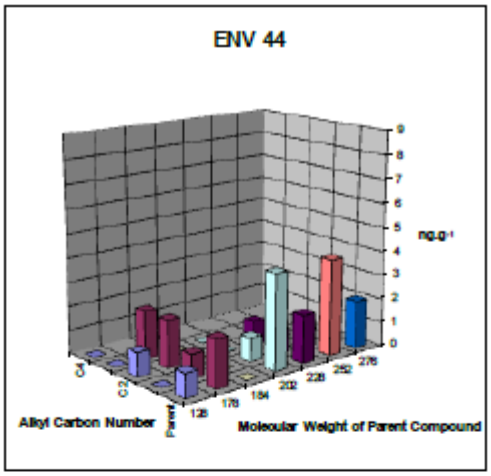


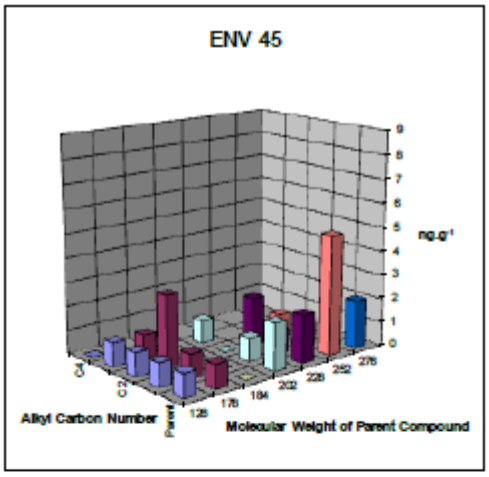


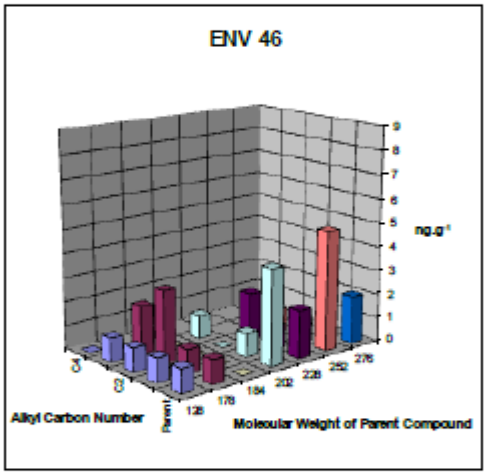


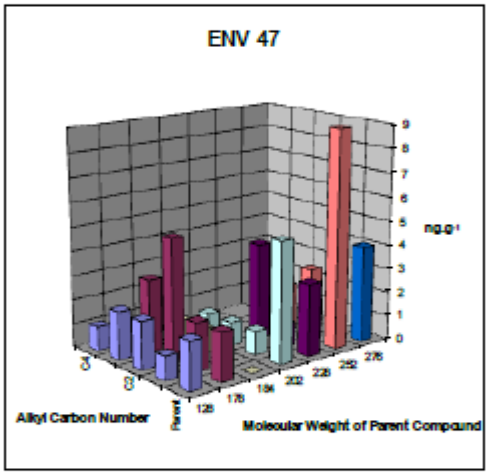


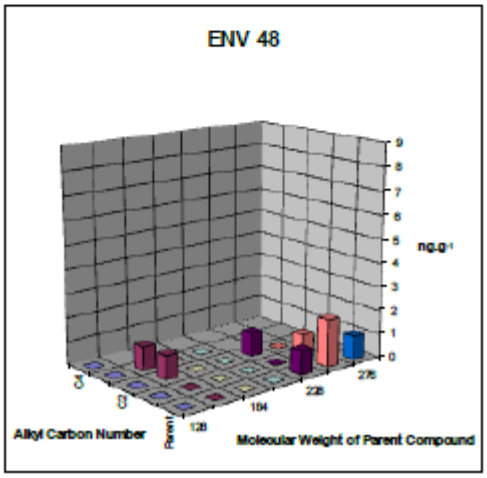


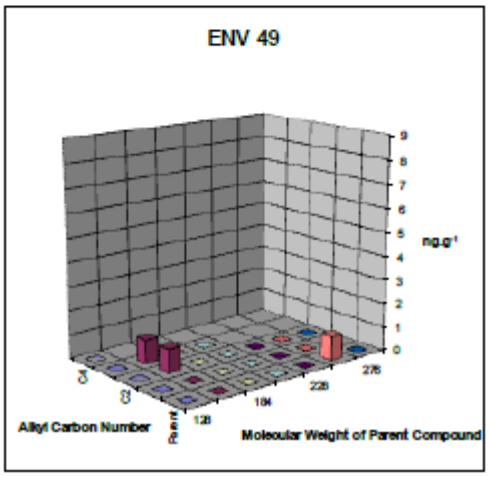

ENV 44
ng.g-1
Alkyl Carbon Number
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound


ENV 45
ng.g-1
Alkyl Carbon Number
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound

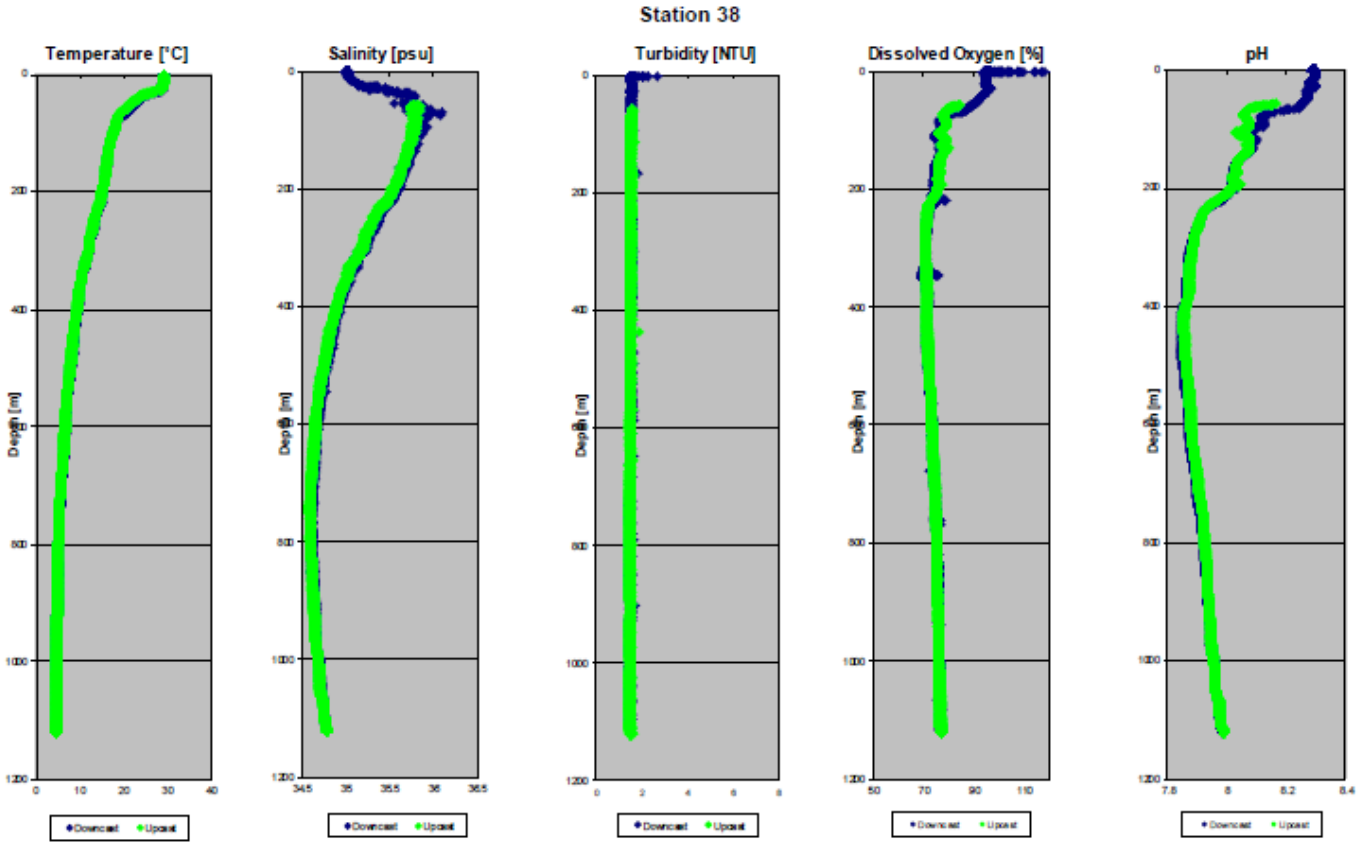

ENV 46
ng.g-1
Alkyl Carbon Number
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound


ENV 47
ng.g-1
Alkyl Carbon Number
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound

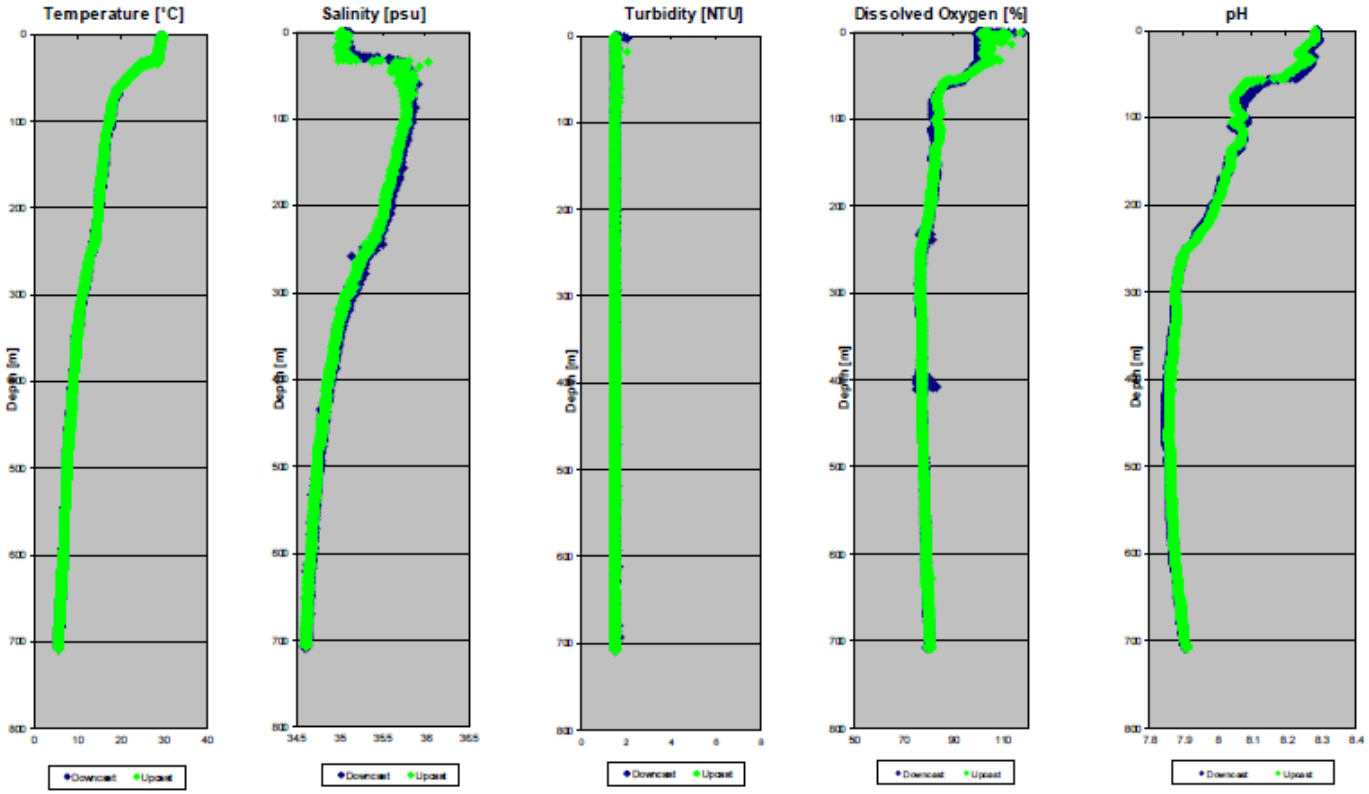

ENV 48
ng.g-1
Alkyl Carbon Number
Parent
128
184
228
276
Molecular Weight of Parent Compound

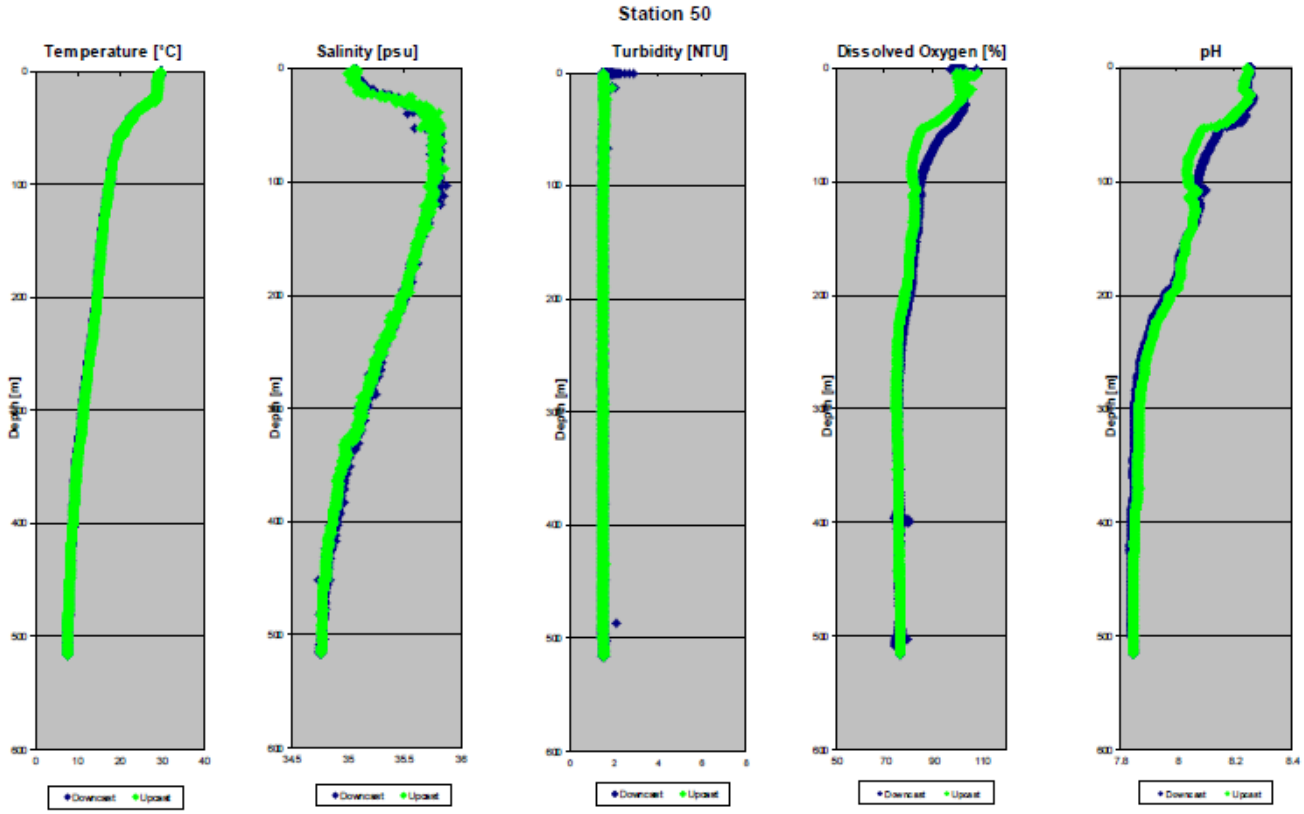

ENV 49
ng.g-1
Alkyl Carbon Number
Parent
128
184
228
276
Molecular Weight of Parent Compound

2.4 Water- Water Profiles



Station 46

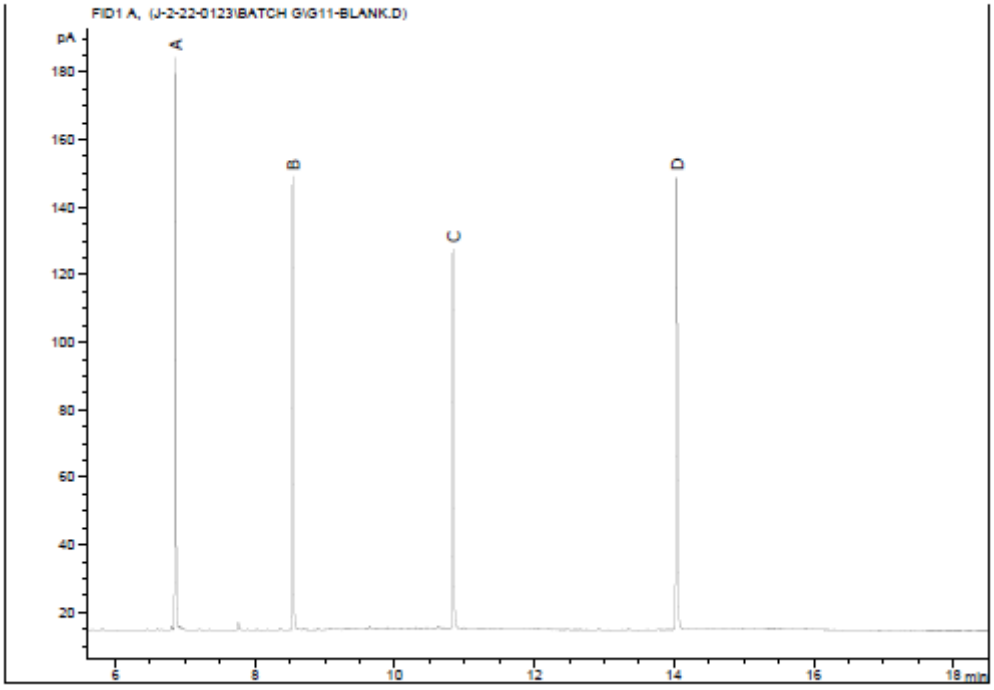

Temperature [°C]
Salinity [psu]
Turbidity [NTU]
Dissolved Oxygen [%]
pH
Depth [m]
Downcast
Upcast


Station 50
Temperature [°C]
Salinity [psu]
Turbidity [NTU]
Dissolved Oxygen [%]
pH
Depth [m]
Downcast
Upcast

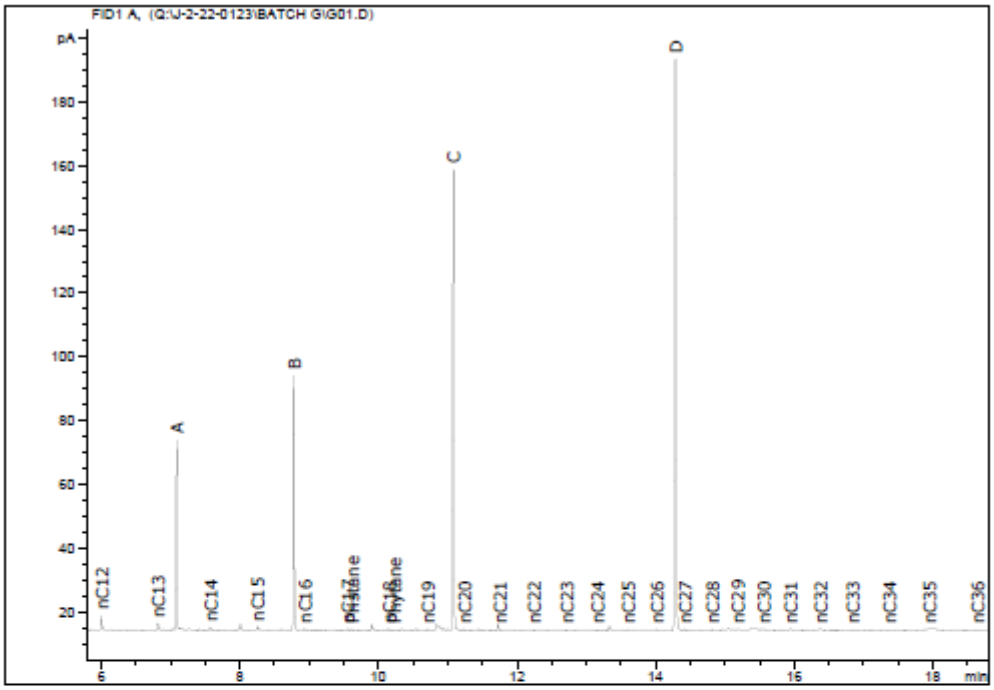
2.5 Water-Gas Chromatography Trace

All Concentrations Expressed as $\mu g g^{-1}$				
Station ID	**Heptamethylnonane (A)**	**D_{34} Hexadecane (B)**	**D_{42} Eicosan (C)**	**Squalane (D)**
STN 38 Surface	5.18	5.19	4.95	5.19
STN 38 100m	4.92	4.94	4.70	4.94
STN 38 200m	5.03	5.05	4.81	5.05
STN 46 Surface	5.06	5.07	4.83	5.07
STN 46 100m	5.25	5.27	5.02	5.27
STN 46 200m	5.31	5.32	5.07	5.32
STN 50 Top	4.94	4.95	4.72	4.95
STN 50 100m	4.92	4.93	4.70	4.93
STN 50 200m	5.11	5.12	4.88	5.12

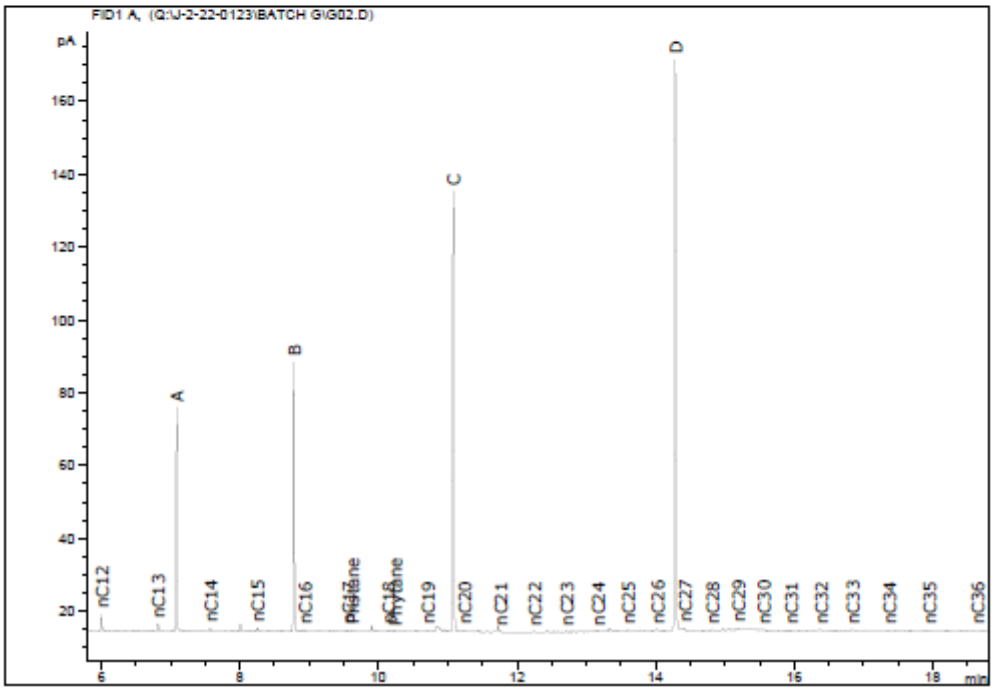
Blank – Water GC Trace



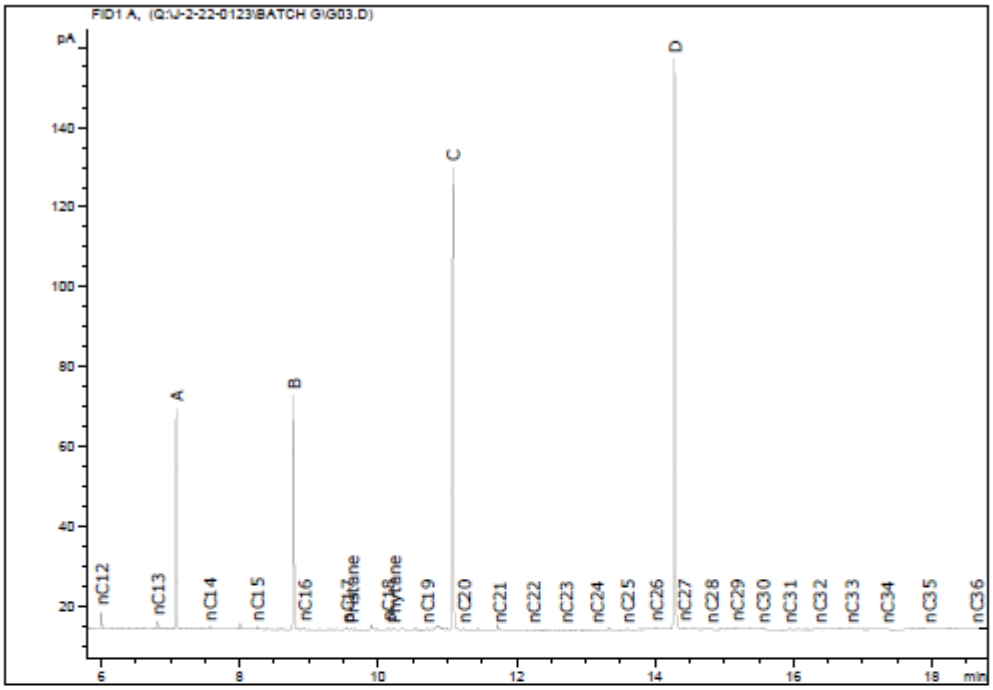
Station 38 Surface 1 m



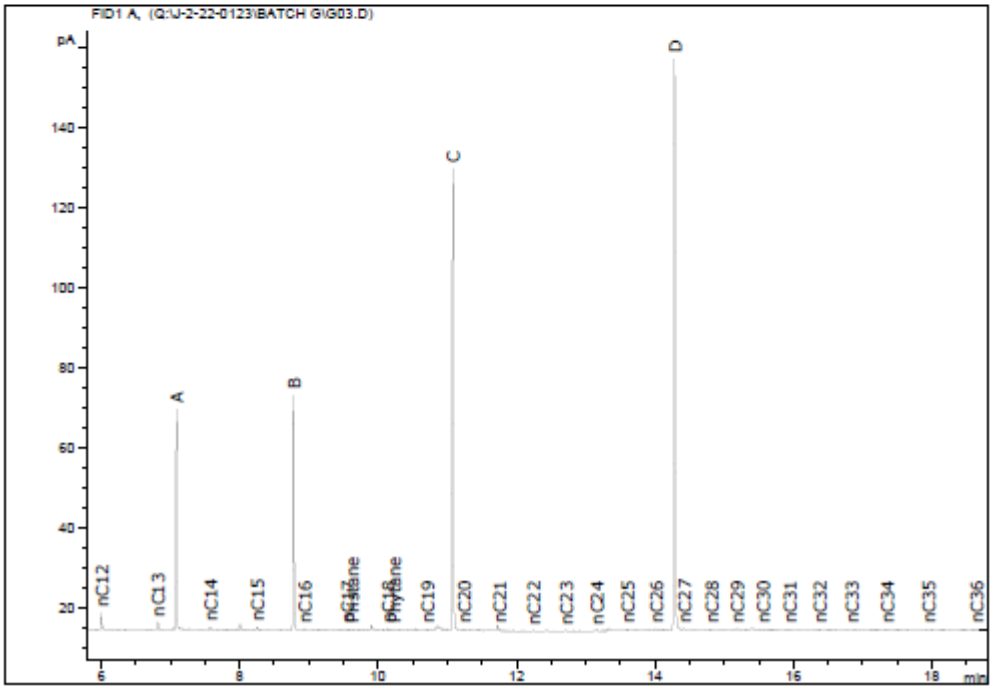
Station 38 100 m



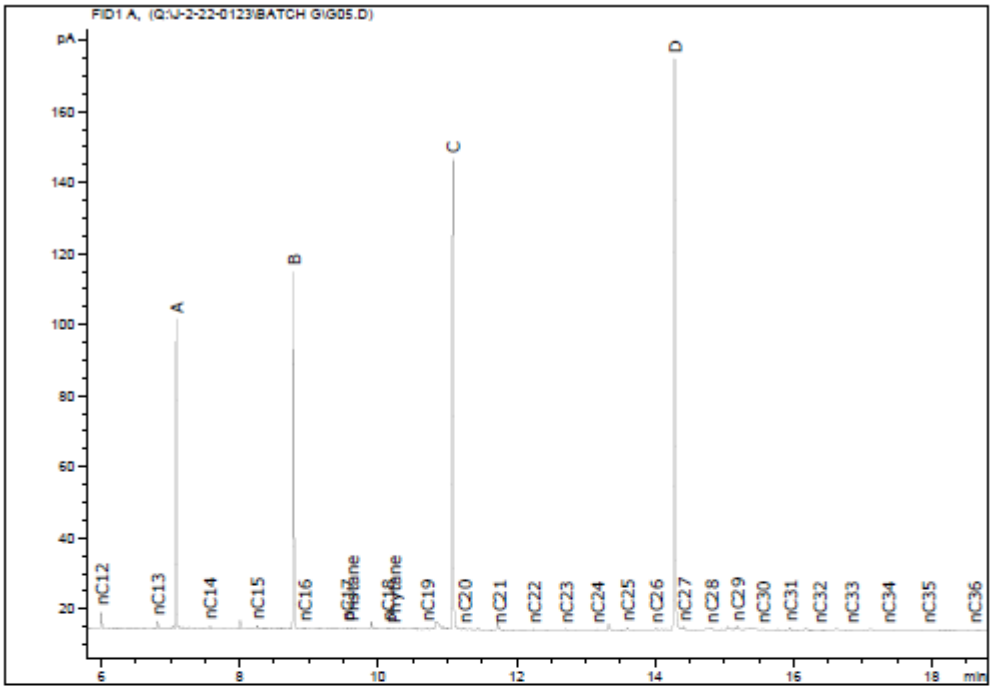
Station 38 200 m



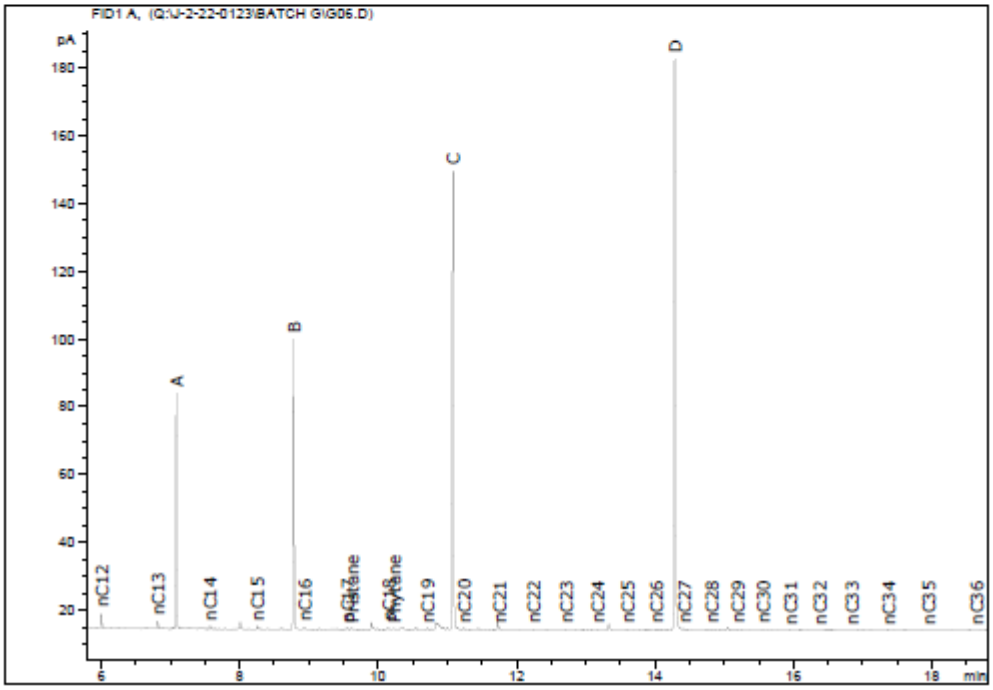
Station 46 Surface 1 m



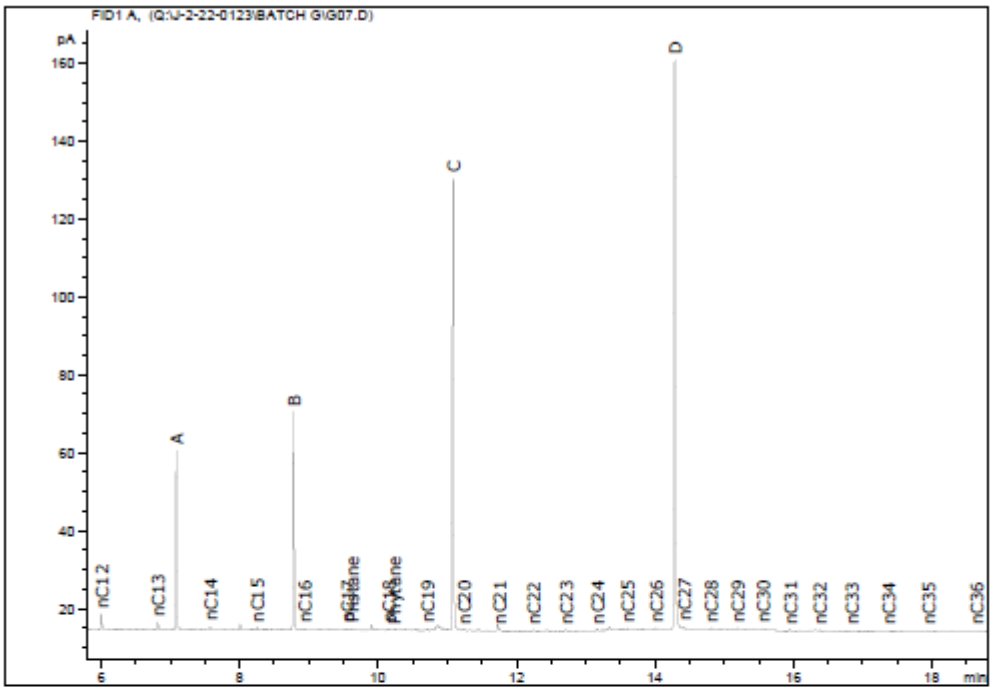
Station 46 100 m



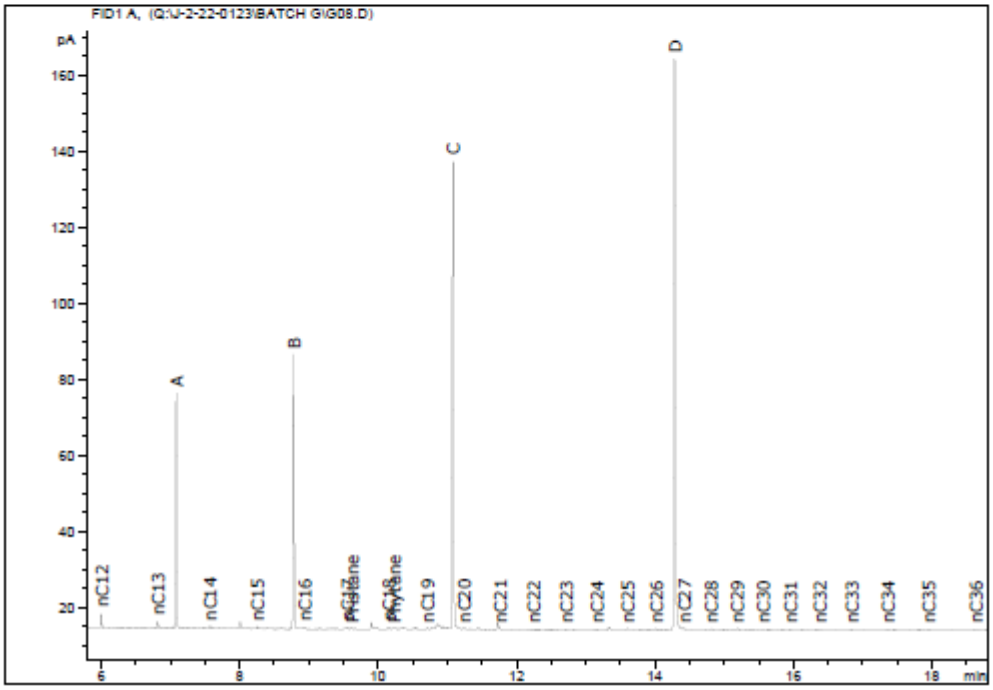
Station 46 200 m



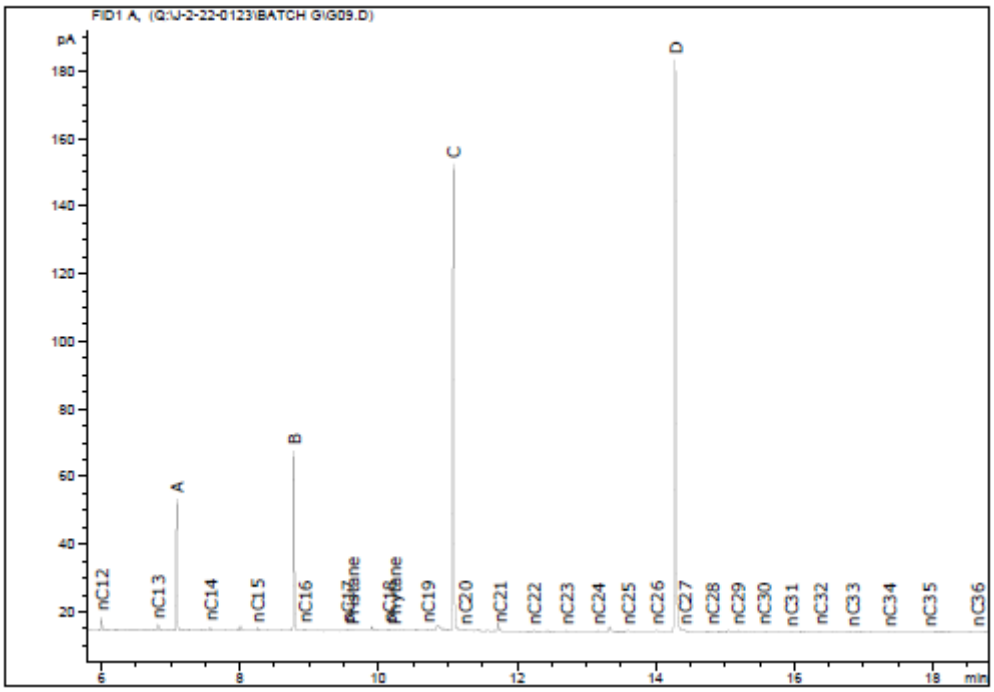
Station 50 Surface 1 m



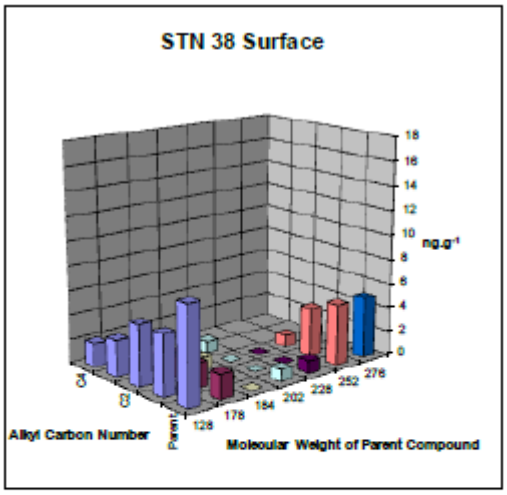
Station 50 100 m

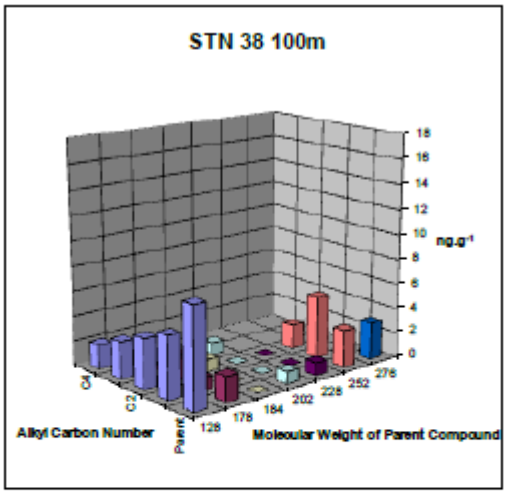


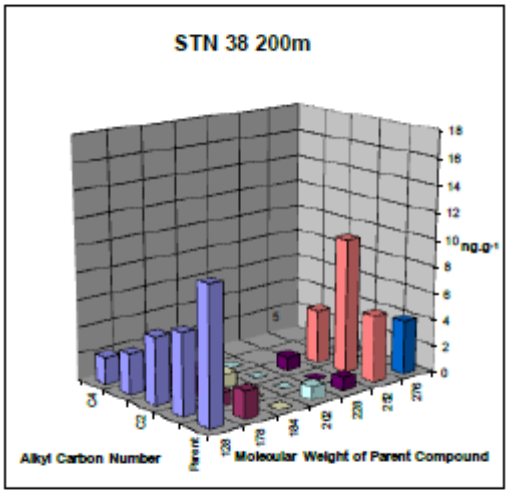
Station 50 200 m

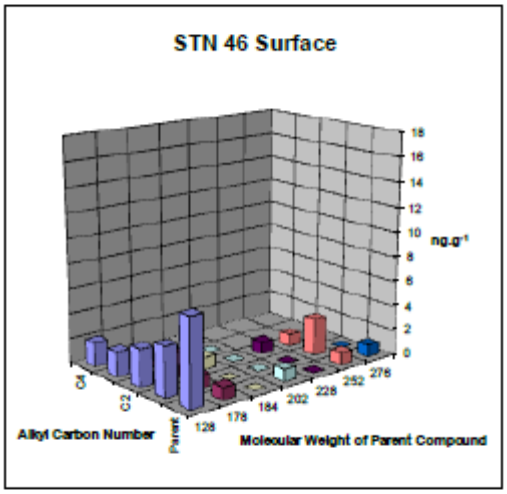


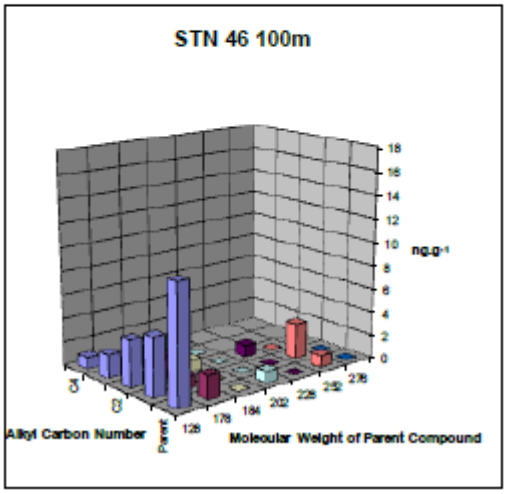
2.6 Water- Parent Alkyl PAH Graphs

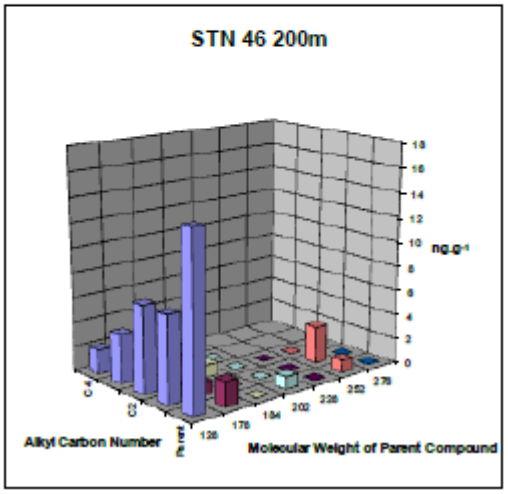


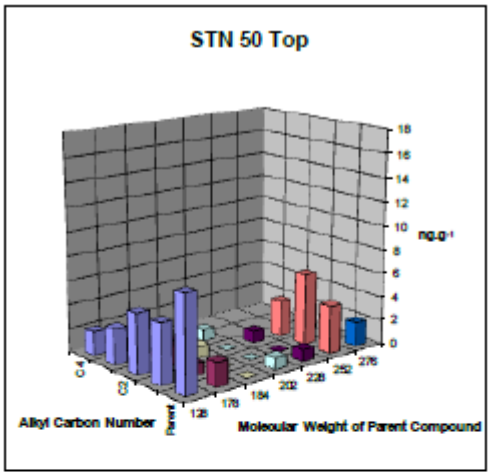


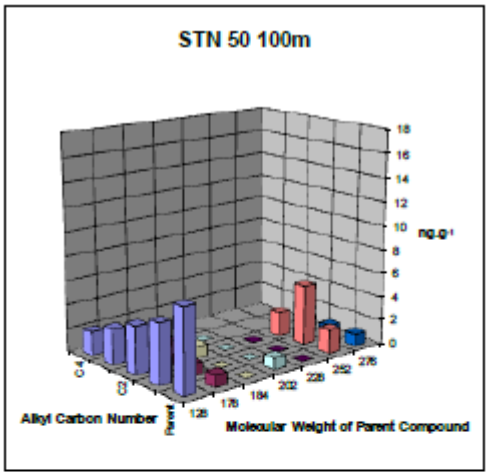


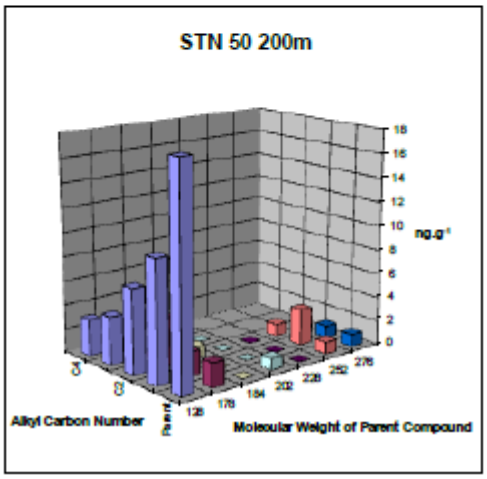







STN 50 Top
ng.g-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


STN 50 100m
ng.g-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


STN 50 200m
ng.g-1
Alkyl Carbon Number
Molecular Weight of Parent Compound

2.7 Plankton-Phytoplankton Analysis

The following list of taxa excludes those that were merged for statistical analysis or excluded from it

Taxon	Unit	Site 38 1 m	Site 38 100 m	Site 38 200 m	Site 46 1 m	Site 46 100 m	Site 46 200 m	Site 50 1 m	Site 50 100 m	Site 50 200 m
Nitzschia sp.	Cells/l	0	0	0	0	40	0	0	0	0
Nitzschia longissima	Cells/l	0	80	0	0	0	0	0	0	0
Diploneis sp.	Cells/l	0	0	0	0	10	0	0	0	0
Pseudo-nitzscia pungens	Cells/l	0	0	0	110	0	0	0	0	0
Rhizosolenia imbricata	Cells/l	0	10	0	0	0	0	0	0	0
Hemiaulus hauckii	Cells/l	10	0	0	0	0	0	0	0	0
Proboscia sp.	Cells/l	0	0	0	10	0	0	0	0	0
Raphiated Pennate Diatom	Cells/l	0	280	0	90	0	0	0	40	10
Pseudo-nitzschia sp. <5µm	Cells/l	0	0	0	0	30	0	0	0	0
Eucampia zodiacus	Cells/l	0	0	0	70	0	0	0	0	0
Proboscia alata	Cells/l	0	0	0	10	0	0	0	0	0
Pseudosolenia calcar-avis	Cells/l	0	0	0	30	0	0	70	0	0
CENTRIC DIATOM	Cells/l	0	780	0	1470	40	0	30	0	0
Eucampia groenlandica	Cells/l	0	0	0	0	0	0	60	0	0
Cyanophyceae	Cells/l	0	0	0	110	0	0	0	0	0
Gymnodinium sp.	Cells/l	0	0	0	50	10	0	0	0	0
Heterocapsa sp.	Cells/l	0	0	0	0	0	0	20	0	0
Protoperidinium steinii	Cells/l	0	0	0	0	0	0	10	0	0
Scrippsiella sp.	Cells/l	0	0	0	80	0	0	0	0	0
Gyrodinium sp.	Cells/l	0	30	0	30	0	0	0	0	0
Oxytoxum	Cells/l	0	0	0	50	10	0	10	0	0
Dinophyceae 20-50um_armoured	Cells/l	0	20	0	0	0	0	0	0	0
Dinophyceae 20-50um_naked	Cells/l	0	20	0	0	0	0	20	0	0
Podolampas palmipes	Cells/l	0	0	0	0	10	0	0	0	0
Ceratium horridum	Cells/l	10	0	0	0	0	0	0	0	0
Microflagellates	Cells/l	0	1499	0	1499	2249	0	0	7496	0
Dictyocha fibula	Cells/l	0	0	0	0	0	0	0	10	0

The following taxa were merged for analysis

Taxon	Unit	Site 38 1 m	Site 38 100 m	Site 38 200 m	Site 46 1 m	Site 46 100 m	Site 46 200 m	Site 50 1 m	Site 50 100 m	Site 50 200 m
Raphiated Pennate Diatom <20µm	Cells/l	0	100	0	50	0	0	0	40	10
Raphiated Pennate Diatom 20-	Cells/l	0	180	0	40	0	0	0	0	0
CENTRIC DIATOM <20um	Cells/l	0	730	0	1410	0	0	30	0	0
CENTRIC DIATOM >50um	Cells/l	0	0	0	10	0	0	0	0	0
CENTRIC DIATOM 20-50um	Cells/l	0	50	0	50	40	0	0	0	0

2.8 Plankton- Zooplankton Analysis

The following list of taxa excludes those that were merged for statistical analysis or excluded from it

Taxon	Qualifier	Station 38	Station 46	Station 50
Ceratium		0	1	0
FORAMINIFERA		10	601	50
Globigerina		0	416	50
ACANTHARIA		10	19	0
ANIMALIA	?	0	0	50
ANIMALIA	Eggs	0	600	Frag
CTENOPHORA		0	1	0
CNIDARIA		0	Frag	Frag
Actiniaria	Juvenile	0	0	51
Siphonophorae	Larvae	3	Frag	50
Diphyidae		43	13	176
Abylopsis		0	5	6
Abyla Sp	?	0	12	0
Abylidae		0	10	6
Sphaeronectes		0	200	1251
Sarsia	?	1	602	1
Boungainvillia	?	0	200	0
Liriope tetraphylla		0	6	0
SCYPHOZOA		0	0	1
Thamnostoma	?	2	801	0
Mitrocomidae	?	0	1	0
Cunina octonaria	?	0	Frag	0
Cunina	?	2	0	0
Tetracanna	?	0	200	0
Octocanna	?	1	0	0
Aequoreidae		1	0	0
Aglantha	?	1	0	0
Cytaeis		8	0	0
Eucheilota	?	0	0	1
Ransonia krampi		0	0	1
Campanulariidae		0	0	3
NEMERTEA		0	200	Frag
POLYCHAETA		10	Frag	Frag
POLYCHAETA	Type A	0	400	0
Tomopteris		1	0	101
Phyllodocidae	Larvae / Juvenile	0	4	13
Alciopidae		1	1005	451
Pelagobia		0	200	2
Travisiopsis		1	3	102
Lopadorhynchus		0	600	3
Maupasia		0	400	0
Amphinomidae	Larvae	0	0	450
Typhloscolex		0	0	1250
Sagitella		0	0	450
Spionidae	Larvae / Juvenile	0	19	2
TEREBELLIDA	Larvae	0	200	150
CRUSTACEA	Naupilus / Juvenile	0	56	115
Evadne		0	601	201
Conchoecia	Type A	0	606	653
Conchoecia	Type B	426	200	0
PODOCOPIDA		0	203	0
MYODOCOPIDA		1	0	0
CALANOIDA		0	21600	0
Euchaeta		0	1100	170
Calanidae		6520	1200	41610
Undinula vulgaris		0	2700	60
Eucalanidae		880	6000	660
Temoridae		0	0	210
Acartidae	?	0	200	0
Oithona		80	5800	3970
Sapphirinidae		800	900	0
Sapphirina	?	3	200	450
Corycaeidae		6930	15000	1880
HARPACTICOIDA		1250	5000	6650
Lubbockia		0	13100	7960
CYCLOPOIDA		0	1600	0
SESSILIA	Nauplius	0	201	0
STOMATOPODA	Juvenile	0	1	0
Longithorax		0	1	0

Taxon	Qualifier	Station 38	Station 46	Station 50
Hyperiidea	?	0	3	0
Hyperiidae		20	2	0
Hyperietta		2	1802	550
Phronima sp.		0	3	0
Phronima curvipes		0	0	1
Phronimopsis spinifera		1	1	0
Phrosina semilunata		1	0	0
Paratyphis		0	602	100
Parascelus		6	0	0
Platyscelus		0	0	51
Streetsia porcella	?	0	2	0
Themistella		0	3	0
Lycaeidae	?	1	0	0
Eusiridae		0	1	0
Cryptoniscidae		0	2	0
Euphausiidae	Zoea / Larvae / Juvenile	0	30	33
Euphausia		2	4	1
Euphausia sibogae		1	2	1
Thysanoessa	?	0	1	1
Thysanoessa cf. longicaudata		1	0	0
Thysanopoda		3	0	0
DECAPODA	Zoea Type E	0	1	0
Penaeoidea	Zoea	0	0	0
Lucifer faxoni		0	403	0
Lucifer typus		1	4	0
Gennadas	?, Zoea	2	0	0
Sergestes *s.l.*		1	1	0
Sergestidae	Protozoea	0	1806	11
Sergestidae	Acanthosoma	1	201	0
Acanthephyra	?, Zoea	1	0	0
BRACHYURA	Megalopa Type C	0	1	0
Atelecyclidae	Megalopa	0	1	0
Palinuridae	Phyllosoma	0	1	0
Gastropoda	Juvenile	0	0	400
Atlanta		0	200	100
Limacina		0	1000	0
Heliconoides inflatus		5	200	50
Diacavolinia		0	1	1
Creseis virgula		1	1	0
Clio pyramidata		4	200	450
Notobranchea		0	1	0
Litiopidae	?, Juvenile	2	10	1
Diacria quadridentata		0	3	0
BIVALVIA		0	0	0
CEPHALOPODA	Larvae	1	0	0
PHORONIS	Larvae	0	1207	450
PRIAPULIDA	?, Larvae	0	1	0
Flaccisagitta enflata		60	443	73
Ferosagitta		50	26	1026
Serratosagitta		41	18	163
Pterosagitta draco		4	11	13
SIPUNCULA	?	0	0	400
OPHIUROIDEA	Ophiopluteus	0	21	20
ECHINOIDA	Larvae / juv	0	0	0
Doliolum		22	1	28
Doliolum	?, Type b	2	4	0
Doliolum	?, Type c	3	1	2
Thalia		1	1	1
Oikopleura		202	3247	788
ACTINOPTERYGII	Eggs	4	204	0
CLUPEIFORMES	Larvae	2	0	1
SCORPENIFORMES	Larvae	1	401	0
Scorpaenidae	Juvenile	2	0	0

The following taxa were merged for analysis

Taxon	Qualifier	Station 38	Station 46	Station 50
Phyllodocidae	Larvae	10	Frag	0
Phyllodocidae	Juvenile	0	200	600
Spionidae	Larvae	8	0	1
Spionidae	Juvenile	0	1003	101
CRUSTACEA	Nauplius	2	2401	5308
CRUSTACEA	Larvae	0	600	0
Euphausiidae	Zoea	0	201	1050
Euphausiidae	Larvae	10	1406	458
Euphausiidae	Juvenile	3	0	2
ECHINOIDA	Larvae	1	0	0
ECHINOIDA	Juvenile	0	0	0

2.9 Benthic Organisms- Macrofauna Analysis

The following list of taxa excludes those that were merged for statistical analysis or excluded from it (Part 1)

MCS code	Taxon	Sample										
		38 FA	38 FB	39 FA	39 FB	41 FA	42 FA	42 FB	43 FA	43 FB	44 FA	44 FB
D759	Edwardsiidae											
G1	NEMERTEA		1								1	
M7	Siboglinidae					1						
N27	Thysanocardia										1	1
N37	Onchnesoma steenstrupii											
	Apionsoma					1					2	1
N46	Aspidosiphon							1				
O1	ECHIURA sp. A											
P116	Eteone sp. B											
	Glycera cf. nicobarica										1	
P267	Glycinde											
P269	Goniada											
P338	Ancistrosyllis cf. groenlandica								1	1		
	Sigambra sp. A									1	2	
P458	**Nereididae**			1							1	
P518	Paramphinome jeffreysii				1							
P538	Aponuphis sp. A										8	4
P548	Paradiopatra					1						
P560	Eunice vittata										1	
P572	Lumbrineris sp. C										1	
	Abyssoninoe											
	Augenaria											1
	Lumbrinerides											
P591	Drilonereis cf. filum				1							
P666	Phylo sp. A								1			
P671	Scoloplos sp. B ?											
P675	**Aricidea**				1			1	1	2	1	1
P690	Cirrophorus branchiatus								1			
P692	Levinsenia										1	
	Malacoceros cf. indicus											
	Paraprionospio dam.											
P763	Prionospio dam.				1					1		
P793	**Spiophanes**							1				
P803	**Magelona**											
P818	Spiochaetopterus											
P843	Monticellina					1			1	1	2	2

MCS code	Taxon	Sample										
		38 FA	38 FB	39 FA	39 FB	41 FA	42 FA	42 FB	43 FA	43 FB	44 FA	44 FB
P845	Tharyx									3		
P895	Fauveliopsis										1	
P903	Capitellidae sp. F											
P903	Capitellidae sp. G											
P903	Capitellidae sp. H											1
	Neomediomastus											
	Paraleiocapitella											
P920	Notomastus			1							2	
P938	Maldanidae sp. A										2	
P938	Maldanidae sp. B											1
P948	Maldane										2	
P960	Euclymene sp. C ?											
P960	Euclymene sp. D											
P993	Opheliidae dam.			1								
P1021	Asclerocheilus								1			
P1091	Galathowenia										1	
P1094	Myriochele											
P1118	Ampharetidae sp. E											1
P1120	Melinna											
P1147	Anobothrus gracilis											
	Pterolysippe bipennata											
P1167	Sosane sulcata										1	
P1174	Terebellides											
P1216	Pista											1
P1264	Chone/Dialychone/Paradialychone											
R17	Scalpellidae			1								
S253	**Harpinia**						1					
S422	**Ampeliscidae**											
	Quantanthura			1	1							
S807	Leptanthura			2								
	Haliophasma sp. C							1				
S1099	TANAIDACEA sp. A											
S1151	Typhlotanais											
	Eocuma calmani											
S1205	Eudorella sp. A						1					
S1211	Leucon sp. A							1				
S1211	Leucon sp. B		1									
S1215	Campylaspis sp. A	1										
S1413	Callianassidae dam.											

MCS code	Taxon	Sample										
		38 FA	38 FB	39 FA	39 FB	41 FA	42 FA	42 FB	43 FA	43 FB	44 FA	44 FB
W2	**CAUDOFOVEATA**						1					
W364	Obtusella										1	
W410	Hyala vitrea ?										1	
	Nassarius wolffi											
W1516	Antalis											
	Dentalium						1					1
W1616	Yoldiella dam.											
	Ledella orstomi										1	
W1833	Thyasiridae sp. B									1		
W1843	Axinulus										1	
W1851	Mendicula ferruginosa		3	3	1						2	6
W2059	**Abra**											1
W2276	Cuspidariidae dam.											
ZB105	OPHIUROIDEA sp. A											
ZB154	Amphiura filiformis											
ZB229	HOLOTHURIOIDEA sp. C			1								

The following list of taxa excludes those that were merged for statistical analysis or excluded from it (Part 2)

MCS code	Taxon	Sample									
		45 FA	45 FB	46 FA	46 FB	47 FA	47 FB	48 FA	48 FB	49 FA	49 FB
D759	Edwardsiidae								1		
G1	NEMERTEA		3	1	1	1					
M7	Siboglinidae										
N27	Thysanocardia										
N37	Onchnesoma steenstrupii									10	8
	Apionsoma							7	6		
N46	Aspidosiphon										
O1	ECHIURA sp. A					3	15				
P116	Eteone sp. B									1	
	Glycera cf. nicobarica							1			
P267	Glycinde										1
P269	Goniada									2	1
P338	Ancistrosyllis cf. groenlandica										
	Sigambra sp. A	1									
P458	**Nereididae**										
P518	Paramphinome jeffreysii										
P538	Aponuphis sp. A							2			
P548	Paradiopatra				1	1	1		1		
P560	Eunice vittata										
P572	Lumbrineris sp. C					1				1	2
	Abyssoninoe		1			1				1	
	Augenaria									1	
	Lumbrinerides									1	
P591	Drilonereis cf. filum										1
P666	Phylo sp. A				1						
P671	Scoloplos sp. B ?									1	
P675	**Aricidea**	**2**	**1**								
P690	Cirrophorus branchiatus										
P692	Levinsenia										
	Malacoceros cf. indicus										1
	Paraprionospio dam.				1	1					
P763	Prionospio dam.	1			2						
P793	**Spiophanes**			1				2			
P803	**Magelona**				1		1			1	
P818	Spiochaetopterus						1		1		
P843	Monticellina							1	3		3

MCS code	Taxon	Sample									
		45 FA	45 FB	46 FA	46 FB	47 FA	47 FB	48 FA	48 FB	49 FA	49 FB
P845	Tharyx		1								
P895	Fauveliopsis										
P903	Capitellidae sp. F	1									
P903	Capitellidae sp. G										1
P903	Capitellidae sp. H										
	Neomediomastus			1							
	Paraleiocapitella								1		
P920	Notomastus	2						1			
P938	Maldanidae sp. A										
P938	Maldanidae sp. B										
P948	Maldane						1				
P960	Euclymene sp. C ?			1							
P960	Euclymene sp. D							1			
P993	Opheliidae dam.										
P1021	Asclerocheilus										
P1091	Galathowenia										
P1094	Myriochele		1			2					
P1118	Ampharetidae sp. E										
P1120	Melinna										1
P1147	Anobothrus gracilis									1	
	Pterolysippe bipennata									1	
P1167	Sosane sulcata										
P1174	Terebellides				1				1		
P1216	Pista										
P1264	Chone/Dialychone/Paradialychone										3
R17	Scalpellidae										
S253	**Harpinia**	1			1		1				
S422	**Ampeliscidae**									1	5
	Quantanthura										
S807	Leptanthura										
	Haliophasma sp. C										
S1099	TANAIDACEA sp. A		1								
S1151	Typhlotanais	1	1								
	Eocuma calmani									1	
S1205	Eudorella sp. A										
S1211	Leucon sp. A										
S1211	Leucon sp. B			1							
S1215	Campylaspis sp. A										
S1413	Callianassidae dam.										3

MCS code	Taxon	Sample									
		45 FA	45 FB	46 FA	46 FB	47 FA	47 FB	48 FA	48 FB	49 FA	49 FB
W2	**CAUDOFOVEATA**					1					
W364	Obtusella										
W410	Hyala vitrea ?										
	Nassarius wolffi							1			
W1516	Antalis									1	
	Dentalium										
W1616	Yoldiella dam.								1		
	Ledella orstomi								1		
W1833	Thyasiridae sp. B										
W1843	Axinulus										3
W1851	Mendicula ferruginosa					1		1			
W2059	**Abra**						1				
W2276	Cuspidariidae dam.										1
ZB105	OPHIUROIDEA sp. A										1
ZB154	Amphiura filiformis										1
ZB229	HOLOTHURIOIDEA sp. C										

The following taxa were merged for statistical analysis (Part 1)

MCS code	Taxon	Sample									
		38 FA	38 FB	39 FA	39 FB	41 FA	42 FB	42 FA	43 FA	43 FB	44 FA	44 FB
P458	**Nereididae**			1							1	
	Eunereis longissima										1	
P458	Nereididae dam.			1								
P675	**Aricidea**				1			1	1	2	1	1
P675	Aricidea dam.				1				1	2		1
	Aricidea cf. ramosa							1				
P688	Aricidea cf. simonae										1	
P793	**Spiophanes**							1				
	Spiophanes afer											
P793	Spiophanes dam.							1				
P803	**Magelona**											
P803	Magelona sp. B											
	Magelona capensis											
P803	Magelona dam.											
S253	**Harpinia**							1				
S253	Harpinia sp. B											
S253	Harpinia dam.							1				
S422	**Ampeliscidae**											
S422	Ampeliscidae dam.											
S423	Ampelisca dam.											
S423	Ampelisca sp. P											
W2	**CAUDOFOVEATA**							1				
W2	CAUDOFOVEATA sp. A							1				
W2	CAUDOFOVEATA dam.											
W2059	**Abra**											1
W2059	Abra alba											
W2058	Abra dam.											1

The following taxa were merged for statistical analysis (Part 2)

MCS code	Taxon	Sample									
		45 FA	45 FB	46 FA	46 FB	47 FA	47 FB	48 FA	48 FB	49 FA	49 FB
P458	**Nereididae**										
	Eunereis longissima										
P458	Nereididae dam.										
P675	**Aricidea**	**2**	**1**								
P675	Aricidea dam.	1	1								
	Aricidea cf. ramosa	1									
P688	Aricidea cf. simonae										
P793	**Spiophanes**			**1**				**2**			
	Spiophanes afer							2			
P793	Spiophanes dam.			1							
P803	**Magelona**				**1**		**1**			**1**	
P803	Magelona sp. B				1						
	Magelona capensis									1	
P803	Magelona dam.						1				
S253	**Harpinia**	**1**			**1**		**1**				
S253	Harpinia sp. B	1			1		1				
S253	Harpinia dam.										
S422	**Ampeliscidae**									**1**	**5**
S422	Ampeliscidae dam.									1	
S423	Ampelisca dam.										2
S423	Ampelisca sp. P										3
W2	**CAUDOFOVEATA**					**1**					
W2	CAUDOFOVEATA sp. A										
W2	CAUDOFOVEATA dam.					1					
W2059	**Abra**						**1**				
W2059	Abra alba						1				
W2058	Abra dam.										

The following taxa were removed from the analysis (Part 1)

MCS code	Taxon	Sample										
		38 FA	38 FB	39 FA	39 FB	41 FA	42 FA	42 FB	43 FA	43 FB	44 FA	44 FB
Juvenile												
N1	SIPUNCULA juv.											1
N30	Phascolion juv.											1
P255	Glycera juv.											
	Sigambra juv.											
P458	Nereididae juv.											
P494	Nephtys juv.											
P537	Onuphidae juv.											1
P655	Orbiniidae juv.											
P938	Maldanidae juv.											
P993	Opheliidae juv.							1				
P1257	Sabellidae juv.										1	
S1200	Iphinoe juv.										1	
S423	Ampelisca juv.											
S793	Gnathia juv.											
S801	Anthuridae juv.						1					
W1563	Nuculidae juv.			1								
W2058	Abra juv.										1	
ZB105	OPHIUROIDEA juv.										1	
Damaged												
N4	Sipunculidae dam.											
P537	Onuphidae dam.											
P720	Spionidae dam.						1					
P822	Cirratulidae dam.											
W88	GASTROPODA dam.											
W1587	Nuculanidae dam.	1										
ZB105	OPHIUROIDEA dam.											
Meiofauna												
HD1	NEMATODA							1				
R142	COPEPODA								1			
R2413	MYODOCOPIDA											
Pelagic												
	Plotohelmis										1	

The following taxa were removed from the analysis (Part 2)

MCS code	Taxon	Sample									
		45 FA	45 FB	46 FA	46 FB	47 FA	47 FB	48 FA	48 FB	49 FA	49 FB
Juvenile											
N1	SIPUNCULA juv.					1					
N30	Phascolion juv.										
P255	Glycera juv.						1				
	Sigambra juv.	1	1								
P458	Nereididae juv.	1									
P494	Nephtys juv.									1	
P537	Onuphidae juv.									1	
P655	Orbiniidae juv.	1									
P938	Maldanidae juv.		1					8	3		
P993	Opheliidae juv.										
P1257	Sabellidae juv.										
S1200	Iphinoe juv.										
S423	Ampelisca juv.									2	
S793	Gnathia juv.									1	
S801	Anthuridae juv.	1									
W1563	Nuculidae juv.										
W2058	Abra juv.										
ZB105	OPHIUROIDEA juv.										1
Damaged											
N4	Sipunculidae dam.	1									
P537	Onuphidae dam.						1				
P720	Spionidae dam.										
P822	Cirratulidae dam.								1		
W88	GASTROPODA dam.								1		
W1587	Nuculanidae dam.										
ZB105	OPHIUROIDEA dam.					1					
Meiofauna											
HD1	NEMATODA		1							3	
R142	COPEPODA	6	1	1							
R2413	MYODOCOPIDA									1	1
Pelagic											
	Plotohelmis										

2.10 Benthic Organisms- Correlations

Parameters	Depth [m]	Mean [µm]	Mean [phi]	Sorting	% Fines	% Sand	% Coarse	TOC	Ammonium	Nitrogen	Total Phosphorus	Available phosphate	Aluminium
Depth [m]													
Mean (µm)	-0.944								Positive correlation (P<0.05)				
Mean (phi)	0.944	-1.000							Negative correlation (P<0.05)				
Sorting	-0.347	0.424	-0.424						Positive correlation (P<0.001)				
% Fines	0.944	-1.000	1.000	-0.424					Negative correlation (P<0.001)				
% Sand	-0.944	1.000	-1.000	0.424	-1.000								
% Coarse	-0.359	0.374	-0.374	-0.281	-0.374	0.374							
Total Organic Carbon	0.531	-0.531	0.531	-0.056	0.531	-0.531	-0.405						
Ammonium	0.524	-0.467	0.467	-0.194	0.467	-0.467	0.145	0.285					
Nitrogen	0.541	-0.457	0.457	-0.056	0.457	-0.457	-0.380	0.914	0.419				
Total Phosphorus	-0.655	0.620	-0.620	-0.158	-0.620	0.620	0.289	-0.042	-0.254	0.032			
Available phosphate	-0.741	0.741	-0.741	0.228	-0.741	0.741	0.016	-0.105	-0.436	-0.098	0.599		
Aluminium	0.965	-0.895	0.895	-0.326	0.895	-0.895	-0.273	0.629	0.576	0.668	-0.564	-0.671	
Mercury	0.877	-0.791	0.791	-0.244	0.791	-0.791	-0.263	0.576	0.594	0.682	-0.513	-0.623	0.898
Arsenic	-0.648	0.571	-0.571	0.084	-0.571	0.571	0.500	-0.865	-0.222	-0.852	0.105	0.249	-0.701
Barium	0.694	-0.623	0.623	-0.016	0.623	-0.623	-0.180	0.424	0.294	0.400	-0.689	-0.529	0.655
Cadmium	0.730	-0.666	0.666	-0.217	0.666	-0.666	-0.222	0.388	0.739	0.422	-0.563	-0.388	0.687
Cobalt	0.657	-0.657	0.657	-0.480	0.657	-0.657	0.156	0.112	0.520	0.046	-0.578	-0.587	0.622
Chromium	0.455	-0.580	0.580	-0.081	0.580	-0.580	-0.117	-0.161	0.271	-0.232	-0.760	-0.580	0.399
Copper	0.797	-0.825	0.825	-0.242	0.825	-0.825	-0.109	0.217	0.650	0.186	-0.732	-0.790	0.762
Iron	-0.371	0.287	-0.287	-0.102	-0.287	0.287	0.538	-0.769	-0.299	-0.742	-0.018	-0.140	-0.392
Nickel	0.888	-0.888	0.888	-0.291	0.888	-0.888	-0.148	0.441	0.707	0.408	-0.690	-0.762	0.860
Lead	0.867	-0.846	0.846	-0.250	0.846	-0.846	-0.094	0.389	0.691	0.372	-0.717	-0.772	0.846
Vanadium	0.727	-0.755	0.755	-0.361	0.755	-0.755	0.031	0.182	0.629	0.134	-0.711	-0.622	0.706
Zinc	0.648	-0.697	0.697	-0.460	0.697	-0.697	0.203	0.231	0.634	0.123	-0.495	-0.648	0.634
THC	0.343	-0.231	0.231	0.326	0.231	-0.231	-0.109	0.566	0.510	0.562	-0.375	0.028	0.434
UCM	0.294	-0.147	0.147	0.425	0.147	-0.147	-0.207	0.525	0.489	0.572	-0.354	0.105	0.375
n-alkanes nC12-20	0.432	-0.339	0.339	0.297	0.339	-0.339	-0.219	0.572	0.431	0.490	-0.472	-0.086	0.464
n-alkanes nC21-36	0.529	-0.438	0.438	0.186	0.438	-0.438	-0.238	0.641	0.567	0.609	-0.414	-0.140	0.606
n-alkanes nC12-36	0.431	-0.340	0.340	0.288	0.340	-0.340	-0.184	0.571	0.525	0.542	-0.453	-0.070	0.501
CPI nC12-20	0.669	-0.543	0.543	0.074	0.543	-0.543	-0.500	0.644	0.470	0.702	-0.323	-0.277	0.739
CPI nC21-36	-0.077	0.049	-0.049	0.084	-0.049	0.049	-0.374	-0.021	-0.587	-0.056	-0.112	0.252	-0.140
CPI nC12-36	0.147	-0.175	0.175	-0.287	0.175	-0.175	-0.538	0.042	-0.587	0.046	0.056	0.077	0.084
Pristane	-0.181	0.291	-0.291	0.489	-0.291	0.291	-0.377	0.323	-0.032	0.399	0.142	0.543	-0.165
Phytane	0.067	-0.067	0.067	-0.015	0.067	-0.067	-0.220	0.420	-0.070	0.264	-0.048	0.349	0.021
Pr/Ph Ratio	0.112	-0.014	0.014	0.441	0.014	-0.014	-0.499	0.503	0.239	0.517	-0.014	0.231	0.091
2-6 Ring PAH	0.350	-0.266	0.266	0.364	0.266	-0.266	-0.148	0.566	0.531	0.510	-0.399	-0.042	0.420
Number of Taxa [S]	-0.705	0.776	-0.776	0.249	-0.776	0.776	0.267	-0.653	-0.374	-0.495	0.528	0.402	-0.681
Abundance [N]	-0.651	0.736	-0.736	0.123	-0.736	0.736	0.258	-0.690	-0.415	-0.526	0.526	0.389	-0.655
Diversity [H']	-0.524	0.580	-0.580	0.042	-0.580	0.580	0.328	-0.573	-0.197	-0.439	0.413	0.238	-0.545

Parameters	Mercury	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Nickel	Lead	Vanadium	Zinc	THC	UCM	n-alkanes nC12-20
Depth [m]															
Mean (µm)															
Mean (phi)															
Sorting															
% Fines															
% Sand															
% Coarse															
Total Organic Carbon															
Ammonium															
Nitrogen															
Total Phosphorus															
Available phosphate															
Aluminium															
Mercury															
Arsenic	-0.615														
Barium	0.801	-0.409													
Cadmium	0.632	-0.332	0.551												
Cobalt	0.526	-0.018	0.420	0.612											
Chromium	0.333	0.207	0.326	0.331	0.601										
Copper	0.616	-0.186	0.476	0.740	0.797	0.762									
Iron	-0.308	0.757	-0.179	-0.523	0.056	0.392	-0.070								
Nickel	0.816	-0.375	0.683	0.804	0.825	0.608	0.923	-0.238							
Lead	0.792	-0.318	0.691	0.804	0.832	0.614	0.937	-0.189	0.989						
Vanadium	0.608	-0.060	0.515	0.747	0.930	0.755	0.923	0.000	0.909	0.919					
Zinc	0.470	-0.091	0.353	0.663	0.921	0.564	0.872	-0.053	0.858	0.865	0.914				
THC	0.447	-0.466	0.539	0.584	0.098	-0.014	0.238	-0.601	0.385	0.386	0.273	0.172			
UCM	0.437	-0.407	0.509	0.595	0.074	-0.063	0.189	-0.634	0.347	0.357	0.235	0.098	0.963		
n-alkanes nC12-20	0.492	-0.548	0.599	0.522	0.186	0.043	0.243	-0.600	0.439	0.405	0.286	0.200	0.914	0.862	
n-alkanes nC21-36	0.534	-0.656	0.453	0.570	0.221	0.091	0.361	-0.658	0.494	0.455	0.350	0.284	0.893	0.821	0.932
n-alkanes nC12-36	0.527	-0.526	0.568	0.549	0.172	0.098	0.284	-0.567	0.452	0.424	0.322	0.204	0.956	0.902	0.975
CPI nC12-20	0.557	-0.749	0.205	0.515	0.301	0.098	0.473	-0.687	0.518	0.494	0.361	0.326	0.487	0.507	0.521
CPI nC21-36	0.097	-0.011	0.322	-0.317	-0.231	0.021	-0.399	0.175	-0.238	-0.274	-0.252	-0.497	-0.119	-0.070	0.029
CPI nC12-36	0.047	-0.228	-0.077	-0.285	-0.098	0.000	-0.196	0.035	-0.182	-0.221	-0.189	-0.301	-0.517	-0.469	-0.379
Pristane	0.052	-0.276	0.209	0.128	-0.535	-0.527	-0.464	-0.582	-0.260	-0.280	-0.433	-0.560	0.574	0.674	0.506
Phytane	0.181	-0.299	0.417	0.212	0.013	-0.282	-0.256	-0.475	0.050	-0.019	-0.042	-0.095	0.462	0.463	0.614
Pr/Ph Ratio	0.197	-0.518	0.249	0.377	-0.329	-0.420	-0.147	-0.825	0.042	-0.004	-0.224	-0.252	0.664	0.725	0.682
2-6 Ring PAH	0.444	-0.476	0.497	0.516	0.168	0.049	0.259	-0.587	0.427	0.400	0.294	0.224	0.944	0.904	0.972
Number of Taxa [S]	-0.729	0.555	-0.793	-0.576	-0.469	-0.360	-0.497	0.374	-0.720	-0.655	-0.568	-0.482	-0.550	-0.445	-0.683
Abundance [N]	-0.717	0.496	-0.775	-0.565	-0.483	-0.403	-0.532	0.361	-0.746	-0.692	-0.602	-0.519	-0.585	-0.505	-0.682
Diversity [H']	-0.537	0.641	-0.543	-0.249	-0.119	-0.273	-0.245	0.336	-0.399	-0.316	-0.245	-0.133	-0.552	-0.399	-0.722

Parameters	n-alkanes nC21-36	n-alkanes nC12-36	CPI nC12-20	CPI nC21-36	CPI nC12-36	Pristane	Phytane	Pr/Ph Ratio	2-6 Ring PAH	Number of Taxa [S]	Abundance [N]	Diversity [H']
Depth [m]												
Mean (µm)												
Mean (phi)												
Sorting												
% Fines												
% Sand												
% Coarse												
Total Organic Carbon												
Ammonium												
Nitrogen												
Total Phosphorus												
Available phosphate												
Aluminium												
Mercury												
Arsenic												
Barium												
Cadmium												
Cobalt												
Chromium												
Copper												
Iron												
Nickel												
Lead												
Vanadium												
Zinc												
THC												
UCM												
n-alkanes nC12-20												
n-alkanes nC21-36												
n-alkanes nC12-36	0.958											
CPI nC12-20	0.726	0.551										
CPI nC21-36	-0.175	-0.028	-0.291									
CPI nC12-36	-0.340	-0.424	0.081	0.615								
Pristane	0.363	0.496	0.079	0.338	-0.118							
Phytane	0.396	0.509	-0.008	0.508	0.038	0.624						
Pr/Ph Ratio	0.606	0.641	0.389	0.021	-0.238	0.857	0.572					
2-6 Ring PAH	0.939	0.981	0.536	-0.112	-0.517	0.496	0.508	0.671				
Number of Taxa [S]	-0.618	-0.654	-0.314	-0.243	0.028	-0.135	-0.596	-0.300	-0.596			
Abundance [N]	-0.616	-0.668	-0.330	-0.186	0.130	-0.138	-0.541	-0.294	-0.641	0.968		
Diversity [H']	-0.732	-0.718	-0.399	-0.301	-0.070	-0.181	-0.479	-0.329	-0.636	0.815	0.746	

GHANA OCTP BLOCK

Fisheries Impact Assessment

ABSTRACT

This report provides a Fisheries Impact Assessment as required by the Fisheries Law of Ghana (Act 625) and follows a structure agreed upon during discussions with the Ghana Fisheries Commission.

Date	Revision	Revision Description	Prepared	Checked	Approved
July 2015	01	Final Issued for Delivery	ERM	HSE & CI Manager Juan Deffis HSE Project Manager Giuseppe Nicotra	Development Project Manager Ezio Miguel Lago

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Summary of Revisions

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July 2015	01	Final Issued for Delivery	ERM	HSE & CI Manager Juan Deffis HSE Project Manager Giuseppe Nicotra	Development Project Manager Ezio Miguel Lago
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ACRONYMS

Acronym	Definition
AoI	Area of Influence
CBD	Convention on Biological Diversity
CDP	Community Development Plan
CLO	Community Liaison Officer
CSR	Corporate Social Responsibility
EEZ	Exclusive Economic Zone
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
eni	Ente Nazionale Idrocarburi
EPA	Environmental Protection Agency
ERM	Environmental Resource Management
ESHIA	Environmental, Social and Health Impact Assessment
FAO	Food and Agriculture Organization
FASDP	Fisheries and Aquaculture Sector Development Project
FIA	Fisheries Impact Assessment
FLO	Fisheries Liaison Officer
FMP	Fisheries Management Plan
FPSO	Floating Production, Storage and Offloading
GCLME	Guinea Current Large Marine Ecosystem Project
GDP	Gross Domestic Product
GNGC	Ghana National Gas Company
HSE	Health, Safety and Environment
ICCAT	International Commission for the Conservation of Atlantic Tunas
IFC	International Finance Corporation
ILO	International Labour Organisation
IMS	Integrated Management System
OCTP	The Cape Three Points
ORF	Onshore Receiving Facility
SEP	Stakeholder Engagement Plan
UNCLOS	United Nation Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change

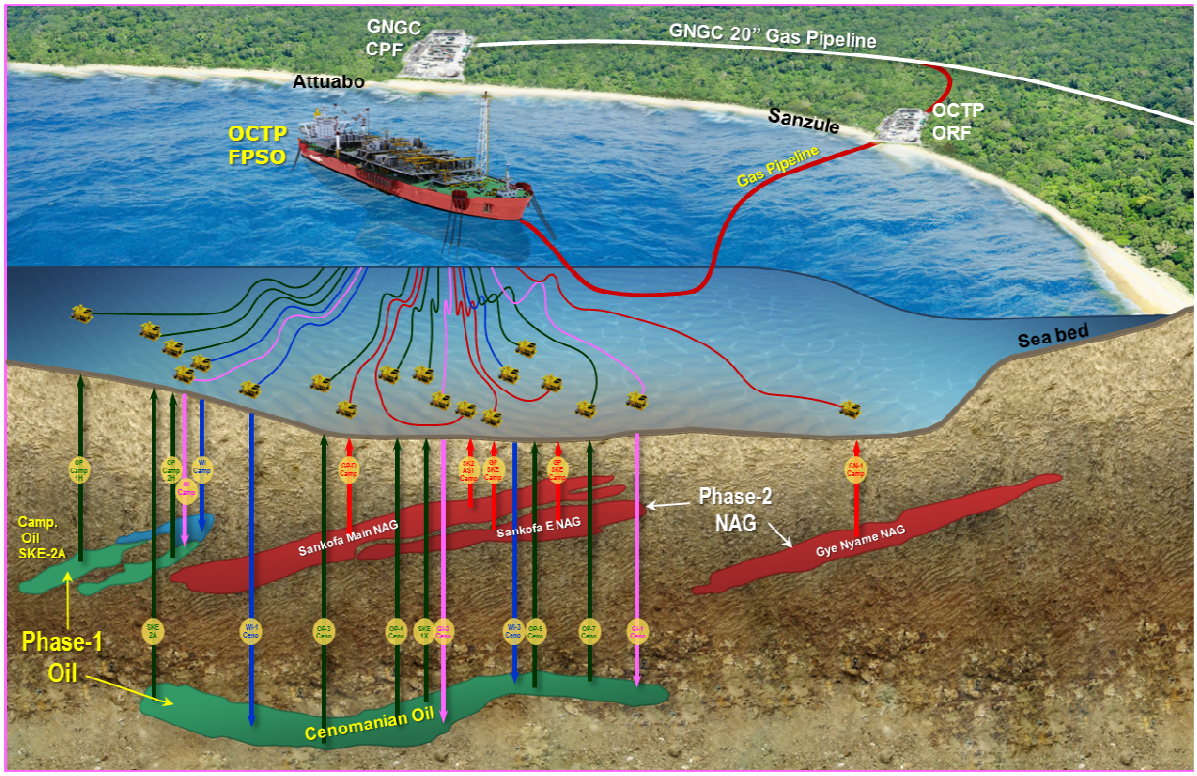
1 NON TECHNICAL EXECUTIVE SUMMARY

The Offshore Cape Three Points (OCTP) project is a deepwater offshore development located approximately 60 km off the Western Region of Ghana (see **Figure 1.1**). The project proponent is Eni Ghana Ltd (eni). It comprises oil and non-associated gas fields namely Sankofa Main, Sankofa East and Gye Nyame. The project will be executed to two phases:

- Phase 1: Oil Production Project
- Phase 2: Gas Production Project

During operation production is expected to reach 45,000 barrels of oil per day (bopd) and 190 million standard cubic feet per day of gas (MMscfd). The project has a 20-year life. Produced gas will support the Ghana Gas Infrastructure Development Project currently under development in the Western Region. The project will also provide employment and other economic benefits to local communities, the Western Region and to Ghana as a whole.

Figure 1.1 OCTP Development Project



Source: eni, 2014

This Fisheries Impact Assessment (FIA) report has been prepared by Environmental Resources Management Limited (ERM) and ESL Consulting (ESL) on behalf of eni.

In preparing this report, ERM and ESL carried out a series of desktop studies, fieldwork and stakeholder consultation performed in several periods across 2014 and 2015. The objective was to understand the implications of oil & gas exploration and production on fisheries in

Ghana (Western Region) and also to suggest an effective management plan and monitoring program to enhance the positive effects and reduce or prevent the negative effects.

Fisheries in the Local Communities

The fishing industry in Ghana is based on fishery resources from the marine and to a lesser extent, inland or freshwater fisheries and aquaculture. There is a long tradition of both artisanal and distant-water fishing fleets. The fisheries sector contributes 4-5% to agricultural Gross Domestic Product (GDP) and offers employment to about 10% of the population and their dependents.

The Ghanaian marine fishing fleet can be classified into four main groups: artisanal, nearshore and inshore, industrial/offshore and tuna. Additionally there is a group of vessels dedicated to the fishing of sharks for their fins. The vast majority of vessels operating in Ghana are involved in the artisanal sector (more than 95%), highlighting its importance in terms of employment. Targeted fish species within the marine sector include pelagic, demersal, crustacean and shellfish resources.

There are two main fishing seasons in Ghana: the first begins towards the end of June and peaks during August and September; the second begins towards the end of November and peaks between late January and March. April to May is a rest period for mending nets, boat repair and fishermen engage in onshore artisanal work to supplement their income.

On a regional level, fishing, fish processing and fish trade are among the most important sources of livelihood not only in coastal communities of the Western Region but also in communities inland.

On a local level, a 2010 rapid assessment of 89 selected fishing communities in the Western region (including 17 fishing communities in the Ellembelle district), indicated that fish landings in most of the fishing communities have declined in recent years. The decline in fish catch is attributed, among other issues, to increasing population leading to over-fishing, and use of damaging or illegal fishing methods. Many community members in the Area of Influence (AoI) believe that the offshore oil production activities have contributed to the decline in fisheries.

Fish mongering is an important livelihood activity for women who process fish by salting and drying or smoking. Women buy fish locally and transport it for sale at Aiyinasie. Large catches are also sold to hotels in Axim. Income from fish mongering is reduced due to lack of cold storage such that fish prices are lowered by the high levels of supply during fishing seasons.

OCTP Project Impacts on Fisheries Resources

The OCTP Project is not expected to have any significant impact on the commercially targeted fish, crustaceans and cephalopods species during the construction phase of the project. During the operations phase, potential impacts derived from the physical presence of the infrastructure, expected discharges and light and noise emissions have been ranked as medium driven mainly by the duration of the impact (approximately 20 years) and not to the sensitivity of the receptor (considered low), the number of elements affected (small) or the extent of the impact (local).

Impacts related to discharges are expected to be mitigated mainly by avoidance and reduction through meeting national and international requirements for discharges, including compliance with the relevant annexes of MARPOL and IMP standards and conventions. Noise and light minimisation measures will be applied.

OCTP Project Impacts on Fisheries Livelihoods

There is concern amongst fishers in the Area of Influence (AoI) that the Project will have a negative effect on fish catch due to exclusion zones. However, considering the mitigation measures put in place by eni, no highly significant impacts on fisheries-based livelihoods are expected.

The following impacts have been considered to have a potential medium effect on fisheries-based livelihood during the construction phase:

- **Disruption of Onshore and Near Shore Fishing Activities**: during construction activities, there will be an exclusion zone of approximately 100 m either side of the gas export pipeline preventing fishers from using the beach in front of the Onshore Receiving Facility (ORF) land acquisition area for landing catches and boats and gathering for fish-mongering/trading activities. This area is small however, relative to the extent of the beach, and the exclusion zone will only be enforced during the installation of the pipeline. Vessel movements to and from onshore base during construction also have the potential to interact with fishing activity in the vicinity of the onshore bases and therefore near-shore artisanal fishing activities could be adversely affected through disturbance by these vessels.

- **Damage to fishing gear**: There is the potential for certain fishing gears that are left floating in the open ocean, to enter the exclusion zone and become entangled in Project vessels and be lost to the fishermen. The exclusion zones around Project vessels are intended to reduce the likelihood of this impact occurring as far as possible by monitoring from the support vessels.

- **Interactions and possibly collisions with artisanal and commercial fishing vessels:** The construction activities will lead to an increase in vessel traffic on local offshore routes connecting the Project and the Takoradi Port. Safety and security exclusion zones will be established around project vessels undertaking drilling and subsea infrastructure placement. However, this will increase the potential for interactions and possibly collisions with artisanal and commercial fishing vessels in the local offshore environment.

During the operations phase, the following additional potential impacts on fisheries livelihoods have been ranked as medium driven mainly by the duration of the impact (approximately 20 years) and not to the sensitivity of the receptor (considered low), the number of elements affected (small) or the extent of the impact (local).

- Restricted access to offshore fishing grounds due to the exclusion zones
- Reduction of fish – catch due to attraction to FPSO lighting
- Interaction with project security forces

eni has foreseen the following mitigation measures in order to minimize and if needed compensate the temporary affection to fisheries-based livelihoods:

- eni will develop and implement a detailed Fisheries Management Plan, which will describe the procedure to be established for compensation and/or livelihood restoration measures to be established for temporary disruption of coastal fishing activities (exclusion zone at the beach) during the construction of the pipeline landing, or damage to fishing gear that can be proved attributable to Project activities.
- If possible, eni will employ a Fisheries Liaison Officer (FLO) to liaise between fishermen and eni. Interaction with fishermen and other users will be monitored through the CLO/FLO and the Project's grievance procedure.
- A vessel transit route will be agreed with the Ghana Maritime Authority and communicated to fishermen and other marine users through the CLO/FLO.
- A security management plant together with a specific patrolling procedure will be developed for both onshore and offshore installations.
- Measures will be implemented to ensure that those engaged in maintaining the exclusion zones have received adequate training on the correct code of conduct and rules of engagement which will be based on the UN Voluntary Principles of Security and Human Rights. These measures will include, among other things, selection or personnel based on a careful background screening, training with regards to human rights requirements, and monitoring of performance.
- Eni will propose to create a technical/management committee involving eni as well as national and local government, and invite other operators in the area, in order to assess the potential cumulative impacts on fisheries.
- A Marine Traffic Transportation Plan will be developed for the Project to ensure appropriate protocol is followed during offshore vessel movements. This Plan will consider vessel movements associated with other oil and gas projects in the area, and artisanal and commercial shipping traffic in the local offshore environment.

OCTP Project Fisheries Management Plan and Monitoring Program

The purpose of the Fisheries Management Plan (FMP) is to ensure that undue or reasonably avoidable adverse impacts of the project phases (drilling & completion of oil and gas wells; FPSO and subsea gas pipeline installation and operation; decommissioning and abandonment) are mitigated.

The structure of the FMP has been set up in this FIA, with details on the project aspects with impact on the fisheries resource, potential impacts assessed, guiding policy applied to each element, action plans through which the policy will be achieved, key performance indicators, corrective actions and responsibilities. An implementation FMP will be developed prior to the commencement of works.

In addition, a fisheries monitoring programme will be developed, employing the following methods within the Project AoI: direct monitoring of nearshore fisheries; quarterly catch analysis of offshore fisheries; satellite monitoring/tracking of fishing activity, quarterly and bi-annual stakeholder engagement, quarterly water quality measurements, and bi-annual plankton sampling. It is proposed that local fishermen be employed to undertake the beach seining surveys.

2 INTRODUCTION AND PURPOSE OF THE REPORT

The Offshore Cape Three Points (OCTP) project is a deepwater offshore development located approximately 60 km off the Western Region of Ghana. The project proponent is Eni Ghana Ltd. It comprises oil and non-associated gas fields namely Sankofa Main, Sankofa East and Gye Nyame. The project will be executed to two phases:

- Phase 1: Oil Production Project
- Phase 2: Gas Production Project

During operation production is expected to reach 45,000 barrels of oil per day (bopd) and 190 million standard cubic feet per day of gas (MMscfd). The project has a 20-year life. Produced gas will support the Ghana Gas Infrastructure Development Project currently under development in the Western Region. The project will also provide employment and other economic benefits to local communities, the Western Region and to Ghana as a whole.

The environmental and social impacts of the project have been assessed and are reported in the OCTP Project Phase 1 and Phase 2 Environmental Impact Statements (EIS). This report constitutes a Fisheries Impact Assessment (FIA) covering both phases of the project, and includes an assessment of impacts on fisheries resources and livelihoods.

2.1 FISHING INDUSTRY IN GHANA

Ghana has a coastline of 550 km and a relatively narrow continental shelf of between 75 and 120 m depth and a total area of approximately 24,300 km^2. Most commercial marine fishing undertaken by Ghanaian vessels takes place within the 200 mile Exclusive Economic Zone (EEZ).

The fishing industry in Ghana consists of three main sectors namely (i) small scale (or artisanal), (ii) semi-industrial (or inshore) and (iii) industrial fisheries. Targeted fish species within the marine sector include pelagic, demersal and shellfish resources.

The fishing industry in Ghana encompasses both marine and inland (freshwater) resources and those from coastal lagoons and aquaculture (Quaatey 1997, NAFAG 2007). The fisheries sector contributes 4 to 5% to agricultural Gross Domestic Product (GDP) in Ghana and offers employment to about 10% of the population. Fishing constitutes an important livelihood source not only to coastal communities but also to inland communities.

Fish and fish-based products provide the largest proportion of animal protein in Ghana, contributing over 60% of the total animal protein intake. Average per capita consumption is estimated to be between 27 kg and 31 kg annually making Ghana the 3rd highest consumer of fish worldwide. About 75% of fish production is consumed locally, with the marine sector contributing over 80% of all fish consumed and exported.

Since the discovery of oil in Ghana in 2007 the fishing communities have raised concerns about potential degradation of the marine environment from oil and gas exploration and production activities.

2.2 FISHERIES IMPACT ASSESSMENT

An FIA is required by the Fisheries Law of Ghana (Act 625). Section 93 of Act 625 of the Ghana Fisheries Law states:

1) A person or government departments or other agency planning to conduct any activity other than fishing, which is likely to have a substantial impact on the fishery resources or other aquatic resources of Ghana, shall inform the Fisheries Commission of the plans prior to the commencement of the planned activity with the view to the conservation and protection of the resources.

2) The commission may make or require reports and recommendations by those conducting the planned activity regarding the likely impact of the activity on the fishery resources or other aquatic resources of Ghana and possible means of minimizing adverse impacts, which shall be taken into account by persons, government department or agency in the planning of the activity and in the development of the means of preventing or minimizing the adverse impacts.

3) The requirement under this section shall be in addition to any other requirements of the Environmental Protection Agency'.

This FIA is intended to satisfy the requirement of the Government of Ghana Ministry of Fisheries & Aquaculture Development and the Fisheries Commission with regards to the Ghana OCTP project.

3 LEGAL AND POLICY FRAMEWORK

3.1 MINISTRY OF FOOD AND AGRICULTURE (FISHERIES COMMISSION)

The Ministry of Food and Agriculture is charged with the development and growth of agriculture in Ghana including fisheries. Its roles include the formulation of appropriate agricultural policies, planning and coordination, monitoring and evaluation within the overall national economic development. The Directorate of Fisheries and the Fisheries Commission fall under this ministry.

Fisheries Commission

The Fisheries Commission is responsible for policy formulation and implementation, management and control of the fishing industry under the general guidance and direction of the Fisheries Commission.

The Fisheries Act (Act No. 625 of 2002) established the Fisheries Commission as a body to regulate and manage the utilisation of the fishery resources of Ghana and co-ordinate the related policies. The commission also advises the Minister on all matters pertaining to the fishery industry. The Commission's functions among other things are to ensure the proper conservation of the fishery resources through the prevention of over fishing.

The Commission's mission is *'…to promote sustainable exploitation and responsible utilisation of fishery resources of Ghana through sound management practices, research, appropriate technological development for both culture and capture fisheries, effective extension and provision of other support services to fish farmers, fishermen, fish processors and traders for improved income and fish food security'.*

The functions of the Commission are:

- To prepare and keep under continual review, plans for the management and development of marine and freshwater capture fisheries and aquaculture;
- To carry out research for the assessment for fisheries resources; and
- To ensure that monitoring, control and surveillance of the fishery waters of Ghana.

The Commission has a number of operational areas with responsibility for marine fisheries management, namely: inland fisheries management (and aquaculture); marine fisheries research; monitoring; control and surveillance; and finance and administration.

The regional Departments of Fisheries carry out and implement policies of the Directorate of Fisheries particular to the different Regions of Ghana. The office for the Western Region is based in Takoradi and this office covers most of the fishing activities in the coastal waters nearest to the offshore OCTP Development area.

3.2 RELEVANT DEVELOPMENT POLICIES AND PLANS

3.2.1 The Republic of Ghana Fisheries and Aquaculture Policy (2008)

The Republic of Ghana fisheries and Aquaculture Policy provides the overall framework for managing the fisheries sector. The Policy aims ensure fisheries contribute to the socio-economic development of Ghana through food security and poverty reduction in a sustainable and economically efficient manner.

3.2.2 The Ghana Fisheries and Aquaculture Sector Development Plan (2011-2016)

The Fisheries and Aquaculture Sector Development Project (FASDP) recognizes the importance of Ghana's fisheries. However, due to over fishing a historical lack of investment average income per catch for artisanal fishing has dropped significantly (40%) in the last 10 years. This has heightened the need to develop the sector plan (ATFALCO, 2012)

The plan includes the following key points (ATFALCO, 2012):

- Maintaining the current levels of fisheries yields;
- Increasing revenue and profitability in the fisheries sector of lifespan of the sector plan;
- Increasing aquaculture production to 35,000 tons a year after five years,
- Maintaining Ghana place as primary landing a processing hub for the western Africa Tuna industry;
- Developing fisheries management across Ghanaian waters
- Build fisheries management sustainable and ensure fisheries is key sector contributing to national development

3.2.3 Ghana Shared Growth Development Agenda (2014-2017)

The current overall development policy intent for the fisheries sector in Ghana is guided by Ghana Shared Growth Development Agenda (GSGDA II, 2014-2017). It provides a consistent set of policy objectives and strategies to guide the preparation and implementation of medium-term and annual development plans and budgets at sector and district levels (NDPC, 2014).

The medium-term priority policies are anchored in the following thematic areas:

- Ensuring and sustaining macroeconomic stability;
- Enhancing competitiveness of Ghana's private sector;
- Accelerated agriculture modernisation and sustainable natural resource management;
- Oil and gas development;
- Infrastructure and human settlements development;
- Human Development, Productivity and Employment; and
- Transparent, Responsive and Accountable Governance.

The fisheries sector falls within the accelerated agriculture modernisation and sustainable natural resource management theme. One of the policies drivers within this theme is to promote fisheries and aquaculture development. According to the Plan it is expected that the fisheries sector will grow by 5.5% annually (NDPC, 2014). Opportunities to transform the fisheries sector in the Plan identify the booming hospitality industry as a key sector of growth. In addition, the introduction of technology and improved skills is expected to boost fishing entrepreneurs. Finally, the emerging aquaculture sub-sector could drive exports of fresh and frozen fish to augment the fisheries endowment from the Atlantic Ocean and the Volta Lake (NDPC, 2014)

3.2.4 Fisheries Management Plan of Ghana (2015-2019)

The primary aim of the Fisheries Management Plan is to rebuild fish stocks to enhance socioeconomic conditions of farming communities, create employment, improve food security, and contribute to GDP and foreign exchange earnings.

More specifically, the plan has the following key objectives:

- To reduce the excessive pressure on fish stocks;
- To ensure that fish stocks in Ghanaian coastal waters are exploited within biologically acceptable levels;
- To ensure that effective fisheries legislation is implemented to protect fish resources;
- To protect marine habitats an biodiversity;
- To contribute to enhancing export opportunities and strengheting value chain addition;
- To strengthen participatory decision making in fisheries management; and
- To meet regional and international obligations in fisheries management.

Ultimately, the plan attempts to put in place an overall strategic framework to halt the declining fish stocks in Ghana and simultaneously ensure the sustainable exploitation of fisheries resources.

3.3 Relevant Ghanaian Laws and Regulations

The legal basis for fisheries management in Ghana involves ordinances, laws and regulations. Over the years, these have been consolidated, improved upon and revised into the Fisheries Act (2002).

3.3.1 Fisheries Act 2002

The Fisheries Act, 2002 (Act 625), repealing the former Fisheries Commissions Act, 1993 (Act 457), was created to consolidate and amend the law on fisheries. The Act provides for the regulation, management and development of fisheries and promotes the sustainable exploitation of fishery resources.

Part I of the Fisheries Act deals with the establishment, functioning and responsibilities of the Fisheries Commission, and its mandate to manage national fishery resources. Part II establishes the composition and the functioning of the administration. Part III regulates the management and development of fishery resources, including conservation measures, while Part IV relates to jurisdiction and evidence related to non-compliance with the Fisheries Act.

Section 91 of the Act allows for the establishment of marine reserves and prohibits fishing, dredging and removal of sand or gravels and the disturbance of natural habitat without permission of the Minister. Section 92 prohibits the pollution of water such that there is an adverse effect on aquatic resources and provides details of penalties. Section 93 requires that the Fisheries Commission be informed of any activities likely to have substantial impact on fishery resources before commencement of the activity and allows the Fisheries Commission to require reports and recommendations by the proponent on the likely impact of the activity and possible means of preventing or minimising adverse impacts which shall be taken into account in the planning of the activities.

With reference to fish production and fisheries management, the Fisheries Act conforms to the relevant sections of the United Nations Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries with particular emphasis on gear selectivity and an

effective institutional framework. The Fisheries Act also gives legislative backing to the recently established Monitoring, Control and Surveillance Division with clearly defined legal powers to regulate fishing operations.

The Directorate of Fisheries under the Ministry of Fisheries and Aquaculture Development has also developed fishery management plans for marine fisheries. As of the time of this report, a new set of Fisheries Regulations to give effect to the Fisheries Act was being developed.

3.4 RELEVANT INTERNATIONAL AGREEMENTS AND CONVENTIONS

The Republic of Ghana is signatory to a number of international conventions and agreements affecting the marine environment and fisheries management. In certain cases, conventions and agreements have influenced policy, guidelines and regulations and therefore are relevant to planning, construction and operation of the Project.

Table 2.3.1 lists the relevant international conventions and protocols to which Ghana is signatory and that have been taken into consideration for the development of the Fisheries Management Plan of Ghana (2015-2019) or that are related to project activities.

Table 2.3.1 Relevant International Convention and Agreements signed by Ghana

Name of the Convention / Agreement	Date of adoption
The International Labour Organisation (ILO) Fundamental Conventions related to forced labour, freedom of association, discrimination and child labour. • Forced labour convention was ratified by Ghana on May 1957 • Freedom of association and protection of the right to organise convention was ratified by Ghana on June 1965. • Discrimination (employment and occupation) convention was ratified by Ghana on April 1961. • Worst Forms of Child labour convention was ratified by Ghana on June 2000.	1930/1948/ 1958/1999
Guinea Current Large Marine Ecosystem Project (GCLME)	1999
Memorandum of Understanding Concerning Conservation Measure for Marine Turtles of the Atlantic Coast of Africa. Signed by Ghana on November 1999.	1998
FAO Code of Conduct for Responsible Fisheries	1995
United Nations Framework Convention on Climate Change (UNFCCC). Signed and by Ghana on June 1992 and ratified by Ghana on 1995.	1992
United Nations Conference on Environment and Development (Earth Summit). A product of this conference was Agenda 21, a non-binding action plan regarding sustainable development which has been signed by Ghana.	1992
Convention on Biological Diversity (CBD). Signed by Ghana on June 1992 and ratified by Ghana on 1994.	1992
Convention on the Ban of the Import into Africa and the Control of Transboundary Movement of Hazardous Wastes within Africa – Bamako Convention. Signed by Ghana on July 2004.	1991

Name of the Convention / Agreement	Date of adoption
Convention on Fisheries Cooperation among African States Bordering the Atlantic Ocean	1991
The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention). Acceded by Ghana on May 2003.	1989
Ramsar Convention on Wetlands of International Importance, especially Waterfowl Habitats (Ramsar, Iran). Entered in to force in Ghana on June 1988.	1988
Montreal Protocol on Substances that deplete the Ozone Layer. Signed by Ghana on January 1989 and ratified by Ghana on July 1989.	1987
Vienna Convention for the Protection of the Ozone Layer. Acceded by Ghana on July 1989.	1985
United Nation Convention on the Law of the Sea (UNCLOS), Montego Bay, Jamaica. Signed by Ghana on 1982 and ratified by Ghana on 1994.	1982
African Charter on Human and People's Rights. Ratified by Ghana on January 1989 and signed by Ghana on July 2004.	1981
Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention). Signed by Ghana on March 1981 and ratified by Ghana on July 1989.	1981
Convention on the Conservation of Migratory Species of Wild Animals. Entered into force in Ghana on April 1988.	1979
Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air Pollution, Noise and Vibration (ILO No 148). Ratified by Ghana on May 1986.	1977
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). The protocol of 1997 was signed by Ghana on October 2010. Annexes I and II were ratified by the Ghana government in 2010, and the remaining Annexes III to VI came into force in January 2011	1973/1978
Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention), Paris. Ratified by Ghana on July 1975.	1972
London Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter. Acceded by Ghana on July 2010.	1972
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND). Ratified by Ghana on April 1978.	1971
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION). Ratified by Ghana on April 1978.	1969
International Convention on Civil Liability for Oil Pollution Damage (CLC). Ratified by Ghana on April 1978.	1969
International Commission for the Conservation of Atlantic Tunas (ICCAT). Founded in 1966 and first meeting was in 1969. Ghana joined in 1968.	1968
African Convention on Conservation of Nature and Natural Resources. Signed by Ghana on September 1968 and ratified by Ghana on May 1969.	1968
International Covenant on Economic, Social and Cultural Rights. Signed and ratified by Ghana on September 2000.	1966
International Covenant on Civil and Political Rights. Signed and ratified by Ghana on September 2000.	1966

Name of the Convention / Agreement	Date of adoption
Geneva Conventions on the Law of the Sea (removal of offshore installations). Signed by Ghana on April 1958.	1958
Convention on International Civil Aviation (Chicago Convention). Ratified by Ghana on May 1957.	1944

4 PROJECT DESCRIPTION

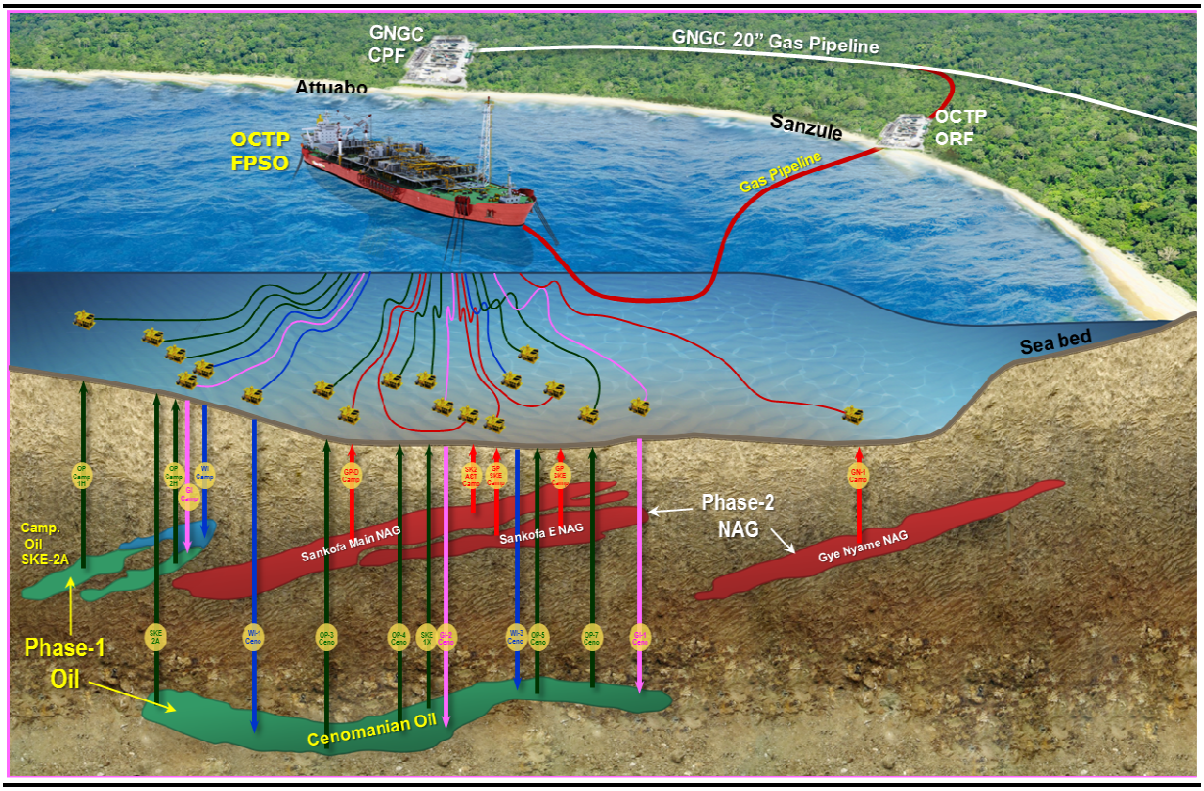
4.1 SUMMARY OF PROJECT ACTIVITIES

The Project and Project activities are described in detail in the EIS report. The following is a summary.

The OTCP Project comprises two phases.

- **Phase 1: Oil Development Project.** This phase will consist of 14 subsea wells (8 oil producers, 3 water injectors and 3 associated gas injectors), subsea facilities, and a Floating Production, Storage and Offloading (FPSO) unit that would be located about 60 km offshore south of Sanzule.
- **Phase 2: Gas Development Project.** This phase will consist of 5 subsea wells, subsea facilities, gas treating facilities on the FPSO unit, a 63 km subsea gas pipeline, an Onshore Receiving Facility (ORF), and tie-in with the GNPC sales gas pipeline.

Figure 4.1 OCTP Development Project



Source: Eni, 2015

Implementation of the development will include the following steps:

- **Onshore Site Preparation**: equipment mobilization, material transport, site clearance and infilling for the ORF (Onshore Receiving Facility) and construction of internal roads.

- **Offshore Construction:** well drilling and completion, subsea system installation, FPSO mooring and hook up, gas export pipeline laying, pre-commissioning and commissioning activities (well testing, FPSO commissioning, pipeline hydrotesting, subsea system testing)
- **Onshore Construction** (related to gas production): gas export pipeline installation (underground), ORF construction, permanent accommodation camp and helipad construction; temporary facilities construction, installation of pipeline from ORF to GNGC (underground), pre-commissioning and commissioning activities (ORF commissioning, pipeline hydrotesting).
- **Operation:** oil and gas extraction, reinjection of excess gas and produced water, oil stabilization and gas treatment on the FPSO, oil transportation via shuttle tankers, gas transportation via subsea pipeline, gas metering and compression at the ORF.
- **Decommissioning:** facilities will be decommissioned and abandoned, either by demolition and removal or cleaned and abandoned in place.

4.1.1 Well Drilling

Well drilling will be performed by the drilling rig *Maersk Voyager* (Figure 4.2). Well drilling requires the use of drilling fluids which are injected in the borehole to serve various purposes: move debris from the bottom of the well and carry it up to the surface, cool and lubricate the drilling bit, contain the fluids present in the rock formations, consolidate the walls of the borehole and reduce infiltration into the formation. The drilling fluids can be water or oil based depending on the drilling conditions. Both drilling fluids will used in this case: water based drilling mud for the shallow drilling section and non-aqueous drilling fluid system for the deep drilling section. There will be no discharges of exhaust drilling muds in the environment. Appropriately treated drilling cuttings will be discharged to the seabed near the drilling point. Collected liquids will be offloaded periodically to the supply vessel tanks and then carried to land for treatment and disposal.

Figure 4.2 Maersk Voyager Drilling Rig (left) and Illustration of an FPSO (right)



Source: Eni, 2015

4.1.2 FPSO Operation

The FPSO unit (Figure 4.2) will be constructed in Singapore and will then be towed to the Ghana for installation.

The FPSO unit's processing systems will perform the following:

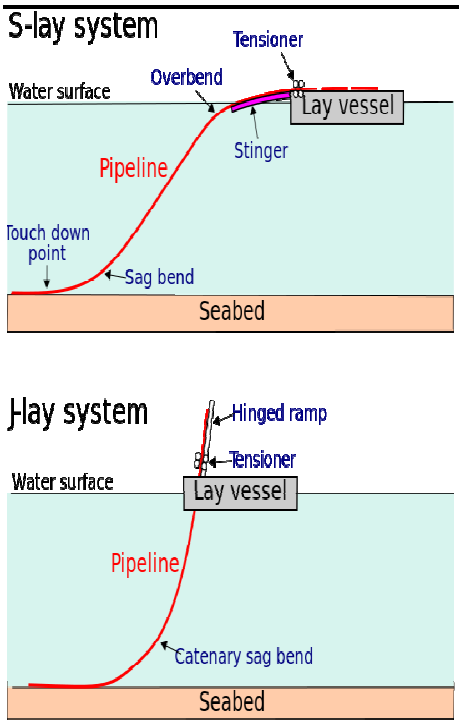
- separate, process to export specification, store and offload crude oil;
- separate, dehydrate, compress and re-inject associated gas;
- treat non associated gas to separate condensates and dry the gas;
- separate, treat and re-inject produced water; and
- lift and treat sea water.

The design, positioning and configuration of the FPSO considers the worst ocean conditions. The hull is designed to withstand 20 years of operation. In order to mitigate tank corrosion, a corrosion protection coating will be applied to ballast tanks and upper and bottom cargo tanks surfaces. The FPSO will provide accommodation for a total of 136 persons.

4.1.3 Offshore Pipeline

A 63 km long rigid pipeline will be laid on the seabed. The main subsea pipeline will be laid by two lay barges using the S laying mode for shallow water section and J laying mode, for the deepest water (Figure 4.3).

Figure 4.3 S-lay and J-lay methods



Source: ERM, 2015

4.1.4 Onshore Facilities

Onshore there will be both temporary construction facilities and permanent operations facilities (Figure 4.4):

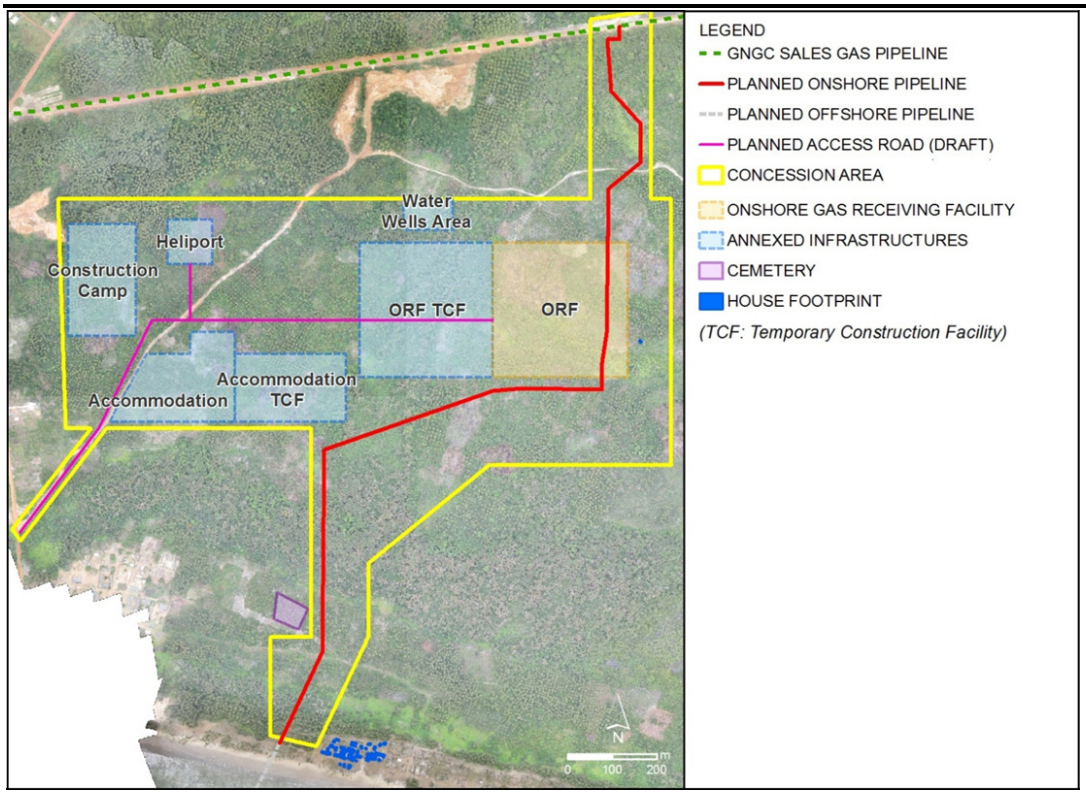
- Permanent facilities: ORF, permanent worker accommodation camp, helipad, roads and pipelines.
- Temporary construction facilities: temporary construction site, temporary accommodation camp, and construction camp.

The initial step in the onshore construction process will involve clearing vegetation and levelling the site. The site road network will be constructed at this stage to assist the movement of heavy equipment.

The construction of the ORF is a conventional civil project and does not require unusual heavy equipment or construction techniques. The major machinery needed are bulldozers, heavy excavators, soil removal trucks, large heavy-lift cranes, generators, excavators, and rock breakers.

The temporary accommodation camp will be constructed to house personnel during the three-year construction phase estimated at 400 to 600 workers. The permanent accommodation camp will be about 27,000 m^2 and will be located near the ORF. The camp will house about 45 workers involved in the operation of the onshore facilities.

Figure 4.4 Onshore Facilities Layout



Source: ERM, 2015

4.1.5 Onshore Pipeline

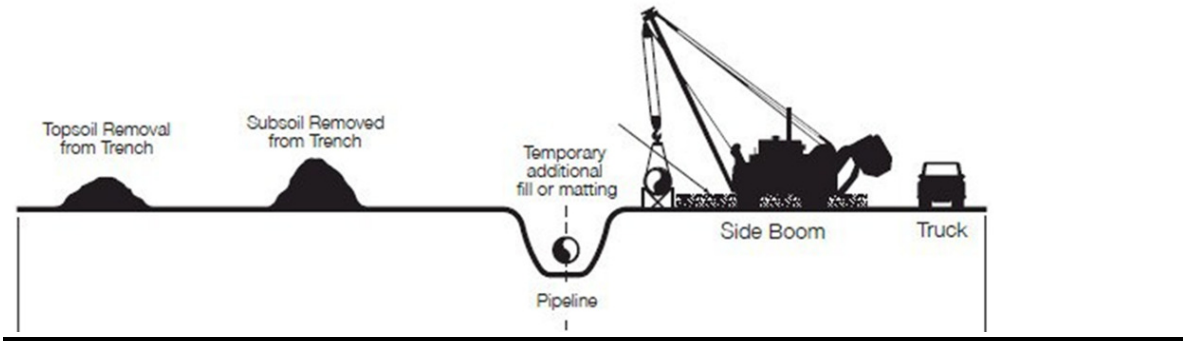
There will be two sections of gas pipeline onshore:

- Pipeline connecting the offshore section to the ORF (about 1,500 m); and

- Pipeline connecting the ORF to the existing GNGC gas pipeline (about 800 m).

The onshore pipelines will be installed underground. This will involve clearing a strip about 34 m wide and digging a trench. On one side of the trench, excavated topsoil and other material will be separately stockpiled. On the other side of the trench the pipeline assembly and vehicles movements will occur. A typical cross section of the construction working strip is shown in Figure 4.5.

Figure 4.5 Pipeline Laying Activity



Source: ERM, 2015

4.2 PROJECT SCHEDULE

Well drilling is planned to start in August 2015. The FPSO will be installed in June 2017. Oil production is expected to start in 2017 and gas production in 2018.

4.3 USE OF RESOURCES AND ENVIRONMENTAL INTERFERENCES

The following section describes the interactions of the Project with the environment in terms of use of marine / coastal resources and environmental interference.

4.3.1 Land Use

Construction Phase

During the onshore construction phase, land will be needed for:

- construction of access roads and site access;
- construction sites for ORF, onshore section of the gas export pipeline, tie-in to the national grid including storage, accommodation, warehouse and parking; and
- temporary infrastructure (e.g. pipeline and construction yard, administration buildings, temporary accommodation camp).

The temporary land use that can temporarily affect fishing activities is the construction of the onshore section of the gas export line (landfall at the beach, and construction of pipeline from

landfall to ORF). After construction, the temporary sites, pipeline right of ways, and land surroundings the sites will be restored to their original condition.

Table 4.1 summarises the land required for construction activities at the onshore section of the gas export line, as foreseen at this stage.

Table 4.1 Land Use during Construction Phase

Component	Temporary Land Use
Onshore section of gas export pipeline (from landfall to ORF)	Working strip: max width 34 m length 1500 m Area: 51000 m^2

Source: ERM based on Eni data, 2014

Operations Phase

Land within the Concession area will be acquired (under a long term lease agreement) to allow for operations, maintenance and emergency access throughout the 20-year operational life of the project. Permanent facilities (ORF, accommodation camp and helipad) will be fenced for safety and security reasons. The remaining land of the Concession area will be accessible for the community commuting activities.

A safety zone of 50 m (25 m on each side) will be established over right of way for the onshore pipelines. The pipeline path will be clearly indicated and construction will be forbidden in this path. Free passage and movement of people will be granted.

Table 4.2 summarises the land required by the operation activities.

Table 4.2 Land Use during Operation Phase

Component	Permanent Land Take	Permanent Constraints
Onshore section of gas export pipeline (from landfall to ORF)	NA	Width 50 m (no construction activities allowed) Length 1500 m Area 75000 m^2

Source: ERM based on Eni data, 2014

Permanent and Temporary Safety Zones

Restricted access areas, such as advisory and exclusion zones, will be enforced around offshore facilities in the development area for the safety of all sea users. These areas will be mapped on international nautical charts and formally designated by the Ghana Maritime Authority and endorsed by the International Maritime Organisation (IMO). eni proposes to establish the following restricted areas:

- **Permanent safety zones.** A safety zone of 500 m radius surrounding the FPSO facility, endorsed by the IMO, will be legally enforceable. eni will provide a dedicated patrol vessel to monitor and patrol offshore buffer zones (personnel will be unarmed). Ghana

Navy, if required, will support eni's patrol vessel to assure the buffer zones to be respected.

- **Temporary safety zones.**

  - A safety zone of 500 m radius surrounding each of the drill centres when the Drilling Vessel will be established. Supply vessel will be supporting drilling activities and be located inside the exclusion zone. An exclusion zone around the pipeline landfall location of the gas export pipeline will also be established.

  - Beach access will be temporarily restricted during the installation of onshore section of gas export pipeline to ensure community safety. There will be an exclusion zone of approximately 100 m either side of the gas export pipeline preventing fishers from using the beach in front of the ORF land acquisition area for landing catches and boats and gathering for fish-mongering/trading activities. This area is small however, relative to the extent of the beach, and the exclusion zone will only be enforced during the installation of the pipeline.

4.3.2 Offshore Vessel Movements

Construction Phase

The Project will create an increase of vessel traffic on local routes connecting with the mainland, and in particular from Takoradi Port:

- traffic increase related to the pipelaying activities;
- traffic increase related to pipelaying barge supply and drilling rig support (diesel, material, pipe, crew on site, etc.); and
- traffic increase due to construction waste handling and waste water transportation.

Drilling material will arrive from abroad, transferred to the Takoradi logistic base and, when needed, sent offshore, through two Platforms Supply Vessels (on average 4 trips/week).

Personnel will be transported to the drilling rig from onshore using one helicopter, on average 2/4 trips per day.

Supply vessel supporting drilling activities will be located inside the temporary drilling safety zone.

Operations Phase

The marine traffic foreseen during the operational phase will be due mainly to supply the FPSO, FPSO offloading, and crew shift changes by air. Further marine traffic (average of 3 trips per week: types of vessels AHTS - Anchor Handling Tag Supply) will be generated during the maintenance and surveillance phase of the flowlines and offshore export pipeline.

The offshore personnel will be transported by helicopter from and to Takoradi, and the helicopter will also be used for emergency purposes. The helicopter will remain in the Takoradi military airport being able to reach all points on/offshore in relatively short time.

4.4 EHS PLANS, PROGRAMMES AND PROCEDURES

Eni Ghana, through its HSE IMS (Integrated Management System), is committed to the sustainable exploration and production of oil and gas in Ghana by applying its best standards, in order to protect the health and safety of its employees, contractors, visitors, and the general public, while preventing pollution and minimizing any adverse effects on the environment and the host community, in respect with their traditional values and historic heritage.

The HSE IMS is structured in line with IOGP Guidelines for the Development and Application of HSE Management Systems. It also is compliant with ISO 14001 and OSHAS 18001 regulations.

5 FISHERIES BASELINE ANALYSIS AND STAKEHOLDER CONSULTATIONS

5.1 INTRODUCTION

This chapter describes the current baseline for fish and fisheries in Ghana. It describes the fish species present in Ghanaian waters, provides information on fishing fleets and supporting infrastructure (eg, fishing ports), and fish landing data. It also describes the status of the Ghanaian fishing industry and its role in the national economy and people's livelihoods.

5.2 PROJECT AREA OF INFLUENCE

The Area of Influence (AoI) for fisheries resource and fishery livelihoods is illustrated in Figure 5.1 and Figure 5.2, respectively.

5.3 DATA SOURCES

Various data sources were used to develop this baseline description. It draws on the FIA prepared as part of the OCTP Phase 1 Environmental Impact Statement (EIS) which included primary data collection along the coastline in the Project area. Information from the OCTP Phase 1 FIA study has been supplemented with a subsequent catch study and further stakeholder engagement undertaken with fishing communities during social studies associated with impact assessments.

The following primary sources were used:

- Catch study of the coastal fisheries at Sanzule and Bakanta that included two seasons of sampling, one in April 2014 and a second one in October 2014, the latter during the upwelling season.

- Focus Group Discussions undertaken as part of the EIS for the OCTP Phase 1 Development: During the period of November 2013 to March 2014 consultations were carried out with the chief fishermen and fishermen of fishing towns in the six coastal districts of the Western Region. These included Sekondi, Axim, Dixcove, Half Assini, Shama, Sanzule and Bakanta. There were also discussions held with the Western Region Fisheries Commission.

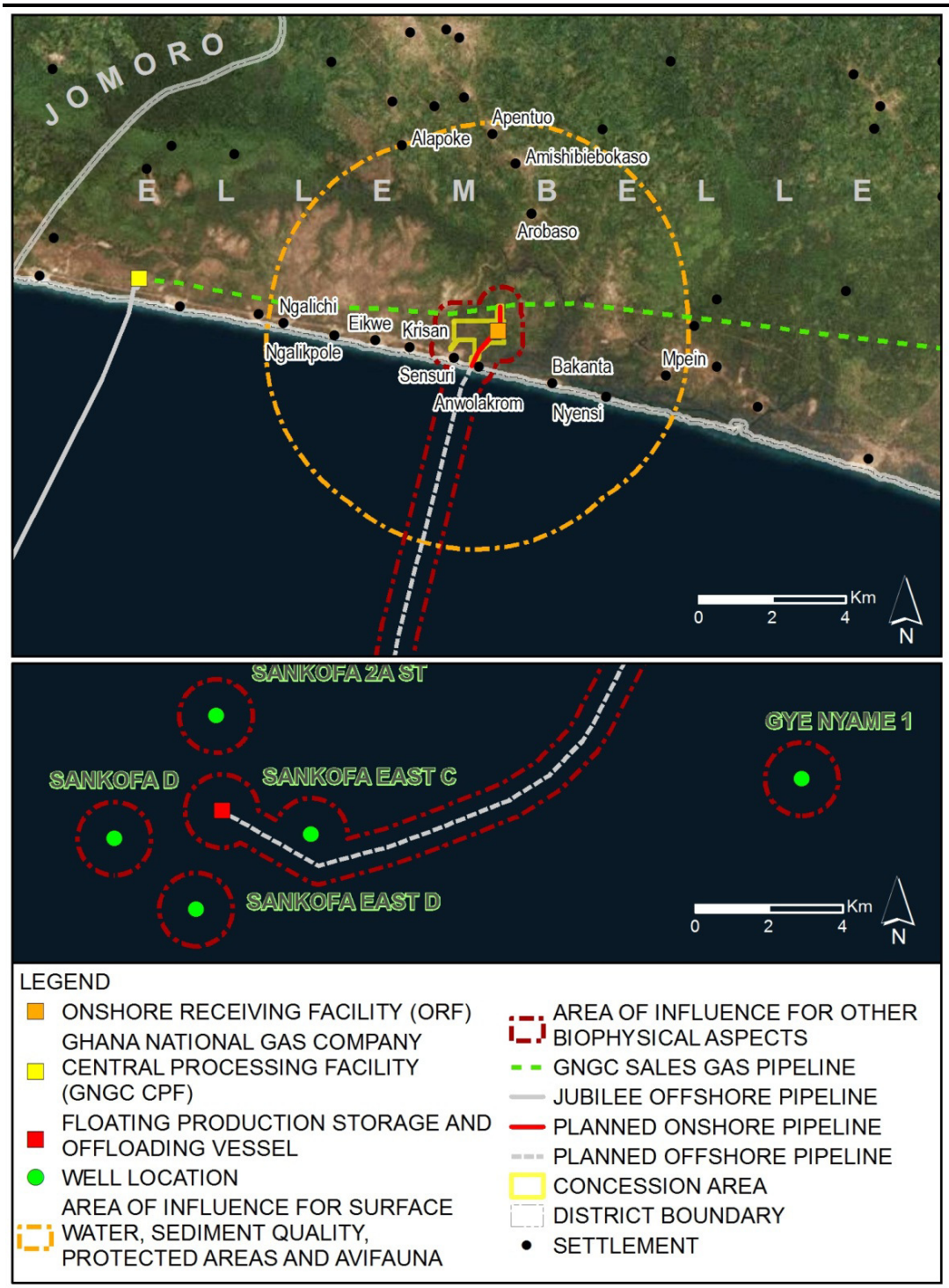
- Stakeholder engagement undertaken as part of the EIS for OCTP Phase 2 Development. Consultations were carried out in December 2014 with chief fishermen and fishermen of the extended AoI. Stakeholders consulted include: fisherman of Essiamam, Chief Fisherman of Upper Dixcove, Chief Fisherman of Upper Axim, Chief Fisherman of Half Assini, and Chief Fisherman of Sekondi. Additionally, as part of the social baseline data gathering, consultations with fishers of the 10 communities within the Direct Area of Influence took place in December 2014. Details can be found in Annex A, SEP.

Secondary sources included:

- FIA of the OCTP Phase 1 Development;

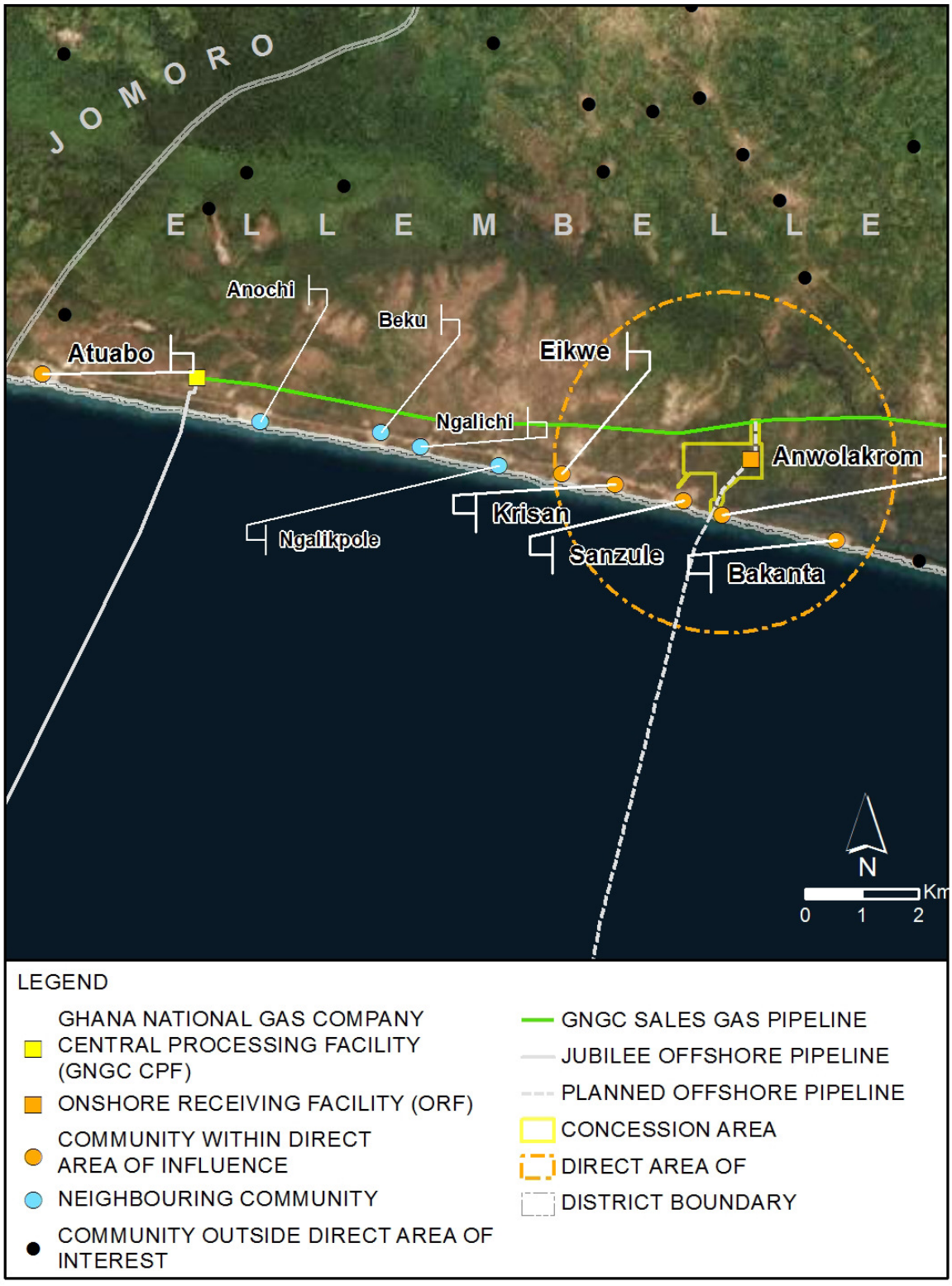
- Environmental impact assessment reports in the public domain;
- Technical studies commissioned by Eni Ghana; and
- Government reports and data from Marine Fisheries Research Division and the Fisheries Commission.

Figure 5.1 Area of Influence for Fisheries Resource (Environmental)



Source: ERM, 2015

Figure 5.2 Area of Influence for Fisheries livelihoods (Social)



Source: ERM, 2015

5.4 RELEVANT SPECIES AND ECOSYSTEMS

The Ghana Exclusive Economic Zone (EEZ) is located within the Central West African Upwelling System. Seasonal upwelling of cold, nutrient rich water stimulates primary productivity in the area, which in turn increases the production of zooplankton and fish. A weak upwelling occurs from January to March, and an intense upwelling from July to September.

The fish species found in Ghanaian waters can be divided into groups, namely:

- Small pelagic species;
- Large pelagic species (eg, tuna and billfish);
- Demersal (ie, bottom dwelling) species;
- Molluscs and crustaceans; and
- Deep sea species.

A review of these groups of species, as well as of threatened and endangered species is found in the following sections.

5.4.1 Small pelagic species

The main small pelagic fish species found in the coastal and offshore waters of Ghana are round sardinella (*Sardinella aurita*), madeira/ flat sardinella (*S. maderensis*), European anchovy (*Engraulis encrasicolus*) and chub mackerel (*Scomber japonicus*). Other notable species that are caught include horse mackerel (Trachurus sp.), little tunny (*Euthynnus alletteratus*), bonga shad (*Ethmalosa fimbriata*), African moonfish (*Selene dorsalis*), West African ilisha (*Ilisha africana*), crevalle jack (*Caranx hippos*), Atlantic bumper (*Chloroscombrus chrysurus*) and barracuda (*Sphyraena* spp.). These species have important functions within in the ecosystem as both predators and prey.

5.4.2 Large pelagic species

Large pelagic fish species include the key tuna species, namely skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*). These species are highly migratory and occupy the surface waters of the entire tropical and sub-tropical Atlantic Ocean. They are important species in the ecosystem as both predators and prey. Billfish species are also exploited in much lower but notable numbers and include Swordfish (*Xiphias gladius*), Atlantic blue marlin (*Makaira nigricans*) and Atlantic sailfish (*Istiophorus albicans*).

Juveniles and small adults of these species school at the surface either in groups of the same species or mixed and are often associated with floating objects such as floating seaweed, pieces of wood and stationary, anchored or drifting vessels. The attraction to these objects is likely to be linked to predator avoidance and a focus of aggregation behaviour. Some species come to feed on prey attracted to floating objects.

5.4.3 Demersal fish species

In general, demersal fish are widespread on the continental shelf along the entire length of the Ghanaian coastline.

Demersal species include the following: porgies or seabreams (Sparidae) (eg, bluespotted seabream *Pagrus caeruleostictus*, Angola dentex *Dentex angolensis* , Congo dentex *Dentex congoensis*, Canary dentex *Dentex canariensis* and pink dentex *Dentex gibbosus*); Grunts (Haemulidae) (eg, bigeye grunt *Brachydeuterus auritus* and to a lesser degree sompat grunt *Pomadasys jubelini* and bastard grunt *Pomadasys incises*); coakers or drums (Sciaenidae) (eg, red pandora *Pellagus bellottii*, cassava croaker *Pseudotolithus senegalensis*); goatfishes (Mullidae) (eg, West African goatfish *Pseudupeneus prayensis*); snappers (Lutjanidae) (eg, golden African snapper *Lutjanus fulgens*, goreean snapper *Lutjanus goreensis*); groupers (Serranidae) (eg, qhite grouper *Epinephelus aeneus*); threadfins (Polynemidae) (eg, lesser African threadfin *Galeoides decadactylus*); emperors (Lethrinidae) (e.g. Atlantic emperor *Lethrinus atlanticus*); and triggerfish (eg, grey triggerfish *Balistes capriscus*).

The composition and abundance of demersal fish species in the western Gulf of Guinea varies according to depth. This is partly due to substrate and food preference, and partly due to temperature preferences. Two distinct groups or demersal assemblages are noted: those that inhabit soft to muddy bottoms usually above the base of the thermocline; and those found on hard bottoms which are above the base of the thermocline at approximately 50 m, while below the thermocline they inhabit a much wider variety of habitats.

In addition, other factors such as total organic matter content, temperature, salinity and dissolved oxygen have also been shown to determine the distribution of demersal fish species within the wider Gulf of Guinea.

5.4.4 Molluscs and crustaceans

Molluscs and crustaceans present in the coastal Area of Influence include the common cuttlefish (*Sepia officinalis*), common squid (*Loligo vulgaris*), common octopus (*Octopus vulgaris*) and the green (Spiny) lobster (*Panulirus regius*), deep-sea roseshrimp (*Parapenaeus longirostris*) and other shrimps (mainly southern pink shrimp *Penaeus notialis*, caramote prawn *Penaeus kerathurus* and Guinea shrimp *Parapenaeopsis atlantica*). Of these species the highest catches are of the cuttlefish species, followed by the crustaceans, particularly green (Spiny) lobster. The cuttlefish species, including the common cuttlefish and the pink cuttlefish, are both caught in Ghanaian waters and are both eastern Atlantic species.

5.4.5 Deepwater species

Deepwater sea species are those beyond and below the depth of the continental shelf, and these can be pelagic or demersal. Over 180 deepwater species have been reported offshore Ghana, including approximately 110 predominately pelagic species, 60 predominantly demersal species, and 10 species that migrate between the lower and higher layer of the water column. There is limited information on the distribution of these species within the project area and, generally, within Ghanaian waters.

5.4.6 Threatened and endangered species

Fish species in Ghanaian waters that are listed on the IUCN Red List as 'Sensitive' include: *Epinephelus itajara* (goliath grouper – Critically endangered), *Pristis pectinata* (wide sawfish– Critically endangered), *Pristis perotteti* (largetooth sawfish – Critically endangered), *Dasyatis margarita* (ray species – Endangered), *Epinephelus marginatus* (dusky grouper – Endangered), *Raja undulata* (undulate ray – Endangered), *Rhinobatos cemiculus* (blackchin

guitarfish– Endangered), *Rhinobatos rhinobatos* (common guitarfish – Endangered), *Rhynchobatus luebberti* (Lubbert's guitarfish – Endangered), *Rostroraja alba* (bottlenose skate – Endangered) and *Sphyrna lewini* (scalloped hammerhead – Endangered).

None of these species are found in depths below 550 m with most being found shallower than 200 m.

There is also a global concern regarding tuna stocks. Bigeye tuna, is listed as Vulnerable on the IUCN Red List and southern bluefin tuna is listed as Critically Endangered. The International Commission for the Conservation of Atlantic Tunas (ICCAT) has listed bigeye tuna as the species of greatest concern after the bluefin tuna, in terms of population status and the unsustainable levels of exploitation.

In addition, two species of angle sharks (*Squatina aculeata* and S. Oculata) are considered as Critically Endangered.

5.5 FISHING FLEETS AND GEARS

The Ghanaian marine fishing fleet is divided into four main groups: artisanal, nearshore and inshore, industrial/offshore and tuna. Additionally there are a large number of vessels from these groups dedicated to fishing sharks for fins.

The number of vessels operating in Ghana for each of the fleets is included in Table 5.1. As can be seen, the vast majority of operational vessels are involved in the artisanal sector (more than 95%), highlighting its importance in terms of employment.

Table 5.1 Number of vessels operating in Ghana (2000-2012)

Fishing Fleet	Number of vessels	
	2000	**2012**
Artisanal	8,610	11,219
Inshore (semi-industrial)	173	381
Industrial* (offshore distant)	49	102
Tuna	37	34
Total	**8,871**	**11,736**

*Excluding tuna fleet

Source: Marine Fisheries Research Division, 2012

5.5.1 Artisanal fleet

Artisanal fishing is mainly operated from beaches by means of canoes. It provides employment in coastal communities to more than 124,000 people. The 11,200 operational artisanal fishing boats in 2012 are estimated to contribute 70-80% of the marine fish output in Ghana (FAO 2010).

The artisanal fleet comprises mainly wooden canoes (Figure 5.3). There are three types of canoe in Ghana: 3 to 5 m small dugout canoes mainly propelled by paddle; medium 6 to 11 m wooden canoes propelled by paddle, sail and outboard engine; and large 12 to 18 m wooden canoes mainly motorized by outboard engine (Doyi 1984). Approximately 50 to 60% of the canoes are powered by outboard motors with engine power of less than 40 hp (FAO

2010, Kwadjosse 2009). Crews for the larger canoes range between 4 and 30 people, depending on the canoe size and fishing gear.

Generally, artisanal fishing targets small pelagic and demersal species but also large pelagic species and some molluscs and crustaceans. The type of fishing gear used depends on the species being targeted and the geographic distributions of the species along the Ghanaian coast. For example, beach seine is widely used in the Volta Region in the eastern part of Ghana, particularly around the mouth of the Volta River and other estuarine areas, to exploit juvenile fish. These areas are nursery grounds for several important fish species such as mullet, carangid and croakers as well as shrimps.

Purse seine nets are prominent in the Greater Accra and Central Region where small pelagic species are heavily exploited. Drift gill nets and set-nets are the most common gear used in the Western and Central Regions. The small pelagic species are mainly exploited by the artisanal purse seines and beach seines. Purse seiners target adult sardinella species and chub mackerel and beach seiners target the sardinella species and during the non-upwelling periods, both target anchovies and juvenile sardinella species in coastal waters. Beach seines are operated from the beach and exploit adult sardinellas during the upwelling periods and anchovies and juveniles ardinellas during the non-upwelling periods (www.fao.org).

Figure 5.3 Typical Large Artisanal Fishing Canoes



Source: ERM 2014

Hook and line, and beach seines are the main artisanal gears used to exploit demersal fish. Hook and line canoes operate in waters of about 80 m in areas of hard bottom. The main species targeted are seabreams (eg pink dentex, bluespotted seabrean and canary dentex), snappers (e.g. golden African snapper, gorean snapper), grunts (e.g. bigeye grunt), goatfishes (e.g. West African goatfish), mullets cutlassfish and groupers (e.g. white grouper)

(FAO, 2010) . The beach seine exploits both adult and juvenile demersal fish but mainly juvenile fish. Some of their target species include burrito (Brachydeuterus auritus), red snapper (Lutjanus fulgens) and grey snapper (www.fao.org).

Drifting gillnets are used offshore to exploit mainly large pelagics such as sharks (Carcharhinus spp.), tunas (Thunnus albacares, Thunnus obesus), sailfish (Istiophorus albicans) and swordfish (Xiphias gladius) (www.fao.org).

Artisanal gears are also used to exploit molluscs and crustaceans. Beach seines are used to exploit shrimps, mainly adult and juvenile Guinea/white shrimp and tiger shrimp/camarote prawn and juvenile pink/candied shrimp as they move from the estuaries into marine waters. Lobster set nets target royal spiny lobster, on rocky bottoms and in depths of about 40 m. In addition cephalopods (common cuttlefish, common squid, and common octopus) are targeted (TFS, 2011).

5.5.2 Nearshore and Inshore fleet

The inshore (or semi-industrial) fishing fleet consists of locally built wooden vessels fitted with inboard engines of up to 400 hp ranging between 8 m and 37 m in length. Vessels with lengths less than 12 m are referred to as small-sized while those between 12 and 22 m are referred to as medium-sized vessels (FAO, 2010). There are about 300 inshore vessels, operating from seven landing centres, the larger centres being Takoradi, Tema, Elmina and Sekondi and the smaller centres being Apam, Axim, Mumford (TFS, 2011). Currently this sector is estimated to land about 2% of the total marine fish production (Kwadjosse, 2009).

The inshore fleets are mainly multi-purpose and operate as purse-seiners during the upwelling periods and switching to bottom trawling for the rest of the year (see Figure 5.4). Most purse-seine nets measure 400 to 800 m long, are 40 to 70 m deep and have a mesh size of approximately 25 to 40 mm. Bottom trawl gear has a mesh of 40 mm at the end of the net (cod end), 45 m head rope and 40 m foot rope. The fishermen in this category can stay offshore for three to five days depending on the availability of catch and as such carry ice for preserving fish. The purse-seiners target the small pelagic species including sardinella species, chub mackerel, fishing in the same coastal waters as the artisanal fleet during the upwelling seasons. Demersal species are targeted through trawling, with the small sized vessels targeting species including grey triggerfish. The medium-sized trawlers exploit seabreams (bluespotted seabream and canary dentex), snappers (e.g. golden African snapper, gorean snapper), grunts (e.g. bigeye grunt), croakers (e.g. red pandora, cassava croaker) and groupers (e.g. white grouper) (FAO, 2010). Bottom trawling is undertaken in waters greater than 30 m depth.

Figure 5.4 Nearshore Fishing Boats and Gear



Source: ESL 2014

5.5.3 Industrial fleet

The industrial fishing fleet is composed of trawlers, shrimpers and tuna boats that may remain at sea for periods that last up to one month. According to FAO (2014) the fleet in Ghana includes approximately 60 trawlers and about 29 tuna boats. Trawlers are normally over 35 m in length and have engines of over 600 hp.

As deep-sea vessels, they are required by the Fisheries Act of 2002 (Act 625) to operate outside the Inshore Exclusion Zone (IEZ), that is in waters greater than 30 m depth, but as they cannot trawl in depths greater than 75 m (due to the state of disrepair of vessels and engines), the operational area is limited to areas between these two depths.

Main targets are semi pelagic and demersal species including porgies or seabreams, jacks (Caranx rhonchus), groupers, snappers, croakers (Pseudotolithus senegalensis), goatfishes (eg Pseudupeneus prayensis), soles and flounders (Soleidae) as well as cuttlefishes (eg Sepia officinalis) and shrimps.

In 2007 the landings of demersal fishes were approximately 70,000 tonnes (FAO, 2014).

Illegal trawling is reported also to occur in Ghanaian waters by foreign vessels entering and fishing illegally within the waters.

5.5.4 Tuna fleet

The gulf of Guinea hosts a very productive tuna fishery as a result of oceanographic conditions that attract tuna species due to the water temperatures, high densities of prey due to the upwelling, and the existence of spawning grounds for at least two tuna species,

yellowfin and bigeye tuna. As a result a tuna fleet has developed in the area that catches between 50,000 and 90,000 tonnes annually of three species: skipjack tuna, yellowfin tuna and bigeye tuna.

According to the assessments of the International Commission for the Conservation of Atlantic Tunas (ICCAT), that regularly assesses the tuna populations, the tuna fishery of yellowfin and bigeye tuna in the Atlantic are exploited to full capacity and do not allow an increase in catches without risk for the species. A 2008 report indicated that the stock of skipjack tuna is not thought to be overexploited despite the difficulties with assessing the real status of the population (ICCAT, 2008).

The geographic range for tuna fishery is between 37 km and 370 km (or 200 NM of the EEZ), while the FPSO is about 60 km from the shore.

5.5.5 Shark fishing

Despite not a specific fleet, the exploitation of shark fins has become a widespread business in Ghana, where species like silky shark (Carcharhinus falsiformis), black tip shark (Carcharhinus limbatus), oceanic whitetip shark (Carcharhinus longimanus), sandbar shark (Carcharhinus plumbeus) and night shark (Carcharhinus signatus) are commonly targeted throughout the year, and specially in October and December (DoF, 2003). The fishing gears used for the sharks are mainly driftnets.

Shark fishing is performed by the inshore artisanal fishermen at very few locations (eg Dixcove) who use outboard motors. This fishery is on the decline as new enforcement regimes are being implemented.

5.6 MARINE FISH LANDINGS

In general, landings of marine fish in Ghana are declining although landings of small pelagics have shown slight increase since 1997. The landings of large pelagics have remained fairly stable, demersal species show a general increase, while landings of molluscs and crustaceans have remained consistently low.

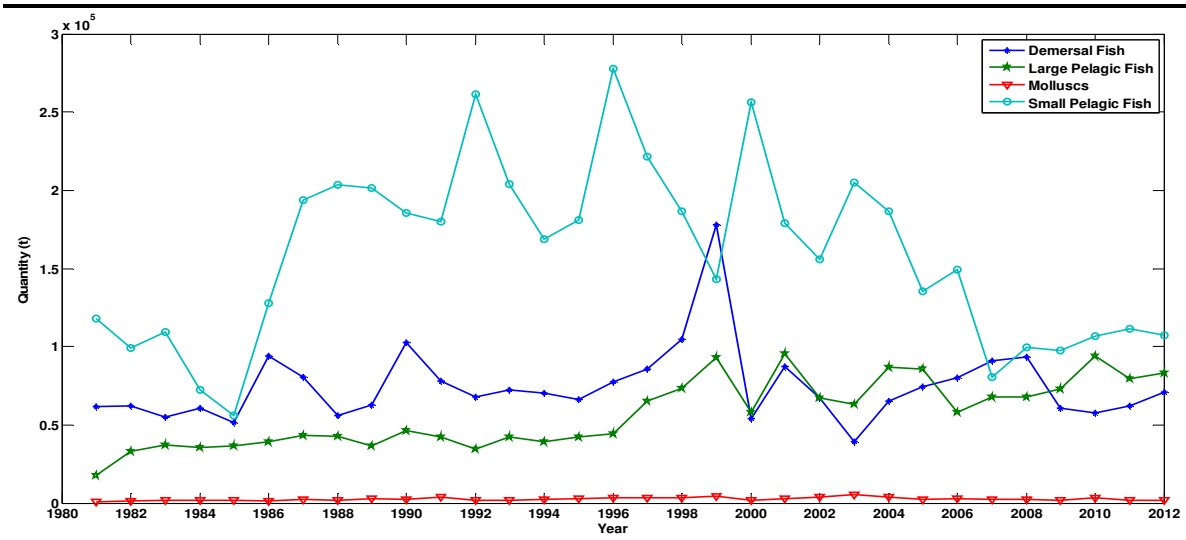
These data represent the total annual catches of the major target groups as seen in Figure 5.5but do not indicate fishing effort, which is an influential factor for quantity of catches.

5.6.1 Landings of Small Pelagic Fish Species

Data obtained for the landings of small pelagic species were limited to that of the four species of the highest economic value: round sardinella, Madeira/flat sardinella, European anchovy and chub mackerel. Annually, these four species account for approximately 80% of the total landings of small pelagic fish in Ghana (MoFA, 2004).

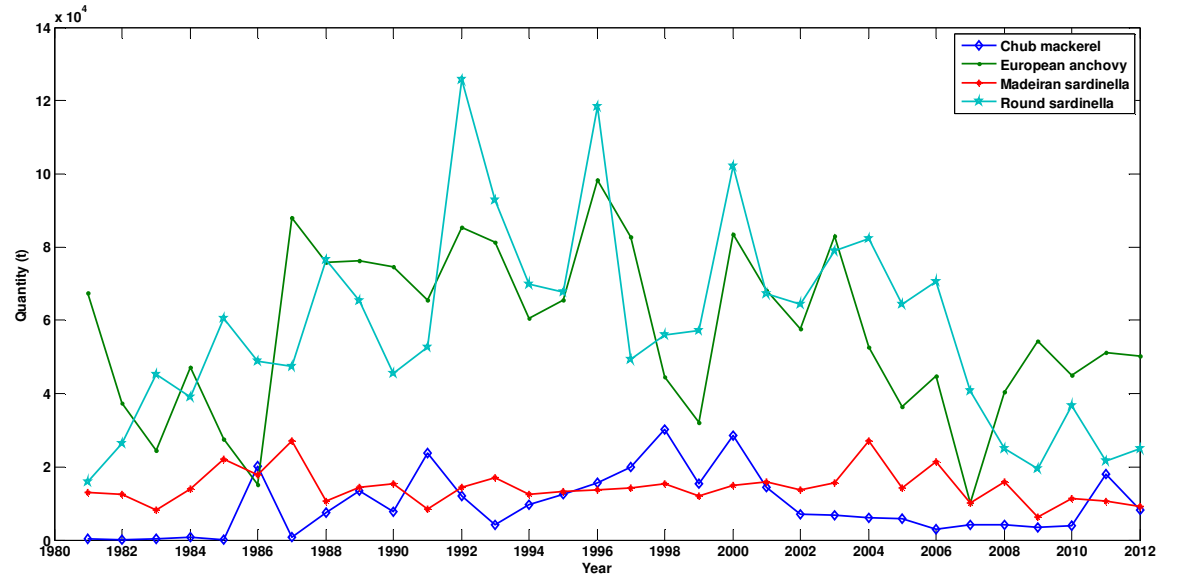
The potential annual yield of these species was estimated to be in the region of 200,000 t in 2004 (MoFA, 2004) but data from 1981 to 2012 show an average annual catch landing of 139,308 t (Standard Deviation: 47,730). The annual reported catches of the key four small pelagic species from 1988 to 2012 showed a rise in the landings of both round sardinella and European anchovy in the past two decades while landings of the flat sardinella and chub mackerel was relatively constant (see Figure 5.6).

Figure 5.5 Total Landings of Major Target Fish Groups in Ghana (1981 to 2012)



Source: (FAO FishStat, 2014)

Figure 5.6 Landings of Small Pelagic Fish in Ghanaian Waters (1981 to 2012)



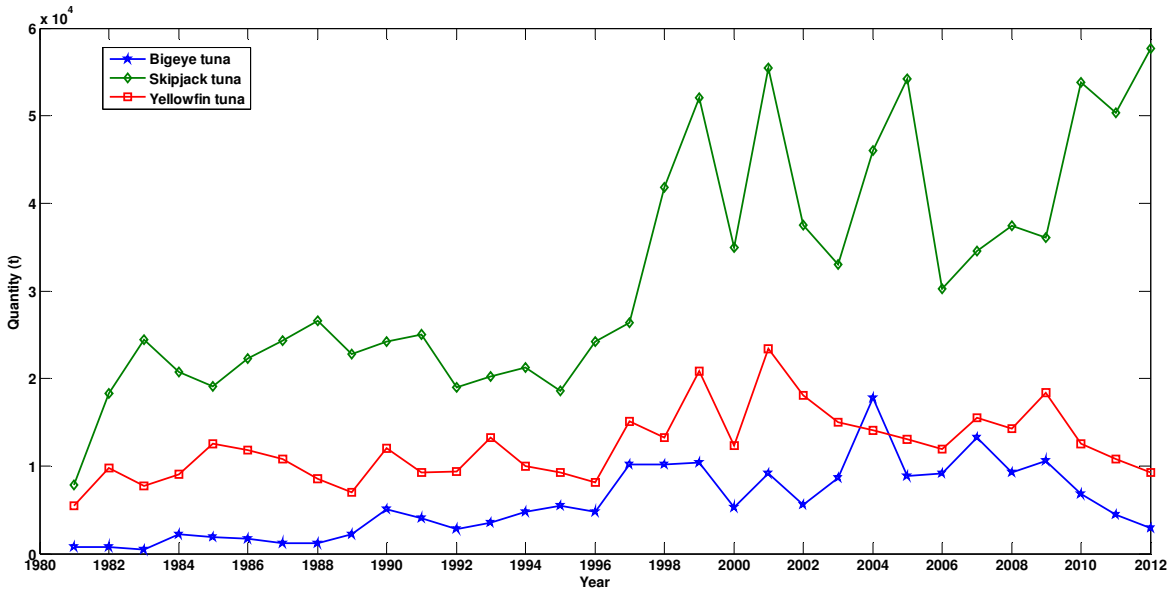
Source: (FAO FishStat, 2014)

5.6.2 Landings of Large Pelagic Fish Species

The landings of this group of fish species found in Ghanaian waters are estimated from the catch estimates of tuna species. The tuna species that occur in Ghanaian waters are part of a wider population found throughout the Atlantic Ocean. More than 60% of all tuna species caught are skipjack tuna due to the fact that skipjack are resident species and hardly migrate from their spawning/ breeding grounds in Ghanaian waters. According to ICCAT, approximately 60% of tuna caught are undersized since tuna fishing usually occurs in spawning areas and as such tuna caught are not yet mature (TFS, 2011)

From Figure 5.7, the total annual landings of yellowfin tuna, bigeye tuna and skipjack tuna have fluctuated between approximately 52,000 t and approximately 70,000 t from 2000 to 2012 with catches of skipjack tuna consistently being larger than the other two. Catches of yellowfin tuna reached a peak in 2001 at just over 33,500 t and has shown a steady decline ever since. The annual mean landing of large pelagic fish is approximately 50,000 t with a standard deviation of approximately 19,000 t estimated between 1981 and 2012.

Figure 5.7 Landings of Large Pelagic Fish Species in Ghanaian Waters (1981 to 2012)



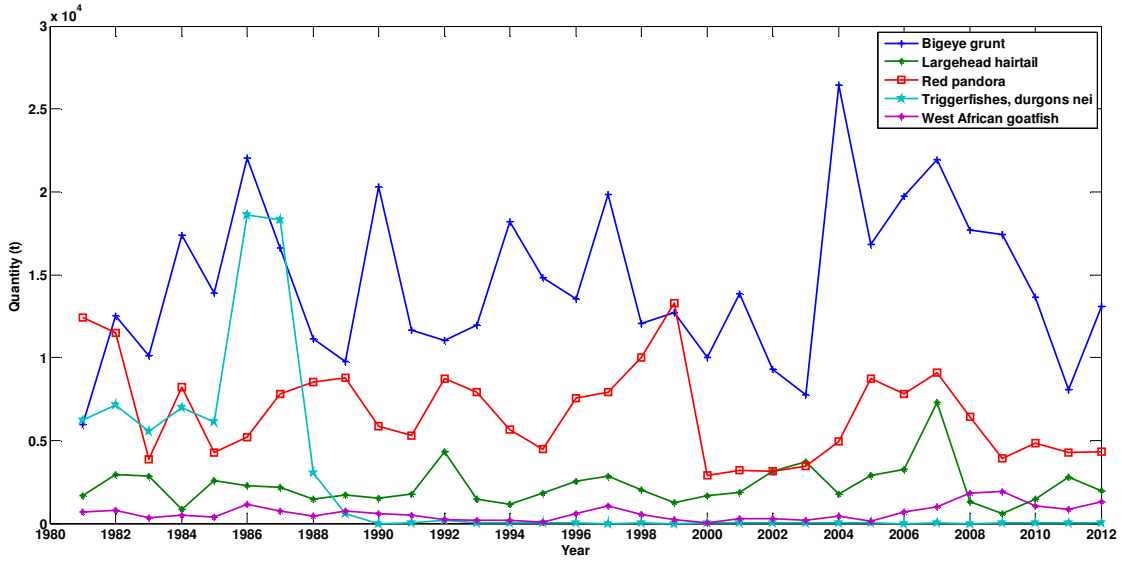
Source: (FAO FishStat, 2014)

5.6.3 Landing of Demersal Fish Species

Landings of key demersal species have varied considerably from 1998 to 2012. There was a marked increase in the landings of bigeye grunt (*Brachydeuterus auritus*) up to 2007, after which landings have fallen dramatically. red pandora (*Pellagus bellottii*) landings were consistently low between 2000 and 2004, with higher levels between 2005 and 2007, after which catch has been declining. An annual average of approximately 26,000 t (standard deviation of approximately 8,000 t) of Demersal fish was landed between 1981 and 2012.

Generally landing of the key demersal species has declined in recent years with the exception of the West African goatfish (*Pseudupeneus prayensis*) which appear to have increased steadily since 2005 (Figure 5.8).

Figure 5.8 Landings of Demersal Fish Species in Ghanaian Waters (1981 to 2012)

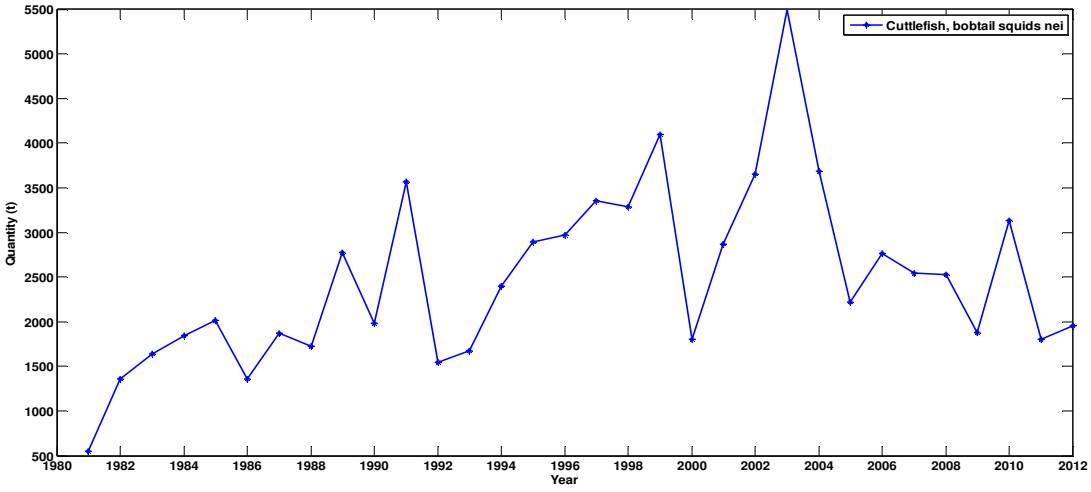


Source: (FAO FishStat, 2014)

5.6.4 Landings of Molluscs and Crustaceans

Cuttlefish are the most important species in this group of fish species. The annual landings of Cuttlefish peaked in 2003 and then declined to 2000 levels from 2005 with marginal fluctuations. An annual average of approximately 2,500 t (standard deviation of approximately 1,000 t) of molluscs and crustaceans was landed between 1981 and 2012 (Figure 5.9).

Figure 5.9 Landings of cuttlefish in Ghanaian waters between 1981 and 2012



Source: (FAO FishStat, 2014)

5.6.5 Bycatch

Bycatch from the industrial fishing sector are important commercially in Ghana as trawlers sell unwanted bycatches of non-target species to smaller vessels at sea (Marquette et al.,2002; Nunoo, 2009). The efficiency of this process has been enhanced by the use of modern communications and navigation equipment (Nunoo 2009). The operation of the bycatch business is centred mainly in Elmina, Apam and Tema.

It is difficult to quantify the importance of this trade since most of the bycatch is not recorded as catch by fisheries officers at the landing locations (the bycatch are transhipped at sea to local artisanal fisherman). The market demand has led to offshore vessels to fish closer to shore and it has been reported that illegal mesh sizes have been used to enhance bycatch quantities.

Some key species of bycatch traded in this way are snakefish (Trachinocephaleus myops) (approximately 32%), wedge sole (Dicologoglossa cuneata) (approximately 25%), pearly razorfish (Xyrichtys novacula) (approximately 13%), and Atlantic bigeye (Priacanthus arenatus) (approximately 6%) (Nunoo, 2009).

5.6.6 Sharks and Rays

Some shark and ray fishing is officially reported for Ghana, however, little data is available. The exploitation of shark fins has become a widespread business in Ghana. Dixcove is one location where many fishermen fish for sharks and there is a trade in shark fins. Shark fishing is a year-round operation with a peak in October and December (IMM, 2003).

Shark fishing is conducted from different types of vessels, including artisanal, inshore and industrial and it is estimated that as many as 150,000 fishermen might be involved in it (Mensah and Koranteng 1988). The sharks are caught using driftnet. Species caught comprise blue shark (*Prionace glauca*), hammerhead shark (*Sphyrna* spp.), silky shark (*Carcharhinus falsiformis*), blacktip shark (*Carcharhinus limbatus*), oceanic whitetip shark (*Carcharhinus longimanus*), sandbar shark (*Carcharhinus plumbeus*) and night shark (*Carcharhinus signatus*). In addition, sharks can be caught as bycatch by purse-seiners as well as bottom set gill nets. The shark fin fishery poses threats to some species listed as 'Endangered' or 'Critically Endangered' on the IUCN Red List.

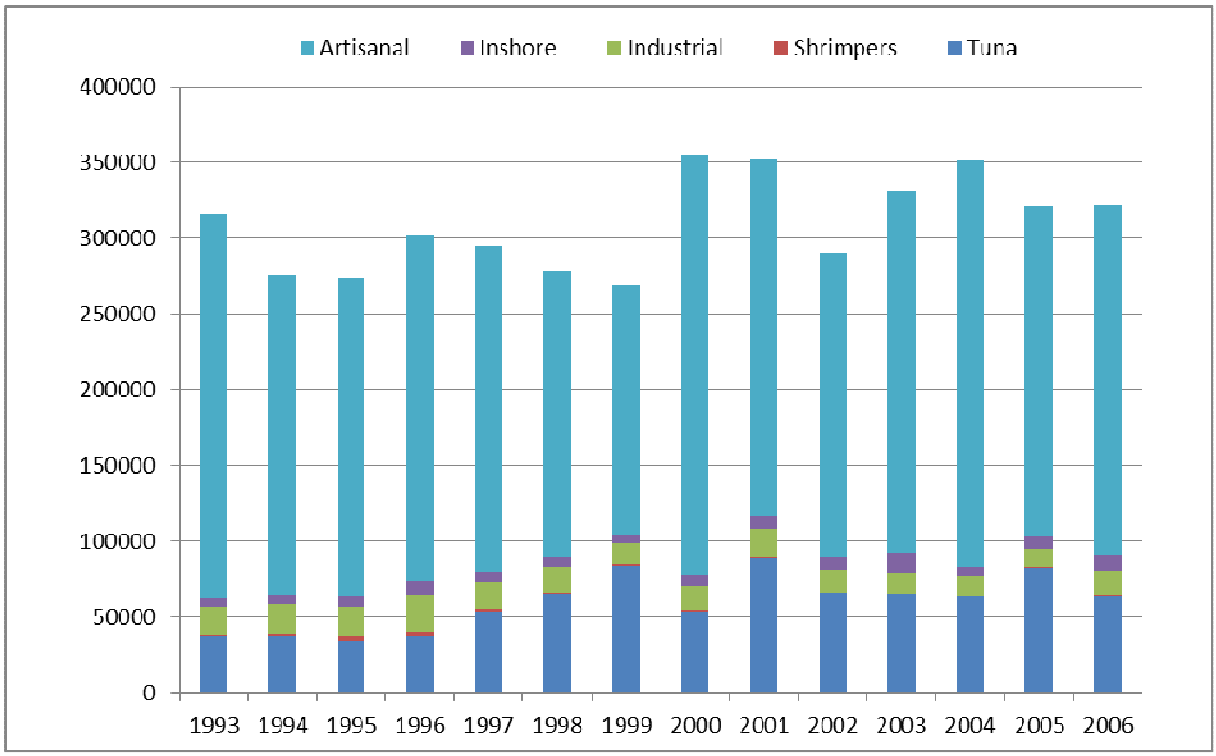
5.6.7 Marine Fish Landings by Fleet

Fish landings for each fleet in the Ghanaian fishing industry has been fluctuating over the years, but the artisanal sector has always landed the majority of the catch in terms of total weight (approximately 70 to 80%). The industrial fleet is the second largest in terms of catch landings followed by the inshore fleet. Within the industrial fleet, the tuna vessels have the largest landings followed by the trawlers (Figure 5.10 and Figure 5.11). The landings for the shrimpers have declined over the years and it is understood that none are operational in Ghanaian waters over the previous five years (MFRD 2011).

Fish landings from the artisanal fleet have been fluctuating over the years. The causes include both natural and man-made factors. Naturally, climatic factors (e.g. increasing sea surface temperature resulting in increasing salinity) as well as man-made pressures in the

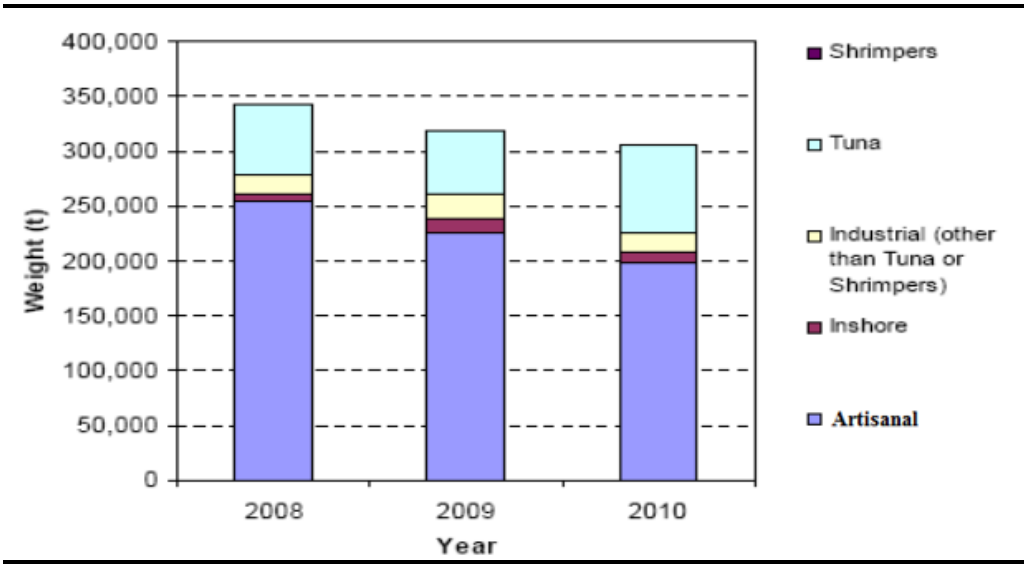
form of over exploitation and the use of illegal fishing practices (e.g. dynamite and destructive chemical practices, light fishing etc.) are believed to have contributed to this situation.

Figure 5.10 Fish landings by Fleet operating in Ghana between 1993 and 2006



Source Marine Marine Fisheries Research Division, 2011

Figure 5.11 Fish landings by Fleet operating in Ghana between 2008 and 2010

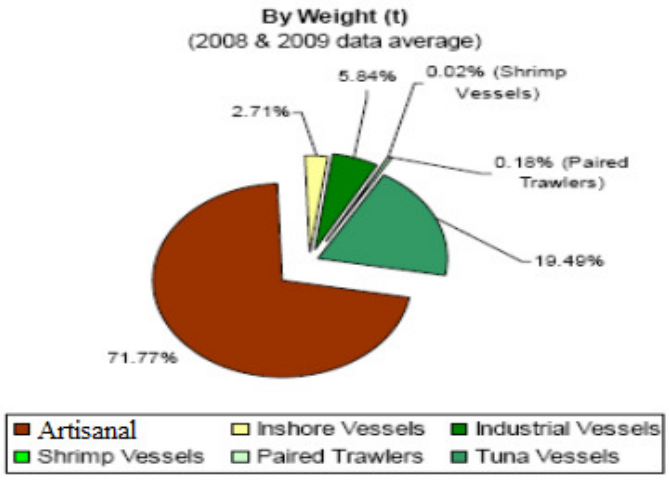


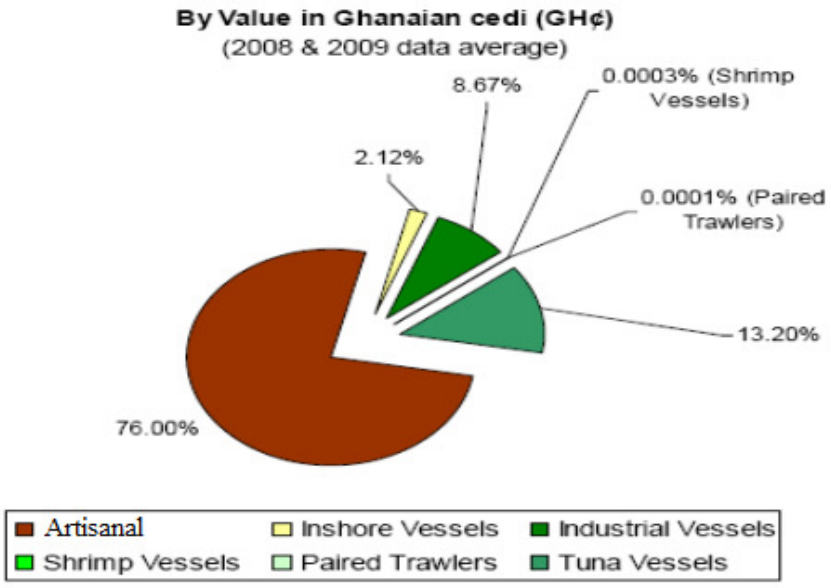
Source Marine Marine Fisheries Research Division, 2011

Even though the fish landings from the artisanal fleet fluctuates it is estimated to account for about 90% of total landings of the small pelagic resources and about 50% of total demersal fish landings annually (FAO, 2010). With regard to molluscs and crustaceans, until the early 1980s artisanal fishers accounted for over 60% of landings annually. More recently the exploitation of this resource has been dominated by the industrial trawlers (FAO 2010). In recent times, artisanal fisheries have accounted for 65 to 75% of total landed catch, the tuna vessels an additional approximately 20% and the other industrial vessels (trawlers) for approximately 6%.

These statistics translate directly into the amount of revenue generated from the landings of these fleets. Artisanal fleets contributed to about 76% of the revenue generated from marine fish landings while revenue from the tuna fleet accounted for 13.2%, industrial fleet (trawlers) 8.7%, and inshore fleet 2.1% as shown in Figure 5.12.

Figure 5.12 Marine Fish Production in Ghana (Averaged for 2008 and 2009, by vessel type according to weight and value)





Source: TFS, 2011

5.7 FISH CATCH SURVEYS

A survey of fish catch was conducted in Sanzule and Bakanta near where the onshore component of the proposed Project will be located. The survey was conducted twice: once in April 2014, end of the dry season, and again in October 2014, during the upwelling season.

5.7.1 Fishing Fleet and Gear

The Sanzule and Bakanta landing beach covers a shore line approximately 4 km long and about 0.5 km wide into the sea. The total number of canoes recorded in the Area of Influence includes five canoes at the Sanzule community and four canoes at Bakanta. The average length of the canoes in these beaches is 4.3 m and none of them use an outboard motor.

Beach seine is the fishing technique used by the fishermen of Sanzule and Bakanta. The particular gear used by fishermen observed during the survey was a net bag about 27.7 m long, and a 19.6 m circumference mouth opening. The mesh size of the end of the net bag is about 5/8th of an inch (approximately 1.6 cm).

The canoes at the study site are solely used for beach seining and operate throughout the year except on days when the sea is too turbulent. In addition, according to tradition canoes are not allowed to operate on Tuesdays.

Fishing operations usually last for four hours. Fishing operations are labour intensive with more than 30 people involved in each hauling process. The beach seine fishery is the only fish producer in the area. The towns have a combined fishing population of over 1500 inhabitants hence, beach seine fishing makes an important contribution to providing employment.

5.7.2 Fish Catch

As detailed in Section 5.3, a catch study was undertaken in April and October 2014 at Sanzule and Bakanta. Figure 5.2 shows the location of Bakanta and Sanzule beaches in relation with the project footprint and its environmental area of influence (orange and red dotted lines).

Fish Catch data collected during April 2014 survey

A total of 34 different species of fish, cephalopods and crustaceans was caught, including 26 species at Bakanta and 22 species at Sanzule. Table 5.2 shows the total catch of each species. Most common species of fish of commercial importance caught in beach seines in the Western Region include the two species of sardinella (round and flat), pompanos, croakers, bumpers, and groupers. The catch included also rays, flounders, crabs and puffer fishes.

The hauls sampled at both Sanzule and Bakanta in April 2014 contained significantly large amount of the Seaweed Sargassum spp. that accounted for the 85% and 89% of the total catch weight respectively. The remaing catch, composed by-catch incluiding fin-fish, crustaceans and mollusks, was 154 kg at Sanzule and 109 kg at Bankata. This indicates a Catch Per Unit Effort (CPUE) of 38.5 kg/hr and 27.25 kg/hr for Sanzule and Bankata respectively.

The catch was dominated by juveniles of commercially important species. None of the species captured were of conservational importance as listed in IUCN in Ghanaian waters.

Table 5.2 Fish Catch Composition at Sanzule and Bakanta (April 2014)

Scientific name	Common name	Total weight (kg)	
		Sanzule	Bakanta
Balistes punctatus	Grey triggerfish	0	1.6
Tylosurus acus rafale	Atlantic agujon needlefish	10	0
Bothus podas	Flounder	0	1.6
Alectis alexandrines	Alexandria pompano	0	2.4
Selena dorsalis	Moon fish	0.8	0
Trachinotus teraia	Shortfin pompano	1.2	14.8
Lichia amia	Leer fish	8	0
Chloroscombrus Chrysurus	Atlantic bumper	9.2	20
Caranx crysos	Blue runner	10	0
Ethmalosa dorsalis	Bonga shad	0	4
Ilisha Africana	West African ilisha	1.6	0
Sardinella aurita	Round sardinella	2	2.6
Sardinella rouxi	Yellowtail sardinella	8	4
Cynoglossus senegalensis	Senegalese tongue sole	1.6	2
Dasyatis margarita	Daisy stingray	2	2
Epinephelus goreensis juv.	Dungat grouper	1.6	2.4
Callinectes amnicola	Blue swimming crab	0	2
Pomadasys incises	Bastard grunt	0	1.6
Pomadasys jubelini	Sompat grunt	3.2	0
Brachydeuterus auritus	Bigeye grunt	22.8	2
Holocentrus hastatus	Squirrel fish	0	1.6
Medusa (Aurelia sp.*)*	Jellyfish	0	10.4
Mugil cephalus	Flathead grey mullet	6	2
Galeoidis decadactylus	Lesser African threadfin	6.8	2.8
Psettodis belcheri	Spottail spiny turbot	0	1.6
Raja miraletus	Brown/ peacock ray	2	0
Pomadisus juv	Burro	0	2.8
Umbrina canariensis	Canary drum	2	0
Pseudotolithus moorii	Cassava fish	2.4	10
Pseudotolithus typus	Cassava fish	50	2.4
Scomberomous tritor	Spanish mackerel	0.8	1.2
Sepia officinalis	Common cuttle fish	0	6.4
Sphyraena sphyraena	Guinea barracuda	2	0
Ephippion guttifer	Prickly puffer	0	1.6
Total		**154**	**105.8**

Source: ESL, 2014

October 2014

In October 2014, three hauls were sampled: one in Sanzule and two in Bakanta. A total of 21 species was recorded. Only three fish species, namely, blue runner, Guinea barracuda, and largehead hairtail (*Trichirus lepturus*) were common to all the three catches. None of the species captured were of conservational importance as listed by IUCN.

Fish catch at Sanzule was dominated by the anchovy (approximately 21% of total fish catch weight), blue runner (18%), and bigeye grunt (15%). Fish catch from the two beach seine operations at Bakanta was dominated by largehead hairtail and blue runner,

The total fish catch weight after the four hour average fishing duration period for was 185.9 kg, 81.32 kg and 109.7 kg respectively for Sanzule, and the two Bakanta hauls. The Catch Per Unit Effort (CPUE) was therefore of 46.5 kg/hr, 20.3 kg/hr and 27.4 kg/hr for Sanzule and Bakanta respectively.

The primary seasonal difference was a lower presence of seaweeds (*Sargassum* spp.) during the October study as only 5 kg were recovered (2.6% of the total catch) in Sanzule and none at Bakanta.

Although the diversity recorded in October is lower than the one recorded in the dry season, the total fish catch recorded at Sanzule was relatively higher than that recorded in April. Total fish catch weight recorded for each of the two beach seine operations at Bakanta, however was lower in October. Table 5.3 shows the total catch for of each species captured.

Table 5.3 Fish Catch Composition at Sanzule and Bakanta (October2014)

Scientific name	Common name	Total weight (kg		
		Sanzule	Bakanta	Bakanta II
Caranx chrysus	Blue runner	33.6	10.4	49.5
Chloroscrombus chrysirus	Atlantic bumper	5.6		0.05
Vomer setapinnis	Moon fish	8.4		0.25
Harengula rouxi	Yellowtail sardinella	2.1	1	
Illisha africana	Long-finned herring	5.6		0.1
Sardinella aurita	Round sardine		2.2	
Drepane africana	African sicklefish		0.5	
Elops lacerta	West African lady fish	4.9		
Engraulis encrasicolus	Anchovy	38.5		
Brachydeuterus auritus	Big eye grunt	27.3		
Pomadasys incisus	Bastard grunt	8.4		0.25
Pomadysis jubelini	Sompat grunt	3.5	1.3	
Medusa spp.	Jelly fish	12		
Panulirus	Spiny lobster	1.4	0.02	
Polydactylus quadrifilis	Threadfin			0.25
Pseudutolithus senegalensis	Cassava croacker	8.4		0.25
Sarda sarda	Atlantic burrito		0.6	
Sepia officinalis	Cuttle fish	1.4		
Sphyraena sphyraena	Guinea barracuda	10.1	1.8	27.5
Stromateus fiatola	Butter fish	3.5	0.5	

Scientific name	Common name	Total weight (kg		
		Sanzule	Bakanta	Bakanta II
Trichirus lepturus	Ribbon fish	11.2	63	31.5
Total		**185.9**	**81.3**	**109.7**

Source: ESL, 2014

5.8 SOCIO-ECONOMIC ASPECTS OF THE FISHING SECTOR

The information in this section is based on a desktop study supplemented by the engagements undertaken in 2014 by ESL and ERM. Additional information will be collected in the future through the Fisheries Monitoring Programme (see Section 6 for details).

The fishing industry in Ghana is based on fishery resources from the marine and to a lesser extent, inland or freshwater fisheries and aquaculture (Bank of Ghana, 2008). Marine fishing is an important traditional economic activity of the coastal communities in Ghana and contributes over 80 per cent of the total fish catch. Artisanal fishing in particular contributes about 70 to 80% of the total annual volume of marine fish catch of the country (Bank of Ghana, 2008). The socio-economic importance of the fisheries sector in coastal communities in the Western Region and the country as a whole cannot be overemphasised.

The Western Region has a 202 km long coastline, divided into six coastal districts namely: Jomoro, Ellembelle, Nzema East Municipality, Ahanta West, Sekondi-Takoradi Metropolis, and Shama (Figure 5.13). Comprising approximately 20-30% of the country's landing sites, the Western Region produces marine fish destined for markets throughout Ghana and beyond (deGraft-Johnson et al., 2010, Finegold et al., 2010, Gordon et al., 2011).

Figure 5.13 Map of the Six Coastal Districts of the Western Region



Source: CRC, 2013

A 2010 appraisal of 89 selected fishing communities in the six coastal districts indicated that most of the fishing communities in the six coastal districts were homogenous as portrayed by their socio-cultural characteristics (CRC / FON, 2010). The few heterogeneous communities were mainly found in the Sekondi-Takoradi Metropolis (CRC / FON, 2010).

There are many stakeholders providing services at each point in the fisheries value chain. The chain is, nevertheless, relatively straightforward involving only fishers, fish traders at the landings, fish processors and retailers (Adupong et al, 2011). Like in other coastal areas of Ghana, men of Western Region are central to fish harvesting while women are central to post-harvest activities such as fish processing and storage and trade activities (Adupong et al, 2011, Bank of Ghana, 2008).

Studies indicate that fishing and farming livelihoods in the coastal districts are interlinked. In the farming season (rainy seasons) income from fishing is used to purchase farming inputs. Investments shift back to fishing during the fishing seasons (CRC, 2013).

The 2010 population and housing census indicates that a population of 76,067 of the active labour force in the six coastal districts of the Western Region are skilled agricultural forestry and fishery workers (Ghana Statistical Service, 2010). The population distribution for the six coastal districts is shown in Table 5.4.

Table 5.4 Population Distribution of Agricultural, Forestry and Fishery Workers in the Six Coastal Districts of the Western Region

District	Total Population	Economically active (15 – 64 years)		Skilled agricultural, forestry, and fishery workers
		Employed	Unemployed	
Jomoro	150,107	54,297	3,572	20,477
Ellembelle	87,501	27,945	1,664	9,447
Nzema East Municipality	60828	22,416	1,436	12,664
Ahanta West	106,215	41,729	22,416	14,503
Sekondi-Takoradi	559,548	207,912	26,017	10,119
Shama	81,966	28,875	2,496	8,857
Total	**1,046,165**	**383,174**	**57,601**	**76,067**

Source: Ghana Statistical Service, 2010

5.8.1 Fish Harvesting

The fish harvesting system in the region involves a chain of activities including: purchase of equipment (canoes, mechanized wooden boats, nets, corks, weights, hook and lines); casting and dragging of nets; and on-board preservation using ice blocks (Gordon et al., 2011).

At most landings in Western Region, marine fishing is dominated by small-scale (artisanal) fishermen (CRC, 2013; Gordon et al., 2011). Studies indicate that roughly 5000 canoes operate in Western Region (Finegold et al., 2010 in Gordon et al., 2011).

For comparative purposes, Table 5.5 shows the various fishing activities and number of fishers in the Central and Western Regions of Ghana in 2004 and 2013. The situation has been relatively stable over this period. In 2004, a total of 118 fishing villages with 203 landing beaches were being operated, whereas in 2013, 116 fishing villages with 194 beach landing sites were operated.

Table 5.5 Composition of the Fishing Sector in the Central and Western Regions of Ghana in 2004 and 2013

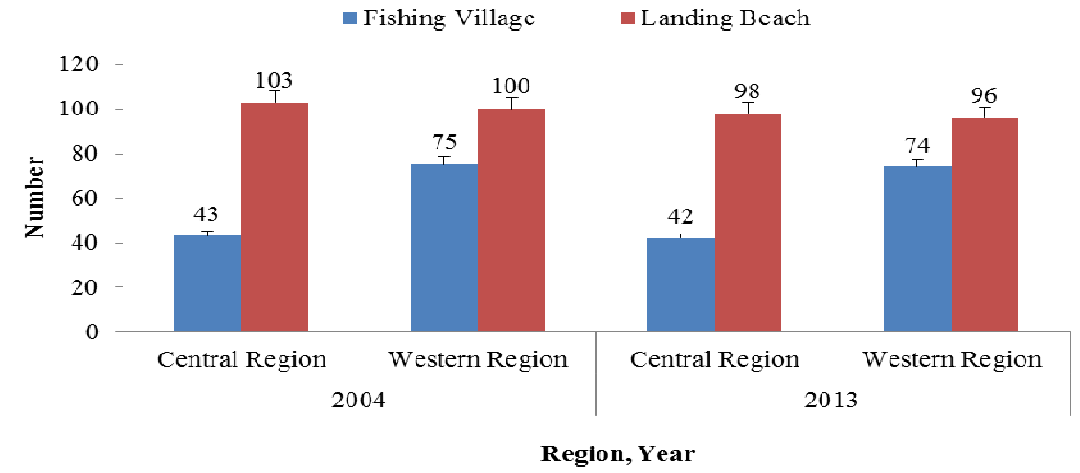
	2004			2013		
Fisheries Component	**Central Region**	**Western Region**	**Total**	**Central Region**	**Western Region**	**Total**
Fishing Village	43	75	**118**	42	74	**116**
Landing Beach	103	100	**203**	98	96	**194**
Pursing Nets	931	382	**1,313**	975	577	**1,552**
Beach Seine	198	163	**361**	221	236	**457**
Line	280	67	**347**	343	163	**506**
Lobster Nets	296	407	**703**	190	1,004	**1,194**
Other Set Nets	1,788	768	**2,556**	1578	679	**2,257**
Ali Net	710	761	**1,471**	527	1,084	**1,611**
Drifting Net	63	373	**436**	32	819	**851**
One-Man Canoe	184	325	**509**	23	452	**475**
Canoes	4,450	3,246	**7,696**	3,895	5,014	**8,909**
Total Motors	2,097	1,841	**3,938**	3,016	3,454	**6,470**
Fishermen	44,303	27,366	**71,669**	40,563	40,705	**81,268**

Source: Marine Fisheries Research Division, Ministry of Fisheries, 2014

Although there was a small decline in the number of fishing villages and landing beaches between 2004 and 2013 (Figure 5.14), the number of fishers (Figure 5.15), canoes (Figure 5.16) and operated gears (Figure 5.17) increased. In 2004, 47% of canoes in the Central Region were motorized, by 2013, 77% were motorized. In the Western Region, 57% of canoes were motorized; whiles in 2013, 69% were motorised. This implies that, more effort is being channelled into fishing activities in both regions.

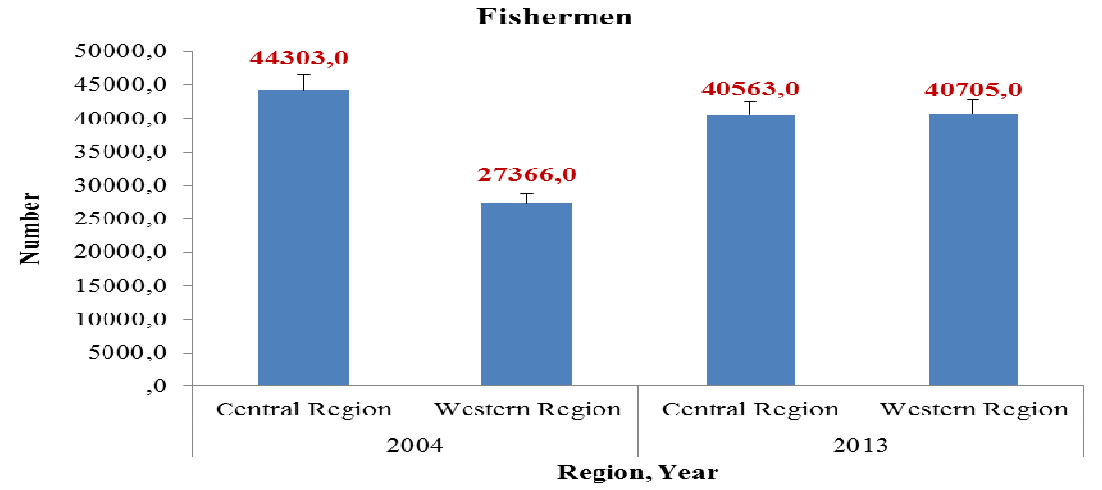
As at 2005, a total of 700 canoes were registered in the Ellembelle District. The Ellembelle District has 20 fishing villages (Ellembelle District Assembly, 2012), being the second largest district in terms of number of marine fishing villages. Thirty-one (31) out the 90 landing beaches in the Western Region are located in the Ellembelle district (Ellembelle District Assembly, 2012).

Figure 5.14 Number of Fishing Villages and Landing Beaches in Central and Western Region in 2004 and 2013



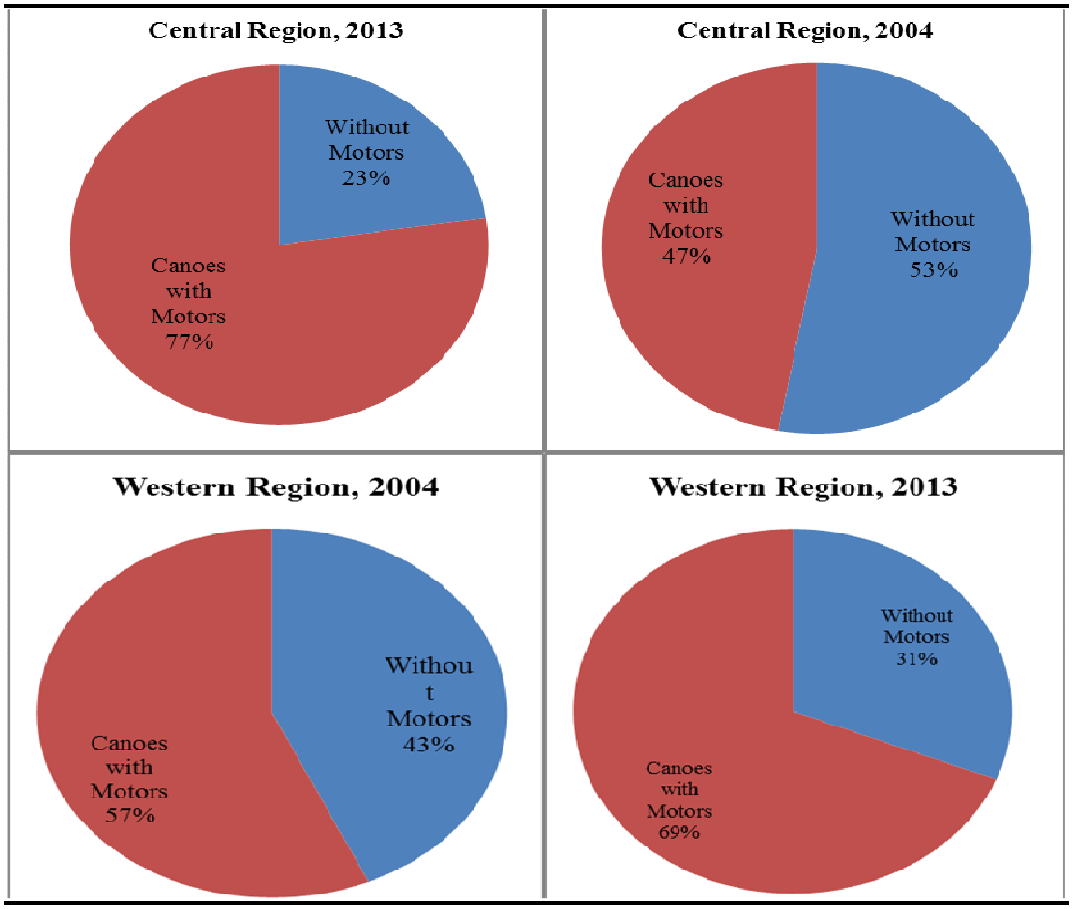
Source: Marine Fisheries Research Division, Ministry of Fisheries, 2014

Figure 5.15 Number of Fishers in Central and Western Region in 2004 and 2013



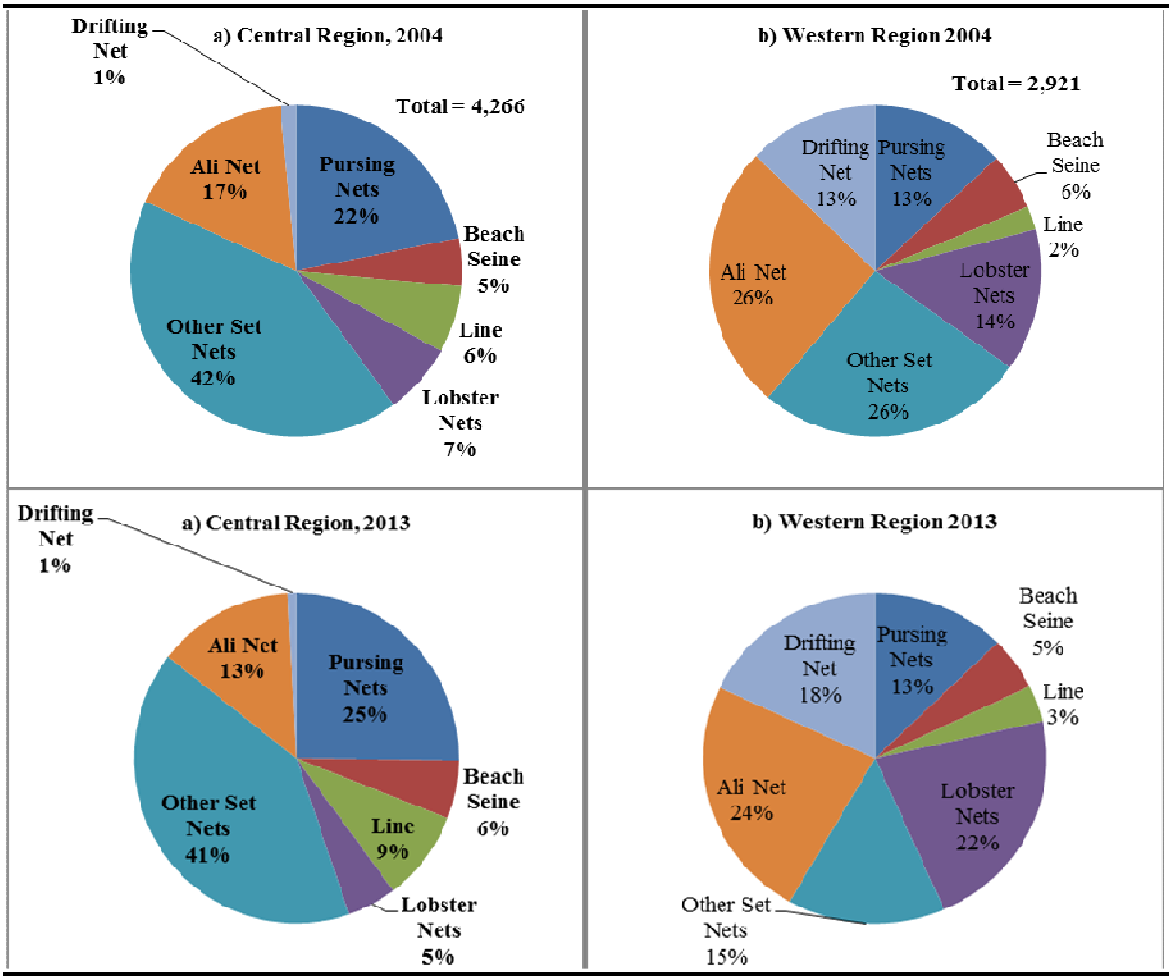
Source: Marine Fisheries Research Division, Ministry of Fisheries, 2014

Figure 5.16 Number of Canoes (motorised and non-motorised) in Central and Western Region in 2004 and 2013



Source: Marine Fisheries Research Division, Ministry of Fisheries, 2014

Figure 5.17 Fishing Gears Used in Central and Western Region in 2004 and 2013



Source: Marine Fisheries Research Division, Ministry of Fisheries, 2014

5.8.2 Fishing Gear and Catch Type

Gear used in the artisanal fishing industry include lobster net, set net, ali/poli/watsa net, drift gill net, ring net, purse seine, beach seine, cast net and crab traps (CRC/FON, 2010).

The artisanal purse seines and beach seines are exploiting mainly small pelagics in Ghanaian waters such as anchovies, sardinellas and chub mackerel. Figure 5.18 below shows beach seine fishing.

Figure 5.18 A Typical Beach Seine in Use



Source: ESL catch assessment study, April 2014

The hook and line and beach seines are the main artisanal gears used to exploit demersal resources (e.g. seamers, snappers and groupers) in Ghanaian deep waters of about 80 m on hard bottoms. Some of the hook and line canoes have facilities for storing ice to preserve fish and are therefore capable of staying up to three days at sea.

Drift gill nets deployed by artisanal fishers are used to target small pelagic species and , but some drift gill nets are used offshore to exploit large pelagic species such as Tunas, Sailfish, Swordfish and Sharks (FAO, 2010).

Artisanal gears are also used to exploit molluscs and crustaceans. Until 1983, the beach seines were the main exploiter of Cuttlefish in Ghanaian waters; accounting for over 60 percent of landings annually. Presently, the industrial trawlers account for majority of landings annually (www.fao.org). Beach seines are used to exploit shrimps mainly *Parapenaeopsis atlantica* and *Penaeus kerathurus* (both adult and juvenile) and juvenile *Penaeus notialis* as they move from the estuaries into marine waters. Lobster set nets target the spiny lobster, *Panulirus regius* on rocky bottoms and in depths of about 40 m (www.fao.org).

Tree trunks are used to make canoes and although the use of the preferred wood (wawa) is officially illegal to harvest (to protect the dwindling numbers of this tree), it seems this trade still occurs (Gordon et al., 2011). Vessel size varies from the small-sized paddled canoe to large-sized outboard motor-powered one, the most common motor being 40 hp outboards (CRC /FON, 2010; Gordon et al., 2011). Boat owners employ a number of fishers for fishing activities. The size of the crew ranges between 2 and 30 depending on the size of the canoe. Crew members are paid after every trip once operational costs are deducted from the proceeds, with larger shares going to the owner of the boat (/nets) and 50% of the profit shared among other crew members (Gordon et al., 2011).

5.8.3 Fishing Seasonality

During the major (July to September) and minor (January to March) upwelling periods, significant increase in fish catches (bumper seasons) is experienced, particularly of small pelagic species such as sardinella. The rest of the year is associated with little or no catches (lean season) in the pelagic fishery. The seasonality in marine fishery creates seasonal unemployment and also affects the balance of power in the market system: in the peak season, it is a buyer's market with the fishermen having less influence over prices, whilst in the low season; the fishermen have a stronger bargaining position (Gordon et al., 2011).

The use of lights (increasingly used by canoe fishers since 2003, but declared illegal in 2010) has to some extent taken the seasonality out of fishing – with lights attracting fish (even juveniles) and fishers able to maintain a reasonable catch year-round. However, with the enforcement of the new regulations, the marked seasonality in fishing is expected to return (Gordon et al., 2011).

Fishers typically fish on a daily basis and most observe a 'day of rest' once a week (Tuesdays in most places), especially in small fishing communities. A typical fishing trip can last up to 20 hours with the exception of hook-and-line fishers and those utilising drift gill nets, who go on 3 to 4 day trips and carry ice to preserve catches (Gordon et al., 2011). While some fishermen are fishing at sea, others are also onshore, mending and making nets and fishing gear (CRC, 2013). During the lean season some fishermen do not go fishing at all, because the small catches do not cover their costs (Gordon et al., 2011).

5.8.4 Fishing Criticalities

A 2010 rapid assessment of 89 selected fishing communities in the six coastal districts of the Western region, including 17 fishing communities in the Ellembelle District, indicated that fish

landings in most of the fishing communities such as Sanzule, Atuabo and Bakanta., have declined in recent years, and this has led to declining fishery livelihoods in the fishing communities (CRC / FON, 2010; CRC, 2013). The decline in fish catch is attributed, among other issues, to increasing people population leading to over-fishing, and use of damaging or illegal fishing methods such as light fishing, use of monofilament nets, dynamite, carbide, pair trawling and fishing with obnoxious substances. Illegal fishing practices also result in poor fish quality and reduces the shelf-life of processed fish (CRC, 2013). Added to this is the arrival of algae bloom which adversely affects artisanal marine fishing. Since 1993, marine algal blooms caused by the filamentous green alga *Enteromorpha flexuosa* - known locally as green-green, have been occurring every year (December- February) from Newtown to Cape Three Points. The presence of algal blooms has also been reported in the rivers and wetlands of the Amansuri at Bakanta and Ankobra at Sanwoma (CRC, 2013).

Post-harvest losses of fresh fish are manifested in down-grading of fish to less remunerative uses. There are reports that, during the peak season, about 10 to 30% of fishermen's catch are down-graded, as a result of poor on-board ice storage and handling (Gordon et al., 2011). Hence, fish that is not fit for smoking is re-graded and used to make a popular fermented fish product (locally known as 'momone'). Fish that is completely unfit for human consumption is traded for use as fishmeal (Gordon et al., 2011; CRC / FON, 2010). Processed fish may also suffer losses due to insect infestation. Though none of the 'spoilt' fish is discarded, it fetches around half the price of fish which is in good condition (Gordon et al., 2011).

5.8.5 Fish Marketing, Processing and Selling

Marketing

Most of the Western Region catch enters the processed fish marketing chain. Fish is purchased at the beach by resident traders, or by 'short-term migrant' traders there temporarily during periods of abundant catch and low prices (sometimes sub-contracting the processing locally, or it is immediately transported back to the home base of visiting traders and sold to processors there). These outcomes depend on relative prices, with traders juggling considerations of fresh and processed fish prices, as well as processing and transport costs, all of which will vary depending on market conditions (Gordon et al., 2011).

Power is concentrated in the hands of fish traders (at the landings) who pre-finance fishing operations, buy from the fishermen and sell to fish processors (CRC / FON 2010; Gordon et al., 2011). Particularly in smaller landing sites, the Queen Mother ('konkohene' – the fish mothers' leader), negotiates a price with the first boat that arrives and this price is generally valid for the rest of the day. In larger landing sites like Sekondi Harbour, this role has reportedly lost its importance and prices are negotiated on a boat-by-boat basis. The position of the konkohene is analogous to the Chief Fisherman. The konkohene is appointed by the fish mothers. She remains in power indefinitely or until her elders (also fish mothers) advise her to step down. Exchanges between fish mothers and processors/consumers are typically carried out at the landing site where the fish is purchased, although, fish mothers sometimes travel to the large landing sites to buy fish (Gordon et al., 2011).

Apart from acting as intermediaries at the various fishing harbours, fish mothers can also play important roles in informal finance. They almost always pre-finance the fishing trips with fuel, gas oil, kerosene, and food, thus securing access to that boat's catch. Depending on the financial position of the fish mothers and fishermen's need for credit, one fish mother

can support more than one fisherman. It is rare for fish mothers not to pre-finance fishers. Their support is not only restricted to fishers since, in some cases, they support processors by selling to them on credit. This however depends on the specific relationship between the processor and the fish mother. Transactions at the harbours are mainly based on informal agreements and mutual trust. It is this ability to command significant funds that gives fish mothers unique access to fish catches and why they are able to collectively influence fish prices.

Processing

Processing of fish, which represents an important sector for women, is concentrated at the small- and medium-scale levels. Processing technology is mainly traditional using manual labour. Fish is processed using several methods but the most common form of fish processing in the Western Region is smoking.

Studies indicate that although some of the larger landings have cold storage facilities, most of the facilities are non-operational or have low fish cold storage capacities (Ellembele District Assembly, 2012; Gordon et al., 2011). For example in the Ellembelle district, there are cold storage facilities at Kikam, Esiama and Aiyinasi. However, these cold storage facilities in the district have low capacities and lack adequate working capital. Furthermore, there are neither developed landing sites nor fish handling or processing facility in the district (Ellembele District Assembly, 2012).

Women engaged in fish smoking use the so-called 'chorkor smoker' kilns, (where fish is slowly smoked on stacked racks, with relatively efficient use of fuel wood and producing a relatively evenly-smoked product) and utilise various inputs such as baskets, basins, grills, basket nets, fuel wood, and brown paper (Gordon et al., 2011). Most of the processing takes place at the individual or household level and the most common species of fish processed is sardinella, known locally as 'eban' (also known as 'amane' in some areas), though it is common to see other types of smoked fish.

Processors mostly purchase fish from the fish traders, but there are cases where they purchase directly from fishermen. If there is insufficient supply of fish, processors travel to other landings to purchase fish (CRC / FON, 2010; Gordon et al., 2011).

Selling

Studies indicate that most fish processors do not wait for traders to come to them, but rather, they actively seek market opportunities by transporting smoked fish to various large markets within and outside their district or region of origin. In these markets, processors are excluded from selling directly to consumers (Gordon et al., 2011). They sell fish in packs of hundred to retailers who in turn retail to consumers in the same markets or smaller neighbouring markets. In some cases women who act as itinerant traders go to processors in their communities to buy the fish, which they sell to retailers in central markets (CRC / FON, 2010; Gordon et al., 2011).

Retailers sell smoked fish to consumers (individuals and food vendors) at the same (central) markets or in smaller, surrounding markets whilst others transport it to villages for retailing. The majority of these traders deal solely in smoked sardinella. However, a few sell other types of smoked fish as well. Though they operate as individuals, most retailers are members of trader associations. Members of these associations help each other in times of need and also share information on prices and supplies. They are typically headed by so called

'commodity queens' or Queen mother. The queen's main functions include the establishment of informal market rules as well as the settling of disputes between retailers. The commodity queens are appointed by an overall market queen whose role is inherited. In the lean season, when fish is scarce, those retailers that are able to afford it resort to purchasing frozen fish from local cold stores and smoke it themselves (CRC / FON, 2010; Gordon et al., 2011).

Smoked fish from Western Region is mainly destined for the domestic market where demand is very strong. Small quantities of smoked fish are traded in Togo, Benin and Nigeria (Gordon et al., 2011). For instance, processors from Shama sell their produce in Denu, a market on the Ghana-Togo border (Gordon et al., 2011). Smoked fish for export to regional countries is prepared and presented in a visually more attractive way and commands a higher price. However, the regional market for this product seems to be limited because the processors co-ordinate to sell on alternate market days, or risk flooding the market. The number of people engaged in this type of processing is small and limited to very few processing villages (only one (Shama) reported in the Western Region).

One study found that the average price per basin of smoked eban during the lean season in March 2011 was GHc 360 in Denu, compared to GHc 270 in other markets (Gordon et al., 2011). Basins (or pans) (Figure 5.19and Figure 5.20) are widely used to transport fish. With wet fish (live weight), a single basin weighs about 30 kgs. With smoked Sardinella, usually packed to hold 500 to 600 pieces each of roughly 25 g, then the basin weighs about 13 kg. For transportation, smoked fish is placed in wicker baskets, which are in turn bundled into packs of two. A single basin of smoked fish is equivalent to three packs (or 6 baskets).

Figure 5.19 Fishers Sorting a Catch



Source: ERM, 2014

Figure 5.20 Women Fishmongers Sorting a Catch

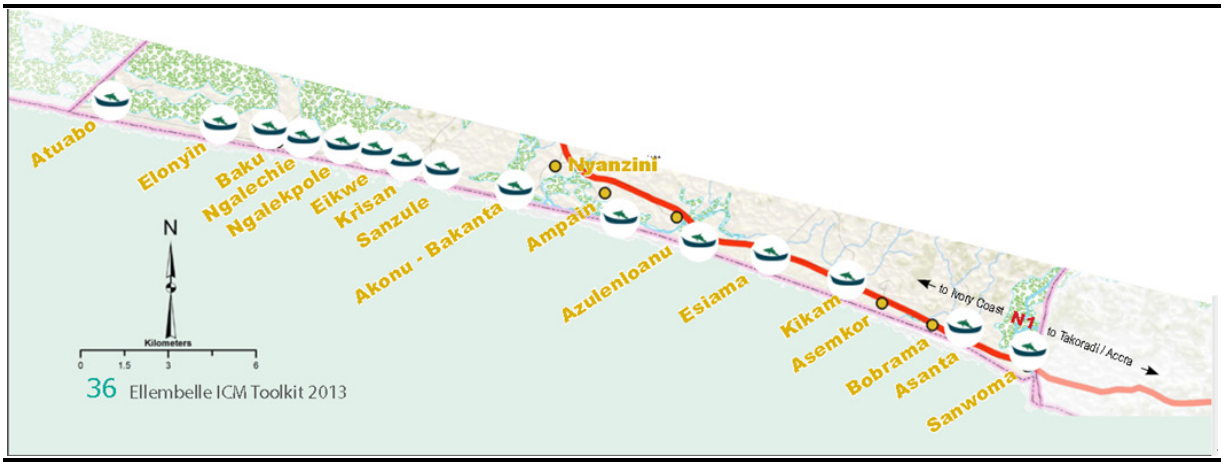


Source: ERM, 2014

5.8.6 Fishing Profile of the Ellembelle District

It is estimated that over 65% of the economically active population in the District are engaged in agriculture (including fishing) and agro-processing (Ellembelle District Assembly, 2012). In Sanzule for instance, the local economy is highly dependent on fishing (CRC /FON, 2010). The Ellembelle District ranks second in the country with regard to number of marine fishing villages. Thirty-one (31) out of the 90 landing beaches in the Western Region are found in the district. Fishing sites in Ellembelle District (where the Project is located) are shown in Figure 5.21, while statistics of the districts marine fishing industry are presented in Table 5.6.

Figure 5.21 Fishing Sites in Ellembelle District



Source: CRC, 2013

Table 5.6 Marine Fishing Statistics of the Ellembelle District

Item	Number
Fishing Villages	**20**
Landing Beaches	**31**
Total Canoes (registered as at 2005)	**700**

Source: Fisheries Department, Axim in Ellembelle District Assembly, 2012

A study conducted in 2010 estimated that, there are a total of 1,400 fishermen in Ellembelle District (CRC /FON, 2010). The size of fishing vessels used in the District varies from the small-sized paddled canoe to large-sized outboard motor-powered ones. Gears used in the artisanal fishing industry include lobster net, set net, ali/poli/watsa net, ali net, drift gill net, ring net, purse seine, beach seine, cast net and crab traps. There are only few motorized canoes using 40HP outboards (CRC / FON, 2010). The major fishing season is between July and September with a minor season occurring in November to January (Ellembelle District Assembly, 2014). The main species caught include Anchovies, Sardinellas, Sail Fish, Lobsters, Shrimps, Burrito, Big Eye Grunt, Bumper, Barracudas, Ribbon, Cassava Fish, King Fish, Tunas, Sole, Squid, Snapper, Sea Breams, Groupers, Threadfin, Mackerels, Sword Fish, and Sting Ray.

Though there are cold storage facilities at Kikam and Esiama and Aiyinasi, these facilities have low capacities and lack adequate working capital. Furthermore, there are neither developed landing sites nor fish handling or processing facilities in the District (Ellembelle District Assembly, 2012). The traditional stoves or kilns (chorkor smokers) used for fish smoking as modern fish processing facilities are non-existent. Thus, similar to that pertaining in other coastal districts in the region, there is poor processing, storage and handling of fish in the Ellembele District (CRC / FON, 2010).

Inland fishing (in fish ponds) is not well developed in the district. Most ponds are small in size usually 7 by 10 feet. It is estimated that there are 40 fish farmers with a total of 64 fishponds in the district (Ellembelle District Assembly, 2014).

In recent years, the area has experienced poverty in the coastal areas due to declining fish catches and invasion by algae bloom in the sea (CRC / FON, 2010). There are reports that fishers from neighbouring districts, especially Nzema-East come to decimate the waters with light fishing and other unapproved, unsustainable and dangerous fishing methods (eg, chemicals, dynamite) (CRC / FON, 2010).

Furthermore, there is a decline of traditional authority in fisheries management. The roles of Chief Fishermen and konkohene have been modified by rapidly changing market and demographic conditions. Political interference by government has further reduced the efficiency in their authority.

Traditionally, the sea is considered as a deity containing lesser gods. Abundance or scarcity of fish was attributed to the activities of these lesser gods (e.g. mermaids and mermen). In the event of fish scarcity, the gods are pacified through performance (CRC / FON, 2010).

A brief socio-economic profile of the fishing communities in the Ellembele District nearest to the onshore Project locationis given below. These communities are: Akonu-Bakanta, Sanzule, Krisan, Eikwe and Atuabo. The information used was sourced from a 2010 report by Coastal Resources Center (CRC) and the Friends of the Nations (FoN).

Akonu-Bakanta

Akonu-Bakanta is one of two towns closest to the onshore Project location (the other is Sanzule). The nearest towns to the west and east of Akonu-Bakanta are Ampain and Sanzule respectively. Ala Bokazo and A. B. Bokazo towns share boundaries with Akonu on the north.

The community is located on a flat sandy landscape. The Amanzule River runs on the north of the town and it is surrounded by mangroves. The population of Akonu-Bakanta was estimated at 1,099 comprising 494 males and 605 females as at 2000. The economy of the community is based on fishing. Farming is also practiced but on a small scale. It was reported in 2010 that there were four canoes in Akonu with all them being wooden paddle-propelled. The common gear used is the beach seine net. The canoes were on average 18 yards in length. The average crew per canoe for an expedition is 6 to 8. About 25 to 30 fishers haul the net after the casting. Species caught include Eban, Akole, Amoei and Manye. Fish processing is undertaken in settlement areas by smoking. The major marketing centres for harvested fish are Agona-Nkwanta, Tarkwa, Ainyinasi and Asasetre.

Regarding the sharing of fish proceeds, sales are divided into two parts. One part is reserved for maintenance and repair of gear while the other part is shared among the crew-members and the canoe owner. The community has a chief fisherman who is in charge of management of the coast and fisheries issues. A 2010 study in the area reported that, there was no 'konkohene' (queen of fishmongers) in the community.

Key coastal and fisheries issues reported in the area are decline in fish catch, coastal erosion and incidence of algal blooms, unsustainable fishing practices (such as light fishing and use of dynamite), and lack of access to capital and credit facility.

Sanzule

The neighbouring towns to the east and west of Sanzule are Bakanta and Krisan respectively. Ala-Bokazo is the nearest community to the north. The landscape is flat and sandy with no major peaks. Coconut plantations border the eastern, western and northern perimeter of the community. About 500 m on the north after the coconut plantations is the Ser lagoon. A few meters from the lagoon are swamps. Another lagoon known as Manzule also runs on the north a few metres from the farm lands.

Sanzule is inhabited predominantly by Nzemas. A few Fantes as well as Ewes also live in the community and are mainly fishers. The 2000 population and housing census report indicated the total population of Sanzule at 1,617, consisting of 843 females and 774 males. The total number of houses recorded was 180 with an average household size of 5. The settlement areas are highly concentrated towards the coast. The local economy is based on farming and fishing, but highly dependent on the latter. Residents remarked the decreased fish landings in the area have been reported to have declined due to incidence of algae bloom, and has thus contributed to the decline in commercial activities.

As at 2010, there were seven canoes in the community with none of them motorised. The canoes are approximately 18 yards in length and 3 yards in width and depth. The fishers

widely deploy 2, 1.5 and 1 inch sized mesh beach seine nets. The major fish landings include Wanwanya, Nkanfona, Ekan, Eban, Sukue, Ebueakwa, Apae and Ahenemandzi. In the past, the fishers reported that they could fish in the near shore areas, but presently they have to go out farther. They attributed this to light and chemical fishing and increasing fishing effort. The lay system reported by the fishers indicates that costs for maintenance of canoe and gear are deducted from the gross income, then the canoe and gear owner takes one-half and the other half goes to the crew. Harvested fish are widely smoked and marketed in Ainyinasi, Agona-Nkwanta and Tarkwa.

Key coastal and fisheries issues reported in the area are coastal erosion and decline in fish catch (due to increased fishing population, algal blooms and bad fishing practices such as light fishing and pair trawling), and lack of access to capital and credit facility.

Krisan

The population size of the community is estimated to be about 550. Fishing is done throughout the year with the major season occurring in July-September and minor season falling between November-January. Fishing employs over 80% of the population during the major fishing season. Also, unemployment level rises during the lean season. The community has no organisation which oversees the operation of fishermen and fishing activities. The type of fish caught include Edoi, Ekpoku, Akole, Ankoawona, Atianuawole, Nkafona, Manye Konsoanu. The type of gears used include, ring net, beach seine net of one inch, two inches and three and half inches. Key coastal and fisheries issues found in the area are decline in fish catch and coastal erosion.

Eikwe

Eikwe is the twelfth largest community in the Ellembelle District and is located in the western coastal zone. It has a flat land surface with a long sandy beach. The population of Eikwe is 1,777 according to the 2000 population and housing census with females numbering 1,026 and males 751. The major economic activity in the community is fishing and farming. Fishing is done all year round with the major seasons between July-September and minor season occurring in November-January. Almost everybody in the community is engaged during the fishing seasons and plays a role. Unemployment levels rises during the off-seasons resulting in low economic activities in the community. Types of fish catch include Manye (sardinella), Ekan, Ebonyi, Akoa, Nrafonla, Abowinba, Eduei, Amgboloma and Sezeke. They use ring net, beach seine net and hook and line (1, $3^1/_4$, 7 inches)

The community is governed by the traditional authorities and other government institutions such as the District assembly, the assembly member and the unit committee members. Key coastal and fisheries issues found in the area are decline in fish catch, coastal erosion and lack of fish storage facilities.

Atuabo

Atuabo is located in the western part of the Ellembelle District on the border with the Jomoro District. It shares boundaries with Menzezor on the north, west and east with Ekabaku and Anochi communities respectively. The population of Atuabo is about 1,500 with men and women in the ratio of 2:3. Economic activities in Atuabo are mainly fishing, farming and livestock production. About 25% of the inhabitants are engaged in fishing.

Atuabo fishers mainly use beach seine nets with mesh sizes of 2 inches and $1^1/_2$ inches. There were six non-motorised canoes which deploy 2 inches and $1^1/_2$ inches beach seine nets since two decades ago. A study conducted in 2010 found that the community has four canoes with one of them powered by a 40HP outboard motor. The canoes are approximately 3 ft in width and depth, and 40 ft in length. The non-motorised canoes have 8 to 10 crew members on board during fishing expeditions. About 45-50 people help haul the net after the expedition. Edue, Eban, Sukue, Ekan, Apae and Ahenemandzi are the major fish species caught during the major season. Reports suggest that significant changes in fishing grounds have occurred over the past two decades. Fishermen are said to have stated that fishes were caught within 700-800m off shore two decades ago, but the current fish grounds are 1,500m from the shore. The use of light and dynamite in fishing and the increasing number of motorised canoes were noted as the causes for the changes of fishing grounds.

Harvested fish is usually sold to fishermongers on credit especially in the major seasons or in the event of bumper catch. During the minor seasons, fish sales are strictly on 'cash and carry' basis. The proceeds from fish sales are shared as follows: the entire fishing crew take 50%; 33% goes to the canoe owner and 17% is used for canoe and net maintenance. Smoking is the major processing method employed by Fishmongers in the community. The processed fish is mainly marketed in Agona-Nkwanta, Ainyinasi and Asasetre.

Key coastal and fisheries issues confronting the fishing community includes decline in fish catches, unsustainable fishing practices (e.g. light-fishing and pair trawling), incidence of algal bloom, lack of access to credit capital for small business operations, and high rate of teenage pregnancy.

5.9 FISHERIES STAKEHOLDER CONSULTATIONS

Consultations for Phase 1of the Project (oil phase) were carried out during the period of November 2013 to March 2014 with the chief fishermen and fishermen of some of the fishing towns in all the 6 coastal districts of the Western Region. These included Sekondi, Axim, Dixcove, Half Assini, Shama, Sanzule and Bakanta. There were also discussions held with the Western Region Fisheries Commission.

Consultations for Phase 2 of the project (gas phase) took place in December 2014 and included engagements with fisherman in all project affected communities as well Chief Fisherman in Upper Dixcove, Upper Axim, Half Assini, and Sekondi, and the National and Regional fisheries Commission.

The aim of the consultations was to inform the fishing communities of the presence of a new oil and gas production offshore, identify their concerns and most important seek their input in the Fisheries Impact Assessment (FIA) in terms of their socio-economic status.

5.9.1 Phase 1 Consultation

Detailed results of the consultations undertaken can be found in Attachment A of the OCTP Phase 1 Development ESIA, which includes meeting minutes, signed attendance sheets and photographs.

The following is a summary of the issues raised during the consultations with regard to fisheries:

- Lack of government level consultations (Petroleum Commission, Ministry of Energy, EPA, GNPC etc) to discuss fishing community issues.
- Harassment of fishermen by Ghana Navy.
- Support vessels colliding with fishing canoes leading to death of fishermen
- Demarcation of safety zone around the FPSO/rigs.
- Increasing cases of support vessels colliding with fishing canoes.
- Further limitation of fishing grounds by a second FPSO with its light effect on the fish threatening the fishing business.
- Flaring gas causing skin diseases and other health issues
- Destruction of fishing nets by supply/support vessels
- Eni Ghana should have an oil spill contingency plan to deal with any oil spill
- The issue of support vessels/oil tankers discharging of ballast water affecting marine resources.
- Occurrence of green algae/grass along the shores hindering fishing.
- Previous promises by oil companies have not been fulfilled.
- No compensation have been giving to fishermen since the oil activities begun
- Eni Ghana to assess appropriate and adequate compensation is given to community members in the event of a relocation/resettlement.
- High cost of living in recent times attributed to the oil find.
- Providing an alternative livelihood support for the fisherfolk.
- Employment of community members as well as use of local goods and services will enhance the local content of the development.
- Eni Ghana should help subsidize cost of fishing gears and premix fuel.
- Build schools for the children and awards scholarship to children of fisherfolk.
- Transparency in the award of scholarships and other benefits
- Request for health clinic to cater for fisherfolk and or a health insurance scheme for fisherfolk
- Provide credit facilities to fishermen.
- Eni Ghana should support the fishmongering business by providing them with equipment for smoking fish and also a cold store for storing excess fish catch.

- The oil companies should unite in dealing with issues affecting the communities instead of pursing haphazard interests.

- The oil companies should help support the government in the implementation and enforcement of the fisheries regulations to preserve the fishing industry.

- Continued consultation with traditional leaders to ensure the smooth running of the project.

5.9.2 Phase 2 Consultation

Detailed results of the consultations undertaken can be found in the OCTP Phase 2 Development ESHIA (Chapter 5, Annex A and Annex F). They include meeting minutes, signed attendance sheets and photographs.

The following is a summary of the issues raised during the consultations with regard to fisheries:

- Fishing: stakeholders indicated their concerns regarding disturbance to fishing activities including access to fishing areas (exclusion zones) and potential catch reduction. Stakeholders expressed concerns related to increased exclusion zones as a result of additional FPSOs in the area.

- Sensitive biodiversity: the impacts on marine fauna (fish, marine mammals) were raised as important aspects for consideration. Concerns were also raised regarding the Project's impacts on the annual algae bloom.

- Air emissions: stakeholders were concerned about the potential air emissions from vessels, including potential for gas leaks and the resultant impacts on marine fauna.

- Pollution and waste management: stakeholders highlighted the importance of marine and onshore pollution control and ensuring responsible waste management.

- Livelihoods and compensation: stakeholders indicated that the proposed Project area is currently used for fishing, and expressed concern regarding the loss of livelihoods and the stressed the need for compensation of any lost livelihood.

5.10 SOCIO-ECONOMIC IMPORTANCE OF THE FISHING SECTOR

The data and information collected during the fisheries baseline survey and the stakeholder consultations reveal how fishing, fish processing (particularly smoking) and fish trade are important sources of livelihood in coastal communities in Western Region – supporting livelihoods not just in fishing activity itself, but also linked to all the goods and services on which fishing and fish marketing depend, as well as providing disposable income to spend on many other consumption items in the local economy (CRC, 2011). A past study in Ghana suggested that one fishing job created seven additional livelihoods (Finegold et al., 2010). The FAO (2007 in Gordon et al., 2011) also suggested that for every person employed directly in fishing, there may be an additional four associated jobs. The household security effect is even wider since each of these incomes will help support an extended family.

6 IMPACTS IDENTIFICATION AND ASSESSMENT

This chapter of the FIA provides an assessment of the impacts on fisheries that may result from the Project. It also provides details of the mitigation measures and management actions that will be implemented to avoid, reduce, remedy or compensate for significant adverse effects and, where practicable, to maximise potential positive benefits and opportunities from the project. The impact assessment covers the construction, operations and decommissioning phases of the project.

6.1 IMPACT ASSESSMENT METHODOLOGY

Potential impacts are identified by predicting the effects of Project activities on local fish populations and fisheries related impacts. The significance of each impact (positive or negative) is assessed through the evaluation of the following criteria:

- temporal scale of the impact (i.e. temporary, short-term, long-term, permanent);
- spatial scale of the impact (i.e. local, regional, national, international, trans-boundary);
- sensitivity, resilience and/or importance of the receptor/resource that is being impacted;
- number of elements (including individuals, households, enterprises, species and habitats) that could be affected by the impact.

Each criterion is scored as defined in Table 6.1 to determine the significance which is equal to the sum of the scores.

The significance of an impact depends on:

- values of the affected society;
- site-specific human and natural environment;
- nature of the Project; and
- specific conditions of the Area of Influence.

Consequently, in the impact assessment, weights are adjusted in some instances due to the actual possibility of occurrence of the impact. Any change in weighting and the reason for change is described.

Based on the impact significance, appropriate control and management measures are defined (Table 6.2).

Table 6.1 Impact Ranking and Evaluation Criteria

Ranking	Evaluation Criteria				Significance
	Duration	**Extent**	**Importance / Resilience of Receptor/ Resource**	**No. of elements involved**	
1 - Low	Less than 1 year / Temporary	Local scale: the proposed operating site and its immediate environs	Low value/ sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	Ranging from 4 to 16
2 - Medium	Between 1 and 5 years	Regional scale: as determined by country's administrative boundaries	Moderate value/sensitivity of receptors or resources, able to adapt with some difficulty and which may require interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	
3 - High	Between 5 and 10 years	National scale: Entire country	High value/ sensitivity of receptors or resources, poorly able to adapt to changes with strong interventions	Affecting great no. of individuals, households and /or medium/large enterprises and/or habitats and ecosystems	
4 - Critical	Over 10 years / Irreversible	International scale: trans-boundary	Extreme value/ sensitivity of receptors or resources, resulting in permanent changes	Affecting huge no. of individuals, households and /or large enterprises and/or habitats structure and ecosystems functions	
Score	*1,2,3 or 4*	*1,2,3 or 4*	*1,2,3 or 4*	*1,2,3 or 4*	

Table 6.2 Impact Significance, Control and Management Actions

Ranking	Impact Level		Control and Management Action
4-6	LOW	Actions in the short term	Ensure that policy and control measures are adequate to control the impact
		Actions in the long term	Verify that monitoring and reporting activities are properly established to guarantee the correct application of policy and ensure that control measures remain adequate.
7-9	MEDIUM	Actions in the short term	Check if current policy and control measures are adequate, and revise them accordingly to set appropriate objectives for improvement.
		Actions in the long term	Develop adequate plans and activities for control measures, ensuring that are approved and implemented with timescales set and resources (budget and personnel) allocated.
10-12	HIGH	Actions in the short term	Plans and activities are implemented to mitigate the impact as soon as possible. Interim reduction measures are established.
		Actions in the long term	Long-term plans and activities are developed. Parameters and KPIs are set and properly measured, monitored, reported and verified. Targets are set for improvement and feedback used for corrective actions.
13-16	CRITICAL	Actions in the short term	Immediate emergency measures to reduce the impact. Align the current level of control and implemented measures to best available practices to address the issue. Parameters and KPIs are measured, monitored, reported and verified. Targets are set for improvement and feedback used for continuous improvement.
		Actions in the long term	The Company demonstrates the delivery of continuously improved performance through Research and Development, technology innovation, training of the personnel, strategic partnerships and input and feedback from internal and external stakeholders.

As shown in Table 6.1, impacts continuing over 10 years receive a "critical" score which automatically raises impacts significance to "Medium". As an outcome, the impacts that are continuous across the operations phase of the project are all classified (at least) as Medium.

This is a reflection of the methodology's conservative approach, where eni wants to ensure that adequate monitoring, management and control measures are applied in a timely manner to any possible impacts whose duration would be more than 10 years (see Table 6.2 for Medium impacts long term control measures).

The specific management, monitoring and control measures to be applied for these impacts will be fully developed at the Environmental, Social and health Management Plan (see Section 7), where measures will be tailored to the specific impacts and its main driver (duration, extent, sensitivity, or affected individuals).

6.2 MITIGATION MEASURES

An objective of the impact assessment process is to reduce the negative effects and enhance the benefits. Once potential impacts are identified and evaluated, mitigation is applied to avoid or reduce the effects according to the hierarchy set out in Table 6.3.

Table 6.3 Mitigation Hierarchy for Planned Project Activities

Avoid at Source; Reduce at Source   Avoiding or reducing at source is essentially 'designing' the project so that a feature causing an impact is designed out (or altered).
Reduction on Site   Adding a control system to the design to abate the impact, such as pollution controls. Often called '*end-of-pipe*'.
Reduce off Site   If an impact cannot be abated on-site then measures can be implemented off-site.
Repair or Remedy   Some impacts involve unavoidable damage to a resource, e.g. vegetation disturbance. Repair essentially involves restoration and reinstatement type measures.
Compensate in Kind   Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate.
Net Positive Outcomes   Make a positive contribution to biodiversity conservation and/or improvement of communities' development.

6.3 POTENTIAL IMPACTS IDENTIFIED

Table 6.4 sets out both positive and negative impacts on fisheries resources. These impacts are not specific to each project phase. The impacts which are phase specific will be assessed in the following subsections. Potential impacts from unplanned events have also been considered, as well as cumulative impacts on fisheries in relation to other oil and gas activities in the area.

The AoI used throughout the assessment are described in Section 4.2.

Table 6.4 Potential Impacts Identified

Topic	Receptors	Potential Impacts Identified
Fisheries Resource	Fish, crustaceans, cephalopods	• Temporary impacts due to FPSO, drilling rig and vessel discharges, as well as discharges of ballast waters. • Disturbance due to physical presence and light emissions. • Disturbance due to underwater noise. • Disturbance due to pipeline installation works.
Fisheries Livelihoods	Disruption/ economic displacement of marine	• Restricted access to offshore fishing. • Disruption of onshore and near shore fishing activities. • Damage to fishing gear.

	fisheries-based livelihoods.	• Lighting.
	Community security	• Interactions with Project Security force.

6.4 FISHERIES RESOURCES

6.4.1 Overview

This section assesses the potential impacts on local fishing resources (fishes, crustaceans and molluscs) population impacts, as a result of Project related activities. Impacts on the economic aspects of fishing are described in Section 6.5.

Box 5.1 presents the key sources of potential impacts, resources and receptors, baseline and Project influencing factors associated with the impacts of the project on marine fisheries.

Box 5.1 Key Sources of Impact, Potentially Impacted Resources and Receptors

Sources of Impact
- Project vessel presence and movement
- Drilling activities
- Offshore pipeline construction activities
- FPSO installation and operation

Potentially Impacted Resources and Receptors
- Fishes, crustaceans and other fishing resources
- Fishermen in the Area of Influence

Baseline Influencing Factors
- Commercially exploited fishing resources in the area
- Fishing activity in the area

Project Influencing Factors
- Pipeline route
- Pipeline, flowlines, wells, construction and installation activities
- Safety zone
- Duration of offshore construction activity

6.4.2 Sensitivity of Commercially Targeted Fish, Crustaceans and Cephalopods

Among the resources exploited there are several species of conservation concern as is the case of some of the tuna species, whose fishing stocks are monitored by the ICCAT (International Commission on the Conservation of Atlantic Tunas), though these are highly migratory species that are not present throughout the AoI.

There is no fish habitat of special interest (spawning, re-stocking, migration) in the immediate AoI and the closest would likely be the mangroves located within the Amansuri River mouth which provide suitable shelter for species of fish, shrimp and shellfish, and functions as nursery and spawning ground.

As a consequence, sensitivity of fishing resources is considered Low in the deep waters-offshore area given the relatively low fishing pressure in that area, and Moderate in the nearshore area considering the importance of these resources to the livelihoods of local communities.

6.4.3 Construction Phase

Impacts Identification and Assessment

The potential impacts related to offshore construction activities on fisheries resource are:

- Impacts due to routine discharges of the drilling rig, supply vessels and FPSO, ballast water discharge;
- Impacts due to light emissions;
- impacts due to underwater noise;
- Impacts due to trench excavation and pipe laying causing noise and vibration, physical presence and increase of turbidity.

Impacts from the discharge of drilling wastes (muds and cuttings) on commercial species have not been considered as, given the location of the wells in more than 500 m water depth, fisheries will not exploit the demersal and benthic species that would be affected. Moreover, increased turbidity and smothering effects are only expected in the immediate vicinity of the wells (within approximately 1 km) and are not considered significant to species which may be commercially targeted.

Temporary Impacts due to Routine Operational Discharges

During the construction phase, routine discharges of treated black water, grey water and from bilge water will take place from project vessels (i.e. supply vessels, drilling rig, barges and FPSO). These discharges will primarily be formed by organic substances, though some toxic components may also be present such as oil content in drainage and bilge waters.

The volumes expected to be discharged correspond to an average of 100 l per day per person. The expected crew complement of the project vessels is not known at this stage, however, an estimate of 60 people on board the FPSO, 150 on the drilling rig and 25 per supply vessel can be made, leading to a total discharge of would lead to a total discharge of 26 m^3 per day assuming 2 supply vessels.

As a result, temporary changes to the distribution of fish species may occur as opportunistic feeders are attracted to organic discharges as a potential source of food. The magnitude of changes expected will be small and within natural variation, and therefore considered to be negligible.

The discharge of organic matter could also lead to an increase of phytoplankton production that would, eventually, lead to an increase in fish biomass. However it could also result in algal blooms that could adversely affect fish populations.

Discharges could also contribute to the proliferation of the algae *Sargassum* sp. that affects fishing activity as it accumulates on the nets used. Recently the amount of *Sargassum* sp in Ghanaian waters has increased significantly and it has been reported that the fishermen in the region attribute this to existing oil and gas activities, although the reason for the increase

in *Sargassum* is unknown. Some researchers suggest an increase in coastal nutrient concentrations (e.g. from run-off from land that has been fertilized), resulting in increased algal growth, as part of a regional or even global phenomenon (CRC 2011).

The toxicity of some discharges (e.g. drainage / bilge water, could also potentially have harmful impacts on the health of fish species.

However compliance with MARPOL requirements on discharges, and considering the intermittent nature of the discharges, the rapid dilution and dispersion in the marine environment and the ability of mobile fish species to avoid polluted waters, effects will be temporary and limited.

The OCTP Project EIS concluded that the impact on water quality from operational discharges during the construction phase is of low significance and therefore secondary impacts on fish populations are expected to be limited. The introduction of invasive or alien species or pathogens into Ghanaian waters is possible through exchanges of ballast water. Invasive and/or alien species have the potential to disturb or alter the ecosystem of a receiving environment including negative impacts on fish, which may contribute to the reduction or extinction of native species thereby altering the food web and affected biodiversity, and impacting human health due to consumption of diseased seafood. These risks are generally much lower in deep offshore waters than in coastal areas, estuaries and ports.

Disturbance due to Physical Presence and Light Emissions

Large pelagic fish species (e.g. tuna and billfish) and demersal fish species (e.g. grunts and croaker) will be present in the AoI. Near surface pelagic species are likely to be impacted by the presence of the FPSO, rig and support vessels as many pelagic fish species are known to readily associate with floating objects (known as Fish Aggregating Devices, FADs) (Røstad et al., 2006).

Fish may also be attracted to artificial lighting used on the project vessels, as light acts as a stimulus for many fish species. By aggregating near to project vessels, some fish move within the safety zone and therefore cannot be fished.

It should also be noted that the main pelagic species targeted by fishermen offshore Ghana are highly migratory and will not be permanent residents in the area, and those attracted to the FPSO and other infrastructure are not likely to spend significant periods of time within the safety exclusion zones of those vessels. Commercial species associated with the FPSO, drilling rig and support vessels and their safety zones will be afforded some protection from fishing activity but it is considered negligible considering its temporary nature.

Disturbance due to Underwater Noise

The OTCP project EIS concludes that based on available data for the area marine fish are not particularly sensitive to underwater sound. Fish may be attracted by the noise of operational vessels (Røstad et al., 2006) but are likely to avoid areas where noise levels are at a level to cause harm.

The sound levels produced by drilling operations, however, have the potential to affect the behaviour of some more sensitive species of fish considered hearing specialists. These effects have been observed between 182 and 207 dB re 1 µPa (rms) and between 160 and 186 db re 1 µPa (peak) (Pearson et al., 1992, McCauley et al., 2000, Wardle et al., 2001).

Sound levels approaching these ranges will only occur very close to project vessels, and it is expected that sound will decrease to levels unlikely to affect fish within 1 to 3 km from the source. The continuous nature of sound produced also reduces the chances of startle reactions in fish. Impacts on fish are therefore expected to be direct, temporary and only occur when project vessels are present. Given the location of sound sources it is likely that only pelagic fish in the OTCP project area will be affected rather than nearshore populations or demersal species.

Pipeline Installation Works

Potential impacts on commercially targeted fish, crustaceans and cephalopods may arise during pipeline laying. This impact is expected to be more intense in the nearshore area given the planned trenching activities and the nature of the local fisheries, characterised by the use of beach seine fishing techniques.

Both demersal and pelagic species could be affected by an increase of suspended solids and/or mobilisation of contaminants caused by installation activity. However, the marine sediments in the area are characterised by low pollutant levels (with the exception of arsenic which is believed to be the result of the local geology), and therefore toxicity above that of natural variation is not expected.

Habitat loss within the pipeline footprint is considered not significant provided the pipeline occupies an area of sandy bottom habitat which is widespread throughout the project area of influence.

The primary potential impact resulting from pipeline installation would be the disturbance from the presence of project personnel and vehicles in the nearshore area, and the temporary displacement of commercially targeted species to nearby areas caused by increases in suspended solids from sediment plumes.

Mitigation Measures

Routine Operational Discharges

- Operational discharges from the FPSO and project vessels will meet national and international requirements, including compliance with the relevant annexes of MARPOL and IMO standards and conventions.

Discharge of Ballast Water

- Discharge IMO Guidelines for the Control and Management of Ship's Ballast Waste and Sediments (Ballast Water Management Convention) will be implemented.
- All vessels involved in the Project, including the FPSO, will carry a Ballast Water Record Book where all ballasting operation will be registered.

Physical Presence and Light Emissions

The Project will control and reduce overall light intensity to the extent practicable to minimise impacts on commercially targeted species, without adversely affecting maritime or operational safety.

Underwater Noise

The Project will ensure that vessel engines are not left to idle unnecessarily to minimise impacts on commercially targeted species. Vessels will be powered down to safe operational levels.

Conclusions

Table 6.5 presents a summary of the residual impact associated with the impacts identified.

Table 6.5 Residual Impacts on Commercially exploited species during Construction Phase

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Impact derived from FPSO, drilling rig and vessel discharges.	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**5-Low**
Score	2	1	1	1	
Impact derived from discharge of ballast waters	Less than 1 year / Temporary	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**4-Low**
Score	1	1	1	1	
Impact derived from the physical presence and light emissions on commercially exploited species.	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**5-Low**
Score	2	1	1	1	
Potential impact of underwater noise commercially exploited species	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**5-Low**
Score	2	1	1	1	

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Pipeline installation works potentially affecting commercially exploited species	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Moderate value/ sensitivity of receptors or resources able to adapt to changes with some difficulties and which may require interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**6-Low**
Score	2	1	2	1	

The overall impact on commercially targeted fish, crustaceans and cephalopods species from construction activities is assessed as Low.

6.4.4 Operation and Maintenance Phase

Impacts Identification and Assessment

The potential impacts on fisheries resource during operation are similar to those described for the construction phase. These include impacts from routine discharges, impacts from the physical presence of the project and light emissions, and impacts from underwater noise. These impacts are described in Section 6.4.3. The key difference between construction and operational phase is the impact duration. Construction phase impacts are between 1 and 5 years whereas operation phase impacts may be experienced for more than 10 years, albeit intermittently in most cases.

Mitigation Measures

Mitigation measures to be applied are the same as those for the construction phase described in Section 6.4.3.

Conclusions

Table 6.6 presents a summary of the residual impact associated with the impacts identified.

Table 6.6 Residual Impacts on Commercially exploited species during Operation Phase

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Impact derived from FPSO, and vessel discharges.	Over 10 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**7-Medium**

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Score	*4*	1	1	1	
Impact derived from the physical presence and light emissions on commercially exploited species.	Over 10 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**7-Medium**
Score	*4*	1	1	1	
Potential impact of underwater noise commercially exploited species	Over 10 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**7-Medium**
Score	*4*	1	1	1	

The resulting Medium impact significance is mainly a consequence of the score assigned to the duration of the impacts in the operational phase (approximately 20 years), and not to the sensitivity of the receptor or the expected magnitude of the potential impacts.

6.4.5 Decommissioning Phase

Impacts Identification and Assessment

The potential impacts of decommissioning will be assessed before decommissioning activities are expected to take place. Decommissioning activities performed will apply to the subsea infrastructure and wells. Thus potential impacts during decommissioning are likely to be similar to impacts during construction.

Mitigation Measures

Mitigation measures are expected to be similar to construction. A Preliminary Decommissioning Plan will be produced by Eni and updated in accordance with the latest good practices in advance of the end of field life.

Conclusions

The residual impacts are likely to be similar to construction, that is. of low significance.

6.5 FISHERIES LIVELIHOODS

6.5.1 Fishing Activity and Community Security

This section presents the potential impacts on fisheries livelihoods as a result of Project related activities. They are mainly related to the existence of exclusion zones, and the interaction with project security forces.

Box 5.2 shows the key sources of potential impacts, resources and receptors, baseline and Project influencing factors associated with the impacts of the Project on fisheries livelihoods.

Box 5.2 Key Sources of Impacts and Risks, Potentially Impacted Resources and Receptors

Sources of Impacts and Risks
- Vessel movements (drilling rig, supply vessels, tankers, FPSO, pipe laying)
- Presence of subsea infrastructure and FPSO
- Temporary exclusion zones during construction activities (pipeline landfall area, drilling sites)
- Permanent exclusion zone during project operations (FPSO).
- Presence of Project security around the exclusion zones

Potentially Impacted Resources and Receptors
- Artisanal and commercial fishers operating near the Project and close to the pipeline shore landing.

Baseline Influencing Factors
- High dependence on artisanal fishing
- Reportedly declining fish stocks
- Local stakeholders highlighted that policing of the offshore pipeline ROW and FPSO exclusion zones from encroachment from other uses could result in conflictual interactions.

Vulnerable Groups
- Households with low income, depending on artisanal fishing as main economic activity; these households have fewer resources or access to alternative livelihood strategies to rely on
- Residents of Awonakrom will be the most disrupted by pipeline construction activities, as they are located adjacent to the pipeline landfall site
- Migrant fishing communities are vulnerable as they have no formal rights to land, they farm very little or no crops and are almost solely dependent on fishing-based livelihoods

Project Influencing Factors
- Exclusion zones will be in place around offshore construction activities
- Security arrangements for onshore and offshore facilitie

Table 6.7 presents the key potential impacts of the Project on fisheries livelihoods during the Project phases.

Table 6.7 Key Potential Impacts and Risks – Fisheries-based Livelihoods

Construction Phase	*Operations Phase*	*Decommissioning Phase*
• Restricted access to offshore fishing grounds • Disruption of onshore and near shore fishing activities • Damage to fishing gear • lighting • Interactions with project security forces • Interaction with increased marine traffic	• Restricted access to offshore fishing grounds • Disruption of onshore and near shore fishing activities • Damage to fishing gear • lighting • Interactions with project security forces • Interaction with increased marine traffic	• Restricted access to offshore fishing grounds • Interactions with project security forces • Interaction with increased marine traffic

The sensitivity of the fisheries livelihoods is reported in the following sections.

6.5.2 Sensitivity of Fisheries Livelihoods

The area closest to the coast is used for residential dwellings as well as for activities supporting marine fishing-based livelihoods including beach canoe landing sites, beach seine or drag-netting landing, and fish-mongering.

There is a strong dependence on both farming and fishing activities in the AoI, and there are few alternative livelihood or employment options due to the relative lack of development of commercial and industrial sectors in the area. Fishing and farming livelihoods are interlinked in the AoI as people transfer between these activities depending on the season. In the farming season (the rainy season) income from fishing is used to purchase farming inputs, while investments shift back to fishing during fishing season.

Disruption to or loss of income and subsistence from fishing could have a detrimental effect on those impacted as they have undiversified livelihoods strategies outside of these two primary activities and generally low education levels and low skills, and would not therefore easily be able to seek alternative livelihoods.

The sensitivity of households in the AoI around loss of fishing livelihoods relates to a number of contributing factors including their marginal living conditions and insecure and undiversified livelihood strategies, lack of income stability, household instability, and poverty. It is anticipated that marginal households including, seasonal fishing employees, migrant fishing communities and refugees from the Krisan camp who depend on work with fishermen and other vulnerable, fishers and fishmongers will suffer the most from any loss of access to fishing resources because they seldom have access to alternative fixed incomes.

Fishing Sensitivity

There is concern amongst fishers that the Project will have a negative effect on fish catch due to exclusion zones which may permanently restrict their access to fishing grounds. Concern was also raised that activities during the laying of gas pipelines might disturb fish habitats and cause environmental pollution causing a further decline in catch. These concerns are raised in the context of historically declining fish stocks in the Western Region and an already a strong perception amongst fishing communities that this, along with an increase in algal blooms affecting activities, can be partly attributed to offshore oil and gas development.

The Sanzule (including the migrant fishing settlement Awonakrom) and Bakanta communities are considered more sensitive to disruption or loss of fisheries-based livelihoods as they are located closest to the ORF site and offshore infrastructure. The main occupation of these villages is fishing which is reportedly undertaken by approximately 60 - 70 percent of the population, while farming is undertaken by approximately 30 percent. Of these, Awonakrom, which is considered part of Sanzule but is directly adjacent to the onshore pipeline landfall site can be considered especially vulnerable to disturbance impacts from the pipeline construction to both their shore-based and offshore fishing activities. This communities' vulnerability to both temporary and permanent loss of fishing livelihoods will be compounded since they have no formal rights to land, farm very little (or not at all) and are therefore almost solely dependent on fishing-based livelihoods.

Finally, a possible sensitivity linked to fisheries livelihoods exists around illegal child labour and already commonly observed (and reported by educators) involvement of school-aged

children, in particular young boys in fishing activities (1). There is a risk of this trend increasing if a gap is created when men start moving into other income generating activities associated with the Project, meaning younger boys are drawn to fisheries to support their families.

6.5.3 Construction Phase

Impact Identification and Assessment

Based on stakeholder consultation and secondary data, at least three quarters of the populations in the villages of the AoI depend of fisheries-based activities for their livelihoods. Temporary or permanent restrictions on access to offshore fishing grounds and a resulting reduction in catch would have a detrimental effect on livelihoods and wellbeing of these communities. Fishmongering is directly dependent upon fish catches and a loss of access to fishing grounds or significant reduction of catch size would have direct impacts on the subsistence of the fishmongers and food security more broadly, since women fishmongers are also key providers for the household. Similarly, though much less significant loss or disruption of livelihoods could result from temporary disruption of shore-based fishing activities such as beach landing sites, use of beach seine ('drag netting') gear as well as the physical location of fish mongering and trading.

These specific impacts on marine fisheries-based livelihoods are described below.

Restricted Access to Offshore Fishing

A legally enforceable safety exclusion zone around drilling vessels will be maintained throughout construction and operation to reduce the risk of collisions at sea and to ensure personnel safety. Fishing vessels will not be able to fish within the exclusion zones for safety reasons. This restriction will result in a very small reduction in the available fishing grounds within the Ghanaian EEZ and will affect only those fishermen who fish in this offshore area, approximately 60 km off shore. This effect could result in a reduction in fish catch. It is important to note, however that the main pelagic species found in offshore deepwater locations in the Gulf of Guinea targeted by fishermen are highly migratory and will not be permanent residents in one area, and those attracted to infrastructure are not likely to spend significant periods of time in those locations.

There will also be a legally enforceable safety exclusion zone around the gas export pipeline when construction activities are taking place, temporarily limiting near-shore fishing activities in this area. This exclusion zone will impact the nearshore fishers.. This temporary restriction is described in the following subsection.

Disruption of Onshore and Near Shore Fishing Activities

Construction activities nearshore (such as trenching and pipe-laying) can cause the re-suspension of sediments and increase turbidity in the water. This effect could be more intense on the near shore area given the trenching activities planned to bury the pipeline and the nature of the local fisheries, characterized by the use of beach seine fishing techniques.

(1) Child labour (often in the form of slavery) in the fishing industry is common in the Volta Lake region and this form of abuse needs to be monitored in the AoI

According to the fisheries baseline (see Chapter 7), near shore marine sediments are characterized by low pollutant levels and therefore no toxic effects are expected. The suspended sediments could result however in the temporary displacement and avoidance of fish species during construction.

Beach access will be temporarily restricted during the installation of onshore section of gas export pipeline to ensure community safety. There will be an exclusion zone of approximately 100 m either side of the gas export pipeline preventing fishers from using the beach in front of the ORF land acquisition area for landing catches and boats and gathering for fish-mongering/trading activities. This area is small however, relative to the extent of the beach, and the exclusion zone will only be enforced during the installation of the pipeline.

Vessel movements to and from onshore base during construction also have the potential to interact with fishing activity in the vicinity of the onshore bases and therefore near-shore artisanal fishing activities could be adversely affected through disturbance by these vessels. During construction, vessels traffic increase related to pipelaying barge supply and drilling rig support will increase, and there will be three supply vessels available to the Project. These vessels will move between the Port of Takoradi and the Project site as needed.

Damage to Fishing Gear

Some fishing vessels use passive fishing gear not attached to a fishing vessel. Fishing nets, hook and lines, trawling, set net fishing, purse seine fishing and lobster traps are often set several meters below the surface and left for many hours. There is the potential for this gear, which is left floating in the open ocean, to enter the exclusion zone and become entangled in Project vessels and be lost to the fishermen, causing a livelihood loss through the cost incurred for the replacement of gear. The exclusion zones around Project vessels are intended to reduce the likelihood of this impact occurring as far as possible.

Lighting

In the offshore environment fish may be attracted to the artificial lights on the Project vessels, as light acts as an important stimulus for many fish species. Fish aggregations around the Project vessels are therefore likely to occur at night time, meaning fish remain in the exclusion zone where no fishing is allowed. This could have the effect of reducing the fish catch. However, as stated above, this is not anticipated to be a significant impact, since the main pelagic species found in offshore deepwater locations in the Gulf of Guinea targeted by fishermen are highly migratory and will not be permanent residents in one area.

Interactions with Project Security force

The area around the FPSO will be established for safety and security reasons. Eni will provide an unarmed dedicated patrol vessel to monitor and patrol offshore buffer zones. Ghana Navy, if required, will support Eni's patrol vessel to assure the buffer zones to be respected. Additional Ghana Navy representatives can be deployed on Eni's patrol vessel for extra support (in this case, they will be unarmed).

During the consultation for the OCTP Project EIS, local stakeholders highlighted that policing by the Ghana Navy of the offshore pipeline ROW and FPSO exclusion zones against encroachment from other uses, in particular local fishermen, could cause conflict. Local fishermen complained about abuses by personnel from the Ghanaian Navy in charge of

security of the existing oil and gas developments (i.e. thefts of nets and fishing equipment, detention, etc.).

Marine Infrastructure and Traffic

The Project activities will lead to an increase in vessel traffic on local offshore routes connecting the Project and the Takoradi Port, as described below:

- Traffic increase related to the pipelaying activities;
- Traffic increase related to supply vessels servicing the pipelaying barge and drilling rig with diesel, material, pipe, crew on site, and other necessities); and
- Traffic increase due to construction waste handling and waste water transportation.

Drilling material will arrive from abroad and be transferred to the Takoradi logistic base, when needed; it will be sent offshore using three supply vessels.

During the construction phase, there will be safety and security exclusion zones around Project vessels undertaking drilling and subsea infrastructure placement. Maritime traffic in the Offshore Project Footprint Area will continue, but will need to avoid these exclusion zones.

These increased vessel movements will result in an increased potential for interactions and possibly collisions with artisanal and commercial fishing vessels in the local offshore environment.

Mitigation Measures

- The Project will limit exclusion zones around Project infrastructure to those required legally, without compromising safety measures.
- eni will develop and implement a detailed Fisheries Management Plan.
- If possible, eni will employ a Fisheries Liaison Officer (FLO) to liaise between fishermen and eni and to provide information to fishing communities, regarding eni's activities during construction. Particularly, they will explain the requirements to keep away from the operations for safety reasons and give advance notice of movements.
- Interaction with fishermen and other users will be monitored through the CLO/FLO and the Project's grievance procedure. In particular, compensation for any proven damage to fishing gear due to the fault of the project will be dealt through this procedure, with costs being agreed through the consultation with the local fisheries officers or similar.
- Additional surveys of fishing effort at the pipeline landfall area will be performed (see section 7.3) to quantify fish catches/effort so that any effects on fishing from the pipeline construction works can be assessed. Potential loss of nearshore fishing effort or fish catches will be quantified by comparing catches with pre-construction data. Any financial losses that may be incurred will be calculated using fish landing market price information.
- As a complementary measure, a dedicated community investment program will be developed to offset the general disturbance caused by the construction activities to the community as a whole.
- A vessel transit route will be agreed with the Ghana Maritime Authority and communicated to fishermen and other marine users through the CLO/FLO. Project vessels will keep within the agreed routes.

- A security management plant together with a specific patrolling procedure will be developed for both onshore and offshore installations.
- The exclusion zone will be monitored with the assistance of the agencies of the Government of Ghana, for the safety of the facility and other users of the area (e.g. fishermen) when potentially close to Project infrastructure or vessels.
- Measures will be implemented to ensure that those engaged in maintaining the exclusion zones have received adequate training on the correct code of conduct and rules of engagement which will be based on the UN Voluntary Principles of Security and Human Rights. These measures will include, among other things, selection or personnel based on a careful background screening, training with regards to human rights requirements, and monitoring of performance.
- Given the ongoing complaints by local fishermen and the concerns raised by community members in the area of influence, eni and its contractors and subcontractors will be particularly attentive to ensuring that their security arrangements respect human rights, with constructive outreach to police and the navy through consultation, as well as training on human rights.
- Eni will propose to create a technical/management committee involving Eni as well as national and local government, and invite other operators in the area, in order to assess the potential cumulative impacts of the developments on fisheries.
- A Marine Traffic Transportation Plan will be developed for the Project to ensure appropriate protocol is followed during offshore vessel movements. This Plan will consider vessel movements associated with other oil and gas projects in the area, and artisanal and commercial shipping traffic in the local offshore environment.

Conclusion

Considering the mitigation measures described in the previous section and the evaluation criteria defined in Section 5.1 the residual impacts on fisheries livelihood resources and community security associated with the construction phase are summarised in Table 6.8.

Table 6.8 Residual Impacts on Fisheries-based Livelihoods during Construction Phase

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Fisheries Livelihood – Construction Phase					
Disruption/Displacement of Fisheries-based livelihoods					
Restricted Access to Offshore Fishing Grounds due to Exclusion Zones	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Low value/ sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**6-Low**
Score	2	1	1	2	

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Fisheries Livelihood – Construction Phase					
Disruption of Onshore and near-shore Fishing activities	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Moderate value/sensitivity of receptors or resources, able to adapt with some difficulty and which may require interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**7-Medium**
Score	2	1	2	2	
Damage to Fishing Gear	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Moderate value/sensitivity of receptors or resources, able to adapt with some difficulty and which may require interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**7-Medium**
Score	2	1	2	2	
Lighting	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Low value/ sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**6-Low**
Score	2	1	1	2	
Interactions with Project Security workforce	Between 1 and 5 years	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources able to recover or adapt to the changes without interventions.	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**5-Low**
Score	2	1	1	1	
Marine traffic and infrastructure	Between 1 and 5 years	International Scale	Low value/ sensitivity of receptors or resources	Affecting small no. of individuals, communities or administrative and/or higher no. of species and habitats	**9-Medium**
Score	2	4	1	2	

6.5.4 Operation and Maintenance Phase

Impact Identification and Assessment

Impacts identified in the construction phase will continue throughout the operation phase.

These are described below.

Fisheries-based Livelihoods

Restricted Access to Offshore Fishing Grounds
A legally enforceable safety exclusion zone around the FPSO maintained during operation to reduce the risk of collisions at sea and to ensure personnel safety. Fishing vessels will not be able to fish within the exclusion zone for safety reasons. This restriction will continue to result in a very small reduction in the available fishing grounds within the Ghanaian EEZ and will affect those fishermen who fish in this offshore area, approximately 50 km off shore. This effect could result in a continued reduction in fish catch. It is important to note, however given the area available to fish for the target species that occur in this offshore location, the exclusion from a small area (approximately 3-4 km^2) around the project site is not likely to significantly affect catches.

There will also be restrictions around the pipeline corridor. Such restrictions include a no anchor zone, and no trawlers or draggers will be allowed within a 500 m buffer of the pipeline.

Fishermen have reported that they have been unduly harassed by the Ghana Navy in their role ensuring the security of the Project assets and enforcing the exclusion zone in the vicinity of the Jubilee Field. There was concern raised by fishers that another exclusion zone will lead to further harassment and disruption to fishing activities.

Eni will to provide a dedicated patrol vessel to monitor and patrol offshore FPSO buffer zone with support if required from Ghana Navy (in this case, they will remain unarmed). The security management plan and patrolling procedure will continue to be implemented both onshore and offshore. These measures will minimize the potential for aggressive interactions between fishing boats and Ghana Navy throughout the operation phase.

Disruption of Onshore and Near Shore Fishing Activities
Since there will be no exclusion zone around the gas export pipeline, beach access will be restored following installation so no further disruption to onshore fishing activities is anticipated.

The construction activities which disturbed the seabed will cease during operations, and the Project associated vessel movements will be reduced. However vessel movements will continue throughout operation, associated with supply of the FPSO and for crew shift changes. Further marine traffic will be generated during the maintenance and surveillance phase of the flowlines and offshore export pipeline. These activities will continue to create the potential for interactions, collisions and or disturbance of near shore fishing boats and activities.

Damage to Fishing Gear
The potential for fishing gear to become entangled on the FPSO and be lost to the fishermen will remain throughout the operation phase, particularly for fishers using passive fishing gear such as hook and lines for tuna which are set several meters below the surface and left for many hours. However, this will only impact a small number of fishermen, fishing over 50 km offshore.

Lighting

The lighting of the FPSO and other offshore infrastructure will continue in the operations phase. As explained above, it is not likely that fish will congregated in these areas for an extended period of time.

Interactions with Project security forces

Eni will have the ORF and FSPO permanently guarded, while the pipeline routes will be regularly patrolled to deter deliberate damage or vandalism and assure the operational safety of the Project is not compromised.

Marine Traffic

During operations, vessel movement will be associated with the supply of the FPSO and Crew shift transportation. Routine maintenance and surveillance of the flowlines and gas export pipeline will generate vessel movement. Exclusion zones will be in place around fixed-position vessels (i.e the FPSO and drilling units), which will reduce the risk of collisions with other vessels.

Support vessel movement is not likely to interfere with international marine shipping, and over time, local sea users will become accustomed the routine movements of the Project vessels reducing the likelihood of vessel collisions and interactions.

Mitigation Measures

The mitigation measures described in Section 6.5.3 will continue to be implemented throughout the operation phase. In addition:

- Eni will notify mariners of the presence of vessels and other marine operations and the exclusion areas will be marked on nautical charts as cautionary advice to all sea-users. The gas export pipeline will also be clearly marked on navigation charts.
- Ongoing mitigation and stakeholder engagement will ensure that the impacts associated with the disruption/displacement of marine fishing-based livelihoods remain of medium significance (driven mainly by impact duration), and that those affected are able to adapt to the changes brought about by the Project.

Conclusion

Considering the mitigation measures described in the previous section and the evaluation criteria defined in Section 5.1, the residual impacts on Land and Livelihood resources associated with the operation phase are summarized in Table 6.9.

Table 6.9 Residual Impacts on Land and Livelihoods during Operation Phase

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Fisheries Livelihood – Operation Phase					
Disruption/Displacement of Marine Fishing-based livelihoods					

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Restricted Access to Offshore Fishing Grounds due to Exclusion Zones	Over 10 years	Local scale: the proposed operating site and its immediate environs	Low value/ sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**8-Medium**
Score	4	1	1	2	
Disruption of near-shore Fishing activities	Over 10 years	Local scale: the proposed operating site and its immediate environs	Moderate value/sensitivity of receptors or resources, able to adapt with some difficulty and which may require interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**9-Medium**
Score	4	1	2	2	
Damage to Fishing Gear	Over 10 years	Local scale: the proposed operating site and its immediate environs	Moderate value/sensitivity of receptors or resources, able to adapt with some difficulty and which may require interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**9-Medium**
Score	4	1	2	2	
Lighting	Over 10 years	Local scale: the proposed operating site and its immediate environs	Low value/ sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**8-Medium**
Score	4	1	1	2	
Public security	Over 10 years / Irreversible	Local scale: the proposed operating site and its immediate environs	Low value/sensitivity of receptors or resources able to recover or adapt to the changes without interventions.	Affecting small number of individuals, communities or administrative and/or higher no. of species and habitats	**7-Medium**
Score	4	1	1	1	

Impacts	Duration	Extent	*Importance / Resilience of Receptor /Resource*	*No. of Elements Involved*	Impact Rank
Marine Traffic and Infrastructure	Over 10 years / Irreversible	Regional scale: as determined by country's administrative boundaries	Low value/ sensitivity of receptors or resources, able to recover or adapt to the change without interventions	Affecting small no. of individuals, households, individual enterprises and/or small no. of species	**8-Medium**
Score	4	2	1	1	

The resulting Medium impact significance is mainly a consequence of the score assigned to the duration of the impacts in the operational phase (approximately 20 years), and not to the sensitivity of the receptor or the expected magnitude of the potential impacts.

6.5.5 Decommissioning Phase

Impact Identification and Assessment

At the end of the economic life of the OCTP Development Project, most project infrastructure will be decommissioned to restore the site to a safe condition that minimises potential residual environmental impacts and permits reinstatement of offshore activities such as fishing and unimpeded navigation. The decommissioning activities are planned to be completed in two years.

The gas export line will be abandoned on the seabed. Wells will be properly plugged and abandoned. Subsea FLETs will be flushed and then abandoned, as well as risers and main umbilical's dynamic sections (depending on the final breakdown of materials), mooring lines and suction piles. Other subsea facilities will be flushed to FPSO topside.

Waste water produced during clean-up operations will be treated on FPSO facilities in order to reach the requested hydrocarbon residual and re-injected in a designated injection well. Dumped items will not cause interference with other Contractors, and will not have potential effects on safety of navigation and environment;

FPSO will be towed to an Onshore Yard from Accra to Singapore (8570 km); the ultimate decommissioning of the FPSO will depend on its condition at the end of the production life and options available for further use.

The decommissioning impacts will be similar to that of the construction phase but of lower magnitude, as works will be performed in a limited area and will be completed in a shorter period. Following the decommissioning, the exclusion zones will no longer be enforced and fishing-based livelihoods will no longer be disrupted by the Project.

Mitigation Measures

Mitigation measures are expected to be similar to those implemented during construction phase, with the benefit of being improved based on lessons learned. Additionally, Eni will prepare a Preliminary Decommissioning Plan that will be developed further during field operations and fully defined in advance of the end of field life.

Conclusions

The residual impacts at decommissioning are likely to be similar to those felt during construction. However, residual impacts depend on the outcome of potential impacts during construction and the effectiveness of mitigation measures. As such, the impacts have not been rated at this stage.

7 FISHERIES MANAGEMENT AND MONITORING PLAN

7.1 PURPOSE OF THE FISHERIES MANAGEMENT PLAN

The purpose of the Fisheries Management Plan (FMP) is to ensure that undue or reasonably avoidable adverse impacts of the project phases (drilling & completion of oil and gas wells; FPSO and subsea gas pipeline installation and operation; decommissioning and abandonment) are mitigated. The FMP is therefore an important tool for ensuring that management actions arising from the Fisheries Impact Assessment (FIA) are clearly defined and implemented through all phases of the project life cycle.

7.2 STRUCTURE OF THE FISHERIES MANAGEMENT PLAN

The FMP comprises a number of project aspects and impacts; each with an overall associated management policy, mechanism of policy implementation, proposed monitoring program, potential corrective action and responsibility as described in Table 7.1.

Table 7.1 FMP Structure

FMP Component	Description of Content
Project Aspect	Aspect of the project with impact on the fisheries
Impacts	Potential impacts on fisheries resource of fisheries-based livelihoods
Policy	The guiding operational policy that applies to the element
Policy Implementation	The actions plans through which the policy will be achieved
Performance Indicators	The criteria by which the success of the implementation of the policy will be determined
Monitoring and Reporting	The measurement of actual performance of the policy and auditing of monitoring results
Corrective Actions	In case where a performance requirement is not met, action to be taken
Responsibility	Personnel responsible for policy

7.2.1 Fisheries Resources

Component	Description
Project Aspect	***1. Project Emissions*** • Discharges to water • Emissions to air • Noise emissions • Light emissions ***2. Presence of Subsea Infrastructure*** • Wells, risers and flowlines • Gas pipeline
Potential Impacts	• Impacts derived from FPSO, drilling rig and vessel discharges • Impact derived from ballast waters discharge • Disturbance to commercially exploited due to physical presence and light emissions • Disturbance to commercially exploited species due to underwater noise • Disturbance to commercially exploited species due to pipeline installation works
Policy	1. To prevent or minimise discharge and emissions into the marine and atmospheric environment 2. To minimize affection to commercially exploited species 3. To comply with requirement and regulations of the Fisheries Commission
Policy Implementation	• Develop and maintain a fish monitoring program to monitor fish catch statistics (see section 7.3 for details) • Operational discharges from the FPSO and project vessels will meet national and international requirements, including compliance with the relevant annexes of MARPOL and IMO standards and conventions. • Discharge IMO Guidelines for the Control and Management of Ship's Ballast Waste and Sediments (Ballast Water Management Convention) will be implemented. • All vessels involved in the Project, including the FPSO, will carry a Ballast Water Record Book where all ballasting operation will be registered. • The Project will control and reduce overall light intensity to the extent practicable to minimise impacts on commercially targeted species, without adversely affecting maritime or operational safety. • The Project will ensure that vessel engines are not left to idle unnecessarily to minimise impacts on commercially targeted species. Vessels will be powered down to safe operational levels. • Eni Ghana should ensure that wellheads, flowlines, gas pipeline, FPSO and associated facilities shall be decommissioned and abandoned in accordance with international good practice
Performance Indicators	• No exceedance of discharges standards for pollutants into the marine environment • Number of received and addressed grievances from fishermen
Monitoring and Reporting	• See section 7.3 Fish Monitoring Programme for details
Corrective Actions	• Review monitoring procedures to ensure all parameters are within acceptable defined limits
Responsibility	• OCTP Project Manager • HSE & CI Manager • Fisheries / Community Liaison Officer (FLO/CLO)

7.2.2 Fisheries – based Livelihoods

Component	Description
Project Aspect	1. Vessel movements (drilling rig, supply vessels, tankers, FPOS, pipe laying) and increased marine traffic 2. Temporary exclusion zones during construction activities (pipeline landfall location, drilling sites) 3. Permanent exclusion zone during project operations (FPSO) 4. Presence of Project security around the temporary and permanent exclusion zones 5. Cumulative impact of project plus other operations in the area
Potential Adverse Impacts	• Restricted access to offshore fishing grounds due to presence of project infrastructure and exclusion zones • Disruption of onshore and near-shore fishing activities • Damage to fishing gear • Lighting • Interaction with Project Security • Cumulative impacts with other relevant projects in the area (Jubilee field development, Lornho Oil Service Port, GNGC Gas Plant and TEN Development) • Interactions and possibly collisions with artisanal and commercial fishing vessels in the local offshore environment.
Policy	• To prevent or minimize conflict between fishermen and the project • To build trust between the fishermen and the project
Policy Implementation	• A vessel transit route will be agreed with the Ghana Maritime Authority and communicated to fishermen and other marine users through the CLO/FLO. • eni will develop an implementation Fisheries Management Plan. • If possible, eni will employ a Fisheries Liaison Officer (FLO) to liaise between fishermen and eni. . • Interaction with fishermen and other users will be monitored through the CLO/FLO and the Project's grievance procedure. In particular, compensation for any proven damage to fishing gear due to the fault of the project will be dealt through this procedure, with costs being agreed through the consultation with the local fisheries officers or similar. • Additional surveys of fishing effort at the pipeline landfall area will be performed (see details in section 7.3) to quantify fish catches/effort so that any effects on fishing from the pipeline construction works can be assessed. Potential loss of nearshore fishing effort or fish catches will be quantified by comparing catches with pre-construction data. Any financial losses that may be incurred will be calculated using fish landing market price information. • As a complementary measure, a dedicated community investment program will be developed to offset the general disturbance caused by the construction activities to the community as a whole. • A security management plant together with a specific patrolling procedure will be developed for both onshore and offshore installations. • Measures will be implemented to ensure that those engaged in maintaining the exclusion zones have received adequate training on the correct code of conduct and rules of engagement which will be

Component	Description
	based on the UN Voluntary Principles of Security and Human Rights. These measures will include, among other things, selection or personnel based on a careful background screening, training with regards to human rights requirements, and monitoring of performance. • Eni will propose to create a technical/management committee involving Eni as well as national and local government, and invite other operators in the area, in order to assess the potential cumulative impacts on fisheries. • A Marine Traffic Transportation Plan will be developed for the Project to ensure appropriate protocol is followed during offshore vessel movements. This Plan will consider vessel movements associated with other oil and gas projects in the area, and artisanal and commercial shipping traffic in the local offshore environment.
Performance Indicators	• No exceedance of discharges standards for pollutants into the marine environment • Level of information and knowledge of local fishermen of the development • Number of received and addressed grievances from fishermen
Monitoring and reporting	• Daily visual sightings and recording of fishing canoes/boats in and around the FPSO • Regular engagement with the fishermen along the coast within the area of influence • For other measures, see section 7.3
Corrective Actions	• Monthly review of monitoring procedures/management strategies • Implement recommendations arising from audits of monitoring procedures / management strategies
Responsibility	• OCTP Project Manager • HSE & CI Manager • Fisheries/Community Liaison Officer (CLO/FLO)

7.3 FISHERIES MONITORING PROGRAMME

7.3.1 Rationale

The FIA has identified residual impacts during construction and operation affecting both nearshore and offshore fishing grounds at a local scale. It is therefore proposed to monitor local fishing operations within the Project Areas of Influence (AoI) on a routine basis to monitor impacts, and compare these against those predicted. Results of monitoring will be shared with the affected communities, set in a broader context via collaboration with the Ghana EPA and Fisheries Commission, and used to focus management plan commitments.

The following documents were considered in developing this programme:

- Fisheries Management Plan of Ghana 2015-2019 (1)
- IFC Guidance on Addressing Project Impacts on Fishing-Based Livelihoods (2)

7.3.2 Methods and Schedule

The fisheries monitoring programme will employ the methods listed below within the Project AoI.

- Direct monitoring of nearshore fisheries.
- Catch analysis of offshore fisheries.
- Satellite monitoring/tracking of fishing activity.
- Stakeholder engagement.
- Water quality measurements.
- Plankton sampling.

Unless stated otherwise, it is proposed that these activities commence prior to construction to allow the collection of a broader baseline dataset, and proceed as set out below for a period of three years, with a review after that period to determine whether to modify or continue with the monitoring.

An outline method for each is given below, though the exact approach will be finalised following consultation with the Ghana EPA and Fisheries Commission. This will ensure that the monitoring conducted by the Project effectively complements water quality monitoring that the EPA may have in place and the Fishery Commission's own fisheries monitoring, including their national observer programme and port sampling activities.

Nearshore Fisheries Monitoring

The key receptors for impacts directly attributable to the project are fishing communities closest to the gas pipeline landfall. These communities are dependent on fishing and on their catches as their primary source of protein. It is therefore proposed that active monitoring is undertaken of the beach seining operations in these areas. It has been reported through

(1) Fisheries Management Plan of Ghana 2015-2019 (Marine Fisheries Sector) 13/02/2015 (3rd Version)

(2) IFC (2014). Addressing Project Impacts on Fishing Based Livelihoods. A Good Practice Handbook: Baseline Assessment and Development of a Fisheries Livelihood Restoration Plan.

consultation that beach seining, with nets deployed using canoes, is the only fishing method practiced at these villages.

The project will conduct quarterly beach seine surveys at locations corresponding to three villages in the immediate vicinity of the gas pipeline landfall. This will build upon previous survey effort during baseline studies at the villages of Sanzule and Bakanta, with additional survey at the village of Krisan (see Figure 3.2). The surveys would cover the months of April and October to complement previous survey effort at the end of the dry season (April) and at the end of the main upwelling period (October), but adding surveys in February and August to cover periods of peak catch during the two upwelling periods.

It is proposed to treat each quarterly survey as a single beach seine survey within the Project AoI, with six hauls, two being conducted at each village.

Basic information gathered for each haul will include:

- date, time and location (coordinates) of the fishing operations;
- weather conditions and tidal state;
- seine net specifications, including both overall dimensions and mesh size;
- time spent fishing; and
- number of people involved in fishing effort.

A detailed catch assessment will also be conducted; recording the following data for each haul:

- total catch by weight;
- species caught;
- total weight of each species; and
- average size and size classes from the lengths of a subsample from each species (up to 100 fish per species where possible).

Offshore Fisheries Catch Analysis

For fishing further offshore, which is within the Project AoI, but operated from outside the immediate landfall area and less likely to experience effects directly attributable to the project, it is proposed to undertake an analysis of landing data. For these operations, it is proposed that landing data is collected from six vessels, every day for one week, four times a year. These surveys will be scheduled to coincide with the timings of the nearshore monitoring described above. The information gathered would be developed in consultation with the Fisheries Commission and local fisheries officers, to complement their data gathering programme at a local scale. Data obtained would include:

- vessel registration number, size and number of crew;
- location of fishing activities undertaken (using GPS trackers);
- gear type used, net sizes and mesh sizes;
- fishing time and number of trawls undertaken;
- total catch by weight;
- species caught;
- photos of catch with size scale.

Tracking of Fishing Activity

Where possible/available, Vessel Monitoring System (VMS) data will be obtained for the offshore vessels which operate in the area to help understand the distribution of fishing effort at sea within the Project AoI and its variation over time. This would be undertaken in consultation with the Fisheries Commission who undertaken this monitoring.

Stakeholder Engagement

The Project's stakeholder engagement programme will include a process to engage fishing stakeholders within directly affected areas as well as the wider Project AoI. This stakeholder engagement programme will include:

- quarterly direct engagements with fishing leaders in each village within the Project AoI, including those involved in both nearshore and offshore operations and those whose livelihoods are tied to fishing activities; and
- bi-annual engagements with the Ghana EPA and Fisheries Commission.

Regular engagement throughout the project cycle will build relationships with affected communities and promote awareness and understanding of the Project risks and impacts and of the fish resources and fisheries, their trajectory and the impact of external forces on them.

The project's grievance mechanism will include provisions specific for grievances associated with fishing. The grievance mechanism will be widely disclosed and communicated, especially in those villages immediately adjacent to the pipeline landfall. Grievances will be monitored to determine patterns or trends and corrective actions taken as required.

Water Quality Measurements

In addition to the routine water quality measurements which form part of the wider environmental monitoring programme at the FPSO, water quality measurements will be taken at the villages closest to the gas pipeline (Sanzule, Bakanta and Krisan) on a quarterly basis during the year of construction. Samples will be taken at the same location each time and timed to coincide with the beach seine monitoring. Water sampling will occur prior to any fishing activity in an undisturbed area of water to avoid unrepresentative readings caused by disturbance of the seabed.

During each monitoring event, sea water samples will be collected at a water depth of 1 metre. Samples will be analysed for e. coli bacteria and physical measurements of pH, salinity and turbidity using a CTD probe and in-field analysers.

Plankton sampling

A survey will be undertaken to measure phytoplankton and zooplankton abundance and composition conducted twice yearly, during the upwelling periods, as a measure of food availability in nearshore fishing grounds. This would be carried using a plankton net for zooplankton and water samples for chlorophyll analysis for phytoplankton. It is proposed that this monitoring take place at the same time as the February and August beach seine monitoring at Sanzule, Bakanta and Krisan.

7.3.3 Local Participation

It is proposed that local fishermen be employed to undertake the beach seining surveys. The sampling would be coordinated by Ghanaian environmental consultants who will be able to

train community members in taking water quality measurements and plankton samples. Community members, including women, who are not directly involved in the fishing operation would be trained to assist in the sorting, weighing and measuring of the catch.

For the offshore landing data surveys, locally based or community based individuals will be identified in consultation with the Fisheries Commission or District Authorities to gather landings data from the returning vessels. This may be someone at the level of an assistant Fisheries Liaison Officer or through links with a local collage.

7.3.4 Data Analysis and Reporting

Statistical analyses of the catch information will be performed following each survey, with results presented in tabular and graphical format as appropriate. Where species were subsampled in sufficient numbers, length-frequency distribution graphs will be created to understand the age distribution of the catch. These analyses will build a picture of intra- and inter-annual variation in catch parameters.

A report of the findings of each survey will be submitted to the Ghana EPA and Fisheries Commission with three months of each survey event. The report will include a full analysis of results with respect to historic data including observed trends and recorded GPS/VMS tracks for fishing vessels within the Project AoI.

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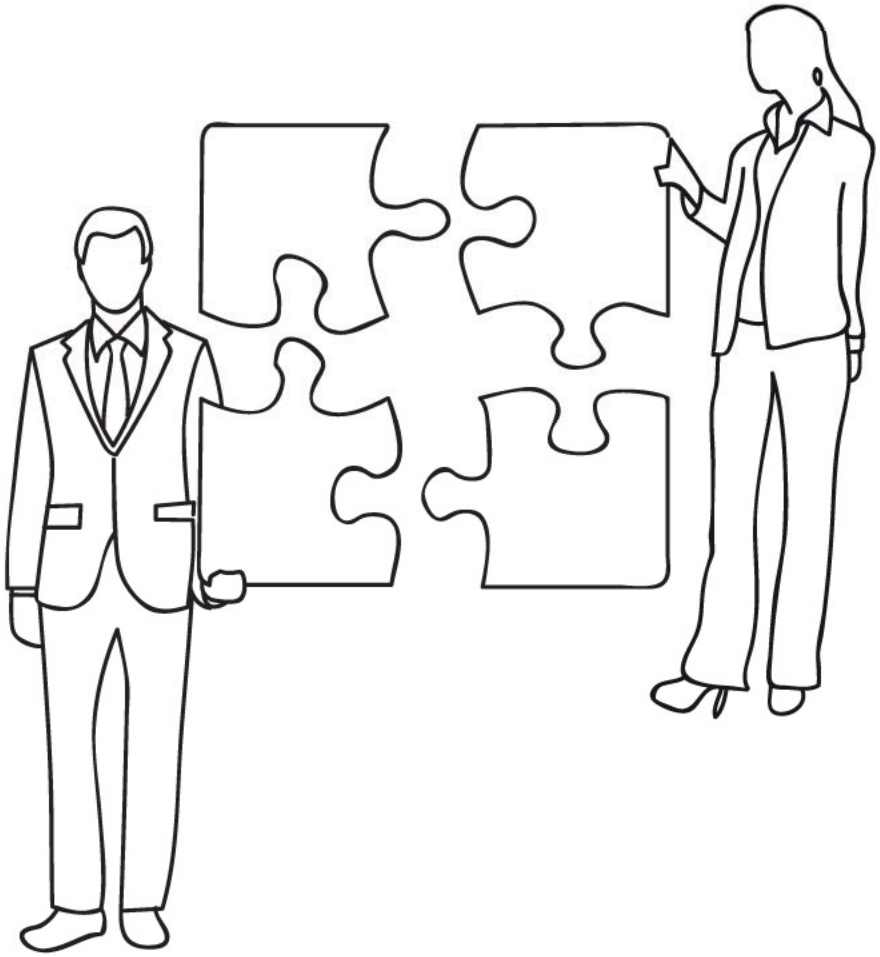
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Plan

HSE-PLAN-003 “DEVELOPMENT DRILLING & PRODUCTION OPERATIONS OIL SPILL CONTINGENCY PLAN – OCTP Block”



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TITLE:
DEVELOPMENT DRILLING & PRODUCTION OPERATIONS OIL SPILL CONTINGENCY PLAN - Offshore Cape Three Points (OCTP) Block
NOTE:
Revised by OSRL to include development drilling and production operations, where information is available.

DATE OF ISSUE:	EFFECTIVE DATE:
May 2015	May 2015

PREPARED BY:	CHECKED BY:	APPROVED BY:
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- All eni Ghana employees

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1. SCOPE AND OBJECTIVE

1.1 Scope

The scope of this Oil Spill Contingency Plan (OSCP) is to cover eni Ghana development drilling and production operations in the Offshore Cape Three Points (OCTP) Block in Ghana. The following development drilling and production operations will be covered by this OSCP:

- Development Drilling operations: Oil spills resulting from the drilling of 19 subsea wells (8 oil producers, of which 2 are re-entry, 5 subsea gas producers wells, 3 water injectors and 3 gas injectors) via the Maersk Voyager Drilling Vessel;
- Production operations:
  - Oil spills resulting from production operations relating to the Floating, Production, Storage and Off-loading (FPSO) unit;
  - 8 subsea oil producer wells;
  - 5 subsea gas producer wells;
  - Subsea network of flexible flowlines and risers to the process facilities on the FPSO;
  - Processed crude oil stored in the FPSO cargo tanks;
  - Shuttle tankers periodically moored to the FPSO;
  - Stored crude oil pumped to the shuttle tanker via an offloading hose;
  - gas sealine 63 km long to the Onshore Receiving Facilities (ORF).
- Field Support: Oil spills resulting from activities involving the field support vessels.

The Plan contains organisational responsibilities, actions, reporting requirements and resources available to ensure the effective and timely management of an accidental oil spill; and supplies the Emergency Response Team (ERT) with a high level strategic document that covers the main procedures and information required during an oil spill response.

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1.2 Objective

The objective of this OSCP is to offer guidance on the necessary actions to prevent and/or minimise any accidental discharge of oil and to mitigate any negative effects. The OSCP is a product of the eni Ghana Integrated Management System and interfaces with the following plans:

- Ghana National Oil Spill Contingency Plan (NOSCP) and;
  - The National Oil Spill Response Dispersant Use Policy;
  - Oil Spill Dispersants Guidelines;
  - Guidelines for Management and Disposal of Oil Spill Debris.
- Environmental Sensitivity Map for Coastal Areas of Ghana;
- eni Ghana Emergency Response Plan (HSE-PLAN-002);
- eni Ghana Waste Management Plan (HSE-PLAN-005);
- eni Ghana / Rig vessel operator in place.

1.3 How to use this document

The implementation of the OSCP is subject to the following general instructions:

- Where a spillage is a part of a wider emergency, such as a blowout or fire or explosion, these aspects of the incident must be addressed first and reference should be made to the eni Ghana Emergency Response Plan.
- Effectiveness of intervention and communication has priority over normal Company hierarchical relationships.
- Should a position be unavailable along the activated/information chain, the action is transferred to that person's stand-by. If the nominated stand-by is absent, the role transfers to that person's signature authority.
- Persons assigned to the Emergency Response Team generally perform their normal daily roles but in the more critical environment generated by an emergency situation.

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2. ACRONYMS

EPA	Environmental Protection Agency
UPSTREAM	Upstream and Technical Services
EC	Emergency Coordinator (eni Ghana)
ERC	Emergency Response Coordinator (eni Upstream)
ERM	Emergency Response Manager
ERP	Emergency Response Plan
ERR	Emergency Response Room
ERT	Emergency Response Team
ft	Feet
GNPC	Ghana National Petroleum Corporation
GPS	Global Position System
HQ	Head Quarters
HRO	Human Resources and Organisation
HR	Human Resources
HSE	Health, Safety, Environment and Public Safety Integrated Management System
HSE & CI	Health, Safety, Environmental And Community Investment
IBC	Intermediate Bulk Container
IMO	International Maritime Organization
IPIECA	International Petroleum Industry Environmental Conservation Association
ITCZ	Inter – Tropical Convergence Zone
JOA	Joint Operating Agreement
km	Kilometre
lts	Litres
LM	Logistics Manager
m	Metre
min	Minute
mm	Millimetre
µm	Micrometre

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NAG	Non Associated Gas
NCA	National Competent Authority
NCP	National Contingency Plan
NEBA	Net Environmental Benefit Analysis
nm	Nautical mile
NOSCP	National Oil Spill Contingency Plan
OSC	On Scene Commander
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
PEAR	People, Environment, Assets and Reputation (An acronym used when assessing the significance of the emergency event under the Incident Command Structure).
PIC	Person in Charge
PoB	People on Board
PPE	Personal Protective Equipment
sec	Second
SITREP	Situation Report
PSV	Platform Supply Vessel
SOPEP	Shipboard Oil Pollution Emergency Plan
UVF	Ultra-Violet Fluorometry
WACAF	West and Central Africa

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3. ACTION PLAN

Figure 1 illustrates the reporting procedures and key actions that the key personnel will follow in the event of an oil spill incident from eni Ghana's operations.

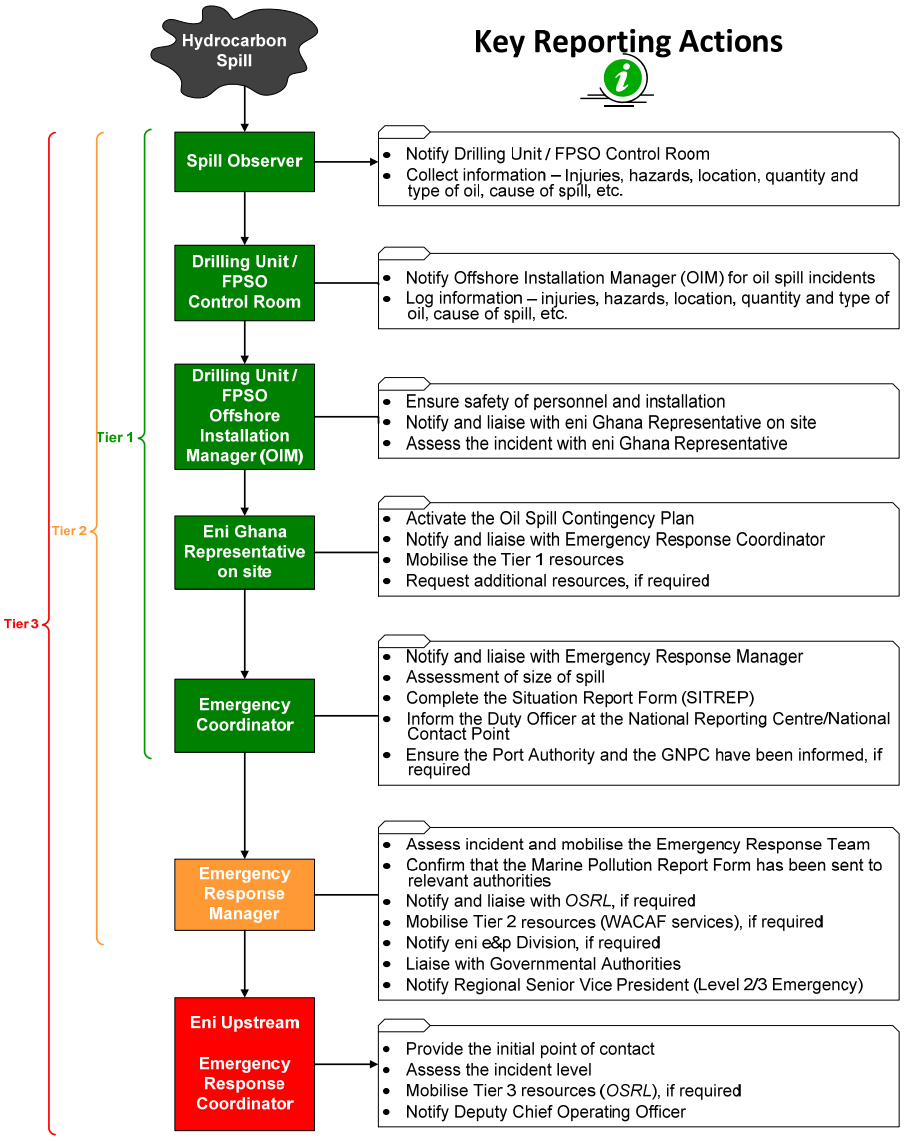


Figure 1 Initial Notifications and Reporting Procedures

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Note: The Emergency Coordinator has to report all spills to the (EPA +233 (0) 0302 664697/8, 667524, 662465).

In the event of a Tier 1 spill in the Harbour from one of the PSVs the Vessel Master will report the incident to the Harbour Master and the eni Ghana Emergency Response Coordinator.

3.1 Action Checklists

Once the OSCP has been activated and the ERT have been mobilized (in part or in full), individual ERT members will assume the roles set out in Section 4.2.1. The checklists describe the supportive response procedures and typical issues that may require being considered and activated. ERT members should familiarize themselves with these checklists prior to commencement of operations and use them as an individual 'aid memoir' in the event of an oil spill response situation. These Checklists are provided in Sections 3.1.1 to 3.1.10. ERT members should ´personalize´ these as appropriate.

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3.1.1 Spill Observer

STEP	ACTION	✓
Initial Actions	Notify Drilling Unit / FPSO Control Room and inform of:	
	▪ Location of spill/incident;	
	▪ Safety and status of personnel	
	▪ Source the cause of spill;	
	▪ Hydrocarbon type (e.g. diesel, utility oils);	
	▪ Extent of spill;	
	▪ Time and duration of incident;	
	▪ Potentially hazardous aspects; and	
	▪ Any other relevant information (particularly: is spill contained or is the release ongoing).	
	Contact all personnel in the vicinity of the source or spill and warn of hazard.	
Further Actions	Cease hot work if applicable, isolate ignition sources.	
	If safe to do so, stay in vicinity of the spill and continue observation.	
	If safe to do so, take reasonable actions to contain or reduce the leak or spill.	
	Only approach the spill from downwind of the source with an area gas monitor and appropriate Personal Protective Equipment (PPE).	
	Do not allow oil to come into contact with the skin.	

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3.1.2 Drilling Unit / FPSO Control Room Operator

STEP	ACTION	✓
Initial Actions	Collate relevant spill information received from the Spill Observer.	
	Notify Offshore Installation Manager (OIM).	
	Request full details of the incident to the Spill Observer:	
	▪ Safety and status of personnel;	
	▪ Location of spill/incident;	
	▪ Source of spill;	
	▪ Hydrocarbon type (e.g. diesel, utility oils);	
	▪ Extent of spill;	
	▪ Time and duration of incident;	
	▪ Potentially hazardous aspects; and	
	▪ Any other relevant information (particularly: spill contained or ongoing release).	
	Start a Personal Log and record time and details of own actions.	
Further Actions	Maintain communication between the spill observer, OIM, Field Supply Vessels and Offshore Emergency Response Team.	

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3.1.3 Offshore Installation Manager

STEP	ACTION	✓
Initial Actions	**ENSURE SAFETY IS A PRIORITY IN ANY SPILL.**	
	Muster/evacuate personnel as required.	
	Notify the eni Ghana Representative on site.	
	Obtain full details of the incident from the Control Room:	
	▪ Safety and status of personnel;	
	▪ Location of spill/incident;	
	▪ Source and cause of spill;	
	▪ Hydrocarbon type (e.g. diesel, utility oils);	
	▪ Extent of spill;	
	▪ Time and duration of incident;	
	▪ Potentially hazardous aspects; and	
	▪ Any other relevant information (particularly: spill contained or ongoing release).	
	Start a Personal Log and record time and details of own actions and own decisions.	
	Assess the source and cause of spill with assistance from eni Ghana Representative on site.	
Further Actions	Ensure that the eni Ghana Representative is provided with timely situation reports as and when required.	
	Obtain information on tides and direction/speed of current and wind.	
	Identify tasks that must be performed to implement the initial strategy with assistance from eni Ghana Representative on site.	
	Channel information to relevant parties and prioritise requests.	
Final Actions	Hold debrief for onsite personnel involved in the response.	
	Complete incident log and pass it to eni Ghana Representative on site.	
	Offer support to the incident investigation.	

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3.1.4 eni Ghana Representative On Site

STEP	ACTION	✓
Initial Actions	**ENSURE SAFETY IS A PRIORITY IN ANY SPILL.**	
	Obtain full details of the incident from the OIM.	
	Activate the Oil Spill Contingency Plan (OSCP).	
	Assume the role of the On-Scene Commander (OSC).	
	Notify and liaise with the Emergency Coordinator (EC)	
	Start a Personal Log and record time and details of own actions and own decisions.	
	Alert the Offshore Emergency Response Team (ERT).	
	If required, request mobilisation and deployment of Tier 1 resources.	
	Make sure action has been taken to stop operational activities and if safe, stop spill.	
	Assist the OIM to assess the source and cause of spill.	
	▪ Estimate quantity of spilled oil (Section 395.2);	
	▪ Estimate direction of slick movement (Section 5.2);	
	▪ Allocate spill into appropriate Tier Level (Section 4.1).	
Further Actions	Complete the Situation Report Form (SITREP) (page 190)	
	Monitor the spill. If observation from deck / Field Supply Vessel is not sufficient, request aerial surveillance via the Emergency Response Coordinator.	
	If tracking of slick is not possible, request oil spill modelling via the Emergency Response Coordinator.	
	Monitor effectiveness of response strategy.	
	Ensure that timely situation reports are provided to the Emergency Response Coordinator, outlining: ▪ Changes to the incident situation. ▪ The effectiveness of the response strategies being employed.Support requirements. ▪ Site safety concerns.	
	Request additional resources from the Emergency Coordinator (EC) as soon as possible.	

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STEP	ACTION	✓
	Coordinate activity for all Site ERT members in line with objectives and priorities.	
	Coordinate the arrival of Tier 2/3 resources and personnel.	
	Ensure new personnel arriving on site are fully briefed, emphasising safety issues associated with the drilling unit / FPSO and incident.	
	Collect and maintain relevant documents for response operations.	
Final Actions	Complete demobilization procedures.	
	Assist OIM to hold debrief for onsite personnel who were involved in the response.	
	Support the incident investigation and analysis as required.	
	Ensure Tier 1 resources are returned to standby.	
	When safe, restart normal operations.	
	Complete incident log.	
	Collect incident logs and pass them to HSE&CI Manager.	

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3.1.5 Offshore Emergency Response Team

STEP	ACTION	✓
Initial Actions	**ENSURE SAFETY IS A PRIORITY IN ANY SPILL**	
	Respond immediately to any oil spill notification.	
	Collect PPE, communications and safety equipment.	
	Go to the muster point to wait for briefing.	
	Receive briefing from the eni Ghana Representative onsite (On-Scene Commander - OSC) before going on site.	
	Ensure awareness of the hazards that may occur (e.g. gas, explosive vapour, fire risk and dangers when using response equipment or chemicals).	
Further Actions	On arrival at the site of the spill:	
	▪ If area is unsafe, leave taking others with you; ▪ Assume fire or explosion risk until proven otherwise; ▪ Test communications; ▪ Be aware of muster points, evacuation routes and on site alerting system; ▪ Be aware of danger/exclusion zones and the areas where entry is forbidden for people, boats or helicopters; and ▪ Know what actions to take if someone is injured (i.e. first aid and contacting emergency services).	
	Follow instructions from the OSC.	
	Deploy oil spill response equipment as instructed.	
	Observe correct safety procedures for working in boats, handling equipment.	
	Know the locations and tasks of others on site and ensure that they are aware of your location and task.	
	Regularly reassess safety hazards to yourself and to other team members.	
Final Actions	Complete demobilisation procedures.	
	Give Individual Logs to the OSC.	
	Recover and clean equipment and if necessary repair all equipment after use.	
	Clean/decontaminate at a pre-identified site.	
	Report any damage to equipment to eni Ghana Representative on site (OSC).	
	Participate fully in debrief.	

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3.1.6 Emergency Coordinator

STEP	ACTION	✓
Initial Actions	**ENSURE SAFETY IS A PRIORITY IN ANY SPILL.**	
	Obtain full details of the incident from the eni Ghana Representative (OSC)	
	Establish nature and severity of incident: ▪ Safety of personnel; ▪ Location of spill/incident; ▪ Source and cause of spill; ▪ Hydrocarbon type (e.g. diesel, utility oils); ▪ Extent of spill; ▪ Time and duration of incident; ▪ Potentially hazardous aspects; and ▪ Any other relevant information (particularly: is spill contained or is the release ongoing).	
	Start a Personal Log, record time and details of actions and decisions.	
	Assist eni Ghana Representative with the assessment of spill size.	
	Notify and liaise with the ERM and give full briefing on the situation.	
	Inform the Duty Officer at the National Reporting Centre and the National Contact Point.	
	Ensure the Port Authority, Petroleum Commission and the GNPC have been informed, if required.	
	Proceed to the ERR, if the ERM decides to mobilise the ERT.	
	Establish communication with incident site.	
	Complete Situation Report Form (SITREP) (Annex B, Section 3).	
Further Actions	Maintain close liaison with eni Ghana Representative onsite.	
	Update the Logistics Manager and HSE&CI Manager on the situation.	
	Update the ERM and agree actions.	
	Obtain all relevant technical information that may be necessary	
Final Actions	Confirm incident closure and agree stand down with ERM.	
	Attend debrief meeting.	
	Complete incident log.	
	Collect incident logs and pass them to Log Keeper.	

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3.1.7 Emergency Response Manager

STEP	ACTION	✓
Initial Actions	**ENSURE SAFETY IS A PRIORITY IN ANY SPILL.**	
	Establish communication with the Emergency Coordinator (EC).	
	Obtain update of available information:	
	▪ People;	
	▪ Safety hazard;	
	▪ Damage to facilities;	
	▪ Extent of pollution (spill size and source, type of spilt oil);	
	▪ Actions taken so far.	
	Start a Personal Log and record time and details of own actions and own decisions.	
	Make, jointly with the EC, an initial evaluation of the situation and the need to mobilise ERT members.	
	Request HSE&CI Manager to mobilize the Emergency Response Team (ERT).	
	Proceed to Emergency Response Room (ERR).	
	With input from the ERC, prepare an assessment of the situation as the basis for a response strategy including:	
	▪ Situation: stable or escalating;	
	▪ Ability of the Site Emergency Teams to control the event;	
	▪ Environment damage status: extent, containment, clean-up actions, expected long-term effects;	
	▪ Assistance: focus on immediate / priority tasks (as requested).	
	Ensure the members of ERT are fully briefed.	
	Identify the initial actions required from the ERT.	
	Ensure that Navy Operations and EPA have been notified.	
	Confirm that the Marine Pollution Report Form has been sent to the appropriate Regulatory Bodies (PC and EPA).	
	For Tier 2/3 spill aerial surveillance should be initiated in order to determine position of slick, progress of natural dispersion and potential requirement for dispersant spraying (Refer to Section 6 for details).	

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STEP	ACTION	✓
	Note: If chemical dispersant strategy is to be initiated, request HSE&CI Manager to make contact with EPA, as appropriate.	
Further Actions	Hold regular update sessions.	
	Notify OSRL even if their mobilisation may not be required.	
	Communicate with Emergency Response Coordinator (eni Upstream & Technical Services).	
	Authorise mobilisation of equipment necessary for implementation of response strategy.	
	If extra resources are needed (or if continuous spill or if shoreline is at risk), mobilize resources from *OSRL*.	
	Establish contact with shareholders' Emergency Response Coordinator and clarify the specific communications between individual ERT members and shareholders' emergency response personnel.	
	Maintain an overview of the status of events and actions, manage the ongoing ERT response effort and delegate actions.	
	Mobilize the Public Affairs Advisor.	
	Ensure that local opinions and concerns are monitored and addressed.	
	Ensure that up-to-date reports are circulated to all notified parties.	
	Discuss situation with Shareholders Business Area.	
	Assess possible escalations and continuation of the emergency, reviewing response strategy accordingly.	
	Establish appropriate authorization for expenditure as required.	
	Ensure that an initial media holding statement is available and ready for issue if required.	
	Ensure logs and records of events, actions and information are being kept.	
	Decide with HSE&CI Manager, *OSRL* and relevant Authorities the close-out response.	
	Decision with ERT to stand-down incident.	
Final Actions	Confirm incident closure with field team.	
	Close out liaison with contractors.	
	Arrange for de-brief and consolidate costs.	

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STEP	ACTION	✓
	Complete incident log.	
	Pass incident log to Log Keeper.	
	Arrange with HSE&CI Manager for a brief summary paper of the incident to be developed, based on the logs. Highlight any issues and make lessons learnt profile after the incident.	

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3.1.8 HSE & CI Manager

STEP	ACTION	✓
Initial Actions	**ENSURE SAFETY IS A PRIORITY IN ANY SPILL.**	
	Obtain a briefing of the situation from the ERM.	
	Request the following information:	
	▪ time and date of the spill;	
	▪ type of oil;	
	▪ cause of spill (if known);	
	▪ estimated quantity spilled;	
	▪ estimated rate of spill if continuing;	
	▪ whether clean-up activities have been initiated;	
	▪ any other relevant comments;	
	▪ actions taken so far.	
	Start a Personal Log and record time and details of own actions and own decisions.	
	Assist the ERM to assess the spill:	
	▪ Estimate quantity of spilled oil (Section 5.2);	
	▪ Estimate direction of slick movement (Section 5.2);	
	▪ Allocate spill into appropriate Tier Level (Section 4.1).	
	Mobilize other ERT members if required by the ERM.	
	Set up the Emergency Response Room (ERR).	
	Obtain copy of the completed Marine Pollution Report Form.	
	Assist Emergency Coordinator (EC) to complete the Situation Report Form (Annex B, Section 3).	
	Ensure that the Statutory Bodies have been informed:	
	▪ National Oil Spill Reporting Centre (Navy Operations);	
	▪ National Oil Spill Response Centre (Environmental Protection Agency - EPA).	
	Assist the ERM to determine the appropriate response strategy and the resources required.	
	Note: If chemical dispersant strategy is to be initiated, make contact with	

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STEP	ACTION	✓
	EPA, as appropriate.	
	Request weather forecast information.	
	Notify *OSRL* and request oil spill modelling. If needed, request a Technical Advisor.	
	Advise the ERM of health or safety risks, staffing and logistics requirements and HSE perspective.	
STEP	**ACTION**	
Further Actions	Continue communications and briefings.	
	Liaise with Logistics Manager regarding mobilisation of air/land transportation.	
	Ensure aerial surveillance flight to monitor slick movement. Ensure you receive an aerial surveillance log from aircraft following each flight.	
	Ensure proper HSE procedures have been implemented for the response.	
	Maintain ongoing liaison with relevant authorities and affected communities through Social Representatives/CLOs.	
	Request *OSRL* to re-run oil spill model on a regular basis using updated sighting reports and weather forecast information.	
	Send the Situation Report Form to eni Upstream & Technical Services (within 24 hours).	
	Request regular updates from the incident site on:	
	▪ Activities of Offshore Emergency Response Team;	
	▪ Condition of oil;	
	▪ Effectiveness of response strategy (via Well Operations Manager).	
	Ensure that proper HSE procedures have been implemented for the response, i.e. teams receive:	
	▪ Personal Protective Equipment (PPE);	
	▪ Communication equipment;	
	▪ Supplies.	
	If the spill is likely to impact the shoreline, liaise with Local Authorities and EPA. Consult environmental sensitivity maps as required.	

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STEP	ACTION	✓
	Assess the environmental and community damages resulted by the spill, waste collected, and waste disposal.	
	If required, contact the oiled wildlife specialist (Sea Alarm) via OSRL. Additionally, discuss the requirement for specialised wildlife response equipment with the OSRL Duty Manager.	
	Establish if extra stocks of dispersant / earth moving equipment from other companies are required.	
	Submit briefing report to Oil Spill Response Contractor.	
	Keep Emergency Coordinator informed of actions taken and status.	
	Ensure that up-to-date reports are circulated to all notified parties.	
Final Actions	Provide status reports on safety, environmental and community impacts to the ERM.	
	Assist ERM with incident investigation.	
	Confirm incident closure and notify all authorities.	
	Complete incident log.	
	Attend debrief meeting.	
	Collect personal incident logs from all members involved in the incident via the Log Keeper.	

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3.1.9 Logistics Manager

STEP	ACTION	✓
Initial Actions	If called, proceed to the eni Ghana Emergency Response Room (ERR).	
	Receive incident status report from the Emergency Response Coordinator.	
	Start a Personal Log and record time and details of own actions and own decisions.	
	Review with eni Ghana Representative on site the need for logistics support.	
Further Actions	Obtain weather forecast (sea conditions / wind direction).	
	Establish contact (and provide briefing) as required with:	
	▪ Aircraft contractor;	
	▪ Contracts for support services;	
	▪ Equipment;	
	▪ Transport.	
	Arrange for overflight (aerial surveillance) to establish spill development/assess response action effectiveness.	
	Update eni Ghana Representative on site on status of resources contacted / mobilized.	
	Monitor progress of mobilization through regular contacts and updates.	
	Coordinate logistic support to the Oil Spill Response Contractor, with assistance from Well Operations Manager.	
	Update the Status Boards with all air / land transportation information. Pass information to Log Keeper.	
	Contact Government Departments and any other relevant agencies that need to be notified of the emergency.	
	Arrange for supplies of:	
	▪ Dispersants;	
	▪ Fuel;	
	▪ Transportation of equipment;	
	▪ Maintenance.	
	In collaboration with the HSE&CI Manager, contact possible waste disposal contractors to arrange for disposal of waste materials based to likely	

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STEP	ACTION	✓
	quantities of wastes.	
Final Actions	Ensure return of all equipment.	
	Confirm incident closure and notify all contractors.	
	Complete incident log.	
	Attend debrief meeting.	
	Pass incident log to Log Keeper.	

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3.1.10 Log Keeper

STEP	ACTION	✓
Initial Actions	If called, proceed to the eni Ghana Emergency Response Room (ERR).	
	Ensure that the ERR is equipped with necessary documentation, maps, information means and provisions if necessary.	
	Obtain a full briefing from the HSE&CI Manager.	
	Ensure that the necessary Status Boards in the ERR are displayed and begin the process of transferring information.	
Further Actions	Consult with the Emergency Response Coordinator to distil the relevant information from the Incident Information Checklist.	
	Register on the log sheet all the events occurring during the incident.	
	Record the corresponding time: facts, received and outgoing messages, facts and actions, human, technical and financial means engaged, phone calls, faxes and emails.	
	Post the following information on an situation display board during incident:	
	o details of the accident (location, nature and severity of the incident);	
	o follow-up of logistical means engaged / available;	
	o weather in progress and forecast bulletin.	
	Ensure that the above-mentioned information is regularly updated.	
	Consult with individual ERT members to ensure actions taken, information received is recognized and transferred to the appropriate board as required.	
	Ensure the information entered on wallboards is consistent. Point out any anomalies to the Emergency Response Manager and/or refer them to the site.	
	Ensure separate copies of the Status Boards are prepared for records/references purposes.	
	Ensure individual team member log sheet slips are placed into the filing tray.	
Final Actions	Ensure that all the registers are collected at the end of the incident.	
	Participate in the debriefing.	
	Assist the Emergency Response Manager with the preparation of the final report.	
	Pass all incident logs from ERT members to HSE&CI Manager.	

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3.2 Termination of Operations

3.2.1 Termination Of Oil Spill Response

Once the oil spill incident has been controlled, an assessment will be made as directed by the Emergency Response Manager. If the assessment reveals that the incident is under control and emergency response is no longer needed, the emergency will be declared over, by the Emergency Response Manager and the Emergency Response Team will be dismissed. This will be communicated to all the concerned external agencies.

3.2.2 Follow – Up Response

Once oil spill response has ended, clean-up of the environment and repairs to equipment may continue, as needed. These continued actions will be directed by eni Ghana's normal chain of command.

3.3 Updating Responsibility

3.3.1 Managing Director

The Managing Director approves the issue of the present document and oversees its drawing-up and updating, with the support of the HSE&CI Manager.

3.3.2 HSE&CI Manager

The HSE&CI Manager co-operates with the Managing Director to ensure the drawing up, updating and distribution of the present procedure and verifies its level of application.

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4. OIL SPILL MANAGEMENT

4.1 Tier Level Assessment

eni Ghana has adopted the internationally recognised Tiered Response system for assessing the severity of oil spills (Figure 2). The purpose of the three tier levels is to establish, as soon as possible, what is the correct level of response needed to combat the spill. The severity of the spill depends on the size of the complexity of the response and the potential consequences for people, assets, reputation, economy and for the environment. By identifying the Tier, the eni Ghana Representative on site and the Emergency Response Manager can mobilise the appropriate resources to combat the spill.

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FOR UNCONTROLLED WELL BLOW OUTS GO IMMEDIATELY TO TIER 3

Establish the tier level of the oil spill

Tier 1

Tier 1 oil spills are likely to be small and effect a localised area. The spill can be managed immediately by using the on site resources or local contractors.

Characteristics of a Tier 1 oil spill:

- ❑ Spill occurs within immediate site proximity and is contained
- ❑ Minor environmental impact and likely to naturally dissipate
- ❑ Spill can be easily managed using eni Ghana oil spill response resources available on site
- ❑ The spill source has been secured
- ❑ No media interest
- ❑ Day time release / Light oil spill
- ❑ Oil is moving away from the coastline

Tier 2

Spill could cause significant pollution resulting in the activation of the local authorities' emergency response plans, and the mobilisation of external oil spill response resources.

Characteristics of a Tier 2 oil spill:

- ❑ Concentrated oil pooling in close proximity to the FPSO, field supply vessel, onshore storage tank etc.
- ❑ Danger of fire or explosion
- ❑ Possible continuous release
- ❑ Tier 1 resources are overwhelmed, requiring additional off site / regional resources
- ❑ Intervention by local / national authorities
- ❑ Night time release / poor visibility
- ❑ Heavy fuel or crude oil
- ❑ Potential impact to sensitive areas and / or local communities, coastline or inland waterway
- ❑ Spill source cannot be immediately secured
- ❑ Local / national media attention

Tier 3

A catastrophic spill requiring the mobilisation of international support and resources

Characteristics of a Tier 3 oil spill:

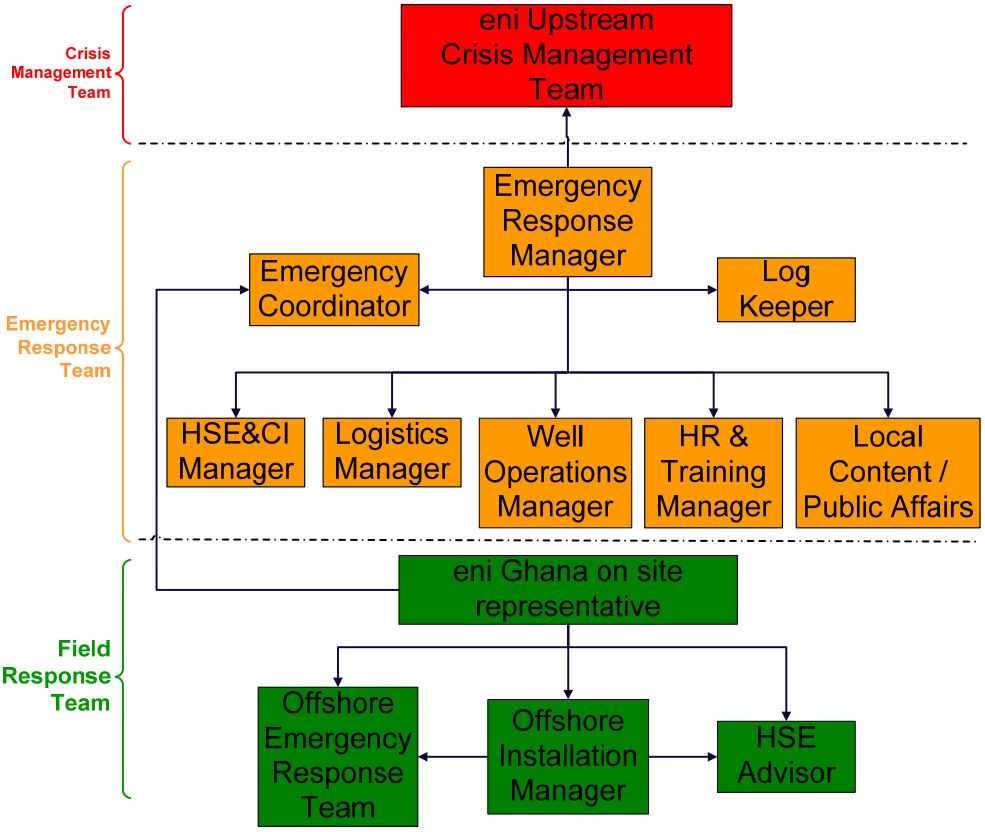
- ❑ Uncontrolled well blow out or loss of well control
- ❑ Actual or potentially serious threat to life, property or industry
- ❑ Tier 1 and 2 resources are overwhelmed requiring international Tier 3 resources to be mobilised (e.g. OSRL)
- ❑ Significant impact to sensitive areas, shoreline and or local communities
- ❑ Spill has crossed international maritime boundaries and potential to impact neighbouring countries (Cote d'Ivoire)
- ❑ International media attention

Figure 2 Tiered Response Assessment System

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4.2 Oil Spill Organisation

This section describes the management structure and reporting lines and roles during an oil spill incident. In the event of a Tier 1, 2 and 3 oil spill incidents, the reporting lines will be as per the flow diagram below.



4.2.1 Tier Level 1

An oil spill that can be dealt with by on-site/location personnel and resources; the oil spill does not have any effect outside the site and external agencies are unlikely to be involved. There is unlikely to be danger to life, to the environment, or to eni Ghana assets or reputation.

The Oil Spill Contingency Plan is activated by the eni Ghana Representative on site; eni Ghana is notified.

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4.2.2 Tier Level 2

An oil spill which may be dealt with locally but requires involvement of wider eni Ghana support and external services. The initial oil spill may be "onsite", have some effect outside the site or be "off-site", and external (national) emergency services will be involved. There is likely to be danger to life, the environment, or to eni Ghana assets or reputation.

The Oil Spill Contingency Plan is activated by the eni Ghana Representative on site; the Emergency Response Team is activated; the eni Upstream & Technical Services is notified.

4.2.3 Tier Level 3

A major oil spill which requires involvement of the eni Upstream & Technical Services Emergency Organization and other National and International Resources. There is likely to be danger to life, the environment. For eni Ghana this may result from insufficient local resources and/or because the incident has broader implications for the JOA members such as reputation, legal, financial, license to operate, etc.

The Oil Spill Contingency Plan is activated by the eni Ghana Representative on site; the Emergency Response Team is activated; the eni Upstream & Technical Services Crisis Management Team is activated.

4.2.4 Eni Ghana Emergency Response Team (ERT)

The Emergency Response Team (ERT) is responsible for the coordination and implementation of the actions required to support the response and to manage any broader implications of the event, such as communicating with Authorities, mobilizing additional resources and equipment and liaising with Upstream & Technical Services.

Table 1 below presents a series of specific responsibilities ascribed to key members of the ERT.

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Table 1 ERT Responsibilities

Position	All Levels	Tier Level 3
ANY COMMUNICATION NODE, SUCH AS SWITCHBOARD, RECEPTION ETC.	Commence notification to the Company representative in accordance with local procedures.	
COMPANY REPRESENTATIVE ON SITE / ON SCENE COMMANDER	Notification/reporting of details of any emergency situation to the Emergency Coordinator (EC). Establishing and maintaining effective communication with EC for situation updates and support request.	
EMERGENCY RESPONSE MANAGER (ERM)	Manages the ERT and the overall response of the on/offshore support and associated eni Ghana activities and ensures it is effective and communicates to PA the ERC contacts. Appoint the On-Scene Commander if needed.	Establish and maintain communications with the Upstream & Technical Services Person in Charge and coordinate support activities.
EMERGENCY RESPONSE COORDINATOR (EC)	Provides the first point of contact for notification/reporting of an incident/emergency on the SITE and maintains a 'permanent' open communication with the SITE.	Maintain contact with specific Upstream & Technical Services resources as necessary
LOGISTICS MANAGER (LM)	Reporting to the Emergency Response Coordinator. They will coordinate the logistical support to the response, in particular related to air service contractor.	Liaise with the specific Upstream & Technical Services Emergency Contacts as necessary

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Position	All Levels	Tier Level 3
HSE&CI MANAGER	Reports to the Emergency Response Manager. Evaluates the HSE implications of the emergency. Establishes contact with Logistics Manager in order to mobilize necessary support. Establish contact with external agencies, Medical Contractor, Oil Spill Contractor and relevant Government agencies as required and mobilize necessary support.	Liaise with Upstream & Technical Services HSE for information and support as necessary
HR & TRAINING MANAGER	Reports to the Emergency Response Manager. Manages the personnel implications of the incident (PoB, Casualties, Personnel movements, Relatives) and establishes contact with the relevant contractors.	Liaise with the Upstream & Technical Services HRO Department for further support if required.
PUBLIC AFFAIRS	Assess the implications of the emergency in terms of media and public stakeholders and advise the Emergency Response Manager.	
LOG KEEPER	Ensures relevant information is transferred to the respective Status Boards in the ERR and updated as required and that appropriate documented records are maintained.	

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4.2.5 Eni Upstream & Technical Services HQ (Milan)

The eni Emergency Response organization is involved for Level 3 emergency situations. They should be informed as necessary of other Level 1 or 2 situations. The principal roles of the Milan organization are to:

- Manage any broader implications to eni Ghana as a result of the incident.
- Provide support to eni Ghana where local/national resources and arrangements are not sufficient to manage the emergency.

The eni Ghana ERT, via the Emergency Response Manager, should inform and establish communications with the "Person in Charge" who will mobilize necessary personnel and resources in Milan.

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5. RESPONSE STRATEGY

This section is designed to aid in the decision making process on which is the most appropriate strategy for the spill depending on type and location. Every oil spill incident is different in terms of the type of oil spilled, volume, location, time of day, weather and sea conditions, and potential impact to environmental and socioeconomic sensitivities, thus not all techniques are appropriate for every oil spill. A degree of flexibility is required as more than one strategy may be appropriate, and the chosen strategy could well change with time as the incident develops, refer to Table 2 below. Guidance is provided for the following strategies:

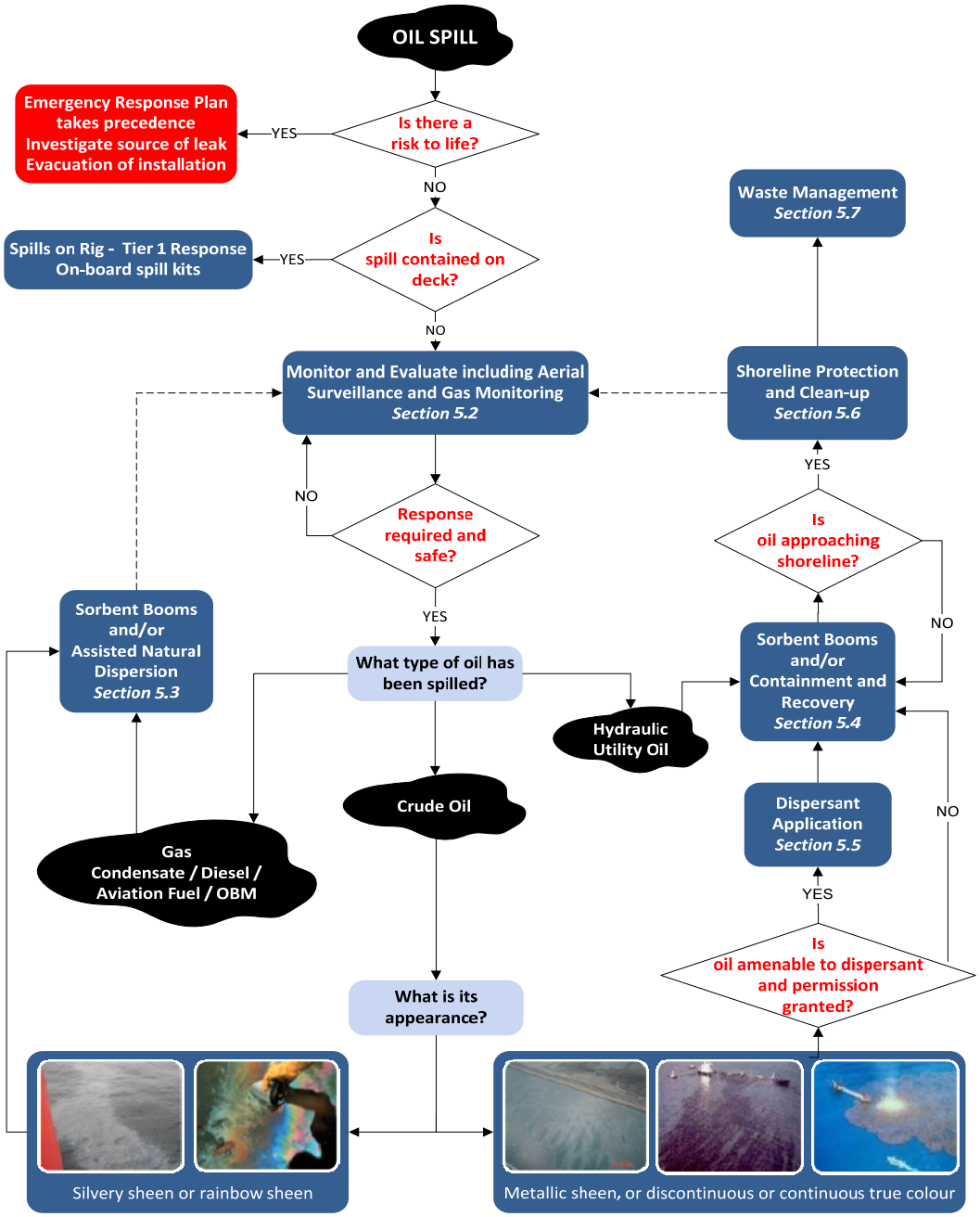
- Monitor and Evaluate (including aerial surveillance);
- Assisted Natural Dispersion;
- Containment and Recovery;
- Chemical Dispersants;
- Shoreline Protection and Clean-up.

Table 2 Response Options for eni Ghana

Section	Response Strategy	Oil Type					Level of Response
		Crude	Gas	Diesel	Oil Based Mud	Utility Oils	
5.2	**Monitor and Evaluate**	✓	✓	✓	✓	✓	1
5.3	**Assisted Natural Dispersion**	✓	✓	✓	✗	✗	1
5.4	**Containment and Recovery**	✓	✗	Likely to evaporate readily both off and near shore	Likely to sink and form a sheen on the water surface	✓	1/2
5.5	**Chemical Dispersion**	✓	✗	✗	✗	✓	2/3
		Obtain approval from the EPA prior to spraying operations. Conduct a test spray.					
5.6	**Shoreline Protection and Clean-up**	✓	N/A	Likely to evaporate readily. Shoreline response is unlikely	Likely to sink and form sheen on the water surface. Shoreline response is unlikely	✓ If oil threatens or impacts shoreline	2/3

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5.1 Response Decision Flowchart



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5.2 Monitor and Evaluate, Aerial Surveillance

Resources Available

Tier 1	• Offshore Dispersant Capability • Oil spill modelling
Tier 2	• OSRL aerial surveillance responders and oil spill modellers
Tier 3	• OSRL aerial surveillance responders and oil spill modellers

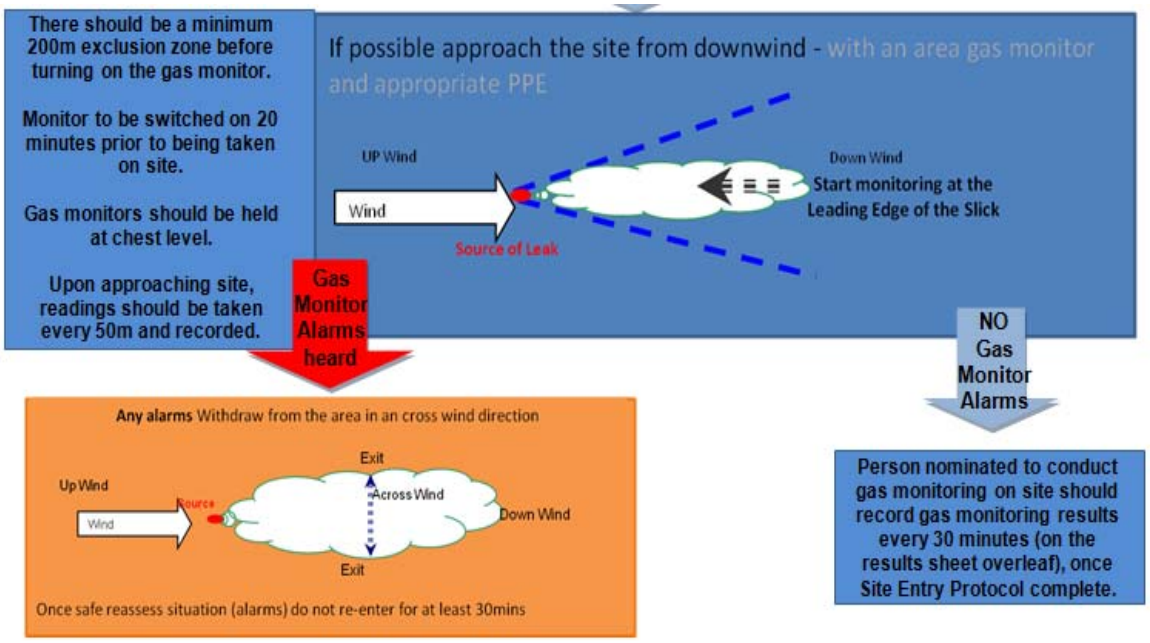
Safety



- **Aircraft** - monitor the area to ensure that there is no explosion risk
- **Support vessels -** approach spill site from downwind of the source with an area gas monitor
- Wear the appropriate Personal Protective Equipment (PPE)
- Identify risks and mitigate them where possible
- Communicate any risks and controls in place to control them through a pre-flight or pre-operation safety brief
- All activities will be carried out under the appropriate systems



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Key Steps



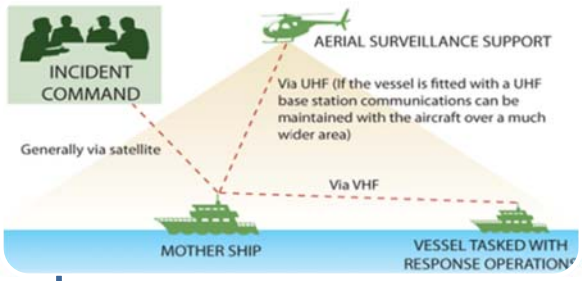
Step 1 - Prepare

Communications

Effective communication can enhance operation success.

Ineffective communication can lead to unsafe situations and accidents.

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Communications Plan

Who to call in an emergency. Names of assets deployed, call signs and radio communication frequencies.

Use of 'mother ships'

Ensures a clear line of communication. Can provide additional resources to response vessels.

GPS Tracking System

To track surveillance operations from Emergency Response Room.

Organise Tools

The resources required for aerial surveillance operations are:

- Report / Log form and clipboard
- Method of communication with the crew of all aircraft and vessels
- Handheld global positioning system (GPS) unit
- Digital camera
- Compass (may be useful to orientate direction in flight)
- Spare batteries
- High visibility jackets for walking on airfield (remove on aircraft)

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Receive Tasking information

Tasks should include:

- Confirm spill location
- Direct response operations. For example, direct dispersant operations to the area of thickest oil
- Survey shoreline to identify oil impacted areas
- Quantify oil slick

Receive Pre-Flight Briefing

Note: For aerial dispersant operations, give joint briefings to the assigned spotter and spray crews

The briefing should include:

- Location of the operational area
- Radio frequencies used for the response in the area
- Call signs of other aircraft operating in the vicinity
- Locations of any temporary or permanent exclusion zones

Factors Affecting Visual Observations

Note: Your perspective will be different from another observer. Ensure a comprehensive hand over brief is given to maintain consistency of approach.

Take note of the following factors that can affect the visual observations of oil.

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Angle of the Sun on the Water

•To obtain the best view, the aircraft should:
- Fly at an altitude of 500 to 1000 feet
- Survey at 30°, with the sun behind the direction of view.



Weather

•Observation can be difficult in:
- Low contrast light conditions (haze or fog)
- Extremely bright sunlight, due to glare.
- Clouds



Sea Conditions

•Oil can become submerged by waves when:
- Surface wind approaches 30 knots
- Sea state becomes moderate (2-4 m wave height)



Water Clarity

•Can affect the visual appearance of oil.
- Convergence zones
- Seaweed/seagrass
- River outlets
- Algal blooms

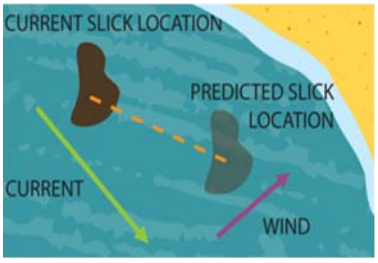
Step 2 – Conduct Mission: Confirm Spill Location

Predict Spill Location

Use wind and current data. Use the predicted location as a starting point for your search.

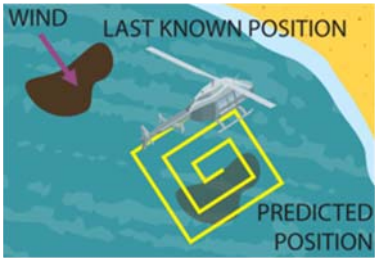
Note: It is useful for the aerial observer to sit directly behind the pilot when in flight. You will share the same perspective making it easier to direct the aircraft to the oil spill.

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Predict Spill Location

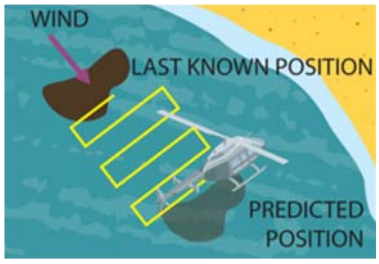
Oil moves ~3% with the wind and 100% with the current.
Use wind and current data to predict the spill location.



Expanding Square/Spiral Search

How: Fly in ever increasing circles around the oil's predicted position until you see the slick.

Why: You expect the oil to have remained within the vicinity of the release position.



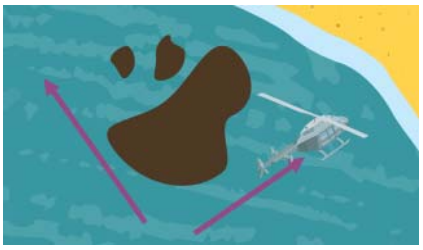
Ladder Search

How: Fly a set length and width from the oil's last known position to its predicted position.

Why: You expect the oil to be anywhere in the allocated search area with equal probability.

Step 2 – Conduct Mission: Quantify Spill

Calculate spill quantity on the return journey or when the aircraft has landed.



Calculate Spill Area

1. Fly the length of the spill - note speed and time taken
2. Fly the width of the spill - note speed and time taken
3. Calculate distance of spill length or width.

$$\textbf{\textit{Distance of slick length or width}}\ (\textbf{\textit{nm}}) = \frac{time\ taken\ to\ fly\ (seconds) \times\ speed\ (knots)}{3600\ (or\ 60\ if\ time\ taken\ to\ fly\ is\ in\ minutes)}$$

Note: Divide answer by 1.85 to convert to km

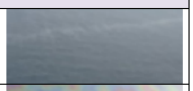
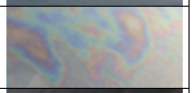
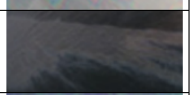
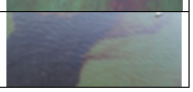
4. Calculate the area

$$\textbf{\textit{Spill area}}\ (\textbf{\textit{km}}^2) = length\ (km) \times width\ (km)$$

Calculate Spill Volume

1. Use the Bonn Agreement Oil Appearance Code (BAOAC) to estimate the percentage spill coverage.

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Code	Description / Appearance	Layer Thickness Interval (Microns)	Litres per km^2	Typical Appearance
1	Sheen (silver / grey)	0.04-0.30	40-300	
2	Rainbow	0.30-5.0	300-5,000	
3	Metallic	5.0-50	5,000-50,000	
4	Discontinuous True Oil Colour	50-200	50,000-200,000	
5	Continuous True Oil Colour	>200	>200,000	

2. Divide the slick into the percentage of each oil thickness based on its appearance.

   For example; 10% Sheen, 40% Rainbow and 50% Metallic.

3. Use the following equation to calculate the minimum and maximum spill volume for each oil type.

$$\begin{aligned} &\textbf{\textit{Spill volume}}\ (\boldsymbol{m^3}) \\ &\quad = total\ area\ oiled\ (km^2) \\ &\quad \times\ area\ covered\ with\ specific\ appearance\ (\%) \\ &\quad \times layer\ thickness\ (max.\ or\ min.)\ (microns) \end{aligned}$$

4. Sum the volumes of all oil types to calculate total minimum and maximum spill volume.

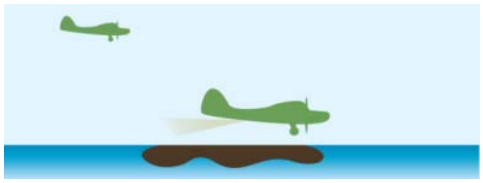
   Note: It is standard practice to calculate two volumes when using the BAOAC: minimum and maximum volume.
   Use the maximum volume to determine the appropriate level of response.

Step 2 – Conduct Mission: Direct Response

Aerial surveillance can increase efficiency of a response.

Aerial Operations

Direct the spray aircraft to the thickest part of dispersible oil. Aerial dispersant aircraft typically fly 30-45 m (100-150 ft) above the water to apply dispersant at the correct droplet size and swath width. This limits visibility from the spray aircraft.



Note: There will be a delay between the spotter crew telling the spray crew to spray, and spraying commencing.

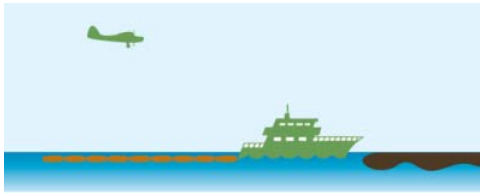
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Vessel Operations

Direct the vessel to the thickest part of the oil for:

- Containment and recovery
- Dispersant application

Note: Although vessels may have a variety of tasks, the role of aerial surveillance support remains broadly the same.



Other uses of the spotter aircraft:

- Visual assessment of dispersant efficacy
- Direct vessels measuring dispersant efficacy by fluorometry and water sampling to the dispersant application area
- Wildlife monitoring

Step 2 – Conduct Mission: Aerial Shoreline Surveys

Two types of survey:

- **Pre-impact** –Prioritise sites for protection. Assess the best method and suggest resources.
- **Post-impact** – Report the location and extent of oiling

Note: Oil can get buried by sediment mobilised by the incoming tide.

A ground based shoreline assessment team can verify the presence of oil.

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How to survey shorelines from the air

Record on Map / Chart	•Incident name, date, flight start/end time, aircraft and observers •Location/source of incident •Locations of sighted oil
Take Photographs	•Ensure the camera date and time settings are correct •If taking photos through a window turn off flash •Photograph with the sun behind you •Geo-reference photos if possible

Step 3 – Record and Report

Record the mission using:



- Annotated maps
- Photographs (preferably geo-referenced)
- Aerial Surveillance Log

Report to the Emergency Response Room:

- Personal Log
- Location of identified oil (either on a map/chart, waypoints on GPS or geo-referenced photo on mapping software)
- Quantity of oil observed, this can be calculated on the Aerial Surveillance Log
- Information on any oil spill response activities

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5.3 Assisted Natural Dispersion

By closely monitoring and evaluating any accidental release of product, eni Ghana will be able to choose the most appropriate strategy to combat any pollutant risk. Given the high ambient air and sea temperature a suitable response strategy for such products as Light Oils (Diesel, Kerosene, Avgas) might be one of allowing them to evaporate safely.

Resources Available

Tier 1	• Supply ships, fire fighting hoses to break up the slick
Tier 2	• local vessels / supply vessel contractor • OSRL

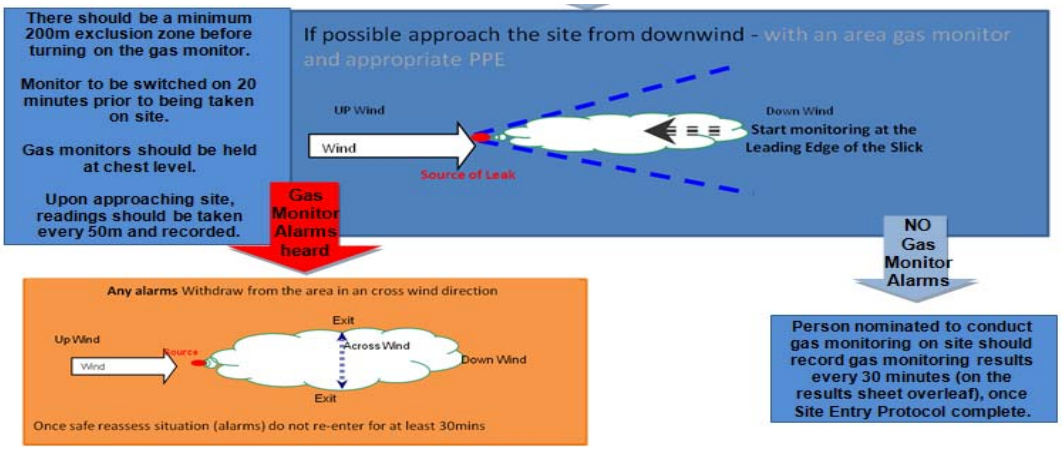
Safety



- Immediately implement all fire, gas and explosive vapour safety precautions
- Wear the appropriate PPE.
- Alert all nearby vessels and installations that there is a spill.
- Emergency shut down if necessary and ensure gas monitoring is undertaken.
- Prevent further spillage (stop or isolate the source if safe).
- Communicate any risks and controls in place through a pre-operation safety brief.
- Approach spill from downwind with an area gas monitor



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Key Steps



Step 1 – Prepare

Communications – Refer to Section 5.2, Monitor and Evaluate, Aerial Surveillance, p. 39. Decide strategy suitability

- Assisted natural dispersion is suitable for **condensate, diesel, aviation fuel and light crude oil**.
- **Do not use on hydraulic oil** – this is likely to produce a frothy emulsion and not disperse.

Step 2 – Assist Natural Dispersion

Select suitable method

Enhanced agitation by water application: Spray seawater onto the surface of the oil spill using fire-fighting hoses to break up slick and aid dispersion.



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Propeller assisted agitation

Use vessel "prop wash" to mechanically break up and disperse the oil. Direct the vessel to the thicker leading edge of the spill if safe to do so.

- Approach the slick from upwind at 90° to the current.
- Assist natural dispersion on non-boomed oil for maximum efficacy.

Step 3 – Record and Report

Record the operation and report to the ERT using:



- Oil Spill Report Forms.
- **Refer to:** Appendix 2 Forms (p.187).
- Annotated maps.
- Photographs (preferably geo-referenced).

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5.4 Containment and Recovery

Effective recovery requires trained operators, suitable and well-maintained equipment, equipment, vessel logistics, aerial support, temporary storage, transportation and waste disposal. If weather conditions are good, then containment and recovery of oil may be possible.

If oil is continuing to escape from the source, the eni Ghana Representative on site needs to estimate the rate of the spill and for how long it is going to continue. Obviously the oil will only begin weathering once it has spilled into the sea.

Resources Available

Tier 1	• Sekondi and Takoradi - Harbour equipment: 100m permanent buoyancy boom, Komara 12k skimmer system, 1,500 gallons temporary storage tank • Spill kits on Field Support Vessels, drilling unit and eni Ghana base
Tier 2	• OSRL
Tier 3	• OSRL

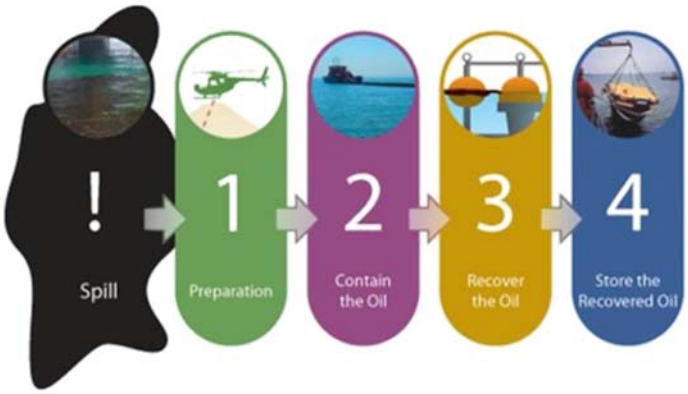
Safety



- Wear the appropriate Personal Protective Equipment (PPE)
- Stop any ignition sources and ensure gas monitoring is undertaken
- Identify risks and mitigate them where possible
- Communicate any risks and controls in place through a pre-operation safety brief
- Do not contain oil directly around the spill site or a tanker. Concentrated oil may increase explosive risk especially when fresh, ensure gas monitoring is undertaken

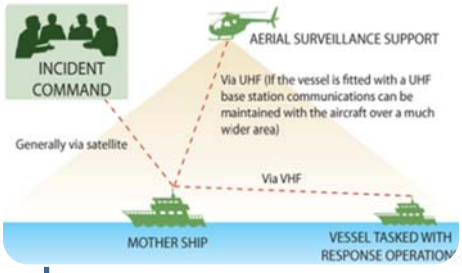
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Key Steps



Step 1 - Prepare

Effective communication can enhance operation success. Ineffective communication can lead to unsafe situations and accidents.



Communications Plan

Who to call in an emergency.

Names of assets deployed, call signs and radio communication frequencies.

Use of 'mother ships'

Ensures a clear line of communication. Can provide additional resources to response vessels.

Automatic Identification System (AIS)

AIS on vessels to track operations from the ERR.

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Step 2 - Contain the Oil

Boom Handling

Do...	Don't...
Nominate one person in charge of the deployment	Proceed with deployment until certain that all equipment is secured
Ensure that all vessels involved in the operation communicate effectively	
Ensure equipment is correctly connected	
Maintain a slow towing speed (~0.75 knots)	

Terminology



1 Encounter

- Distance between the two vessels.
- The larger the encounter, the more oil contained.

2 Apex

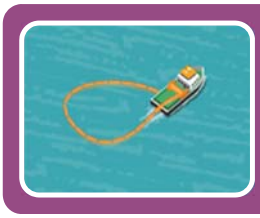
- The part of the boom where oil will collect.
- Recovery devices are placed in the apex to recover the oil.

Deployment Strategies



Straight lay

- Boom is deployed straight from the boom reel with a buoy attached to the towing line.
- Once the entire boom is deployed the second vessel recovers the buoy and attaches the tow line.
- This is the quickest, most straight forward method of boom deployment; however the vessel which deploys the boom has less control of the boom.



Loop lay

- The boom tow line is secured to the deployment vessel. As the boom is deployed it forms a 'loop' around the stern of the vessel.
- The secondary vessel takes the towing line from the end of the boom as it comes off the reel.
- This method ensures the deployment vessel has control over the boom. It is more complicated and the transfer of lines between vessels can be hazardous. It should be well communicated and undertaken with care.

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Boom Configurations



Pro

Simultaneous containment and recovery is possible.

Primary vessel should direct the speed and course of the recovery vessel.

Con

Provides a smaller encounter.



Pro

Provides a wide encounter.

Only the third vessel need break configuration to dispose of oil, leaving the U formation to continue collection.

Con

Difficult to coordinate vessels.

Wide boom apex - difficult to position recovery device for optimum oil recovery.

Greater demand on resources.



Pro

Wide encounter with oil.

Narrow apex, assists in maximising the amount of oil recovered.

Con

Difficult to coordinate vessels.

Wide boom encounter, difficult to hold position of recovery device for optimum oil recovery .

Greater demand on resources.



Pro

Less demand on logistics as only one vessel is required.

Quick to deploy (if side sweep system is available).

Easy to manoeuvre.

Con

Small encounter area.

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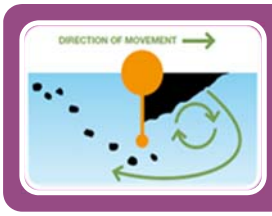
Causes of Boom Failure



Weather

•Conditions must be favourable:

WIND	WAVES	CURRENT	BOOM PERFORMANCE
0-10kts (0-20km/hr)	Calm, swells	0-0.5kts (0.25m/s)	GOOD
<20kts	<3-4ft (<1m)	>1kt (>0.5m/s)	BAD



Undercutting

- If the boom is towed at excessive speed or the current is running quickly, then oil may undercut the boom and escape.



Boom Saturation

- If the boom fills with oil and a recovery device is not deployed the oil collected may overwhelm the boom and escape.



Boom Damage

- If a chamber is damaged during operations the remainder of the boom will stay afloat.
- Oil may escape though the resultant gap so it should be repaired as soon as practicably possible.

Step 3 - Recover the Oil

Skimmers have a **pump rating.** This is based on test tank conditions and does not reflect offshore recovery operations. **Rated pumping volume will rarely be achieved in field conditions.**

Select the most appropriate skimmers to recover the oil.

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Pro

Less water collected compared to other types of skimmers

Efficiency can be increased by using brush or alternate attachments

Con

Generally ineffective in heavily emulsified oil

Oil will not adhere to the oleophillic surface if dispersant has been used

Step 4 – Store the Recovered Oil

Storage could be a limiting factor for offshore containment and recovery operations.



Arrange for suitable types and quantities of temporary storage for containment and recovery operations.

It is likely that a mix of oil and water will be recovered (not purely oil) which will increase the amount of storage required.

Types of temporary storage include:

- Inflated barge (pictured)
- Tanks loaded onto vessel decks
- Vessel internal tanks
- Storage barge

Ensure local oily water discharge regulations are adhered to. Authorities **MAY** allow oily water that has separated in recovery tanks to be discharged back into the apex of the boom to reduce the storage volume and onshore treatment.

The logistics of storage and transfer of recovered oil and oily waste must be organised by the Logistics Manager. The success of the oil recovery operation depends on temporary storage, transportation and identified methods of final disposal.

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5.5 Chemical Dispersants

Dispersant should only be applied to crude and not light oils such as diesel. Ensure the dispersant has been approved for use and any necessary authorisation has been granted – contact EPA Ghana. Mobilise OSRL dispersant aircraft if large spill.

Resources Available

Tier 1	• 2 x dispersant spray sets, boat spray 50 • 8 x 1000ltrs IBC of Dasic Slickgone Dispersant • Sorbent booms and pads
Tier 2	• OSRL support and resources
Tier 3	• OSRL vessel and wide scale aerial application and fluorometry

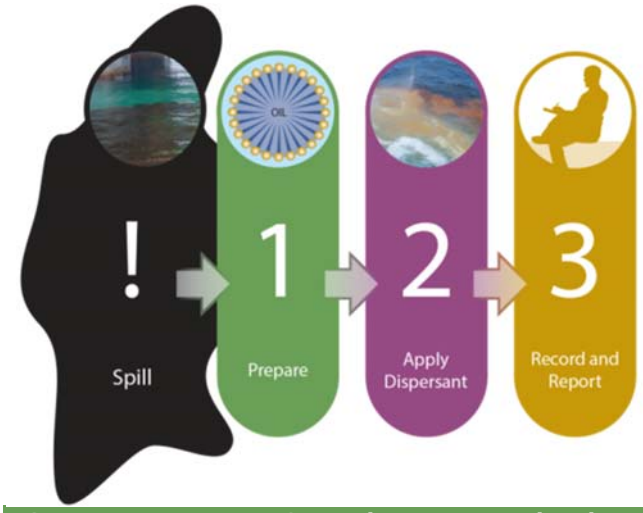
Safety



- Wear the appropriate Personal Protective Equipment (PPE)
- Identify risks and mitigate them where possible
- Communicate any risks and controls in place through a pre-operation safety brief
- Use dispersants in accordance with the manufacturer's guidance and Safety Data Sheet (SDS)
  - Risk of eye irritation or damage
  - Harmful if inhaled or ingested
  - Can be absorbed through the skin
- Carry out under appropriate 'Permit to Work' systems, following the Life Saving Rules

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Key Steps



Step 1 – Prepare: Organise communications

Aerial surveillance should be utilised for all dispersant application operations to direct events and monitor the effectiveness. A helicopter should fly an observation mission about 30 min after application. Application from a vessel is most likely method that may be employed.

Refer to: Section 5.2, Monitor and Evaluate, Aerial Surveillance, p. 39

Effective communication can enhance operation success. Ineffective communication can lead to unsafe situations and accidents.

Produce a communications plan to document:

- Emergency contacts
- Names of assets deployed, call signs and radio communications frequencies

Step 1 – Prepare: Determine dispersant suitability

Is the oil amenable to dispersant?

Dasic Slickgone is effective on heavy oils and water-in-oil emulsions and can be used undiluted or is compatible with seawater and can be used diluted to 10% with good results.

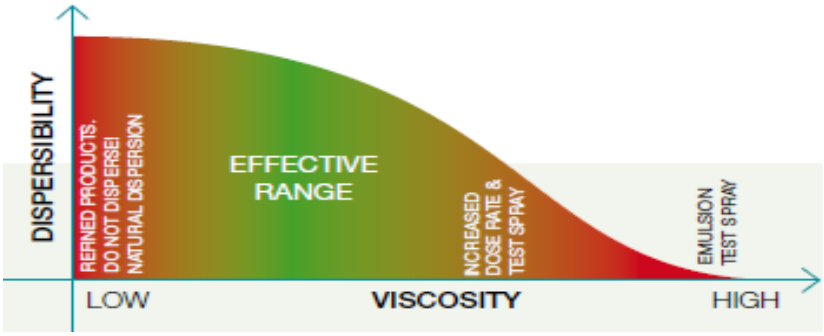
Dispersant effectiveness will decrease as the viscosity of oil increases, and will be ineffective for spills between 2,000–3,000 mPa.s (cP). It is unlikely that dispersant will be effective on emulsified crudes. Agitation will be required to produce the required mixing energy.

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In calm sea states, the bow wave of the vessel should be sufficient. Applying dispersant in conditions above a Force 5 is not recommended as the turbulence will cover the oil and spray droplets will be blown away.

Manufacturer's guidelines need to be followed and any system should only be operated by trained personnel. Droplet size should be between 500–700 µm. Vessel speed should normally be between 5 and 10 knots. Use the chart below to determine if dispersant is likely to be effective on the spilled oil.

Use a basic dispersant effectiveness 'jar test' to confirm dispersant efficacy.



Is there a suitable window of opportunity to spray dispersant?

There is a window of opportunity in which dispersants are effective. The length of this window varies according to:

Climate: Oil viscosity decreases with temperature making the same oil more responsive to dispersants in warmer climates. However, some oils will be dispersed at 0 °C.

Weathering: Oil weathers as volatile light ends evaporate and emulsification occurs. Dispersants are ineffective on emulsified oil. The rate of weathering is determined by the oil type (in particular its asphaltene content), source of release and environmental conditions.

Are the weather conditions suitable?

Vessel operating conditions for dispersant application:

- Minimum wave height 0.2 m (10") or an active chop
- Calmer sea conditions require mixing energy from the vessel
- Maximum wave height 4 m (12')
- Optimal wind speed 4-12m/s

Aircraft operating conditions for dispersant application:

- Minimum wave height 0.2m
- Maximum wave height 4m
- Optimal wind speed 4-12m/s

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- Pilots determine if weather conditions are suitable for flying

Will the EPA grant approval to apply dispersant?

Conditional Approval Zone: The use of any chemical agent in response to an oil spill in the coastal waters of the Republic of Ghana within two nautical miles of the mainland or has a mean low water depth of less than 40 ft will require approval under the methods and restrictions set forth in the latest National Oil and Hazardous Substances Pollution Contingency Plan, unless otherwise pre-authorized.

Pre-Authorized Zone: The use of chemical dispersants as described in the EPA guidelines for importation of chemical dispersants in response to an oil spill in the coastal waters of the Republic of Ghana, which are seaward of 2 nm of the mainland and have a mean low water depth of greater than 40 ft is pre-authorized under the supervision of the Pre-designated On-Scene Commander with restrictions set forth below.

Special Consideration Areas: Special Consideration Areas will consist of restrictions imposed on the use of chemical dispersants for a specific geographic area. These restrictions may range from outright prohibition to a requirement for consultation prior to deployment of the chemicals. They may be spatial, seasonal or species-specific in nature.

Are there adequate stockpiles of dispersant?

- How much is available?
- Has it been stored correctly? Out of direct sunlight?
- Is the dispersant within its recommended shelf life?
- **Refer to:** Section 6, Oil Spill Response Resources, (p. 87)

Step 1 – Prepare: Vessels

Select a suitable vessel

The Field Support Vessel must be able to:

- Maintain steerage at low speeds
- Provide enough deck space to load, store and secure dispersant
- Communicate with aerial support
- Accommodate responders onboard

Select a suitable spray system

The spray arms should be mounted at the bow of the vessel to avoid the effect of the bow wave which can push the oil beyond the spray width. The bow wave will also provide the required mixing energy. May need drop down tubes to ensure correct coverage at the water's surface

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- 5-10% dispersant is typical
- May need to change nozzles - refer to manufacture's guidelines

Prepare dispersant application recording tools

Dispersant should be applied when steaming into the wind. Record the amount and location of dispersant sprayed and reported back to the Emergency Control Team. Use the following resources:

- Dispersant log form
- GPS
- Digital camera

Receive Tasking

Including:

- Location of the operational area
- Radio frequencies used in the area and on the response
- Call signs of other vessels operating in the vicinity
- Locations of any temporary or permanent exclusion zones
- Health and safety briefing for the vessel and operation

Step 2 – Apply Dispersant: Calculate dosage and assess efficacy

Conduct a small-scale test spray to check efficacy before continued, large-scale spray operations.

Calculate the correct dispersant dosage

Correct application is determined by the two variables i.e. pump speed (ltrs/min) and vessel speed (knots) – see formula below:

Discharge rate (ltrs/min) = application rate (ltrs/m2) x speed (m/min) x swath (m)

Target the thickest areas of the oil

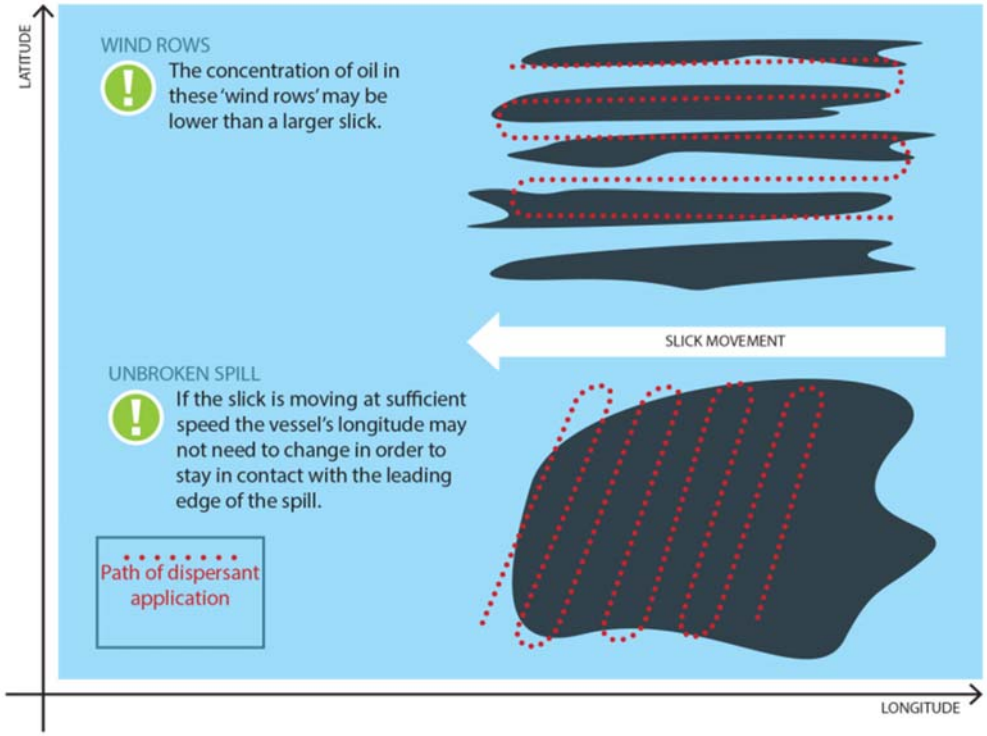
Concentrate dispersant operations on the thickest portion of the slick (leading edge). Aerial support can assist with this. Vessel mounted operations can accurately target the thickest part of the slick, compared to fixed wing aerial operation.

Apply dispersant

Apply in a ladder or zig-zag pattern through the thickest area of the oil, as shown in figure below. Maintain the dispersant to oil ratio recommended in the manufacturer's guidance.

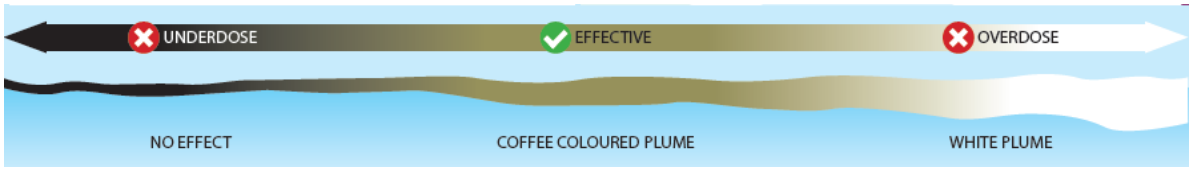
Note: Without feedback from aerial support this can be difficult.

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Determine efficacy

The effectiveness of chemical dispersion should be monitored continually. Monitoring is best conducted from the air or at the highest point on a vessel. As soon as monitoring indicates that dispersant application is not effective; stop operations. In clear weather conditions successful dispersion will often produce a coffee-coloured plume seen to spread under the water surface. If a milky-white plume is visible, then the dispersant application has not been effective or the dose rate has been much too high:



Ultra-Violet Fluorimetry (UVF) can be used to provide an estimate of the concentration of dispersed oil in the water column during the application of dispersants. This technique can be provided by OSRL. Information gathered this way should be used in combination with visual observations to decide whether a worthwhile response can be achieved.

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Step 3 – Record and Report

Record the operation using:

- Annotated maps
- Photographs (preferably geo-referenced)
- Dispersant Application Log



Report to the Emergency Response Room:

- Unit/personal Log
- Location of treated oil (either on a map/chart, waypoints on GPS or geo-referenced photo on mapping software)
- Quantity of dispersant applied
- Fluorometry measurements (if taken)
- Visual observations of effectiveness

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5.6 Shoreline Protection and Clean up

In the event of a major oil spill a shoreline impact is possible. Eni Ghana will work closely with the EPA who must be informed of the likely impact to commence strategic discussions with the relevant Local Authority. Effective oil deflection and protection requires trained operators, using the correct equipment. The efficacy of booms is limited by wind, sea-state, and current. OSRL, can provide assistance should any shoreline contamination occur. As such the following information should be used for awareness/guidance.

Resources Available

Tier 1	• eni Ghana
Tier 2	• Local Authority • EPA
Tier 3	• OSRL - Shoreline Cleanup Assessment Technique (SCAT) and equipment

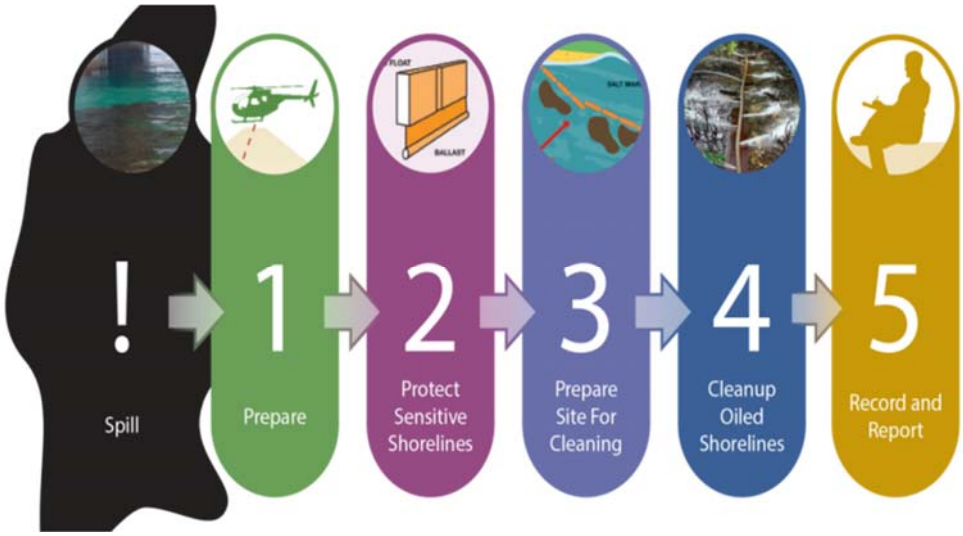
Safety



- Wear the appropriate Personal Protective Equipment (PPE) including respiratory protection
- Identify risks and mitigate them where possible
- Communicate any risks and controls in place through a pre-operation safety brief

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Key Steps



Step 1 – Prepare: Communications

Effective communication can enhance operation success. Ineffective communication can lead to unsafe situations and accidents.

Communications Plan

- Emergency contacts
- Names of assets deployed, call signs and radio frequencies

Step 2 – Protect Sensitive Shorelines: Identify and Prioritise for Cleanup

Monitor and predict the trajectory of the spill to provide an indication of where the impact may occur. Suitable protection strategies can then be determined as appropriate. Priority should be given to protecting coastal resources which are particularly sensitive to oil pollution and which can be boomed effectively if time allows (refer to the Coastal Sensitivity Maps). Some shorelines are more sensitive to oil due to their ecological, economic or cultural importance.

Refer to: Environmental and Socioeconomic Setting, Section 7.5, (p.114).

1. **Predict Spill Location** by aerial surveillance and oil spill modelling.

   Refer to: Aerial Surveillance, (p.39).

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2. Identify Shoreline Ranking

Rank shorelines from 1-10 (where 10 is most sensitive, see Table 3) using information from the following resources:

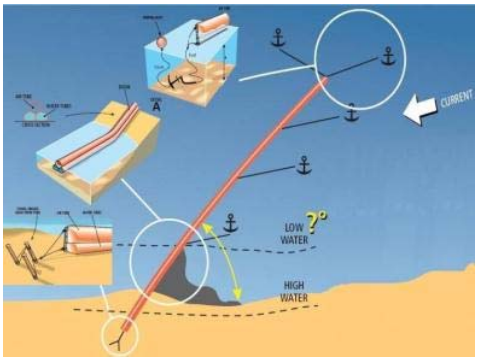
- Overflights
- Aerial photography
- Remotely sensed data
- Ground truthing
- Existing maps and data, for example, GIS files

Table 3 Environmental Sensitivity Index

ESI Value	Shoreline type
1	Exposed rocky shore
2	Exposed rocky platforms
3	Fine grained sand beaches
4	Coarse grained sand beaches
5	Mixed sand and gravel beaches
6a	Gravel beaches
6b	Riprap structures
7	Exposed tidal flats
8a	Sheltered rocky shores
8b	Sheltered artificial structures
9	Sheltered tidal flats
10a	Salt to brackish marshes
10b	Freshwater marshes
10c	Swamps
10d	Mangroves

Step 2 – Protect Sensitive Shorelines: Deploy Shoreline Boom

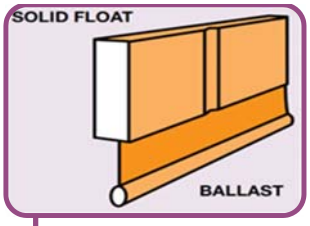
The principle of protection is to deflect oil away from those areas of most importance in order to minimise damage. It is often desirable to direct oil to an accessible, less sensitive part of the shoreline where it can be easily collected. The shoreline can be protected by deploying shore sealing booms to deflect or contain oil as appropriate. Boom is best deployed at an angle to the current to reduce the possibility of oil escaping beneath the boom.



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Choose the most appropriate boom type

Rigid Fence Boom



Pro

Quick to deploy.

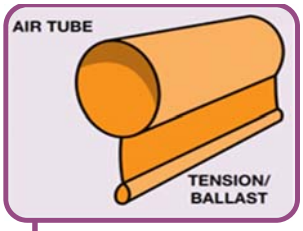
Functions well in calm sea conditions.

Con

Large storage space.

Less effective wave-following characteristics than inflation boom.

Inflation Curtain Boom



Pro

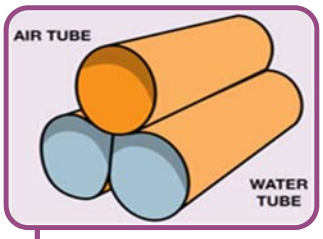
Good wave-following characteristics.

Stored deflated so require little storage space.

Con

Air fan needed to fill air chamber.

Shore Sealing Boom



Pro

Forms an effective barrier in intertidal areas.

Stored deflated so require little storage space.

Con

Water pump needed to fill two water chambers.

Air fan needed to fill air chamber.

Sorbent Boom



Pro

Useful for small spills.

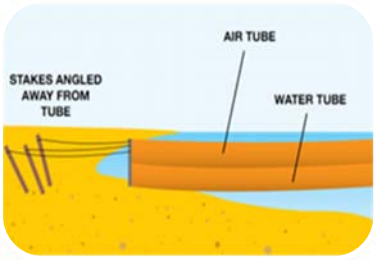
Can use with other types of shoreline boom.

Con

Generates waste - control use.

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Boom deployment and handling techniques



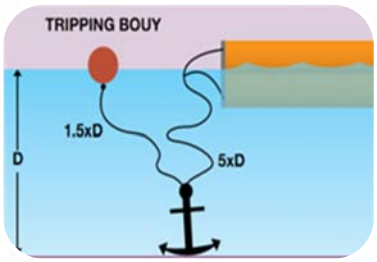
1. Ensure the boom is securely staked, anchored (using land anchors) or attached to a strong fixed point on the shoreline.



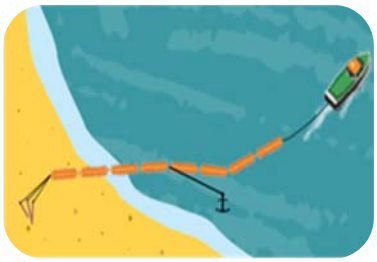
2. 'Flake' the boom along the shoreline.



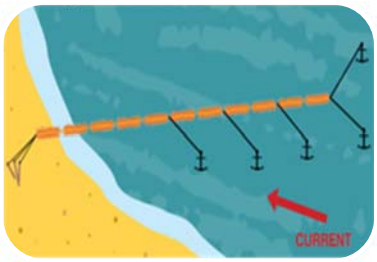
3. If it is a long piece of boom or there is a strong current running, tow the boom from one of the anchor points fixed midway along the boom.



4. Drop the anchor point. The length of the anchor lines should be 5x the water depth; the tripping buoy line should be 1.5x the water depth.

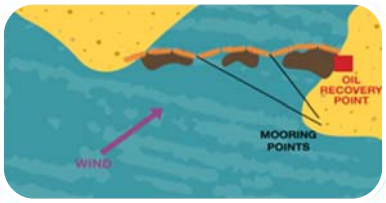


5. Return to the shoreline to retrieve the last anchor point. Drop the anchor to create a straight line of boom.



6. Set more anchors if necessary to hold the boom in place once the position is set.

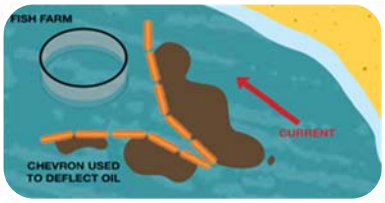
Boom formations



Exclusion booming

Protects sensitive sites such as inlets and harbour entrances.

Contains oil for recovery.



Chevron booming

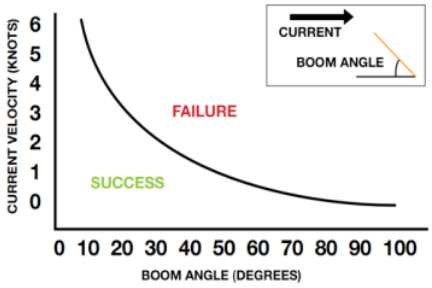
Deflects oil away from sensitive sites or resources.



Cascade booming

Deflects oil away from sensitive shorelines to a point of enhanced natural collection for recovery.

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Boom Angle

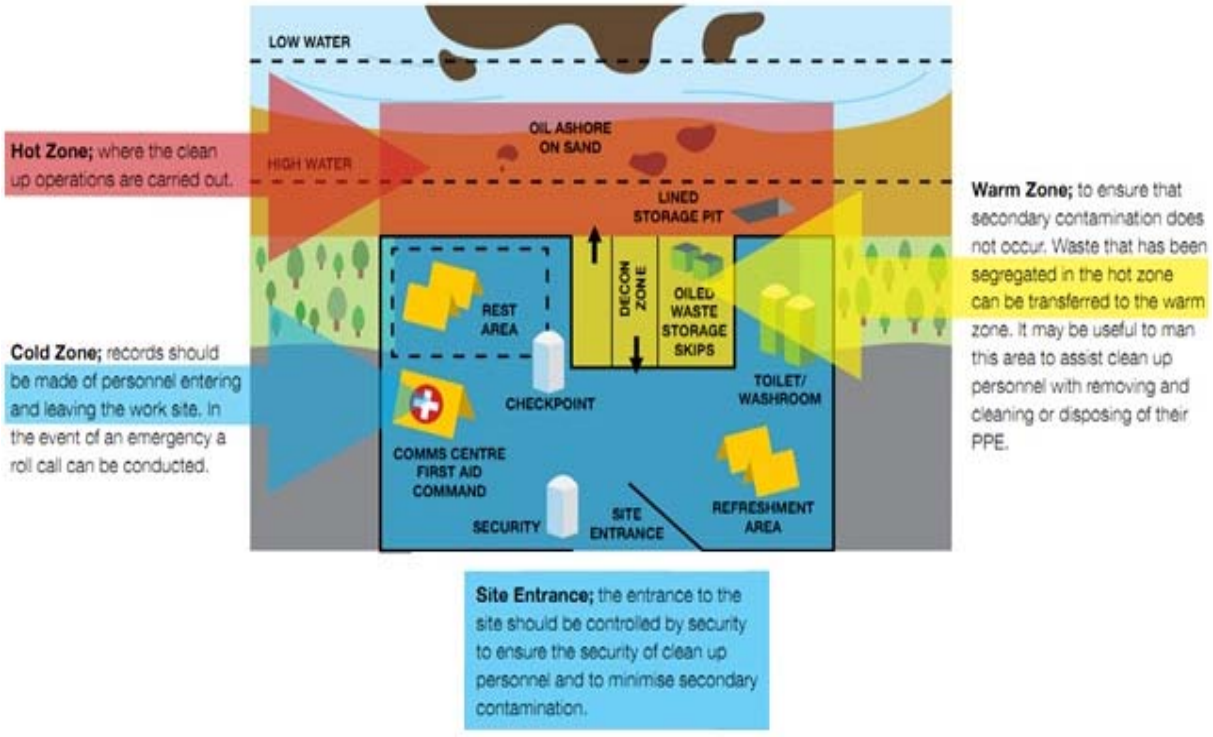
The angle of the boom influences its success.
The faster the current, the narrower the boom angle should be.
Boom will be successful when deployed at an angle of 70-100° in slow current.

It is desirable that a good seal is made between the boom and the intertidal zone at low tide. Be prepared to allow oil to beach at areas that are of a lower sensitivity. It is better to use inshore booming techniques, to redirect oil away from sensitive locations to less sensitive areas where oil can be easily recovered.

Step 3 – Prepare Site For Cleaning: Site Set-up

Effective site set up will maximise site security and minimise secondary contamination.

Identify cold, warm and hot zones for each oiled site.



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Step 4 – Cleanup Oiled Shorelines

The relevant Ghanaian Local Authority will coordinate the shoreline clean-up operations with the support from eni Ghana. OSRL, can provide assistance should any shoreline contamination occur. As such the following information should be used for awareness/guidance.

Depending on the degree of emulsification, amount of oiled debris and shoreline type, vast amounts of waste can be generated. In extreme cases, 30 times more waste can be generated than the volume of oil spilled.

Shoreline impact is often widely distributed as oil breaks up, spreads and fragments at sea under the influence of wind and currents. As a result, a range of different shores, of differing sensitivities, will inevitably be impacted by varying amounts of oil.

Sensitive areas should be protected where possible prior to oiling, the spill being deflected to less sensitive areas. Shoreline cleanup is generally extremely labour intensive and can in itself have a significant impact on the environment.

In general, heavily contaminated areas should be cleaned first so that bulk oil is not re-mobilised impacting other areas:

- Stage 1: Removal of heavy contamination and floating oil;
- Stage 2: Clean up of moderate contamination, stranded oil and oiled beached materials;
- Stage 3: Clean up of lightly contaminated shorelines and removal of oily stains.

In some circumstances oiled shorelines are best left to recover naturally, for example any areas exposed to high energy conditions.

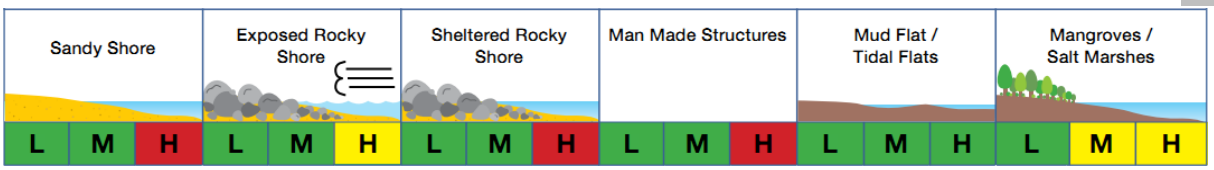
Shoreline cleanup strategies are described below. The figures indicate how appropriate the strategy is for each shoreline type depending on the level of oiling (Low, Medium or High). The colours indicate whether the strategy is recommended (green), has potential (yellow) or should be avoided (red).

Natural recovery

This strategy leaves the shoreline to recover naturally without any human intervention.

- It may be less environmentally damaging to allow sensitive shorelines to recover naturally
- This process is slower than other cleanup srategies

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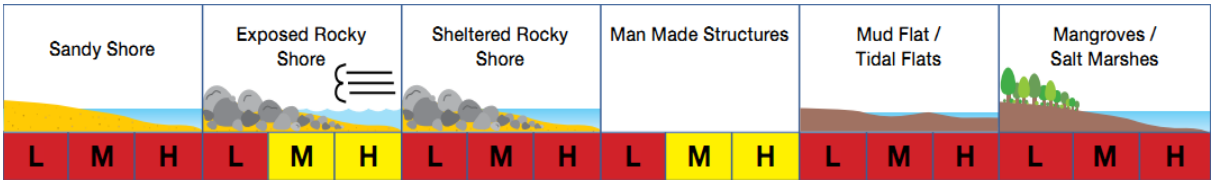


Dispersant application

Oil dispersants and surface cleaners could be appropriate for cleaning hard surfaces.

Check local regulations for approval before using dispersants or surface cleaners.

- Dispersed oil may contaminate lower shoreline areas that had previously been unaffected by oil

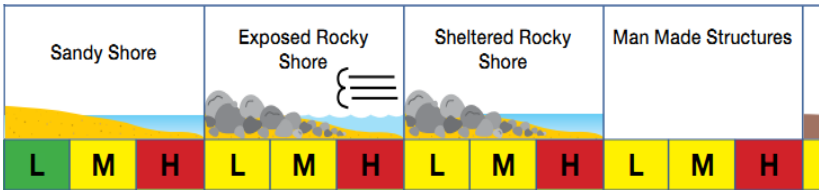


Absorbents

Absorbents (blanket or boom form) are made of oleophillic material which selectively absorbs oil whilst repelling water.



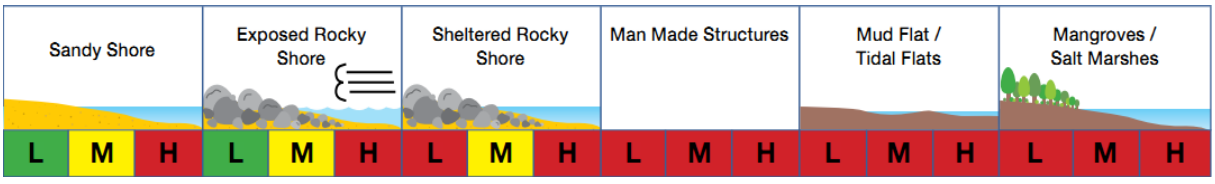
Note: Absorbents are designed for use with light hydrocarbons. Heavy oils will adhere to the outside rather than absorb into the product. Use absorbents sparingly, they create solid waste which must be disposed of appropriately.



Sediment relocation

Relocate oiled sediment (surface or buried) to the surf zone where it is cleaned by waves.

- Remobilised oil may impact other shoreline areas

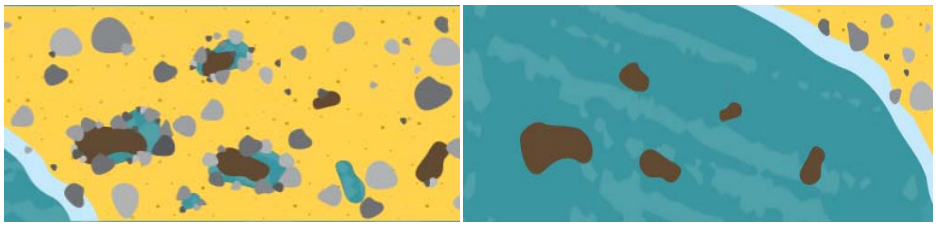


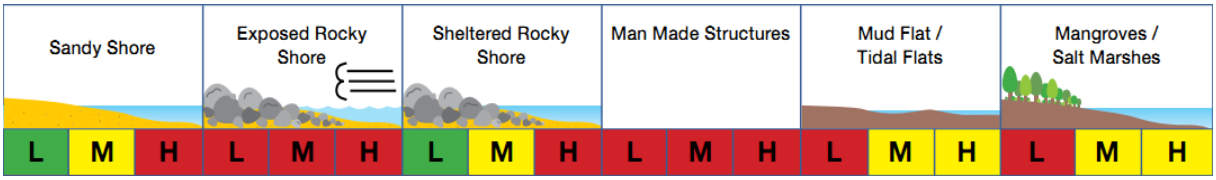
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Flooding

Flood oiled areas enclosed by booms or contained in natural geological features (such as rock pools) with seawater. Recover the remobilised oil using skimmers and pumps.

Before Flooding **After Flooding**

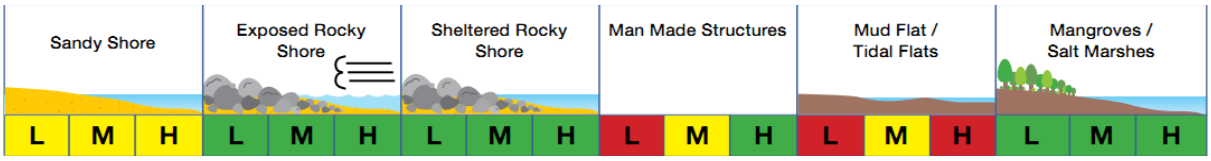




Mechanical recovery using pumping or vacuum equipment

Use specialist oil spill vacuum/pumping equipment or vacuum trucks to recover oil.

- Heavy machinery driving over oiled sediment will bury oil. Consider NEBA before using this equipment
- Don't use vacuum equipment for light oils until light ends have evaporated - risk of explosion
- Most successful on thick oil layers



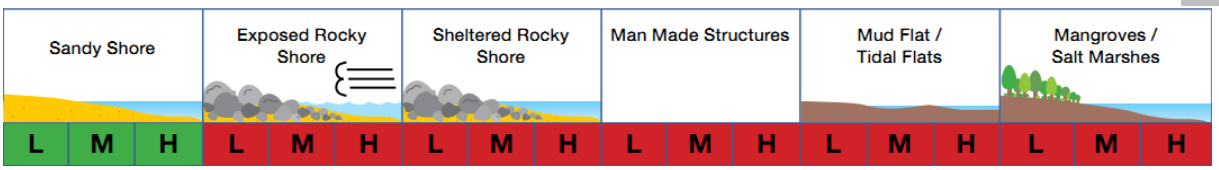
Mechanical recovery using graders and scrapers

Remove oiled sediment from the beach using mechanical equipment if the beach needs to be cleaned quickly for socio-economic reasons.

- Heavy machinery driving over oiled sediment will bury oil.



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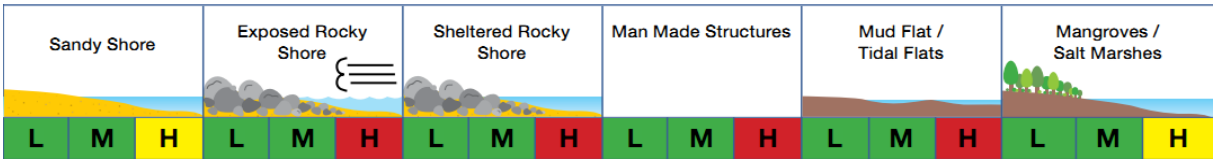


Low pressure washing at ambient water temperature

Use pumps and hoses to wash bulk stranded oil from the shoreline. Position containment boom to capture and recover the oily water wash off.



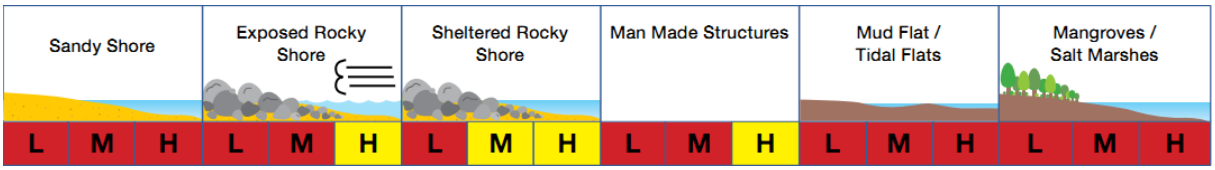
- Ambient water may harm shoreline organisms unaffected by oil



High pressure washing at ambient water temperature

Use high pressure pumps to wash more persistent oil from the shoreline. Position containment boom to capture and recover the oily water wash off.

Note: This can dislodge shoreline organisms and potentially sterilise the area.

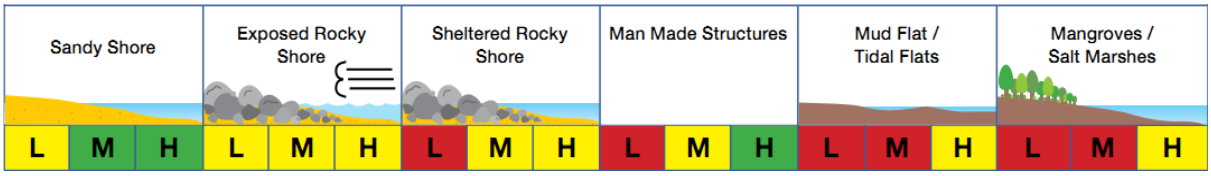


Manual cleanup

Large groups of people collect stranded oil either by hand or with tools.

- Labour intensive
- Must be managed

Note: Ensure cleanup personnel only remove oiled sediment to minimise waste generation.



Use of volunteers in shoreline cleanup

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Benefits

- Local volunteers may know the affected area
- Can reduce response costs

Challenges

- Often unfamiliar with spill response and associated health and safety issues
- Require management and supervision
- Can be unreliable; may not be available for duration of response

Legal Considerations

It is advisable for the incident owner to ask volunteers to sign a legal release of liability form. This may or may not prevent legal claims, but can assist in clarifying expectations of cleanup volunteers.

Training

Give volunteers safety and operational training before they start work.

Work Assignments

Identify job role and responsibilities for volunteers. Ensure they are aware of the Volunteer Supervisor. Communicate their location, date and time of work.

Assign PPE

Supply volunteers with sufficient and appropriate PPE and safety equipment.

Step 5 – Record and Report

Repeat surveys throughout cleanup operations to assess progress and decide if strategy should be changed.

Record and report the following data to the Emergency Response Room:

- Time, date and location of survey
- Composition of shore substrate
- Shoreline features, such as access and potential lay down areas
- Beach profile
- Extent of surface oiling
- Extent of subsurface oiling
- Presence of sensitivities
- Treatment recommendations



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5.7 Waste Management

Refer to: HSE-PLAN-005-WASTE MANAGEMENT PLAN, Rev 05

Oil spill response operations have the potential to generate liquid and solid wastes, if there is a shoreline impact. The types and quantities of waste material largely depend on the amount of oil that reaches the shoreline and the specific clean-up methods employed.

The objectives of waste management are addressed below:

- Provide safe working conditions and necessary personal protection;
- Comply with all applicable laws and regulations;
- Co-operate with all local community and government agencies to minimize the impact on local waste disposal facilities;
- Handle, store, and transport oily waste in appropriate containers or tanks;
- Minimize the amount of waste generated;
- Segregate oily and non-oily waste to allow optimum recovery and minimise disposal of each waste stream.

If waste oil and contaminated material are produced as a result of an oil spill incident, then eni Ghana has a duty of care to ensure that the waste is handled, transported and disposed of in an appropriate manner (eni Ghana Waste Management Procedure, HSE.PRO.018), with approval from the Environmental Protection Agency (EPA).

A useful reference document for oil spill waste Operations is the IPIECA Report Series Volume 12 'Guidelines for Oil Spill Waste Minimization and management', available for free download at www.ipieca.org

Ghana's National Guidelines for Management and disposal of oil spill debris states that "Environmentally and technologically sound disposal of oil spill debris is essential for minimizing the environmental damage from an oil spill".

A Waste Management Action Plan for the incident will require to be produced and the approval for an onshore waste contractor from Ghana's Regulator Authorities must be sought in accordance with their environmental standards.

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Resources Available

Tier 1	•Vessels portable tanks, containers on recovery barges, shallow water barges, tank trucks, towable bladders, IBCs, barrels

Safety



- Wear the appropriate Personal Protective Equipment (PPE)
- Identify risks and mitigate them where possible
- Communicate any risks and controls in place through a pre-operation safety brief

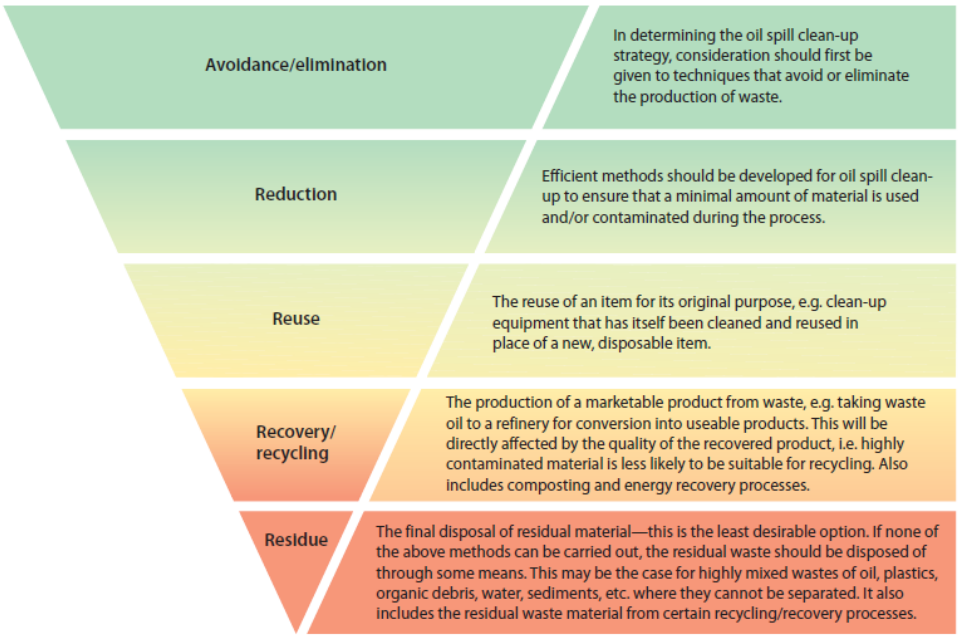
Key Steps



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Step 2 – Prepare: Storage identification and workforce orientation

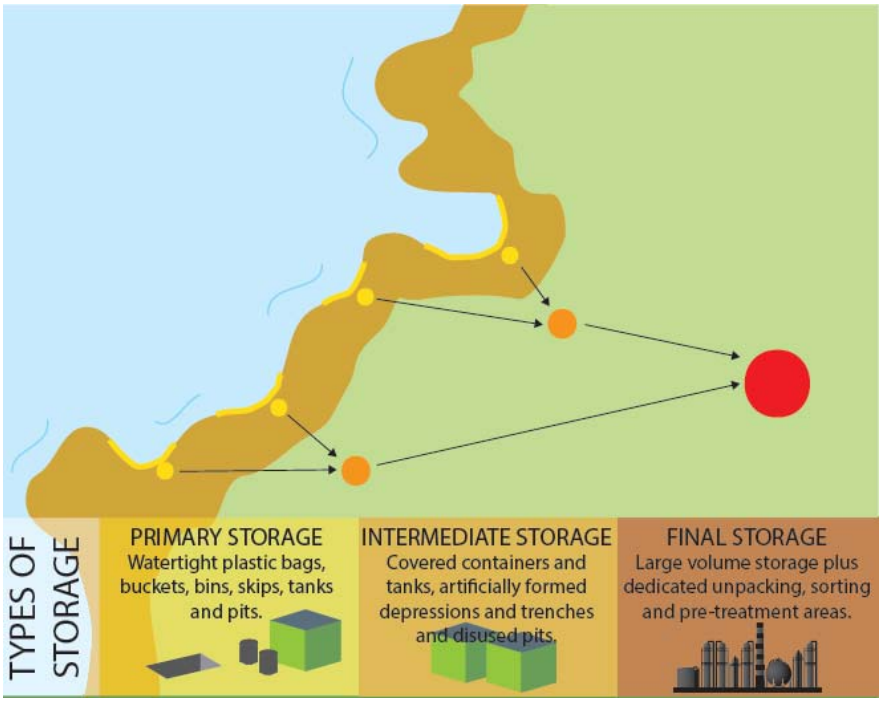
Use the waste hierarchy to manage the total amount of waste generated:



(Source: IPIECA, 2014)

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Organise waste storage:



- Identify storage facilities for every stage of the response, from recovery to long term storage, treatment and/or disposal.
- Consider the use of staged storage facilities to minimise cross-contamination.
- Consult stakeholders (local authorities, government) to identify suitable locations of intermediate and long term storage sites.
- Establish waste minimisation guidelines with workforce and instruct in the proper use of equipment and storage facilities

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Temporay Storage Facilities will:

- Prevent delays resulting from many vehicles trying to access one site.
- Allow time to organise final disposal sites or methods whilst the response effort continues.
- Assist in appropriate waste segregation.

Considerations:

- Local, regional and national legal regulations.
- Waste should be labelled with type and source of waste.
- The site set up should allow for waste separation to minimise secondary contamination.

Waste Sites Should:

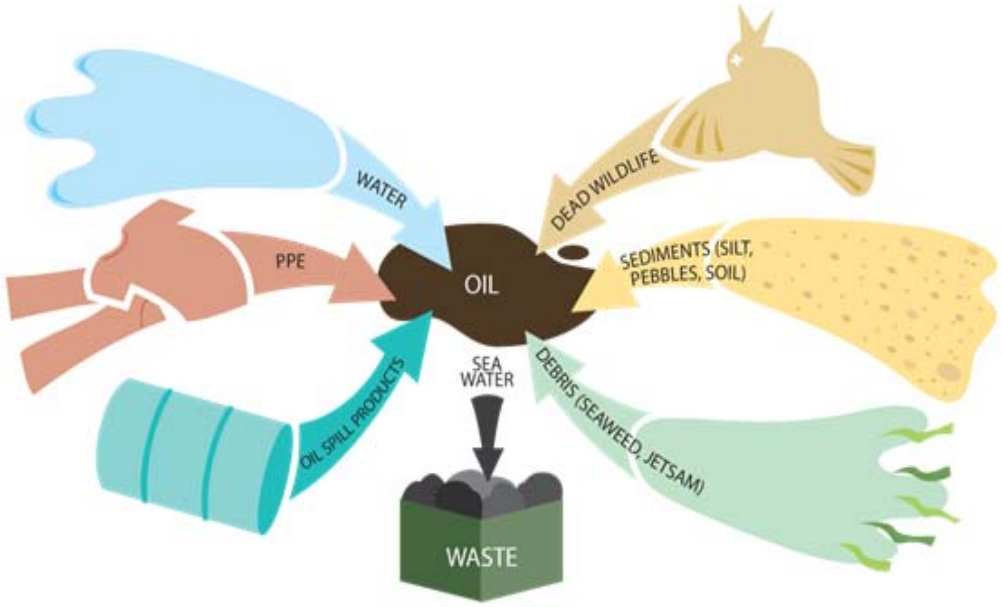
- Be fenced off with controlled site access.
- Have good access and egress.

Storage Containers Should:

- Be suitable for the waste type.
- Have useful and appropriate signage to reflect the site set up.
- Be water tight and lined with polyethylene sheeting to prevent oil leaching.

Step 3 – Reduce Waste: Site Set-Up and Housekeeping

Components of oily waste produced from a response operation



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Shoreline / Inland

- Pre-clean beach/bank sections at risk of contamination before oil impacts to reduce oily waste.
- Block drainage points, if present, which could transfer oil beyond the immediate site.
- If beach/bank has been impacted, minimise contamination by using a defined site set-up (below).

Contain and recover pollution as close to the source as possible.

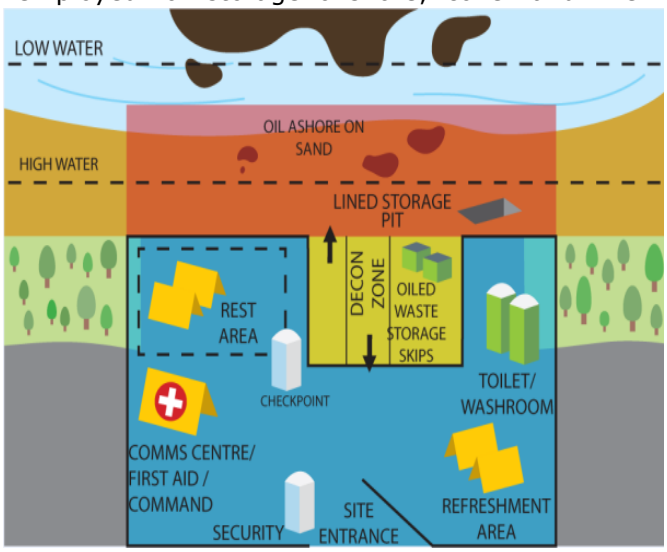
- Minimise the use of sorbents and re-use PPE where possible.
- Store shoreline response resources above high water mark and on level surfaces.
- A wide variety of options can be employed for storage onshore; cover and line storage containers.

Site Set-Up

Hot Zone: Oiled work area, all oil stays in this zone.

Warm Zone (Decontamination Zone): Clean down area; use one entrance/exit channel. Anyone leaving must pass through an organised decontamination process here.

Cold Zone: Waste removal vehicles collect full containers from this clean area so that they do not spread oil onto the roads.



Offshore

- Prepare sufficient temporary onboard waste storage to last operational period.
- Consider the use of inflatable barges, heated tanks and vessel storage tanks.
- Arrange intermediate storage or bulking facility for remote response operations, particularly if more than one vessel is recovering oil.
- Follow work zone arrangement on vessel of opportunity to prevent secondary contamination. Set up defined areas (hot, warm and cold zones) if vessel lacks defined work zones.
- Minimise the use of sorbents, re-use PPE where possible.

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Housekeeping

Secondary contamination is the spread of oil via transport, people and equipment to unpolluted areas.

Avoid secondary contamination with good housekeeping:

- Regularly check pumps and hose connections for leaks
- Ensure all storage is water-tight and oil-proof to prevent leakage
- Cover waste containers to prevent rainwater increasing the waste volume
- Line and decontaminant all waste transportation vehicles before leaving site
- Establish a traffic circulation plan for vehicles
- Locate waste storage sites close to recovery equipment

Types of waste produced by each response technique

User guidance – remove irrelevant techniques

	Technique	Waste collected	Waste generated
Offshore Response	Natural Recovery	-	-
	Containment and Recovery	Oil and emulsified oil Contaminated water Contaminated debris	Contaminated boom and skimmer equipment Contaminated vessel
	Dispersant	-	PPE Dispersant storage containers Contaminated vessel
	In-Situ Burning	Burnt and viscous residue	Contaminated fire boom PPE Contaminated vessel
Shoreline and Inland Response	Sediment Relocation	-	Contaminated equipment (spade, bags) & PPE
	Manual Recovery	Oil and oiled sediment (tarballs, emulsified oil) Oiled debris & vegetation	Contaminated equipment (spades, buckets) PPE
	Sorbents	Oil	Sorbents, PPE
	Mechanical Recovery	Oil and oiled sediment	Contaminated equipment (skimmers, pumps) & PPE
	Flushing	Remobilised oil	Sorbents and/or containment boom & PPE

Step 4 - Reuse: Segregate

Segregation is the first step to reusing and recycling waste. Waste should be classified, segregated and labelled. Segregate different types of oiled waste and keep non-oiled waste separate. Oily debris should be segregated by types (i.e. sorbents, vegetation,

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sand, trash, etc.) and placed on a vessel or barge in a manner that will not allow seepage to occur. Oily debris will be transported in leak proof, sealable containers along with separate containers of recovered oil to temporary storage sites(s) onshore that are convenient to the recovery operation.

Consider the following to reuse or segregate different types of waste generated

Oiled waste	Considerations
Fluid oil	Feasibility of using recovered oil as a raw material or low grade fuel Prevent water or debris entering waste oil containers (consider decanting) Use cleaners and wash sparingly with water
Heavily contaminated oil	Discharge into lined lagoons, pits or large open topped tanks Separate oil, water and oiled debris; pre-treat if possible.
Solid waste (includes oiled debris and response material)	Do not mix oiled waste with domestic/non-oiled waste Prevent oily wastes from contaminating soil; use liners Use sorbent pads until they become moderately oiled Minimise collection of underlying, non-oiled sediment Clean and re-use recovery equipment (e.g. pom-poms) rather than discarding
Oiled wildlife	Keep dead animals separate from other waste types to prevent spread of disease

Step 5 - Recycle: Pre-treat

Pre-treat waste in situ to reduce the amount of waste that needs to be transported and treated.

Pre-treat by:

- surf washing
- burning
- sand sieving
- bioremediation

Step 6 – Dispose

Waste generated during the course of the spill incident should be minimized to the extent possible to reduce associated manpower and expenses. Each waste stream should be treated separately for waste determination, characterisation, and classification.

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Table 4 provides some useful guidance on waste management considerations related to different strategies.

Table 4 Waste Management Considerations for Response Options

	Oily Liquids			
Location	**Recovery system(s)**	**Temporary storage area & resource**	**Emulsified**	**Non emulsified**
At sea	Single ship system	Barges, pillow tanks, offloaded at port into skips and trucks	✓✓	✓✓
Shoreline	Vacuum truck, oleophillic & mechanical skimmers, manual labour, adsorbent material	Heavy-duty plastic bags, skips, lined pits	✓✓✓	✓
	Waste Management Method (in order of preference)		Separation / Processing	Separation / Processing
	Oily Solids			
Location	**Biodegradable debris**	**Non-biodegradable debris**	**Sand**	**Pebbles**
At sea	✓	✓	n/a	n/a
Shoreline	✓✓*	✓*	✓✓	✓
	Waste Management Method (in order of preference)		Biodegradation / Landfill	Landfill / Incineration

✓✓✓ Relatively large amounts of waste produced
✓✓ Relatively moderate amounts of waste produced
✓ Relatively low amounts of waste produced
× Negligible amounts of waste produced
* Eni Ghana to remove debris from identified areas of coastline before oil impacts shoreline. This will severely reduce waste volumes

Initial transportation will involve small vehicles such as dump trucks and front end loaders. Subsequent transportation to intermediate or final disposal sites can include tankers for liquid waste and sealed trucks for solid waste.

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Document and retain consignment notes for:

- all waste leaving the site
- waste being transferred from an intermediate storage site to a final suitably licensed disposal/treatment site

Disposal options depend on volume and type of oil, contaminated debris volume, spill location (offshore/shoreline), environmental and legal considerations, practical limitations and cost.

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Oil-Water Separation



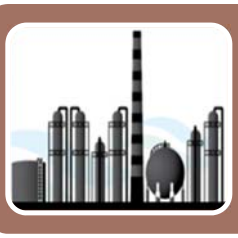
- Use an onboard oil-water separator to reduce contaminated waste quantities going to final disposal.
- The oil/water residue from separation should meet 15 ppm discharge standards for release into the environment.

Emulsion Breaking



- Waste emulsion can be broken down into its constituent parts of oil and water using a specialised emulsion breaking chemical.
- Oil can then be sent for refining. The emulsion breaking chemicals remain in the water which has to be disposed of appropriately.

Re-Processing



- Treatment of recovered liquid waste.
- Oil is reprocessed through an oil refinery or recycling plant.
- Oil with a high salt content may corrode refinery pipe work.
- Only debris free oil or an oil/water mix can be processed.

Incineration



- Treatment of recovered liquid waste.
- Small portable incinerators must be permitted by the Regulator prior to use.
- High salt content in the oil may render this option unsuitable.
- Costly option (environmentally and economically).
- Facilities are uncommon and are unable to deal with large quantities.

Land Fill



- Treatment of other oily waste (debris/PPE).
- If waste contains approximately 5% oil it can usually be disposed of with general waste, however local and national regulations should always be adhered to.
- Chemical testing required to determine hazardous content.
- Facilities able to receive this type of waste are limited.

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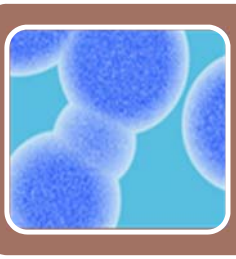
Sand Cleaning

- Treatment of oiled sediment
- Specialist mechanical sand cleaners sieve contaminated sand to removed oil
- Consider NEBA to prevent damage by over cleaning or sterilisation



Beach Washing

- In-situ cleaning of sand, pebbles and cobbles
- Lightly oiled substrate can be cleaned naturally at the surf zone; collect remobilised oil in containment booms
- It is not always easy to identify when pebbles are oil free
- Produces oily water requiring treatment - costly and time consuming.



Bioremediation

- Treatment of oiled sediment
- Addition of microbes to breakdown oil contamination
- Can be done in-situ or oil waste can be removed and treated elsewhere
- Produces inert substance which can be disposed of at landfill if oil loading within permitted levels
- Should be carried out in a controlled environment

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6. OIL SPILL RESPONSE RESOURCES

The Tier 1 response resources available in field are presented in Section 6.1, and can be mobilised by the eni Ghana Representative on site. The Tier 2 and Tier 3 response resources can be mobilised as per Section 6.2 and Section 6.3, respectively.

6.1 Tier 1 Capability

eni Ghana has at its disposal the following response equipment:

- Containerised Conventional Offshore Containment and Recovery Package (2 x 10ft DNV Containers)
  - 200m offshore boom and hydraulic reel system (2x)
  - Offshore skimmer, complete with diesel power pack, offloading screw pump and hose sets (2x)
  - Floating storage inflatable barge, 25m3 capacity (2x)
  - PPE sets (12x)
- Containerised High Speed Offshore Containment and Recovery Package (2 x 10ft DNV Containers)
  - High speed containment system, incl hydraulic reel
  - Diesel power pack, hose sets and offloading pump
  - Oil storage bags for containment system, 20m3 capacity (2x)
  - Paravane
  - PPE Sets (6x)
- Containerised Offshore Vessel Dispersant Spray Package (1 x 10ft DNV Containers)
  - Chemical dispersant spray unit, with Afedo nozzles (2x)
  - Corexit 9500 chemical dispersant, 1000 ltr in IBC tanks (8x)
  - Absorbent pads, bale (6x)
  - PPE sets (12x)
- Containerised Harbour Containment and Recovery Package (1 x 10ft DNV Containers)
  - 150m fence boom
  - skimmer and pump unit
  - Fastank 2000, incl box/ground sheet/liner
  - Absorbent pads, bale (3x)
  - PPE sets (6x)

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- Shoreline Protection Containment and Recovery Package (1 x 20ft DNV Containers)
    - Response trailer (2x)
    - 250m shoreline skirt/shore sealing inflatable boom (2x)
    - Brush skimmer and pump unit (2x)
    - Fastank 2000, incl box/ground sheet/liner (2x)
    - Shoreline flushing equipment (2x)
    - Absorbent pads and 50m absorbent boom (2x)
    - Shoreline ancillary equipment, various (2x)
    - PPE sets (40x)
- Shoreline Support Package and Additional Support Package (2 x 20ft DNV Containers)
    - Trailerised 4.19 m vessel with a 40-70hp engine (stored in one of 20ft container)
    - Utility vehicle (UTV)
    - A command centre tent and supporting ancillaries
    - Communication equipment
    - Marine Tacking Buoy
    - Dispersant Sampling Kit

6.2 Tier 2 Arrangements

Eni Ghana have access to Tier 2 and Tier 3 resources through their contract with OSRL. It is the responsibility of eni to arrange transport of any equipment from the airport in Accra, this is the only international airport in Ghana. The distance from Accra to Takoradi (onshore logistics support base) is estimated to be 200km and will take roughly 3-4 hours by road. However, this is dependent on the availability of suitable hauliers.

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6.2.1 West And Central Africa (WACAF) Aerial Surveillance And Dispersant Service

Eni Ghana have access to Tier 2 aerial surveillance and dispersant through OSRL. This service is provided by the WACAF aerial surveillance and dispersant application services. An Embraer Bandeirante aircraft has been modified to accommodate the fittings of the dispersant pod and spray arms. Details on the WACAF aircraft are presented in Table 5 below.

Table 5 WACAF Aircraft Information

Aircraft type	Embraer Bandeirante EMB110P
Location	Accra, Ghana
Transit Speed	200 knots
Spray Speed	120 knots @ 30-40 m altitude
Empty equipped	3,515 kg
Max take off	5,700 kg
Dispersant payload	2 tonnes (estimated)
Mobilisation time from San Tome Airport	4 hours surveillance 6 hours dispersant application
Dispersant Equipment	Palletised spray system installed internally on seat rails External mounted spray arms 2 m^3 internal tank and pump Swath width: 3 5 m
Surveillance Equipment	Fixed mount forward facing IR camera Fixed mount high resolution digital stills camera Camera stabilisation and protection Geo-referencing capability

The dispersant spraying equipment and a complete aerial observation package are available at Accra, with supporting dispersant stockpiles at the following locations:

- 4 m^3 in Accra (Ghana);
- 2.5 m^3 in Sao Tome;
- 5 m^3 in Malabo (Equatorial Guinea);

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- 4 m^3 in Abidjan (Cote d'Ivoire);
- 4 m^3 in Sonils (Angola); and
- 8 m^3 in Port Gentil (Gabon).

Response Time

Response times to the predetermined dispersant stockpiles are given in Table 6. Flying times are for the aircraft in full spraying configuration including 1,000 litres of dispersant on board. *OSRL* will endeavour that response times from the initial call-out to first flight are 4 hours for aerial observation and 6 hours for dispersant spraying. Note that the response times below are in decimal rather than minutes.

Table 6 WACAF Response Times

Destination	Mobilisation Time (hrs)		Flight Time (hrs)	Total time (hrs)	
	Aerial Observation	Dispersant Spraying		Aerial Observation	Dispersant Spraying
OCTP area	**4**	**6**	**1.5**	**5.5**	**6.5**
Sao Tome	4	6	2.9	6.9	8.9
Malabo	4	6	3.1	7.1	9.1
Abidjan	4	6	1.2	5.2	7.2
Port Gentil	4	6	3.7	7.7	9.7
Luanda	4	6	7.8	11.8	13.8

Note: The flying time includes any fuel stop periods (if applicable).

Role of eni Ghana in Support of WACAF Aircraft

In advance of spraying operations it will be the responsibility of eni Ghana to obtain permission for dispersant spraying and blanket clearance for the aircraft to operate in the required region, and assistance with airport clearance / customs and immigrations, which equally applies for aerial observation. Immediate arrangement of these will aid the response time and thus the efficiency.

A helicopter must give aerial support to the dispersant spraying operations and provide aerial observation. A suitably trained person should be on board the helicopter to act as a spotter, to guide the spraying aircraft accurately onto the required oiled areas, and to observe the effectiveness of the spray operation. It is the responsibility of eni Ghana to arrange for a helicopter and spotter.

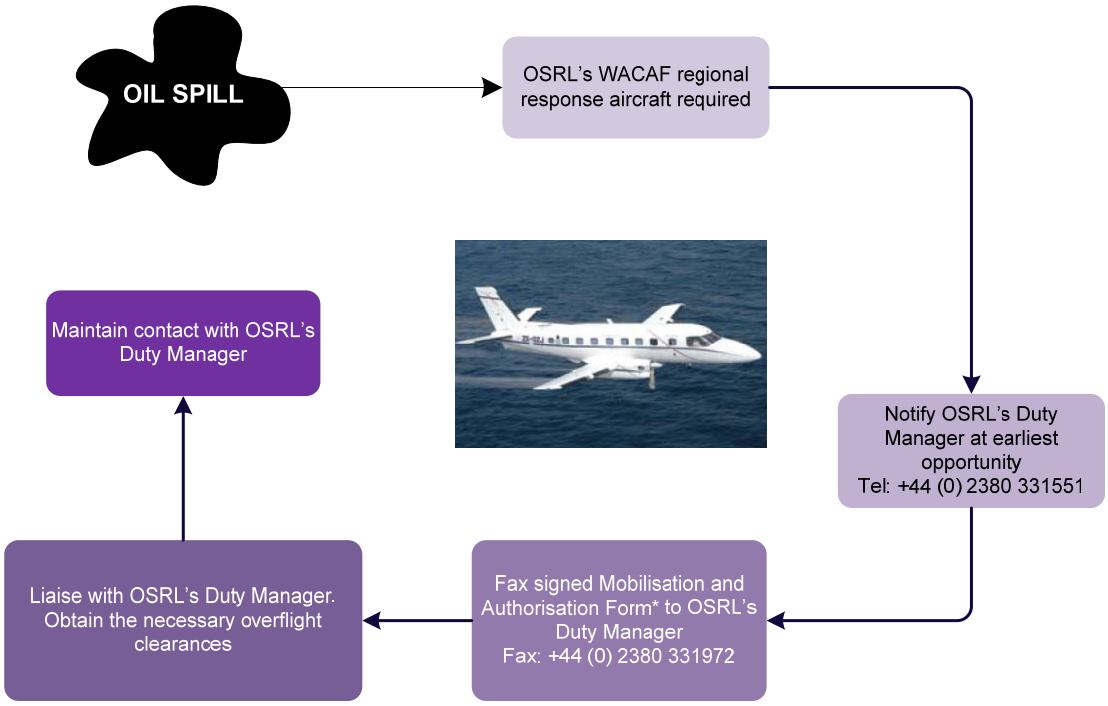
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It is important that only the OSRL Duty Manager is used to contact WACAF (Aberdair) for additional flight times and other details for the WACAF plane. Over flight clearances for Togo, Benin, Nigeria and Cameroon can be secured within 48 to 72 hours, unless the request is made on a Friday – when it will be delayed until the Monday.

Note: All response times are subject to suitable weather conditions and over flight clearances.

6.2.2 WACAF Services Mobilisation Procedure

The mobilisation procedure for the WACAF aerial surveillance and dispersant application services is presented in the flow diagram below.



Note: any eni representative can notify *OSRL* but only the eni Call-Out Authorities have the authority to mobilize *OSRL*.

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6.3 Tier 3 Arrangements

6.3.1 Oil Spill Response Limited

Eni is a Participant member with OSRL, therefore has immediate access to Tier 3 technical advice, resources and expertise 365 days a year on a 24 hour basis. OSRL can be mobilised by those personnel listed in Table 7. To maximise communication efficiency, it is recommended that one person acts as the eni Ghana point of contact for *OSRL*.

OSRL must receive official notification to mobilise from one of eni's Nominated Call-Out Authorities using the 'Mobilisation Authorisation Form', (Annex B, Section 6). The Nominated Call-Out Authorities are people within eni Ghana who have been appointed to approve the expenditure of mobilising Tier 3 resources.

In addition the 'Notification Form' should be provided to *OSRL* to convey technical details of the oil spill incident (Annex B, Section 5). The Emergency Response Manager would be in direct communication with the *OSRL* Duty Manager who would assist in coordinating the response. Eni Ghana is entitled to the services of a Technical Advisor.

Table 8 summarises the OSRL service level agreement (SLA) available to eni Ghana.

Table 7 Eni Ghana nominated call-out authorities

Eni Ghana
Managing Director
Emergency Coordinator
HSE & CI Manager

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Table 8 OSRL Service Level Agreement (SLA) summary

Service	Service Standard		Eni Membership Type: Participant	
Response notification, mobilisation, service and advice	Notification of a spill should be placed to one of the following locations:			
	OSRL BASE	**Southampton, UK**	**Loyang, Singapore**	**Fort Lauderdale, USA**
	TELEPHONE	+44 (0)23 8033 1551	+65 6266 1566	+1 954 983 9880
	FAX	+44 (0)23 8072 4314	+65 6266 2312	+1 954 987 3001
	EMAIL	dutymanagers@oilspillresponse.com		
	FORMS	**Refer to:** *OSRL* – Notification Form		
	The Duty Manager will speak and advise eni Ghana immediately, or call back within 10 minutes.			
Nominated contact	OSRL must receive an official mobilisation authorisation from one of Eni Ghana's Nominated Call-Out Authorities (Table 7). Anyone can notify OSRL.			
Spill response equipment	SLA response equipment is housed in secure facilities in Southampton, Fort Lauderdale, Bahrain and Singapore. Response equipment is customs cleared response ready. **Refer to:** OSRL Yearbook for a complete list of equipment available, www.oilspillresponse.com and refer to the equipment stockpile status report http://www.oilspillresponse.com/activate-us/equipment-stockpile-status-report			
	As per the SLA, eni Ghana can mobilise up to 50% of the global stockpile. If there is more than one spill eni Ghana can mobilise 50% of what remains.			
Global dispersant stockpile	Following an incident, eni Ghana is entitled to 50% of the dispersant located in Southampton, Singapore, Fort Lauderdale and Bahrain. OSRL may be able to obtain further dispersant through the Global Response Network (GRN) and other organisations, if required.			
World-wide transportation of equipment	Global aerial dispersant coverage provided by aerial platforms and application systems. Aerial dispersant coverage is mobilised within a six hour notice period. Accra is the only international airport in Ghana able to accept equipment. Logistics support including: Own fleet of vehicles for local mobilisation of equipment. 24 hours a day access to global network of cargo and passenger charter services through a dedicated broker with specially negotiated payment terms.			

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Oil spill trajectory and tracking	Trajectory and stochastic services for surface or subsurface oil spills on request, and backtrack services for surface oil spills using commercial modelling software:		
	Oil Spill Information System (OSIS)	OILMAP	Oil Spill Contingency and Response Model (OSCAR)
	Satellite imagery services can be provided on request.		
Response personnel	OSRL will provide the following response personnel on a first come, first served basis: 1 x Senior oil spill response manager. 1 x Oil spill response manager. 15 x Spill response specialists/responders. 1 x Logistics Service branch coordinators.		
	A Technical Advisor (TA) can be deployed to support eni Ghana during an actual or potential oil spill incident. TA support is free for the initial assessment period of up to 48 hours. If a full response team is mobilised, the TA will form part of the team headcount.		

6.3.2 Logistical Support

OSRL respond to locations around the world. To ensure equipment gets through customs clearance quickly and on to the lay down area for response, eni shall make the necessary arrangements for the equipment and OSRL personnel once in country.

Note: Mobilisation times **EXCLUDE** the time taken to get appropriate flight clearances and the time taken for the equipment to clear customs at Accra, which is the only international Ghanaian airport.

The times may vary depending on the events at the time and are given for guidance purposes only. The time taken to road-freight the equipment from Accra to Takoradi also should be taken into account, and is dependent on the availability of suitable hauliers. This will be arranged by eni Ghana. It is estimated that the 200 km journey along the coast road from Accra to Takoradi will take an estimated 3–4 hours.

The diagram below show in more details the different mobilisation responsibilities held by eni Ghana and *OSRL*.

An overview of the responsibilities for eni and *OSRL* are presented in Figure 3.

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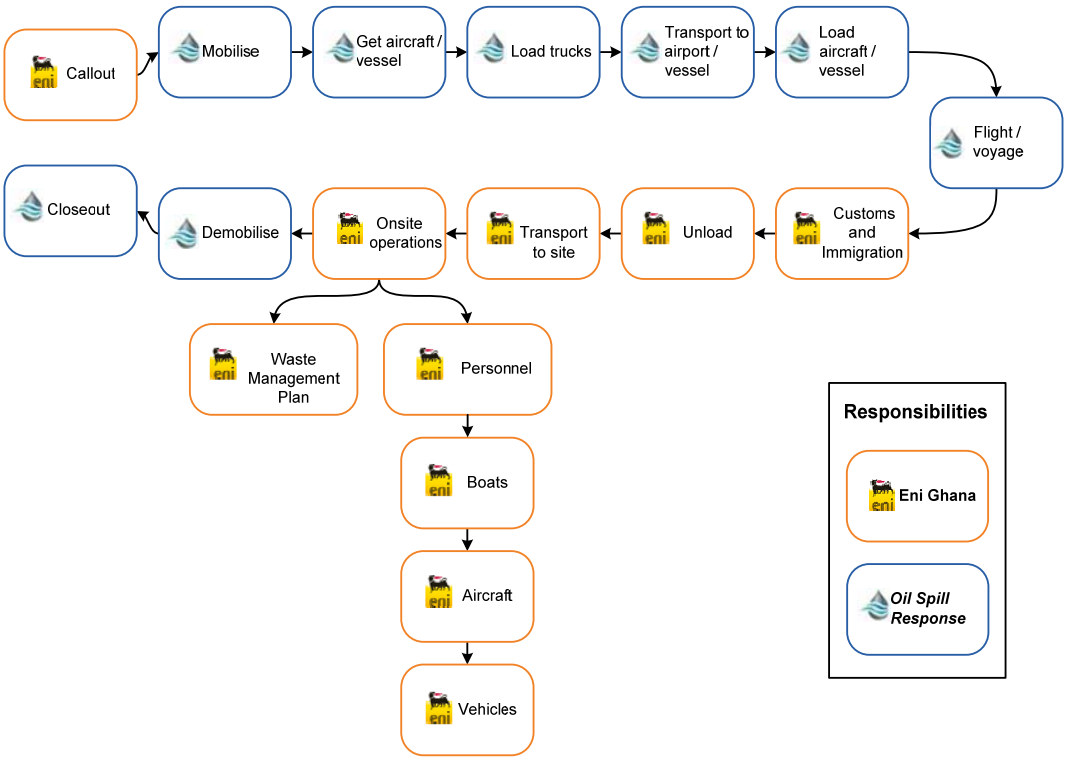


Figure 3 Overview of logistical responsibilities

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6.3.3 Dispersant Stockpile

The Global Dispersant Stockpile (GDS) is an additional dispersant stockpile to the SLA. The GDS will total 5000 m³ and will be located across the OSRL bases in the UK, Singapore, South Africa, USA, Brazil (in 2015) and France (Table 9). The dispersant types chosen are those with the largest worldwide approval. Unlike the SLA, 100% of the Global Dispersant Stockpile can be mobilised for a single incident.

Table 9 Global Dispersant Stockpile Quantities and Locations

Dispersant	Quantity (m³)	Storage Location
Finasol OSR 52	3150	Southampton, South Africa, Singapore and France
Slickgone NS	850	Southampton and Singapore
Corexit 9500	350	Fort Lauderdale

6.3.4 Global Response Network

OSRL can facilitate the mobilisation of further resources through the Global Response Network (GRN). The GRN is a collaboration of six major oil industry funded spill response organisations whose mission is to harness cooperation and maximise the effectiveness of oil spill response services worldwide. It includes:

- Alaska Clean Seas (ACS)
- Australia Marine Oil Spill Centre (AMOSC)
- ECRC (formerly, Eastern Canada Response Corporation)
- Marine Spill Response Corporation (MSRC)
- Oil Spill Response Limited (OSRL) (America, Europe, Middle East, Africa, Asia and Pacific)
- Western Canada Marine Response Corporation (WCMRC)

6.3.5 Relief Well

Eni Ghana will drill a relief well should there be an uncontrolled blowout at the OCTP area. This is anticipated to take up to 95days.

The company has in place a global agreement for Emergency Subsea Well Capping Equipment.

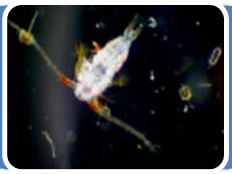
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6.3.6 Oiled Wildlife Response

There are no formal guidelines for dealing with oiled wildlife incidents in Ghana. In case of an oiled wildlife incident, different organizations and bodies, such as the Ghana Wildlife Society or the University of Ghana (Oceanography and Zoology Departments), would probably get involved. The nearest area with experience in bird rehabilitation is in South Africa. Extensive expertise exists in Europe (France, United Kingdom) or the U.S.A. A report, *A Guide to Oiled Wildlife Response Planning* (IPIECA Report Series, Vol. 13) is available which provides an overview of the critical components of an oiled wildlife response. *OSRL* can also offer an oiled wildlife response service through an agreement with Sea Alarm (www.sea-alarm.org/).

Through OSRL, eni has access to an external international wildlife response capability. Sea Alarm has extensive experience in dealing with oiled wildlife emergencies. Specialised wildlife response equipment is pre-packaged, custom approved and stockpiled at OSRL. This equipment can be mobilised by the OSRL Duty Manager on request by eni. The mobilisation of Tier 3 wildlife emergency teams will be guaranteed both through voluntary commitment (external to the company) and internal dedicated resources through specific training. This equipment is available 365 days a year on a 24 hour basis, as part of the SLA. Experts from outside of OSRL and Sea Alarm are required to operate the equipment. Figure 4 outlines the effects of oiling on various wildlife.

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Plankton

- Includes juvenile fish and shellfish.
- Toxic, leads to death of plankton.
- Reduced future populations of fish and shellfish.



Coral

- Decreased growth, reproduction and colonisation capacity.
- Negative effects on feeding and behaviour.
- Death.
- Effects can be far-reaching.



Fish and Shellfish

- Smothering: loss of habitat, irritation and damage to the respiratory system, suffocation, damage to fins and scales, shell closure.
- Ingestion: enlarged liver, fish tainting, reduced growth, heart failure.
- Reduced egg hatching and larval survival.



Reptiles

- Smothering: irritation of skin, eyes and other orifices, limited mobility (especially juveniles) increasing vulnerability to predation.
- Ingestion: damaged digestive system and other organs, death by starvation.
- Inhalation: damaged respiratory system, death by suffocation.
- Loss of hatchlings and juveniles on oiled beaches.



Birds

- Smothering: loss of habitat, reduced mobility (increased vulnerability), loss of buoyancy, hypothermia, death.
- Ingestion: organ damage, gastrointestinal irritation and ulceration.
- Inhalation: pneumonia and death.
- Deformities, decreased reproduction / irregular breeding bevaviour.



Mammals

- Smothering (haired species): irritation, inflammation, infection, suffocation, hypothermia, reduced buoyancy and swimming ability.
- Ingestion: digestive complications, decreased chance of survival.
- Inhalation: respiratory system damage, disorientation, unconsciousness, paralysis, pneumonia, death.
- Loss of habitat

Figure 4 Effects of wildlife oiling

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7. OPERATIONAL OVERVIEW

Eni Ghana intends to drill and produce oil from the Offshore Cape Three Points (OCTP) oil fields. The OCTP block is located in the Gulf of Guinea, in the Republic of Ghana, and is situated approximately 55 km South of the town of Atuabo and 60 km South of Sanzule. The water depth in the development area ranges from approximately 800 m to 1,000 m.

The development of the Sankofa and Gye Nyame fields will be carried out by an FPSO, which collects both the oil and gas production from different regions of the fields to collect and process the Oil. Sankofa field can be divided into four regions: North East, North West, South East and South West, while Gye Nyame is approximately 15 km East. Because of the well distance, the majority of the wells are satellite. The campaign will include the development of three non-associated gas fields (Sankofa Main, Sankofa East and Gye Nyame) and two oil fields (Sankofa East Cenomanian and Sankofa East-2A Campanian reservoirs). Figure 5 details the OCTP development project area.

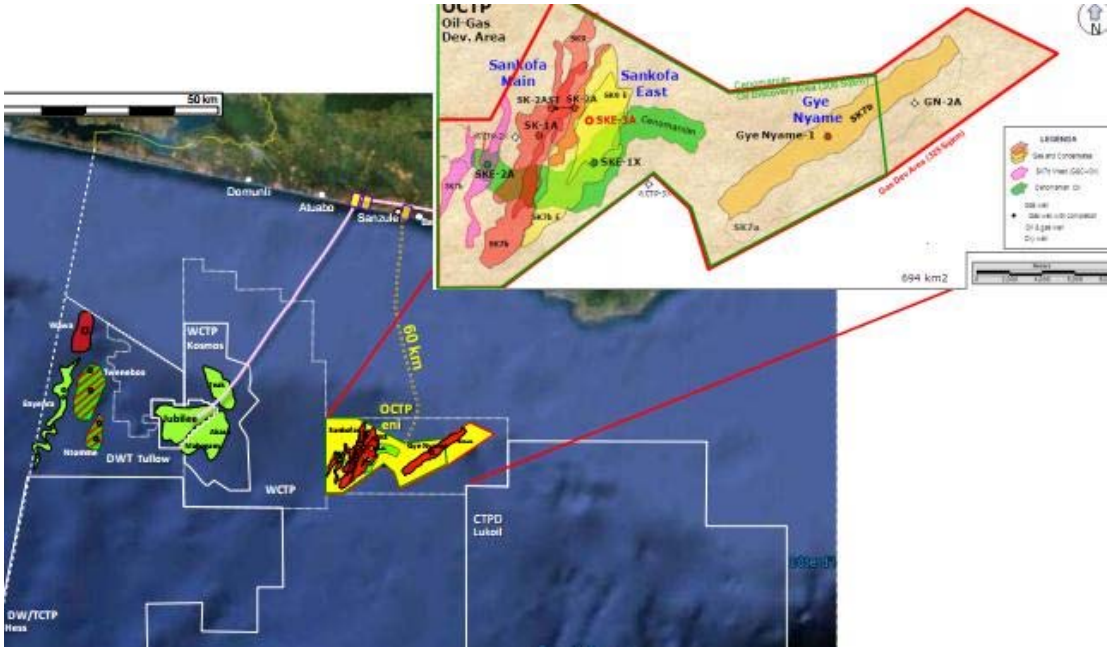


Figure 5 OCTP Development Project Area

The project considers drilling and then installing 19 subsea wells (8 Oil Producer wells (of which 3 are re-entry), 3 water injection wells, 3 gas injection wells and 5 subsea gas producer wells). A new conversion double hulled Floating Production Storage Offloading (FPSO) unit will be installed in the middle of the oil development area to collect and process the oil (dehydration and stabilization).

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The project activities will include mobilization and rig installation, wells drilling; Production tests; Well completion and installation of X-Trees; Subsea Umbilical, Riser, Flowline installation; Installation of FPSO and mooring system; and then the Operation phase. See Table 10 for further information.

Table 10 OCTP Project Stages, Activities and Actions

Stage	Activity	Action
Wells Drilling	Drilling activities	Drilling system installation and removal
		Drilling system operation
		Production test
	Drilling support	Use of support vessels
X-Trees Installation and Removal	X-TREES installation and removal	Installation/removal activities
		Use of support vessels
Well Heads Operation	Normal operating procedures	Presence of production structures
		Protection of structures against corrosion (anodes)
	Production support, maintenance	use of support vessels
FPSO – Mooring System Installation	Installation activities	mooring system installation activities
		use of support vessels
	Structures normal operating conditions	protection of structures against corrosion (anodes)
		presence of mooring system
		use of support vessels
FPSO Process Commissioning and Operation	Commissioning	commissioning procedures, hydro test
	Process normal operating conditions	process operation production water discharge
		offloading activities
	Production support, maintenance	use of support vessels

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7.1 Drilling Operations

Development drilling operations are scheduled to commence in Q1 2015, with an estimated drilling and completion total duration planned for 40 months baring offsets situations and drilling difficulties.

Common pollution prevention strategies, management systems and oil spill response plans will be covered in the bridging document with the drillship and FPSO contractors. The bridging document is to be issued as per eni's standard Doc. N° 1.3.1.30 'Contract HSE requirements for abroad activities', § 9.4.

The drilling and completion activities will be performed by the Maersk Voyager drilling rig. The rig will be capable of operating in water depths up to 3,300 m. It will be an advanced drilling ship, dynamic positioned (DP-3), Dual Activity/Dual BOP rig designed to minimize emissions and discharges to sea. The unit shall be capable of performing all the planned drilling and completion operations required to develop the fields and deploying the Subsea Production Trees and other associated subsea equipment. Table 11 lists the drillship storage capacities.

Table 11 Maersk Voyager Dynamic Positioned Drillship storage capacities

Maersk Voyager Dynamic Positioned Drillship


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Maersk Voyager Dynamic Positioned Drillship	
Fuel (diesel or heavy fuel oil)	6,210 m^3
Drilling water	2,410 m^3
Potable water	1425 m^3
Liquid mud (active & reserve)	2,767 m^3
Waste liquid (mud & washing water)	2,000 m^3
Brine	777 m^3
Oil base Mud	998 m^3
Crude Oil	452 m^3
Bulk bentonite/Barite	452 m^3
Bulk Cement	2,300 m^3
Sack storage	7,540 m^3
Ballast water	6,210 m^3

Project Schedule

The activities listed below, as reported in the project schedule, partially overlap in order to limit the environmental impacts and their total duration. The activities taken into consideration will start in Q1 2015 and will end in Q2 2018 and so the total duration is 3 years. The Gye Nyame 1 well is excluded from this schedule, as its start is foreseen for 2028.

See Table 12 for details relating to the drilling project and also the facilities & equipment Installation. The expected duration of the production phase is 20 years.

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Table 12 Project Schedule for Drilling, Facilities & Equipment Installation

Activity	Duration (months)
Wells Drilling and Completion	25 (with suspensions)
Flowlines, Risers, Umbilical's installation (3 major campaigns)	18 (total for all 3 campaigns)
Mooring / anchoring system installation	2.5
Mobilization/Demobilization drilling rig	1

OCTP Wells to be drilled

The campaign will include the development drilling of three non-associated gas fields (Sankofa Main, Sankofa East and Gye Nyame) and two oil fields (Sankofa East Cenomanian and Sankofa East-2A Campanian reservoirs). The project considers drilling and then installing 19 subsea wells (8 Oil Producer wells, of which 3 are re-entry), 3 water injection wells, 3 gas injection wells and 5 subsea gas producer wells. The wells to be drilled are as per Table 13.

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Table 13 Well names and drilling targets

Phase	Well Name	x (m) @target	y (m) @target	z (m) @target	x(m)@seabottom	y(m)@seabottom	WD (m)
1	OP-1 (SkE-2A)	544565.81	493151.73	3760	544565.81	493151.73	989
1	OP-3	548775	492106	3654	549071.47	491302.15	941
1	OP-4	550628	492579	3527	551303.31	491585.16	870
1	OP-5	553853	495047	3422	554864.57	494507.31	708
1	OP-6 (SkE-1x)	551399.84	493700.60	3500	551399.84	493700.60	826
1	OP-7	555176	495628	3403	554910.35	494492.78	708
1	OP-CAMP1	HDst 542665.15	HDst 493841.22	2657.99	543170.00	494598.00	997
		HDe 542333.46	HDe 493349.70	2662.37			
1	OP-CAMP2	HD start 544716	HD start 492894	2655	545000.00	493500.00	967
		HD end 544580	HD end 492684	2658			
1	WI-1	547088	491508	3682	546451.05	492455.66	1014
1	WI-3	553506	495987	3497	553922.96	494882.71	726
1	GI-1	557346	495142	3369	557346.00	495142.00	630
1	GI-2	551600	491490	3481	551600.00	491490.00	865
1	WI-CAMP1	544907	497702	2710	545329.36	497321.86	954
1	GI-CAMP1	545647	495692	2630	545647	495692	897
2	Sk-2Ast (IWC)	549009.66	496590.61	2553	549396.50	496615.96	863
		548968.74	496588.26	2605			
2	Sk-D	547300	492850	2551	546627.504	493271.719	947
2	SkE-C (IWC)	551270	493750	2558	551976.939	493375.518	811
		551270	493750	2599			
2	SkE-D	548917.59	492133.46	2608	548847.18	491336.56	948
2	GN-1	565366.58	494899.22	2432	565340.77	494894.25	520

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Table 14 Producer wells locations

Well name	Latitude (DMS)	Longitude (DMS)	Water depth (m)	Distance offshore (km)
OP-Camp 1	4° 28' 28.5198" N	2° 36' 39.1206" W	997	55
OP-Camp 2	4° 27' 52.7256" N	2° 35' 39.7572" W	967	56
OP-1 (SKE-2A)	4° 27' 41.3922" N	2° 35' 53.8506" W	989	57
OP-6 (SKE-1x)	4° 27' 59.1186" N	2° 32' 12.084" W	826	53
OP-3	4° 26' 41.0706" N	2° 33' 27.6834" W	941	57
OP-4	4° 26' 50.2434" N	2° 32' 15.2586" W	870	55
OP-5	4° 28' 25.3338" N	2° 30' 19.638" W	708	51
OP-7	4° 28' 24.8628" N	2° 30' 18.1548" W	708	51
Sk-2Ast	4° 29' 34.1226" N	2° 33' 17.031" W	863	52
Sk-D	4° 27' 45.2622" N	2° 34' 46.9488" W	947	56
SkE-C	4° 27' 48.5388" N	2° 31' 53.3634" W	811	53
Ske-D	4° 26' 42.1974" N	2° 33' 34.9632" W	984	57
GN-1	4° 28' 37.6854" N	2° 24' 39.6858" W	520	44

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Sequence of operations

Pre drilling

The sequence foresees the positioning of the rig in the well location and the jetting of 36" conductor pipe. The drilling of 24" phase is made with sea water and viscous pillows, the cutting will be scattered on the sea bed because there isn't connection with the surface facilities through the marine riser. Then the 20" casing with wellhead housing is run and cemented in place.

The next sequence is to run the BOP stack with the marine riser and latch it onto the wellhead housing. Thereafter, all the drilling fluids and debris will be managed from the surface facilities of the rig. The operations will carry on in the same way until the 9 5\8" liner is set.

At that time the well is temporary suspended, the riser and BOP are recovered and the rig will move in the location of another well.

Re-entry and completion campaign

At the end of the drilling campaign eni will start the completion phase, so the rig will be back on the well, the corrosion cap will be removed and the Horizontal X-tree will be landed and installed with the BOP (Blow Out Preventer) on top.

The last 8 1\2 "drilling section is performed through X-Tree, then the cased hole logs are recorded.

Now the well is completed with lower, gravel or frac pack, and upper completion, tubing string packer and safety valves.

The last operation before to install the corrosion cap on X-Tree will be the well clean up.

Well start up

At the end of all the drilling and completion activities is highly recommended a well production test.

The main purpose of the operation is to eliminate all the debris from the well in order to avoid some damages of the downhole and surface equipments.

The test is usually done from the rig as soon as finished the completion job.

The period of the clean-up is quite short, around 3-4 hours, but it can hold up about 24 to better understand the productivity of the well.

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Pollution prevention measures

All the systems on the drilling rig will be classified as controlled discharge to prevent any type of spill, drilling mud or bilge oil into the sea.

All drains will collect the liquids into the drain holding tanks. Operating on 3-way valves installed on drainage system, heavy rainfall could be diverted overboard. Collected liquids will be offloaded periodically to the supply vessel tanks and then carried to land for treatment and disposal. There will be no discharges of these liquids in the environment.

Civil wastewater (sewage, water from washbasins, showers, kitchen) will be treated with approved systems to achieve legal concentration limits, before being discharged into the sea, accordingly with MARPOL.

The machine room, pump zone and engine area will also be fitted with coaming and bilge to collect oily liquids. The fluids will be gathered and sent to an oil-water separation system. The water separated will be sent to the liquid waste collection tank while the oil will be stored in special drums to be transferred to land for disposal.

Drilling parameters will be monitored by two independent systems of sensors. Sensors will operate in continuous mode, during all drilling operations as monitoring permits ready recognition of any operating anomaly. The first monitoring system will be integrated in the drilling rig monitoring system, while the second is a computerized unit manned by skilled personnel and installed on the drilling rig by service contractor.

Blow Out Preventer

The rig will be equipped with 15,000 psi Blow Out Preventer (BOP) in accordance with eni well control policy and international standards. as they are critical to the safety of crew, rig and environment.

The two fundamental types of BOPs are annular and ram.

Annular BOPs will be installed on top of the BOP stack. They will have a suitably shaped rubber element that can close and seal the casing/drill string.

Ram-type BOPs able to perform several functions, such as closing around a tubular, or cutting a tubular and ensuring hydraulic sealing, or closing without tubular in the wellbore will have two prismatic gates to fit the diameter of the equipment in the borehole.

BOPs will be assembled to form the BOP stack, generally including 1 or 2 annular BOPs and 3 or 4 ram BOPs. There will be a set of shear rams that ensure total closing of the borehole during emergency situations by shearing the drilling pipes.

The BOPs will be hydraulically operated from 2 remote panels.

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7.2 Production Operations

Oil producers, gas and water injection wells will be connected directly to the FPSO unit (no manifolds) through flexible risers and flowlines. Crude oil will flow continuously from subsea trees through the subsea flowlines via risers to the process facilities on the FPSO (coordinates: 549548.848 mE; 494023.114 mN).

The produced oil will be separated from both water and associated gas, stabilized and stored into storage tanks in the FPSO prior to being properly metered. Shuttle tankers will then be periodically moored to the FPSO and the stored crude oil will be pumped to the shuttle tanker via an offloading hose. Exported crude will be fiscally metered on board of the FPSO. Condensates produced later, during the following non associated gas project, will be separated offshore and blended with the oil on the topside facility of the FPSO.

The associated gas produced from the oil separation train, will be compressed dehydrated before being re-injected into the reservoirs (Cenomanian and Campanian) and sent by the gas sealine (63 km long) to the Onshore Receiving Facilities (ORF). Part of this gas will be used for fuel for power generation. Oily and accidentally oily waters will be stored in drums to be transferred to land for proper disposal/treatment.

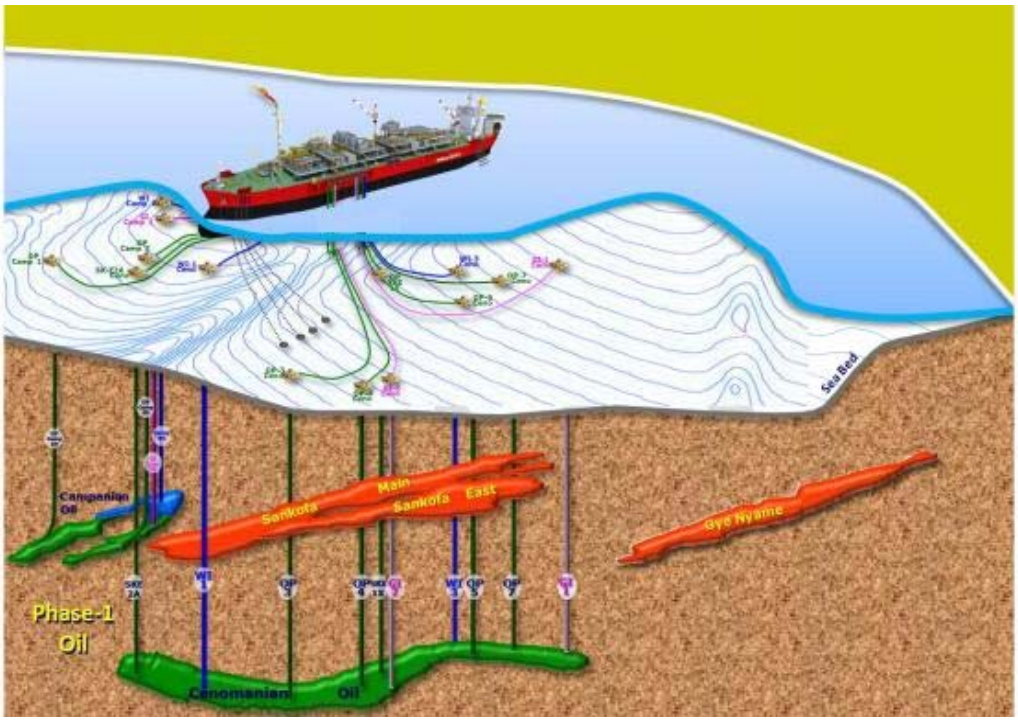


Figure 6 OCTP Schematic Operational Layout

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The FPSO will be constructed through the conversion of an existing very large crude carrier (VLCC). The FPSO will be a double hull and will be classified with DNV that will ensure all the hull requirements are in accordance to international and local standards. The design is according to worst conditions (100 years) return period. FPSO design characteristics are reported in Table 15.

Table 15 Floating Production Storage Offloading (FPSO) unit

Floating Production Storage Offloading (FPSO) unit	
Non Associated Gas design capacities	
Gas production	210 MMSCFD (including overdesign)
Condensate production	8,000 bblsd
Water production	1,000 bblsd
Gas treatment capacity	210 MMSCFD (including overdesign)
Booster compressor capacity	210 MMSCFD (future installation)
Oil design characteristics	
Total liquid capacity	75,000 bblsd
Oil treatment capacity (including condensates from NAG)	58,000 bblsd
Produced water treatment capacity	45,000 bblsd
Gas injection capacity	150 MMSCFD
Water injection capacity	55,000 bblsd

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7.3 Field Support Vessels

Both drilling and production operations will be assisted by supply vessels. The main hydrocarbon inventory onboard the vessels is detailed in Table 16.

Table 16 Hydrocarbon Inventory for Field Support Vessels

Vessel	Hydrocarbon Inventory
Platform Supply Vessel	Marine Gas Oil storage tank: 1,000 m^3 (actual capacity may slightly vary from vessel to vessel)

Precautions include a supply vessel normally stationed on location, 24-hour watches, establishment of a 500 m radius exclusion zone around the unit, and access to current weather data.

The drilling system is manned from a supply vessel that not only serves as temporary storage for drilling materials (diesel fuel, water, bentonite, barite) but also holds drums of dispersant and equipment with special arms for deployment in the sea in the case of accidental oil spills.

During the production phase, supply vessels (one on stand by and one commuting) will provide food and materials to the FPSO.

Additionally, the onshore logistics support base is located at Takoradi, which is approximately 100 km from the OCTP locations. The marine support base at Takoradi Port provides dock space which serves as a loading/offloading point for equipment and machinery. It also provides quayside facilities for dispatching fuel, chemicals and equipment, and allow for the temporary storage of spares, production chemicals, fuel and other supplies. On occasion if the Takoradi Port is full, the Naval Port at Sekondi may be used.

Normal operations will include well drilling and completion, loading and offloading of supply vessels and helicopters, fuel transfers and mud and chemical transfers.

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7.4 Oil Properties

The main properties that affect the behaviour of oil spilled at sea are:

- Specific gravity (its density relative to pure water often expressed as °API).
- Distillation characteristics (its volatility).
- Viscosity (its resistance to flow).
- Pour point (the temperature below which it will not flow).

The International Tanker Owners Pollution Federation (ITOPF) classifies oil into four main groups according to specific gravity. This classification can be used to predict rate of dissipation. Figure 7 shows the oil classifications and the time anticipated for the oil to dissipate naturally in the marine environment.

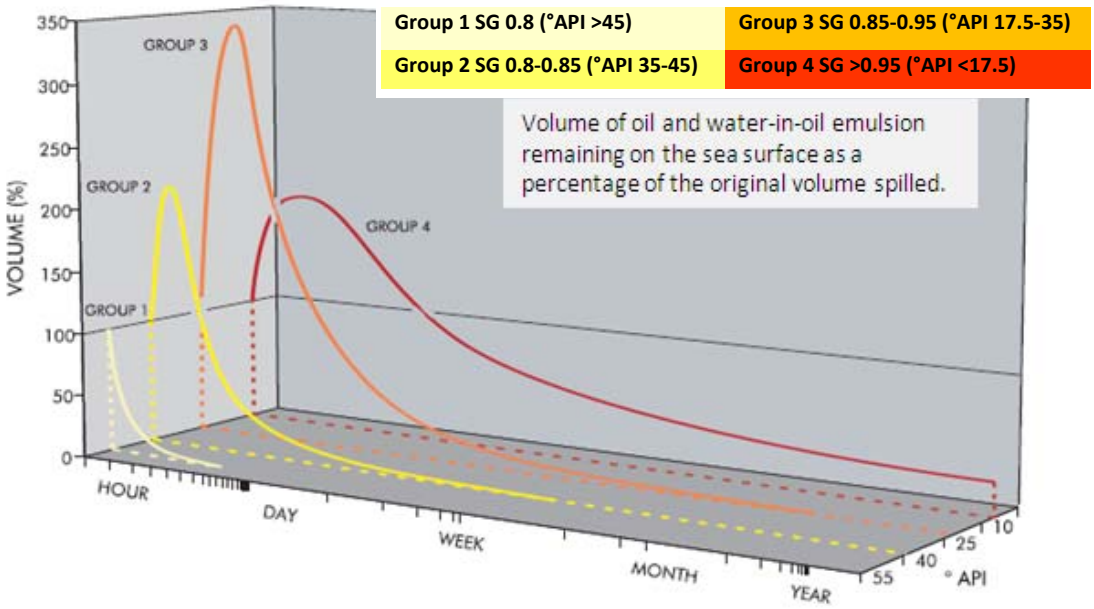


Figure 7 Variation in persistence between oil groups defined by the ITOPF classification[1].

Spill Fate and Behaviour in the Marine Environment

The fate and behaviour of oil spilled at sea depends largely on the physical and chemical properties of the oil. It is the oil's chemical composition, in combination with meteorological conditions, which affect the way in which the oil breaks up and dissipates into the marine

[1] ITOPF. 2010. Handbook 2010/11. Fate of Marine Oil Spills.

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environment, or persists. This interaction between the spilled oil and its new environment is a process known as weathering and it can only be predicted if the oil's properties are known.

The Weathering Process

The weathering processes applicable to oils covered by this OSCP are described in Table 18. Response techniques have been suggested using oil spill models that include algorithms for weathering processes based on tested oils. If oil is spilled, additional modelling will predict the fate and behaviour of the spilled oil based on the current and forecast meteorological conditions.

Oil Properties for the Sankofa East Fields

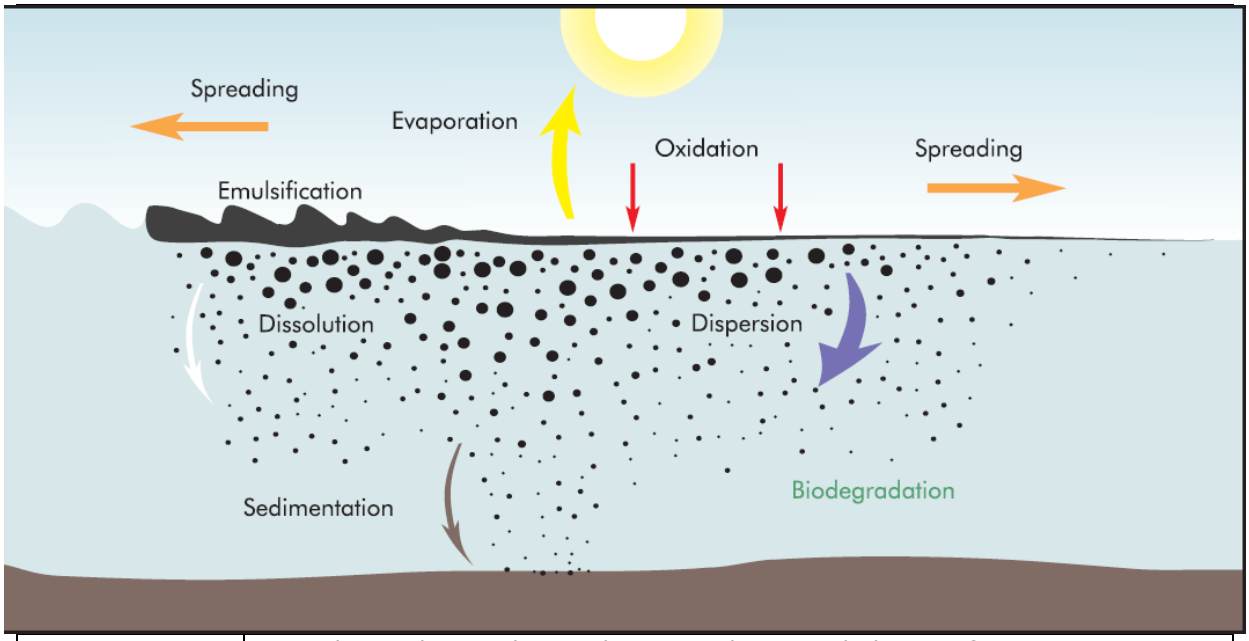
The oil properties for the Sankofa East 'Campanian' and 'Cenomanian' crudes are detailed within Table 17.

Table 17 Oil Properties for Sankofa East Fields

Field	Sankofa East	
Level	Campanian	Cenomanian
Oil type	Oil	Oil
Specific gravity	0.865	0.876
Density (°API)	32	30
Viscosity @BP (cP)	0.79	0.69
Sulfur (%)	4	-
Asphaltenes	4,9	-
Psat (psia)	3915	5349
Solution GOR (MSCF/STB)	0.817	1.103

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Table 18 Weathering of oil spilled in the marine environment



Spreading	• Oil spreads over the sea, becoming thinner with distance from source. • Rate depends on oil viscosity, wave action, wind speed, and air and sea temperature. • Condensate, light crude oil, diesel and base oil spread thinly rapidly.
Evaporation	• Light ends evaporate quickly - can produce an explosive atmosphere. • Rate depends on volatile content of oil, wind speed, and air and sea temperature.
Emulsification	• Seawater mixes with oil to form a viscous and persistent emulsion. • Emulsion is difficult to recover and cannot be burnt or dispersed. • More likely to happen to hydraulic oil than condensate, diesel or base oil.
Dispersion	• Oil breaks down into droplets which mix into the water column. • Small droplets may remain dispersed in the water, large droplets may resurface. • Rate increases with decreasing oil viscosity and increasing wave action
Sedimentation	• Oil adheres to suspended particles which sink the oil to the seabed. • Rate depends on suspended sediment concentration. • High concentrations can occur in shallow seas, particularly during storm events.
Biodegradation	• Oil is consumed by bacteria that break it down into smaller compounds until it becomes carbon dioxide and water. • Rate depends on oil type, availability of nutrients (varies seasonally), oxygen concentration and water temperature.
Dissolution	• Water soluble components dissolve into the water column. • A large fraction of condensate, light crude oil, base oil, diesel and helifuel can dissolve; hydraulic and lube oils contain smaller soluble fractions.
Photo-oxidation	• Breaks down oil into smaller, soluble compounds – a slower process than evaporation

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7.5 Environmental Settings[2]

This section describes the important physical and biological aspects of the Ghanaian environment with a particular focus on the well locations and its adjacent area.

Ghana lies along the Gulf of Guinea in West Africa, bounded within latitudes 04° 35′ N and 11° 00′ N and longitudes 03° 05′ W and 01° 10′ E. It covers an area of approximately 239,000 km^2. The country is bordered by Togo to the east, Côte D'Ivoire to the west and Burkina Faso to the north. The coastline of Ghana is approximately 550 km long. Around 70% of the coastline consists of sandy beaches, and the coastal zone is dotted with over 90 coastal lagoons, most of which are small.

The well locations fall within the west coast of Ghana, which covers 95 km of shoreline, extending from Ghana's border with Côte D'Ivoire to the estuary of the Ankobra River. The majority of this coastline is fine sand with beaches backed by coastal lagoons.

7.5.1 Climate

The climate of the region is governed by the latitudinal displacement of the Inter–Tropical Convergence Zone (ITCZ). The ITCZ separates two air masses: the humid air mass of oceanic origin (characterizing the monsoon period) and the dry air mass of continental origin (representing the Harmattan season). Alternation of the rainy and the dry seasons is regulated by zonal and seasonal variations of the ITCZ along the coastline. Ghana receives most rainfall during the major wet season (May to July). Rainfall is usually between 1,500 and 2,000 mm per year. The major dry and hot season occurs between December and March. Air temperature shows little variation around 26°C with an average daily and monthly change of 4 °C and 8 °C respectively. Monsoon trade winds blow for 10 months a year from the south-west and south-south-west. In January and February, the Northeast Trade winds blow offshore. The surface atmospheric circulation in the region is influenced by north and south trade winds and the position of ITCZ.

[2] Additional details are explored in the eni Ghana ESHIA developed for the Phase 1 and 2

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7.5.2 Oceanography

Surface water temperatures are expected to be warm (27–29 °C), but with a marked thermocline at ~30 m depth. Currents at the surface (<30 m depth) are likely to be flowing in an eastwards direction (average velocity 0.26 $m.s^{-1}$ and maximum velocity 1.03 $m.s^{-1}$), and in a westwards direction in the deeper layers (average velocity of 0.21 $m.s^{-1}$). Tides are semi-diurnal with a diurnal inequality, with a range from 0.4 m to 1.5 m. The bathymetry of the continental shelf off the Ghanaian coastline is generally regular with isobaths running parallel to the coast. The continental shelf is mostly narrow (about 25 km in width) with a marked increase in width to about 80 km off the central Ghana coastline (between Cape Three points and the Delta of the River Volta). The sediment types in the vicinity of the proposed well (outer part of the shelf and upper slope) are likely to be detrital sands with an admixture of carbonate and glauconite-rich sediment mixtures of biogenic carbonate.

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 0.9 m and 1. m. The most common amplitude of waves in the region is 1.0 m but annual significant swells could reach 3.3 m in some instances.

The bathymetry of the survey area is characterized by water depths that range from a minimum of 82 m in the north to a maximum of 1390 m in the south-west part.

7.5.3 Coral Reef

The continental shelf of Ghana's western region is traversed by a belt of dead madreporarian coral from 75 m depth. Beyond this coral belt, the bottom falls sharply, marking the transition from the continental shelf to the slope Soft sediment (mud and sandy mud) predominates along the coast and offshore of the coral belt. The central part of the continental shelf has extensive hard bottom areas, which are widest off Takoradi and Cape Coast and extend eastward. They consist of flat rocks and shoals and are covered by gorgonians, branched corals, and bryozoans (Rijavec, 1980). Mixed gravel and pebble bottoms, on the other hand, are usually covered with corallinaceous algae

7.5.4 Marine Mammals

The following populations of marine mammals pass through or live permanently/seasonally in the area of the project:

Common bottlenose dolphin, Clymene dolphin, Spinner dolphin, Pantropical spotted dolphin, Atlantic spotted dolphin, Long-beaked common dolphin, Fraser's dolphin, Rough-toothed dolphin, Risso's dolphin, Melon-headed whale, Pygmy killer whale, Short-finned pilot whale,

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Killer whale, False killer whale, Cuvier's beaked whale, Dwarf sperm whale, Sperm whale and Humpback whale.

7.5.5 Sea Birds

The west coast of Africa forms an important section of the East Atlantic Flyway, an internationally-important migration route for a range of bird species, especially shore birds and seabirds (Boere et al, 2006, Flegg 2004). A number of species breed in higher northern latitudes winter along the West African coast and many fly along the coast on migration. Seabirds known to follow this migration route include a number of tern species, skuas and petrels.

Species of waders known to migrate along the flyway include sanderling and knott. The highest concentrations of seabirds are experienced during the spring and autumn migrations, around March and April, and September and October. Waders are present during the winter months between October and March. The marine birds of Ghana include storm petrels and Ascension frigatebirds.

During the environmental baseline studies for the West African Gas Pipeline (WAGP, 2004) in 2002/2003, the survey crew recorded several sightings of black tern, White winged black tern, royal tern, common tern, sandwich tern, great black-back gull, lesser blackback gull, pomarine skua and great skua.

There are 40 Important Bird Areas (IBAs) designated by Birdlife International within Ghana located along the coastline of Ghana, namely: Amansuri wetland, Densu Delta (Ramsar Site), Keta Lagoon Complex (Ramsar Site), Muni-Pomadze (Ramsar Site), Sakumo (Ramsar Site) and Songor (Ramsar Site).

According to BirdLife International (2013) in Ghana there are a total of 676 species of birds divided in Landbirds (555 species), Migratory (211 species), Seabirds (15 species) and Waterbirds (120 species).

7.5.6 Sea Turtles

The following populations of sea turtles pass through or live permanently/seasonally in the area of the project: Olive Ridley, Green Turtle, Leatherback Turtle, Hawksbill Turtle, Loggerhead Turtle.

7.5.7 Fish Ecology

The composition and distribution of fish species found in Ghanaian waters, and the wider Gulf of Guinea, is influenced by the seasonal upwelling that occurs between Nigeria and the Ivory Coast mainly in July to September and to a lesser extent in December to February. The rising of colder, dense and nutrient-rich deep waters stimulate high levels of primary

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production (phytoplankton) and consequently this will increases the production of zooplankton and fish.

The fish species find in Ghanaian waters belong to four groups: small pelagic species, large pelagic species (tuna and billfish), demersal (bottom dwelling) species and deep sea species.

The most important pelagic fish species find in the coastal and offshore waters of Ghana are: round sardinella, flat sardinella, European anchovy and chub mackerel. These species are important commercially as they represent approximately 80 percent of the total catch landed in the country. Other pelagic species found in Ghanaian waters include: horse mackerel, little tunny, bonga shad, African moonfish, West African Ilisha, largehead hairtail, crevalle jack, Atlantic bumper and Barracuda.

Large pelagic fish stocks off the coast of Ghana include tuna and billfish. These species are highly migratory and occupy the surface waters of the entire tropical and sub-tropical Atlantic Ocean. The tuna species are: skipjack tuna, yellowfin tuna and bigeye tuna. Billfish species occur in much lower numbers and comprise: swordfish, Atlantic blue marlin and Atlantic sailfish.

Demersal fish are widespread on the continental shelf along the entire length of the Ghanaian coastline. Species composition is a typical tropical assemblage including the following families: Three Porgies or seabreams, Two Grunts, One Croakers or drums, Goatfishes, Snappers, Groupers, Threadfins and Emperors. The demersal species that are most important commercially are cassava croaker, bigeye grunt, red pandora, Angola dentex, Congo dentex and West African Goatfish.

7.5.8 Marine Habitats And Protected Areas

In the marine area affected by the project operations no protected or restricted areas have been highlighted by the desktop study. Ghana has not declared any marine protected area with the exception of Ramsar sites that are all located onshore.

7.5.9 Socioeconomic

Enrichment of coastal waters due to upwelling events is transferred to higher tropic levels and results in productive fisheries in Ghanaian waters. Ghana's coastal zone represents about 6.5% of the land area of the country, yet houses 25% of the nation's population and fishing is the primary economic activity in this zone (Amlalo 2005). It is estimated that 230,000 people in Ghana are employed in the fishing industry; fish protein forms 19% of the populations total protein supply and Ghanaian fish exports were worth some US$78 million in 2000 (http://earthtrends.wri.org 2000). The average annual marine fish catch in Ghana has increased substantially since 1970, reaching nearly 400,000 metric tonnes in 2000.

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The general coastal area of Ghana has heavy shipping traffic, hence proper permitting and diligence during the performance of the development work will be necessary to ensure that there is no disturbance to or from shipping activities.

Tourism is an important yet relatively underdeveloped industry in Ghana in general and along the coastal zone in particular. Although the tourism industry is not yet operating at full potential, it is growing and the country features on travel websites. The most important tourist season is from October to March. Any accidental environmental degradation that impacts on the coast would impact negatively on tourism.

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8. OIL SPILL RISK ASSESSMENT

This risk assessment has been carried out in accordance with the eni Company Risk Register Management (Document Number 1.3.0.05).

8.1 Risk Assessment Methodology

The oil spill risk assessment methodology consists of five key steps and meets the IMO guidance as issued in the Manual on Oil Spill Risk Evaluation and Assessment of Response Preparedness (2010 Edition).

Step 1 **Oil Spill Scenarios**	Identification of potential scenarios that may lead to an accidental release of oil. The source of the spill, event, oil type and volume are considered.
Step 2 **Likelihood and Consequence**	The likelihood and consequence of all oil spill scenarios identified are semi-quantitatively measured in accordance with the eni risk assessment process. Only the likely consequence and impact of the scenario on surrounding environment is considered.
Step 3 **Oil Spill Scenario Impacts**	The potential impact and likely trajectory of an oil spill identified in the oil spill scenarios outlined in the Risk Register has been assessed by conducting oil spill modelling of the potential worst-case scenario as to provide an indication of the likely trajectory of the oil spill. **Refer to:** Oil Spill Modelling, section 8.4. Reviewing the environmental and socioeconomic sensitivities that may be influenced from an oil spill from eni Ghana operations. **Refer to** Environmental and Socioeconomic Sensitivities Section 7.4.
Step 4 **Tiered Response**	The tiered response approach and response technique suitable for each scenario has been defined. Influencing factors include oil type, spill volume, climate, proximity to sensitive resources and response capability. **Refer to** Section 4 for the Tier Level Assessment. **Refer to** Section 5 for Response Strategy Selection.
Step 5 **Risk Assessment Matrix (RAM)**	The risk profile is completed using the RAM. The RAM highlights the scenarios that are deemed low, medium or high risk.

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8.2 Operational Risk Assessment

The Ghana OCTP Block Phase 1 ESHIA, Attachment C, Fisheries Impact Assessment outlines that during the drilling and completion phase there is the potential for spills of fuels and oils during drilling operations, well head installations, fuelling, handling and storage of chemical and fuels including repair, fabrication and maintenance of machinery, as well as from support vessels.

During FPSO installations and operations (offloading), accidental spills may occur from a loss of well integrity, leaks in subsea manifolds, flowlines, riser through which crude oil is pumped into the FPSO. Also the water/oil separation operation in the FPSO has potential to spill produced water and oil. Offloading operations, ship to ship transfers as well as tanker vessels colliding are also key sources of spills of oil into the marine environment.

Evaluating oil spill risks requires consideration of two factors, namely the probability of a spill occurring, and the consequences. The probability was determined by using historical data and referring to eni Ghana's probability and consequence definitions as summarised in Table 19 and Table 20 below.

Table 19 Probability Definitions

Rating	Probability
0	Practically non-credible occurrence (Could not happen in E&P industry)
A	Rare occurrence (heard of in E&P industry)
B	Unlikely occurrence (occurred at least once in Company)
C	Credible occurrence (occurred several times in the Company)
D	Probable occurrence (occurred once in this location)/(occurred several times in the Company)
E	Likely/ Frequent occurrence (occurred several times in one location)

Table 20 Consequence Definitions

Severity		Environment Consequence
1	Slight Effect	Slight environmental damage – contained within the premises.
2	Minor Effect	Minor environmental damage, but no lasting effect.
3	Local Effect	Limited environmental damage that will persist or require cleaning up.
4	Major Effect	Severe environmental damage that will require extensive measures to restore beneficial uses of the environment.
5	Extensive Effect	Persistent severe environmental damage that will lead to loss of commercial, recreational use or loss of natural resources over a wide area.

Potential oil spill scenarios have been identified from the information in the operational overview. Understanding the overall oil spill risk requires these scenarios to be defined in

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terms of the likelihood of occurrence and potential consequences. The likelihood of each scenario has been qualitatively estimated based industry data and experience.

The potential oil spill scenarios for exploration drilling activities and associated operations are summarised in Table 22. The scenarios presented here are indicative only. Not every eventuality can be accounted for; however these represent a broad cross section of possible oil spill scenarios. The credible release quantities given are only an indication and an actual oil spill may vary significantly.

The Gye Nyame 1 well has been excluded from the risk register, as it will be started in 2028.

The sea gas line to the Onshore Receiving Facilities (ORF) has not been taken into account since the carried fluid, whose typical composition is shown in Table 21, is a dry gas at sea bottom environmental conditions (about 80 bar, 4.5 °C) and along the water column, therefore not posing a risk of oil spill.

Table 21 Typical composition of the fluid exported via the sea gas line.

Component	Molar fraction
Nitrogen	0.0043
CO2	0.0044
Methane	0.9117
Ethane	0.0428
Propane	0.0234
i-Butane	0.0034
n-Butane	0.0061
i-Pentane	0.0014
n-Pentane	0.0011
C6*	0.0008
Mcyclopentan	0.0001
Benzene	0.0000
Cyclohexane	0.0001
Mcyclohexane	0.0001
Toluene	0.0000
E-Benzene	0.0000
p-Xylene	0.0000
o-Xylene	0.0000
124-MBenzene	0.0000
C7*	0.0001

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Component	Molar fraction
C19*	0.0000
C20+(SKF_GAS)*	0.0000
C20+(GYN)*	0.0000
C20+(OIL)*	0.0000
H2O	0.0001
TEGlycol	0.0000
EGlycol	0.0000

8.3 Mitigation Measures

Risk management evaluates the risk assessment results and puts in place measures to ensure that identified risks are acceptable or need mitigation measures. Risk reduction measures must be technically feasible and cost effective. The associated costs should not be disproportionate to the benefits gained.

It is eni Ghana's policy that all operations minimize the risk of oil spillage and pollution. eni Ghana, recognizing that spills can occur, implement precautionary measures to reduce the possibility of a spill occurring and minimizing the potential impacts. eni Ghana has put in place the following mitigation measures to reduce the potential for an oil spill to occur and the impact it may have. These include the following measures:

1. Process Safety Management and Training

Personnel who work on for eni Ghana are trained to ensure the prevention of unintentional releases of chemicals, energy, oil or other potentially dangerous materials during the course of operations at any of the facilities. There is focus on ensuring that the design and engineering of the facilities are of the highest quality and standards.

2. Asset Integrity Assurance

There are routine operator inspections, maintenance inspections and internal and external audits. These systems incorporate a number of management processes such as Risk, Safety, Maintenance and Environment management alignment in ensuring identification, reduction and eventually elimination of potential oil spill scenarios within the eni Ghana operations.

3. Process Isolation

Emergency Shut Down (ESD) valves exist offshore at every well head and platform. The ESD system is an integral part of the Combined Safety System (CSS) and executive actions, and provides full alarm and fault status indication as well as valve isolation.

4. Incorporation of Industry Lessons

Process incidents have been widely studied by industry and the lessons learned have been reviewed by eni Ghana to ensure that the recommendations have been understood and considered during the operation of the onshore oil production facilities.

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- The design, installation and verification of barriers are critical and are key factors in operation of onshore processes;
- Secondary and emergency controls systems shall be understood and tested;
- Procedures will be followed on all occasions and not circumvented;
- Deviations and unexpected results are rigorously reviewed and appropriate actions generated;
- Disasters can result from multiple failures which often involve decisions made, actions taken or omitted and effectiveness of barriers;
- Human factors such as complacency represent a significant hazard that is recognized and is mitigated by having in place robust procedures, training and supervision.

5. Emergency Preparedness

eni Ghana have emergency preparedness in place. Detailed in this OSCP are the procedures, training requirements, equipment and agreements for assistance with contractors and other oil companies.

Guidelines for Mitigation Measures *(extracts from the Ghana OCTP Block Phase 1 ESHIA)*

Mitigation Measure	Description
Communications	Environmental issues will be communicated to the workforce on a regular basis. Daily project meetings, which follow a set agenda incorporating Health, Safety and Environmental issues will be held on-board the project vessels and a daily report will be generated and distributed. All staff and sub-contractors involved in all phases of the project will be encouraged to report environmental issues.
Environmental Policy Objectives	Environmental performance will be managed, monitored and improved through the implementation of this Sustainable Environmental Management Plan and associated Operational Control Procedures in accordance with ISO 14001:2004 standard.
Environmental Control & Monitoring	Environmental Control Procedures, Monitoring and Reporting, Environmental Performance Monitoring
Environmental Audit	eni Ghana shall conduct periodic HSE audits (monthly / quarterly / annually, etc) of the oil wells activities in OCTP Development project Area in order to ascertain extent of compliance with policy and regulatory requirements. The audits shall be carried out by certified auditors and in accordance with ISO 14001 guidelines.
Waste Management	All on-board waste discharge, from vessels, will follow the

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	guidelines from MARPOL 73 / 78 for domestic waste discharges to the environment.
Pollution Emergency Procedures	The oil spill contingency plan outlines coordinated and integrated response actions to be implemented in the event of an oil spill. It highlights the roles and responsibilities of key personnel in eni operations and lists equipment and materials available to combat oil spills. The plan is designed to cover the control and removal of any oil spill occurring at any of the facilities operated by eni. On board procedures for pollution prevention and emergency response are laid down in each vessel Shipboard Oil Pollution and Emergency Plan (SOPEP). Details on project specific (oil) pollution combat equipment will be available on-board along with locations of equipment, availability, and contact details for support personnel / services. Each individual vessel will have regard to eni Oil Spill Contingency Plan, which contains detailed procedures to be followed in the event of a pollution emergency.
Safety Philosophy	The Project shall incorporate an Integrated Control and Safety System (ICSS) that shall provide an integrated monitoring, control, protection and safety system for the entire production, topsides, marine, and subsea facilities. The safety systems shall be separate from the Process Control System (PCS).
Safety Shutdown System	In the event that the primary control system fails to keep the process within specified operating limits, separate, dedicated safety systems shall be provided for the safe shutdown of equipment and/or process units. The purpose of these systems shall be; first, to protect personnel from an abnormal condition; second, to protect the environment and equipment from damage; and third, to safely isolate problem areas. An automatic and hierarchical Emergency Shut-Down System (ESD) shall be foreseen on the FPSO including a vessel shutdown system, a topsides shutdown system.

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8.4 Oil Spill Scenarios

Table 22 Potential oil spill scenarios associated with eni Ghana drilling and production operations

#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
OCTP Block, development drilling phase 18 subsea wells (8 oil, 4 gas condensate, 3WI, 3GI), Maersk Voyager Rig																
1	Maersk Voyager Rig	Collision causing full rupture of fuel tank	Diesel or HFO	n/a	6,210	m^3	Diesel spill likely to naturally dissipate, but due to large volume likely to spread over a large area.	B	3	Medium		B	3	Medium	Monitor and evaluate Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
2	Maersk Voyager Rig	Collision causing full rupture of crude oil storage tank	crude	n/a	452	m^3	Sea surface and water column. Could potentially spread over a large area.	B	2	Low		B	2	Low	Monitor and evaluate Offshore containment and recovery	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
3	Maersk Voyager Rig	Collision causing full rupture of OBM tank	Synthetic Oil Based Mud system SBM	n/a	998	m^3	Sea surface and water column. Could potentially spread over a large area.	B	2	Low		B	2	Low	Monitor and evaluate Offshore containment and recovery	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
4	Development drilling	Minor operational or maintenance spills at sea (Lubricant Oil, Base Oil, Hydraulic Oil)	Utility Oils	n/a	<1	m^3	Spill unlikely to have a significant impact due to size, and it would be easily mitigated. Release may not reach with the marine environment if contained on deck	C	1	Low		C	1	Low	Monitor and evaluate	Tier 1: Response vessel with dispersant application system
5	Drilling operations	Operational spill of OBM (low toxicity)	Synthetic Oil Based Mud system SBM	n/a		m^3										
6	Drilling operations - OP-Camp 1 well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	Days 1-5: 22,053 Days 6-30: 9,762 Days 31-94: 7,264	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
7	Drilling operations - OP-Camp 2 well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	Days 1-5: 22,053 Days 6-30: 9,762 Days 31-94: 7,264	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
8	Drilling operations - OP-1 (SKE-2A) well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	8,715	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
9	Drilling operations - OP-1 (SKE-1x) well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	8,715	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
10	Drilling operations - OP-3 well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	8,715	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
11	Drilling operations - OP-4 well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	8,715	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
12	Drilling operations - OP-5 well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	8,715	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
13	Drilling operations - OP-7 well blowout whilst drilling	Blowout causing an uncontrolled release of crude over 95 days	crude	8,715	819,175	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
14	Drilling operations – SNK-D well blowout whilst drilling	Blowout causing an uncontrolled release of gas condensate over 95 days	gas condensate	5,104	484,865	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
15	Drilling operations – SK-2AST well blowout whilst drilling	Blowout causing an uncontrolled release of gas condensate over 95 days	gas condensate	5,104	484,865	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
16	Drilling operations – SKE-C well blowout whilst drilling	Blowout causing an uncontrolled release of gas condensate over 95 days	gas condensate	5,104	484,865	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
17	Drilling operations – SKE-D well blowout whilst drilling	Blowout causing an uncontrolled release of gas condensate over 95 days	gas condensate	5,104	484,865	m^3	Possibility of fire and explosion. Sea surface and water column. High potential for oiling along shoreline.	B	5	High	Develop and maintain a regular training schedule. Develop and maintain a regular emergency drill schedule. Make sure that the equipment is in place and in perfect state of maintenance.	B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
18	Drilling operations	production test release oil to atmosphere (liquid carry over from flare KO drum to flare)	crude	n/a		m^3										
19	Drilling operations - loss of containment	metering skid equipment failure	crude	n/a		m^3										
20	Hawser line failure	overstretching or unintended overstretching of the quick release	crude	n/a		m^3										
21	Drilling operations	Towline failure or breakage		n/a		m^3										
OCTP Block, Production phase 18 subsea wells (8 oil, 4 gas condensate, 3WI, 3GI), FPSO, subsea network with flexible flowlines and risers																
22	FPSO oil storage operations	catastrophic failure due to collision or grounding, leading to rupture of cargo tanks	processed crude	n/a	7,000.0	tons	Sea surface and water column. Potential for oiling along shoreline.	B	3	Medium		B	3	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
23	FPSO oil storage operations	Stored crude oil pumped to the shuttle tanker via an offloading hose	processed crude	n/a		m^3										

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
24	FPSO storage operations	catastrophic failure due to collision or grounding, leading to rupture of cargo tanks	hydraulic oil	n/a		m^3										
25	FPSO storage operations	catastrophic failure due to collision or grounding, leading to rupture of cargo tanks	lube oil	n/a		m^3										
26	FPSO storage operations	catastrophic failure due to collision or grounding, leading to rupture of cargo tanks	diesel	n/a		m^3										
27	FPSO production operations	production operations leading to minor oil spills	crude	n/a		m^3										
28	OP-CAMP, SKE-2A, OP-2 Production Loop	2 x risers and 4 x flowlines 6 inch (3,610m is worst case length) - Human error, corrosion, failure of flowline, loss of containment - worst case scenario	crude	n/a	345	m^3	Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
29	OP-3, OP-4 Production Loop	2 x risers and 2 x flowlines 6 inch (3,500m is worst case length) - Human error, corrosion, failure of flowline, loss of containment - worst case scenario	crude	n/a	345	m^3	Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
30	OP-5, OP-7, SKE-1x Production Loop	2 x risers and 2 x flowlines 6 inch (3,790m is worst case length) - Human error, corrosion, failure of flowline, loss of containment - worst case scenario	crude	n/a	345	m^3	Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
31	SK-D, SKE-D Production Loop	2 x risers and 2 x flowlines 6 inch (3,790m is worst case length) - Human error, corrosion, failure of flowline, loss of containment - worst case scenario	gas condensate	n/a	37.7	m^3	Sea surface and water column. Potential for oiling along shoreline.	B	3	Medium		B	3	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
32	SK-2AST, SKE-C Production Loop	2 x risers and 2 x flowlines 6 inch (3,790m is worst case length) - Human error, corrosion, failure of flowline, loss of containment - worst case scenario	gas condensate	n/a	37.7	m^3	Sea surface and water column. Potential for oiling along shoreline.	B	3	Medium		B	3	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
33	Shuttle tankers moored to FPSO	Collision during operations resulting in rupture and loss of containment from a tank	processed crude	n/a		m^3										
34	Shuttle tankers transferring stored crude from FPSO via offloading hose	Minor flexible hose leak during loading operations.	processed crude	n/a		m^3										
35	Tanker and loading operations	Catastrophic, full bore failure of flexible hose during maximum load rate conditions.	processed crude	n/a		m^3										
36	Production Operations	Condensates produced non associated gas project	gas condensate	n/a		m^3										
37	FPSO fuel tank rupture	catastrophic failure due to collision, leading to rupture of fuel tanks	Diesel	n/a	7,000	tons	Diesel spill likely to naturally dissipate, but due to large volume likely to spread over a large area.	B	4	Medium		B	4	Medium	Monitor and evaluate Offshore containment and recovery	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
38	Platform Supply Vessel	Loss of entire inventory due to collision or grounding	Diesel or HFO	n/a	1,000	m^3	Diesel spill likely to naturally dissipate, but due to large volume likely to spread over a large area.	B	2	Low		B	2	Low	Monitor and evaluate Offshore containment and recovery	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources
39	Production Operations	Malfunction of produced water clean up facilities allowing high crude concentration in effluent.	processed crude	n/a		m^3										

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
40	Production Operations	Isolatable loss of containment from topsides equipment (e.g. Production Separator).	processed crude	n/a		m^3										
41	Production Operations	Non- isolatable loss of containment from FPSO	processed crude	n/a		m^3										
42	Production Test	Uncontrolled release to the environment	crude	n/a		m^3										
43	Production operations - OP-Camp 1 well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
44	Production operations - OP-Camp 2 well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
45	Production operations - OP-1 (SKE-2A) well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
46	Production operations - OP-1 (SKE-1x) well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
47	Production operations - OP-3 well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
48	Production operations - OP-4 well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
49	Production operations - OP-5 well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
50	Production operations - OP-7 well	Loss of well control and uncontrolled release to the environment	crude	121	3,641	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
51	Production operations – SK-D well	Loss of well control and uncontrolled release to the environment	gas condensate	216	6,482	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
52	Production operations – SK-2AST well	Loss of well control and uncontrolled release to the environment	gas condensate	216	6,482	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
53	Production operations – SKE-C well	Loss of well control and uncontrolled release to the environment	gas condensate	216	6,482	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
54	Production operations – SKE-D well	Loss of well control and uncontrolled release to the environment	gas condensate	216	6,482	m^3	Possibility of fire and explosion. Sea surface and water column. Potential for oiling along shoreline.	B	4	Medium		B	4	Medium	Monitor and evaluate Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources Tier 3: OSRL Tier 3 resources
GENERIC OFFSHORE OPERATIONS																

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
55	Development / Production Operations	Minor operational or maintenance spills at sea (Lubricate Oil, Base Oil, Hydraulic Oil)	Utility Oils	n/a	<1	m^3	Spill unlikely to have a significant impact due to size, and it would be easily mitigated. Release may not reach with the marine environment if contained on deck	C	1	Low		C	1	Low	Monitor and evaluate	Tier 1: Spill kits
56	Development / Production Operations	Minor diesel spills during fuel transfer operations	Diesel	n/a	<1	m^3	Likely to naturally dissipate quickly	C	1	Low		C	1	Low	Monitor and evaluate	Tier 1: Spill kits
57	Development / Production Operations	Major spills during fuel transfer operations – Full flow release of diesel due to rupture of transfer hose	Diesel	n/a	<50	m^3	Diesel spill likely to naturally dissipate, but due to large volume likely to spread over a large area. Exact volume depends on shut down time	B	2	Low		B	2	Low	Monitor and evaluate Assisted natural dispersion	Tier 1: Spill kits
58	Development / Production Operations	Towing Supply Vessel incident resulting in total loss of fuel oil	Diesel	n/a	1191	m^3	Diesel spill likely to naturally dissipate quickly, but due to large volume likely to spread over a large area. Exact volume depends on vessel	B	3	Medium		B	3	Medium	Monitor and evaluate Assisted natural dispersion Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources
59	PSV	Collision/grounding/structural failure, resulting in loss of fuel	Diesel	n/a	1000	m^3	Diesel spill likely to naturally dissipate. Due to large volume likely to spread over a large area. Exact volume depends on type of vessel	B	3	Medium		B	3	Medium	Monitor and evaluate Assisted natural dispersion Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources
60	Aircraft/Vessel transfer	Crew transfer vessel/aircraft incident resulting in loss of fuel oil	Diesel, Jet A-1	n/a	10	m^3	Diesel/Jet A-1 spill likely to naturally dissipate quickly	B	2	Low		B	2	Low	Monitor and evaluate Assisted natural dispersion	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources
NEARSHORE OPERATIONS																
61	PSV - crew transfer vessel	Minor fuel spill	Diesel	n/a	<1	m^3	Likely to naturally dissipate quickly	C	1	Low		C	1	Low	Monitor and evaluate Assisted natural dispersion	Tier 1: Spill kits

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#	Source	Event	Oil Type	Well Flowrate (m^3/day)	Spill Volume (Total)	unit	Impact	Likelihood	Consequence	Risk	Mitigation	Likelihood	Consequence	Risk	Response Actions	Tiered Resources
62	PSV - crew transfer vessel incident	Collision/grounding/structural failure, resulting in loss of fuel	Diesel	n/a	10-1,191	m^3	Diesel spill likely to naturally dissipate. Due to large volume likely to spread over a large area. Exact volume depends on type of vessel	B	3	Medium		B	3	Medium	Monitor and evaluate Assisted natural dispersion Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources
63	PSV - crew transfer vessel incident	Collision/grounding/structural failure, resulting in loss of utility oils	Lubricant / Base / Hydraulic Oils	n/a	<1000	m^3	Spill likely to have a significant impact due to size, and it would be easily mitigated. Exact volume depends on type of vessel	B	3	Medium		B	3	Medium	Monitor and evaluate Assisted natural dispersion Dispersant application if conditions allow Offshore containment and recovery Shoreline protection and clean-up	Tier 1: Response vessel with dispersant application system Tier 2: Additional resources

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8.4.1 Risk Assessment Matrix

The matrix used for the qualitative assessment is based on the concept of applying experience of events in the oil and gas industry and the statistical incidents rates of the operations (the oil spill scenarios are defined in Table 22):

- The vertical axis represents increasing consequences (severity levels 1 to 5) in terms of harm to people, effect on the environment, damage to assets and impact on reputation (PEAR categories);
- The horizontal axis represents increasing likelihood (levels 0 to E) of the consequence under consideration;
- Boxes in the matrix represent levels of risk, increasing from top left to bottom right corners of the matrix;
- The matrix is divided into green, yellow and red areas to illustrate the increasing level of risk.

Table 23 shows the risk assessment matrix neglecting the effects of the mitigation actions planned.

Table 23 Risk Assessment Matrix - Before mitigation actions.

Severity	Consequence	Probability					
		0	A	B	C	D	E
1	Slight Effect				4, 55, 56, 61		
2	Minor Effect			2, 3, 38, 57, 60			
3	Local Effect			1, 22, 31, 32, 58, 59, 62, 63			
4	Major Effect			28 ÷ 30, 37, 43 ÷ 54			
5	Extensive Effect			6 ÷ 17			

Key Colour

Low Risk Medium Risk High Risk

The risk assessment matrix shows that relatively small spills are the most likely to occur whereas larger spills become increasingly unlikely to occur and major spill events, such as

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vessel collisions and blowouts would only be expected less often. Statistically the most likely spills are small operational type spillages, for example those occurring during routine maintenance operations, re-fuelling and transfer hose during oil unloading operations.

Table 24 shows the revised risk assessment matrix, considering the risk reduction due to the effects of the mitigation actions planned.

Table 24 Risk Assessment Matrix - After mitigation actions.

Severity	Consequence	Probability					
		0	A	B	C	D	E
1	Slight Effect			3	4, 55, 56, 61		
2	Minor Effect			2, 3, 38, 57, 60			
3	Local Effect			1, 22, 31, 32, 58, 59, 62, 63			
4	Major Effect			6 ÷ 17, 28 ÷ 30, 37, 43 ÷ 54			
5	Extensive Effect						

Key Colour

Low Risk Medium Risk High Risk

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8.5 Oil Spill Modelling

Oil spill modelling has been conducted to predict where impact may occur for certain scenarios identified in the risk assessment. It is used to predict and assess where an oil spill may impact for defined time periods and is useful to help plan response strategies and response actions. Oil spill modelling is a decision support tool and not a decision-making tool and should be backed-up with aerial surveillance during a response.

8.5.1 Oil Spill Modelling Scenarios

Oil spill modelling was done at Eni using SINTEF's Oil Spill Contingency And Response (OSCAR) software. Oil spill computer modelling predicts the fate and effect of oil in the environment. In this risk assessment two types of modelling using the OSCAR model have been utilised.

Deterministic modelling is used to predict the route of a hydrocarbon slick over time, and to estimate the oil weathering profile, under specific meteorological conditions. It investigates potential beaching under a constant (worst case) wind speed and direction.

Stochastic modelling is used to estimate the likelihood of particular trajectories occurring, based on historical wind speed and direction data. This is then calculated to provide a probability range of oiling representative of the prevailing conditions.

Six reference scenarios have been identified (see the document: *"Ghana OTCP Block. Hazard Identification for Oil Spill Analysis"*), two for each of the three response Tiers. Such an approach covers a wide range of events, as a combination of different release points, spill duration, oil characteristics, and total volume spilt. Among each response Tier, the most probable (i.e. highest frequency) and the most severe (i.e. largest volume spilt) have been simulated as worst cases.

Two additional diesel spill scenarios have been simulated, covering diesel spills from impacts involving the FPSO or a supply vessel.

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8.5.1.1 Tier 3 Scenarios

To represent possible Tier 3 oil spills, the following three scenarios have been simulated:

- **Most severe case**: blowout through the main bore and atmospheric discharge from the OP-Camp1 well. This is not only due to the total volume of oil that could be released (due to lack of backpressure of the water-column), but also from the point of view of the potential slick, since the oil does not disperse into the water, while rising from the seabed to the sea surface.
- **Most probable case**: blowout through the main bore and atmospheric release from the OP5-Cenom well. Again, the lack of water backpressure and dispersion into seawater maximize the volume spilt.
- **Diesel spill from FPSO**: diesel release from FPSO fuel tank due to collision with another vessel.

8.5.1.2 Tier 2 Scenarios

To represent possible Tier 2 oil spills, the following two scenarios have been simulated:

- **Most severe case**: topside (atmospheric release at FPSO) leak from an oil-producing riser through a 70 mm hole.
- **Most probable case**: release at seabed from an oil-producing flowline through a 22 mm hole.
- **Diesel spill from Supply vessel**: diesel release from a supply vessel fuel tank due to collision with another ship.

8.5.1.3 Tier 1 Scenarios

To represent possible Tier 1 oil spills, the following two scenarios have been simulated:

- **Most severe case**: leak from a condensate-producing riser in shallow water under the FPSO, resulting from complete breakage of the riser.
- **Most probable case**: release at seabed from a condensate-producing flowline through a 70 mm hole.

The exact characteristics of Campanian and Cenomanian crudes do not exist in the OSCAR modelling database, therefore a match has been made within OSCAR using intermediate values for the API and specific gravity. 'STÆR 2010, 5C' crude has an API of 31.7 and specific gravity of 0.867 has been subsequently used for modelling purposes. For the gas condensate releases the fluid 'TRYM KONDENSAT, 13C, 2011' (45.7 °API, SG: 0.798) has been used. Diesel spills have been simulated with the fluid 'MARINE DIESEL' (36.4 °API, SG:0.843)

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Table 25 summarizes the modelling parameters OSCAR has been fed with. For the Tier 3 most severe case (atmospheric blowout from OP-Camp1 well) the modelling was performed taking into account well depletion and the flowrate has been therefore declining over time. Days 0-5 were modelled with a flowrate of 22,053 m^3/day, days 6-30 were modelled with a flowrate of 9,762 m^3/day and days 31-94 were modelled with a flowrate of 7,264 m^3/day.

OSCAR blowout scenarios have been simulated, both in the stochastic and in the deterministic approach, assuming a release duration of 95 days (the maximum period necessary to bring the well under control), and for a further 25 days after the source had stopped discharging in order to examine the full extent of the fate of the oil in the marine environment. For the same reason, the fate of leaks from risers and flowlines, having a duration of approximately 1-2 hours, have been modelled for 30 days.

Modelling has been carried out with the assumption that no intervention measures have been implemented on the spill after the release.

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Table 25 OSCAR modelling parameters

Tier	Case	Release site	Phase	°API	Latitude (WGS84)	Longitude (WGS84)	Release Depth	Release duration	Simulation duration (days)	Volume spilt (m^3)
Tier 3	Most severe	OP-Camp1	Drilling	31.7	4°28’28.52’’ N	2°36’39.12’’ W	Sea level	95 d	120	819,175
	Most probable	OP5	Completion	31.7	4°28’25.33" N	2°30’19.64’’ W	Sea level	95 d	120	121,311
	Diesel spill	FPSO	Production	36.4	4°28’9.68’’ N	2°33’12.14’’ W	Sea level	2 h	45	8,304
Tier 2	Most severe	OP riser @ FPSO	Production	31.7	4°28’9.68’’ N	2°33’12.14’’ W	Sea level	2 h	30	329.9
	Most probable	OP flowline @ seabed	Production	31.7	4°28’9.68’’ N	2°31’2.34’’ W	Seabed	2 h	30	230.9
	Diesel spill	Supply vessel	Production	36.4	4°28’9.68’’ N	2°33’12.14’’ W	Sea level	2 h	45	1,000
Tier 1	Most severe	GP riser in shallow water	Production	45.7	4°28’9.68’’ N	2°33’12.14’’ W	100 m	1 h	30	37.7
	Most probable	GP flowline @ seabed	Production	45.7	4°28’42.27’’ N	2°33’44.57’’ W	Seabed	1 h	30	30.8

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8.5.2 Stochastic Modelling Output

The results of the stochastic modelling are detailed in the following sections. For each Tier and for each scenario, the following statistical maps are given:

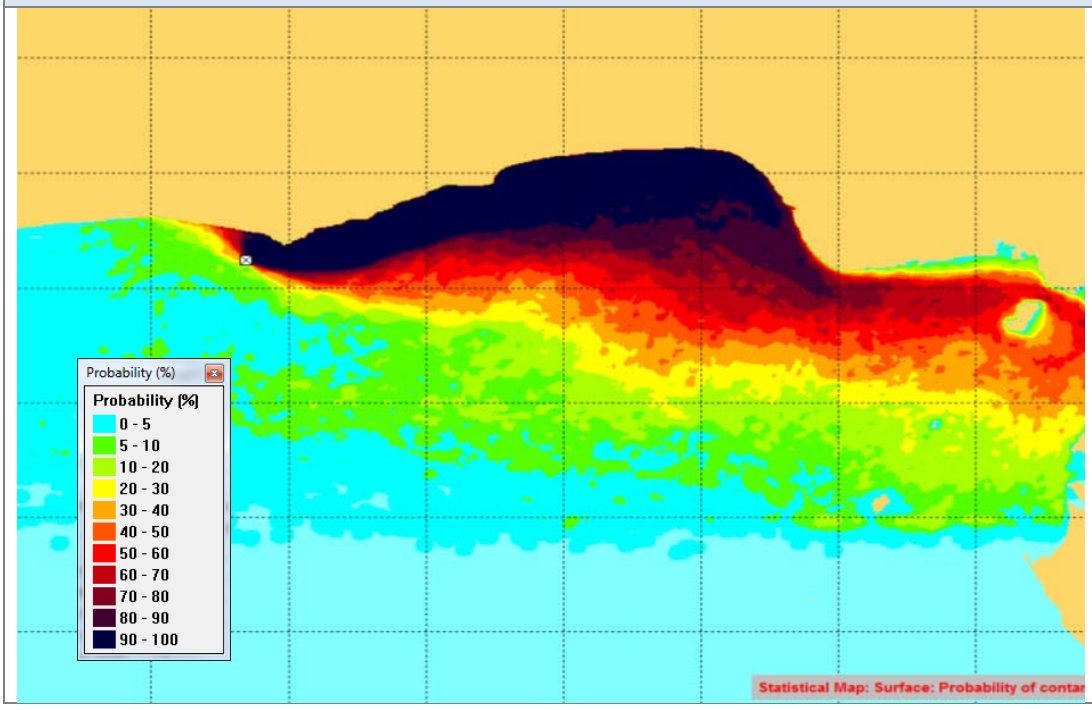
- Probability of contamination, offshore;
- Probability of contamination, ashore;

8.5.2.1 Tier 3 Scenarios

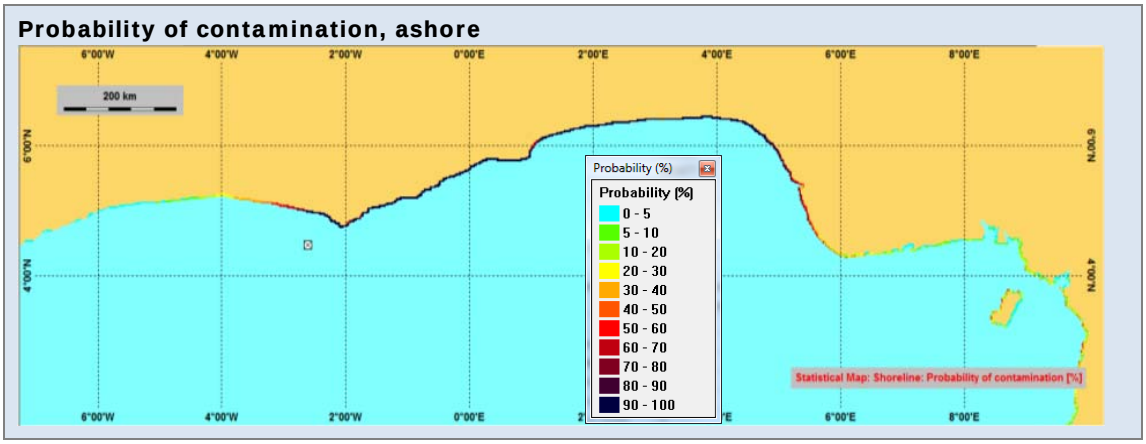
Most severe scenario: atmospheric blowout from OP-Camp1 well.

Table 26 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. The probability of contamination is more than 90% from 3° W (West of Cape Three Points) to 5° E, then decreases. The maximum thickness of the emulsion of oil expected in this length of shore is approximately 10-11 cm. The same pattern in shown also by stranded oil.

Table 26 Stochastic simulation. Tier 3 – most severe scenario. Probability of contamination

Probability of contamination, offshore


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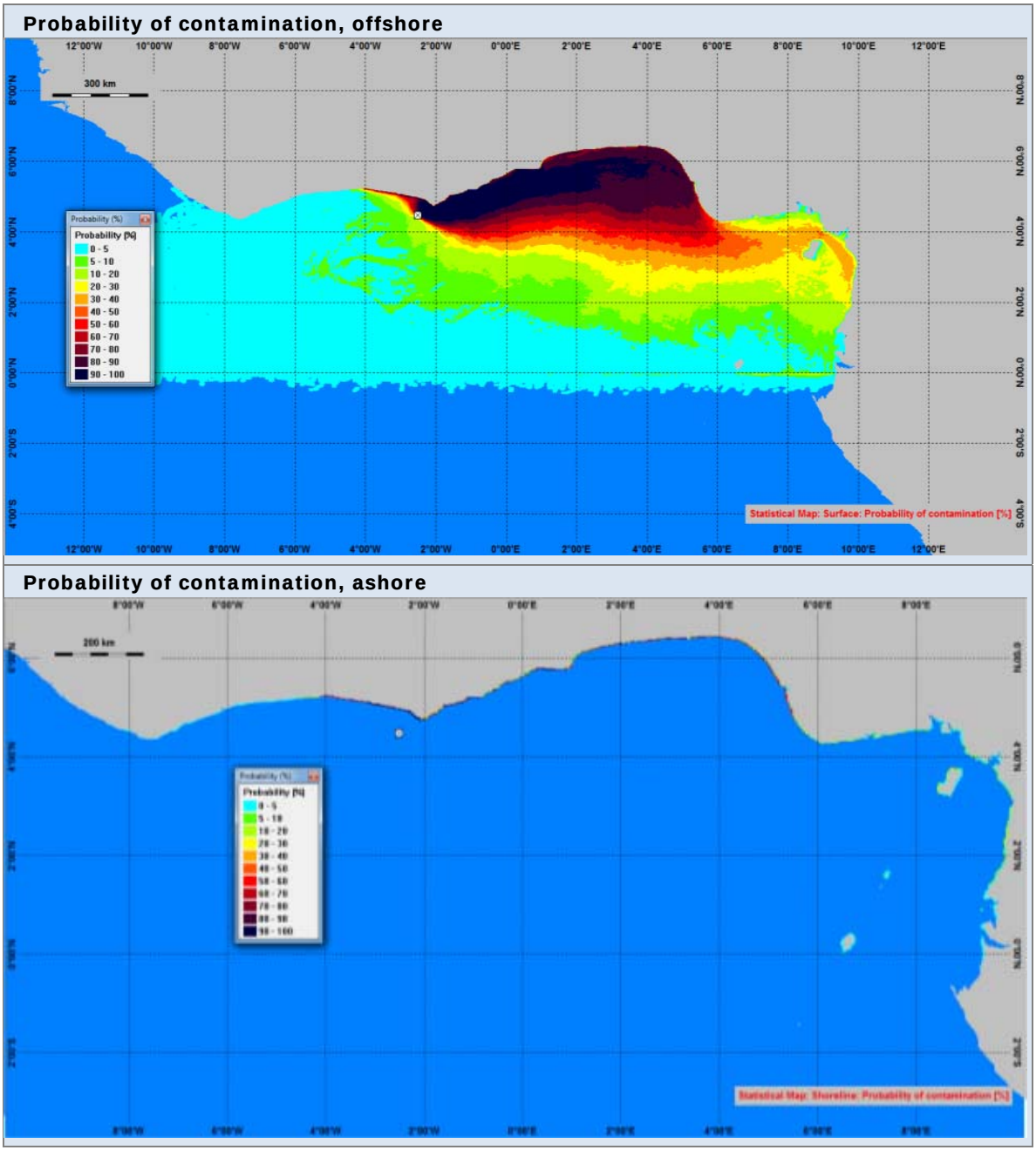


Most probable scenario: atmospheric blowout from OP5 well.

Table 27 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. Released oil, driven by wind and marine currents, drifts mainly eastwards, giving an area in which the probability of contamination is over 90 % off the coasts of Ghana, Togo, Bénin and Nigeria.

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Table 27 Stochastic simulation. Tier 3 – most probable scenario. Probability of contamination

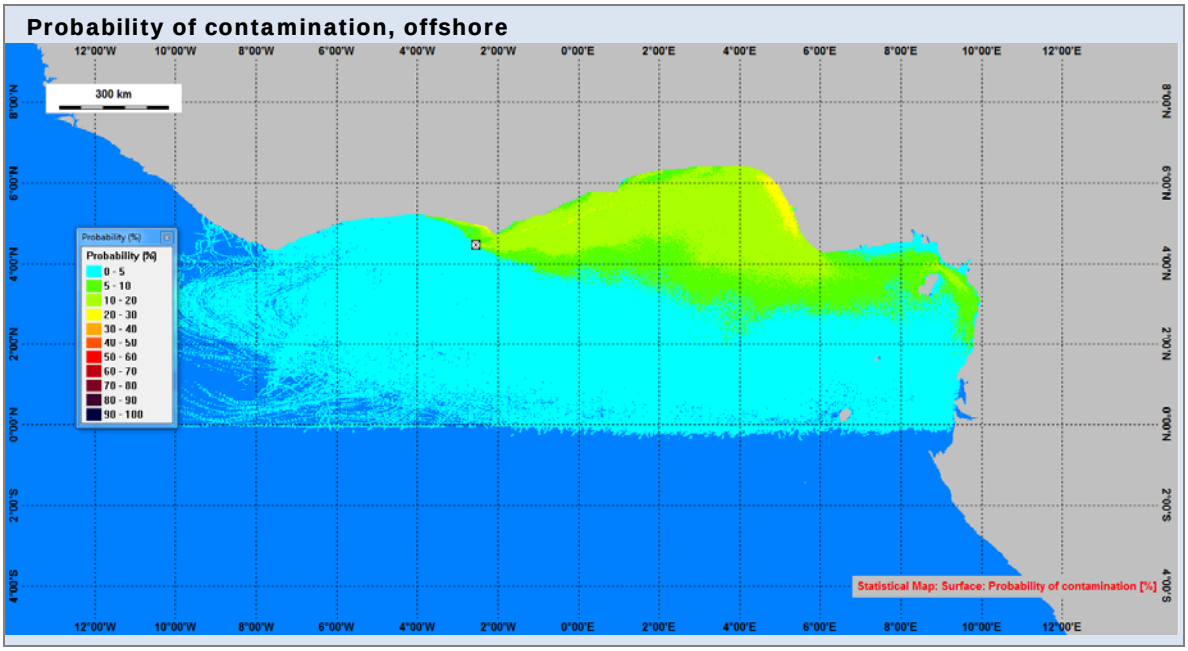


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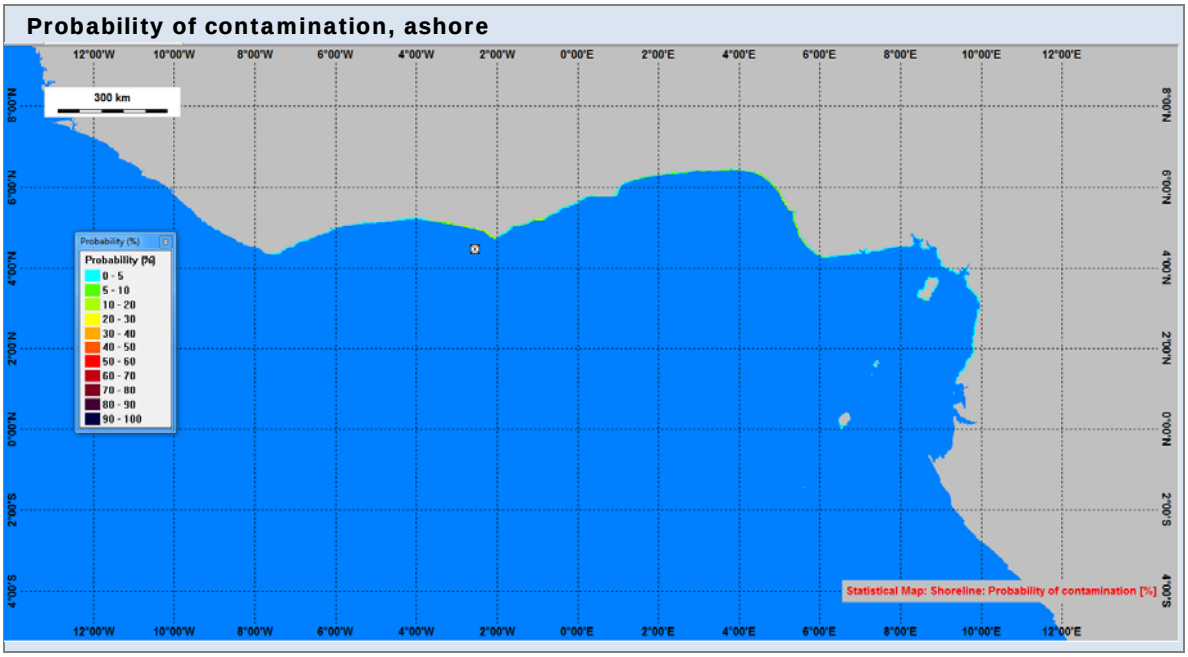
Diesel spill: diesel spill from FPSO following an impact.

Table 28 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. Released oil, driven by wind and marine currents, drifts mainly eastwards, reaching a maximum probability of contamination of 30 %.

Table 28 Stochastic simulation. Tier 3 – diesel spill. Probability of contamination



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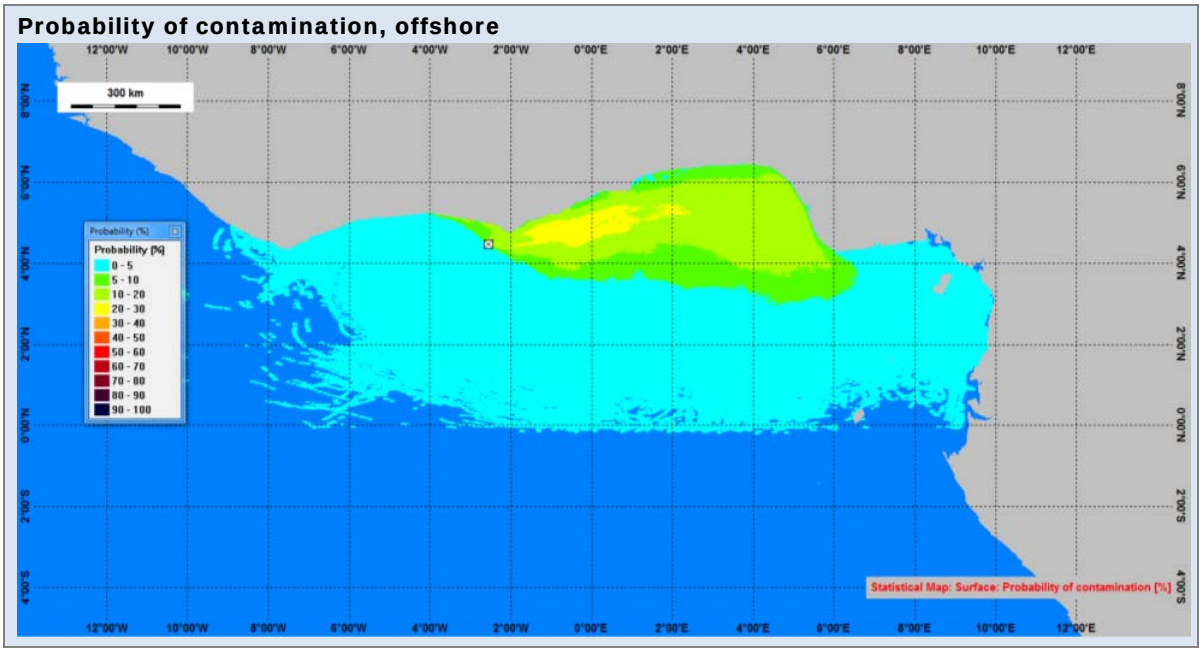
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8.5.2.2 Tier 2 Scenarios

Most severe scenario: OP leak from riser at FPSO.

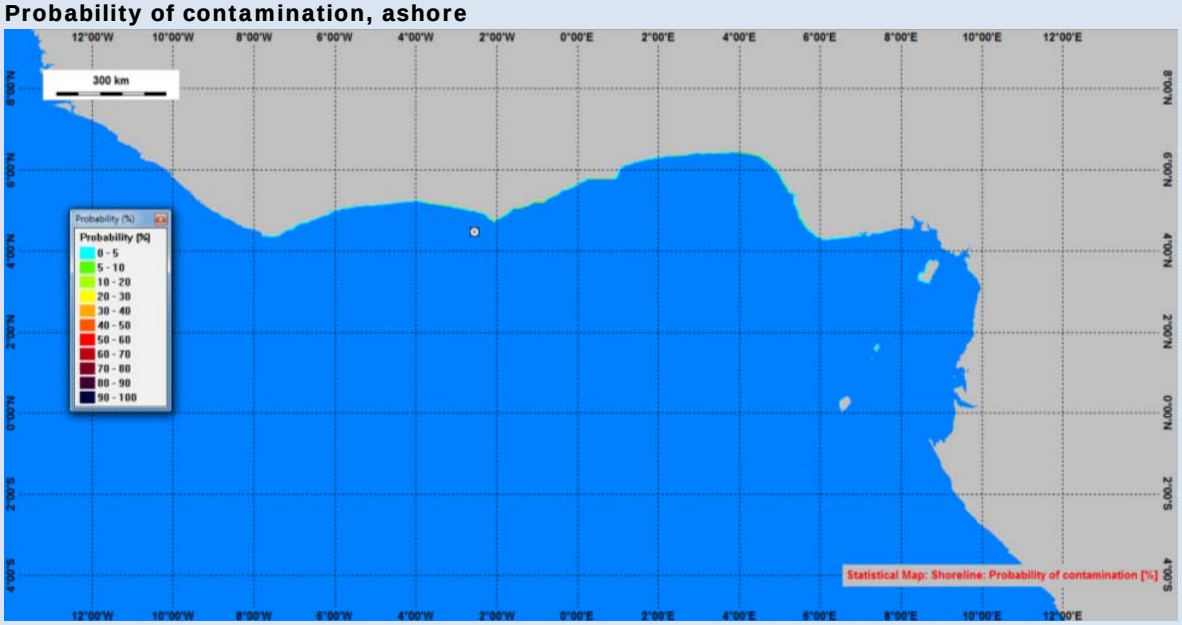
Table 29 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. Released oil, driven by wind and marine currents, drifts mainly eastwards and, given the volume of oil released, the sea surface probability of contamination does not exceed 30 %. The probability of contamination ashore is expected to be lower than 20 %.

Table 29 Stochastic simulation. Tier 2 – most severe scenario. Probability of contamination



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Probability of contamination, ashore

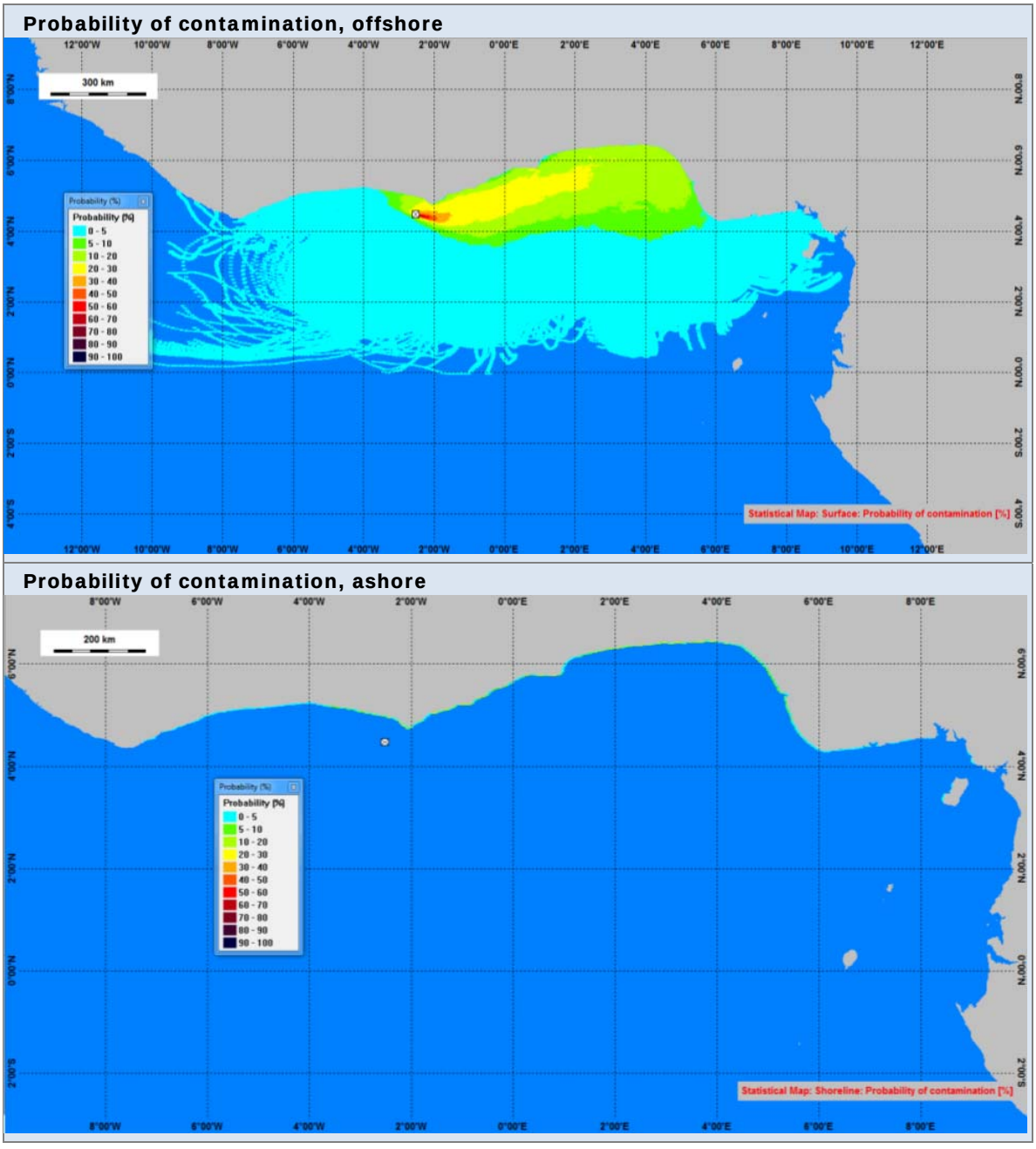


Most probable scenario: OP flowline leak at seabed.

Table 30 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. Released oil, driven by wind and marine currents, drifts mainly eastwards and, given the volume of oil released, the sea surface probability of contamination near the shore ranges between 0 and 30 %. The probability of contamination ashore is predicted to be lower than 20 %.

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Table 30 Stochastic simulation. Tier 2 – most probable scenario. Probability of contamination

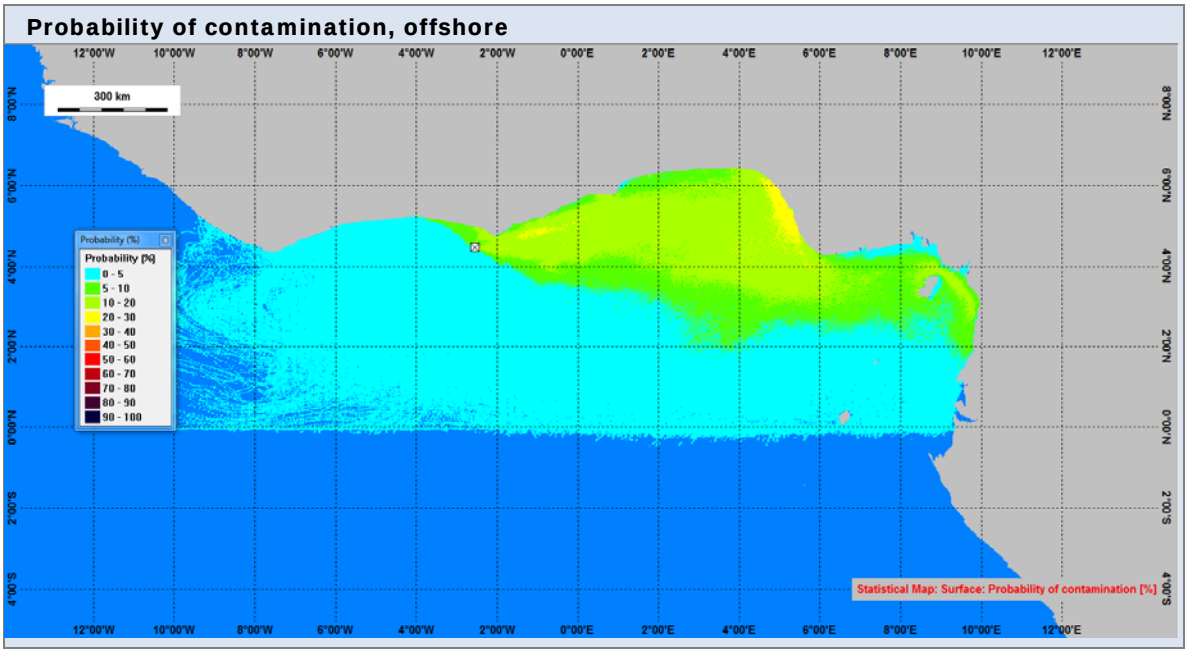


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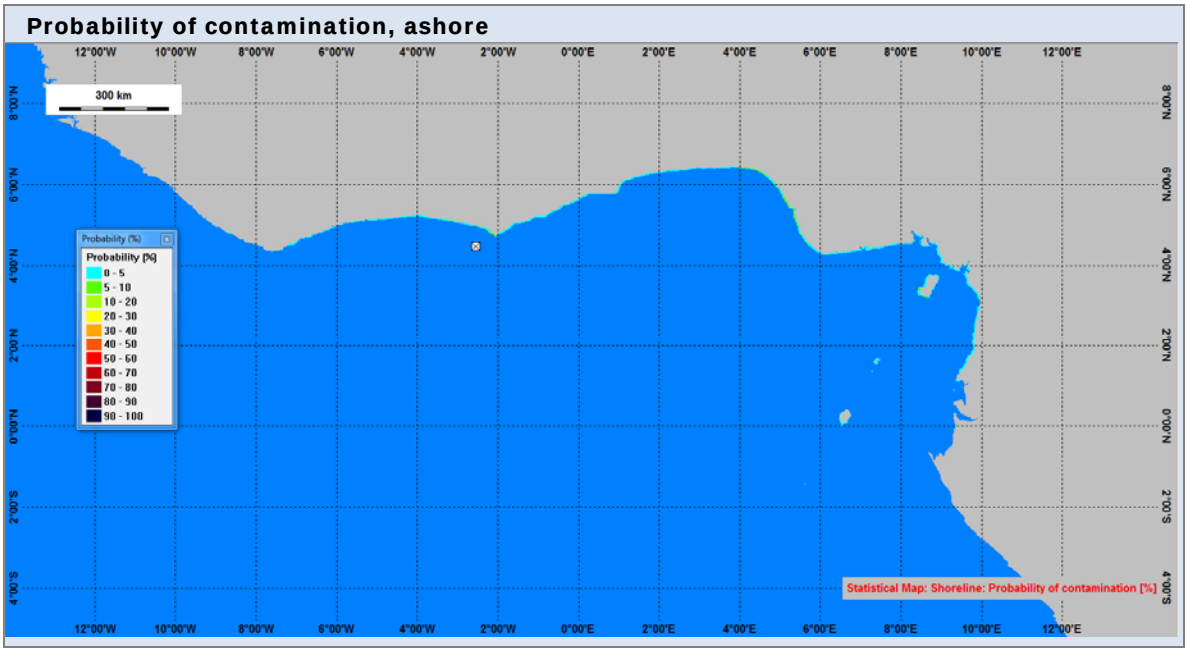
Diesel spill: diesel spill from a supply vessel following an impact.

Table 31 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. Released oil, driven by wind and marine currents, drifts mainly eastwards, reaching a maximum probability of contamination of 30 %.

Table 31 Stochastic simulation. Tier 2 – diesel spill. Probability of contamination



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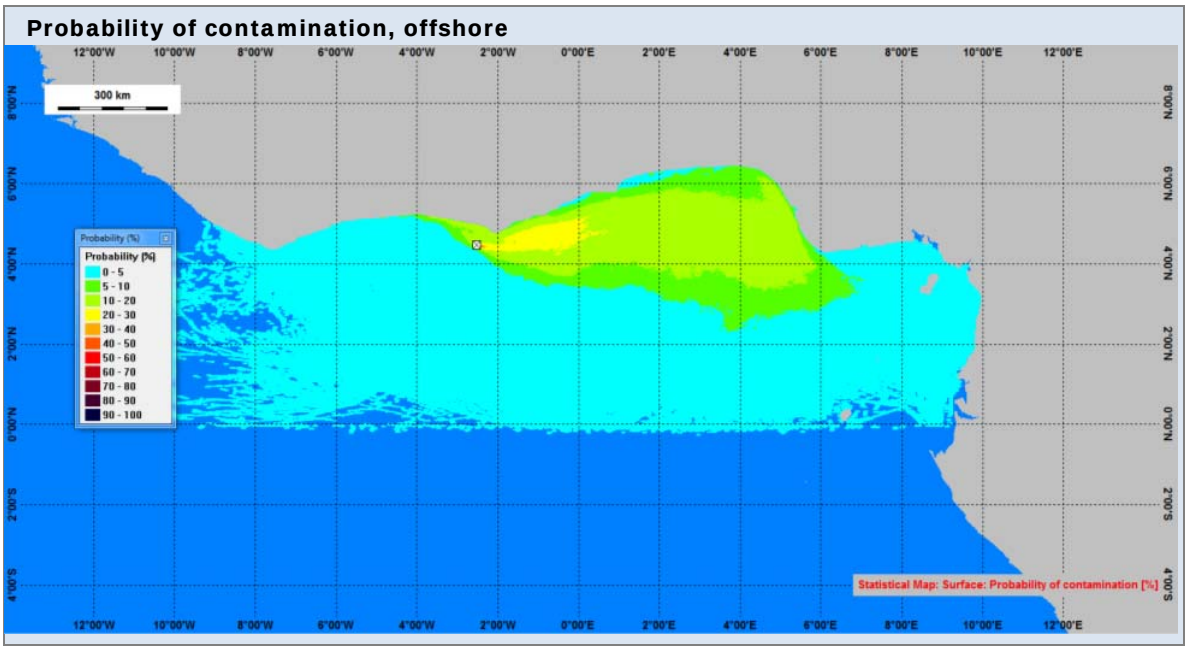
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8.5.2.3 Tier 1 Scenarios

Most severe scenario: GP riser leak in shallow water.

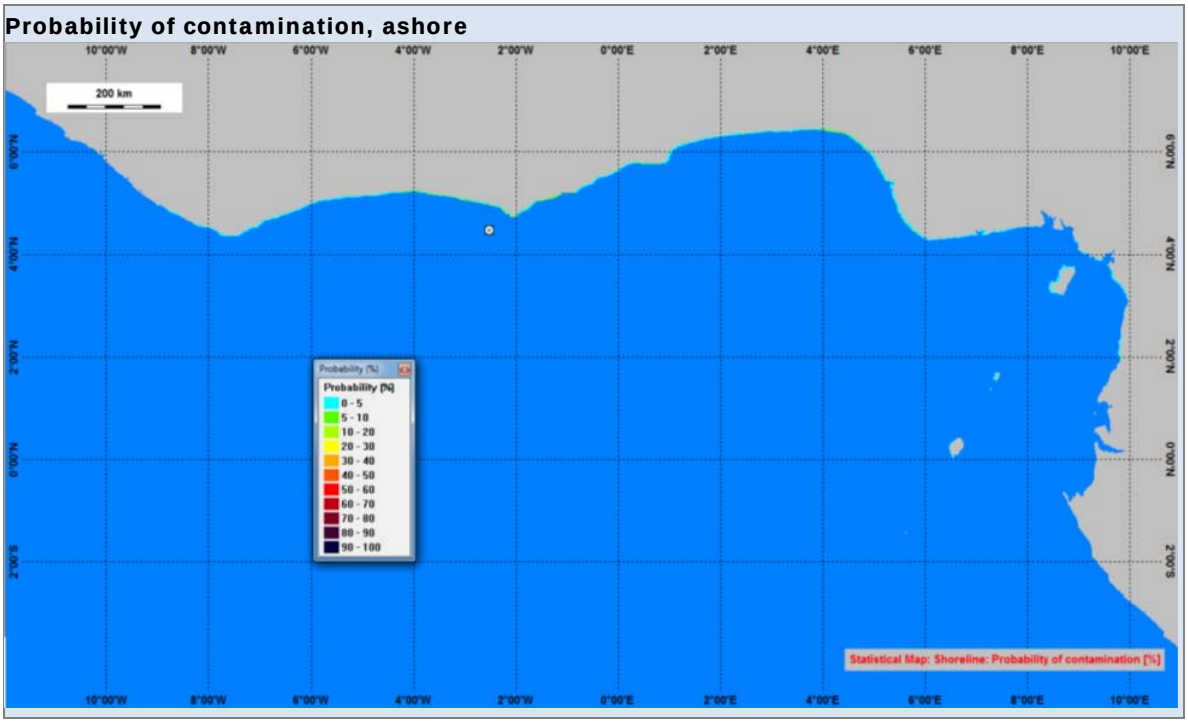
Table 32 shows the probability of contamination from oil on the sea surface and from condensate stranded ashore. The area of probability of sea surface contamination over 30 % is located approximately 50 km away from the coastline and the probability of condensate reaching close proximity to the coast is less than 20 %.

Table 32 Stochastic simulation. Tier 1 – most severe scenario. Probability of contamination



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Probability of contamination, ashore

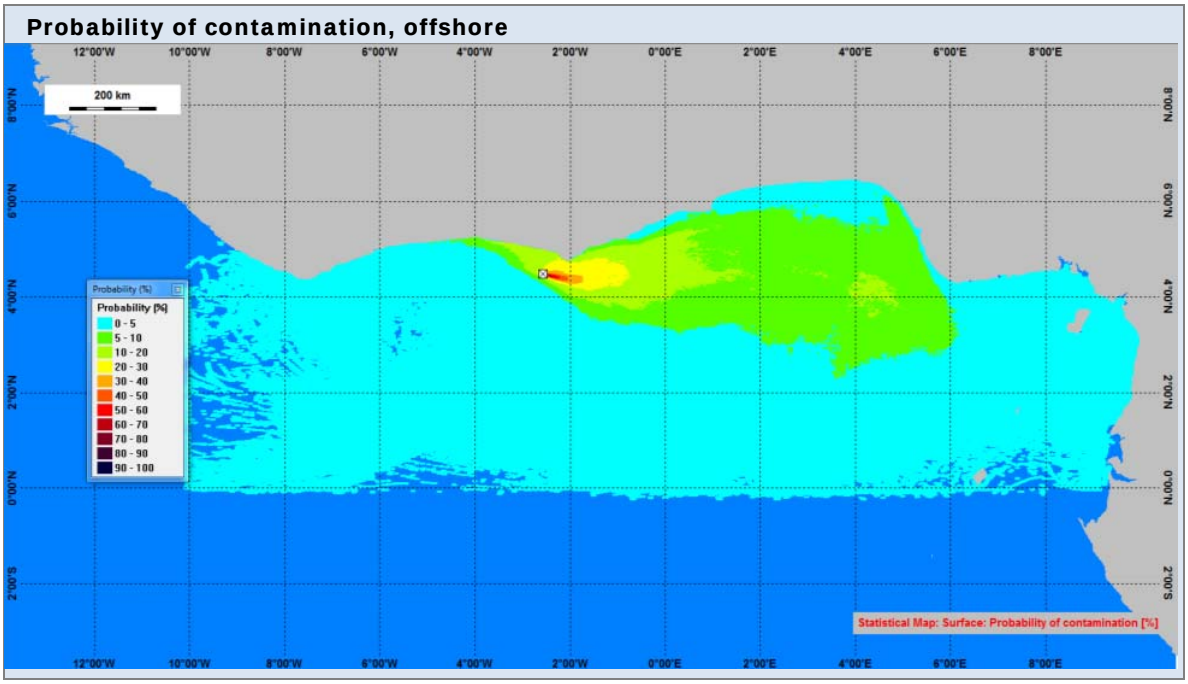


Most probable scenario: GP flowline leak at seabed.

Table 33 shows the probability of contamination from oil on the sea surface and from oil stranded ashore. Gas condensate, released at seabed, is primarily driven by marine currents, and drifts underwater eastwards, leading to a lower probability of sea surface contamination near the shore than in other scenarios. The probability of gas condensate reaching the shore is lower than 20 %.

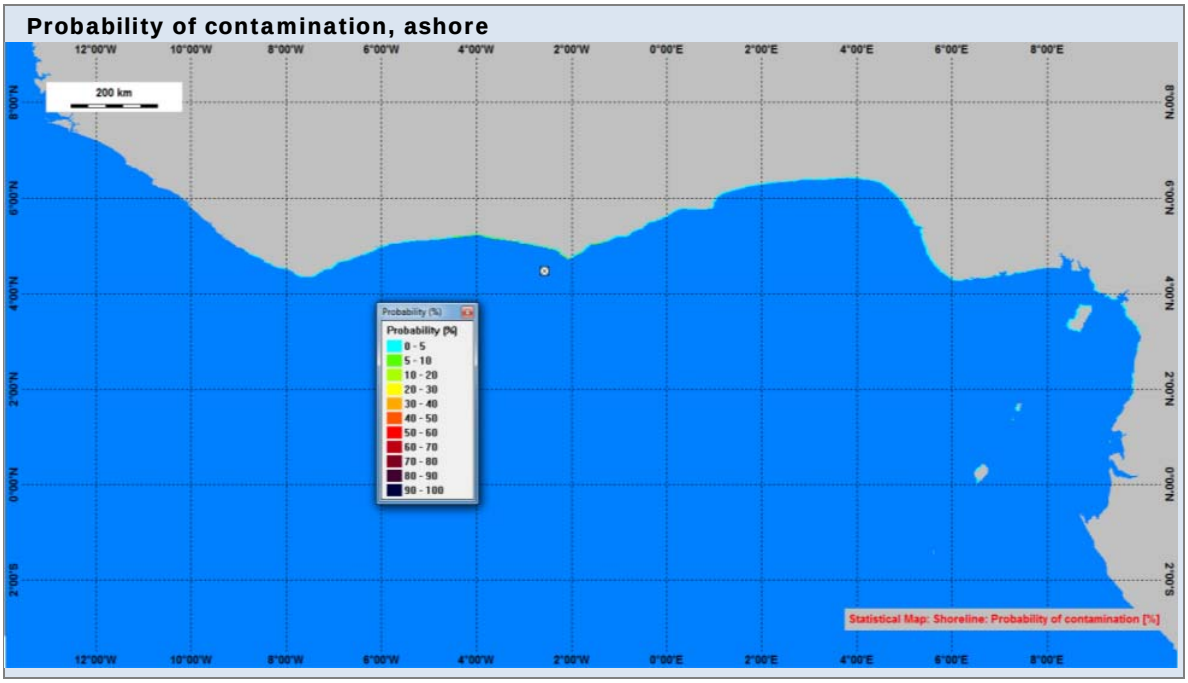
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Table 33 Stochastic simulation. Tier 1 – most probable scenario. Probability of contamination



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Probability of contamination, ashore



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8.5.3 Trajectory Modelling Output

The results of the trajectory (deterministic) modelling are detailed in the following sections. The modelling of a release scenario under specific metocean conditions defines an event. For each Tier and for each scenario, two events have been simulated:

- The event leading the maximum mass of oil ashore;
- The event having the minimum time for oil to get ashore;

For each of the two events, trajectory maps are presented, showing respectively the picture at the end of the simulation and at the time the first oil reaches the coastline. Furthermore, for the most severe scenario among each Tier, a chart of the fates of oil through time is shown.

The results of the Tier 3 most severe scenario (the overall most severe scenario) have been further detailed, giving a sort of time-lapse of the oil fate throughout the simulated period.

8.5.3.1 Tier 3 Scenarios

Most severe scenario: atmospheric blowout from OP-Camp1 well.

Table 34 and Table 35 show the fates of oil in the events simulated, respectively:

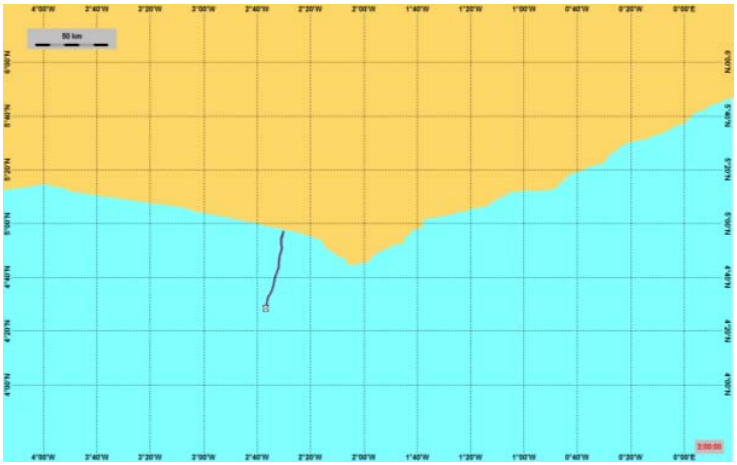
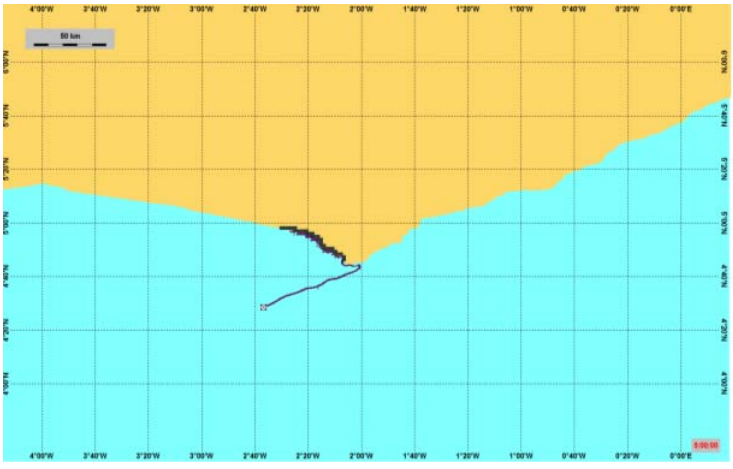
Maximum amount of oil ashore;

Minimum time for oil to get ashore.

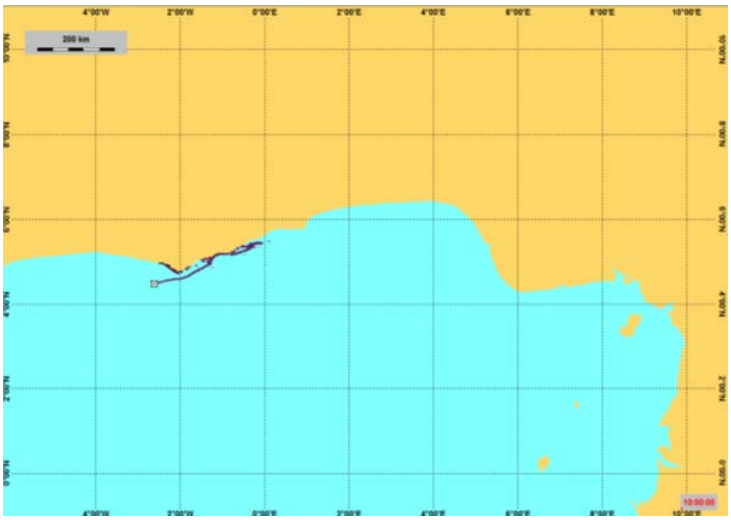
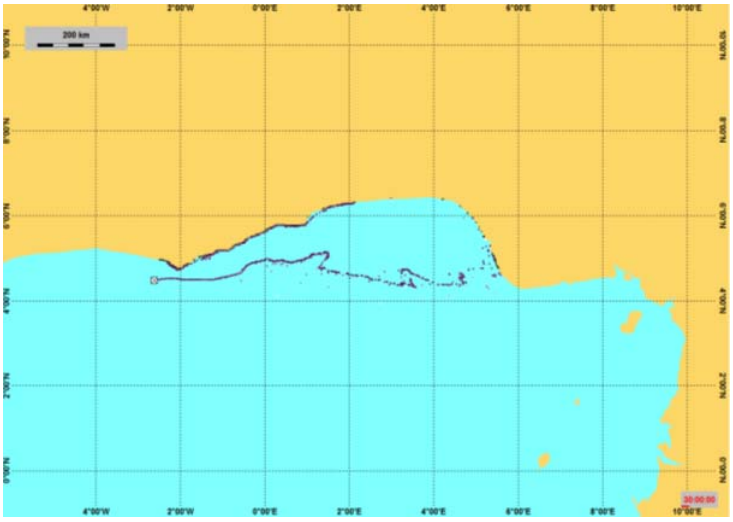
The maximum amount of oil ashore, after 120 days, is 63960 tons, while 35.2% evaporates, 33.2% remains on the surface of the ocean and the remaining oil is in the water column or biodegrades. Figure 8 shows the fate of the oil.

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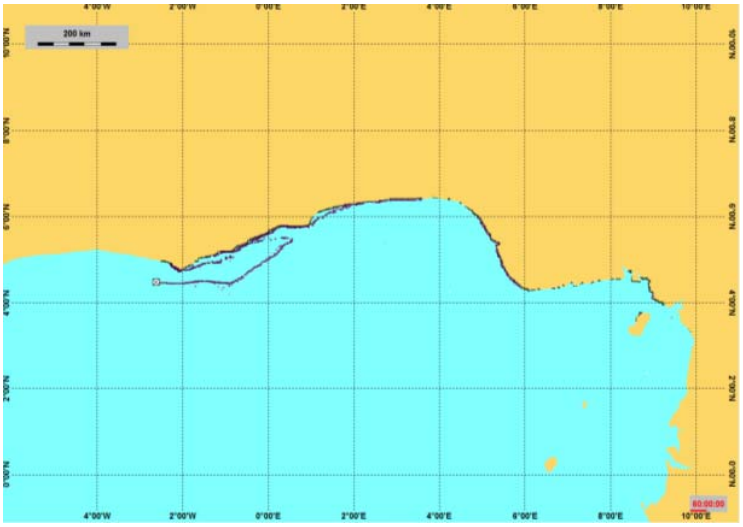
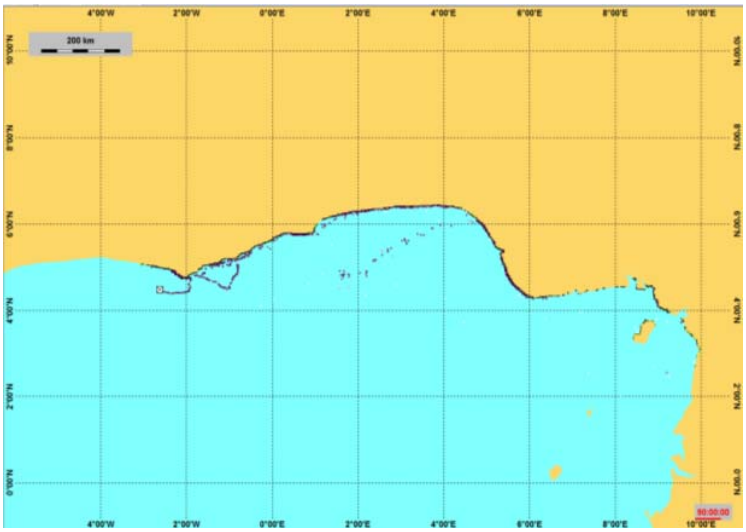
Table 34 Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)

Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
Situation	The evolution of the slick in the case of a maximum amount of oil ashore is shown in the following series of modeling results. The affected shore is from 3°W to the estuary of Gabon, if no response actions are undertaken.
48 hrs (first shoreline oiling)	
5 days (arrival of oil to the Keta Lagoon)	

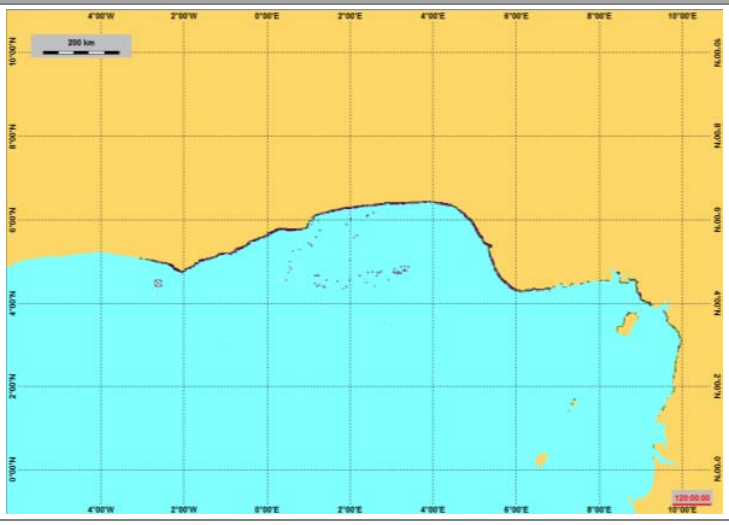
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Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
10 days (oil spreading towards Togo)	
30 days	

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Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
60 days	
90 days (end of spill)	

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Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
120 days	

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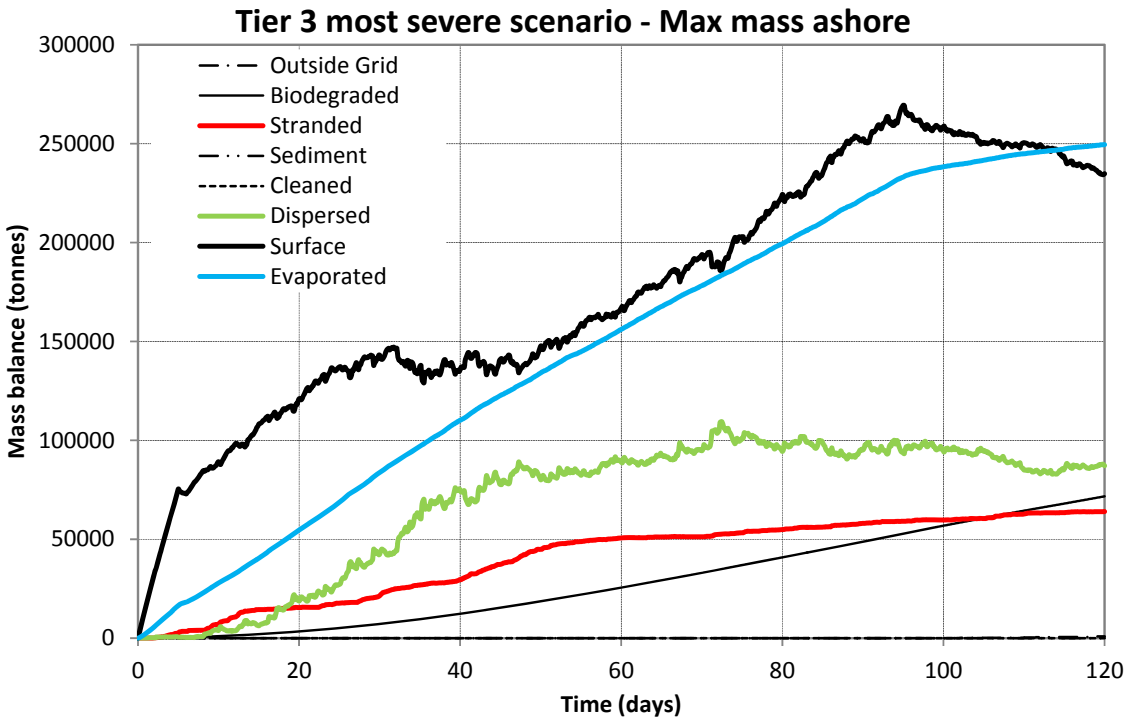


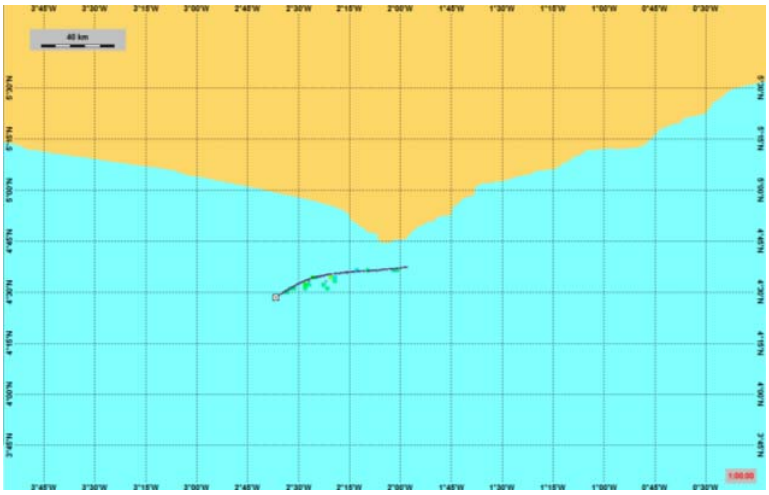
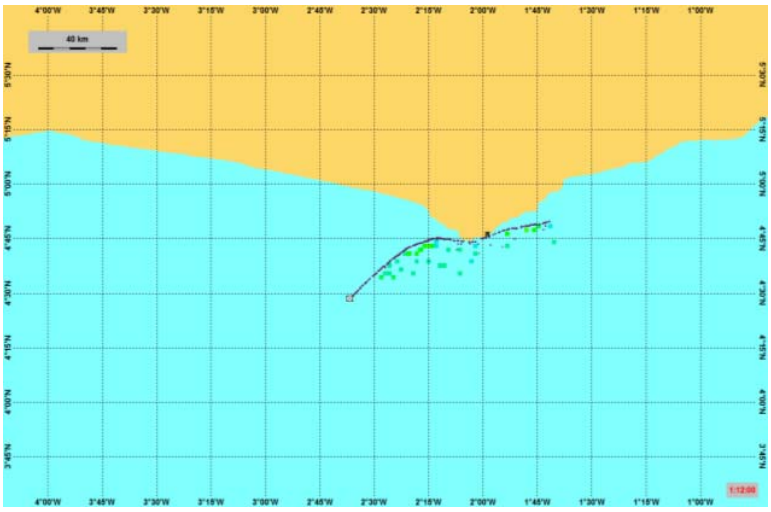
Figure 8 Tier 3 most severe scenario, max amount ashore. Mass balance plot.

The minimum time of arrival ashore modeling details that first oil reaches the shoreline in 1 day and 12 hours.

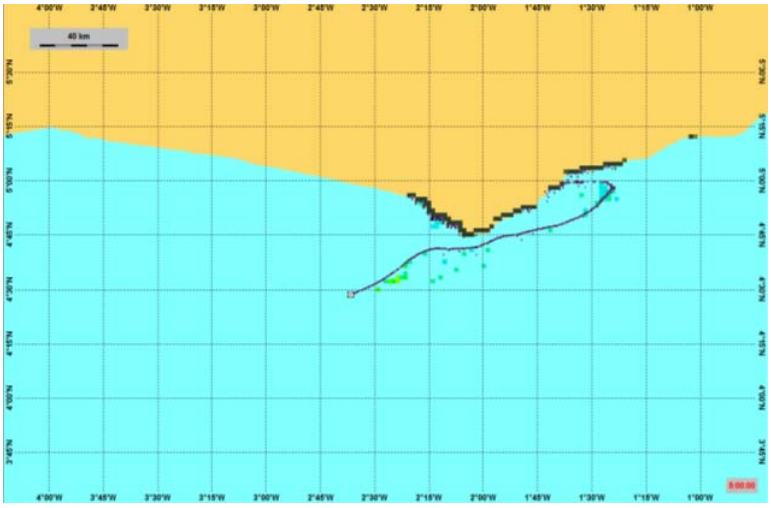
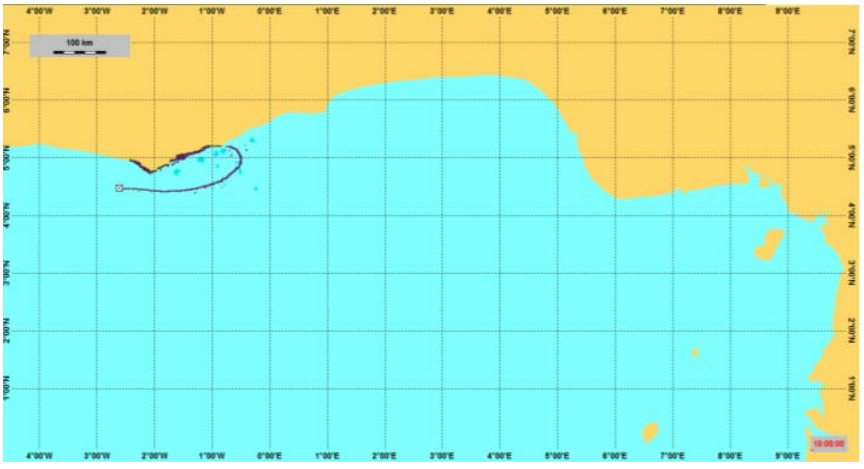
The mass of oil reaching the shore, after 120 days and in the worst case (minimum time to get ashore), is 48640 tons (6.9% of the total oil spilled), while 34.3% evaporates and 43.5% remains on the surface of the ocean. The remaining oil remains in the water column or biodegrades. The fate of the oil is shown in the Figure 9.

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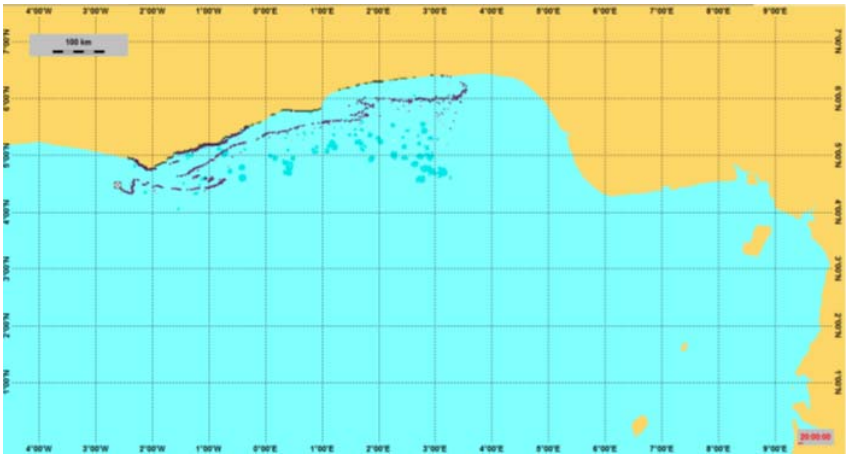
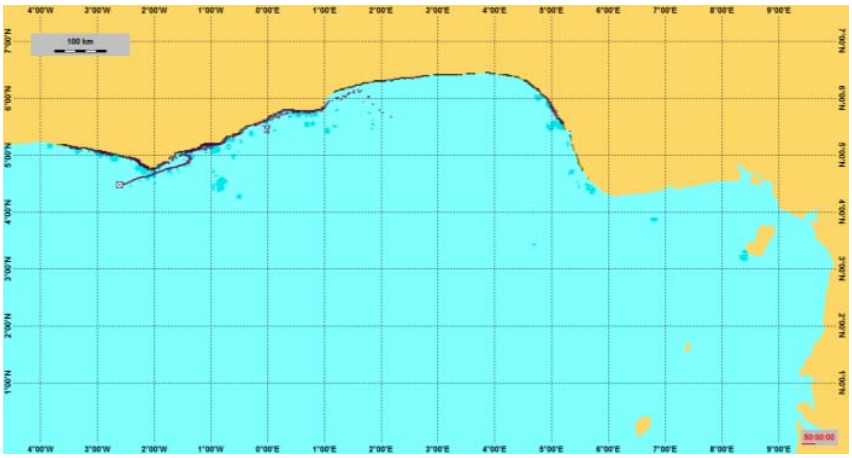
Table 35 Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)

Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
Situation	The first hours and the end of simulation is shown hereafter. The oil hits the shore firstly at Keta Lagoon after 2 days, then extending towards Maximum extension ashore is from 2°W to Port Harcourt.
1 day	
1 day and 12 hours	

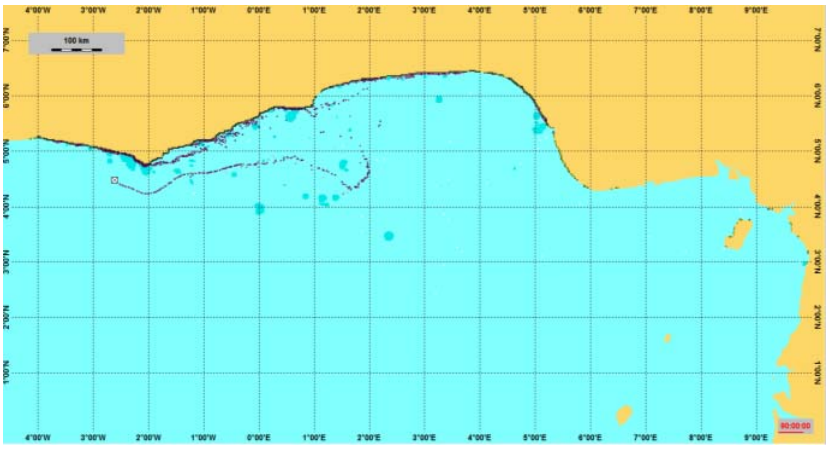
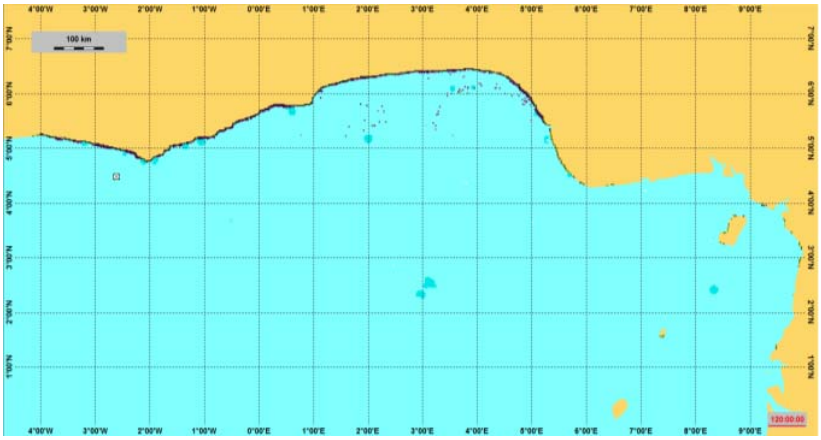
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Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
5 days	
10 days	

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Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
20 days	
50 days	

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Trajectory Results Scenario: OP – Camp1 well blowout (over 95 days)	
90 days (end of spill)	
120 days	

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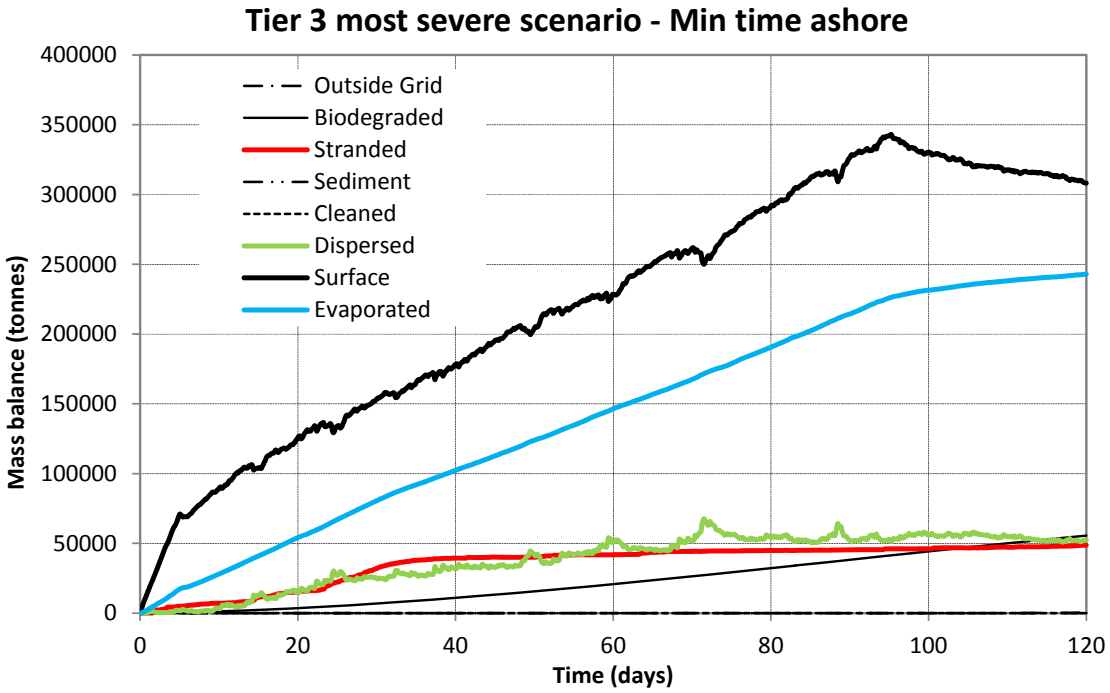


Figure 9 Tier 3 most severe scenario, min time ashore. Mass balance plot.

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Most probable scenario: atmospheric blowout from OP5 well.

Table 36 shows the fates of oil in the events simulated, respectively:

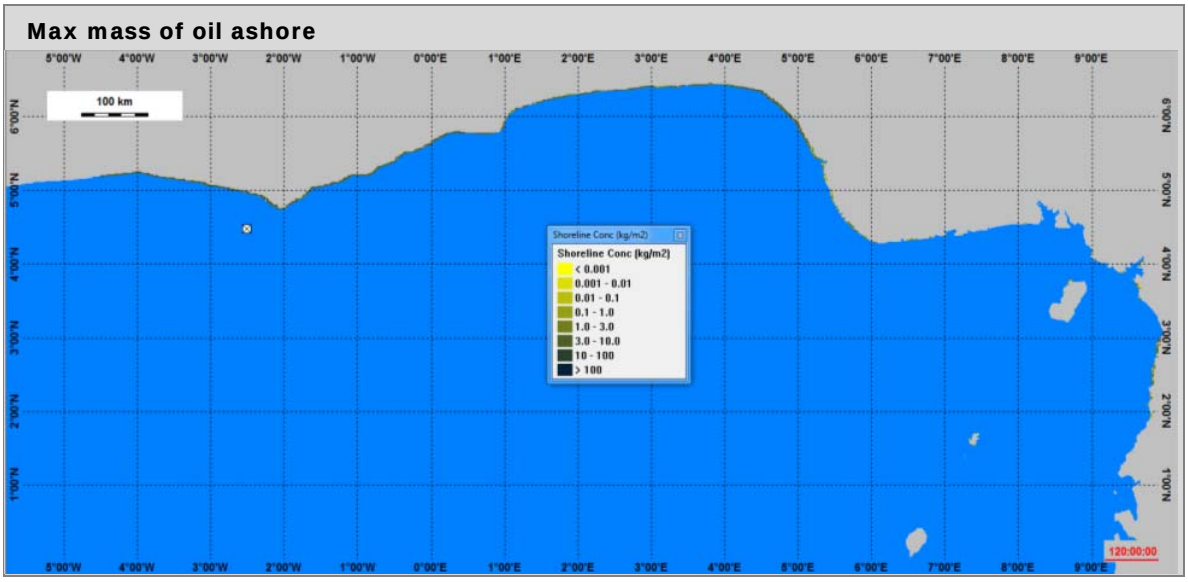
Maximum amount of oil ashore;

Minimum time for oil to get ashore.

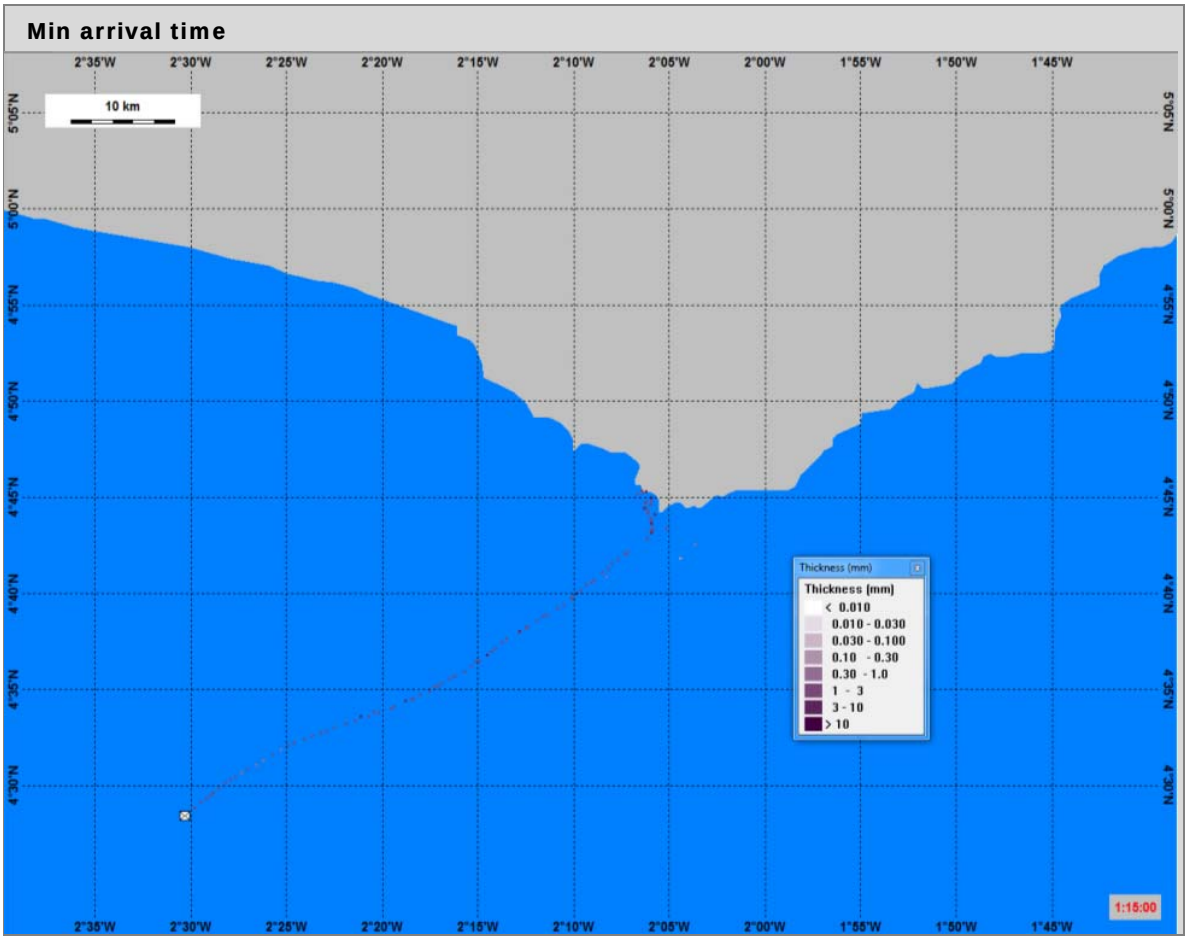
The maximum mass of oil ashore, after 120 days, is 27132 tons, while 40.5 % evaporates, 25.9 % remains on the surface of the ocean and the remaining oil is in the water column or biodegrades.

The minimum time for the oil to reach the shore is 1 day and 15 hours. The mass of oil reaching the shore in this event is 18245 tons (17.4 % of the total oil spilled), while 38.3 % evaporates, 24.0 % remains on the surface of the ocean and the remaining oil is in the water column or biodegrades.

Table 36 Tier 3 most probable scenario – maximum mass of oil ashore, minimum arrival time.



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Diesel spill: diesel spill from FPSO following an impact.

Table 37 shows the fates of oil in the events simulated, respectively:

Maximum amount of oil ashore;

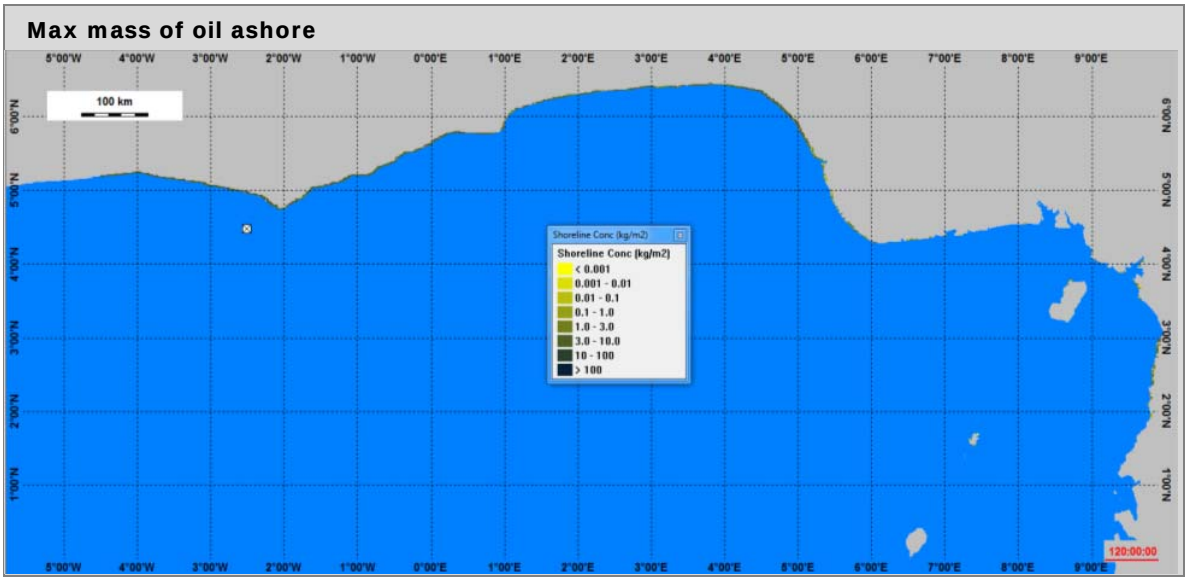
Minimum time for oil to get ashore.

The maximum mass of oil ashore, after 45 days, is 2532 tons (36.2 % of the whole spill), while 27.2 % evaporates and 36.3 % biodegrades. No diesel is left in the water column.

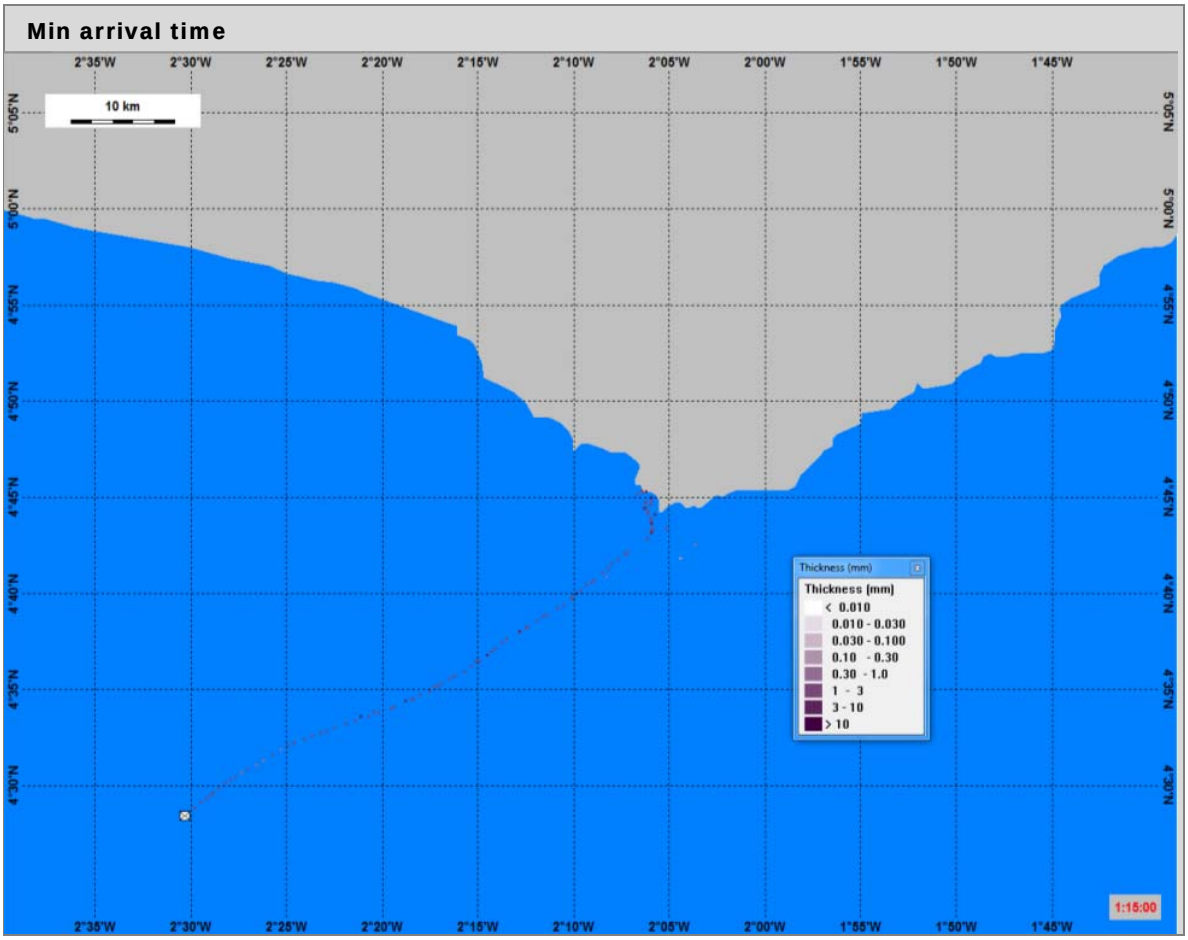
The minimum time for the oil to reach the shore is 1 day and 18 hours. The mass of oil reaching the shore in this event is 1575 tons (22.5 % of the total oil spilled), while 39.6 % evaporates and 31.6 % biodegrades. No diesel is left in the water column.

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Table 37 Tier 3 diesel spill – maximum mass of oil ashore, minimum arrival time.



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8.5.3.2 Tier 2 Scenarios

Most severe scenario: OP leak from riser at FPSO.

Table 38 shows the fates of oil in the events simulated, respectively:

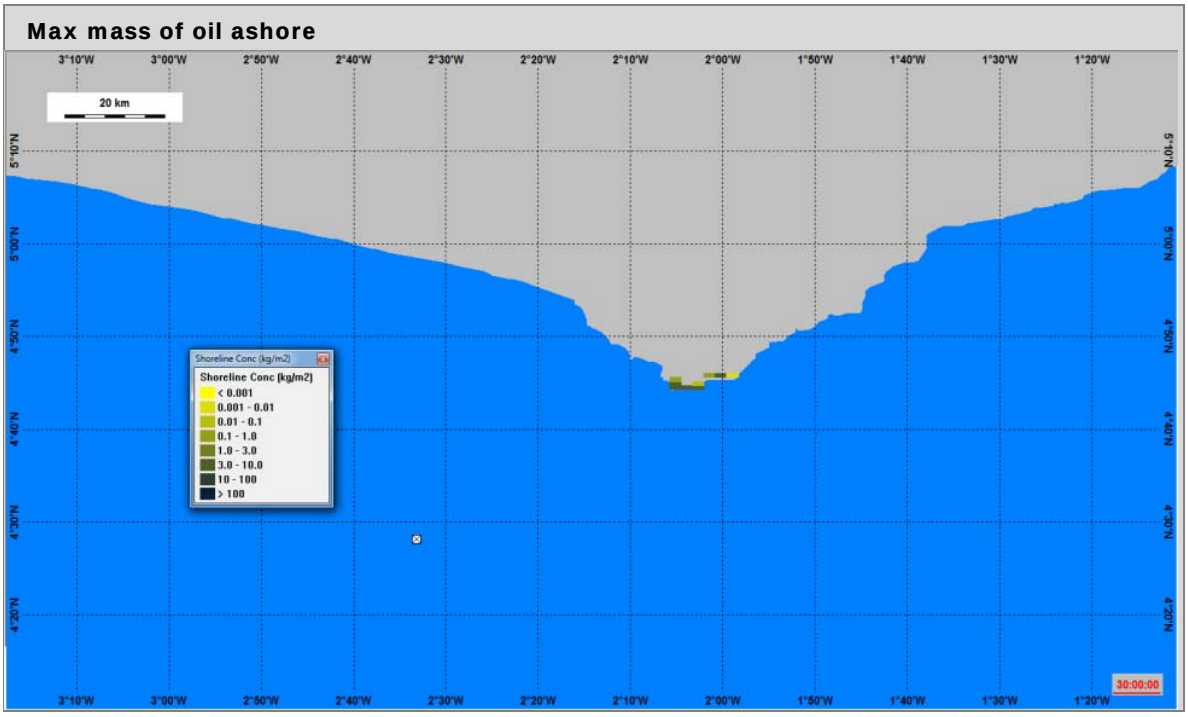
Maximum amount of oil ashore;

Minimum time for oil to get ashore.

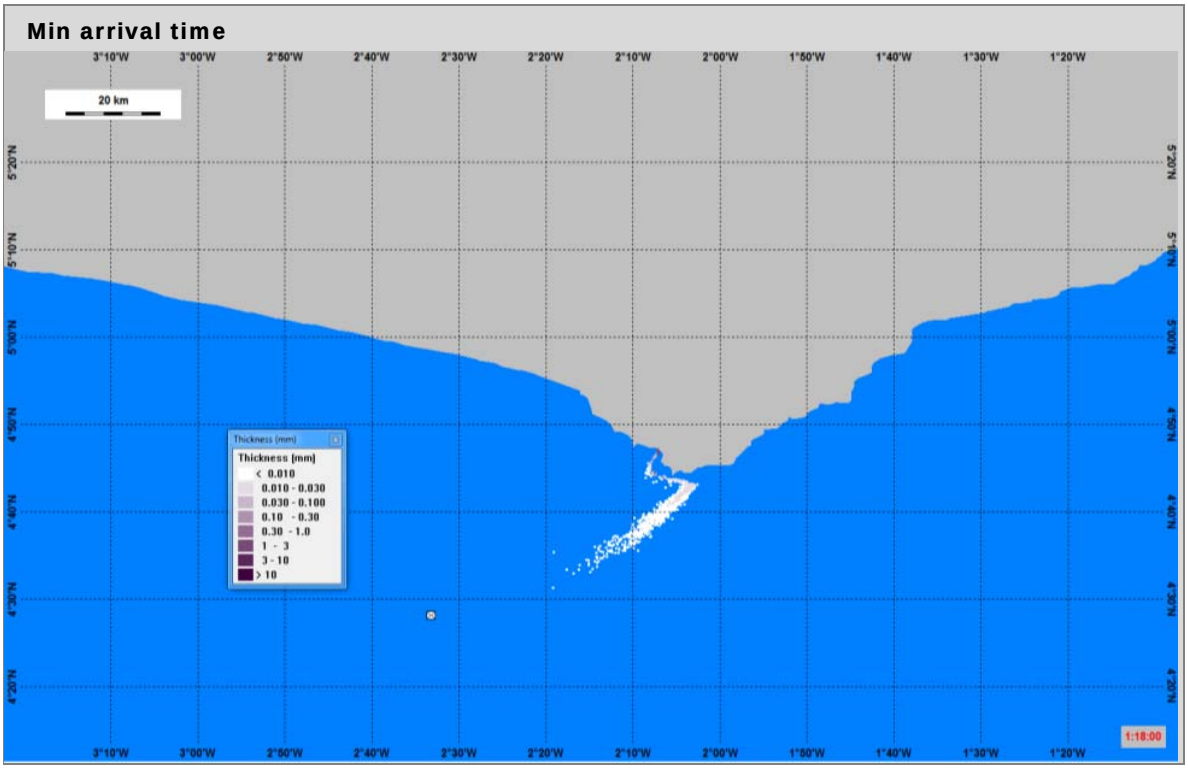
The maximum mass of oil ashore, after 30 days, is 158.3 tons, while 23.9 % evaporates, no oil remains on the surface of the ocean and the remaining oil is in the water column or biodegrades. The maximum mass of stranded oil, approximately 209 tons, is reached 5 days after the end of the release. Figure 10 shows the fate of the oil.

The minimum time for the oil to reach the shore is 1 day and 18 hours. The mass of oil reaching the shore in this event is 8 tons (2.8 % of the total oil spilled), while 49.3 % evaporates, 0.4 % remains on the surface of the ocean and the remaining oil is in the water column or biodegrades. Figure 11 shows the fate of the oil.

Table 38 Tier 2 most severe scenario – maximum mass of oil ashore, minimum arrival time.



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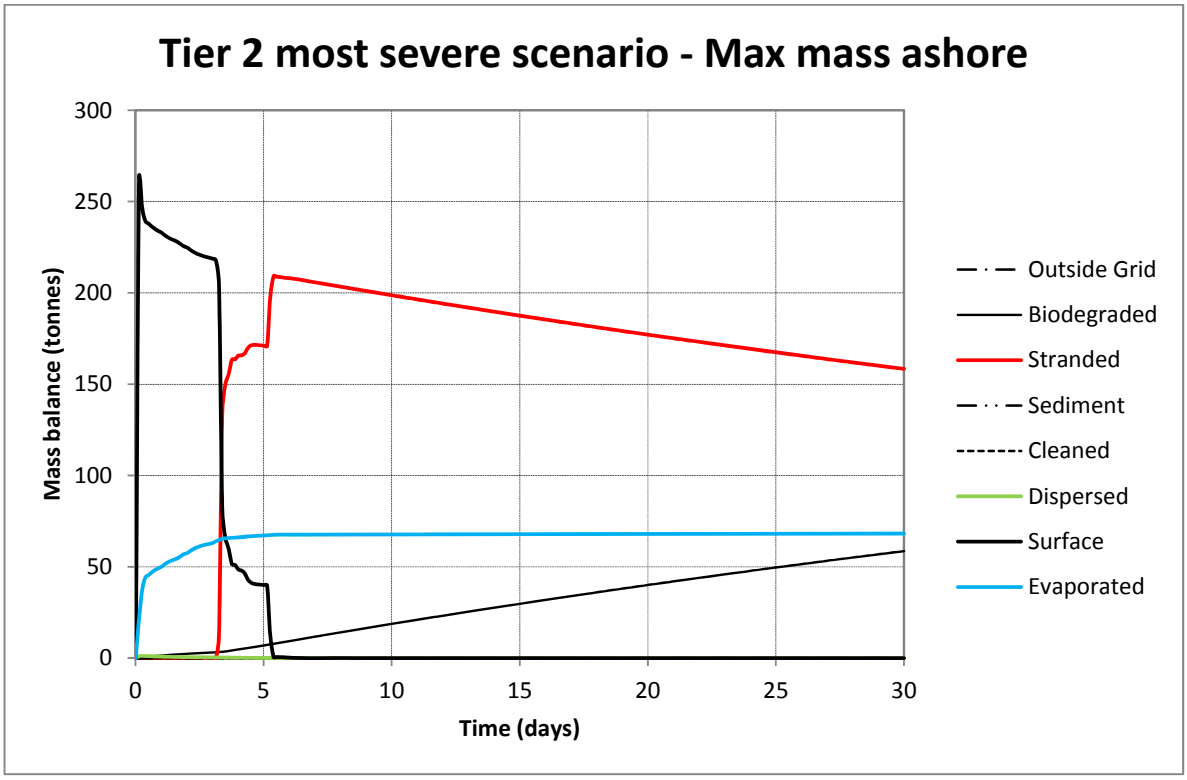


Figure 10 Tier 2 most severe scenario, max mass ashore. Mass balance plot.

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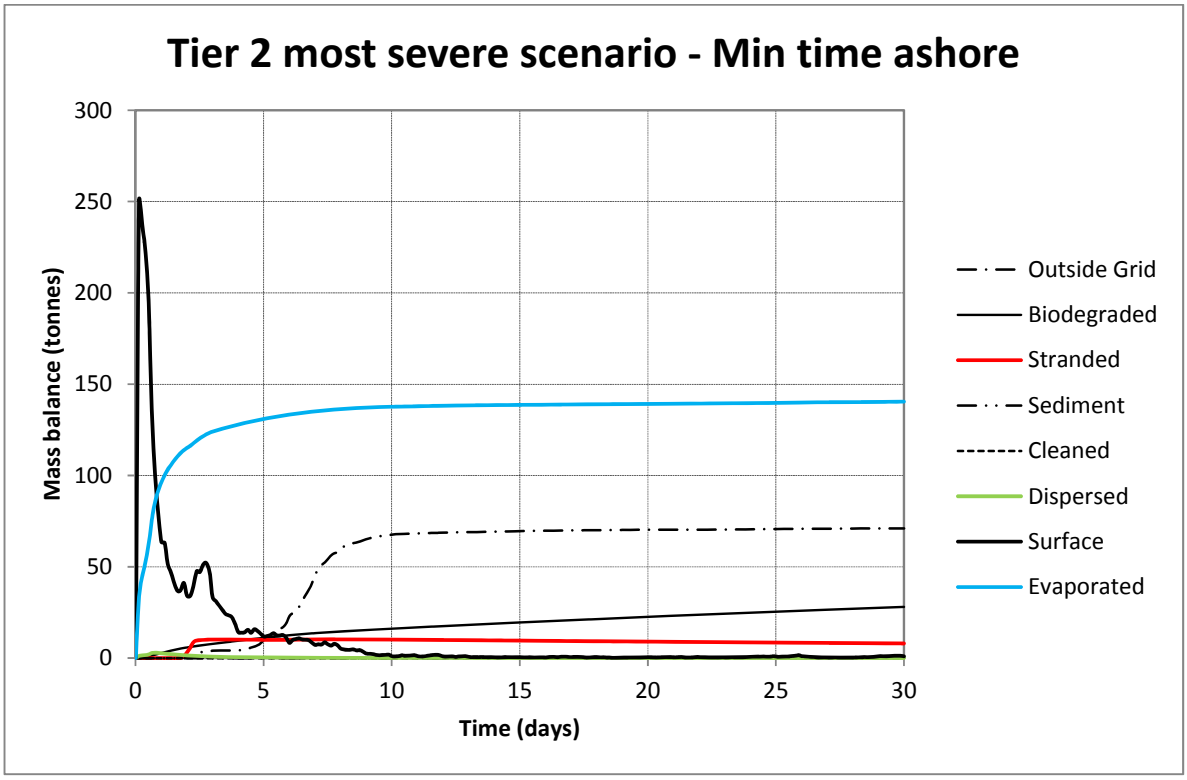


Figure 11 Tier 2 most severe scenario, min time ashore. Mass balance plot.

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Most probable scenario: OP flowline leak at seabed.

Table 39 shows the fates of oil in the events simulated, respectively:

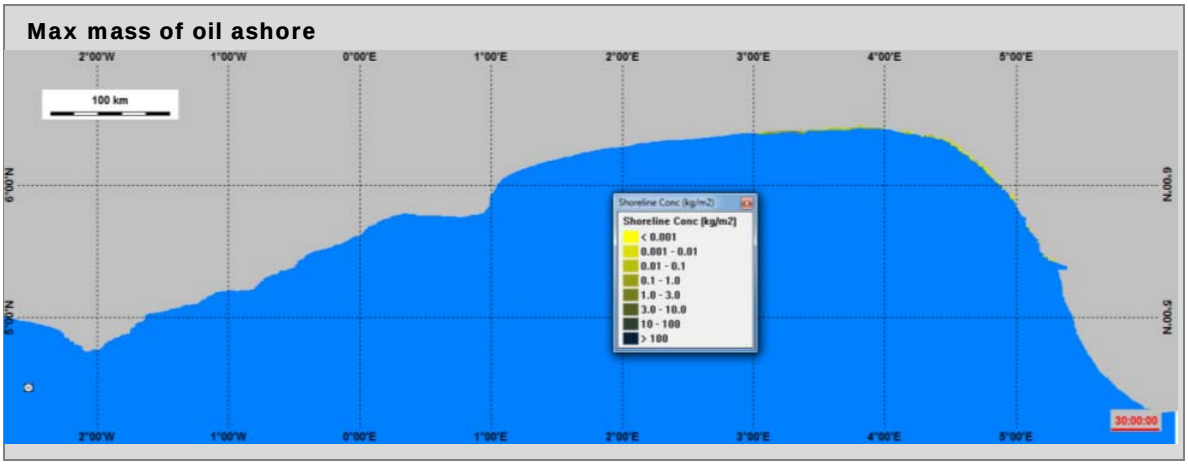
Maximum amount of oil ashore;

Minimum time for oil to get ashore.

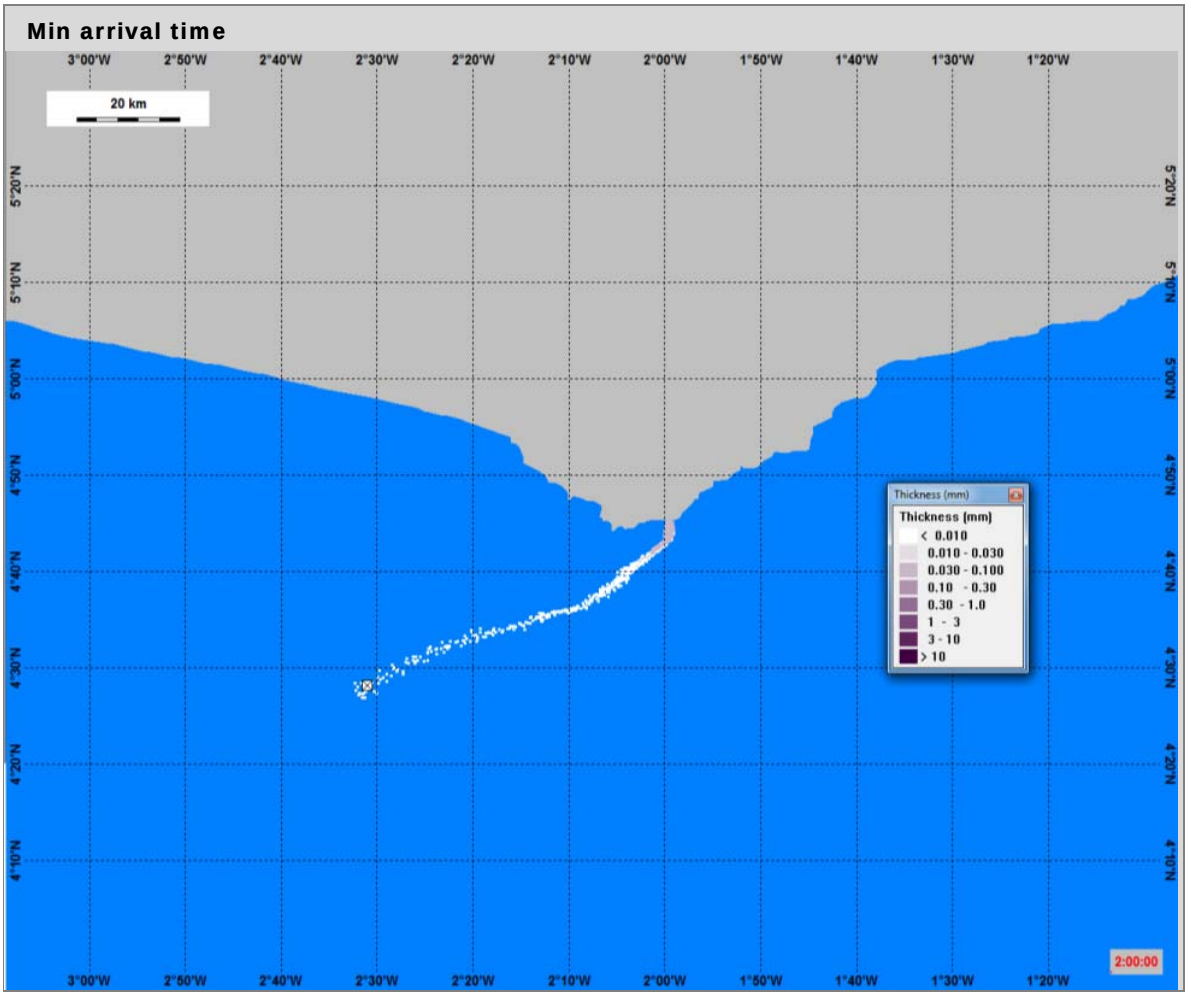
The maximum mass of oil ashore, after 30 days, is 54.4 tons, while 37.5 % evaporates, 0.1 % remains on the surface of the ocean and the remaining oil is in the water column or biodegrades.

The minimum time for the oil to reach the shore is 2 days. The mass of oil reaching the shore in this event is 4 tons (2 % of the total oil spilled), while 21.7 % evaporates, 0.1 % remains on the surface of the ocean and the remaining oil is in the water column or biodegrades.

Table 39 Tier 2 most probable scenario – maximum mass of oil ashore, minimum arrival time.



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Diesel spill: diesel spill from a supply vessel following an impact.

Table 40 shows the fates of oil in the events simulated, respectively:

Maximum amount of oil ashore;

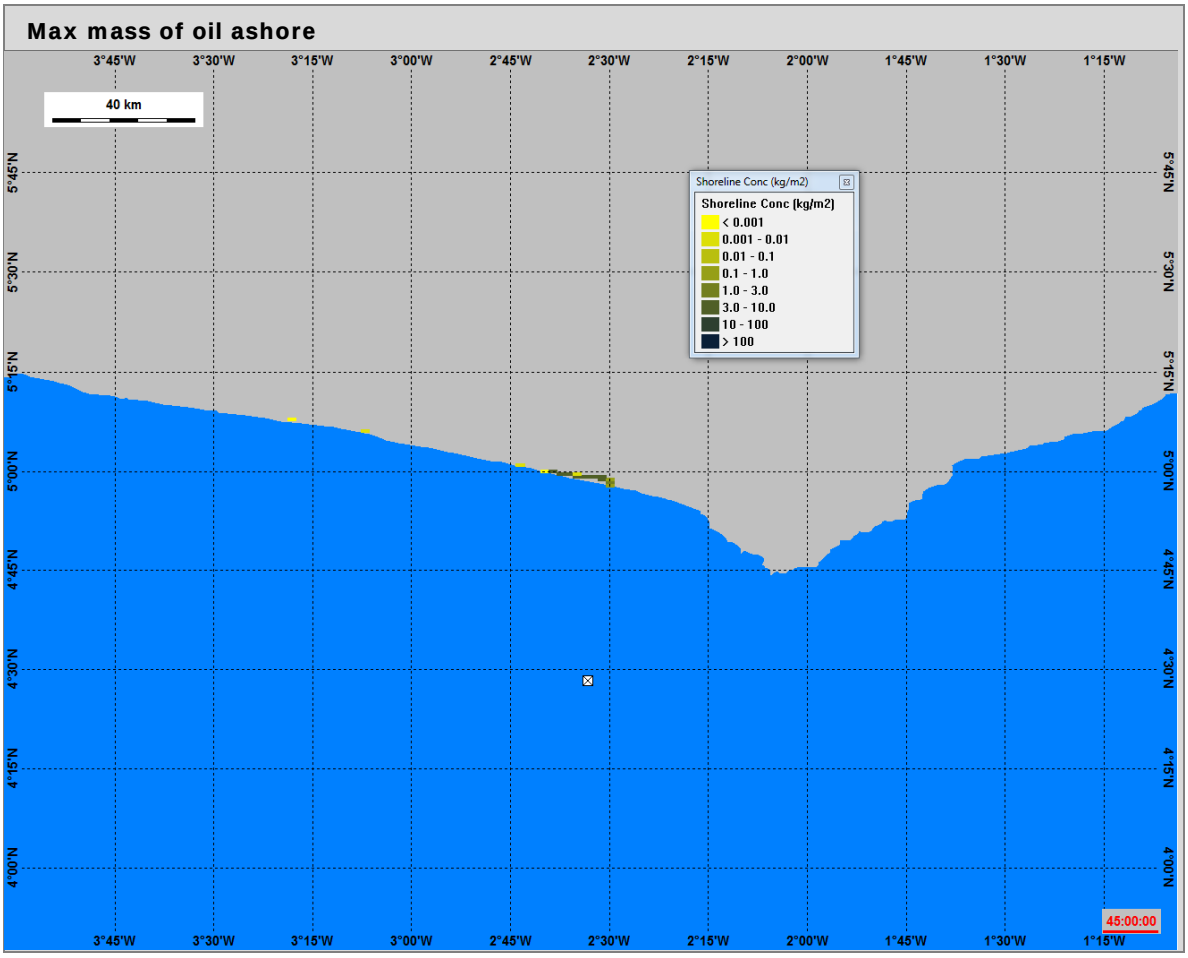
Minimum time for oil to get ashore.

The maximum mass of oil ashore, after 45 days, is 287.7 tons (33.1 % of the whole spill), while 32.5 % evaporates and 34.0 % biodegrades. No diesel is left in the water column.

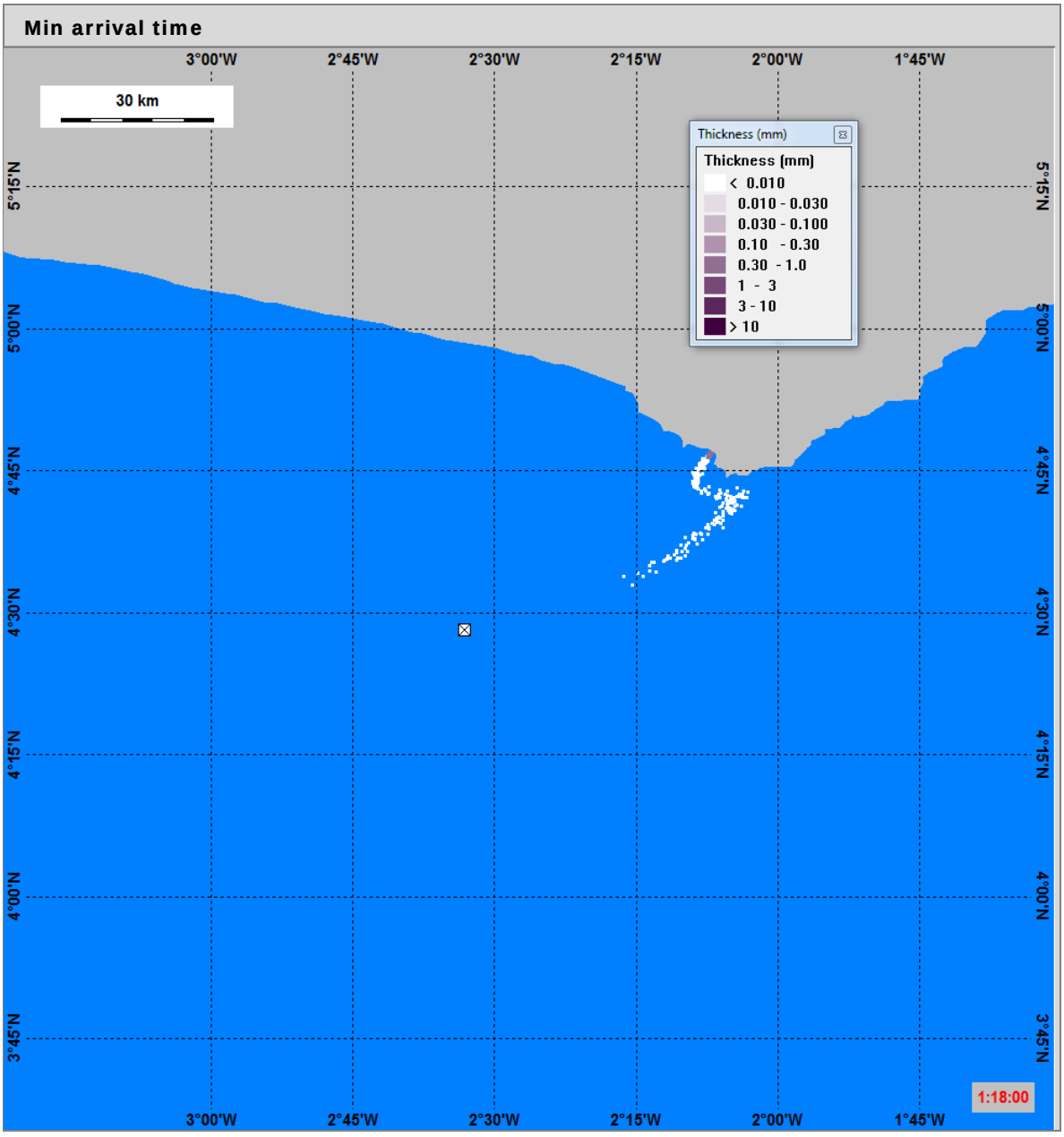
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The minimum time for the oil to reach the shore is 1 day and 18 hours. The mass of oil reaching the shore in this event is 86.1 tons (9.9 % of the total oil spilled), while 50.2 % evaporates and 29.4 % biodegrades. No diesel is left in the water column.

Table 40 Tier 2 diesel spill – maximum mass of oil ashore, minimum arrival time.



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8.5.3.3 Tier 1 Scenarios

Most severe scenario: GP riser leak in shallow water.

Table 41 shows the fates of condensate in the events simulated, respectively:

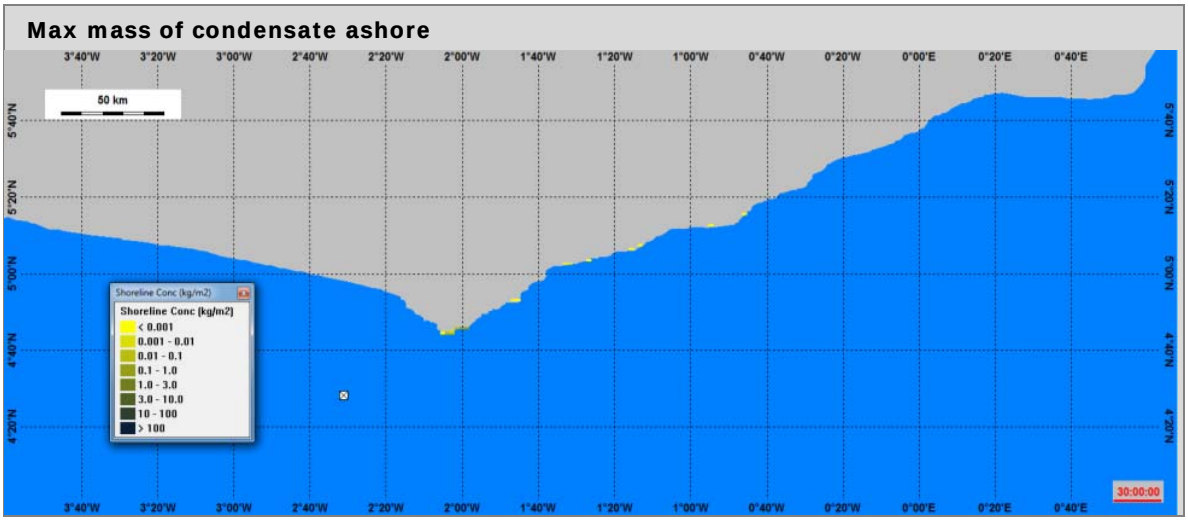
Maximum amount of condensate ashore;

Minimum time for condensate to get ashore.

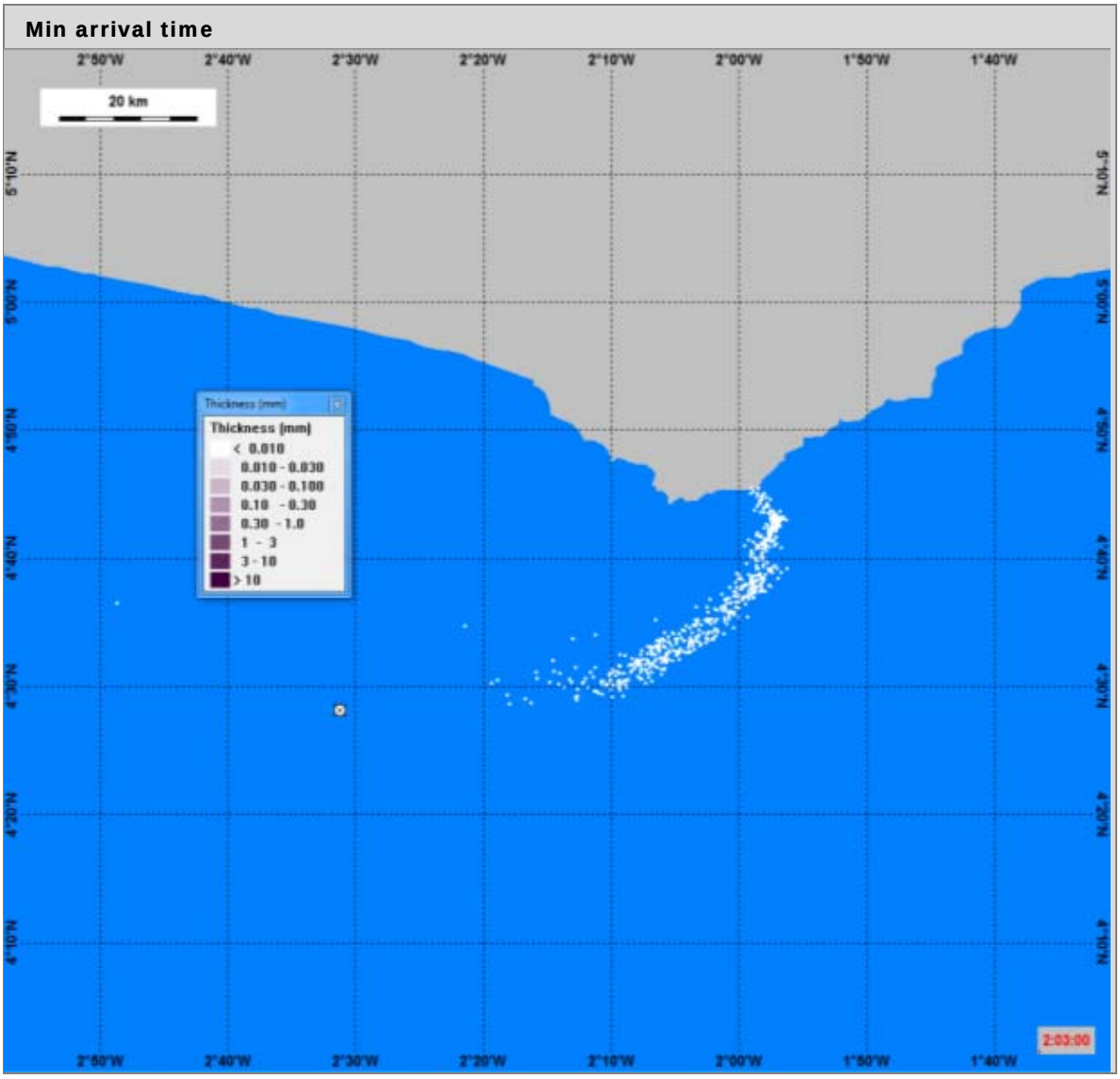
The maximum mass of condensate ashore, after 30 days, is 7.6 tons, while 45 % evaporates, no condensate remains on the surface of the ocean and the remaining condensate is in the water column or biodegrades. The maximum mass of stranded condensate, approximately 10 tons, is reached 4 days after the end of the release. Figure 12 shows the fate of the condensate.

The minimum time for the condensate to reach the shore is 2 days and 2 hours. The mass of condensate reaching the shore in this event is 2.5 tons (0.1 % of the total condensate spilled), while 31.6 % evaporates, 0.5 % remains on the surface of the ocean and the remaining condensate is in the water column or biodegrades. Figure 13 shows the fate of the condensate.

Table 41 Tier 1 most severe scenario – maximum mass of condensate ashore, minimum arrival time.



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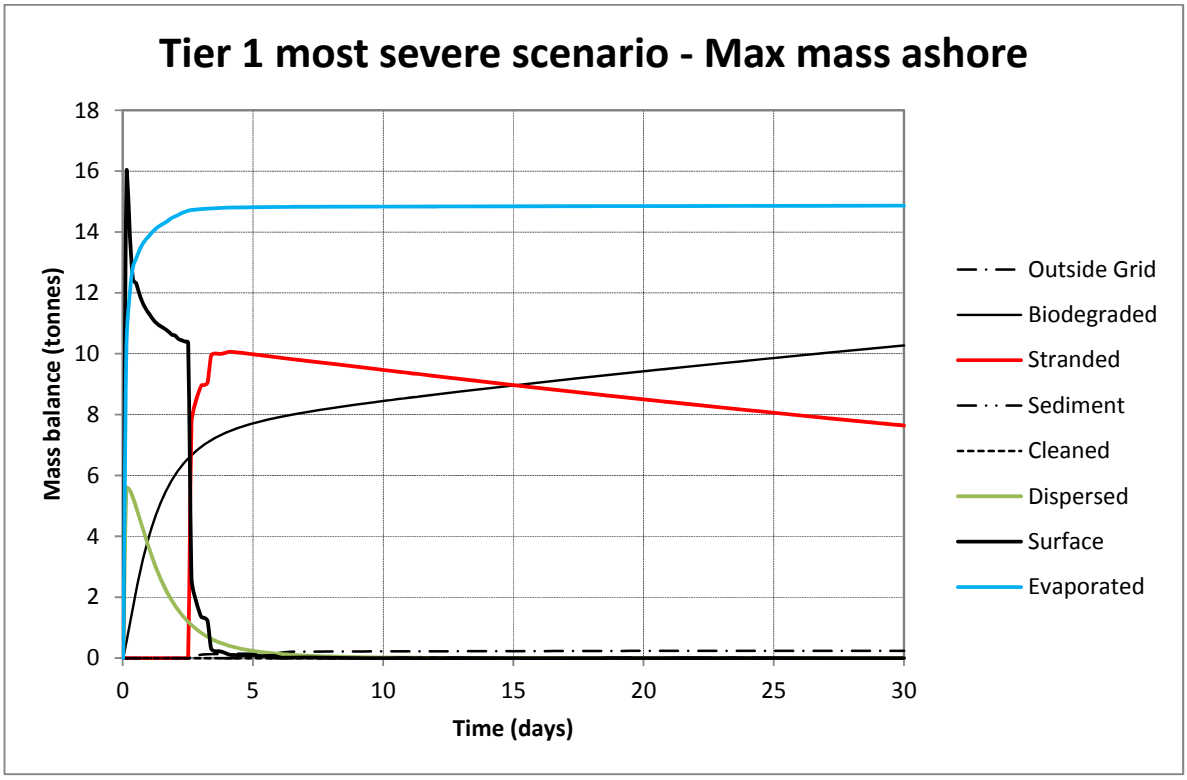


Figure 12 Tier 1 most severe scenario, max mass ashore. Mass balance plot.

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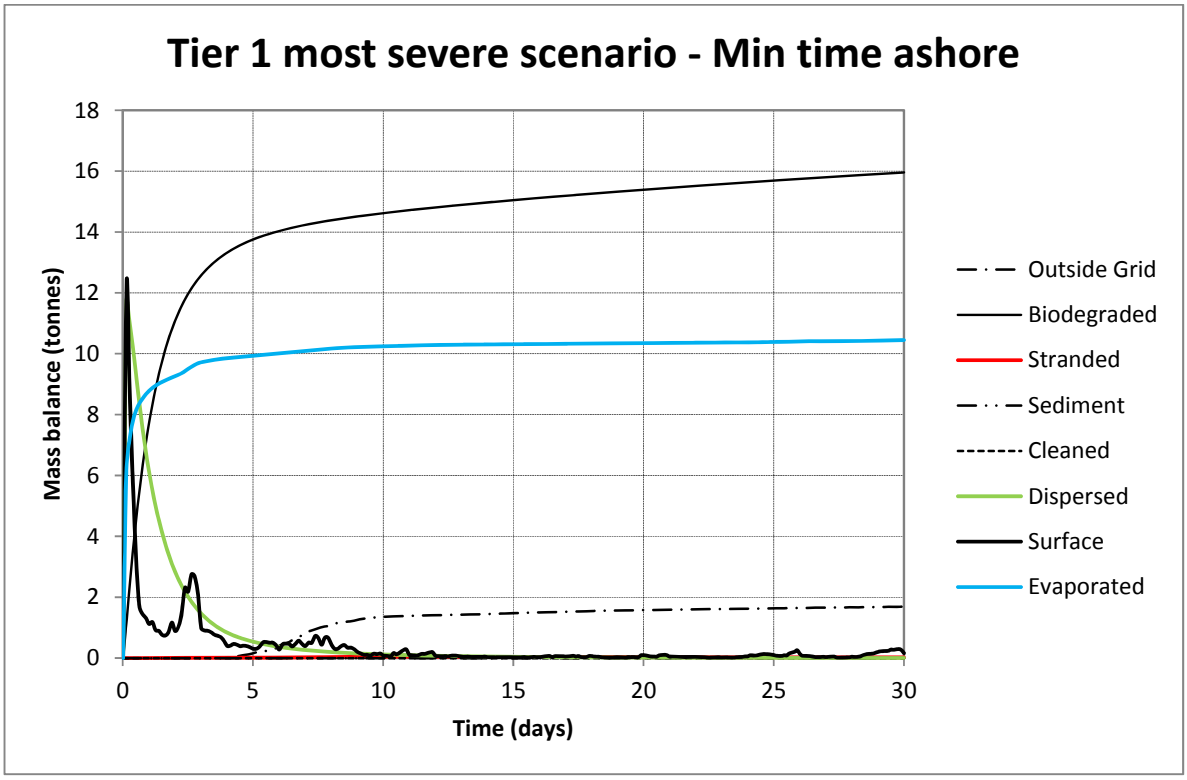


Figure 13 Tier 1 most severe scenario, min time ashore. Mass balance plot.

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Most probable scenario: GP flowline leak at seabed.

Table 42 shows the fates of condensate in the events simulated, respectively:

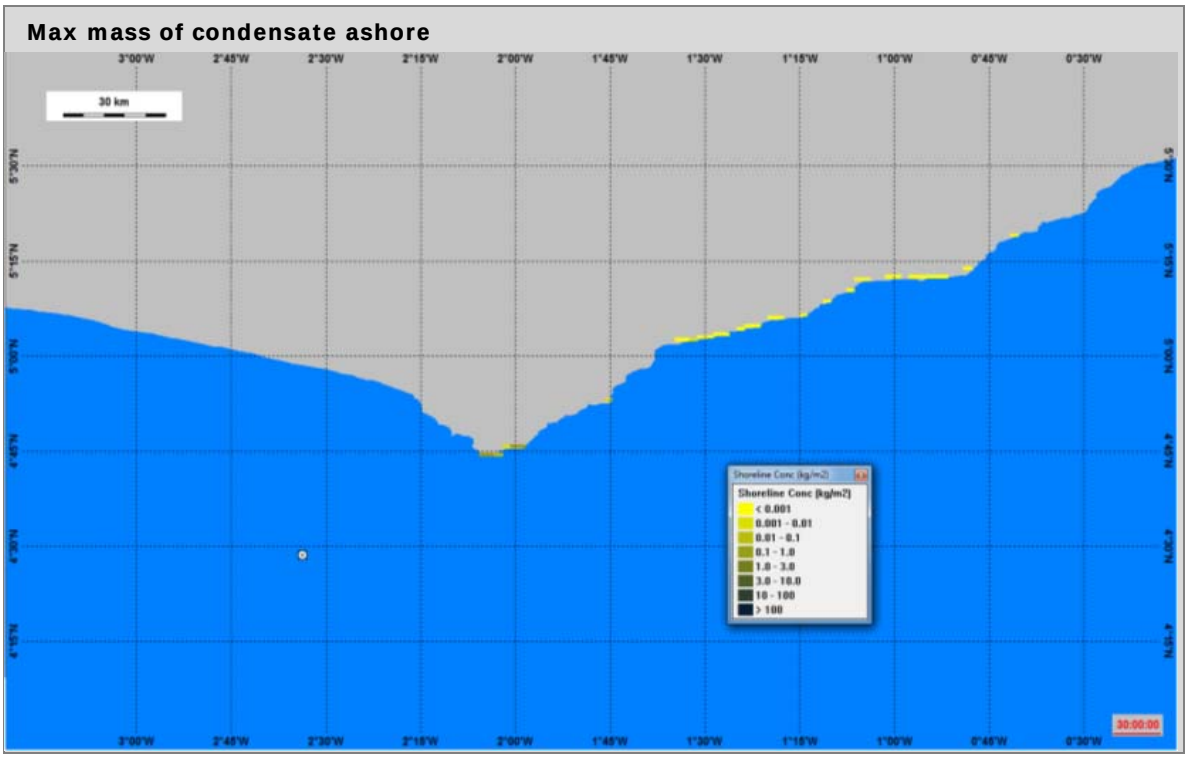
Maximum amount of condensate ashore;

Minimum time for condensate to get ashore.

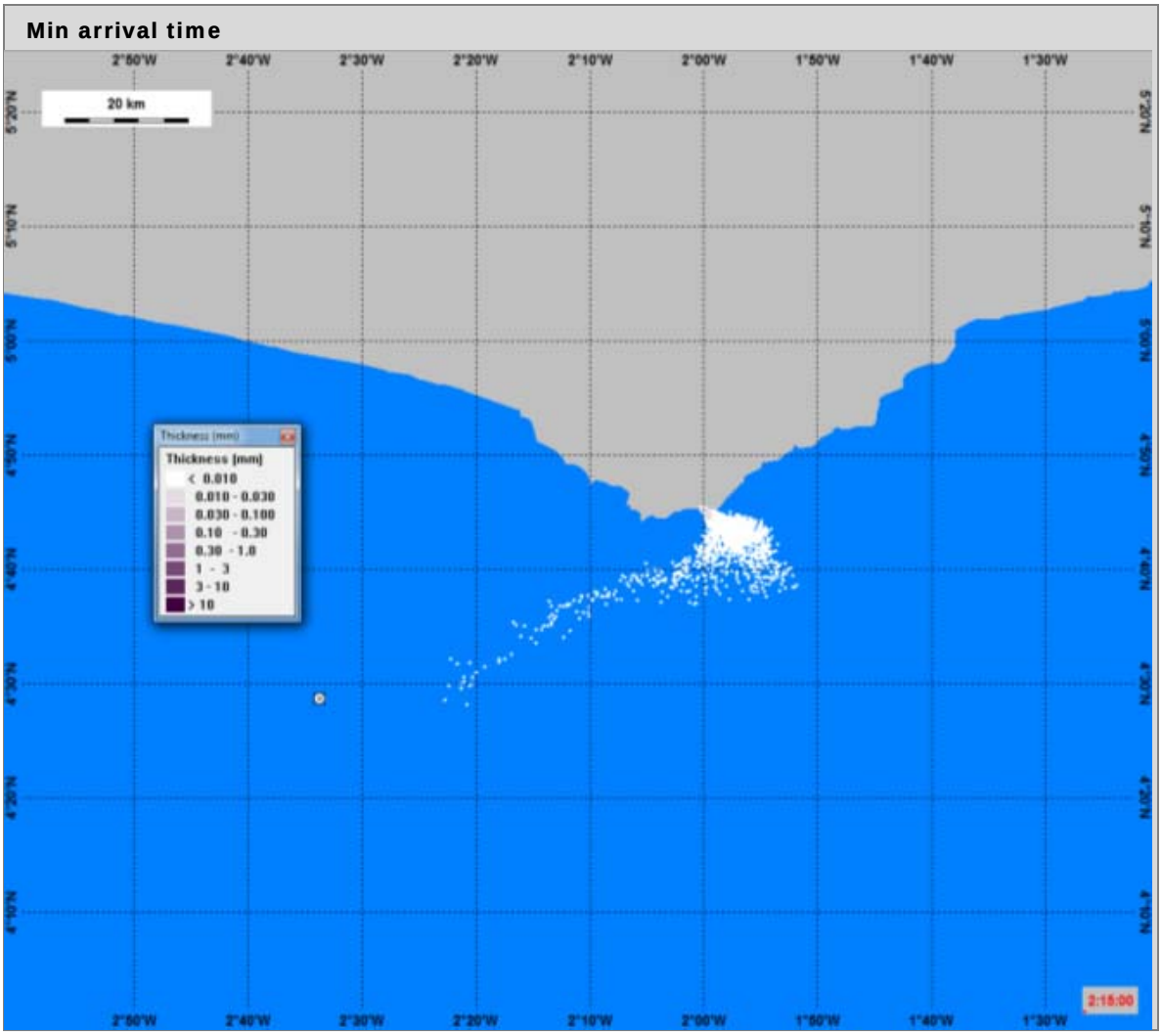
The maximum mass of condensate ashore, after 30 days, is 4.4 tons, while 22.8 % evaporates, no condensate remains on the surface of the ocean and the remaining condensate is in the water column or biodegrades.

The minimum time for the condensate to reach the shore is 2 days and 15 hour. The mass of condensate reaching the shore in this event is 2.3 tons (8.5 % of the total condensate spilled), while 22.1 % evaporates, 0.2 % remains on the surface of the ocean and the remaining condensate is in the water column or biodegrades.

Table 42 Tier 1 most probable scenario – maximum mass of condensate ashore, minimum arrival time.



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9. ANNEXES

Annex A – Contact Details

Annex B – Forms

Annex C – Oil Spill Training and Exercises

Annex D – Legislative and Regulatory Framework

Annex E – Eni Health, Safety & Environmental (HSE) Guidelines

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ANNEX A –CONTACT DETAILS SAMPLE

eni Ghana ERT Contact Details				
	Emergency Response Team		Alternate Emergency Response Team	
POSITION	NAME	MOBILE	NAME	MOBILE
Emergency Response Manager	*F. Cavanna*	*0544 347 057*	*F. Roncarolo*	*0540 109 269*
Emergency Coordinator	*F. Roncarolo*	*0540 109 269*	*E. Lago*	*0544 334 994*
Logistics Manager	*R. Costantini*	*0544 347 058*	*K. Amankwah - Poku*	*0544 343 270*
Well Operations Manager	*K. Rrokaj*		*S. Borra*	*0544 347 056*
HSE&CI Manager	*J. Deffis*	*0544 334 993*	*M. Bartels-Kodwo*	*0261 600 666*
Public Affairs Coordinator	*R. Crivari*	*0544 311 690*	*A. Renzulli*	*0540 119 718*
Health Manager	*S. Grazia*	*0544 339 148*	*J. Deffis*	*0544 334 993*
HR&T Manager	*M. Ruscio*	*0544 311 692*	*F. Osei-Bonsu*	*0540 115 399*
Log Keeper	*M. Bartels-Kodwo*	*0261 600 666*	*F. Osei-Bonsu*	*0540 115 399*
Emergency Response Room		*0302 761 941*		

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GOVERNMENT AUTHORITIES

Navy / Environmental Protection Agency (EPA)

Designation	Mobile Phone
EPA Switchboard	+233 (0) 0302 664697-8
Navy Operations Room Navy Headquarters (Accra)	+233 (0) 21 777991 / 233 21 766850 / 233 21 777621

Petroleum Commission (PC)

Designation	Office Phone
Switchboard	+233 (0) 0302 953 392 / 393

Ghana National Petroleum Corporation (GNPC)

Designation	Office Phone
Head Office	+233 (0) 303 206020 / 204654

OSRL

Designation	Direct Ph.
UK/Bahrain Emergency	+44 (0)23 8033 1551
Regional Director (UK)	+44 23 8033 1551 +44 23 8072 4303
Regional Representative, West Africa	+447881342182 +233244635583

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OTHER OIL AND GAS OPERATORS

Designation	Office	Mobile	Fax	Email
VITOL Ian McNeil **Asset Manager (Primary Contact)**		+44 078 1398 3838		imn@vitol.com
GNPC **Engineering Manager**	+233 (0) 22 202824	+233 (0) 20 8132579	+233 (0) 22 202854	ap.kwarteng@gnpcghana.com
TULLOW				
Logistics Base Manager Takoradi	+233 (0) 244 342671	+233 (0) 31 27847		gh_logisticsbasemanager@tullowoil.com
EHS Advisor Takoradi	+233 (0) 244 342103	+233 (0) 31 27847		Ehsadvisoe.ghana@tullowoil.com
EHS Manager Accra	+233 (0) 244 342096	+233 (0) 21 763600 ext. 116		cesar.molina@tullowoil.com

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ANNEX B – FORMS

1. Oil Spill Report Forms
2. Marine Pollution Report Form
3. Situation Report Form (SITREP)
4. Personal log
5. Modelling request form for oil spill release
6. Modelling request form for uncontrolled blowout
7. Aerial Surveillance Form
8. *OSRL* – Notification Form
9. *OSRL* – Mobilisation Authorisation Form
10. Vessel dispersant application log

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1. OIL SPILL REPORT FORMS

In the event of an oil spill occurring or if pollution is seen in the vicinity of eni Ghana's operations the following forms/checklists must be completed and distributed as specified. Instructions for use are as follow:

Pollution Report Form	**From**	Eni OSC/PIC (for example Vessel Master)
	To	Emergency Response Team (Accra) (for Tier 1, 2 and 3 spills)
	When	All oil spills
	How	Early facts by phone to Duty Manager, full facts by email (primary) or Fax (secondary) to ERT
Situation Report	**From**	Eni OSC/PIC (for example Vessel Master)
	To	Emergency Response Team (Accra)
	When	All oil spills
	How	Early facts by phone, full facts by Email/Fax to ERT
OSRL Notification Form	**From**	Emergency Response Team (Accra)
	To	*OSRL* Duty Manager
	When	As and when required
	How	Email /Fax
OSRL Mobilisation Form	**From**	The eni Ghana Nominated Call-out Authority
	To	*OSRL* Duty Manager
	When	For Tier 2 / 3 Spills
	How	Email /Fax

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2. MARINE POLLUTION REPORT FORM

Marine Pollution Report Form		
☐ Urgent	☐ Critical	
Date/Time of Report:		
Date/Time of Incident:		
Location of Incident:		
Latitude:	Longitude:	
Original Report Source:		
Contact:	Phone/Mobile:	Fax/Email:
Nature of incident and spill source (if source unknown give identity and position of adjacent vessels):		
Point of Discharge from Source:		
Cause of Discharge:		
Oil Type or Description:		
Has Discharge Stopped/Temporarily Stopped?		
Extent of Spill:		
Projected Trajectory of Spill:		
Samples Taken: ☐ Yes ☐ No	Photographs Taken: ☐ Yes ☐ No	
Weather / Sea / Tide Conditions:		
Initial Response Actions:		
Corrective Actions Taken		
Additional Information:		
Report Prepared By:	Phone/Mobile:	Fax/Email:

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3. SITUATION REPORT FORM (sitrep)

Situation Report Form (SITREP)		
Report number:	Report date:	Time issued:
Incident name:		
Incident location:		
Latitude:	Longitude:	
Date of incident:	Time of incident:	
Type of incident:		
Brief account of incident:		
Assets affected:		
Nature and extent of spill:		
Third parties involved:		

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Incident objectives:	
Summary of events since last report:	
Expected developments:	
Planned course of action:	
Other pertinent information:	
Report Prepared By:	Position:
Phone/Mobile:	Fax/Email:

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4. PERSONAL LOG

Time: _____

Place: _____

Author: _____

Time	CONTACT Telephone N° of contacted person or external body	T/R*	COMMUNICATION AND ACTION

*T: Transmitted R: Received

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5. MODELLING REQUEST FORM FOR OIL SPILL RELEASE

For the Attention of:				
Date/Time :				
From:	Name			
	Organisation/Company			
	Tel Number			
	Fax Number			
	Email Address			
Spill Release:	Date			
	Start Time			GMT/Local Time
	Latitude PLEASE MAKE FORMAT CLEAR			
	Longitude PLEASE MAKE FORMAT CLEAR			
Release Rate:	Instantaneous Release (i.e. Total Amount) **PLEASE STATE UNITS**			
	OR Continuous Release PLEASE STATE UNITS	Per Hour	For _____ Hours/Days	**Total Amount** to be Released _____
Oil Type: PLEASE STATE UNITS	Oil Name			
	API			
	Specific Gravity			
	Pour Point			
	Wax Content			
	Sulphur Content			
Wind Data:	Date/Time of Wind Data			
	Wind Direction (wind direction given from)			
	Wind Speed PLEASE STATE UNITS			
Sea Temperature:		°C/°F		
Air Temperature:		°C/°F		
Notes:				

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6. MODELLING REQUEST FORM FOR UNCONTROLLED BLOWOUT

Blow-out Scenario Characterization Data		
Parameter	Value/Range	unit of measurement
Water deep (for underwater blow-out)		m
Top Reservoir depth (see note 1)		m sea level for offshore location, m RT for onshore location
Reservoir temperature (see note 1)		°C
Static pressure (see note 1)		Bar_g (see note 2)
Static pressure datum		m sea level for offshore location, m RT for onshore location
Oil gravity (see note 1)		°API
Bubble point (for crude oil wells) (see note 1)		Bar_g at T reservoir (see note 2)
Dew point (for dry gas and gas condensate wells) (see note 1)		Bar_g at T reservoir (see note 2)
Solution G.O.R. (for crude oil wells) (see note 1)		Sm^3/m^3
Blow-out G.O.R. (see note 1)		Sm^3/m^3
H_2S (see note 1)		ppm
Surface gas molecular weight stock tank condition (see note 1)		g/mole
Productivity index (for crude oil wells) (see note 1)		$Sm^3/d/bar$
Bottom absolute open flow (BAOF for dry gas and gas condensate wells)		$MMSm^3/d$
Release point elevation with reference to:	Land level (for atmospheric onshore blow-out) ☐ Sea level (for atmospheric offshore blow-out) ☐ Sea bottom (for underwater blow-out) ☐	
Rotary table/Rig floor elevation with reference to:	Land level (for atmospheric onshore blow-out) ☐ Sea level (for atmospheric offshore blow-out) ☐	
Type of hydrocarbons:	crude oil ☐ dry gas ☐ gas condensate ☐	

Note 1) in case of uncertainty about the value please supply the range of possible variation
Note 2) barg is "gravitational" pressure that doesn't include atmospheric pressure

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Blow-out Scenario Characterization Data			
Event	Flow through	Description	Selection
During drilling	Casing	Well cased. Flow through open hole and internal casing/liner sections without drilling string inside	□
	Annulus (including outside casing)	Well cased and with drilling string. Flow through the annulus generated between the drilling string and open hole/casing/liner sections or inside different casing/liner/gaps (outside casing)	□
	Drilling string	Well cased and with drilling string inside pipe. Flow through drilling string only	□
	Drilling string and annulus	Well cased with drilling string inside. Flow through the annulus between open hole/casing/liner sections and drilling string and inside drilling string itself	□
During production	Tubing	Flow through liner section from the perforated intervals top to the tubing bottom and through the production tubing up to wellhead	□
	Annulus	Flow through liner section from the perforated intervals top to the tubing bottom and through the annulus between the casing/liner sections and the tubing up to wellhead	□
	Annulus and tubing	Flow through liner section from the perforated intervals top to the tubing bottom and both through the annulus and production tubing up to wellhead	□

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Contents

- Depth data must be supplied both in Measured depth (MD) and True Vertical Depth (TVD)
- Diameter data must be expressed both in term of Inner Diameter (ID), Outer Diameter (OD)
- Component data must be supplied both in term of Nominal Diameter (ND) and Linear Weight (LW)
- Please specify measurement units (into round parentheses)
- Please specify the reference of the depth data (Rotary Table, Sea Level, Sea Bottom, Rig Floor, etc.) together the measurement units (into round parentheses)

The following list of data be supplied (in quoted well sketch) if present in the well:

- Casing/Liner shoes depth
- Top liner depth
- Top and Bottom depth each type of drill pipe composing the drilling string
- Top and Bottom of each tubing section
- ID and OD of each section
- Bit depth
- Open hole bottom depth and ID
- Perforation interval(s) top and bottom depth

TYPE	ND (")	ID (")	OD (")	LW ( )	TOP DEPTH		BOTTOM DEEP	
					MD ( ) [ ]	TVD ( ) [ ]	MD ( ) [ ]	TVD ( ) [ ]

QUOTED WEEL SKETCH

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7. AERIAL SURVEILLANCE FORM

Aerial Surveillance Form			
Incident		**Aerial Surveillance Report No.**	

Date and time	Day	Month	Year	**Takeoff time**	
				Landing time	

Type of Aircraft		**Aircraft Company**	

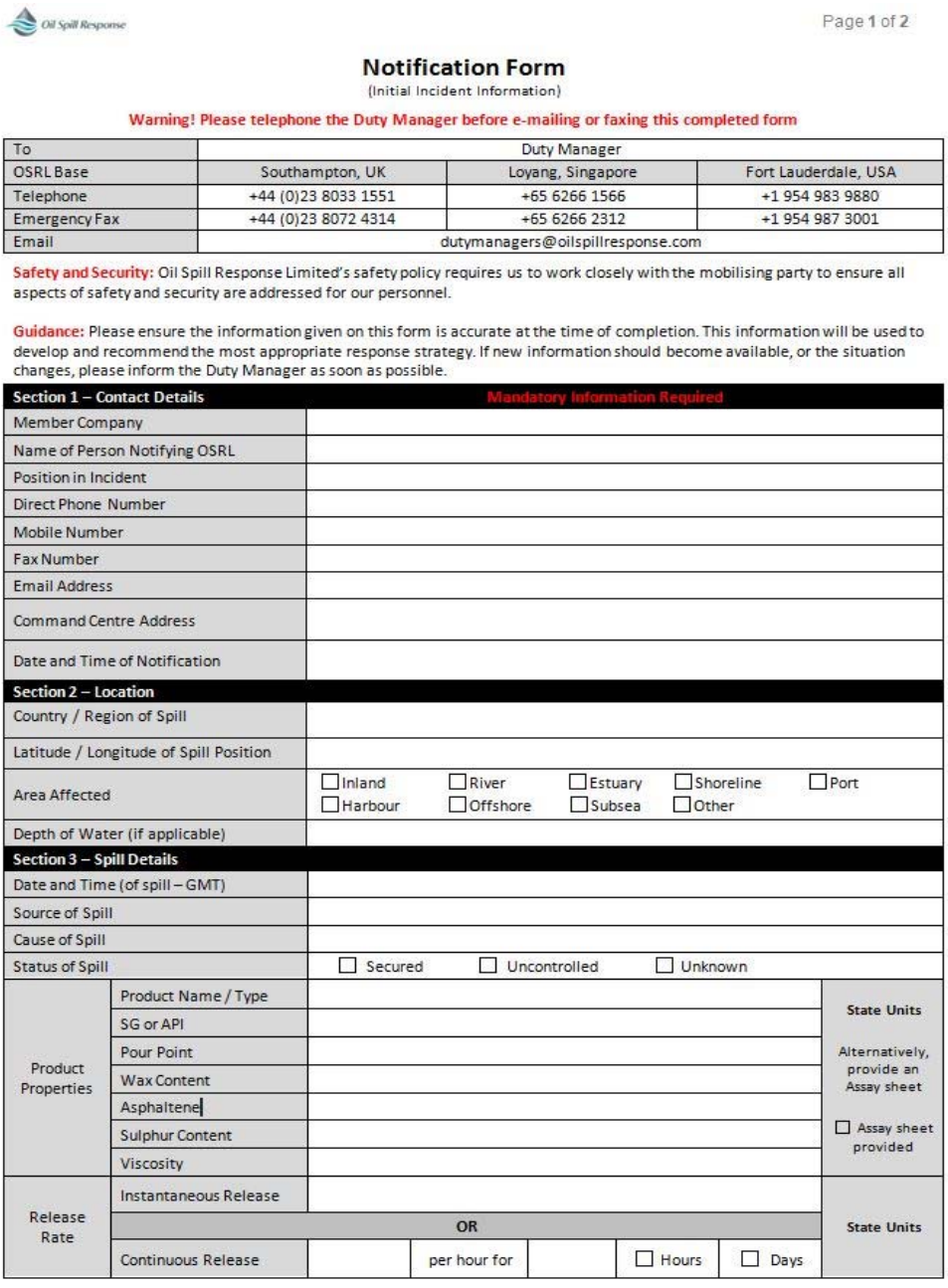
Eni Ghana Observer		**Short description of route**	**Weather**	
Eni Ghana Assistant Observer			**Wind Direction**	
Photos	☐		**Wind Speed**	
Use of GPS	☐		**Sea State**	
Video	☐		**Weather**	☐ Sunny ☐ Cloudy ☐ Rainy

Observations											
Time	**Position**		**Dimensions**		**Oil appearance / Coverage (%)**					**Volume**	**Slick Movement**
Local	Latitude (N)	Longitude (E)	Length (m)	Width (m)	1	2	3	4	5	m^3 / km^3	Direction

Comments / Remarks

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8. OSRL – NOTIFICATION FORM



Oil Spill Response

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Notification Form

(Initial Incident Information)

Warning! Please telephone the Duty Manager before e-mailing or faxing this completed form

To	Duty Manager		
OSRL Base	Southampton, UK	Loyang, Singapore	Fort Lauderdale, USA
Telephone	+44 (0)23 8033 1551	+65 6266 1566	+1 954 983 9880
Emergency Fax	+44 (0)23 8072 4314	+65 6266 2312	+1 954 987 3001
Email	dutymanagers@oilspillresponse.com		

Safety and Security: Oil Spill Response Limited's safety policy requires us to work closely with the mobilising party to ensure all aspects of safety and security are addressed for our personnel.

Guidance: Please ensure the information given on this form is accurate at the time of completion. This information will be used to develop and recommend the most appropriate response strategy. If new information should become available, or the situation changes, please inform the Duty Manager as soon as possible.

Section 1 – Contact Details	**Mandatory Information Required**
Member Company	
Name of Person Notifying OSRL	
Position in Incident	
Direct Phone Number	
Mobile Number	
Fax Number	
Email Address	
Command Centre Address	
Date and Time of Notification	
Section 2 – Location	
Country / Region of Spill	
Latitude / Longitude of Spill Position	
Area Affected	☐ Inland ☐ River ☐ Estuary ☐ Shoreline ☐ Port ☐ Harbour ☐ Offshore ☐ Subsea ☐ Other
Depth of Water (if applicable)	
Section 3 – Spill Details	
Date and Time (of spill – GMT)	
Source of Spill	
Cause of Spill	
Status of Spill	☐ Secured ☐ Uncontrolled ☐ Unknown

Product Properties	Product Name / Type						**State Units**
	SG or API						Alternatively, provide an Assay sheet
	Pour Point						
	Wax Content						
	Asphaltene						☐ Assay sheet provided
	Sulphur Content						
	Viscosity						
Release Rate	Instantaneous Release						**State Units**
	OR						
	Continuous Release		per hour for		☐ Hours	☐ Days	

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Section 3 – Spill Details cont.		Mandatory Information Required	
Description of Observed Spill	Estimated Quantity		State Units
	Size		
	Appearance		
	Direction of Travel		

Section 4 – Weather		
Wind Direction (wind direction given from)		State Units Alternatively provide a local weather forecast ☐ Weather forecast provided
Wind Speed		
Air Temperature		
Sea Temperature		
Sea State		
Visibility		
Cloud Base		

Section 5 – Oil Spill Model Request			
Information you supply in Section 3 (Spill Details) and 4 (Weather) will be used for the modelling			
Do you require Oil Spill Trajectory Modelling?	☐ Surface 2D	☐ Sub-surface 3D*	☐ Not at this time
Additional information (please include start date and time)			
*Separate model request form required. Sub-surface models require additional time and costs.			

Section 6 – Safety and Security		
Highlight any known Safety or Security Risks		☐ N/A
Describe Security arrangements for OSRL staff (if applicable)		☐ N/A

Additional information if available

Section 7 – Resources at Risk	
Environmental or Socio-economic sensitivities that may be impacted (If possible provide the relevant oil spill contingency plan)	
Section 8 – Equipment	
Equipment already deployed or being mobilised (other than OSRL resources)	

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9. OSRL – MOBILISATION AUTHORISATION FORM

Oil Spill Response

Mobilisation Authorisation Form

Warning! Please Telephone the Duty Manager before e-mailing or faxing this completed form

Safety and Security

Oil Spill Response Limited's safety policy requires us to work closely with the mobilising party to ensure all aspects of safety and security are addressed for our personnel.

To	Duty Manager		
OSRL Base	Southampton, UK	Loyang, Singapore	Fort Lauderdale, USA
Telephone	+44 (0)23 8033 1551	+65 6266 1566	+1 954 983 9880
Emergency Fax	+44 (0)23 8072 4314	+65 6266 2312	+1 954 987 3001
Email	dutymanagers@oilspillresponse.com		

Details of Authorised Contact	
Subject	Mobilisation of Oil Spill Response Limited (OSRL)
Incident Name	
Mobilising Company	
Name of Person Authorising OSRL	
Position in Incident	
Direct Phone Number	
Mobile Number	
Fax Number	
Email Address	

Invoice Address	
Purchase Order Number	

I, authorise the activation of Oil Spill Response Limited and its resources in connection with the above incident under the terms of the Agreement in place between above stated Company and Oil Spill Response Limited.

Signature:		Date / Time:		

If Oil Spill Response Limited personnel are to work under another party's direction please complete details below;

Additional Details	
Company	
Contact Name	
Position in Incident	
Direct Phone Number	
Mobile Number	
Fax Number	
Email Address	

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10. VESSEL DISPERSANT APPLICATION LOG

Vessel Dispersant Application Log

Incident:			Date:		
Location:			Vessel Name:		
Operator :		Port Name:		Vessel Type :	
				Vessel Imo Reg. No.:	
Launch Time From Port:		Time Arrived At Spray Site:		Remote Sensing Used:	Yes / No

Observed Conditions In Spray Area

Wind Direction:		Sea State:		Visibility:		Weather Conditions:	

Oil & Dispersant Information

Oil Type:		Oil Volume:		Dispersant Type:		Manufacture Date:	

Run No.	Start Time	Position Lat/ Long Start	Position Lat/ Long Finish	Course Bearing	Spray Run Duration	Quantity Dispersant Remaining	Observed Effects of Dispersant	Comments / Actions Required

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ANNEX C – OIL SPILL TRAINING AND EXERCISES

Training

Individual training requirements will be dependent on the role of the person involved. For example, members of the ERT are isolated from the scene of the actual incident. It is their responsibility to co-ordinate and make strategic decisions, so even though they do not physically use oil spill response equipment they should be aware of all the issues surrounding the response operation. On the other hand, the Offshore ERT will not need to be concerned with crisis management issues, liability, finance and incident analysis. Their duty and purpose is to prepare spill response equipment, liaise with on site local and national authorities, monitor plant function and deploy equipment for clean-up phase. Therefore, eni Ghana must ensure that there are sufficient personnel trained in first aid, oil spill response, oil spill response management and waste management.

Table 43 IMO Course Levels

Course Level	Content and Issues
Level 3 Senior Managers and Administrators	Provides an overview of the roles and responsibilities of senior personnel in the management of incidents, cause and effect of oil spills, response policy and strategies, contingency planning, crisis management, public affairs and media relations, administration and finance and liability and compensation.
Level 2 Supervisors and On-Scene Commanders	Provides detailed training in oil spill behaviour, fate and effects, spill assessment, operations planning, containment, protection and recovery, dispersant use, shoreline cleanup, site safety, storage and disposal of waste, media relations, record keeping, command and control management, communications and information, liability and compensation, response termination and post incident review / briefing.
Level 1 First Responder	Provides training on practical aspects of oil properties, response techniques, health and safety, boom and skimmer deployment, dispersant application, use of sorbents, shoreline cleanup, debris / waste handling and disposal and wildlife casualties.

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Typical levels of training recommended for eni Ghana personnel involved in an oil spill response are provided in Table 44.

Table 44 Training Levels for Oil Spill Response

Emergency Response Role/Job Title	Oil Spill Incident Response Personnel Course			
	IMO Level 3	IMO Level 2	IMO Level 1	Requirement
ER Manager (Managing Director or Deputy)	✓			Recommended
ER Coordinator	✓			Recommended
Logistic Manager	✓			Recommended
HSE Manager	✓			Compulsory
Environmental Department Head	✓			Compulsory
On-Scene Commander		✓		Compulsory
Eni and Contractor Oil Spill Responders			✓	Compulsory

Training Records

It is recommended that eni Ghana database is maintained containing a record of oil spill training, for all company personnel who have attended training (or participated in oil spill response exercises).

Recommended Exercises

It is recommended that eni Ghana exercises the procedures and systems outlined in the OSCP. The various components may be practised separately to minimise disruption to normal operations. As well as improving people's skills and maintaining their awareness, exercises would provide management with an opportunity to assess equipment, familiarise personnel with their roles, measure performance, obtain feedback from participants, update and correct the contingency plans and give a clear message about the company's commitment to oil spill prevention and response.

Exercises may involve any or a combination of the following:

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- Oil Spill Contingency Plan orientation;
- Table top scenarios for the ERT;
- Notification procedures and callouts;
- Equipment deployment;
- Workshops on specific aspects of response, e.g. health and safety, media management, logistics;
- Joint exercises with other oil companies and local authorities;
- Full-scale emergency management exercises.

Oil Spill Contingency Plan Orientation: best conducted as an informal workshop, which focuses on familiarising with roles, procedures and responsibilities. The aim is to review each section of the plan, encourage discussion and make useful and practical improvements to the plan by using local knowledge and expertise.

Tabletop Exercise: uses a simulated oil spill incident to test teamwork, decision-making and procedures. The exercise needs to be properly planned with a realistic scenario, clearly defined objectives for participants, exercise inputs, and a well-briefed team in control of the running and debriefing of the exercise. A tabletop exercise will typically last from 2-8 hours.

Notification and Callout Exercise: practises the procedures to alert and call out the oil spill response teams. They are usually conducted over the telephone or radio, depending on the source of initial oil spill report. Callout exercises test communications systems, the availability of personnel, travel options and the ability to transmit information quickly and accurately. This type of exercise will typically last 1-2 hours and can be held at any time of the day or night.

Equipment and Personnel Deployment Exercise: Exercises or deployments for the marine terminal or joint deployment exercises with the ERT may be simply designed to give personnel a chance to become familiar with equipment, or they may be a part of a detailed and specific emergency response scenario where maps, messages, real-time weather and other factors can be included. Exercises are designed to test or evaluate the capability of equipment, personnel or functional teams within the wider oil spill response. Teams could be located at different places in the field with each team practising different skills. This type of exercise also verifies the availability of oil spill response equipment and that it is in good working order. In deployment exercises the level of difficulty can be varied by increasing the pace of the simulation or by increasing the complexity of the decision-making and co-ordination needs. A deployment exercise would typically last from 4-8 hours. It is recommended that these exercises are carried out every 6 months.

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Full-Scale Incident Management Exercise: provides a realistic simulation by combining all of the elements of the tabletop exercise (maps, communications, etc.) as well as the actual mobilisation and deployment of related personnel and equipment. This complexity requires the response to be more integrated and co-ordinated than in basic tabletop or deployment exercises. The effort and expense in organising a realistic full scale exercise means that it is recommended that they be run only once every three years. It may also be cost effective to run full-scale exercises in partnership with other organisations in the local area.

Full-scale exercises can create a very intense learning environment that tests co-operation, communications, decision making, resource allocation and documentation. People involved in full-scale incident management exercises should have attended earlier tabletop exercises. Organising a realistic full-scale exercise could take many months, requires an experienced planner and a large support team to run the exercise. They generally last at least one day and often carry on overnight into a second or third day.

Training and Awareness – Site Induction

All Contractor employees and subcontractors involved in the project will be given a comprehensive induction before they start work. This environmental training will take place in conjunction with safety awareness training. The environmental aspects will include:

- An overview of the Environmental Management Plan, goals and objectives.
- Awareness in relation to the risk, consequences and methods of avoiding noise pollution, hydrocarbon spills, disturbance to wildlife and disturbance to fisher-folk on the high sea.
- Awareness of individual environmental responsibilities and environmental constraints to specific jobs.
- Location and sensitivity of the proposed OCTP Block project.

All personnel who have attended the Environmental Induction will sign a Register which will be kept on the Project Files. Toolbox talks, based on the specific activities being carried out, will be given to personnel by the nominated project representative. These will be based on the specific activities being carried out. These talks will take place either on the appropriate off-shore vessel or on-site and will include environmental issues particular to the proposed OCTP Block Project, namely:

- Hydrocarbon spill prevention offshore including safe refuelling practice.
- Emergency response procedures used to deal with hydrocarbon spills.

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ANNEX D – LEGISLATIVE AND REGULATORY FRAMEWORK

INTERNATIONAL CONVENTIONS

Ghana is a signatory to following international conventions;

- MARPOL 73/78 (Annex I&II);
- Convention on Civil Liability for Oil Pollution Damage (CLC 1992);
- Protocol Of 1992 To Amend The International Convention On The Establishment Of An International Fund For Compensation For Oil Pollution Damage, 1971 (Fund 1992); and
- United Nations Convention on the Law of the Sea (1982).

International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

The Convention includes regulations aimed at preventing and minimising pollution from ships, both from accidental pollution and from routine operations. There is a requirement for ships to have a SOPEP, in accordance with IMO guidelines and approved by the government of the state under whose authority the ship is operating.

The SOPEP must include

- Procedures for reporting oil pollution incidents;
- List of authorities and persons to be contacted in the event of an incident;
- Detailed description of immediate action to be taken to reduce or control discharge of oil following an incident;
- Procedures and point of contact for co-ordinating spill response actions with national and local authorities

MARPOL 73/78 also provides guidelines for reporting pollution incidents to the authorities and outlines standard reporting procedures. However, most countries have developed their own national guidelines which must be used when reporting an oil spill incident.

Compensation and Liability Conventions

Ghana is a signatory to CLC 92 and Fund 92 providing a higher level of compensation. The Convention on Civil Liability for Oil Pollution Damage (CLC 1992) deals with compensation for damages from spills of persistent crude and fuel oil from tankers. It does not cover oil spills from offshore installations.

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Eni Ghana does not have any oil tanker interests, however if an incident occurs in the Ghanaian Exclusive Economic Zone there may be strong business, political and ethical reasons for eni Ghana to play an active role in the oil spill response.

The United Nations Convention of the Law of the Sea (1982)

The United Nations Convention on the Law of the Sea (1982) also referred to as the Law of the Sea Convention or the Law of the Sea treaty, is the international agreement that 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 resources. UNCLOS came into force in 1982.

REGIONAL CONVENTIONS

Abidjan Convention

Ghana is a contracting party and has ratified the Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the Abidjan Convention) and its Protocol Concerning Co-operation in Combating Pollution in Cases of Emergency. The provisions cover the development of legislation and contingency plans, exchange of information, reporting of incidents and mutual assistance. The Emergency Protocol describes how governments in the region should work towards co-operation in responding to marine pollution incidents, including oil spills.

NATIONAL LEGISLATION

The EPA Act 490 designated the Minister for Environment & Science responsible for the implementation of the National Oil Spill Contingency Plan (NOSCP) and enforcement of relevant laws relating to the protection of the Marine Environment, inland waterways including Lake Volta, and terrestrial eco-systems.

National Response System

A Model National Response System to oil spills comprises of the following:

- National Competent Authority (NCA);
- National Contingency Plan (NCP);
- National Notification Point(s).

This comprises of the following:

- Emergency response staff that are trained and exercised;
- Emergency equipment for salvage, search & rescue and counter pollution;

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- National budget:

    a) The lead agency is the Environmental Protection Agency (EPA), which works in conjunction with the Ministry of Transport & Communications. The Chief of Naval Operations would provide the On-Scene Commander (OSC) to coordinate military involvement in reconnaissance and clean-up.

    b) A NOSCP has been issued. Containment and recovery is reported as the preferred response strategy. Dispersant use is permitted in some cases. The risk assessment reports the high risk of shoreline oiling due to onshore winds.

    c) The National notification point for oil spills is the Operations Room, Navy Headquarters, Burma Camp, Accra. Alternatively notification may be made via Coast or Port radio to the stations at Tema or Takoradi.

    d) IMO Model Training Courses have been conducted with the relevant agencies. The IMO/IPIECA Global Initiative program has also been actively raising the awareness and capability of both Government and Industry up to IMO Level 3 standard.

    e) The Ghana Ports & Harbour Authority have two tugs in Tema and one tug in Takoradi fitted with booms, skimmers and temporary storage for recovered oil*. Also some vacuum trucks are also available. Military sources under the control of the OSC would provide aircraft for surveillance and monitoring duties. (*information source slightly out of date, accuracy to be confirmed).

Ghana National Oil Spill Contingency plan

Ghana has documented a NOSCP which covers minor and major spills for both coastal and inland waters. The NOSCP details the government response to a spill, reporting requirements and in the case of an oil spill not having an owner, the oil spill response. The NOSCP requires the government to have sufficient oil spill equipment to respond to an oil spill of 25,000 tonnes. This equipment is based at the Tema Port.

Detailed in the NOSCP and the National Oil Spill Strategy Document, the Ghanaian government expects industry to fulfil the following requirements and responsibilities:

- prevent possible oil spills during normal operations;

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- Develop and maintain oil spill contingency plans appropriate to their industry, location and risk profile;
- Provide, at least, an initial response to oil spills they are responsible for, and more if practical;
- Develop, actively promote and audit an oil spill prevention philosophy and practice to a high standard among all those associated with handling oils;
- Develop and maintain approved, site-specific OSCPs, including:
  - identifying locally sensitive environments;
  - identifying a means to rescue and rehabilitate oiled wildlife;
  - nominating suitably qualified persons to act as the industry representative to the National Oil Spill Centre.
- Develop and maintain an operational response capacity to oil spills, as specified in the site OSCP;
- Ensure the safety of industry personnel;
- Be a party to the national response effort as agreed to in the NOSCP;
- Assist the National Oil Spill Centre with the salvage, storage, disposal and recycling of recovered oil;
- Assist the Oil Spill Centre as required with skills, resources and expertise; and
- Support Role to the National Competent Authority.

Support Role to the National Competent Authority

The role of eni Ghana is to support the National Competent Authority (i.e. EPA) towards the successful conclusion of any oil spill with eni Ghana interest.

- In cases where eni Ghana holds the lead response organisation role (100% interest), eni Ghana will employ all such reasonable dedicated and opportunity combat resources as are available by company access, mutual aid, contract or opportunity (market) to mitigate the impacts of the oil spill.
- In cases where eni Ghana does not hold the lead response organisation role i.e. third party spills; eni Ghana must be prepared to offer proactive support to help remedy the emergency situation. Proactive support includes offering all such resources available to eni Ghana that would be considered for stand-by/mobilization if eni Ghana held the lead response organisation role. Proactive support will stop short of taking overall command.

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ANNEX E – ENI HEALTH, SAFETY & ENVIRONMENTAL (HSE) GUIDELINES

eni ghana exploration and production ltd

Health, Safety & Environmental (HSE) Guidelines

GUIDELINES

eni ghana is committed to guarantee a sustainable Exploration & Production of Oil & Gas in Ghana by applying its best standards in order to achieve and maintain excellence in all aspects of its operations. As a responsible corporate citizen, the Company recognizes and accepts a duty to conduct its operations in such a way that protects the health and safety of its employees, contractors, visitors, and the general public, while preventing pollution and minimizing any adverse effects on the environment and the greater community.

The Company shall, in all of its operations and in all of its locations where work is being carried out under its control, promote the highest standards for the protection of health, safety & and the preservation of the environment.

PRINCIPLES

The Company's HSE Guidelines are based on the following principles:

- To comply with the appropriate legal requirements of the Republic of Ghana, including but not limited to the upstream rules and regulations for oil & gas exploration and production activities, as well as other requirements which eni ghana voluntarily subscribes to, and those international standards which the Company intends to follow.
- To adopt and be fully compliant with all the eni s.p.a Policies.
- To prevent illness and injury and promote both health & safety of the Company staff, Contractors and Subcontractors and other persons involved in the Company business activities.
- To minimise/avoid workplace incidents and continuously improve the Company's HSE performances.
- To prevent pollution and minimise any negative impacts on the environment.
- To take into account the social impact of the Company's business activities.
- To be fully prepared to respond to any HSE emergency event.
- To promote a culture in which all employees of the Company share this commitment.
- To manage Health, Safety,Environment and Sustainable Development issues in the same manner as any other critical business activities.

METHODS

In order to guarantee the practical application of these principles, the Company shall:

- Identify, evaluate and manage risks for both human health and environment from the Company's operations and take appropriate and timely actions.
- Establish accountability & responsibility for Health, Safety, Environment and Sustainable Development within the organization and its management.
- Ensure that its contractors and their HSE Management Systems are in line and consistent with this document.
- Provide HSE awareness training to all personnel and promote the exchange of experience and information and encourage the active involvement of employees in the management of HSE aspects.
- Include HSE performances in the appraisal of all staff.
- Maintain externally certified Health, Safety and Environmental Management Systems.
- Take into account the expectations of local community stakeholders in the Environmental Impact Assessments of all new operational activities.
- Require and fully support its staff to intervene and stop an activity in case they believe it is unsafe or fails to meet the Company's HSE Guidelines.
- Measure, appraise and report on HSE and Sustainable Development performances and implementation of the HSE Management System and ensure adequate feedback of information in order to facilitate continuous improvement.
- Establish and maintain, effective Emergency Response Plans (ERP's), where appropriate, in conjunction with the competent local authorities.

In this way the Company aims to ensure and maintain the highest level of HSE standards and performances and to be proud of, to earn the confidence of its stakeholders and society at large, and to promote Sustainable Development.

This document shall be reviewed at least every 12 months or when considered necessary to verify its on-going relevance and adequacy in light of changes in the nature and scale of the Company's activities, legal and other requirements to which the Company subscribes, and the expectations of the Company's stakeholders.

Fabio Cavanna

Managing Director **March 2013**

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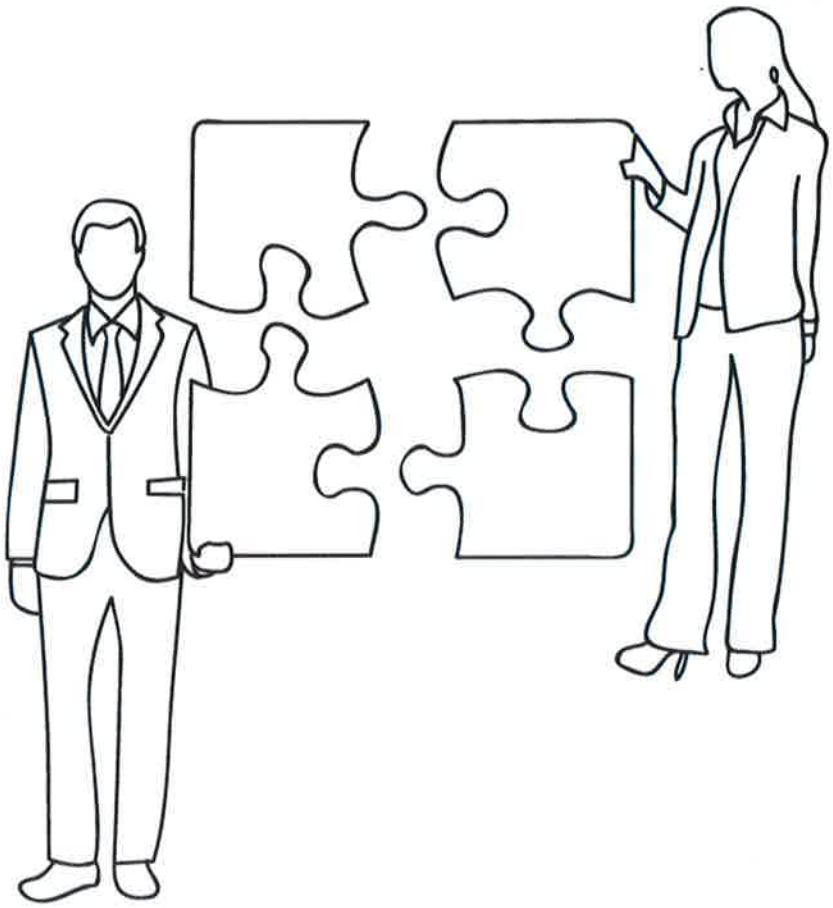
ANNEX F – ENI REFERENCES UTILISED

- Eni GHANA OCTP DEVELOPMENT PROJECT BASIS OF DESIGN (Company Document ID 351400FGRB09400)
- Eni GHANA OCTP DEVELOPMENT PROJECT HAZID Reort (Company Document ID 351400BFRB09952)
- Eni GHANA OCTP DEVELOPMENT PROJECT SSIV (Sub Sea Isolation Valve) Study (Company Document ID 351400BFRF09501)
- Eni GHANA OCTP DEVELOPMENT PROJECT BLOWOUT AND DYNAMIC KILLING STUDY IN THE GHANA OCTP BLOCK (Company Document ID 000000AAAA00000)
- Eni HSE-PLAN-003 "DRILLING OIL SPILL CONTIGENCY PLAN – OCTP Block" rev.02
- Eni Ghana OCTP Block Phase 1 Environmental Social and Health Impact Assessment (ESHIA) (Doc. 000415_DV_CD.HSE.0208.000_00)
- Eni Guidelines for Oil Spill Contingency Planning Process (opi sg hse 013 e&p r01)

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Plan

HSE-PLAN-005 "Waste Management Plan"



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TITLE:
Waste Management Plan
NOTE:
To be consider as uncontrolled copy once downloaded from intranet

DATE OF ISSUE:	EFFECTIVE DATE:
April 2015	April 2015

PREPARED BY:	CHECKED BY:	APPROVED BY:
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DISTRIBUTION LIST

For application:

- eni Ghana department managers

For information:

- All eni Ghana employees
- eni e&p EMERG/SEQ

REVISION SHEET

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1 PURPOSE

This document details the overall strategy adopted by Eni Ghana for the management of waste to be generated during the course of conducting offshore and onshore operations (rigs, seismic, charter vessels, onshore support facilities). It covers collection, storage, treatment, transport, disposal, discharge, reporting and data management.

Activities identified as generating waste should have an individual Waste Management Plan (WMP). These WMPs will include site-specific procedures detailing exactly how waste is to be managed, treated and disposed-of. The WMPs should identify the waste stream, point of generation and handling procedures. It should define the approved waste handling contractors, final disposal sites and provide with guidelines for the management of Duty of Care tracking system and site audits and inspections program.

2 SCOPE OF APPLICATION

This document covers the following disciplines:

Health	Safety	Environment
✓	✓	✓

This procedure applies to activities in all eni Ghana locations/sites for the waste management activities.

3 REFERENCES

3.1 External References

[Rif.A1]	*Organization of the Health, Safety, Environment and Public Safety Integrated Management System P n. 1.3.0.1*
[Rif.A2]	*"Standard", eni E&P Document Number 1.3.4.05 - "Waste, wastewater, tenorm and drilling residues management" except wastewater (*)*

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3.2 Internal references

[Rif.B1]	*"HSE Manual", eni Ghana Document Number HSE.MAN.001*

3.3 Compliance With Statutory Regulations

General Waste Management in Ghana is the responsibility of the Ministry of Local Government and Rural Development, which supervises the decentralized Metropolitan, Municipal and District Assemblies (MMDAs). However, regulatory authority is vested in the Environmental Protection Agency (EPA) under the auspices of the Ministry of Environment and Science. The Metropolitan, Municipal and District Assemblies are responsible for the collection and final disposal of solid waste through their Waste Management Departments and their Environmental Health and Sanitation Departments.

The legislation guiding the management of hazardous, solid and radioactive waste is scattered amongst a range of Acts and policies, including the Local Government Act (1994), Act 462, the Environmental Protection Agency Act (1994), Act 490, the Pesticides Control and Management Act (1996), Act 528, the Environmental Assessment Regulations 1999, (LI 1652) the Environmental Sanitation Policy of Ghana (1999), the Guidelines for the Development and Management of Landfills in Ghana, and the Guidelines for Bio-medical Waste (2000).

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4 ACRONYMS

E&P	Exploration & Production
HSE	Health, Safety, Environment and Public Safety Integrated Management System
BAT	Best Available Techniques
IMS	Integrated Management System
BAT	Best Available Technology
ALARP	As low as Reasonable Practicable
DOT	United States Department of Transportation
IMDG	International Maritime Dangerous Goods Code
MSDS	Material Safety Data Sheets

5 DEFINITIONS

Hazardous Waste	Any material that, because of its quantity, concentration, or physical or chemical characteristics, may pose a real hazard to human health or the environment.
Waste	Any material which is introduced into the work location as a product of the work but which fulfils no further useful purpose, at the location.
Discharge	Any controlled and regulated release of wastewater or liquid waste to surface water bodies
Disposal	Any waste management operation different from reuse, recycling, treatment and discharge, even where the operation has as a secondary consequence, the reclamation of substance or energy.
Treatment	Any operation, including reprocessing, that makes the waste suitable for recycling or disposal by reducing its contaminant load and/or changing its chemical-physical properties
Recycling	Any operation by which waste materials are reprocessed into products,

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	materials or substances whether for the original or other purposes
Reuse	Any operation by which by [residual] product or component that are not waste are used again for the original or other purposes without reprocessing

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6 WASTE MANAGEMENT GENERAL PRINCIPLES

All waste resulting from Operations and other activities will be managed to ensure protection of the natural environment and the health and safety of personnel and the community – Refer to Decision Making Tree. Waste management activities will be performed in accordance with the following waste management hierarchy principles to:

- Reduce the quantity by better management.
- Re-use materials where possible
- Recycle where feasible.
- Recover as much as possible.
- Responsible disposal

Waste minimization and the application of these principles shall be addressed in the Contracts and Procurement Execution Strategies for the project and taken into consideration when reviewing shipping, storage and disposal method throughout the project life span.

6.1 Duty Of Care

Eni Ghana recognizes that it has a duty to ensure that any waste it generates is handled safely and in accordance with local regulations and Company Policies. Eni Ghana recognizes his responsibility to ensure the safe and proper collection, transportation, treatment and final disposal or recovery of waste that it generates.

6.2 Waste Identification And Classification

For all waste, both hazardous and non-hazardous, a risk assessment will be carried out by the Waste Handling Contractor with the support of the HSE&CI Department as required, to properly identify and classify each waste generated. Once identified, the proper waste handling techniques should be defined to determine on the manifest and provide appropriate handling

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guidance.

The HSE&CI Department should be consulted in the event that new waste streams are identified by Rig, Contractor, etc ensure that all relevant risks are assessed and appropriate storage and disposal options are provided. The risk classification will be included in any relevant waste documentation. Any unidentified wastes will be quarantined and investigated until an appropriate disposal option is identified.

6.2.1 Hazardous Waste

Waste that exhibit one or more of the characteristics such as ignitability, corrosivity, reactivity, toxicity, which are mutagenic, teratogenic, infectious, irritant, carcinogenic, ecotoxic and non-biodegradable, flammable and highly flammable, explosive, e.g. which can be harmful to health and can cause damage to the environment (land, water contamination, air pollution). The following table lists hazardous waste examples and their sources in the oil industry.

Waste	Activity	Hazardous content
Batteries	Various	Heavy metals, acid, alkali, cadmium
Cement spacers	Cement chemicals	Metals, thinners, viscosifiers, pH salts
Oily contaminated material	Spill, leaks, bunkering errors, rig wash	Hydrocarbons, detergents
Dispersants	Spill clean up	Surfactants
Drilling fluid chemicals / completion fluids	Drilling	Biocides, surfactants, metals, emulsifiers, viscosifiers, organics, salts
Fire fighting agents	Fire fighting	Dry chemical powder, chemical foam and CO2
Synthetic oil based mud	Vessel tank cleaning / Drilling	Linear Alpha Olefins and mud additives
Incinerator ash	Burn box	Heavy metals, salts, ash
Clinical waste	First aid and	Pathogenic Organisms, Plastic, Glass, Medicines,

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	medical support. Sharps and softs.	Needles, Dressings, Cleaning Materials Etc, Blood
Mercury	Instruments, production test	Mercury
Stimulation fluids	Well stimulation	Acids, hydrocarbons, methanol, corrosion inhibitors, oxygen scavengers, formation fluids, gelling agents
Unused chemicals	Drilling	Various mud chemicals
Waste lubricants	Equipment lubrication	Contaminated hydrocarbons
Office waste	Printing material	Cartridges, and toner

Table 1 – Hazardous Waste and Sources

In addition, special hazardous waste categories include:

- **Biohazards** such as medical waste, (sharps e.g. syringes, scalpels & softs e.g. soiled medical dressings). See Appendix 4. Medical Waste Procedure.
- **Radioactive waste** such as Naturally Occurring Radioactive Material (NORM) or Technologically Enhanced Naturally Occurring Radioactive Material (TENORM).

6.2.2 Non-Hazardous Waste

Waste that do not exhibit any of the characteristics of hazardous waste which are biodegradable or inert and do not cause any harm to people and environment. When placed in a landfill it is reasonably expected that non hazardous waste will not undergo any physical, chemical, and/or biological changes to such an extent as to cause pollution or hazard to public health and safety. Categories of non-hazardous waste or inert waste are further classified according to their source. These are:

- **Industrial Waste.** This is defined as any non-hazardous operational waste. It includes: scrap metal, construction waste (concrete, bricks etc.), wooden pallets, plastics and cardboard packaging. It excludes

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materials contaminated with hazardous substances. It can also include some categories of drilling fluid components and drill cuttings and some waste from offices.

Note: There is often considerable potential for reusing and/or recycling industrial waste. This requires segregation into discrete sub-categories, e.g. scrap metal, plastics, wood, glass, general, etc.

- **Office Waste.** This includes items such as used stationary, plastics, packaging materials, printer cartridges and toner for copying machines.
- **Domestic Waste.** This category includes kitchen waste from the rig galleys, offices, operational and residential accommodation and locations, as well as refuse from general maintenance activities such as cleaning, cooking (except spent cooking oil) and gardening.

6.3 Waste Storage And Segregation

Waste storage areas will be provided for waste containers at each facility. Hazardous and non-hazardous waste will be segregated in designated storage areas. These areas are to be indicated on the facility site plan. Waste must be stored in a manner to prevent:

- Accidental spillage or leakage
- Accidental fire
- Contamination of soils and groundwater
- Corrosion or wear of containers
- Loss of integrity from accidental collisions or weathering
- Theft by people
- Scavenging by animals.

Waste storage containers will be appropriate in terms of volume, composition, shape and access for the material that is being stored. Only containers in good condition will be utilized. Bungs and lids will be securely

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fastened or other forms of covering shall be provided. Storage of waste will be carried out in accordance with the MSDS sheet, in a designated area, with a suitable surface and a method to contain any leakage or contaminated runoff water. Containers used shall be inert in relation to their content, clearly labelled, indicating the characteristics of the content, date of containerizing or packing, and data on toxicity and/or potential contaminant.

6.4 Container Suitability And Labelling

Prior to allowing the consignment of waste to leave an operational site, the eni Ghana HSE Department through delegation shall ensure that the waste containers are:

- Clearly labelled to describe the waste it contains – using the appropriate waste labels which should be completed in full – old labels should also have been removed to avoid confusion as to the contents of the container. Refer to Section 5.1 for Colour Coding;
- In good condition and are not leaking;
- Acceptable for shipment to avoid the need to change containers prior to shipping (e.g.: in compliance with applicable legislations on transport of dangerous goods such as : IMDG, DOT, etc.);
- Sufficiently sized to prevent overflow;
- Appropriate to the waste they contain;
- Appropriately sealed e.g., with a lid or bung;
- Not emitting any harmful gases or generating heat. This could be a sign that incompatible waste have been stored together resulting in an adverse chemical reaction.

6.4.1 Shipping Offshore Waste Container

As much as reasonably possible, the waste containers should be compliant as

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per ISO 1496 or EN 1279 standards, in order to ensure that the wastes are stored in fit for purpose containers.

Note: Any unidentified waste should be quarantined. If any of these have not been done or have been done to a poor standard, the waste consignment should not be allowed to leave the facility. The HSE&CI Department or responsible person should be contacted who will take all necessary corrective action(s) to rectify the situation before allowing the waste to leave the facility.

6.5 Waste Transfer Notes (WTN)

Waste Transfer Notes (Waste Transfer and Disposal Waybill) are fundamental to ensuring that waste is transferred from the producer, though transportation chain to the disposer and provide a record of due diligence and 'Duty of Care'.

It is a paper or hard copy waste consignment / transfer system, that tracks the waste stream from the point of origin to the deposit location. Transfer notes will accompany all waste consignments originating from relevant operational sites, and will be duly completed with the details required within the Waste Transfer Notes and the appropriate signatories. An example of the Waste Transfer Notes is included as Annex 1.

6.5.1 Waste coding

For accounting purpose and easily waste identification have been put in place a waste coding system as follows:

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Code	Waste category	Code	Waste category
001	WBM (Only if waste)	**032**	Produced water
002	WBM Cuttings	**033**	Oily sludge
003	OBM (Only if waste)	**034**	Production slops / paraffin
004	OBM Cuttings	**035**	Spent production chemicals
005	SBM (specify synthetic base)	**036**	Oily wastes and rags
006	SBM Cuttings (specify Synth. base)	**037**	Plastic
007	Spent Brines	**038**	Wooden pallets
008	Spent non – Hazard. chemicals (list)	**039**	Mixed waste (paper, plastic, wood)
009	Spent Hazardous chemicals/cushions	**040**	Oil polluted soil/concrete
010	Milling waste	**041**	Clinic Waste
011	Cooling water	**042**	Expired medicines
012	Scrap metals: tubings	**043**	Spent Oil
013	Scrap metals: other metals	**044**	Gaskets non containing asbestos
014	Scrap metals: steel	**045**	Dismissed piping/vessels
015	Empty metal drums	**046**	Production scales
016	Empty plastic drums	**047**	Sand blasting residuals
017	Rig mixed waste (paper, plastic, wood)	**048**	Paint residuals
018	Accumulators/Batteries	**049**	Soot
019	Spent Lubricants	**050**	Spent activated carbon
020	Contaminated soil	**051**	Fluorescent lamps
021	Contaminated Concrete	**052**	Glass and bulbs
022	Other masonry waste	**053**	Refrigerating fluids containing CFC
023	Tyres	**054**	Waste containing PCB/PCT
024	Dismantled piping/vessels	**055**	Sewage water
025	Scales	**056**	Septic tanks settlings
026	Wood and Pallets	**057**	Non-food waste (detergents etc.)
027	Plastic Packaging/Wrapping	**058**	Spent cooking oil
028	Waste containing Asbestos	**059**	Food waste (except cooking oil)
029	Waste containing rock- or glass fibre	**060**	Oily water
030	Spent lubricants	**061**	Removed Vegetation
031	Filters	**062**	Unused Soil

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Table 2 – Waste coding

6.6 Waste Monitoring, Inspection And Reporting

All waste producers (Operations, Contractors and sub-contractors) are required to keep a waste register and an inspection and reporting plan.

The frequency and type of inspection shall be agreed by all parties with the inspection covering all waste generating activities through segregation, handling, storage and final disposal.

A designated on-site staff member shall maintain the waste register (waste log) and copies of all consignment notes (Waste Transfer Notes) that have been produced from the site. The waste register (waste log) will be available on all eni Ghana workplaces in hard copy. The waste register shall contain a record of all waste arising. It will also serve as an index for all WTN consignments.

The Waste Register (waste log) shall include, as a minimum, the following information:

- Source of waste (eg rig, vessel, Logistics Base, etc)
- Waste description (e.g.: oily rags)
- Classification of waste streams (i.e. hazardous or non-hazardous)
- Quantity (weight (kg) or volume (lt or m3).
- Waste Transfer Note numbers
- Dates of transfer.

All reports shall be passed from the waste contractor to the HSE&CI Department for review and provide feedback to Management.

6.7 Waste Transportation, Disposal Sites – Approved Contractors

All waste shall be handled in a safe and efficient manner taking into consideration associated MSDS information (if any).

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Transportation will be via well maintained, legally compliant and 'fit for purpose' vehicles, with appropriate documentation and driven by fully trained operators. Where relevant vehicle shall carry spill containment equipment.

Only approved contractors, which meet the appropriate standards will be used for transportation and disposal of waste. Site visits of disposal sites will be conducted and later inspected / audited by the HSE&CI Department, or independent consultants.

6.8 Spent Oil ,Spare Parts, Paint/ Thinner Tins From All Contractors

Spent oils, spare parts (ex. Filters, batteries, ext) and paint/thinner tins produced by rig maintenance or other 3rd party equipments, will be disposed by the producer himself that shall ensure a correct storage, transfer and disposal being able to provide evidence of this process if requested by eni Ghana.

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7 DISPOSAL GUIDELINES

Waste management is an activity whereby the application of the Reduce, Reuse, Recycle principle should always apply. In effect each waste stream must be addressed to determine the optimum disposal option. The sequence for evaluation is as follows:



7.1 Waste Reduction, Disposal and Decision Tree

A key feature of this process is the need to ensure appropriate identification and segregation of waste streams. To facilitate this colour coded containers as described below will be used. The Waste Reduction, Disposal and Decision Tree, shown in Figure 1 details the overall process used for determining the most appropriate method of disposal.

General Waste	
Hazardous Waste	
Scrap Metal	
Wood	
Spill Kit	

Table 3 – Waste Management Color Coding

7.2 Drilling and Logistics Base Waste

This section covers the waste segregation instructions for drilling operations and eni Ghana Logistics Base operations

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Listed in table 2 are the waste streams generated and the preferred disposal method;

7.2.1 Non-Hazardous Waste

Category	Type	Source	Transportation method	Sea transport	Storage Logistics base	Final treatment / Destination
Wood	Pallet, crate, beam, general packaging, plywood, doors, furniture	Rig/Ship/ Yard	Open skip / empty return container	Same, but cover with net	same	Reuse/Municipal Landfill
Food	Organic waste, food etc.	Rig/Ship/ Yard				Ground for discharge to sea, at base treated as general waste to landfill
General Waste	domestic waste, paper, tins, cardboard, plastic, glass; textiles (non-contaminated),	Rig/Ship/ Yard	Open skip	Same, but cover with net	same	Municipal Landfill
Metal	steel, gratings, sheet steel, iron beams, 20ubular and casings etc	Rig/Ship/ Yard	Open skip	Same, but cover with net	same	Recycle in Ghana – send to scrap metal merchant
Empty barrels	empty barrels	Rig/Ship/ Yard	Closed container or half height	same	same	Recycle (after puncturing or crushing) – send to scrap metal merchant
Top soil	from ORF excavations and trenching works	Preliminary works, earth moving, excavation	Tipping truck covered with net	no		Reuse at source
Vegetation	ORF area trimmings, felled trees, cleared vegetation, etc.	Site clearance, early works	Tipping truck	no		Reuse at source

Table 4 – Drilling – Non Hazardous Waste Handling

Note: Plastic, drums and other receptacles / containers should not be made available to locals as they could be used as potable water containers.

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Because their contents could previously have included degreasers, soap, thinners and other chemicals, it is advisable to make such containers unserviceable and not to allow them to be dumped at uncontrolled landfill sites.

7.2.2 Hazardous Waste

The eni Ghana hazardous waste stream is listed below.

Type	Source Rig/Ship	Rig container	Sea / road transport method	Storage supply base	Final treatment / Destination
Battery (containing heavy metals / acid)	Rig/Ship/ Yard	Barrel	Return container	Barrel	Contractor continuous discussion with EPA to determine approved treatment and disposal
Paint and thinner (liquid)	Rig/Ship/ Yard	Barrel	Return container	Barrel	Contractor continuous discussion with EPA to determine approved treatment and disposal
Spray can/ aerosol	Rig/Ship/ Yard	Barrel	Return container	Barrel	Contractor continuous discussion with EPA to determine approved treatment and disposal
Fluorescent tube/light bulb	Rig/Ship/ Yard	Original packing	Return container	Barrel	Contractor continuous discussion with EPA to determine approved treatment and disposal
Chemical (pure)	Rig/Ship/ Yard	Barrel / tote tank/ or original packaging	Closed container or tote tank	Closed container or tote tank	Contractor continuous discussion with EPA to determine approved treatment and disposal
Chemical mixture	Rig/Ship/ Yard	Barrel / tote tank/ or original packaging	Closed container or tote tank	Closed container or tote tank	Contractor continuous discussion with EPA to determine approved treatment and disposal
Oily solid waste (rags, filter, gloves, etc)	Rig/Ship/ Yard	Clip top drum or lidded skip	Clip top drum or lidded skip	Clip top drum or lidded skip	Contractor continuous discussion with EPA to determine approved treatment and disposal
Used oils	Rig/Ship/ Yard	Mobile tank/barrel or ships hold	Mobile tank/barrel or ships hold	Mobile tank/barrel	Delivered to recycling contractor approved by EPA
Oily water (slop)	Rig/Ship/ Yard	Mobile tank/barrel or ships hold	Mobile tank/barrel or ships hold	Mobile tank/barrel	Delivered to recycling contractor approved by EPA
Low toxicity Oil Based Mud	Rig	Mobile tank/barrel or ships hold	Mobile tank/barrel or ships hold	n/a	Third part recovery
Medical Waste (needles, bandages, blood, etc)	Rig	Bio-hazard bag & box	Bio-hazard bag & box	Bio-hazard bag & box	For Incineration at Takoradi hospital

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Medicines			By Air -Escorted Sealed bag		For medical disposal at Takoradi Hospital
Asbestos containing material (If any)	Caf gaskets, building material				To be treated on an ad hoc basis subject to separate risk assessment
Radioactive waste					Separate risk assessment and procedure

Table 5 – Drilling – Hazardous Waste Handling

Note: Hazardous waste, excluding oily waste, will be stored in a suitable disposal as there is no suitable hazardous waste treatment facility in Ghana.

Note: Discharge at sea of OBM cuttings should be avoided, in case of discharge at sea of OBM cutting these shall not exceed 1 % oil content or ALARP using BATs.

7.2.3 *Drilling Waste Strategy*

The strategy for management and disposal of drilling waste is below described:

- Minimize waste generation.
- Waste shall be segregated and deposited where practicable into clearly coded skips (see colour codes above) for: General waste, Hazardous waste, Recyclable/metal). Maintain sufficient containers or skips for each waste stream. Where it is not practicable alternative containers may be used provided they are fit for purpose and clearly labeled.
- Liquid waste shall be contained in tote tanks, and / or suitable containers and appropriately palletized.
- Offshore monthly waste reports sheets will be transmitted to:
  - Operations Logistics Base Superintendent who shall verify and compare quantities received by Disposer and compare, and to HSE&CI Department for monitoring and reporting purposes.

7.2.4 *Logistics Base Strategy*

The strategy for management and disposal of logistic base waste is below described:

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- Minimize waste generation.
- Waste shall be segregated and deposited into color coded containers.
- Waste to be disposed of via licensed Landfill Waste Management Contractor.
- Disposal of reusable waste, scrap and lubricants will be arranged by the Logistics Base.
- Logistics Base staff will complete the respective Waste Transfer Notes to detail waste leaving the premises.

7.2.5 Waste Contractors Responsibilities

- Submit a Monthly Waste Report to eni Ghana.
- Provide eni Ghana of all waste transfer and disposal waybill duly signed in all his sections.
- Provide documentation confirming receipt of waste and quantities involved using the Waste Transfer Note system.
- Dispose of waste in accordance with contract conditions.
- Provide feedback to eni Ghana HSE&CI Department to inform or advise on areas of difficulties encountered in waste handling with either documentation or packaging and to suggest areas for potential improvements.

7.3 Available Disposal Options

Existing methods of disposal for waste streams arriving in Takoradi, or directly on the rig, are summarized below.

- **Incineration**

  For non-hazardous and hazardous wastes an approved contractor will use incineration site in Takoradi. (Zeal is the EPA approved contractor

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for Takoradi).

- **Landfill**

  For non-hazardous wastes an approved contractor will use the Takoradi landfill site. (Zeal is the EPA approved contractor for Takoradi).

- **Scrap Metal recycling**

  The plan is to dispose of scrap metal via existing recycling nodes using an approved contractor.

- **Waste Oil treatment and recycling**

  Waste Oil will be disposed of for recycling by an EPA approved contractor to be used by EPA approved operators in the bitumen producing industry, various industrial heating and drying process and the wood treatment industry.

- **Other Hazardous waste**

  Storage at a safe secured site (this is the short term method in place at present – the key objective is to ensure no possibility of hazardous waste entering the non-hazardous waste stream and risk to human and environmental health).

- **Burning Basket**

  The use of a burning basket for non-hazardous galley and cabin waste can be considered offshore if suitable and sufficient risk assessment and procedure is complied with, and provided the provisions of MARPOL Annex V are complied with, and care is taken that no plastic is in this waste stream. In addition, any identified risk issues would preclude the use of this method.

7.4 Discharge At Sea (Off Shore)

- Uncontrolled disposal or discharge of drilling wastes is strictly forbidden.

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- Evidences of the assessment to minimize the marine environmental impact adopted all the precautions (for example reduced waste volumes and used environmental friendly products) shall be maintained available for review.
- Drill cuttings discharge shall be in compliance with government and local regulations, and at the same time comply with IFC EHS Guidelines for Offshore Oil and Gas Development.

7.5 Monitoring And Documentation

The HSE&CICI Department shall monitor and record the Monthly Waste Reports submitted by the waste contractor. Waste generated on and off shore shall be recorded.

Reports shall be reviewed:

- to confirm the accuracy of reporting.
- to ensure the Waste Management Plan is being implemented correctly and that standards are being met.
- to monitor waste volumes and streams to identify trends and areas of improvement.,
- to report to the eni Ghana HSE Steering Committee,
- to report to eni E&P Corporate offices.

7.6 Records

Records are required to be kept by relevant parties as follows:

- Waste records will be formally be kept by :
  - the Rigs and vessels – i.e Waste Register including transfer note copies.

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- by the HSE&CI Department – Waste register, Monthly Waste Reports for rigs and Logistics Base and disposal contractor Monthly Waste Reports,

- The MSCRO shall submit a Monthly Waste Report (see Annex-3) to HSE&CI Department in Accra.
- The eni Ghana HSE Advisor on the rig shall have access to all records and maintain a record of waste monitoring activities and audits.

7.7 Review and Update

The waste management system needs to adapt to relevant changes such as in the event of:

- Changes to laws and regulations;
- Changes in eni Ghana guidelines, protocols and reporting procedures;
- Changes in eni Ghana program activity;
- Identified deficiencies or improvement opportunities;
- Infrastructure developments.

Audits and inspections are performed according to the HSE Management System audit programme and include both in-house and external auditing.

External audits may be commissioned on an annual basis by the HSE&CI Department.

Key outcomes from review and audit activities are tracked to ensure that waste minimisation opportunities are identified, to help establish goals and objectives, and to improve the Waste Management Strategy.

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8 HEALTH AND SAFETY ASPECTS

The potential hazards of materials and unsafe conditions must be determinate for both new waste materials. All applicable Material Safety Data Sheet (MSDS) shall be considered for the material to be handled and all applicable company safety procedures shall be followed. Appropriate personal protective equipment shall be worn.

Some waste materials present physical hazards, such as:

- Fire from a charge of static electricity (e.g., flammable liquids);
- Explosion from compressed gases;
- Spontaneous combustion (e.g., some used gas filters and iron sponge);
- Corrosive damage (e.g., chemical burn or frostbite) to skin upon contact;
- Irradiation, external exposure;
- Contamination, internal exposure (inhalation, ingestion, absorption via dermal contact);

Physical hazards of the job tasks shall be identified and adequate personal protective equipment shall be considered. For example, when moving drums or sampling wastes the following protective practices shall be considered:

- Wear gloves to protect against slivers, cuts, scratches and burns;
- Keep hand clear of pinch points;
- Lift with your legs and avoid twisting your body. Get help if necessary to save your back;
- It take two people to move a heavy drum;
- Use adequate grounding and non-sparking/explosion-proof tools to open a flammable liquids container;
- Bulging drums may be under pressure. Open with extreme

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caution;

- Avoid touching or sniffing unknown materials;
- Avoid mixing incompatible materials such as:
  - Acids with caustics (causes heat, bubbling and off-gases);
  - Acids with hydrocarbons (causes fire);

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9 UPDATING RESPONSIBILITIES

Responsibilities relevant to the updating of the present procedure are as follows:

9.1 Managing Director (MD)

The Managing Director approves the issue of the present document and oversees the drawing-up and updating of the procedure, with the support of the HSE staff personnel.

9.2 HSE Manager

The HSE Manager co-operates with the Managing Director to ensure the drawing up, updating and distribution of the present procedure and verifies its level of application.

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10 RECORDING RESPONSIBILITY

10.1 HSE&CI Manager

The HSE Manager is responsible to maintain, update and archive all the records aforementioned.

The present procedure is distributed to all eni Ghana's departments and archived by the HSE Department, according to the modality illustrated herewith.

10.2 Most Senior Company Representative On-site (MSCRO)

The MSCRO will be responsible to properly manage the records included in this document.

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11 ANNEXES

Annex 1 – Waste Transfer And Disposal Waybill

Annex 2 – Waste Register

Annex 3 – Monthly Waste Report

Annex 4 – Medical Waste Procedure

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ANNEX – 1 Waste Transfer and Disposal Waybill

Part A – GENERATOR

Source Site Location		**Waste Transfer N.**	
Origin of waste:			**Receiver use only (Part C)**

Waste description	Waste code	Hazard	Container		N. Units	m3	Kg	Containers type	Quantity received	Units (ton or m3)	Recycle = R Treatment = T Disposal = D
			Serial N.	Type							

Notes:	
Name of Transporter off-shore:	
Intended receiver:	

I declare that the information I have provided in part A Is correct and complete

Name:	Signature:	Date (dd/mm/yy)
Telephone:	e-mail:	

Part B – Eni Ghana harbour representative

I declare that I have received the wastes as described in Part A for delivery and agree with Transporter onshore figures certification as stated in part C

Name:	Signature:	Date (dd/mm/yy)

Part C1 – Transporter on shore

Name of transporter on-shore:		

I declare that I have received the wastes as described in Part A for delivery to the Intended Receiver and that the information in Part B1 and complete.

Name:	Signature:	Date (dd/mm/yy)
Telephone:	e-mail:	

Part D – Receiver

Receiving Location (site name and address):		
Irregularities/discrepancies:		

Except for the irregularities/discrepancies noted above, I declare that I have received the wastes as described in Part A and that the information in Part C is correct and complete.

Name:	Signature:	Date (dd/mm/yy)
Telephone:	e-mail:	

Part E – Generator

Name of Authorized Person:	Signature:	Date (dd/mm/yy)

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Annex – 2 Waste Register

Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste: code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:

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Annex – 3 Monthly Waste Report

eni	Monthly Waste Report					Month:						Year:			
code	Waste category	hazardous	non hazardous	m3 Estimated	Weigth (ton) Estimated	code	Waste category	hazardous	non hazardous	m3 Estimated	Weigth (ton) Estimated				
001	WBM (Only if waste)					044	Gaskets non containing asbestos								
002	WBM Cuttings					045	Dismissed piping/vessels								
003	OBM (Only if waste)					046	Production scales								
004	OBM Cuttings					047	Sand blasting residuals								
005	SBM (specify synthetic base)					048	Paint residuals								
006	SBM Cuttings (specify Synth. base)					049	Soot								
007	Spent Brines					050	Spent activated carbon								
008	Spent non – Hazard. chemicals (list)					051	Fluorescent lamps								
009	Spent Hazardous chemicals/cushions					052	Glass and bulbs								
010	Milling waste					053	Refrigerating fluids containing CFC								
011	Cooling water					054	Waste containing PCB/PCT								
012	Scrap metals: tubings					055	Sewage water								
013	Scrap metals: other metals					056	Septic tanks settlings								
014	Scrap metals: steel					057	Non-food waste (detergents etc.)								
015	Empty metal drums					058	Spent cooking oil								
016	Empty plastic drums					059	Food waste (except cooking oil)								
017	Rig mixed waste (paper, plastic, wood)					060	Oily water								
018	Accumulators/Batteries					061	Removed Vegetation								
019	Spent Lubricants					062	Unused Soil								
020	Contaminated soil					063									
021	Contaminated Concrete					064									
022	Other masonry waste					065									
023	Tyres					066									
024	Dismantled piping/vessels					067									
025	Scales					068									
026	Wood and Pallets					069									
027	Plastic Packaging/Wrapping					070									
028	Waste containing Asbestos					071									
029	Waste containing rock- or glass fibre					072									
030	Spent lubricants					073									
031	Filters					074									
032	Produced water					075									
033	Oily sludge					076									
034	Production slops / paraffins					077									
035	Spent production chemicals					078									
036	Oily wastes and rags					079									
037	Plastic					080									
038	Wooden pallets					081									
039	Mixed waste (paper, plastic, wood)					082									
040	Oil polluted soil/concrete					083									
041	Clinic Waste					084									
042	Expired medicines					085									
043	Spent Oil					086									

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ANNEX – 4 Medical Waste Procedure

Medical Wastes produced should be separated and packed according to their category in proper containers correctly identified.

Group A: Includes the following articles: identifiable human tissues, blood, animal carcasses, and tissues from veterinary centres, hospitals or laboratories. Bandages, gauze and other dirty wastes. Other wastes with materials, for instance in cases of contagious diseases, excluding anything from Groups B-E.

Group B: Disposed syringes and needles, packages, broken glasses, and other sharp, contaminated, disposable articles or instruments.

Group C: Microbiological cultures and potentially infected waste from pathology departments (laboratories and autopsy rooms) and other wastes from medical stations and research labs.

Group D: Drugs or other pharmaceutical products.

Group E: Articles used to put urine, faeces and other bodily secretions which do not belong in group A.

Their deposition should take place whenever it is necessary, and in order to do so, one should follow the following procedure:

1. Closing and identification of the containers.
2. Call Medical Provider to set the date and place of delivery of the containers.
3. Deliver the containers on the agreed date and time.

Fill out the Waste Delivery Registration Sheet at Medical Provider, verifying that the clinic's person in charge signs and stamps the respective sheet

Summary of Waste delivered

Type of Waste (group)	Quantity	Delivery Date	Receiver

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eni ghana exploration and production limited	*WASTE TRANSFER NOTE*

Part A – GENERATOR

Source Site Location		**Waste Transfer N.**									
Origin of waste:								**Receiver use only (Part C)**			
Waste description	Waste code	Hazard	Container		N. Units	m3	Kg	Containers type	Quantity received	Units (ton or m3)	Recycle = R Treatment = T Disposal = D
			Serial N.	Type							
Notes:											
Name of Transporter off-shore:											
Intended receiver:											

I declare that the information I have provided in part A Is correct and complete

Name:	Signature:	Date (dd/mm/yy)
Telephone:	e-mail:	

Part B – Eni Ghana harbour representative

I declare that I have received the wastes as described in Part A for delivery and agree with Transporter onshore figures certification as stated in part C

Name:	Signature:	Date (dd/mm/yy)

Part C1 – transporter on shore

Name of transporter on-shore:

I declare that I have received the wastes as described in Part A for delivery to the Intended Receiver and that the information in Part B1 and complete.

Name:	Signature:	Date (dd/mm/yy)
Telephone:	e-mail:	

Part D – Receiver

Receiving Location (site name and address):

Irregularities/discrepancies:

Except for the irregularities/discrepancies noted above, I declare that I have received the wastes as described in Part A and that the information in Part C is correct and complete.

Name:	Signature:	Date (dd/mm/yy)
Telephone:	e-mail:	

Part E – Generator

Name of Authorized Person:	Signature:	Date (dd/mm/yy)

eni Ghana Exploration and Production Limited	WASTE REGISTER

Waste registerWaste Transfer Note N. ..... Date (dd/mm/yy)	Characteristics of waste: code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:

eni Ghana Exploration and Production Limited	WASTE REGISTER

Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:
Waste Transfer Note N. ..... Date (DD/MM/YY)	Characteristics of waste code: ..... description: ..... hazardous: ☐ Y ☐ N	Quantity m3 ..... Kg	Source Site Location: ..... Generator: ..... Receiver:	Notes:

Monthly Waste Report

Month: **Year:**

code	Waste category	hazardous	non hazardous	m3 Estimated	Weigth (ton) Estimated	code	Waste category	hazardous	non hazardous	m3 Estimated	Weigth (ton) Estimated
001	WBM (Only if waste)					044	Gaskets non containing asbestos				
002	WBM Cuttings					045	Dismissed piping/vessels				
003	OBM (Only if waste)					046	Production scales				
004	OBM Cuttings					047	Sand blasting residuals				
005	SBM (specify synthetic base)					048	Paint residuals				
006	SBM Cuttings (specify Synth. base)					049	Soot				
007	Spent Brines					050	Spent activated carbon				
008	Spent non – Hazard. chemicals (list)					051	Fluorescent lamps				
009	Spent Hazardous chemicals/cushions					052	Glass and bulbs				
010	Milling waste					053	Refrigerating fluids containing CFC				
011	Cooling water					054	Waste containing PCB/PCT				
012	Scrap metals: tubings					055	Sewage water				
013	Scrap metals: other metals					056	Septic tanks settlings				
014	Scrap metals: steel					057	Non-food waste (detergents etc.)				
015	Empty metal drums					058	Spent cooking oil				
016	Empty plastic drums					059	Food waste (except cooking oil)				
017	Rig mixed waste (paper, plastic, wood)					060	Oily water				
018	Accumulators/Batteries					061	Removed Vegetation				
019	Spent Lubricants					062	Unused Soil				
020	Contaminated soil					063					
021	Contaminated Concrete					064					
022	Other masonry waste					065					
023	Tyres					066					
024	Dismantled piping/vessels					067					
025	Scales					068					
026	Wood and Pallets					069					
027	Plastic Packaging/Wrapping					070					
028	Waste containing Asbestos					071					
029	Waste containing rock- or glass fibre					072					
030	Spent lubricants					073					
031	Filters					074					
032	Produced water					075					
033	Oily sludge					076					
034	Production slops / paraffins					077					
035	Spent production chemicals					078					
036	Oily wastes and rags					079					
037	Plastic					080					
038	Wooden pallets					081					
039	Mixed waste (paper, plastic, wood)					082					
040	Oil polluted soil/concrete					083					
041	Clinic Waste					084					
042	Expired medicines					085					
043	Spent Oil					086					

TOTAL Hazardous Waste		m3:	ton:
TOTAL Non-Hazardous Waste		m3:	ton:

Ghana OCTP Block Phase 1 ESHIA
Attachment F
Additional Project Description

ABSTRACT

This document provides additional Project Description, particularly relating to Project Alternatives and the Drill Rig Description.

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1. ADDITONAL PROJECT DESCRIPTION DETAILS

1.1 PROJECT OPTIONS

The preferred Project design is described in this Chapter and is the basis for the EIS. This Section describes alternatives that evaluated during design to maximize and ensure environmental and social sustainability of the Project and aiming to identify the option that allows meeting project objectives with less impacts on the environment. The alternatives evaluated include:

- do nothing alternative; and
- location alternatives.

1.1.1 Do Nothing Option

This option implies that no hydrocarbon well drilling, Laying/operation of flowlines; Installation and operation of FPSO/ mooring system etc. This means the non-implementation of the planned activities in the project area.

The implications of this are that the benefits expected would not be achieved. For example:

- Impacts associated with oil and gas exploration and production will remain as it is in the area,
- The huge reserve of crude oil would remain unexploited.
- Pressures in the target reservoirs would continue to decline

On the other hand, the no project alternative will ensure the area selected for the Project will remain available for fishing purposes, despite that given the distance to the coast this area is not intensively fished. Similarly there would be no need to proceed in the future to install transport pipelines to the shore and neither to install any onshore facility and therefore the near shore and onshore areas will be left unmodified and available for the current land use. Finally the do nothing alternative will result in the absence of noise and effluent emissions into the environment as well as disturbance to fauna due to physical presence of project facilities.

This option was rejected, given that it would not allow meeting project objectives and associated benefits.

1.1.2 Location and technological alternatives

This project entails wells drilling; Laying and operation of Transport Systems (flowlines); Installation and operation of FPSO (Floating Production, Storage and Offloading) with mooring system and Installation, operation/ removal of well heads in the project area. This shall be carried out using the most up-to-date and proven technology. Also, International ENI HSE Guidelines and Standards and acceptable best practices shall be adopted at all phases of the project execution. This option, which assures the realization of the aspirations of the Ghana Government and the stakeholders with its various benefits as well as the sustainability, has been selected for implementation. The potential direct benefits to the region and the country from the exploitation of natural resources are financial income and local business opportunities. Secondary indirect benefits are a potentially increased standard of living and better education, social services and amenities, all of which can potentially help raise awareness of the importance of environmental protection in the area.

Considering the adoption of the most up-to-date and proven technology, a site selection process was carried out prior to selecting the preferred Project site.

OCTP field is located in the 63 Km offshore Ghana, in an area with existing and future nearby developments. This OCTP field area is represented in Figure 1-1. The area primarily consists of the Capanian NAG, the Sankofa East 2A, and the Cenomanian areas.

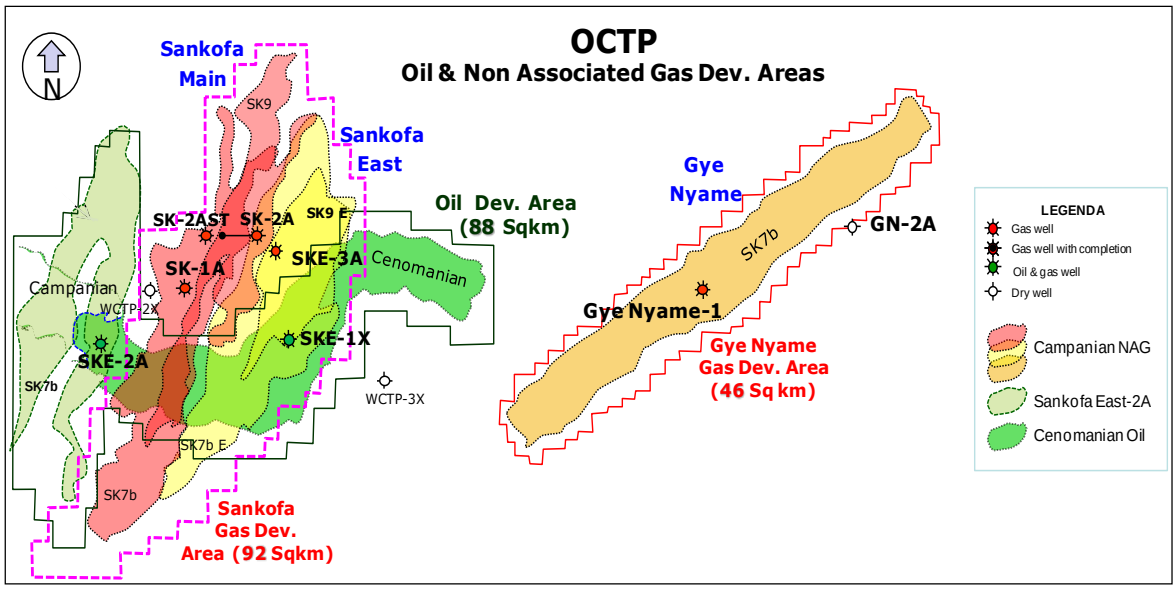


Figure 1-1 OCTP Development Project Area map

Due to the reservoir target position (approx. 500-1000m water depth) and considering the West Africa area offloading parcel, the natural solution to develop the field is through a Floating Production Storage and Offloading facility (FPSO). The FPSO location was evaluated and four positions were selected as shown in Figure 1-2. The FPSO positions evaluated are:

- Over the canyon with an approx. water depth of 600 m (Option Best Case);
- On the east side of the canyon between Sankofa field and Gye Nyame field with an approx. water depth of 600 m (Option 1);
- Over the canyon with an approx. water depth of 800 m (Option 2);
- In Sankofa field area with an approx. water depth of 1000m (Option 3).

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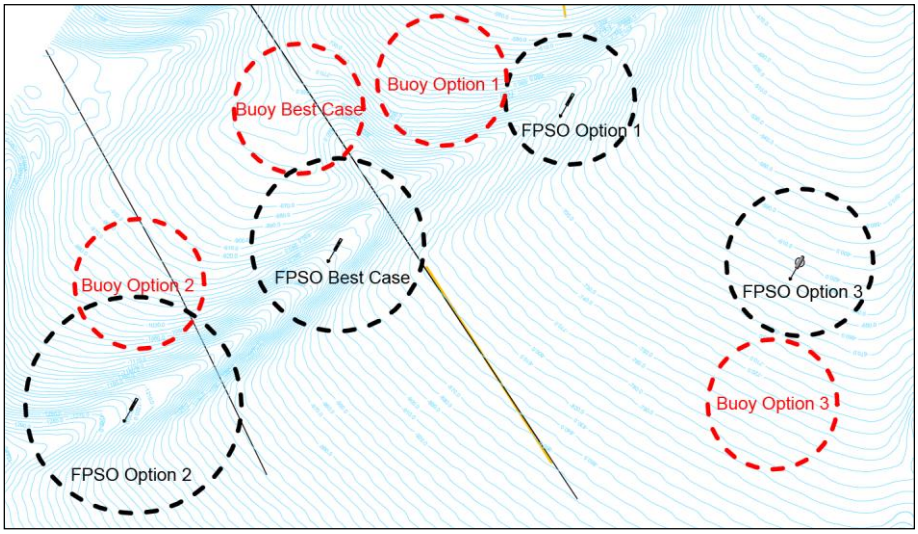


Figure 1-2 OCTP Development Project FPSO evaluated position

The preferred option for the location of the FPSO is the fourth as it will allow minimization of flowlines and umbilicals lengths, and thus, as a consequence risks and costs minimization.

Similarly, an evaluation of the mooring configuration was performed. In this context both Turret and Spread mooring were considered, taking into account local seabed and weather conditions. The spread mooring option will be used in the OCTP project in order to allow the possibility to anchor the FPSO outside the canyon (even if the location is exactly on the canyon) and assure a high level of flexibility to the plant configuration.

For flowlines from wells to FPSO, construction rigid and flexible flowlines options were evaluated. Consequently subsea layout solutions entailing both rigid and flexible options were considered. Flexible flowlines were selected as preferred solution, in order to minimize sea bed disturbance and the need of excavation works. In particular the selection of the routes of the deep water flowlines has been performed based on the available bathymetric data and geohazard studies. The criteria for the route selection are:

- Minimization of the overall route length;
- Minimization of the risks related to evidences of geohazards (faults, canyons, channels and scours, steep slopes and slope instabilities, pockmarks, gas hydrates, mud volcanoes and fluid/gas expulsion features, turbidity currents and hydrodynamic effects, rock outcrops, rough seafloor and liquefaction, anomalous soil conditions and other issues, man-made features from fishing activity); evidences found have been described in Chapter 4.
- Avoiding the evidences of seabed features and bottom irregularities and keep the bottom profile along the route as smooth as possible;
- Adequate clearance from debris and other obstacles;
- Horizontal radii at turn points along the routes compared with regard to the lateral curves stability;
- Avoiding crossing over lines of the same field.

1.2 DESCRIPTION OF THE DRILLING UNIT

The well drilling operations shall be performed by the Maersk Voyager as shown in Figure 1-3,
The rig will be capable of operating in water depths up to 3,300 m. It will be an advanced drilling ship, dynamic positioned (DP-3), Dual Activity/Dual BOP rig designed to minimize emissions and discharges to sea. The unit will be capable of performing all the planned drilling and completion operations required to develop the fields and deploying the Subsea Production Trees and other associated subsea equipment.

The storage capacities of the Maersk voyager are presented in Table 1-1.

The seaworthiness certification as well as Eni's Safety, Health and Environment standards requires that safety precautions will be taken to minimise the possibility of an accident during drilling operations. Collision prevention equipments include radar, multi-frequency radio, fog horns, etc. Additional precautions include generally the presence of two supply vessels normally stationed at the well location, 24-hour watches, establishment of a 500 m radius exclusion zone around the drilling unit, and access to current weather data.

Table 1-1 Drilling Rig Storage Capacities

Fuel (Diesel Oil or Heavy Fuel Oil)	6210 m^3
Drilling water	2410 m^3
Potable water	1425 m^3
Liquid mud (active & reserve)	2767 m^3
Waste liquid (mud & washing water)	2000 m^3
Brine	777 m^3
Oil base Mud	998 m^3

Crude Oil	452 m^3
Bulk bentonite/Barite	452 m^3
Bulk Cement	2300
Sack storage	7540 m3
Ballast water	6210 m^3



Figure 1-3 The Maersk VoyagerDrilling Rig

1.3 SUBSEA PRODUCTION SYSTEM (SPS)

The Subsea Production System (SPS) is tied back through Subsea Umbilicals, Risers and Flowlines (SURF) to a spread moored Floating Production Storage and Offloading (FPSO) unit, installed in approximately 1000m water depth.

Subsea Architecture

The subsea field Oil development is divided into 5 main regions (Sankofa NE, SE, SW, and NW plus Gye Nyame), with a spread moored and double balcony FPSO located above the Sankofa Canyon at approximately 1000m water depth and some 60km from the shore (Sanzule).

It is envisaged to develop a total of 14 (fourteen) wells consisting of 8 (eight) Oil Producers (OP), 3 (three) Water Injectors (WI) and 3 (three) Gas Injectors (GI) all tied-back to topsides on the FPSO by means of flexible flowlines and risers.

Oil Production wells are arranged in 3 (three) daisy-chained loops by means of single branch FlowLine End Terminations (FLET), while the WI, GI and GP wells, plus OP-CAMP2 are arranged in a satellite configuration.

The relative distances between the 3 main OP loops are in the order of 6 and 10 km. A canyon is also present in the central part of the field, limiting the layout flexibility.

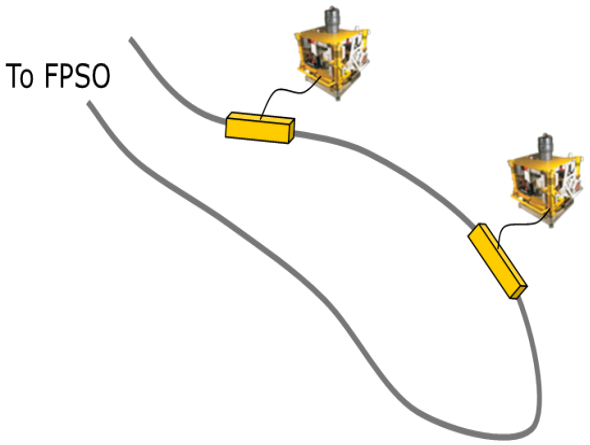


Figure 1-4 Scheme of the Planned Subsea System Architectute

In such conditions of dispersed wells field, the use of Daisy Chain configuration allows:

- large spread between wells
- minimize dead legs to improve flow assurance
- minimize Lead Time and time to market
- minimize Flowline crossings

Hereinafter the main components of the system are described:

- Subsea Completion System
- Subsea Structures System
- Flowline Tie-in System
- Subsea Control System

SUBSEA COMPLETION SYSTEM

To optimize and standardize, all XTs are Horizontal Drill Through, with the same spool body and wing block. Each Tree is equipped with the same Subsea Control Module (SCM) and a retrievable Flow Control Module (FCM), which is configured to suit the specific service (OP, WI and GI). Acoustic Sand Detection (ASD) is installed on the OP XTs.

All XT valves shall be remotely operated by an electro-hydraulic control system and, as a back-up, overridden by ROV.

Chemical injection porting shall be the same for all X-tree blocks. For XTs which don't need all chemical injection points, chemical injection Throttle Valves are supplied for metered chemical delivery at each XT from a common umbilical header for each service. MeOH is unmetered for bulk transient and remedial purposes only.

The preservation strategy to increase No Touch Time (NTT) on the OP XTs and FLETs etc shall be insulation for the OP system. All other XTs are not thermally insulated. GI XTs shall have the ability to inject MEG on a continuous basis at such a level as to preserve the lines indefinitely in case of shutdown. Due to the uncertainties regarding fluid composition, sour service is required.

OP XTs provide controls and signals to its local a-FLET. Downhole penetrations at the TH / XT interface shall be standard for all XTs, whilst unused DH service valves etc. may be left off the final XT assembly. Each TH shall have the same standard number of penetrations for all types of well,

with unused functions capped at the DH end. The SCSSV shall have two (2) hydraulic HP penetrations in the TH for its remote control.

SUBSEA STRUCTURES SYSTEM

FLET Systems

The Flowline End Termination (FLET) is be terminated to the flowline by a subsea connector and includes a foundation and interface supports. A standardized single branch design is considered as the Base Case solution for all FLET types.

Tie-in and Connection Systems

For Ghana OCTP Development Project the Tie-in System base case considers that all Risers and Flowlines are flexible. Jumpers and Spools are Rigid for all the lines but Water and Gas Injectors, directly connected to the X-Trees.

For the thermally insulated Production Flowlines, the Tie-in Connection System includes a thermal insulation system designed to avoid any cold spots.

SSIV Systems

The SSIVs consist of one 6” ID Gas Injection, two 8” ID for Gas Producers and one 22” SSIV for the Gas Export system. Each has a single piggable Header with connectors for the flowline and riser. This excludes the Gas Export (GE) SSIV, whose header is not piggable.

The header has an hydraulically actuated Ball Valve (SSIV) providing FSC protection from Gas flowline inventory. A header access valve arrangement is included for ROV intervention.

The SSIVs are controlled via direct hydraulic supplies from a dedicated control panel on the FPSO. With a healthy ESD signal to the local control panel, the hydraulic output to the SSIVs valve actuator can be manually reset thereby applying hydraulic pressure on dedicated dual redundant umbilical cores via the SSIV UTA and HFL to the valve actuator to open the SSIVs. The SSIVs maintain an open position whilst hydraulic pressure is maintained.

Subsea Control System

The Subsea Production Control System is used to provide supervisory control and data acquisition for the Subsea Production System during normal operating conditions. It is an electro-hydraulic multiplexed control system, with communications network overlaid on the power distribution network (Communications Overlaid on Power, COP).

The hydraulic system architecture is an open loop system with bio-degradable, water glycol based hydraulic fluid venting to the subsea seawater environment.

An appropriate level of interlocks shall be provided to ensure safe and reliable operation.

The Subsea Control System is composed of the following major items:

- Topsides:
    - Master Control Station (MCS) and associated Workstations
    - MPFM processing station system
    - Electrical Power Unit (EPU)
    - Hydraulic Power Unit (HPU)
    - Electrical Junction Boxes

- Topside Umbilical Termination Unit (TUTU)
- SSIV Local Control Panel(s)

- Subsea system:
  - Umbilical System, including Umbilical Termination Assembly
  - Subsea Control Modules (SCMs)
  - Subsea Instrumentation
  - Flying Leads (Hydraulic and Electrical)

- Installation, Workover, Running and test equipment

Table 1-2 Foreseen umbilicals

Line Tagging	From	*To*	Umbilical Type	Static Length (m)	Dynamic Length (m)
UNE1	**FPSO**	***SkE-1x***	**Oil Production**	**-**	**2354**
UNE2	**SkE-1x**	***OP-5/OP-7***	**Oil Production**	**3883**	**-**
UNE3	**OP-5/OP-7**	***GI-1***	**Oil Production**	**2458**	**-**
UNE4	**OP-5/OP-7**	***WI-3***	**Oil Production**	**1116**	**-**
UNE5	**SkE-1x**	***SkE-C***	**Mini umbilical**	**621**	
USSIV 1	**FPSO**	***SSIV UTA***	**SSIV**	**-**	**3615**
USE 1	**FPSO**	***GI-2/OP-4***	**Oil Production**	**-**	**3578**
USE 2	**GI-2/OP-4**	***OP-3/SkE-D***	**Oil Production**	**3084**	**-**
USW 1	**FPSO**	***UTA***	**Oil Production**	**-**	**3540**
USW 2	**UTA**	***SkE-2A***	**Oil Production**	**2399**	**-**
USW 3	**SkE-2A**	***OP-CAMP1***	**Oil Production**	**2164**	**-**
USW 4	**UTA**	***Sk-D***	**Oil Production**	**1333**	**-**

USW 5	**Sk-D**	***WI-1***	**Oil Production**	**777**	**-**
USW 6	**SkE-2A**	***OP-CAMP2***	**Oil Production**	**427**	
UNW 1	**FPSO**	***UTA***	**Oil Production**	**-**	**3776**
UNW 2	**UTA**	***WI-CAMP1***	**Oil Production**	**2084**	**-**
UNW3	**UTA**	***GI-CAMP1***	**Oil Production**	**1655**	**-**
UNW3	**UTA**	***GI-CAMP1***	**Oil Production**	**2261**	**-**

Subsea control umbilicals and respective umbilical termination assemblies (UTA) provide required control, communication, and chemical injection services from FPSO to XT by means of electrical and hydraulic flying leads.

Subsea Control System - Topsides

The topside equipment provides all necessary hydraulic and electric power to feed the subsea equipment and provides the necessary interface for operators to monitor the subsea process parameters and issue commands and shutdowns.

Subsea Control System - Subsea part

All SCMs are subsea retrievable with ROV assistance.

To guarantee maximum inter-changeability among the Flying Leads, their configuration is standardized as far as possible.

SUBSEA PRODUCTION SYSTEM EXPANSION PHILOSOPHY

General

The facilities design ensures that the subsea infrastructure can accommodate future tie-ins to the offshore architecture of up to 20% extra capacity within the control system.

Oil Production Expansion Capability

Operating strategy for the OCTP field Development is that the production risers, flowlines and FLETs shall be pigged during the field life. Therefore, flowline loops are installed within each oil production flowline system to allow round-trip pigging and circulation of each Flowline loop from the FPSO with the exception of the ROP6 production riser which is electrically heated.

Should there be a requirement to tie-in new well, it is possible to disconnect the flexible flowline and tie-in an additional flowline and FLET by firstly purging the system, isolating the section to be modified and then breaking the production loop.

Flow Assurance considerations may limit subsea expansion capability considerably.

Gas Production, Injection and WI System Expansion Capability

There are three WI, three GI risers and five Gas Production risers, all configured as satellite wells. The Gas Production flowlines are terminated with a FLET which will allow each flowline to service more than one well. WI and GI flowlines are terminated direct to the XT, and will have to be disconnected from the XT and connected to a new FLET should future expansion be required.

1.4 FLOW ASSURANCE / PRODUCTION CHEMISTRY

Production Fluid Characterization

The main activities were as follows:

- Steady state analysis and deliverability of the target production profile;
- Turndown scenarios and flow stability analysis;
- Calculation of the cool-down time;
- Shutdown and preservation philosophy;
- Restart philosophy;
- De-pressurization;

The main result of the flow assurance study was the review of the field layout according to the updated production profiles. The turndown and transient analysis contributed to define the availability of the field; the operating philosophy determined in the previous phase was generally confirmed.

The flow assurance analysis confirmed or updated the requirements of the SPS, RFI and FPSO packages in terms of:

- Line diameters;
- Insulation requirements;
- Pressure and temperature operating conditions;
- Chemical injection requirements;
- Gas lift flow rates;
- Slug catcher volume.

On the basis of the available oil characterization, the following considerations about expected issues on deposition, hydrate and emulsion formation can be highlighted:

Wax appearance: based on performed tests the critical temperature is fixed at 39-46°C for the Cenomanian oil and at 40°C for the Campanian oil.

Asphaltene deposition: no asphaltene instabilities were shown by the tests on the Cenomanian oil. However, in case of commingled production between oil and condensates, asphaltene deposition is expected when the condensate is more than 70% in volume. No samples were available for the Campanian oil.

Oil Gelling: as far as gel formation concerns, the critical temperature of the Cenomanian oil is 18°C. No samples were available for the Campanian oil.

Stable Emulsion formation: The emulsifying capacity of the Cenomanian oil is very low and no stable emulsion formation is expected.

Naphthenate (Soap) Formation: no microscopic calcium-naphtenate solid formation was observed for the Cenomanian oil.

The identified risks reported above are considered manageable through appropriate chemical injection and operating procedures (i.e. hydrate management) which will be implemented during normal operation and shut-down/restart phases.

An indication of chemicals requirement and injection point are reported in the table below:

Table 1-3 Foreseen umbilicals

Chemical	Injection Requirements	Injection Point
Hydrate inhibitor (Production)	At start-up and during planned/ unplanned shutdown	On the X-T, into the production bore, between PMV and PWV.
Hydrate inhibitor (Injection)	For remediation, in case of hydrate plugs.	On the X-T, into the injection bore, between PMV and PWV.
Wax inhibitor (compatible with PPD)	Injection required mainly for transient conditions. Continuously injected only during some periods of the field life.	On the X-T, into the production bore between PMV and PWV
Pour Point depressant (PPD) (compatible with Wax inhibitor)	Injection required only in transient conditions.	On the X-T, into the production bore between PMV and PWV
Asphaltene inhibitor	Continuous injection	Down hole into the production tubing as low as possible
Scale inhibitor	Continuous injection	Down hole into the production tubing as low as possible

Flow Assurance and Hydrates Management

The following main flow assurance activities have been performed for full field subsea development:

- Hydrocarbon transportation system sizing
- Flow assurance analysis of the selected development concept, to deeply analyze system deliverability and identify possible operability issues;
- Flow assurance analysis of transient operations, in order to evaluate feasibility and criticalities during system start-up/restart and turn-down;
- Evaluation of system cool-down time, for the definition of preservation strategy and requirements.

The carried out simulations validate the configuration and confirm the possibility to deliver production at the required conditions on the topside starting from the available bottom-hole pressures.

For oil production network, gas lift injection is required only in the SW loop. In the other regions, the increase in GOR predicted from the reservoir is enough to deliver the fluid to the FPSO.

No thermal issues have been identified for oil network for most of the field. Operating temperatures are maintained at outside hydrate formation region, nevertheless wax deposition is expected during the first years of production for the fluid of the well OP-CAMP1 and during the last years of production for the fluid of the well OP-3. For thermal reasons, the well OP-CAMP2 is required to be connected alone to the FPSO, choked topside, and the line is required to be electrically heated.

The OHTC required for the flexible flowlines and risers of the oil production network is 4 W/m2K. No insulation is foreseen for gas production network (13 W/m2K has been considered).

In case of a field shut down, the loop SW and SE are displaced simultaneously. The loop NE can be displaced soon after finishing preservation of the SW loop.

Transient analyses (shut-down, restart, start-up and turndown) for the full field system were performed. The main results and findings are summarized here below:

- Hydrate formation risk was assessed: a hydrate management philosophy and hydrate inhibitor requirements are defined;
- Temperatures were continuously monitored during transient simulations in order to verify that the temperature limits for WAT and hydrate formation were not exceeded.

In case of start up or restart, methanol injection is required for a certain amount of time with the aim to not have hydrates issues until the flowline is in safe operating conditions.

Slug management: based on the sensitivities performed, during steady state the current design of subsea production system no slug flow is expected. The production HP separator is able to handle moderate slug volumes, which is sufficient to manage the restart operations.

Subsea Layout

The preliminary Subsea layout for the Sankofa Field considers an FPSO positioned in the centre of production and injection wells.

1.5 TRANSPORT AND INSTALLATION (T&I)

The offshore installation philosophy focuses on achieving first Oil as early as possible. In order to reach this goal, the scope of work has been divided in 3 (three) campaigns for Oil development, one for each regions.

The other main constrains considered are as follow:

- SPS equipment delivery - 4 (four) separate batches
- Drilling rig completion campaign sequence – main principle applied is zero SIMOPS
- FPSO arrival in the field and mooring – (zero SIMOPS)

The South East region development accounts for the 1st Oil milestone. It consists of 2 off production wells, 1 off gas injection and 1 off water injection well from the South West loop.

Note that the water injection well (WI-1) is not required for the 1st oil, nevertheless the installation of this system is included within the installation campaign.

The South West region development accounts for the 2nd Oil milestone. It consists of 3 off production wells, 1 off gas injection and 1 off water injection well.

The North East region development accounts for the 3rd Oil milestone. It consists of 3 off production wells, 1 off gas injection and 1 off water injection well from the north west loop.

Description of installation activities

For installation of the flexible flowlines, flexible risers, infield umbilicals and dynamic umbilicals the installation methodology will be the same. It is foreseen a flexible pipelay vessel complete with a Vertical Lay Tower (VLS) for depth water installation. The products (flexibles etc) will be transported on the installation vessel using carousels or installation reels. The vessel will have onboard Work Class ROV (Remotely Operated vehicle) – all operation are diverless. This installation vessel is the main one, and there may be another vessel in the field to support all the above described activities, for example for connection of flying leads, support etc. This support vessel is normally called Light Construction Vessel, which is a small vessel compare to the main installation vessel.

Flowlines and umbilicals

Installation of the flowlines (production, water injection and gas injection) will be performed by a DP lay vessel which will lower the flowlines between the FPSO location and subsea structures. Pruduction Wells and subsea structures will both be connected via rigid jumpers.

Installation of the control umbilicals will proceed in a manner similar to installation of flowlines and by the same lay vessels that installs the flowlines.

Risers

Installation of umbilical risers, production risers, and the gas and water injection risers are required to complete the FPSO installation. The installation vessel will perform the installation of the risers: the bottom end of the riser will first be connected to the flowlines, then the top termination will pass to the FPSO, or viceversa.

Pipeline laying (for Rigid Pipeline only)

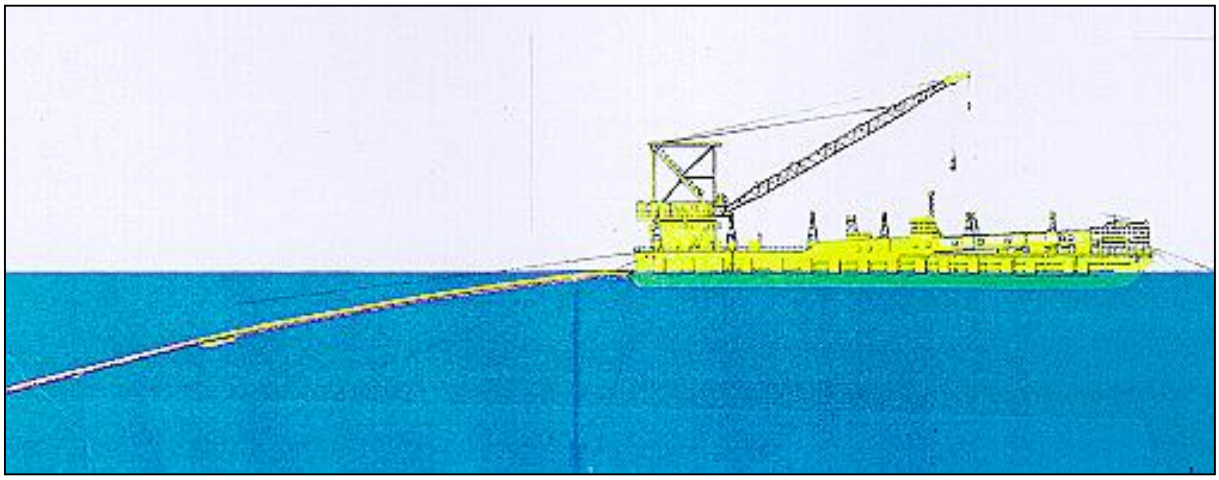


Figure 1-5 Pipeline-laying vessel

The rigid pipelines will be built of sections of about 12 m. The, use of a laying vessel that will be navigated along the planned pipeline route is forecast, typically using 8 mooring points which will be relocated when necessary with the help of one or more tugs.

The bars are welded in succession on the launch line and progressively deposited on the sea bed. The welds are protected against corrosion by coating the possibly affected area of pipe with resine of adequate thickness and density.

1.6 SAFETY EQUIPMENT (BLOW-OUT PREVENTERS)

Annular B.O.P., also called BOP Bags given their bag-like shape (see **Figure 1-6**). They are installed upstream of everything else. They have a suitably shaped rubber element and, when a hydraulic piston exerts an axial pressure against this element, it adheres to the internal shape, thus closing it tight. Such closing is ensured for every diameter and for every drill string or casing, no matter what the shape. Even when the borehole is free of the drill string, the annular B.O.P. always ensures tightness.

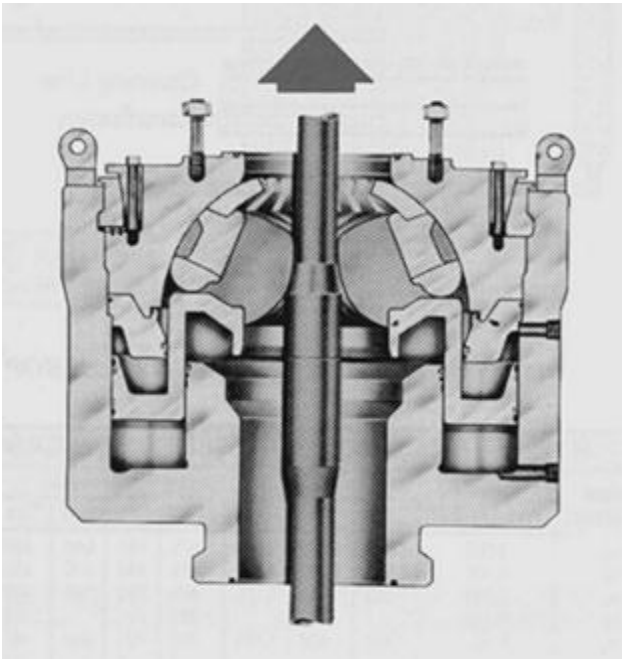


Figure 1-6 Safety Equipment – Example of an Annular BOP

Ram-type B.O.P. These units have two prismatic gates appropriately shaped to fit the diameter of the equipment in the borehole and may be secured together with a hydraulic mechanism. The number and size of the rams depend on the diameter of the elements in the drill string (see Figure 1-7).

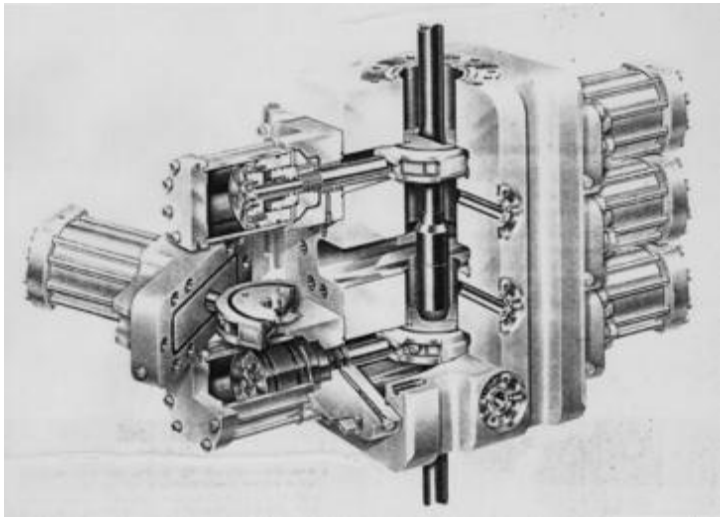


Figure 1-7 Safety Equipment – Example of a Ram-type BOP

There is also a set of *shear rams* that ensure total closing of the borehole when it is free of any equipment. In an emergency, these rams can even sear the drilling pipes if they are present when it is tripped.

These elements are normally assembled to form the "BOP stack" generally composed of 1 or 2 BOP Bags and 3 or 4 rams. The BOPs are operated hydraulically from 2 remote panels.

The formation fluids are circulated and expelled using high pressure lines — called *choke* and *kill* lines — and special variable section valves — called *choke valves* — able to control the pressure and ejection flow rate. Floating deep-sea off-shore rigs use a BOP stack installed on the well head at the sea floor. Like the valves and *kill* and *choke* lines, the BOPs are operated from the surface using electrodynamic controls. All functions and controls are redundant and "*fail safe*".

Number and type of BOP actually employed for the activities planned in the project area depends on the typology of the drilling equipment (Jack-up drilling unit) employed end on the features of drilled formation and waters encountered

1.7 DESIGN CHOICES AIMED AT REDUCING ENVIRONMENTAL IMPACT

The Drilling Operations Environmental Philosophy shall adopt the following principles:

- Use of resources: efficient use of chemicals, material, natural resources and energy sources, aimed at resource conservation and minimization of discharges;
- Emission to air: minimization through abatement at source of gaseous emissions (no flare emissions) that have the potential for negative impact on the environment;
- Discharge to water: minimization through abatement at source of aqueous effluents which have the potential for negative impact on the environment;
- Solid waste: Correct handling, treating and disposing of solid wastes to avoid/eliminate liabilities in the future and to meet the requirements for due diligence;
- Use of Best Available Technology Not Entailing Excessive Costs (BATNEEC) and good international oil field environmental practices.
- The volume or relative toxicity of liquid or solid wastes will be reduced, to the minimum possible; the four principles of waste minimization process (recycling, reduction, reuse and recovery) shall be adopted as applicable.
- For effective implementation of proper handling and appropriate waste disposal methods, waste materials generated in the course of this work will be defined,

segregated, preferably at source into clearly designated bins at strategic locations, the same shall be done during operation phase.

1.7.1 Emission to Air

The engineering design approach shall be to minimize emissions to the atmosphere where practical and economically possible and to apply good engineering practice in the choice of materials and equipment to minimize fugitive emissions. Where emissions are unavoidable, the approach shall be for point sources, to provide stacks of adequate height to ensure good dispersion.

The main sources of emissions (continuous or non-continuous) resulting from Project activities include the following, as a minimum:

Exhaust gas emissions produced by the combustion of fuels in diesel engines and power generator turbines can be the major source of air emissions from the facilities.

Gas venting/Flaring during production test or emergency situations is arranged by venting/flare to the atmosphere.

Fugitive emissions may be associated with leaking piping, valves, connections, flanges, pumps, open-ended lines, packing, pressure relief valves, tanks or open pits/containments.
Principal pollutants from these sources include: nitrogen oxides (NOx), sulphur oxides (SOx), carbon monoxide (CO) and particulates.

1.7.2 Wastewater

Waste liquid effluents may mainly arise from:

- oily and accidentally oily waters (e.g. drainage waters, wash waters, plant bilge waters, etc);
- civil sewage.

The project envisages the reinjection of the production water after mixing with seawater, process cooling water and test water; nevertheless, in the present document potential impacts deriving from discharge of the production water into the sea are described. In that case, production water will be discharged after treatment to reduce the oil content in line with applicable regulation and best practices.

Oily and accidentally oily waters are stored in special drums to be transferred to land to be properly disposed/treated. The recycling contractor selected by eni is Zeal & Zoil in the Integrated Oilfield Waste Management Facility.

Civil wastes (sewage, water from washbasins, showers, the caboose) are treated, as to achieve legal concentration limit, with approved systems before being discharged into the sea.

1.7.3 Solid Waste

All waste produced during drilling operations which cannot be reused, will be managed and disposed of in accordance with National Regulations. All wastes associated with hydrocarbons, oils, hydraulic fluids, oily sump water, etc. shall be recycled, treated or placed in an appropriate facility.

All debris, spoil materials, rubbish and other waste shall be cleared regularly from the site and disposed of.

Contaminated wastes or hazardous waste shall be stored in suitable tanks or skips and transported to shore by supply-vessel.

Available disposal options for hazardous and non-hazardous wastes in the OCTP area are:

- Incineration: for non-hazardous and hazardous wastes will be used the incineration site in Takoradi. The eni's approved contractors are Zeal & Zoil in their Integrated Oilfield Waste Management Facility.
- Landfilling: the municipal Sokofrom landfill, approved by EPA, will be used for non-hazardous wastes. The eni's approved contractor are Zeal & Zoil.
- Scrap Metal Recycling: using an in-Country existing recycling contractor, as is the case of Ferro Fabric in Tema (EPA approved)..
- Waste Oil Treatment and Recycling: through a recycling contractor in the bitumen producing industry or other Ghanaian industries. Selected contractor is Zeal & Zoil in the Integrated Oilfield Waste Management Facility.
- Medicines and medical waste: Incineration at Takoradi Hospital or Incineration at Zeal/Zoil's Integrated Oilfield Waste Management Facility
- Burning Basket: it will be used only for non-hazardous kitchen, canteen and cabin waste on the drilling rig, the FPSO, the pipe laying barges and the support vessels. It will be used only in compliance with MARPOL Annex V.
- Discharge at sea: for riserless drilling cuttings, where water based mud is used and for cuttings contaminated by non-aqueous drilling fluid after proper treatment on board of rig.

eni will only use contractors that are certified and authorized by authorities to perform waste transportation, handling and management of wastes. Furthermore, at its own discretion, eni will carry out audits to ascertain disposal sites are being operated to acceptable standards and all necessary permits are maintained

1.7.4 Drilling fluids

The drilling fluids programmed are WBM in the riser-less phases and NADF in the riser phases.
The base fluid used in the NADF will be an environmental friendly ultra Low Toxic synthetic or mineral Oil Based Mud (LTOBM).

The type of waste that can be discharged into the sea are the following:

- Exhausted WBM
- Cuttings contaminated by WBM
- Cuttings contaminated by NADF

1.8 RESOURCES CONSUMPTION, WASTE GENERATION, AIR AND NOISE EMISSIONS DURING DRILLING AND COMPLETION ACTIVITIES

1.8.1 Natural Resources Consumption

The main consumption of natural resources related to project activities are:

- Fossil fuel consumption for drilling and transportation activities
- Water consumption for civil use by the rig's crew

Amount and quality of fuel are defined in the following sub-sections, in order to assess polluting air emissions.

Water may be transported to the site via barge as may be necessary. Potable water will be supplied by bottled water; during drilling activities will be used also desalinated sea water for project needs.

Water consumption estimated for the Maersk Voyager is presented in Table 1-4.

Table 1-4 Estimated Water Consumption

Water Withdrawal	Fresh Water (from 3rd party)	Sea Water (desalinated)	Water Withdrawn (not including non-desalinated water used for engine cooling, ballasing, steam generation)
	(m^3)	(m^3)	(m^3)
2013 3rd Q	-	13.515,00	13.515,00
2012	-	28.336,00	28.336,00
2011	-	24.440,00	24.440,00
2010	4.955,00	17.901,00	22.856,00
2009	15.838,00	17.300,00	33.138,00
2008	16.661,00	17.445,00	34.106,00

2011	2012	2013
Working day	Working day	Working day
341	312	248
Water/ working day (mc)		
71,68	90,84	
Discharged water /working day (mc)		
63,25	87	

1.8.2 Waste Generation

The wastes produced on the platform are stored temporarily in suitable yard structures. As regards the well drilling phase, diesel engines and mechanical moving parts are used with the inevitable production of noise and polluting atmospheric emissions.

The wastes produced are:

- drilling wastes (excess mud, debris mixed with mud),
- solid urban wastes (cans, cartons, wood, rags, etc.),
- sewage (from w.c. washbasins, showers).
- oily and accidentally oily waters (e.g. drainage waters, wash waters, plant drainage waters, etc);

Drilling wastes

The management of drilling wastes is based on Eni's experience in similar environments and complies with local Regulations.

Local regulation permits the discharge into the sea of drilled cuttings contaminated by synthetic/pseudo oil based mud system with a residual oil on cuttings content less than 3% of dry

matter if discharged beyond 500 m water depth ("Ghana EPA Guidelines for Environmental Assessment and Management in the Offshore Oil and Gas Development" article 12 and section 7). However, EPA in the Permit n° CE00217880115, issued in relation to the OCTP Block Development Project, stated the requirement of ensuring that NADF cuttings discharged to sea must have an oil concentration lower than 2% by weight on dry cuttings.

To the purpose of reaching the right residual O.O.C., it will be necessary to install Thermo mechanical Cuttings Cleaner besides of the standard solids removal equipment, to allow the LTOBM drilled cuttings discharge.

Thermo mechanical Cuttings Cleaner

In order to meet the residual oil on cuttings content < 1% it is necessary to install a TCC. It use a technology designed to separate the various components on cuttings and contaminated soils, where NADF is used during drilling operations, or where soil has been contaminated with oil.

Direct thermo-mechanical desorption is different from thermal separation technologies, based on external heating sources and indirect heating of waste, in that it achieves thermal separation by transforming kinetic energy into thermal energy through friction created by the hammer mill in the waste itself. It is the only thermal treatment equipment can be installed on offshore rigs.

Exhausted LTOBM will be stored in a dedicated tank on the rig and will be transported to shore to be properly treated with a thermal desorption method by the waste service company in our waste treatment and disposal area.
The estimated produced cuttings volume is:

Table 1-5 Estimated quantity of cutting produced

	Cuttings m^3 (single well)	Cuttings m^3 (12 wells)
Riserless phase	580	6960
Riser phase	480	5760

The above estimation is based on the following considerations:
30% excess for 42" and 24"
20% excess for 17 ½", 14 ¾" and 12 ¼"
10% for 8 ½"
NADF remaining on cuttings after Vertical centrifuge treatment 15% v/v

Civil wastes

During positioning and installation/sealing activities and throughout the entire sequence of drilling activities it is estimated that an average of about 120 operatives will be present on the jack-up drilling unit; on the basis of the data available in the literature for drilling sites similar to the one under consideration, we can provide an initial estimate as follows:

- Civil waste water: 100 l x 30 days x 120 pers = 36000 lt/month (12000 l/day)

Food waste is shredded and dumped at sea through a sieve with an aperture of 25 mm., as determined by "MARPOL (Marine Pollution) international standards."

Civil sewage discharged from w.c., washbasins, showers and camboose — are treated in a purification system before being dumped into the sea. Discharge is compliant with "MARPOL" international standards. A biological-type purification system is used. The sewage to be treated is conveyed to an aeration chamber where it remains for approximately 24 hours, mixing with water

containing a high concentration of aerobic bacteria which breakdown the organic substances contained in the sewage being treated.

A compressor injects pressurized air into the sewage in order to keep the bacteria active, create a certain degree of agitation and keep the particles containing the organic substances and bacteria in suspension. This suspension is then passed into the clarification chamber where, in approximately 6 hours, the flakes settle and the supernatant is stratified into zones containing the clarified supernatant liquid, particles still in suspension and the settled flakes.

The supernatant liquid overflows into a chamber where it remains in contact with hypochlorite for 30 minutes (to eliminate the residual bacteria), the dissolved oxygen content and pH are checked, and then it is dumped into the sea.
The material still suspended and the settled materials are sent on by insufflation into an aeration chamber where the treatment cycle continues.

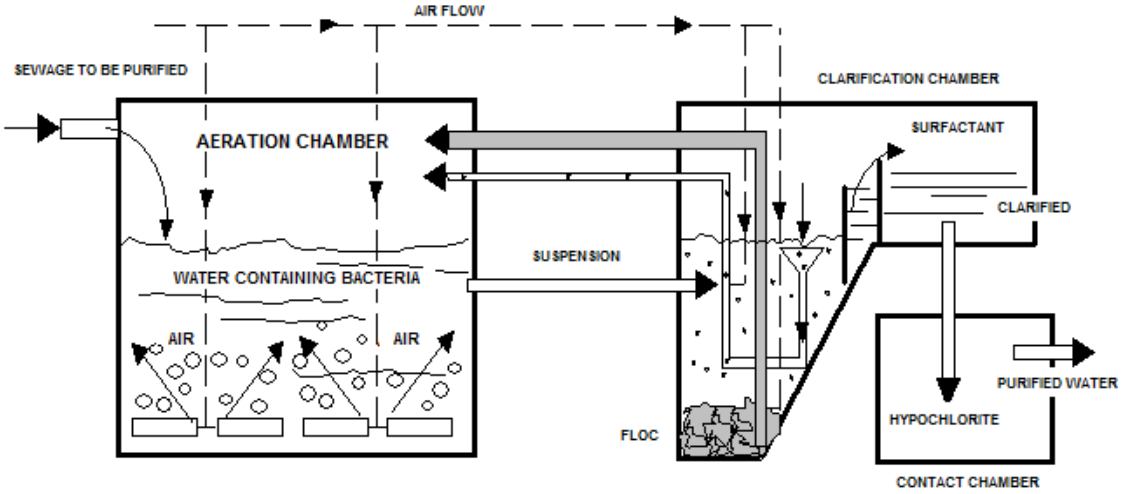


Figure 1-8 Scheme of a Domestic waste water treatment system

Oily and accidentally oily waters (bilge water)
Bilge liquids are composed of oil and water mixed together. From the bilge oil/water, where collected, are sent via a pump to a separator. The oil is filtered and collected in a tank to be subsequently put into barrels and transferred to shore, while the cleaned water is sent to the liquid waste collection tank and then dumped into the sea.

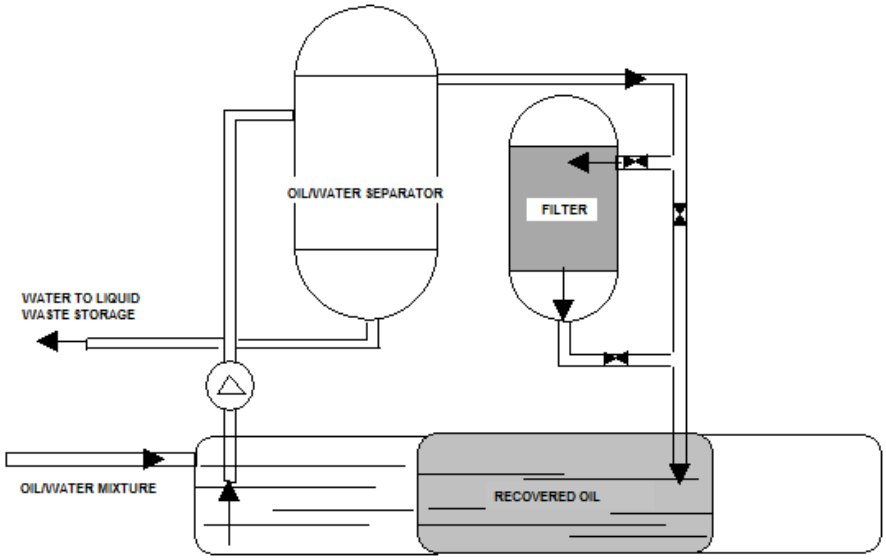


Figure 1-9 Scheme of the Bilge liquids separator system

Table 1-6 Total amount of water produced

	Water peroduced
	(m^3)
2013 3rd Q	10.564,00
2012	8.069,80
2011	21.566,00
2010	17.838,00
2009	2.198,00
2008	897,00

Hazardous/non-hazardous wastes

The whole amount of waste generated is estimated using data collected by ENI for Saipem 10000, a rig similar to the one planned for the Project, in years 2008-2013 (Table 1-7).

Table 1-7 Estimated quantity of waste produced

	Hazardous Waste	Non-Hazardous Waste	Waste
	tons	tons	tons
2013 3rd Q	599,93	495,27	1.095,20
2012	765,11	543,35	1.308,46
2011	792,67	410,59	1.203,26
2010	996,71	379,15	1.375,86
2009	4.152,29	230,82	4.383,11
2008	2.769,51	226,20	2.995,71

High amount of hazardous waste in 2008 and 2009 was caused by the fact that drill cuttings were included in the reported data.

2011	2012	2013
Working day	Working day	Working day

341	312	248
Water/ working day (mc)		
71,68	90,84	
Discharged water /working day (mc)		
63,25	87	

	2008	2009	2010	2011	2012	2013 3rd Q
Hazardous waste						
Batteries & accumulators	0,50	0,05	0,48	1,43	7,60	0,00
Contaminated soil	0,00	0,00	38,50	0,00	0,00	0,00
Electronic apparatus	0,00	0,20	0,71	6,33	3,00	11,46
Exhausted oils (from engines, hydraulic circuits and other greases)	82,52	22,40	60,97	9,50	16,77	24,73
Light Tubes	0,20	0,31	1,15	0,09	1,02	0,00
Medical Waste	0,34	0,23	0,31	0,07	0,14	0,05
Mixed Industrial Hazardous Waste	0,00	0,00	2,50	135,20	0,00	320,50
Oil Filters	0,75	0,50	1,17	5,47	0,61	0,71
Oily Water	0,00	0,00	594,25	548,14	259,07	134,90
Other Hazardous Waste (*notes)	2.624,70	4.029,20	206,38	69,30	418,70	53,00
Paints, varnishes and solvents	0,00	0,00	0,08	0,00	2,00	0,00
Sludge and mud from Waste Water treatment plants	60,00	99,00	90,12	17,16	56,20	54,58
Worn out printing toner (cartridges included)	0,50	0,40	0,09	0,00	0,00	0,00
Non-hazardous waste						
Absorbents, filtering materials, rags, protective clothing	0,00	9,90	0,00	0,00	0,00	0,00
Cooking organic waste	14,70	18,22	16,49	0,09	0,26	23,21
Ferrous metal refuses / Steel / Non-ferrous metal refuses	81,10	32,50	138,38	100,40	120,90	118,50
Mixed industrial Non-Hazardous Waste	0,00	0,00	21,13	0,00	0,00	0,00
Mixed urban waste	0,00	0,00	34,00	0,00	0,00	0,00
Other non-hazardous waste	0,00	21,60	8,00	65,10	0,00	0,00
Paper and cardboard	47,00	71,00	55,48	69,66	95,60	65,00
Plastic	74,40	73,50	75,08	96,84	153,09	184,76
Wood	9,00	4,10	30,60	78,50	173,50	103,80
TOTAL	**2.995,71**	**4.383,11**	**1.375,86**	**1.203,27**	**1.308,45**	**1.095,20**

1.8.3 Atmospheric emissions

The following sources of atmospheric emissions are considered:

- discharge of exhaust gases from the engines of the drilling unit
- discharge of exhaust gases from the engines of the supply vessels
- emissions of gas burning during production tests.

The fuel considered for the project activities is diesel, with a sulphur content below 0.2% by weight.

Drilling unit emissions

Data on fuel consumption for the Maersk Voyager are based on those available from a similar drillship, the Saipem 10000, that are available from eni's environmental database

Table 1-8 Fuel consumption and electricity generation of Saipem 10000

Year	*Diesel*	*Self-generated electricity. from non-renewable sources*	*Efficiency performance indicator*
	M3	*(kWh)*	*(lts diesel/kWh)*
2010	15165	26209	0.380
2011	13763	35232	0.580
2012	12283	32168	0.390

Considering the annual activity days of Saipem 10000 in years 2010-2011-2012, a mean daily consumption of 37.64 m3 of diesel is calculated.

As a result fuel consumption expected for the Maersk Voyager are a mean daily consumption of 35 to 40 m^3 of diesel,

Table 1-9 shows the mean atmospheric pollutant emissions. This estimate is based on data reported in ENI environmental database.

Table 1-9 Pollutant emission factors for drilling rig

POLLUTANT	EMISSION FACTORS	EMISSION FACTORS	EMISSION FACTORS
	g/kg(diesel) Year : 2010	g/kg(diesel) Year : 2011	g/kg(diesel) Year : 2012
Methane (CH_4)	0.002123	0.001927	0.001720
Carbon dioxide (CO_2)	47.351954	42.974279	38.353053
Nitrogen oxide (NO_x)	0.003336	0.003028	0.002702
Sulphur dioxide (SO_2)	Not Available	Not Available	Not Available

Supply Vessels Emissions

Three 5000/6000 hp supply vessels, 70/80 min. in length, capable of storing muds and chemicals, are present during drilling and completion phase. One remains stationary at the concession field while the others travel back and forth (meaning that 2 vessel are always on the field). An on-board crew of 15 is forecast.

For the supply vessels, used to carry materials and waste, the emissions have been determined using literature emission factors Saipem Corporate Criteria "Emission Estimation Methodology – CR-COR-HSE-075-E" for diesel internal combustion engine (see Table 1-10).

Table 1-10 Pollutant emission factors of supply vessel

POLLUTANT	EMISSION FACTORS
	g/kg(diesel)
Methane (CH_4)	0,20
Carbon dioxide (CO_2)	3.137,00
Carbon monoxide (CO)	20,08
Nitrogen oxide (NO_x)	55,93
Sulphur dioxide (SO_2)	20,00

Fuel consumption is estimated, according to a precautionary approach, considering two (2) supply vessel docked using 0,1 kg/s of diesel with a sulphur content of 0.2%, as reported in Williams *et. al*., 2003.

Production Tests

In Table 1-11, data on foreseen production test of OCTP field-1 are presented. The maximum gas flow rate is used in order to estimate the gas flow rate in production test of the field, according to a cautionary approach.

Table 1-11 Relevant parameters of production tests of Sankofa East

Period	Duration hrs	Choke 1/64"	WHP psia	WHT °F	BHP psia	BHT °F	BH DP (*) %	Avg Q_o Stb/d	Avg GOR(**) Scf/STb
Clean-up	2.0	24	1950	77	5275	245	4	1992	905
	1.2	28	1844	74	5201	245	5	2434	1000
	1.8	36	1635	73	5062	246	7	3500	1000
	2.0	40	1480	73	4979	247	9	3750	880
	0.8	44	1345	74	4909	247	10	4288	910
	1.0	48	1251	75	4856	247	11	4455	885
First BU	12.0	-	-	-	5455	240	-	-	
Main Flow	8.0	28	1819	77	5113	247	6	2600	830
	8.0	36	1566	77	4937	248	10	3710	806
	8.0	44	1291	80	4770	250	13	4700	790
Main BU	59.0	-	-	-	5457	240	-	-	
Sampling	3.2	24	1924	74	5209	246	5	1950	816
	2.5	20	2027	74	5271	246	4	1280	890
	5.0	16	2101	76	5327	246	3	800	1075
Flow	3.4	28	1807	78	5097	248	7	2570	830
	3.0	36	1554	81	4942	248	10	3500	860
	2.8	44	1280	78	4784	248	12	4610	850
BU	4.5	-	-	-	5422	244	-	-	

Tests will be performed in flow-rate steps for more accurate monitoring of the wells' performance; the planned tests will have the following characteristics:

- duration of production test: 4,5 days
- flow-rate of gas burnt in flare: 11,25 MScf

Naturally, the estimates of times and flow-rates are purely guideline. During production tests, emissions are mainly due to flare combustion, operation unavoidable as the connection to flowline occurs only in one second time.

A low amount of H2S in the OCTP gas flared during production tests is foreseen so the gas can be classified as "sweet".

The Ecoinvent database, from the Swiss Centre for Life Cycle Inventories, is the world's leading supplier of consistent and transparent life cycle environmental inventory (LCI) data, with more than 4'000 LCI datasets in the areas of agriculture, energy supply, transport, biofuels and biomaterials, bulk and speciality chemicals, construction materials, basic and precious metals, metals processing, as well as waste treatment, etc.

Table 1-12 shows the air emission related to 1 Nm^3 of sweet natural gas burned in flare, according to Ecoinvent. SO_x emissions are estimated using maximum value of H_2S in Table 1-13.

Table 1-12 Estimated atmospheric emission from gas flaring

POLLUTANT	EMISSION FACTORS
	g/Nm3 gas flared
Methane (CH_4)	0,25
Carbon dioxide (CO_2)	2.451,60
Carbon monoxide (CO)	0,54
Nitrogen oxides (NO_x)	12,13

Ecoinvent data for "air emissions from combustion of crude oil drilling test" is presented in **Table 1-13**, in order to describe the emissions of oil burned in production test.

Table 1-13 Estimated atmospheric emission from oil flaring

POLLUTANT	EMISSION FACTORS
	g/kg oil burned
Methane (CH_4)	0,121
Carbon dioxide (CO_2)	3500
Carbon monoxide (CO)	54
Nitrogen oxides (NO_x)	9,03
Sulphur dioxide (NO_2)	0,606

1.8.4 Noise emissions

On the drilling rig, the sources of noise are the diesel engines, rotary table, winch, pumps and cementing unit.

The noise produced is low frequency noise and the noisiest side of the platform is the side where the engines are located. In previous wells, the noise detected in the vicinity of the noise generation sources was as follows (see Table 1-14):

Table 1-14 Noise levels from previous well drilling activities

engine zone Leq (A)	derrick floor (rotary table and winch) Leq (A)	pump zone Leq (A)	cementing unit Leq (A)
105.5	93.6	85.6	104.2

Source: EIA

The values in Table 1-14, expressed in dB(A), indicate the A-weighted equivalent continuous sound level.

Ghana OCTP Block Phase 1 ESHIA

Attachment G

Impact Assessment Methodology and Mitigation Measures Guidelines

ABSTRACT

This document provides additional detail around the impact assessment methodology, and guidelines for mitigation measures.

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1. IMPACT ASSESSMENT METHODOLOGY

1.1 POTENTIAL IMPACT IDENTIFICATION AND CHARACTERISATION

In order to identify all of the potential impacts of a project, all proposed project activities must be analysed in relation to the environmental, social and health components of the natural and socio-economic environment that may be affected by the project.

The procedure applied for the impact analysis of the project and the analysis of the environment conducted in the study has involved the breakdown of the project into operating stages:

- Mobilization and rig installation, wells drilling;
- Production tests
- Well completion and installation/removal of well heads;
- SURF (Subsea Umbilical, Riser, Flowline) installation/operation,
- Installation/removal of FPSO and mooring system
- FPSO process commissioning/operation
- Decommissioning
- Overhead (i.e. comprises activities which are cross-cutting to all stages, affecting the socio-economic and health components)

Next, for each individual project stage considered, different project sublevels have been identified leading to identification of the project actions. (see Table 1-3 Table 1-8)

While the environmental, social and health components considered were:

- Atmosphere
- Water environment (characteristics of the water column)
- Sea bed and marine subsoil (characteristics of the sea bed sediments)
- Vegetation, flora and fauna (characteristics of the animal and plant associations of the water column, sea bed and avifauna)
- Coastal economic resources
- Local economy
- Community health and safety
- Community relations

For each individual project stage considered, different project sublevels have been identified leading to identification of the project actions with clearly defined interactions with the environmental components listed above, in some cases expressible by means of parameters.

For each project action, it has been thus possible to identify the Potential Impacts and make a qualitative estimate of the potential impacts on the various environmental components, through the identification of appropriate parameters.

The list of Potential Impacts has been drawn up on the basis of the characteristics of the environmental parameters and with a view to subsequent definition of the interactions between the project and the marine environment.

The selection of the Potential Impacts highlights the parameters of greatest significance in relation to the project, and is the outcome of multidisciplinary studies and experience, an in-depth survey of the bibliography, and data and information obtained from scientific research: the parameters were also chosen on the basis of the specific characteristics of the environment concerned.

In order to identify the parameters potentially affected by the execution of the planned project activities, the project actions were examined in depth to produce the graph of ACTIONS against POTENTIAL IMPACTS shown below (Table 1-1), which clearly reveals that, directly or indirectly, each action included in the project may lead, in quality terms, to specific forms of impact.

The graph underlines the relationship of cause and effect between the operations related to the project and the impacts on the various environmental components generated in the different contexts. This has been followed by a thorough examination of the impacts of the various operations, the different types of effect, and the processes which might potentially be triggered.

The Potential Impacts selected are those potentially capable of shifting the balances of environmental systems in the marine context, or interacting with on-going environmental processes. The factors highlighted are those considered to be of significance, on the basis of the knowledge acquired, for the purposes of providing a complete description of the project under examination and a clear definition of its impacts.

For example, the project action “use of support vessels”, which takes place during installation of the sub-sea well heads and laying of the flowlines, has the corresponding Potential Impact of the emission of atmospheric pollutants arising from the generators installed on board the craft.

Table 1-1 details, for each of the operations, the Potential Impact which generate significant environmental alteration, leaving aside forms of impact which lead to changes to the environment which, although not negligible, are often of slight or very slight extent.

The impacts deriving from activities of water reinjection into the reservoir have been preliminarily evaluated and found negligible with respect to ground water contamination; impacts on surface environment of the said activities, such as atmospheric and noise emissions, are part of the considerations included in the present chapter.

The following assessments includes a description of the impacts deriving from the discharge into the sea of the civil sewage produced during the proposed project, after physical-chemical treatment.

The project envisages the total reinjection of the production water after mixing with seawater, process cooling water and test water; nevertheless, in the present document potential impacts deriving from discharge of the production water into the sea are described. In that case, production water will be discharged after treatment to reduce the oil content in line with applicable regulation and best practices.

Table 1-1 Relationships between Project Actions and Potential Impacts

STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
WELLS DRILLING	Drilling activities	Drilling system installation and removal	damages to morphological structures and benthic biocenoses
			mobilisation and resuspension of sediments
		Drilling system operation	emission of pollutants into the atmosphere
			generation of noise in the water
			damages to benthic biocenoses
		Production test	emission of pollutants into the atmosphere
	Drilling support	Use of support	release of pollutants and metals in solution

STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
		vessels	discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
			risk of invasive species introduction from ballast water exchange
WELL HEADS INSTALLATION AND REMOVAL	Well heads installation and removal	Installation/removal activities	damages to morphological structures and benthic biocenoses
			mobilisation and resuspension of sediments
			generation of noise in the water
		Use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
			risk of invasive species introduction from ballast water exchange
			risk of marine mammals collision with project facilities associated to the physical presence of structures and vessels
WELL HEADS OPERATION	Normal operating procedures	Presence of production structures	mobilisation and resuspension of sediments
			Increased availability of organic matter
			physical presence of structures
		Protection of structures against corrosion (anodes)	release of pollutants and metals in solution
	Production support, maintenance	use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
			risk of invasive species introduction from ballast water exchange

STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
FPSO – MOORING SYSTEM INSTALLATION	Installation activities	mooring system installation activities	damages to morphological structures and benthic biocenoses
			mobilisation and resuspension of sediments
			generation of noise in the water
		use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
			risk of invasive species introduction from ballast water exchange
			risk of marine mammals collision with project facilities associated to the physical presence of structures and vessels
	Structures normal operating conditions	protection of structures against corrosion (anodes)	release of pollutants and metals in solution
		presence of mooring system	mobilisation and resuspension of sediments
			Increased availability of organic matter
			physical presence of structures
		use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
			risk of invasive species introduction from ballast water exchange
FPSO PROCESS COMMISSIONING AND OPERATION	Commissioning	commissioning procedures, hydrotest	release of pollutants and biocides in solution
	Process normal operating conditions	process operation	emission of pollutants into the atmosphere
			discharge of cooling water, hot waste water
			release of pollutants and biocides in solution
			generation of noise in the water
			risk of marine mammals collision with project facilities

STAGE	ACTIVITY	ACTION	POTENTIAL IMPACTS
			associated to the physical presence of structures and vessels
		production water discharge	release of pollutants and biocides in solution
		offloading activities	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
	Production support, maintenance	use of support vessels	release of pollutants and metals in solution
			discharge of engine cooling water, hot waste water
			generation of noise in the water
			discharge of nutrients and organic matter from civil sewage
			emission of pollutants into the atmosphere
			risk of invasive species introduction from ballast water exchange
			risk of marine mammals collision with project facilities associated to the physical presence of structures and vessels

The Potential impacts are briefly listed in Table 1-2.

Table 1-2 List of Potential Impacts identified

Emission of pollutants into the atmosphere
Generation of noise in the water
Discharge of cooling water into the sea Hot waste Water
Discharge/availability of Nutrients and Organic Matter
Damages to morphological structures and benthic biocenoses
Mobilisation and Resuspension of sediments
Physical Presence of Structures
Release of pollutants, biocides and metals in Solution

The Activity/Potential Impacts table shows which Potential Impacts are caused by the various project activities.

Our scrutiny of the project's characteristics arising from the available technical design, thus enabled us to identify and select the main Potential Impacts potentially capable of creating interferences with the marine, coastal and anthropic environment and the relative components identified.

The interactions between project actions and ESH components affected result in the following impact identification matrices, organised by Project Stage:

Table 1-3 Matrix to identify potential environmental, socio-economic and health impacts – Well Drilling Stage

STAGE	ACTIVITY	ACTION	ENVIRONMENTAL, SOCIAL AND HEALTH COMPONENTS							
			Atmosphere	Water Environment	Seabed & Marine Subsoil	Vegetation, Flora, Fauna	Coastal economic resources	Local/national economy	Community Health & Safety	Community Relations
WELLS DRILLING	Drilling activities	Drilling system installation and removal			Damages to morphological structures and benthic biocenoses	Damages to morphological structures and benthic biocenoses	Disturbance to marine & fishing resources			
				Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments				
		Drilling system operation	Emission of pollutants into the atmosphere				Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
		Drilling cuttings discharge			Damages to morphological structures and benthic biocenoses	Damages to morphological structures and benthic biocenoses				
		Production test	Emission of pollutants into the atmosphere						Impact on health due to emission of pollutants into the atmosphere	
	Drilling support	Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of cooling engine water into the sea – Hot waste water		Discharge of cooling engine water into the sea – Hot waste water				
						Generation of noise in the water				
						Potential introduction of invasive species through ballast water exchange				
						Damages to marine mammals colliding with project vessels or infrastructures				

Table 1-4 Matrix to identify potential environmental, socio-economic and health impacts – Well Heads Installation, Operation and Removal Stages

STAGE	ACTIVITY	ACTION	ENVIRONMENTAL, SOCIAL AND HEALTH COMPONENTS							
			Atmosphere	Water Environment	Seabed & Marine Subsoil	Vegetation, Flora, Fauna	Coastal economic resources	Local/national economy	Community Health & Safety	Community Relations
WELL HEADS INSTALLATION AND REMOVAL	Well heads installation and removal	Installation/removal activities		Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Disturbance to marine & fishing resources			
					Damages to morphological structures and benthic biocenoses	Damages to morphological structures and benthic biocenoses				
						Generation of noise in the water				
		Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
						Generation of noise in the water				
						Potential introduction of invasive species through ballast water exchange				
						Damages to marine mammals colliding with project vessels				
WELL HEADS OPERATION	Normal operating procedures	Presence of production structures		Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Disturbance to marine & fishing resources			
				Increased availability of organic matter	Increased availability of organic matter	Increased availability of organic matter				
					Physical presence of structures	Physical presence of structures				
		Protection of structures against corrosion (anodes)		Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution				
	Production, support, maintenance	Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
						Generation of noise in the water				

Table 1-5 Matrix to identify potential environmental, socio-economic and health impacts – Transport Systems Construction and Operation Stages

STAGE	ACTIVITY	ACTION	ENVIRONMENTAL, SOCIAL AND HEALTH COMPONENTS							
			Atmosphere	Water Environment	Seabed & Marine Subsoil	Vegetation, Flora, Fauna	Coastal economic resources	Local/national economy	Community Health & Safety	Community Relations
TRANSPORT SYSTEMS CONSTRUCTION	Laying of flowlines	Laying of flowlines		Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments				
					Damages to morphological structures and benthic biocenoses	Damages to morphological structures and benthic biocenoses				
		Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
						Generation of noise in the water				
						Potential introduction of invasive species through ballast water exchange				
						Damages to marine mammals colliding with project vessels				
TRANSPORT SYSTEMS OPERATION	Flowlines operations	Protection of structures against corrosion (anodes)		Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution				
		Presence of flowlines		Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments				
				Increased availability of organic matter	Increased availability of organic matter	Increased availability of organic matter				
					Physical presence of structures	Physical presence of structures				

Table 1-6 Matrix to identify potential environmental, socio-economic and health impacts –FPSO Mooring System Installation Stage

STAGE	ACTIVITY	ACTION	ENVIRONMENTAL, SOCIAL AND HEALTH COMPONENTS							
			Atmosphere	Water Environment	Seabed & Marine Subsoil	Vegetation, Flora, Fauna	Coastal economic resources	Local/national economy	Community Health & Safety	Community Relations
FPSO MOORING SYSTEM INSTALLATION	Installation activities	Mooring system installation activities					Disturbance to marine & fishing resources			
		Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
						Generation of noise in the water				
	Structures normal operating conditions	Protection of structures against corrosion (anodes)		Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution				
		Presence of mooring system		Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Mobilisation and resuspension of sediments	Disturbance to marine & fishing resources			
				Increased availability of organic matter	Increased availability of organic matter	Increased availability of organic matter				
					Physical presence of structures	Physical presence of structures				
		Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
						Generation of noise in the water				
						Potential introduction of invasive species through ballast water exchange				
						Damages to marine mammals colliding with project vessels				

Table 1-7 Matrix to identify potential environmental, socio-economic and health impacts –FPSO Process Commissioning and Operation Stage

STAGE	ACTIVITY	ACTION	ENVIRONMENTAL, SOCIAL AND HEALTH COMPONENTS							
			Atmosphere	Water Environment	Seabed & Marine Subsoil	Vegetation, Flora, Fauna	Coastal economic resources	Local/national economy	Community Health & Safety	Community Relations
FPSO MOORING SYSTEM INSTALLATION	Commissioning	Commissioning procedures, hydrotest		Release of pollutants and biocides in solution	Release of pollutants and biocides in solution	Release of pollutants and biocides in solution				
	Process normal operating conditions	Process operation	Emission of pollutants into the atmosphere	Release of pollutants and biocides in solution	Release of pollutants and biocides in solution	Release of pollutants and biocides in solution			Impact on health due to emission of pollutants into the atmosphere	
				Discharge of cooling water – Hot waste water		Discharge of cooling water – Hot waste water				
		Production water discharge		Release of pollutants and biocides in solution		Release of pollutants and biocides in solution				
		Off-loading activities	Emission of pollutants into the atmosphere	Release of metals and pollutants in solution	Release of metals and pollutants in solution	Release of metals and pollutants in solution			Impact on health due to emission of pollutants into the atmosphere	
				Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage				
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
	Production support, maintenance	Use of support vessels	Emission of pollutants into the atmosphere	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Discharge of nutrients and organic matter from civil sewage	Disturbance to marine & fishing resources		Impact on health due to emission of pollutants into the atmosphere	
				Release of pollutants and metals in solution	Release of pollutants and metals in solution	Release of pollutants and metals in solution	Increase in marine traffic	Increase in marine traffic		
				Discharge of engine cooling water into the sea – Hot waste water		Discharge of engine cooling water into the sea – Hot waste water				
						Generation of noise in the water				
						Potential introduction of invasive species through ballast water exchange				
						Damages to marine mammals colliding with project vessels				

Table 1-8 Matrix to identify potential environmental, socio-economic and health impacts – Overhead Activities all stages

STAGE	ACTIVITY	ACTION	ENVIRONMENTAL, SOCIAL AND HEALTH COMPONENTS							
			Atmosphere	Water Environment	Seabed & Marine Subsoil	Vegetation, Flora, Fauna	Coastal economic resources	Local/national economy	Community Health & Safety	Community Relations
OVERHEAD	Employment of personnel and contractors	Employment of personnel and contractors						Increase in employment levels and income generation		Alteration in community expectations on employment opportunities
	Procurement of goods and services	Procurement of goods and services						Increase in GDP		
								Increase in employment levels and income generation		
	Payment of taxes, royalties and fees to Government	Payment of taxes, royalties and fees to Government						Increase in Government revenues		Alteration in community expectations on socio-economic development investments
								Increase in GDP		

Table 1-9 represents, for the different ESH components, the summary list of all the potential direct impacts caused by the Project, as identified in the Activity/potential Impacts (or Impact Identification) matrix. The table also allows to represent how each component may be disturbed by a synergy of potential impacts.

Table 1-9 ESH Components/Potential Impacts

Environmental, social & health components Potential Impacts	Atmosphere	Water environment	Soil - Subsoil	Vegetation Flora Fauna	Coastal Economic Resources	Local economy	Community Health & Safety	Community Relations
Emission of pollutants into the atmosphere	■							
Generation of noise in the water				■				
Discharge of cooling water into the sea - Hot waste Water		■		■				
Discharge/availability of Nutrients and Organic Matter		■	■	■				
Damages to morphological structures and benthic biocenoses			■	■				
Mobilisation and Resuspension of sediments		■	■	■				
Physical Presence of Structures			■	■				
Release of pollutants, biocides and metals in Solution		■	■	■				
Disturbance to marine and fishing resources				■	■	■		

Increased employment levels and income generation						■		■
Increase in marine traffic						■		
Alteration in expectations of local communities								■
Increase in Government Revenues						■		■
Increase in GDP						■		■
Impacts on health							■	

Once the direct impacts are established, the next step is to determine the impact pathway to identify the further socio-economic and health implications (indirect impacts) of these changes, as well as any subsequent cumulative and perceived effects (Table 1-10).

Table 1-10 Impact pathway to identify *indirect* (as well as cumulative and perceived) socio-economic and health impacts (both positive and negative)

Direct	Indirect		Cumulative	Perceived
Increased employment levels and income generation	Increased capacity to access services such as schooling and health	Improved education levels, health status, etc.		Expectations regarding new opportunities for employment and public services
Biophysical impacts on marine resources	Interruption or disturbance to fishing activities	Loss of income and decreased food security	Impacts to local economy	Marine pollution will harm fish and coastal communities, especially in the case of an oil spill
Increase in marine traffic	Hazards to and disruption of navigation	Potential emergency situation from vessel collision		Conviction that physical structures and activities of Project are responsible for fish catch reductions
Alteration in expectations of local communities	Risk of unmet expectations		Company sector reputational damage	Expectations regarding new opportunities for employment, improved infrastructural conditions like water, electricity, public transport, health centres and schools, etc.

Direct	Indirect		Cumulative	Perceived
Increase in GDP and Government revenues	Increased public investment in infrastructure & services provision (education, health, etc.)		Improved standards of living	Expectations regarding new opportunities for social and infrastructural services improvement & provision

1.2 POTENTIAL IMPACTS INDICATOR PARAMETERS

It is possible to express the ESH components by means of specific indicator parameters. (see Table 1-11). This table of INDICATOR PARAMETERS against POTENTIAL IMPACTS illustrates which environmental, social and health (ESH) parameters are potentially affected by the Potential Impacts. The latter modify the parameters more or less significantly, directly and/or indirectly, by causing a change in the control value of the indicator associated to each parameter before the start of the project operations.

The chosen Parameters/Indicators are “sensitive” to the changes triggered by the Potential Impacts, and are therefore capable of describing and quantifying the impacts caused, and providing a clear picture of their boundaries and characteristics, even where the Potential Impacts interact with each other to generate more complex forms of environmental/social stress, involving a variety of interconnected components.

The table is therefore intended as a tool which provides an overview of the environmental, social and health sensitivity factors and the current or potential criticalities, in relation to the specific, often synergetic, agents of impact identified and arising from the project operations.

For example, the parameter of the T.O.C. of the sediments and/or water column is clearly influenced by the discharge of organic effluents, but less explicitly, it is also strongly affected by the physical presence of a hard substrate in the sea (permanent structure), due to bio-fouling.

Table 1-11 Relationships between Indicator Parameters and Potential Impacts

POTENTIAL IMPACTS / **PARAMETERS/ Indicators**	Discharge of Nutrients and Organic Matter	Emission of pollutants into the atmosphere	Generation of noise in the water	Discharge of cooling water, hot waste water	and benthic biocenoses	Mobilisation and resuspension of sediments	Physical Presence of Structure	Release of pollutants, Biocides and Metals in Solution	Disturbance to marine & fishing resources	Increased employment levels and income generation	Impact on health and safety	Increase in marine traffic	Alteration in expectations of local communities	Increase in GDP and Government revenues
Ammoniacal Nitrogen Concentration	■													
Orthophosphate Phosphorus Conc.	■													
Nitrate Concentration	■													
Nitrite Concentration	■													
Total Hydrocarbons								■						
Oxygen Concentration/BOD	■			■										
Temperature				■										
Transparency	■			■		■	■							
Bioaccumulation of Lead								■						
Bioaccumulation of Aluminium								■						
Bioaccumulation of hydrocarbons (IPA)								■						
Sulphur Dioxide Concentration		■												
Aromatic Hydrocarbon Concentration		■												

Nitrogen Oxide Concentration														
Carbon Oxide Concentration														
Dust Concentration														
Organic Carbon Concentration TOC														
Lead Concentration														
Aluminium Concentration														
Chlorine concentration														
Particle Size														
Sediment Thickness														
Chlorophyll “a”														
Fishing Yield														
Reduction in Fishing Grounds														
Average Number of Species														
Specific Diversity Index														
Average Low Frequency Noise														
Zone Affected by noise														
Fish catch trends														
Employment levels by sector														
staff health & safety accidents/incidents														
GDP growth by sector														
Social infrastructures availability														
Grievance mechanism / Community relations reports														

Once identified and characterised, potential impacts need to be assessed in order to determine the significance of each impact, as well as any required mitigation/enhancement and/or management measures to ensure that impacts are of acceptable levels of significance. The significance of an impact is qualitatively established on the basis of clearly defined criteria that describe each impact’s Consequence and Probability, using a methodology developed by eni and defined in the eni ESHIA Standard (eni doc. no. 1.3.1.47). In relation to some affected components impacts are also assessed quantitatively through the application of modelling techniques.

This following sections present more detailed discussions on the environmental, social and health aspects as well as the associated and potential impacts of the proposed projects. As already indicated in the previous section, these impacts have been assessed (characterized and

evaluated) and the results presented in Table 1-3 toTable 1-8. The discussions presented in this section are intended to provide insight into the nature and magnitude as well as duration of identified impacts of the various project activities.

1.3 EVALUATION OF IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

Environmental Effects of Potential Impacts Identified

As previously illustrated in Table 1-9 (ESH Components/Potential Impacts) each environmental component may be affected by a synergy of potential impacts, which stem one from the other. For example, the component Seabed and Marine Subsoil is potentially affected by 5 different types of impact, and these impacts in turn may be generated by one or more project actions. Moving towards the impact evaluation it is therefore necessary to first provide a description of the environmental effects of each potential impact, as well as which project actions give rise to the same potential impact.

The presence of the vessels supporting the installation and operation of the drilling system and the installation of the sub-sea well heads and the mooring system, the positioning of the FPSO, its operation and offloading activities, and the support vessels which lay the flowlines linking the sub-sea well heads and install the connections and protective systems, causes the **emission of pollutants into the atmosphere** as a result of operation of the engines and power generators. However, these emissions are small in quantity, temporary, and partly restricted to the installation site and partly occurring along the route of the sealines**.**

The presence of the support vessels necessary for the operations, the drilling operations, subsea installation and operation activities leads to an **increase of the low frequency underwater noise level** which may drive fish species away, although only temporarily and within the small area where the noise is heard, and may also interfere with the normal physiological functions and behaviour of some species of mammals and reptiles.

The presence of the support vessels and the operation of FPSO including offloading activities will also cause the discharge of engine cooling water containing biocides and anticorrosion substances into the sea; the main effect of the **discharge of engine cooling water** is a possible local increase in temperature, with possible consequences for primary production and a light contamination of the water column.

The **discharge of treated sewage** from the drilling unit, support vessels, the FPSO and the offloading vessels involves the discharge both of dissolved substances (e.g. nutrients easily assimilated into the primary production cycle) and **suspended matter** (which causes an increase in turbidity and the consumption of significant amounts of oxygen to degrade the matter through the affected column of water, also triggering an increase in primary production). In the event that this discharged material reaches the sea bed (this might not occur in the zone where the water is very deep) there is an **increase in organic matter** and thus a reduction in the amount of oxygen at the interface.

Treated sewage will be discharged for the time for which the support vessels are required for drilling operation, well heads installation, FPSO installation and operation, offloading activities and laying operations, and this will take place in the installation sites and along the route of the flowlines.

The operations for installation, of the flowlines and anchoring of the lay barge and mooring system construction may cause small, localised morphological changes, which may lead to **interference with morphological structures** (formed by sediments or biological processes) and **benthic biocenoses** with potentially damages depending on the vulnerability of involved ecosystems.

Morphological variations of this kind are filled, levelled and returned to their previous conditions by the currents and hydrodynamics, at varying speeds which depend on the sedimentation rate and hydrodynamics of the areas where the installation site and flowlines route are located.

During drilling operations, a solid waste processing system will be in operation at the point where the mud flows out of the well. It will comprise equipment such as a vibrating screen, desilter, desander, centrifuges, etc., which will separate the mud from the drilling cuttings, which will be collected after treatment and properly disposed onshore in line with Ghana Regulations.

The drilling fluids used consist of a basic liquid (synthetic oil) rendered colloidal and weighted through the addition of specific products. The colloidal properties provided by special clays (bentonite) and enhanced by special compounds such as carboxyl methyl cellulose give the mud the rheological properties needed to keep the weighting materials and cuttings in suspension, even when the circulation is at a standstill, with the formation of a gel.

Another consequence of the operations of installing the drilling system and the mooring system, and of laying the flowlines, is the **mobilisation and resuspension of sediments** from the sea bed. This leads to a temporary increase in the turbidity of the water over a small area, the size of which depends on the local hydrodynamics, and the particle size and cohesiveness of the sediment. The degree of turbidity decreases as the particle size increases is greater in specific hydrodynamic conditions, such as where there is stratification of the water column, and leads to a reduction in the level of light penetration. If this reduction in light levels continues for some time, there may be a decrease in the amount of oxygen in the water due to a reduction in the rate of photosynthesis and the activation of degradation/oxidation processes only; primary production is thus directly affected.

The positioning of the drilling and production structures and their presence leads to burying of the organisms and benthic biocenoses, and the removal of a small area of habitat; this removal is temporary in the case of the drilling system and restricted to drilling period and much longer in the case of well heads and sealines.

The temporary physical presence on the sea bottom of drilling structures and the much longer presence of the sub-sea well heads, the flowlines and the mooring system, produces an amplification/modification of the local hydrodynamics and the normal sediment resuspension and erosion phenomena, with negligible effects on the local particle size and local changes to the typical percentage of sand, clay and silt, and consequent negligible variations in the numbers and types of macrobenthic species (especially polychaetes and molluscs), which depend to a considerable extent on the types of sediment found on the sea bed.

An increase in the organic matter both in suspension and on the sea bed, with a possible reduction in the amount of oxygen near the sea bed and an increase in the turbidity, with potential direct and indirect effects on the area's biology, may arise as a result of the physical presence of the sub-sea structures (well head, flowlines, FPSO mooring system). These cause an increase in the availability of the organic matter in the area, thanks to the F.A.D. (Fish Aggregating Device) effect, creating a new community of fauna different from that typically found in the waters around the well heads. This will also have beneficial effects on fishing in the zones close to these sub-sea structures.

Changes in the trophism (increase in organic matter available during installation due to the treated sewage discharges, and during normal operation due to the F.A.D. effect) may modify the concentration of chlorophyll a, linked in turn to the algal biomass.

During normal operation the subsea structure will discharge no nutrients into the sea; the variations in chlorophyll concentrations derive essentially from the normal seasonal fluctuations, indirectly influenced by the presence of the offshore structures, which create a microhabitat where biological activity is amplified compared to the surrounding environment.

There will be a de facto **reduction in the area available for commercial fishing** due to the presence of the production structures and the flowlines, or operations related to them. The operations may also temporarily chase the fish stock available for commercial fishing away from the involved areas and could partially modify the migratory routes for the young of some species. However, this will not in any way compromise survival or create any significant impact on commercial fishing conducted in the vast area.

The fishing performed by coastal communities will not be affected in any way because such fishing does not involve the area covered by the proposed project which is at a quite some distance from the coast.

The presence of the vessels needed to lay the flowlines and support installation, operation and offloading activities may generate an increase in the lead concentration in the water column and sediments, since this element is present in the fuels used to power the craft.

The quantities of relatively heavy aliphatic compounds (from C10 to C15) and the concentration of IPA (generally of the order of ppb) can be considered quite low, since the only emission source is the exhaust water of Diesel-powered vessels used for support activities. The highest levels of hydrocarbons (and lead) in sediments occur generally along the routes followed by the vessels which travel to and from the offshore structure, allowing us to assume that their presence is caused by the passage of the craft.

The resuspension of sediments may trigger a limited **release into the water column of pollutants** in the sediments themselves, and in the final analysis indirect effects on the biology of the area arising from the possible burying of organisms and biocenoses due to the re-sedimentation of material placed in suspension during operations.

The use of sacrificial anodes to protect the submerged structures against corrosion has negligible effects on the water column and sediments, and marginally also on the biocenoses. The anodes (which contain no mercury) **shed metals**, especially Al, causing a slight increase in the concentration of these elements in the water column and in the sediment, to which they are confined, unable to significantly affect the biocenoses.

The bibliography on the effects of the presence of Al in marine sediments or the water column is very limited. However, there are no reports of cases in which this element has been toxic to marine organisms, and apparently sea-dwelling filtering organisms are not capable of bioaccumulating Al.

The project envisages the total reinjection of produced water, nevertheless, in the present document potential impacts deriving from discharge of the produced water into the sea are described. In that case, produced water will be discharged after treatment to reduce the oil content in line with applicable regulation and best practices. The produced water will be discharged into the sea, after treatment, only in case of unavailability of the water injection system.

Associated with oil and gas deposits, these waters are brought to the surface along with the hydrocarbons produced. The quantity and quality of the production water generated during cultivation activities depends on the type of well, the nature of the geological formation and the extent to which the well is exploited.

In some cases chemical compounds can be added to the production waters. The amounts of such additives — e.g. corrosion inhibitors, biocides, de-emulsifiers, etc. — found in production water does not generally exceed a few parts per million (pm).

The production waters typically contain an inorganic component — essentially composed of chlorides, bicarbonates and ions of sodium, potassium, calcium, barium and strontium, with concentrations increasing as depth increases — and an organic component — alkanes from C7 to C31, aromatic compounds and polycyclic hydrocarbons.

The volatile hydrocarbon liquids (VHLs) — including light aromatics and, in particular, compounds ranging from benzene to naphthalene of ecotoxicological interest since they are most highly soluble in water — are those most commonly found in the production water.

The fraction of petroleum insoluble in water is, above all, composed of high molecular weight aliphatic hydrocarbons (HMW-HC) and cyclical and aromatic hydrocarbons, again with high molecular weight: only small amounts of polycyclical aromatic hydrocarbons, PAH, are present in the production waters.

The temperature of the production water increases as the production zone deepens (in shallow wells the temperature ranges from 30 to 50°C while it can even reach 250°C in the deepest wells).

The solid content suspended in the production water can vary quite significantly; the presence of major amounts of suspended solids can lead to a significant decrease in the transparency of the discharge water column. However, that it could have repercussions on the photosynthetic community on the sea floor is ruled out because of its great depth; thus can be assumed that the consequence for phytoplankton would be negligible.

In any case, the discharge of volumes of hot water and water (production water, process water) containing pollutants, biocides and anti-corrosion substances from the production process, FPSO and flowlines hydrotest into a large and deep basin like the one under consideration may trigger environmental interferences of negligible intensity.

There is little knowledge of the type and gravity of the consequences of these discharges on the biological community, which will depend to a large degree on the size of the area affected to varying extents by the discharge of the cold sea water.

Different environmental scenarios can be considered possible depending on the hydrodynamic conditions present, whether there is a thermocline with stratification of the temperature gradient and variation in density at different depths, whether a vertical/horizontal flow is established, etc.

In this context, it is important to consider the limited size of the discharges compared to the volume of the receptor body and the system and procedures by which the water is discharged along the water column, in order to ensure a good level of mixing. The extent of the effects of a given impact varies depending on the stage in the operations, but the processes triggered on the sea bed or through the water column are generally the same.

The types of change on which attention has been focused have basically been:

- anomalies in the morphology, sediments and macro-fauna caused by the physical impact of installation of drilling structures, mooring system and the well heads, and the presence of the sub-sea structures (mooring system, well head and flowlines), in terms of both a physical obstacle interfering with the waves and currents, and occupation of the sea bed;
- physical and biological effects (changes in the morphology, sediments, and burying of benthic organisms) caused by the material suspended as a result of the installation operations and subsequently resedimented, by the ballast water exchange and by the treated sewage discharged from the offshore structure during activities;
- chemical, chemical-physical and biological anomalies in the water column and sea bed caused by the possible release of any toxic substances or elements present in the sediment disturbed, with effects on the planktonic and benthic organisms;
- chemical, chemical-physical and biological anomalies of the atmosphere, water column or sea bed caused by the possible release of any organic and inorganic pollutants and the impacts caused by the presence of the vessels involved in the activities and by process operation.

To allow a more effective assessment of the impact of the activities on each individual sector, it is necessary to make a detailed analysis of the project actions, the relative impacts, and the processes with which they interact. To simplify this analysis, the project actions were subdivided

into groups on the basis of the type of effect induced, and the relative forms of impact, i.e. the ways in which they interact with and change the environment, were identified for each group.

Table 1-12 Effects of project actions and Potential Impacts identified

Effects of the project actions		Potential Impacts
Modification of primary production and phytoplankton population density	Actions which may affect the level of trophism	Discharge of Nutrients and Organic Matter
Increase of organic particulate in suspension		Physical presence of structures with increase in organic matter availability
Changes in oxygen consumption with variation in compensation point		
Variation in the quantity of organic matter in the sediment		
Change in the level of microbic decomposition		Discharge of cooling water, hot waste water, potentially containing hydrocarbons
Increase in resources of debris-eating animals		
Modification in thickness of the oxidised layer of the sediment		
Increase in sedimentation of particulate on sea bed	Actions which cause mechanical and physical disturbance to the substrate	Damage to morphological structures and benthic biocenoses from sea bottom activities
Shifting of sediments and increase in organic particulate in suspension		
Increase in hydrodynamic energy on sea bed		Mobilisation, distribution and re-depositing of sediments
Increase in sedimentary instability of sea bed		
Clogging of breathing surfaces		Physical presence of structures and interference with the sea bed
Release of metals in solution and their incorporation into sediments	Actions causing inorganic pollution	Release of pollutants and metals in solution from sacrificial anodes, and as a result of shifting of any contaminated sediments
Bioaccumulation and biomagnification		Discharge of pollutants and biocides
Modification of the physiological functions of organisms	Actions which disturb physical parameters (not on sea bed)	Generation of noise in the water
Increased risk of marine mammals collision with Project vessels and infrastructures		Physical Presence of Structures and vessels
Driving away of fish and breeding stock and interference with routes used by fry		
Attraction of fish species (FAD effect)		Emission of pollutants into the atmosphere

Eutrophying disturbing actions

This first group includes the actions which cause impacts capable of directly or indirectly increasing the level of nutrients or the level of organic enrichment of the water column and sediment.

This class of impact includes:

- discharge into the sea of hot water from the cooling of the engines of the vessels present during installation, operations and offloading activities, and the system power generators;
- discharge into the sea of hot production water containing hydrocarbons and salts (the produced water will be discharged into the sea, after treatment, only in case of unavailability of the water injection system).
- discharge of nitrogen and phosphorus compounds (treated sewage) or other organic substances, and the actual presence of the sub-sea structures which may indirectly cause an enrichment of the organic matter due to the variations triggered in the circulation near the sea bed.
- the physical presence of the sub-sea structures causes an increase in the availability of organic matter due to the colonisation of the structures by filtering bivalves, algae and other organisms as a result of what is known as the F.A.D. (Fish Aggregating Device) effect, thus creating a new fauna community different from that typically found on the soft sea beds around the well heads, with beneficial effects for fishing around the zones close to the sub-sea structures themselves.

Eutrophying impacts lead to temporary interferences of the kind described, closely correlated to the increase in primary production, and significant over a limited area, negligible and fading into nothing along the route of the flowlines in the open sea.

The eutrophying actions cause an increase in the concentration of chlorophyll in the water column, due to the increase in the densities of the phytoplankton population; the increase of organic particles in suspension may lead to reduction in the transparency of the water column and a raising of the depth below which respiration predominates over production, while within the sediment it may cause an increase in organic matter and thus in the resources for debris-eating animals and microbic decomposition, causing a rise in oxygen consumption and a reduction in the depth of the oxidised layer.

Mechanical and physical disturbing actions

This category includes all forms of impact, which, while their impact on the chemical characteristics of the water column and sea bed is low, have a mainly physical disturbing action, for example by modifying the hydrodynamics, particle size breakdown and morphology of the sea bed. They comprise the discharge/leakage of particulate inorganic matter (production water, treated sewage etc.), movements of sea bed sediments due for example to the laying of the flowlines, burying of portion of the sea bed, hydrodynamic variations caused mainly by the continuing presence of the sub-sea structures, which interfere with the waves and currents to cause turbulence and local erosion-sedimentation, as well as instability of the sedimentation mechanisms.

The presence of the well heads, the mooring system and the flowlines may lead to some level of distortion of the current field, and local changes of sediment distribution; however, the results of hydrodynamic models applied to similar structures have revealed that the variation only occurs over a band just a few metres wide around the structures; moreover, in the case of the flowlines, the effects will diminish over time as the line gradually becomes covered with sediments.

The interferences caused by mechanical and physical changes to the substrate relate also to the transparency of the water column and a variation in the sedimentation of the sea bed. The effects vary depending on the type of the sea bed and the communities to which it is home, and are particularly severe only on rocky sea beds or organogenic substrates, which are not found in the areas affected by mooring system, the well heads and laying of the flowlines.

The physical presence of the structures, and the operations which may interact with the sea bed to cause erosion/resuspension of sediments in general, together with the emission of fine material, organic matter and nutrients from the treated sewage from the FPSO and the vessels providing support for the drilling activities, discharge of production water containing particulate matter, FPSO operation and offloading and flowlines laying operations, cause a variation in the transparency of the water and a local alteration in the typical percentages of sand, clay and silt, although this is limited in both time and space.Although affecting only a limited area, the reduction in transparency is particularly noticeable in the deepest layers of the water column, due to the movement and resuspension of the sediments caused by the operations too.

A variation in the average number of polychaete and mollusc species and the specific diversity, equidistribution and abundance indicators of the benthic biocenoses arises as a result of the installation and laying of the flowlines, and in general from the operations or activities which affect the sea bed, although this is of fairly short duration and only occurs in the area immediately around the operating zones.

The physical presence of the structures and the shifting and re-depositing of the sediments caused by the operations may lead to habitat loss and changes in the type of the sediment and thus in the microbiology and in the number and type of the macro-benthic species which depend to a large extent on the characteristics of the sea bed sediments.

However, it must be remembered that once the flowlines have been laid, its effects will only be felt for a few metres either side of it, and thus the loss of habitats caused by its presence and that of the other sub-sea structures is negligible.

Over the long term, the sub-sea structures may encourage colonisation by sessile organisms, leading to habitat conditions different from those in the surrounding area. There is also the possibility of species enrichment or the appearance of new species, especially since the surrounding sea beds are mobile and not hard.

Actions causing inorganic pollution

This is chemical pollution, originating both from the sub-sea structures and the cathodic protection systems (sacrificial anodes), and from the shifting and resuspension of any sediments containing pollutants which are thus put back into circulation; the release of ions into the water column by support vessels is another form of pollution in this category.

The release of hydrocarbons and ions in the sediments and into the water column by the FPSO (production water) and by support and offloading vessels, and the discharge into the sea of the biocides or anticorrosion substances (chlorine) contained in the cooling water used during the production process and in the production water, are other forms of impact in this category. The potential interaction between these forms of impact and the biological entombment arises from the bioaccumulation/magnification (incorporation by organisms).

Al is used in the construction of the anodes which protect sub-sea structures from corrosion. This cathodic protection is provided by applying a certain number of mercury-free strap-on sacrificial anodes consisting of an alloy containing about 95% aluminium.

The purpose of these anodes is to form batteries with an electromotive force which depends on the potential difference between the anode and the cathode. They thus wear at a rate calculated on the basis of a number of environmental parameters, such as the percentage of oxygen, the exposed surface area, the salinity and the temperature, all factors which affect the normal corrosion of submerged metal structures.

Apart from Al, the mercury-free anodes contain variable amounts of other elements including Mg, Mn and Zn, and also In (0.02-0.05 %), Cu (0-0.006%) etc., and during their lifetime, they release positive ions of these elements.

The presence of the anodes leads to an increase in the concentration of aluminium in the sediments around the flowlines, where it remains without causing changes to the biocenoses, and Al in ionic form in the water column. The presence of Al may lead to co-precipitation with silica (if concentrations of 0.5 ppm of Al, water temperature of 2° C and 0.5 ppm of Si all occur), and further to this event zeolitic formations may be deposited on the sea bed in the affected areas.

These substances are not considered harmful or pollutant, and it must also be underlined that Al is not bioaccumulated by organisms but rather tends to be eliminated by clearance. A slight increase in the level of the element in filtering organisms may be due to the presence of Al in the intravalvular liquids.

There may be an increase in the concentration of lead in the water column and sediment as a result of secondary activities relating to navigation and presence of vessels since it is found in the fuels used, lead is bioaccumulated by filtering organisms.

From the bibliography available it is clear, that higher lead concentrations are found in sediments along the routes used by the vessels which visit offshore structures on a regular basis, appearing to point to an origin linked to the presence of these craft.

Hydrocarbons (IPA in particular) are bioaccumulated by organisms; the data point to negligible bioaccumulation of hydrocarbons on organisms taken from the legs of offshore structures during operation (the offshore structure does not discharge IPA), but reveal that mussels are affected by the presence of the aromatic hydrocarbons derived from the ship traffic.

Some of the chlorine discharged into the sea with the water from the FPSO operation is rapidly consumed by oxidation reactions with a number of inorganic ions (bromide and ammonium); another part of this element reacts more slowly, especially with the dissolved organic substances, but also with the particulate organic matter.

The difference between the chlorine discharged and the residual chlorine is known as the “chlorine demand”, which depends on the amount of chlorine discharged, the contact time and the characteristics of the water, which themselves vary depending on the time of year, as a consequence of the water’s level of oxygenation and phytoplankton blooms. During hypoxic or anoxic phases, considerable amounts of ammonium are produced and interfere with the chlorine due to the formation of chloramines, increasing the chlorine demand. Similarly, a larger amount of plankton in suspension means a higher chlorine demand.

The chlorine discharged into the sea water mainly leads to the formation of organic halogen compounds (mainly bromine compounds) such as trihalomethanes (especially bromoform), haloacetic acids, haloacetonytriles and halophenols, compounds with a certain degree of toxicity.

The quantities produced depend on the quantities of chlorine discharged and the concentration of organic matter present in solution and as particulate; in general terms, it can be assumed that 1% of the chlorine consumed bonds to the organic matter to form halogen compounds with varying degrees of toxicity.

Actions which disturb physical parameters

This category includes all physical disturbing actions which do not specifically affect the sea bed, such as the generation of noise in the water or the discharge into the sea of hot production water, and hot water used to cool the engines of the vessels operating in the area or during the FPSO operation process. These impacts, especially those related to water-borne noise emissions, may

cause modifications of organisms' physiological functions at various levels, or may simply temporarily drive fish away, up to interfering with the normal physiological functions and behaviour of some species of mammals and reptiles

The heat discharged through the production water and the cooling water of the engines of vessels and the power generators and of the FPSO process is only capable of causing a marginal, local variation in the temperatures of the zone, since the homoeothermic properties of the open sea rapidly cool the discharges to the temperature of the surrounding area.

The presence of permanent structures on the sea bed, combined with the relative bans on shipping and fishing, may cause conflict between the project and fishing activities; the Harbourmaster's Office generally establishes protection zones around the well heads, with restrictions on fishing and mooring.

The fishing performed by coastal communities will not be affected in any way because such fishing does not involve the area covered by the proposed project which is at a quite some distance from the coast.

The presence of the vessels, including the FPSO can also lead to an increase in the risk of collision with marine mammals.

Analysis of Impacts/Effects on Environmental Components

Based on analyses of the previous sections a detailed assessment of the expected impacts on the individual components of the environment has been carried out; these evaluations are presented in the following parts of this document.

The estimated values of the impacts produced by the potential impacts, whose behaviour can be predicted by a simulation model, were obtained through the use of mathematical tools capable of calculating the variation of the value of a given parameter (e.g. the concentration level of the metals released from the anodes into the water column) caused by the changes induced by the specific perturbation considered.

The formulation of reliable and significant quantitative estimates of the disturbing effects caused by certain activities on selected indicators is not necessarily easy. The difficulties are linked to the substantial lack of data due to the small number of studies conducted in this sense.

From a statistical point of view, it is therefore necessary to have a consistent data base to obtain meaningful results. And the use of mathematical simulation models does not solve in a comprehensive way the existing problems in impact estimation. Especially in cases like this, where the impacting actions are actually of modest quantitative significance in relation to the quality and capacity of the receiving body; given that the project area's water depth is approximately 800-1000 m and about 55 km from nearest landfall, chances that the impacts arising from the project should affect in any way the sea bed or the coast are very slim. Moreover, the dilution capacity of the receiving body renders virtually negligible impacts on the water column and on the biological component.

Despite these limitations, the findings made and the estimates given in this chapter are considered sufficient to focus on the real extent of the impacts of the project, which overall are very low.

Hereby follows an assessment of the impacts identified, i.e. of the alterations in the indicator parameters. In more general terms an assessment of the interaction between the Project and the receptor environment, emphasizing and taking into account:

- the characteristics of sensitivity and thus the vulnerability of the environment,
- the duration and extent of the potential impacts, as well as,

- the number of elements involved.

The sensitivity of the project activities is crucial in influencing the real effect of the impacts identified.

2. ENVIRONMENTAL MANAGEMENT PLAN GUIDELINES

1.4 GUIDELINES FOR MITIGATION MEASURES

The guidelines covering the various project phases, activities/aspects and impacts, mitigation measures and designation of responsibilities for implementation, were presented in chapter five and give detailed information on waste management, safety, emergency response/contingency. A detailed environmental monitoring plan, audit and review as well as decommissioning and abandonment are presented in paragraphs 1.4.1 - 1.4.10.

1.4.1 Roles and Responsibilities

The roles and responsibilities (HSE) for the proposed OCTP Block Development project include:

Resident Engineer

- HSE management on the project
- Provide visible leadership, systems and resources for environmental management
- Initiate action to maintain compliance with requirements
- Specify and participate in project audits/reviews as required

Assistant Project Manager(s)

- Review procedures for environmental aspects
- Follow up actions from project risk assessments and environmental reviews
- Be focal point for environmental matters with subcontractors as required
- Participate in project audits/review as required

HSE Advisor

- Be pro-active in promoting HSE
- Follow-up /monitor requirements with responsible parties
- Provide specialist HSE advice
- Facilitate project risk assessment as required
- Lead/participate in audits, as required
- Maintain HSE Activities matrix and monitor close out of Project Environmental Review
- Development of Project HSE documentation

Environmental Lead

- Provide specialist environmental advice

- Jointly monitor project Environmental aspects with Project Team
- Review relevant project documentation on circulation by Project Team
- Facilitate project environmental review
- Lead / participate in audits and inspections as required
- Review project environmental documentation

1.4.2 Training and Awareness – Site Induction

All Contractor employees and subcontractors involved in the project will be given a comprehensive induction before they start work. This environmental training will take place in conjunction with safety awareness training.

The environmental aspects will include:

- An overview of the Environmental Management Plan, goals and objectives.
- Awareness in relation to the risk, consequences and methods of avoiding noise pollution, oil/diesel spills, disturbance to wildlife and disturbance to fisher-folk on the high sea.
- Awareness of individual environmental responsibilities and environmental constraints to specific jobs.
- Location and sensitivity of the proposed OCTP Block project.

All personnel who have attended the Environmental Induction will sign a Register which will be kept on the Project Files. Toolbox talks, based on the specific activities being carried out, will be given to personnel by the nominated project representative. These will be based on the specific activities being carried out. These talks will take place either on the appropriate off-shore vessel or on-site and will include environmental issues particular to the proposed OCTP Block Project, namely:

- Oil/Diesel spill prevention offshore including safe refuelling practice.
- Emergency response procedures used to deal with an oil/diesel spill.
- Minimising disturbance to wildlife such as cetaceans.

1.4.3 Communications

Environmental issues will be communicated to the workforce on a regular basis. Daily project meetings, which follow a set agenda incorporating Health, Safety and Environmental issues will be held on-board the project vessels and a daily report will be generated and distributed.

All staff and sub-contractors involved in all phases of the project will be encouraged to report environmental issues.

Environmental Reporting

The contractor will report the status of project environmental activities to ENI on a regular basis. These reports will summarize the key environmental issues in the period and identify any non-conformances and the status of corrective actions.

Communication of Initiatives and Project Information

Communication of initiatives and project information will be developed as the project progresses. Typically, these will include campaigns to raise environmental awareness, circulars to inform staff of key environmental issues such as lessons learnt from incidents or accidents and the impact of any new legislation.

Subcontractor Environmental Reporting

All external communications with local interest groups, external agencies and also the response to any complaints will be conducted by ENI. Contractors shall notify the onsite ENI representative if any communications are received from external stakeholders.

1.4.4 ENI Environmental Policy Objectives

Operations have a direct impact on the natural and built environment as such environmental management is an integral part of this project. All project personnel will be accountable for the environmental performance of the project.

Environmental performance will be managed, monitored and improved through the implementation of this Sustainable Environmental Management Plan and associated Operational Control Procedures in accordance with ISO 14001:2004 standard.

ENI's environmental policy is personally endorsed by ENI's Managing Director and is well documented and circulated within the system and requires all contractors to manage HSE in line with this policy.

In line with the ENI HSE Policy commitment to 'Protect the environment', ENI and their subcontractors shall ensure that:

- Impact on watercourses, the aquatic environment, terrestrial habitats and all species therein are minimized.
- Emissions to the atmosphere will be minimized.
- Environmental legislation applicable to activities undertaken is complied with and contractual obligations are met.
- Performance is monitored and procedures are reviewed to ensure continual improvement.
- Companywide awareness of environmental issues is raised.

1.4.5 Environmental Control & Monitoring

Environmental Control Procedures

Operational control is required to ensure the management of all operations and activities associated with significant environmental aspects, policies, objectives and targets. The required level of control is achieved through the implementation of approved project procedures which document the methodology for executing the works. As part of the procedures development and approval, the methodology is subject to peer review and risk assessment processes which considers environmental impacts and required mitigation measures. The internal audit process will check that these procedures are being implemented correctly and that they are effective.

Although project procedures, execution plans and method statements represent the most significant control mechanism, controls also include communication of company requirements particularly to subcontractors and suppliers, the provision of health, safety and environmental training, and carrying out effective checking and monitoring. Project procedures will be reviewed and amended as necessary. The amended procedure will be reviewed to ensure that any new regulation or training requirements are identified and acted upon.

All activities are required to demonstrate that the Project Team have considered the requirements of ENI Environmental Policy in the design, construction and installation of the project. The key environmental goal set for the OCTP Block Development project is that "Discharges and emissions associated with the development and subsequent production of hydrocarbons from the proposed OCTP Block project shall be minimized as far as reasonably practicable, and the disturbance to the environment shall be kept to a minimum". For the project, this environment goal means minimizing the impact on Seabed community, marine community (fish, mammals), sensitive uses (fishing etc.), seawater quality, air quality, etc.

The stated goal shall be achieved primarily through minimizing pollution ('reduction at source') by the effective control of all operations and the monitoring of the potential sources of impact to ensure that the legislative and regulatory limits are maintained and also to track the progress towards the environmental targets.

Monitoring and Reporting

Environmental monitoring is essentially a process aimed at detecting negative impacts of a project on the environment early enough to take remedial actions. ENI representatives on-board each Contractors vessel will be responsible for routine day-to-day monitoring of environmental compliance and shall submit the environmental data for all HSE and community relations aspects.

Environmental Performance Monitoring

The environmental concerns identified will be controlled through adherence to the Environmental Operational Control Procedures, Method Statements and recommendations. The project will be monitored by inspections of work activities and internal auditing. The HSE Advisor shall work with ENI to assess the need for further monitoring.

Monitoring Objectives

The activities of the proposed project have such characteristics:

- The water depth (about 1000 m) make little or non-significant the protocols frequently used for the physical examination, chemical, biological and sediment monitoring.
- benthic community at those depths is very simplified and uniform and according to both a temporal and spatial point of view; the distance from the surface and the currents along the water column (potentially very large and not known) does not ensure that the benthic community located near the means of drilling is the most affected by the discharge of water, cuttings or other contaminants.
- Regarding to the water column, an examination of the physico-chemical and biological parameters do not provide useful assessment of the state nor the quality of the water column itself (the change is very fast) nor induced impacts from activities project (for the

same reasons described above, the effects could be spread in huge areas currently not identified).

In addition to the measures that will be defined to monitor possible impacts on the surrounding environment in particular in relation to the fisheries activities, the post-operation monitoring shall involve a check of the implementation of the EMP on the environmental performance of facilities (waste management, wastewater systems, oil consumption and atmospheric emissions, etc.), via audits and inspections.

Performance Indicators

Table 2-1 shows the parameter monitored in audits and the relative performance indicators are provided.

Table 2-1 Monitoring Impact Indicators

Parameter	Unit of measure	Performance indicator
Diesel consumption	Kg	
Electricity generated	kWh	Kg diesel / kWh
CO_2 emission	Kg	Kg CO2 / kWh
CH_4 emission	Kg	Kg CH4 / kWh Kg CO2eq. / kWh (Global Warming Potential)
SOx emissions	µg/m^3	Kg SOx / kWh
NOx emissions	µg/m^3	Kg NOx / kWh Kg SOx eq. (Acidification Potential)
Waste generation	Kg	
Water consumption	Litre	

1.4.6 Environmental Audit

eni Ghana shall conduct periodic HSE audits (monthly / quarterly / annually, etc) of the oil wells activities in OCTP Development project Area in order to ascertain extent of compliance with policy and regulatory requirements. The audits shall be carried out by certified auditors and in accordance with ISO 14001 guidelines. The scope of the audits must include the following, as a minimum:

- compliance with all necessary codes, standards and procedures;
- examine line management systems, plant operations, monitoring practices etc.;
- identify current and potential environmental problems especially during the operational phase of the project;
- check the predictions in EIA and assure implementations and application of recommended practices and procedures; and

- make recommendation for the improvement of the management system of the operation.
- after every audit exercise, the environmental auditor shall produce an Environmental Audit Report (EAR) which shall be submitted to eni Ghana and the operating contractor.

The audit and inspection frequencies will be established by eni Ghana, and may be increased or decreased according to the findings and degree of confidence arising from the ongoing audit program.

All audit findings will be reviewed by the HSE and Community Relations teams and where corrective actions are deemed necessary, specific plans (with designated responsibility and timing) will be developed aimed at achieving continuous improvement in performance. In fact, in addition to assessing operational aspects and monitoring, audits will also assess the effectiveness of the EMP and its implementation. The EMP will therefore be subject to ongoing review and development to ensure that it remains appropriate for all aspects of the Project.

1.4.7 Waste Management

Waste Management Strategy

All on-board waste discharge, from vessels, will follow the guidelines from MARPOL 73 / 78 for domestic waste discharges to the environment.

Solid Waste will be treated on-board and recycling will take place wherever practicable. Incineration of combustible, non-hazardous waste will take place wherever an approved on-board incinerator is available. Chemical waste will be properly stored on-board and periodically transferred onshore to be treated within an appropriate and EPA approved facility. Bilge water will be treated on board of vessels in accordance with MARPOL standards prior to discharge into the sea. All waste discharge will be monitored & recorded as per vessel procedures. Compliance to this EMP will be monitored throughout the duration of the project through the project monitoring process.

ENI Policy on waste management

It is the policy of to;

- Adopt effective and responsible measures to minimize the generation of solid and liquid waste as well as reduce emissions into the air.
- Track and maintain records of the full life cycle of waste streams and provide an auditable trail as to its management and disposal.
- Manage and dispose all waste in line with relevant regulatory requirements and environmentally responsible manner.

Solid Waste Discharge

No solid waste, other than food waste will be disposed of into the sea. Food waste will only be disposed into the sea, at least 12 nautical miles from the nearest land, after passing through a dedicated grinder and in accordance with MARPOL 73 78 standards. Any other solid waste that cannot be incinerated on-board shall be brought to shore for disposal and a record will be kept on the type and quantities of waste brought to the shore for disposal.

Waste Identification

ENI Marine Wastes Management plan (MWMP) and the Environmental Aspects and Impacts Register for this project summarize the primary types of waste streams encountered during vessel operations. Descriptions for typical waste stream, main sources and possible environmentally significant constituents are also given.

The physical, chemical and toxicological properties of hazardous wastes shall be identified via Material Safety Data Sheets (MSDS), manufacturer information, process knowledge, and historical information or lab analysis. Wastes can be grouped according to their health and environmental hazards.

Waste Minimization

To minimize the quantity of waste to be disposed of onshore, construction vessels where possible, will be equipped with a food grinder / waste compactor.

On a monthly basis, project vessels will report the amounts of hazardous and non-hazardous waste generated by the vessels, as per the vessel operators environmental management system. This data will be used to establish baseline data and targets for improvement.

Onshore Waste Management and Disposal Options

A local contractor / agent will arrange onshore transport and disposal of waste arising from the project vessels. Any waste that cannot be processed on-board of the vessels will be transported to the quayside for transport by a permitted waste handler to a permitted/licensed facility, which may be a Landfill Site or a Transfer Station. Scrap metals and chemical wastes will be transported to port for reprocessing through approved recycling facilities.

1.4.8 Waste Water Management

Ballast Water Discharge

Ballast tanks will be separated from any hydrocarbon storage areas on board the vessels and no potentially contaminated drain systems will be routed to the ballast tanks. De-ballasting shall be undertaken offshore in accordance with IMO guidelines and away from sensitive environmental areas to prevent introducing marine organisms from outside the project location.

Bilge Water Discharge

All construction vessels will be equipped with oil-water separation systems in accordance with MARPOL requirements.

Deck Run-Off Water

Any spills on deck will be contained and controlled using absorbing materials. This will be collected in dedicated drums to avoid contamination of deck run-off water.

Sewage Discharge

Vessels and FPSO will be equipped with a sewage treatment system. If a vessel does not have a sewage treatment system it will have a suitable holding tank, waste water will then be brought back to shore for treatment by a licensed contractor.

1.4.9 Oil Spill Contingency Plan

Some of ENI's most important objectives include: Enhancing safety, reducing health risks and protecting the environment. In light of this, ENI has developed a structured and comprehensive oil spill contingency plan to cover activities in OCTP Project area.

The oil spill contingency plan outlines coordinated and integrated response actions to be implemented in the event of an oil spill. It highlights the roles and responsibilities of key personnel in ENI operations and lists equipment and materials available to combat oil spills. The plan is designed to cover the control and removal of any oil spill occurring at any of the facilities operated by ENI. It is a generic plan to be used in conjunction with a separately designed specific operational annex applicable to the particular project area. The main components of the contingency plan are namely spill categorization, offshore response action plans, reporting and notification guidelines.

Pollution Emergency Procedures

On board procedures for pollution prevention and emergency response are laid down in each vessel Shipboard Oil Pollution and Emergency Plan (SOPEP). Details on project specific (oil) pollution combat equipment will be available on-board along with locations of equipment, availability, and contact details for support personnel / services. Each individual vessel will have regard to ENI Oil Spill Contingency Plan, which contains detailed procedures to be followed in the event of a pollution emergency.

1.4.10 Safety Philosophy

The Project shall incorporate an Integrated Control and Safety System (ICSS) that shall provide an integrated monitoring, control, protection and safety system for the entire production, topsides, marine, and subsea facilities. The safety systems shall be separate from the Process Control System (PCS).

Fire and Gas Detection

The overall goal of the Fire and Gas System shall be to:

- Continuously monitor all areas of the installation where either a fire hazard may exist or an accumulation of flammable gas may occur,
- Alert personnel at the CCR to the presence, location and nature of the fire or gas emergency,
- Alert personnel on board to the hazard via the PA/GA system,
- Automatically activate fixed fire protection systems, and
- Reduce the risk to personnel by implementing executive control actions and/or shutdown events.

Lifeboats and Life Rafts

The rig will be provided with life boats on either side of the accommodation having a capacity each for 100% of the complement. Two 100-persons Totally Enclosed Self Propelled Survival Crafts (TEMPSC) are installed, one on the port side and the other on the on starboard side. The rig will also be equipped with a fast rescue boat. The crafts are located and arranged such that boarding of the units in stowed position will be in accordance with the latest SOLAS requirements. On the

forward main deck area near the turret, on either side, life rafts will be installed in case crew members cannot return to the accommodation in case of emergency. The number and capacity of the life rafts will be established by an Escape, Evacuation and Rescue Analysis performed during detailed design.

Safety Shutdown System

In the event that the primary control system fails to keep the process within specified operating limits, separate, dedicated safety systems shall be provided for the safe shutdown of equipment and/or process units. The purpose of these systems shall be; first, to protect personnel from an abnormal condition; second, to protect the environment and equipment from damage; and third, to safely isolate problem areas.

Active Fire Protection

The rig shall be sufficiently equipped with fixed automatic, manual and portable fire fighting equipment. Mechanisms for release of fixed automatic systems shall be:

- Pneumatic fusible plugs for each fire/deluge area;
- F&G input (for inside enclosures);
- Manual buttons in the CCR;
- Manual buttons in local area;
- Remote trips for diesel oil valves, and
- Manual buttons for rotating equipment shutdown and manual released fixed fire fighting systems.

Accommodation

The living quarters for the rig have a sprinkler system that shall be charged with fresh water and backup seawater from the ring main.

Helideck

The helideck for the rig shall be provided with two foam hose reels with 0.23 m^3 (60 gallons) of foam for each reel and deliver foam for a period of 20 minutes.

Electrical Rooms

Rooms containing electrical equipment [transformer room, battery room, high voltage/low voltage (HV/LV) switchboard rooms and instrument rooms] shall be protected with automatically actuated non-halon, gaseous fire suppression systems. In addition, portable CO_2 extinguishers will be provided.

Hull Equipment Spaces

None of the hull equipment spaces have oil fuelled machinery and they shall be, therefore, not 'Category A spaces' according to safety of life at sea (SOLAS). These compartments shall be provided with a sufficient number of portable extinguishers and hose reels.

Deluge System

A pressurized fire water system shall be installed to cover the firewater demand for foam generation systems, deluge systems and hydrants located throughout the rig.

Water Mist Systems

Fixed self-contained automatic water mist systems shall be used in gas turbine enclosure hoods.

Escape Routes

The general requirement for number and location of escape routes on the rig shall follow the requirements of specification 'Facilities Layout and General Operational and Safety Systems. The EER Analysis contains a more detailed description of the arrangements, which include:

- Main escape routes shall have a minimum height of 2.39 m (7.8') and a minimum width of 1.525 m (5');
- Secondary escape routes shall have a minimum height of 2.1 m and minimum width of 1.0 m (3'-3");
- Dedicated routes shall be provided to both the helicopter deck and the lifeboats that allow the transportation of an injured adult on a stretcher from every manned area;
- Two paths of escape shall be provided from every area on the facilities that may be normally manned. This requirement also applies to enclosed areas and rooms that will not be continuously manned. However, this does not apply to tanks where normal tank entry procedure is assigned around tank access. Each tank shall be fitted with a second access hatch which can be fitted with ladders and access in the event there is major work required in that space. Smaller rooms/areas where the distance from any location to the exit will be less than 5 m (16') may have a single exit, however, all electrical rooms will have at least two exits; and
- Stairs shall be installed to ensure proper and easy access between all levels of the facilities. Wherever access shall be needed to a platform or any level below base, access will, as far as possible, also be performed via stairs.

Means of Evacuation

The primary means of emergency evacuation shall be lifeboats. Escape to sea via life rafts shall be considered the secondary means of evacuation. If helicopters shall be in the vicinity of the field, it shall be the decision of the Emergency Incident Coordinator to determine the best means by which helicopters may be used. The Emergency Incident Coordinator may also instruct the standby vessel(s) to assist with the evacuation of personnel via the boat landing area or via tertiary means of evacuation.

Equipment Room Evacuation

Machinery spaces can be evacuated by using the main stairways leading into the space from the main deck from both the east and west sides. The stairs drop down to the first level of the machinery space. Escape from the lower levels of each machinery space will also be by stairways.

Deck Escape Routes

There shall be two unobstructed longitudinal escape routes on the main deck. One will be located on each side of centreline at the outboard edge of the main deck. There shall be also five east-west or transverse escape routes that join with the longitudinal escape routes at almost equally spaced intervals. The transverse routes offer at least 7 feet of clearance under the centreline pipe rack and do not crossover any piping. There shall be one other longitudinal escape route that shall be provided on the topsides deck near centreline and can be used for escape along the entire

length of the topsides deck. Stairs shall be provided at intervals along both sides of the deck for access between the main deck and the process deck.

Personnel caught on deck during a fire can proceed east to west through one of the east-west escape routes into one of the longitudinal escape routes located farthest away from the fire. The route taken through the longitudinal escape route shall be either north or south, whichever takes the trapped persons farther away from the fire or to the closest life boat. Protection against blast and fire can be provided (for at least 60 minutes) in the North TSR, in the LQ or behind the main deck blast wall under the LQ.

Each escape route shall be clearly marked, including arrows showing direction of the nearest life boat.

Muster Areas

The primary muster area on the rig shall have direct access to the life boats and requires a minimum area of 0.56m^2 (6ft^2) per person, per specification 'Facilities Layout and General Operational and Safety Systems'. Arrangements/location of the muster areas for rig shall be detailed in the EER Analysis. The study considers the location for the muster area for the rig. The extent of protection required for personnel mustering will be defined in, based on the hazard scenarios to which personnel could be exposed; however, the intention will be to use the same size of lifeboat.

An alternative (backup) muster area will be provided on the rig. The location/size basis will be based on an analysis of the hazard scenarios for which it may be required. This will be located at the flare end of the rig. The alternative muster area will be protected from flare radiation and from the effects of any process hazard scenarios that could impair the muster area.

Based on predicted evacuation times for the rig, primary muster areas will remain intact for a minimum of 45 minutes in order to allow an orderly evacuation. Protection will be required for this period from the effects of fire, explosion, un-ignited gas/smoke ingress and excessive heat.

Muster areas will be considered to be impaired if:

- heat radiation exceeds 1.6 kW/m2 (500 BTU/ft2);
- blast overpressure exceeds 0.3 barg;
- smoke levels lead to visibility below 5 m; or
- unignited gas concentrations exceed 50% of the gas lower flammable limit (LFL).

An emergency control centre shall be provided on the rig in close proximity to the primary muster areas. Telephone and radio communication will be provided to enable coordination of emergency response actions between the primary and alternative muster areas. The emergency control centre will be protected to the same extent as the accommodation. The location will be in the central control room (Rig). It will be possible to initiate ESD from the muster areas.

Life Saving Equipment

Safety and information signs shall be provided in accordance with relevant regulations and operational requirements.

Helicopter Crash Equipment

Appropriate helicopter crash equipment shall be provided adjacent to the helideck of the rig. Personnel going offshore shall undergo mandatory helicopter ditching and water survival training.

Lifeboats/Liferafts

Two (2) lifeboats of the free fall type shall be installed at the Primary Muster Area and one (1) at the Secondary Muster Area. Each of these free fall lifeboats will be rated for 60 persons minimum. Sufficient life rafts will be provided to comply with the applicable regulations.

Fast Rescue Boat

A line boat shall be used as the fast rescue craft for the proposed Development Wells Drilling in Area. This boat shall be mounted on the Westside adjacent to the workshop in Module C on the process deck. However, this is the windward side for squalls. The boat will be used for rescuing any personnel who have fallen overboard from the rig, from the export tanker, or if a helicopter goes down. In a major emergency, the boat can be used to gather and tow life rafts after launching into the water. The boat can carry up to six persons and will be equipped with a Hamilton water jet propulsion engine. The engine will be capable of sustaining a speed of twenty knots.

Miscellaneous Safety and Lifesaving Equipment

In the accommodation cabins, for each occupant there shall be provided one lifejacket and also a grab bag containing flashlight, heat resistant gloves and a smoke hood. The provision of additional equipment items such as safety equipment cabinets, emergency showers and lifejackets will be determined in detailed design based on the findings of the updated EER Analysis. An emergency shower will be located adjacent to the chemical usage areas, battery rooms, etc. Self-contained eye bath bottles and stretchers will be located at strategic points. Emergency response equipment lockers will be located adjacent to the primary muster area for rig and for other areas will be determined in detailed design as defined by the updated EER analysis.

Vessel Security

The vessel shall have suitable arrangements to prevent unauthorized personnel access to the vessel and reduce the risk of sabotage.

Gangway Access

All access ladders on the rig shall have alarms to identify people boarding the ladders and gates at the top of the ladders.

Riser Support and Protection Security

The riser areas shall have means of preventing unauthorized personnel access to the riser valves and the vessel. Access ladders to the riser valve platforms will have means to be secured.