

## 7.1 INTRODUCTION

The purpose of this chapter is to outline the key monitoring requirements identified through the EIA process to monitor the environmental and social performance of the project.

A detailed environmental and social monitoring plan (the Monitoring Plan) will be developed for the Jubilee Phase 1 Development project and implemented by Tullow and its contractors. This plan will be modified and updated as the project develops and in response to the outcomes of monitoring activities and in discussion with stakeholders as new issues arise. The plan will be implemented prior to first oil (planned for the fourth quarter of 2010), although certain elements will be in place earlier than this as outlined in *Table 7.1*.

The overall objectives of the Monitoring Plan are to:

- ensure regulatory requirements are met;
- check that impacts do not exceed project standards and other environmental standards described in *Chapter 2*;
- verify predictions made in the EIA by obtaining real time measurements;
- verify that mitigation measures are effective and implemented in the manner described in *Chapter 6*;
- provide early warning of potential environmental impacts; and
- inform future operations and contribute to continuous improvement in the management of environmental and social issues related to the project.

The Monitoring Plan has been designed to measure the Jubilee Phase 1 project's environmental and social performance against;

- Regulatory requirements (eg EPA);
- Standard industry practices in established oilfield provinces such as the North Sea, Gulf of Mexico and Australia; and
- Good practice requirements as described in the International Association of Oil and Gas Producers (OGP) and the International Petroleum Industry Environmental Conservation Association/ American Petroleum Institute (IPIECA/ API).

Monitoring requirements for the drilling phase, including drill cuttings monitoring, identified through the drilling EIAs and agreed with the EPA are also addressed within the Monitoring Plan.

## 7.2 MONITORING APPROACH

Monitoring will be carried out by Tullow's EHS and technical departments, and its contractors pursuant to their contractual obligations to undertake

inspections, monitoring and reporting. The following four types of inspections and monitoring will be employed.

- **Inspections** planned and conducted on a regular basis to ensure that mitigation measures and commitments are properly maintained and implemented, and that specific management procedures are being following (eg practices on waste storage and disposal).
- **Receptor monitoring** undertaken to verify predictions made in the EIA and to confirm that the activities at the site are not resulting in an unacceptable deterioration in the quality of habitats or infrastructure (eg monitoring disturbance to affected residents through a grievance mechanism).
- **Compliance monitoring** involving periodic sampling or continuous recording of specific environmental quality indicators or discharge levels to ensure compliance of discharges and emissions with project standards (eg produced water discharges and air emissions).
- **Auditing (internal and external)** to assess compliance of the project activities with both regulatory and site management system requirements.

The frequency of inspection, monitoring and audits are listed in *Table 7.1* and are based on project risk management requirements and standard industry practices. The outputs will be used in the following ways;

- To provide early warning for asset/site management, to adjust mitigation measures on a day to day basis to suit evolving conditions.
- To enable Tullow and its contractors to demonstrate that mitigation measures and procedures laid down in mitigation plans are being followed and operations are being conducted within compliance limits.
- To provide formal assurance to Tullow and third parties, such as the Ghanaian regulatory authorities, that the project is compliant with regulations and agreed limits and that relevant mitigation / enhancement measures are being adhered to.

Monitoring results will be presented in regular reports and reviewed at EHS, Joint Venture, Operating Committee and Government management meetings. The results of the inspection and monitoring activities will be reported to Tullow on a weekly/monthly basis, or as required. The approach to EHS management, including responsibilities, and checking and corrective actions relating to monitoring activities are outlined in the provisional EMP for the Phase 1 Jubilee project (*Chapter 9*).

In addition to routine reporting, an annual monitoring report, aggregating much of the data produced by the other reporting processes, will be submitted to the Ghana Government and appropriate external stakeholders (eg lenders). The monitoring plan and parameters will be reviewed periodically and, if

necessary, will be modified to include any additional parameters necessary to ensure good environmental and social performance. Similarly, the monitoring methods and frequencies will be subject to periodic review by the Jubilee JV.

### 7.3

#### *MONITORING PLAN FOR SPECIFIC MITIGATION MEASURES*

The Monitoring Plan is presented *Table 7.1*. Issues are listed following the format used in the EIA. The plan describes what potential impact is to be measured, the frequency of monitoring and an indicative time when that programme will start. Specific monitoring parameters and reporting for discharges from the project will be outlined in the Monitoring Plan.

**Table 7.1 Monitoring Plan for Specific Mitigation**

Potential Impact	Monitoring	Frequency of Monitoring	Commencement
<b>Project Footprint</b>			
Impacts of project activities including vessel movements and underwater sounds on marine mammals and turtles	Monitor sightings of marine mammals, turtles from vessels in the vicinity of the proposed Jubilee Field development. TGL personnel to be trained to identify marine mammals and turtles in the project area and report sightings on daily basis. Monitoring from both the Jubilee Field and from the supply ship when steaming between Takoradi and FPSO.	Continually throughout project life (ie during completions, commissioning, operations and decommissioning) from support vessels attending the FPSO and on regular passage between Takoradi port and the FPSO.	1Q 2010
	Appoint experienced marine ecologist to inspect and analyse sighting records.	Annually	
	Undertake dedicated marine mammal surveys to assess cetacean population in Jubilee Field and immediate area potentially affected by the project. Include Ghanaian and international cetacean experts to undertake survey. Use data from Marine Mammal Observations to aid in identifying potential seasonal variations in population.	One-off programme to be developed once first 12 months of data from marine mammal observation programme (see above) has been analysed. To be undertaken from 4Q 2010 to 3Q 2011.	4Q 2010
	Audit vessel and helicopter movements (route, speed, height) between Takoradi Port / Takoradi Air Force base and the Jubilee Field.	As part of quarterly / annual audit process.	1Q 2010
Impacts and subsea infrastructure and drill cuttings on benthic environment	Undertake a scan of the seabed prior to the installation of subsea infrastructure to ensure that is not placed on any significant seabed features. <i>Note</i> : side scan sonar of seafloor already undertaken.	One-off scan of seabed by ROV prior to installation of subsea infrastructure from 1Q to 2Q 2010.	1Q 2010
	Undertake a scan of the seabed after installation of subsea infrastructure to ensure that is placed correctly and undamaged.	One-off scan of seabed by ROV once flowlines and other subsea equipment have been installed. To be undertaken from 2Q-3Q 2010.	2Q 2010

Potential Impact	Monitoring	Frequency of Monitoring	Commencement
	Undertake seabed sampling programme to investigate the impact of drill cuttings discharges and recovery over time. Monitoring to include benthic sampling (macro-fauna fauna abundance and biodiversity, sediment particle size distribution, sediment chemical analysis for metals and hydrocarbon content). Methodology to follow international good practice.	Before drilling commences, at a representative drill site and periodically thereafter. <i>Note:</i> Baseline work started in 2009 with Fritjof Nansen cruise in May 2009. Further work being planned for 2010; detailed survey programme to be developed.	2009-2011
<b>Operational Discharges to the Marine Environment</b>			
Impact of discharges on pelagic marine biodiversity	Record all deaths of marine organisms (fish, turtles, cetaceans) in vicinity of FPSO.	Daily visual inspections and recording throughout project.	Q4 2010
	PAH and metal concentration in muscle and liver tissue from fish caught in vicinity of FPSO to be analysed and compared with international standards and fish caught in reference sites. Up to three pelagic species that are common to the FPSO area to be selected as part of the study.	Once off programme to be undertaken after 12 months of operations.	2011
	Evaluate presence of pelagic fish in vicinity of Jubilee Field.	Once off programme to be undertaken.	2010
Pre-commissioning pressure (hydrotest) test fluids	Monitoring and reporting of quantity of chemicals used and discharge volumes.	Daily monitoring and monthly data reporting during commissioning of FPSO.	Q3 2010
Chemical use	Monitor volume of chemicals used, quantity discharged via various routes and any quantity spilled.	Monthly data reporting throughout project.	Q1 2010
Desulphation discharge water	Monitor volume discharged	Monthly data reporting throughout project.	Q4 2010
Reverse osmosis discharge water	Monitor volume discharged	Monthly data reporting throughout project.	Q4 2010
Well completion and workover fluids	Monitor quantity of different chemicals/materials used, volumes discharged to environment, quantity downhole and quantity returned to supplier. Include quantity of freshwater used.	Daily monitoring and monthly data reporting during completion and workover operations.	Q3 2010

Potential Impact	Monitoring	Frequency of Monitoring	Commencement
	Monitor oil content in discharge and compare against discharge standards (15 ppm oil and grease maximum)	Discharge to be analysed during commissioning and operation.	Q3 2010
	If acid used for well workover, monitor pH of discharge and compare with allowed discharge range (i.e. pH 5-7)	pH to be analysed prior to discharge of any acid workover fluids.	At any time acid discharge undertaken
Produced water	Monitor oil content in produced water discharge and compare against discharge standards (29 mg/l maximum monthly average and 42 mg/l maximum daily average oil content and no visible sheen).	Discharge to be analysed using automatic in-line monitoring throughout project life.	4Q 2010
	Monitor receiving water quality around FPSO to verify discharge modelling for produced water in <i>Annex D</i> .	One-off programme to be started once FPSO fully commissioned	2011
FPSO black water (sewage)	Visual observations to check for no floating solids, foam or discolouration of surrounding water.	Daily visual inspections and recording throughout project.	4Q 2010
	Monitor compliance of discharge against Marpol Annex IV discharge standards (residual chlorine content of less than 1 mg/l).	Weekly monitoring and recording throughout project	4Q 2010
	Monitor volume of sewerage discharged	Weekly monitoring throughout life of project.	4Q 2010
Deck drainage and bilge water from FPSO	Monitor oil content in FPSO deck drainage and bilge water discharge and compare against discharge standards (15 ppm oil and grease maximum) including oil content and visual inspection of sea surface.	Discharge to be continuously analysed using automatic in-line monitoring throughout project life.	4Q 2010
Drilling fluids and drill cuttings	Monitor volume and type of drilling fluids discharged into the sea, including concentration of oil in cuttings.	Daily monitoring during drilling operations	2009
	Analyse Hg and Cd concentration in stock barite.	Composite sample analysed for each new bulk delivery.	2009
	Calculate volume of drill cuttings created by each well.	End of well reporting	2009

Potential Impact	Monitoring	Frequency of Monitoring	Commencement
<b>Atmospheric Emission</b>			
Atmospheric pollutants	Monitor volumes of diesel, gas and oil used in flaring, vehicles and energy generation. Include quantity of well completion fluids flared. Calculate emissions using accepted conversion factors and report against MAPROL guidelines for all major sources of emissions. Parameters to be calculated include; CO <sub>2</sub> , CO, NO <sub>x</sub> , SO <sub>x</sub> , non-methane VOCs and methane.	Annual data reporting throughout life of project.	4Q 2010
	Monitor bird life congregating around the FPSO at night.	One off programme	2010-2011
	Monitor deaths of birds around the FPSO.	Record any bird deaths on the FPSO and report monthly. Ongoing throughout life of project.	4Q 2010
	Monitor air quality and noise in vicinity of FPSO and in Takoradi to verify predicted low significance of impact.	One off programme that will cover seasonal variation in conditions.	2010-2011
<b>Waste Management</b>			
Segregation, storage and transport of wastes	Monitor volumes of hazardous and non-hazardous waste streams generated. Identify for each waste type the quantity of waste recycled or reused, treated, incinerated or sent to landfill,	Ongoing throughout life of project. Data collected monthly from waste contractors.	2009
	Inspect waste storage areas on Tullow and waste contractor's sites for compliance with project standards. Specifically assess state of containment, bunding, presence of spills, performance of treatment measures, correct segregation, safety systems, transport equipment and systems to ensure that appropriate mitigation and measures are enforced	Audit of waste contractors prior to agreeing any formal contracts  Six monthly in first year and thereafter annual audits of facilities that receive project wastes throughout project	2009
	Report and investigate all leaks and spills, including type and quantities of substances spilled.	Ongoing throughout life of project	2009

Potential Impact	Monitoring	Frequency of Monitoring	Commencement
<b>Socio-economics</b>			
Human resources strategy for creation / transfer of employment opportunities	Monitor employment levels and local staff content against targets for Tullow and its contractors	Quarterly review of HR data and recruitment and organisational development plans.	2009
Stakeholder understanding of Project	Organise stakeholder consultation and feedback sessions to ensure community clearly understand the impacts of the project, what actions are ongoing and have access to opportunities created by project. Assess community understanding of project.	Quarterly monitoring ongoing throughout life of project	2010
Project Performance Evaluation	Monitor CSR project execution targets via assessment meetings attended by beneficiaries and contributors (NGOs, District Assemblies, and Jubilee Partners).	Quarterly reviews ongoing throughout life of project	2010
Grievance	Monitor levels of complaints through the grievance procedure and track actions taken to resolve complaints	As required in response to complaints and six monthly review of records and audit of actions arising throughout project.	2010
Impacts to commercial navigation and fisheries from MODUs, FPSO and support vessels.	Continuous monitoring of safety exclusion zone and recording of all vessel interactions between project vessels and other users of the area	Auditing with Accident Reporting Procedure	2010
	Develop and implement a system for inspection and maintenance of navigation, communication and safety equipment.	Monthly audit of equipment inspection reports.	
	Recording all complaints/ suggestions through the Community Liaison Officer and assign specific remedial actions and responsibilities	Six monthly review of interaction/grievance records and audit of actions arising throughout project.	