Environmental and Social Impact Assessment

Project Number: 48330-001 & 50117-001
July 2014

AZE: Shah Deniz Stage II Gas Field Expansion Project / Shah Deniz Gas Field Expansion Project

Prepared by URS Corporation Limited

ACKNOWLEDGEMENTS

This Environmental and Socio-Economic Impact Assessment (ESIA) for the Shah Deniz 2 Project was carried out by URS on behalf of BP (operator) and the SD PSA Co-Venturers.

URS acknowledges the collective and individual contributions from a range of companies, academic and scientific experts in the preparation of this ESIA. URS is grateful for the willing assistance of these companies and individuals and their contributions to a rigorous and comprehensive report.

URS acknowledges with thanks the following:

Companies

CBM Caspian
ECS
Environmental and Social Advisory Services
ERM
Genesis
Granherne Limited
Synergetics
The Social Consultancy
WRA

Academic and Scientific Experts

Individual	Expertise
Mehman M. Akhundov	Fish Specialist
Ilyas Babayev	Bird Specialist
Tariel Eybatov	Caspian Seal Specialist
Alun Lewis	Oil Spill Specialist
Peter Ward	Underwater Noise Specialist

Academic and Scientific Institutions

Azerbaijan Ministry of Ecology and Natural Resources
Azerbaijan Ministry of Culture and Tourism
Institute of Archaeology and Ethnography
Baku State University National Hydrometeorological Department
National Academy of Sciences of Azerbaijan
State Oil Company of Azerbaijan Republic
Institute of Botany
Institute of Geography
Garadagh District Executive Power

Stakeholder and Socio-Economic Survey participants within the Umid, Sangachal, Masiv 3 and Azim Kend communities.

Contents

Non-Technical Summary

7. Socio-Economic Description

11. Operations Environmental Impact Assessment, Mitigation and Monitoring

12. Socio-Economic Impact Assessment, Mitigation and Monitoring

List of Figures

List of Tables

Appendices

Shah Deniz 2 Project

Environmental and Socio-Economic Impact Assessment

Non-Technical Summary

BP Azerbaijan

November 2013

Contents

Introduction

This document presents a non-technical summary of the Shah Deniz 2 (SD2) Project Environmental and Socio-Economic Impact Assessment (ESIA).

The Shah Deniz (SD) Contract Area lies approximately 100km south east of Baku (refer to Figure E.1). Full Field Development (FFD) of the SD Contract Area is being pursued in stages under the terms of a Production Sharing Agreement (PSA) between the State Oil Company of the Azerbaijan Republic (SOCAR) and a consortium of Foreign Oil Companies (FOC).

The SD Stage 1 development, which commenced production in 2006, includes a fixed platform with drilling and processing facilities limited to the separation of gas and liquids and two marine export pipelines to transport gas and condensate to onshore reception, gas-processing and condensate facilities at the Sangachal Terminal.

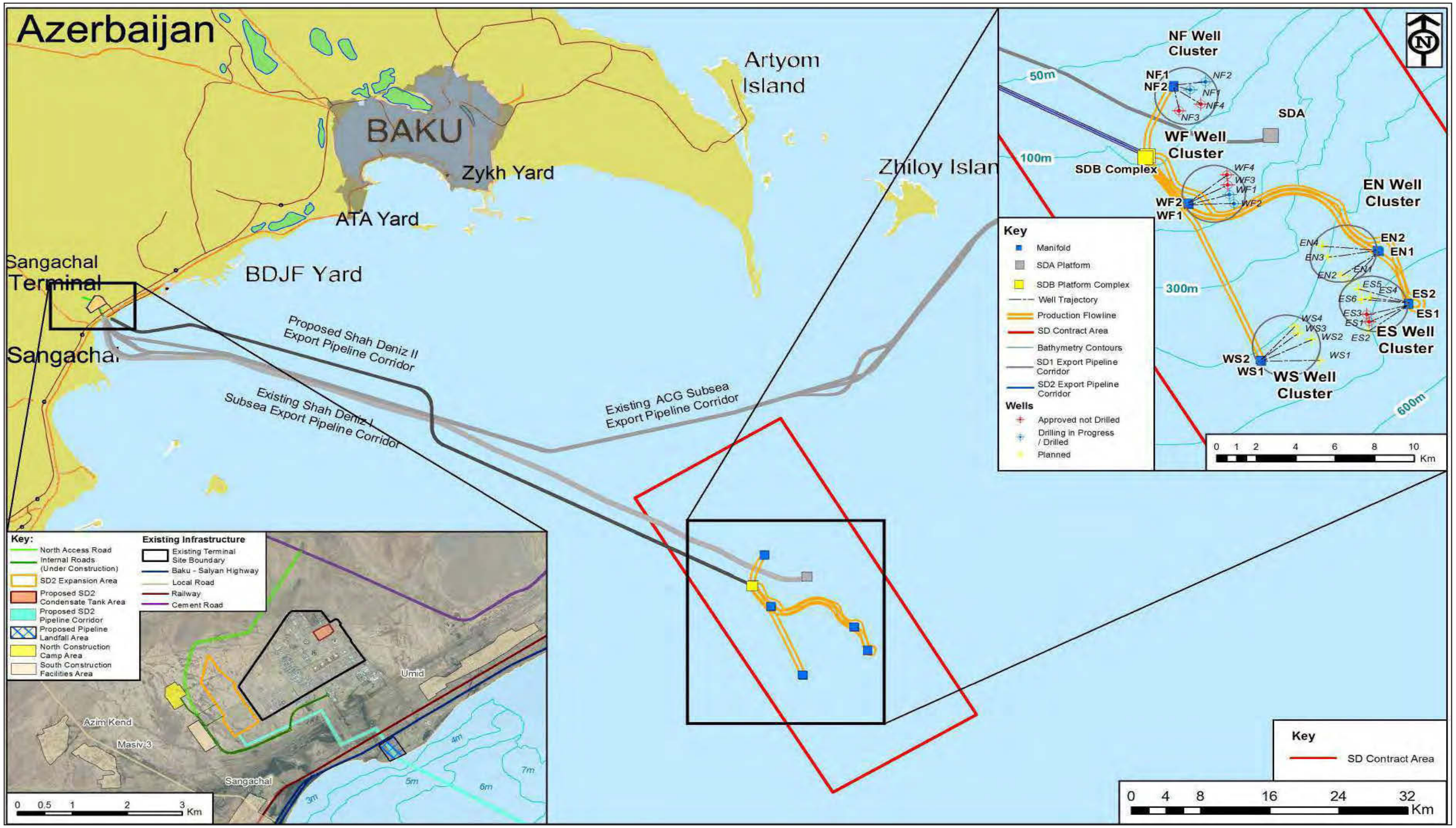
The SD2 Project represents the second stage of the SD field development. It is planned to comprise:

- A fixed platform complex, denoted SD Bravo (SDB), that includes 2 new bridge linked platforms:
    - A Production and Risers platform; and
    - A Quarters and Utilities platform
- Subsea manifolds, associated well clusters and flowlines. The subsea development incorporates a total of 26 wells, drilled using mobile drilling rigs (MODU); and
- New subsea gas and condensate export pipelines to the onshore terminal facilities and a dedicated monoethylene glycol (MEG) import pipeline from the Terminal to the platform complex;
- Onshore processing facilities for the SD2 Project within an expansion area at the Sangachal Terminal.

The scope of the SD2 Project includes the design and construction of the gas export compression, metering and associated utilities at the Terminal, but does not include the work involved in a separate project to expand the capacity of the existing South Caucasus Pipeline, which transports gas from the Terminal to its customers.

Figure E.1 shows the location of the offshore and onshore SD2 facilities, the approximate well locations, subsea infrastructure layout and the routing of the subsea pipelines between the platform complex and the Terminal. The location of the potential construction yards where the platform complex will be constructed (known as the BDJF and ATA yards) are also shown.

Figure E.1 Scope of the SD2 Project



The key onshore, subsea and offshore elements of the SD2 Project Base Case are shown in Figure E.2.

Figure E.2 Project Overview

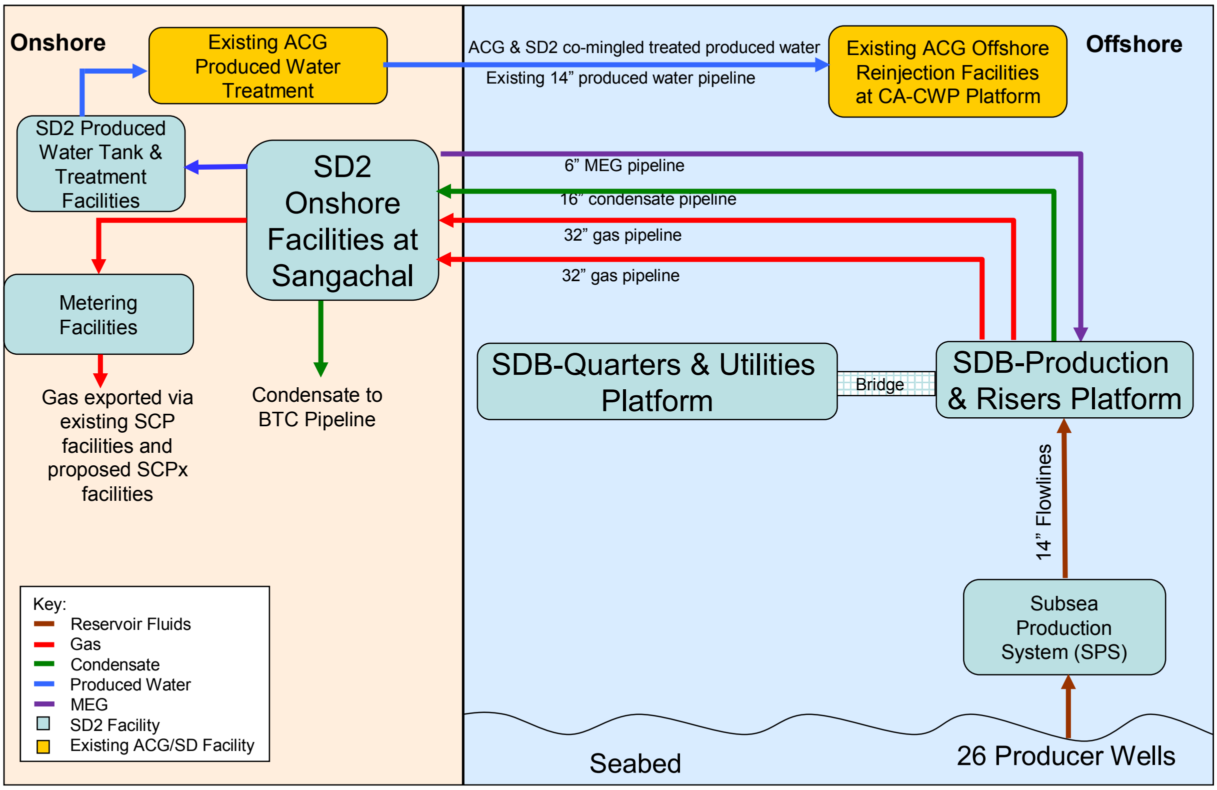


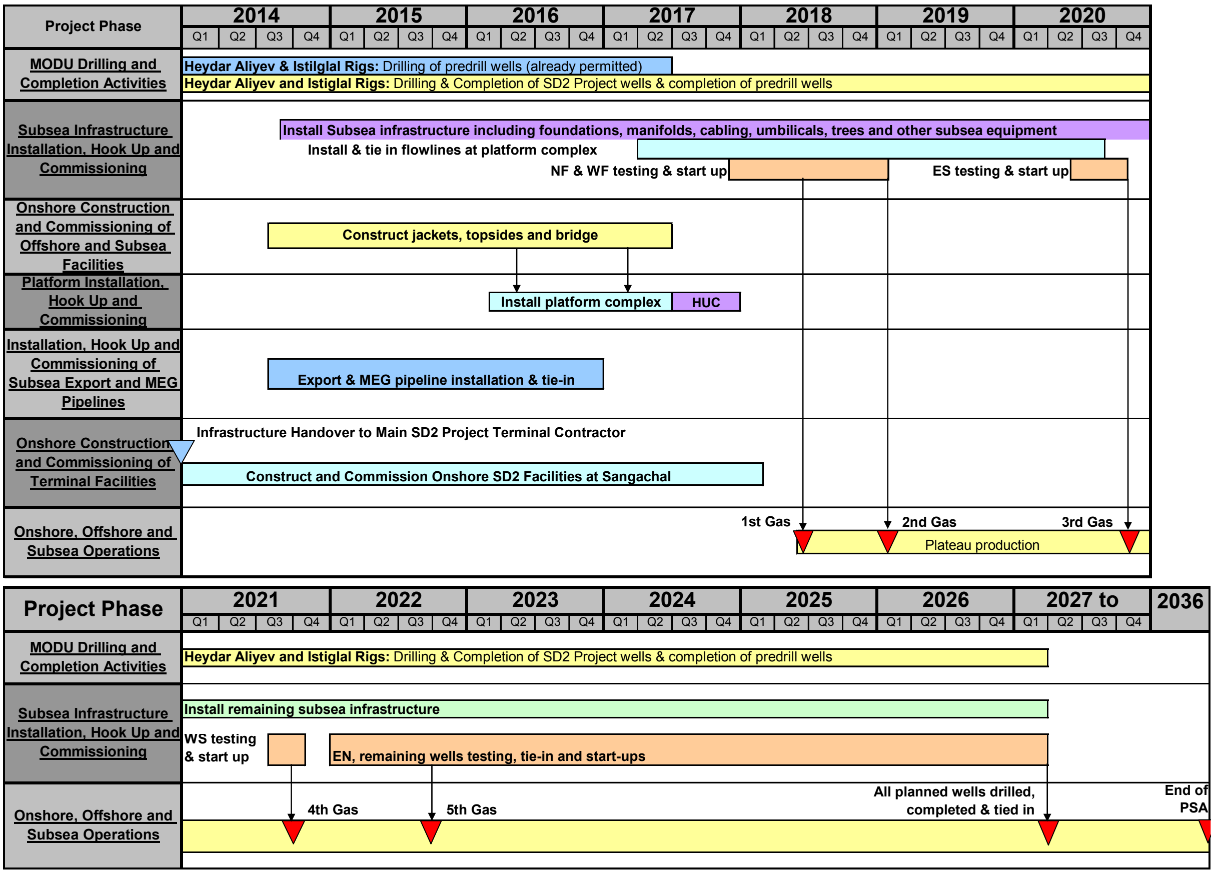
Figure E.2 shows how the production fluids from the wells are sent to the offshore SDB platform complex, via the subsea production system, where the fluids are separated into two primary streams; gas and condensate. From the platform complex the separated fluids are sent to the new SD2 facilities at the Terminal where the fluids are further processed to produce sales gas which meets export specifications and condensate. Produced water will either be sent to the existing ACG facilities (1st option), sent to a third party for treatment and disposal (2nd option) or stored in a new pond at the Terminal.

The project facilities have been designed to process up to:

- 1,777 million standard cubic feet per day (MMscfd) of gas;
- 107 thousand barrels per day (Mbd) of condensate; and
- 25 thousand barrels per day (Mbd) of produced water.

Figure E.3 shows the anticipated schedule for the drilling, construction, installation and commissioning and operations phase activities.

Figure E.3 Indicative Project Schedule

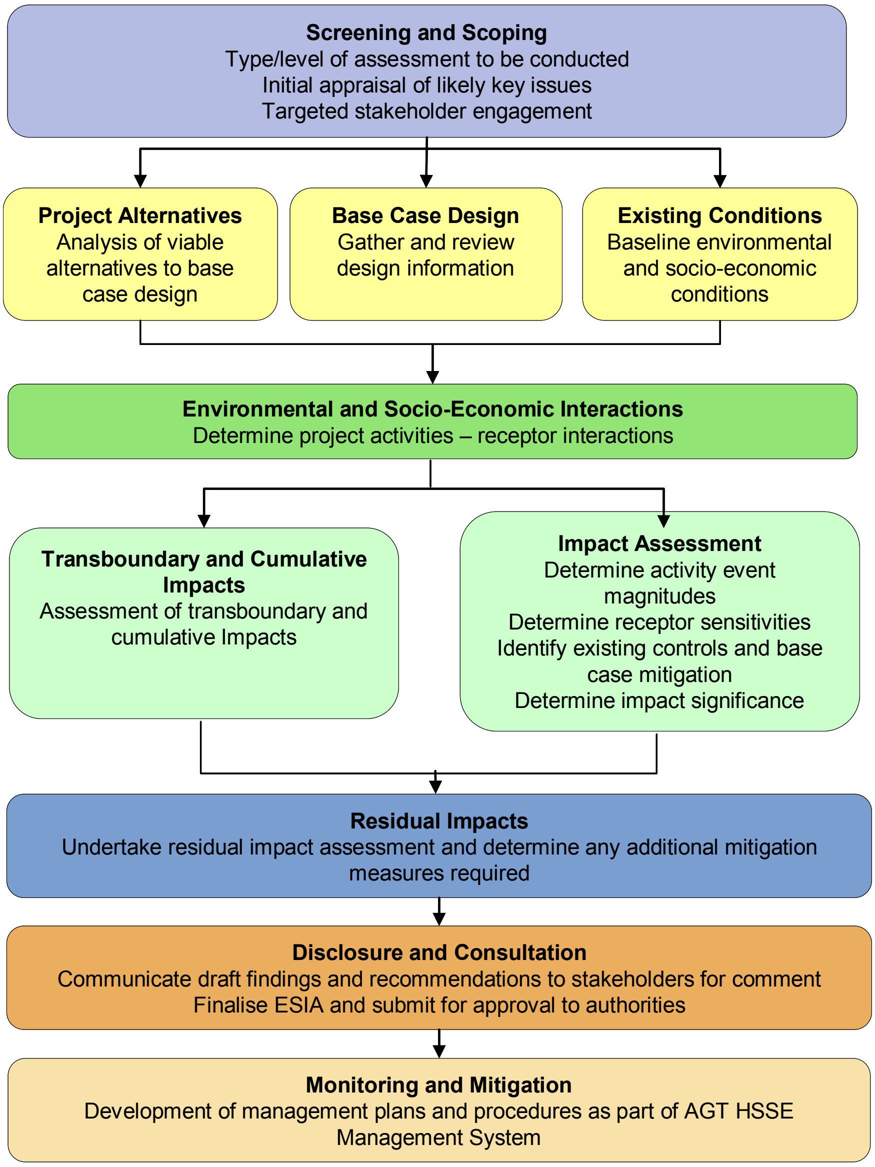


As the figure shows, the majority of the onshore construction activities at the construction yards and the Terminal and pipeline and platform installation activities will occur between 2014 and the end of 2017. It is currently anticipated that first gas will be achieved in 2018 following completion of installation and start up activities in the north flank (NF) of the Contract Area. Wells in the west, east south, west south and east north flanks (WF, ES, WS and EN) will be subsequently completed and started up in stages until 2027.

The environmental and socio-economic impacts associated with each project phase were assessed in accordance with the ESIA methodology presented below. The volume of emissions, discharges and waste associated with each phase was also estimated.

The ESIA has been conducted in accordance with the legal requirements of Azerbaijan as well as BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy. The ESIA process (illustrated in Figure E.4) constitutes a systematic approach to the evaluation of a project and its associated activities throughout the project lifecycle.

Figure E.4 The ESIA Process



Assessment of SD2 environmental impacts has been undertaken based on identified SD2 activities and events for each project phase that have the potential to interact with the environment. The expected significance of the impact has been assessed by taking into account:

- ***Event Magnitude:*** Determined based on the following parameters;
  - ***Extent*** – the size of the area that is affected by the activity being undertaken;
  - ***Duration*** – the length of time that the activity occurs;
  - ***Frequency*** – how often the activity occurs; and

  - ***Intensity of the impact -*** the concentration of an emission or discharge with respect to standards of acceptability that include applicable legislation and international guidance, its toxicity or potential for bioaccumulation, and its likely persistence in the environment.
- ***Receptor Sensitivity:*** Determined based on:
  - ***Presence –*** whether species/people are regularly present or transient in the area of impact, whether species present are unique, threatened or protected or not vulnerable or whether features are highly valued or of little or no value; and
  - ***Resilience –*** how vulnerable species/people/features are to the change or disturbance associated with the environmental interaction with reference to existing baseline conditions and trends (such as trends in ecological abundance/diversity/status).

The SD2 impact assessment process has benefited from the fact that offshore SD and Azeri-Chirag-Guneshli (ACG) Contract Area discharges and emissions have been comprehensively studied and characterised during the operational phase of the existing SD and ACG facilities. As a result, impacts have been evaluated and understood to a far greater extent than was previously possible.

The evaluation of impacts has been based on three principal sources of information:

- Previous environmental risk assessments, including results of toxicity tests and modelling studies applicable to the SD2 Project;
- Modelling studies, including discharge and spill modelling, onshore and offshore noise assessments and air dispersion modelling, undertaken specifically for the SD2 Project; and
- Results from the Azerbaijan Georgia Turkey (AGT) Region Environmental Monitoring Programme (EMP), which has included systematic and regular offshore monitoring at all new and operational platforms and which has regularly carried out ‘regional’ monitoring to identify and quantify natural environmental trends, and with onshore surveys including ecological and air quality monitoring in and around Sangachal Terminal.

The EMP has provided a clearer picture of the composition and sensitivity of benthic biological communities in both the SD and ACG Contract Areas and of the effect of platform and pipeline installation, drilling activities and platform operations on these receptors. With SD Stage 1 and ACG Phases 1, 2 and 3 now in operation, the EMP demonstrates that the control measures (design and operation) included in previous ESIAs have adequately mitigated impacts on the marine environment.

The assessment has also included examination of how agreements, legislation, standards and guidelines apply to the project.

The detailed legal regime for the joint development and production sharing of the Shah Deniz field is set out within the PSA signed by BP and its co-venturers and SOCAR in June 1996 which was enacted into law in October 1996. The analysis clarifies that the PSA prevails in the event of conflicts with any present or future national legislation, except for the Azerbaijani Constitution; the highest law in the Republic of Azerbaijan.

The PSA sets out that petroleum operations shall be undertaken *“in a diligent, safe and efficient manner in accordance with the Environmental Standards to minimise any potential disturbance to the general environment, including without limitation the surface, subsurface, sea, air, lakes, rivers, animal life, plant life, crops, other natural resources and property”*. In developing relevant standards and practices, environmental quality objectives, technical feasibility and economic and commercial viability must be taken into account. In accordance with the PSA, environmental protection standards relevant to production activities have been developed for approval and permitting, planning, risk assessment and management, environmental quality, discharges and emissions, chemical selection and management, condensate and chemical spill contingency planning and waste management.

The project also takes account of a wide range of international and regional environmental conventions and commits to comply with the intent of current national legal requirements where those requirements are consistent with the provisions of the PSA, and do not contradict, or are otherwise incompatible with, international petroleum industry standards and practice. The project will also adhere to the framework of environmental and social standards within the ESIA approved by the MENR. The PSA also makes reference to international petroleum industry standards and practices which the Project will comply with.

Options Assessed

In developing the project, a number of design options were assessed in accordance with a formal BP process for appraising, selecting and defining projects prior to their execution and operation.

The key options assessed during the project design development focused on defining the project concept, selecting the optimal offshore strategy to exploit the SD reservoir, and where possible avoid, adverse environmental impacts. The potential impacts are those associated with discharges to the marine environment, atmospheric emissions, onshore noise, and waste. The environmental evaluation of project options was undertaken alongside technical and economic evaluation and consultation with stakeholders including SOCAR and SD partners.

A number of development concepts were identified for assessment including deepwater platforms, platform drilling options, and multiphase tie-back to shore and subsea development concepts. The concept selection was primarily informed by drilling conditions, seabed depths and reservoir characteristics.

The option of not developing the SD2 Project has also been considered. The decision to not proceed would result in a reduction of potential revenues to the Azerbaijan government with a resultant inability to deliver the associated benefits to the Azerbaijan economy. Pursuing the SD2 Project will result in employment creation for national citizens during both the construction and operational phases of the development, as well as increased use of local facilities, infrastructure and suppliers. The option of not proceeding was therefore disregarded when considered against these socio-economic benefits.

The environmental assessment draws on a wide range of surveys principally from 1999-2004, and the survey data collected from the EMP from 2004 to date, in which survey work was overseen by stakeholder representatives including SOCAR, ministerial bodies and the Azerbaijan National Academy of Sciences. Where additional data linked to the project has been required, specific surveys have been undertaken. Overall, 69 terrestrial and coastal surveys, 24 nearshore surveys, 20 offshore survey, and three pipeline surveys were reviewed.

Existing archaeological and cultural heritage sensitivities were also examined and described, taking account of previous field survey work undertaken in 2001 for the SD1 Project, a follow up survey carried out in 2002 and a reconnaissance and baseline archaeological survey conducted in 2011.

Environmental impacts have been identified and assessed for the following phases of the project: Drilling and Completion; Construction, Installation, Hook-up and Commissioning (HUC); and Operations.

Table E.1 presents the residual impacts of the environmental assessment for the Drilling and Completion phase of the project. As the table shows, the impacts of all aspects of the Drilling and completion programme were predicted to be of minor negative significance, with adequate control, monitoring and mitigation measures.

Table E.1 Summary of SD2 Project Drilling and Completion Activities Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from mobile drilling rig power generation	1	3	3	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
Atmosphere	Emissions from MODU flaring (well testing, clean up or intervention flaring)	1	3	1	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
Atmosphere	Emissions from support vessel engines	1	3	3	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
Marine Environment	Underwater noise from drilling and vessel movements	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Drilling discharges	1	2	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Cement discharges to seabed	1	3	1	2	1 1	Medium	Low	Minor Negative
Marine Environment	Cement unit washing discharges	1	2	1	2	1 1	Medium	Low	Minor Negative
Marine Environment	BOP testing discharges to sea	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	MODU cooling water discharges to sea	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Vessel and drilling rig ballast water discharge	1	2	1	1	1 1	Medium	Low	Minor Negative
Marine Environment	Vessel and drilling rig treated black water discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Vessel and drilling rig grey water discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Vessel and drilling rig drainage discharges	1	3	3	1	1 1	Medium	Low	Minor Negative

Table E.2 presents the residual impacts of the environmental assessment for the Construction, Installation and HUC phase of the project, which includes:

- Expansion of Sangachal Terminal to accommodate SD2 facilities (including temporary facilities for construction and construction workers);
- Installation and commissioning of gas and condensate export lines, and a MEG import line, between the SDB platform complex and the new Terminal facilities;
- Installation and commissioning of the subsea flowlines and associated subsea infrastructure;
- Onshore construction and pre-commissioning of the platform topsides and jackets; and
- Offshore installation and HUC of the platform complex.

Table E.2 Summary of SD2 Project Construction, Installation and HUC Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying)	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Offsite Vehicles	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Terminal Commissioning	1	3	2	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Construction Yard Plant and Vehicles	1	3	3	1	1 1	Medium	Low	Minor Negative
	Emissions from Onshore Commissioning of Main Platform Generators and Topside Utilities	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel Emissions	1	3	3	1	1 1	Medium	Low	Minor Negative
Terrestrial Environment	Terminal Construction Plant and Vehicles (Noise)	3	3	3	2	2 2 1 2	High	Human: Medium Biological / Ecological: Medium	Major Negative - reduced to Moderate Negative following additional mitigation
	Onshore & Nearshore Pipelay (Noise)	3	1	3	1	2 2 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	SD2 Export and MEG Pipeline Pre-Commissioning and Drying	1	1	3	1	2 2 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	Terminal Commissioning (Noise)	1	1	2	1	2 2 1 2	Low	Human: Medium Biological / Ecological: Medium	Minor Negative
	Construction Yard Plant (Noise)	1	3	3	1	3 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Terrestrial Environment	Platform Commissioning and Topside Utilities (Noise)	3	1	1	1	3 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	Onshore SD2 Export Pipeline Installation (Ecology)	1	1	3	1	2 1	Medium	Medium	Moderate Negative
	Onshore Pipeline Installation (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
	SD2 Condensate Tank Area Works (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
	Piling within the SD2 Expansion Area (Cultural Heritage)	1	3	1	1	1 2	Medium	Medium	Moderate Negative
	Onshore Pipeline Installation (Cultural Heritage)	1	1	3	2	1 2	Medium	Medium	Moderate Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Pipeline and Flowline Pre-commissioning Discharges	3	3	2	1	1 1	High	Low	Moderate Negative
	MEG Discharge During Subsea Infrastructure Installation	1	1	1	1	1 1	Low	Low	Negligible
	Ballast Water (Vessels)	1	2	1	1	1 1	Medium	Low	Minor Negative
	Treated Black Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Grey Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Drainage (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Piling – Jackets and SSIVs (underwater noise)	3	2	1	2	1 1	Medium	Low	Minor Negative
	Vessels During Nearshore and Offshore Pipelay (underwater noise)	2	3	3	1	1 1	High	Low	Moderate Negative
	Vessels During Subsea Infrastructure Installation (underwater noise)	1	3	3	1	1 1	Medium	Low	Minor Negative
Nearshore/Coastal Environment	Construction of Finger Piers	1	3	3	1	1 1	Medium	Low	Minor Negative
	Nearshore Pipeline Installation Works	1	2	2	1	1 1	Medium	Low	Minor Negative
	Seabed disturbance (cultural heritage)	1	3	1	1	2 2	Medium	Medium	Moderate Negative

Atmospheric emissions and noise associated with onshore construction at the Terminal, onshore and nearshore pipelay and construction at the yards were predominantly predicted to result in impacts of moderate negative significance. Additional measures to reduce noise impacts associated with terminal construction plant and vehicles include completion of a detailed noise assessment immediately prior to works commencing, completion of work plans to include when noisy works are anticipated (to be communicated to the local communities) and noise monitoring prior to and during construction focused on identifying and addressing the reasons for any exceedances of the relevant noise limit Discharges to the marine environment associated with pipeline and flowline pre-commissioning were also assessed as having a moderate negative impact. The marine impact of other offshore installation and HUC activities were predominantly assessed as being of minor negative significance.

During operations, noise and emissions associated with onshore terminal activities were assessed as being of moderate negative significance (refer to Table E.3). Impacts associated with offshore activities during operations were predominantly assessed as being of minor negative significance. Impacts associated with odour due to the anticipated non routine use of ponds for produced water storage were assessed to be of moderate adverse impact, taking into account existing controls and additional mitigation, which includes use of a treatment package to manage any potential exceedances of air quality thresholds from the produced water stored in the pond and evaluation of odour control techniques to be included in the design, if practicable.

Table E.3 Summary of SD2 Project Operations Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Non-GHG Emissions from Routine Offshore Operations	1	3	3	1	1 1	Medium	Low	Minor Negative
Atmosphere	Non-GHG Emissions from Non Routine Offshore Operations (DEH)	1	3	1	1	1 1	Medium	Low	Minor Negative
Atmosphere	Non-GHG Emissions from Non Routine Offshore Operations (Emergency Flaring)	1	3	1	1	1 1	Medium	Low	Minor Negative
Atmosphere	Non-GHG Emissions from Routine Onshore Operations	1	3	3	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
Atmosphere	Non-GHG Emissions from Non Routine Onshore Operations (Emergency Flaring)	1	3	1	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
Terrestrial Environment	Noise associated with Routine Onshore Plant Operations	1	3	3	1	3 1	Medium	Medium	Moderate Negative
Terrestrial Environment	Noise associated with Non Routine Onshore Flaring	3	2	2	1	3 1	Medium	Medium	Moderate Negative
Terrestrial Environment	Odour from non routine pond storage of produced water	2	2	3	2	3 2	High	High	Major Negative - reduced to Moderate Negative following additional mitigation
Marine Environment	Offshore Operations: Cooling Water intake and discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: Treated Black and Grey Water	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: Galley Waste	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: Drainage	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: Freshwater Maker – Saline Effluent	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Subsea Operations: Routine and Non Routine Control Fluid Discharge:	1	3	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative
Marine Environment	Discharges due to Subsea Interventions	1	2	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative

Control measures to mitigate impacts to the marine environment from routine and non routine discharges associated with the SD2 Project and associated reporting requirements are detailed within Chapters 9, 10 and 11 of this ESIA. These include design and operating principles (e.g. no planned discharge of non-water based mud), facility maintenance regimes, appropriate chemical selection and monitoring to confirm effective operation and/or confirm compliance with standards.

Monitoring and reporting procedures and documentation requirements for the each SD2 Project phase are included within BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy (Refer to Chapter 14). Once operational, the SD2 Project will develop a set of specific monitoring, management and reporting procedures based on, and consistent with, the procedures already in use on existing SD and ACG platforms.

An extensive range of survey work was undertaken to describe the socio-economic baseline conditions relevant to the project, drawing on a wide range of primary and secondary sources. Primary sources included data collected from a qualitative and quantitative stakeholder and socio-economic survey undertaken in 2011, while secondary data included information from recognised institutions such as the United Nations, the International Monetary Fund, the Statistical Committee, of the Republic of Azerbaijan and the Garadagh Executive Committee, the authority responsible for administration within the district where the onshore facilities are located (refer to Table E.4).

Table E.4 Relevant Socio Economic Data Sources

Date	Title of document / survey
2006	ACQUIRE, Reproductive Health & Services in Azerbaijan 2005: Results of a Baseline Survey in Five Districts, E&R Study #6
2006	USAID, Country Profile
2007	UNDP, Gender Attitudes in Azerbaijan: Trends and Challenges, Azerbaijan Human Development Report
2007	USAID, Country Health Statistical Report Azerbaijan
2008	International Monetary Fund, Republic of Azerbaijan: Statistical Appendix 2007
2008	State Statistical Committee of the Republic of Azerbaijan, Demographic & Health Survey 2006
2009	Garadagh Cement Project New Dry Kiln 6 ESIA 2009
2009	Gizildash (Qizildas) Cement Factory ESIA, NORM, 2009
2010	United Nations Azerbaijan, United Nations Development Assistance Framework 2011-2015
2010	AIOC Chirag Oil Project ESIA,2010
2010	International Crisis Group (ICG) Global 2010 Report
2010	State Statistical Committee of the Republic of Azerbaijan, Socio-economic Development of the Settlements of Baku City
2010	ICG, Azerbaijan: Vulnerable Stability Europe Report No.27
2010	Agents of Change: Reflections on a working partnership between BP Azerbaijan and the International Institute for Environment and Development (IIED)
2011	Data provided to BP from Garadagh ExComm
2011	SD2 Project Stakeholder and Socio-Economic Survey (SSES)

The following socio-economic interactions resulting from project activities were identified based on the anticipated project activities:

- Employment creation and de-manning;
- Training and skills development;
- Procurement of goods and services (including construction yard operations and their workers);
- Disruption to fishing and commercial shipping operations; and
- Offsite construction vehicle movements and an associated increased risk to community health and safety.

Survey work indicated that those individuals and groups most likely to be affected by project activities:

- The local communities of Sangachal Town, Umid, Masiv 3 and Azim Kend, which are the four main settlements in the vicinity of the Terminal;
- Recreational, small-scale and artisanal fishermen, commercial fishermen and recreational users of the shoreline;
- Users of regional road infrastructure;
- Local, regional and national businesses and their staff (including the contractors and workers at construction yard operations); and
- Owners and the crew of vessels engaged in commercial shipping operations and local government authorities responsible for regulating such activities.

The assessment predicted predominantly positive impacts in terms of employment, training and skills development and procurement of goods and service with potential negative impacts (e,g, disruption to fishing and shipping) minimised through the use of appropriate plans and mitigation.

Consultation

Stakeholder consultation is an important element of the ESIA process, ensuring that the opinions of potentially affected people and interested parties are solicited, collated and documented.

The stakeholder engagement and consultation process has:

- Made use of the consultation framework and methods established for other BP projects in Azerbaijan;
- Been developed with reference to accepted international guidance on expectations of ESIA consultation and disclosure;
- Considered the extent of consultation and disclosure previously undertaken, linked to expansion of the Sangachal Terminal over the past ten years;
- Incorporated recommendations made from a ”lessons learned” review of earlier consultation programmes; and
- Primarily involved the Ministry of Ecology and Natural Resources as the ESIA approving authority. Other national state bodies (such as the Ministry of Culture and Tourism, on cultural heritage aspects) have been involved during the planning and completion of supporting studies as and when required, as well as the general public. Engagement processes involved regular meetings, workshops and surveys with communities and stakeholders near the terminal and a wide range of other individuals, organisations and groups.

A Public Consultation and Disclosure Plan has been prepared for the project which outlines the objectives of consultation, the process for identifying and consulting stakeholders, roles and responsibilities, and the process for lodging and responding to complaints. The draft ESIA report was made widely available in English and Azerbaijani, and comments on it were collated and analysed with responses provided where relevant.

Cumulative Impacts and Accidental Events

A detailed assessment of environmental and socio-economic project impacts, based on expected activities and events, is presented in Chapters 9, 10, 11 and 12 of the ESIA. The assessment takes into account each activity and the existing controls and additional mitigation identified to minimise and manage impacts.

A review of other projects and activities identified the following as having potential cumulative interactions with the SD2 project:

- Qizildas cement plant;
- BP SD1 flare project at Sangachal Terminal;
- Garadagh District Jail House;
- New Baku Port;
- SOCAR petrochemical complex;
- Baku Shipyard Company; and
- Navy and Military camp for Navy Officers;

Cumulative impact evaluation focuses on assessing the potential temporal and geographical overlap between impacts, based on the current project schedule. The construction of the cement plant and the petrochemical complex are expected to alter local hydrological conditions, with a potential increase in flood risk at receptors; however, the SD2 Terminal expansion is not, in itself, expected to have a significant impact on flood levels at any receptor location assessed.

Modelling of noise levels associated with SD1 and SD2 non routine flaring undertaken for safety reasons indicated a potential for noise limits to be exceeded approximately 12% of the time. The majority of the exceedance was estimated to be due to SD1 flaring. The SD1 flare project has committed to implement a flaring policy aimed at reducing this value.

The assessment of cumulative impacts from atmospheric emissions took into account both non-greenhouse gases (GHG) (e.g. NO2) and greenhouse gases (e.g. CO2).

The cumulative emissions of non-GHG onshore were modelled, and are predicted to remain well within the annual average air quality standards. No cumulative impacts are expected from offshore drilling, construction, installation or commissioning activities.

GHG emissions associated with offshore activities were estimated. Drilling and completion activities will account for 13.0% of total project emissions, compared with 79.8% for onshore and offshore operations combined. On an annual basis, SD2 Project is estimated to account for 13% of total ACG and Shah Deniz operational emissions; by 2020, SD2 is expected to contribute approximately 0.36% of the national GHG emissions total for Azerbaijan.

The expected activities and events that may result in a cumulative socio-economic impact from different components of the SD2 Project are:

- A rise in employment opportunities during the construction phases;
- A rise in economic flows from the use of major construction and installation contractors and their associated supply chain network of companies; and
- An increase in road traffic on the Baku-Salyan Highway.

The assessment of socio-economic cumulative impacts demonstrated that negative cumulative impacts associated with the SD2 Project and other projects in the vicinity of the Sangachal Terminal are expected to be limited. Positive cumulative impacts are expected to occur from employment, increased economic flows and the implementation of community development initiatives. These positive impacts will occur in parallel with increasing industrialisation across the Garadagh region which may lead to improvements in transport, communications, utility connections and social infrastructure.

Cumulative Impacts and Accidental Events

The potential for cumulative impacts to the marine environment (from drilling, installation, hook-up, commissioning and operation) was considered. The impacts identified in Chapters 9, 10, 11 and 12 are all either localised, transient, infrequent or small in magnitude. It was concluded that, as all impacts would be restricted to a relatively small area around the points of release, there would be no overlap or interaction, and that cumulative impacts would not occur.

Several types of accidental event were considered:

- Well blow-out;
- Flowline rupture (between subsea installations and the platform complex);
- Condensate export line rupture (between the platform complex and the shoreline); and
- Spillage of diesel fuel from the platform complex.

A well blow-out represents the largest potential event, with the most severe consequences. It is estimated that condensate could be released at a rate of 25,000 barrels per day for up to 224 days (the time required to mobilise a rig and to drill a relief well). This would lead to the presence of dissolved and dispersed hydrocarbons in the water column over a distance of tens of kilometres, with the potential for substantial ecological harm. Some of the condensate components will either not dissolve, or will reach the surface; once on the surface, the condensate will weather to a form of waxy ‘flakes’. This wax residue might come ashore in some circumstances, but is expected to have substantially less impact on the shoreline than would be the case with an oil spill.

A Spill Response Plan has been developed, which provides guidance and actions to be taken during a condensate spill incident associated with all Shah Deniz offshore operations, which include mobile offshore drilling units, platforms, subsea pipelines and marine vessels. It is valid for spills that may occur during the commissioning, operations, and decommissioning.

The Spill Response Plan is designed to:

- Establish procedures to control a release or the threat of a release, that may arise during offshore operations from offshore facilities;
- Establish procedures to facilitate transition of response operations from a Tier 1 incident (least significant) to a Tier 2/3 release or threat of release;
- Minimise the movement of the spill from the source by timely containment;
- Minimise the environmental impact of the spill by timely response;
- Maximise the effectiveness of the recovery response through the selection and use of
- appropriate equipment and techniques; and
- Maximise the effectiveness of the response by having trained and competent operational teams in place.

BP’s response strategy is based on: an in-depth risk assessment of drilling and platform operations and subsea pipelines; analysis of potential spill movement; environmental sensitivities and; the optimum type and location of response resources.

Environmental and Social Management

Each phase of the SD2 Project will be subject to formal environmental and social management planning. During drilling, construction, installation, hook-up and commissioning, the key contractor companies will be contractually required to develop and implement environmental and social management systems. BP will operate the SD2 facilities using an Operations Phase ESMS that is certified to ISO 14001 Environmental Management System (EMS) and will be based on the ‘plan-do-check-act’ cycle.

BP’s has implemented an Environmental Monitoring Programme (EMP) in Azerbaijan, designed to provide a consistent, long-term set of data, with the objective of developing an accurate picture of potential impacts on the surrounding environment, so that they can be managed and mitigated as effectively as possible. The EMP will be expanded for the SD2 Project, to integrate operational monitoring of key discharges and emissions. The aim of regular monitoring is to establish an understanding of trends over time, taking account of the results from concurrent regional surveys and initial baseline data. Combined with operational discharge and emissions monitoring, this approach provides a robust method for assessing the impact of SD2 Project operations based on actual monitoring data.

ESIA Disclosure

The draft ESIA was widely disseminated and was available (along with feedback forms) for a period of 60 days at the following locations and via the Internet:

- BP Energy Centre at Sangachal Terminal;
- BP Offices in Baku;
- Community Centre at Umid (Umid Settlement);
- Public libraries in Sangachal and Sahil (Sahil Settlement E. Guliyev Street, Sangachal Settlement M.A. Sabir Street 1);
- Aarhus Public Environmental Information Centre (MENR, 100 B. Agayev Street, Baku);
- Baku Education Information Centre (40 J. Jabbarli Street, 2nd Floor);
- M.F.Akhundov Central Public Library (29 Khagani Street);
- International Eco-Energy Academy (5 Mammad Arif Street, Baku);
- The Azerbaijan State Oil Academy (20 Azadlig Avenue, Baku); and
- Scientific Library of the National Academy of Sciences (31 H.Javid Avenue).

In addition the following meetings were held (in addition to meetings with the MES, SOCAR and MES):

- Scientists meeting, Baku, 12th August 2013
- Public meeting, Baku, 13th August 2013
- Sangachal community meeting, 15th August 2013
- Umid community meeting, 15th August 2013

The draft ESIA was then revised to address comments provided by stakeholders during disclosure, and will be submitted formally to the Ministry of Ecology and Natural Resources for final approval.

The Final NTS and ESIA are available in the Reports and Publications Section of www.bp.com/caspian

Units and Abbreviations

Units

%	Percent
%AAC	Absolute Area Coverage
%CV	Low Coefficient of Variation
μg	Micrograms
μg/g	Micrograms per gram
μg/l	Micrograms per litre
$\mu g/m^3$	Micrograms per cubic meter
μm	Micrometer
μPa	Micro Pascal
~	Approximately
˚C	Degrees Celsius
"	Inches
+/-	Plus/minus
<	Less than
>	Greater than
‰	Parts Per Thousand
3D	Three dimensional
1Q	Quarter one (of year)
2Q	Quarter two (of year)
3Q	Quarter three (of year)
4Q	Quarter four (of year)
B	Billion
barg	1 bar (gauge) = 14.5 psi
bbl	Barrel (6.2898 barrels = 1 m3)
Bbls/day	Barrels per day
Bcma	Billion cubic metres per annum
Bstb	Billion standard barrels
cm	Centimetre
cm/s	Centimetres per second
cm/year	Centimetres per year
cm^3	Cubic centimetre
dB	Decibel
dB (A)	A weighted unit of sound intensity weighted in favour of frequencies audible to the human ear
dB_{ht}	A measurement of sound that relates to its potential for an adverse effect by accounting for inter-species differences in hearing ability.
dB L_{AEQ}	Sound pressure level
dB re. 1 μPa	Decibels relative to one micropascal
g/l	Grams per litre
g/m^3	Grams per cubic metre
ha	Hectare
HP	Horsepower
h	Hour
hr	Hour
kg	Kilograms
km	Kilometre
km^2	Square kilometre
Knots	Measurement of wind speed (1 Knot = 0.514 m/s)
Kt	Thousand tonnes
ktonne	Thousand tonnes
kV	Kilovolt
kVA	Kilovolt- ampere
kW	Kilowatts
L	Litres

LC_{50}	Lethal Concentration 50. The concentration of a chemical which kills 50% of a sample population.
Litres/Day	Litres per day
m	Metres
M	Million
mAOD	Metres above ordinance datum
m/s	Metres per second
m^2	Square metres
m^3	Cubic metres
m^3/m^3	Cubic metres per cubic metre ratio
m^3/min	Cubic metres per minute
m^3/day	Cubic metres per day
m^3/hour	Cubic metres per hour
m^3/hr	Cubic metres per hour
m^3/person/day	Cubic metres per person per day
m^3/s	Cubic metres per second
Mbd	Thousand barrels per day
mg/kg	Milligrams per kilogram
mg/l	Milligrams per litre
mg/Nm3	Milligrams per cubic meter (at normal conditions)
min	Minutes
ml	Millilitres
mm	Millimetres
Mm^3	Million cubic metres
MMscf	Million standard cubic feet
MMscfd	Million standard cubic feet per day
MPN	Most Probable Number
MPN/100ml	Most Probable Number per 100 millilitres
mS/cm	Milli siemens per centimetre
MW	Megawatt
ng/g	Nanogram per gram
nV/m	Nano Volts per metre
pH	-log 10 [H+] (Measure of acidity or alkalinity)
PM_{10}	Particulate matter measuring 10µm in diameter
ppb	Parts per billion
ppbv	Parts per billion by volume
ppm	Parts per million
PSI	Pounds per square inch
rain/month	Rain per month
Tcf	Trillion cubic feet
tonnes/day	Tonnes per day
US$	US dollars
US$M	US dollars (Millions)
V/m	Volt per metre

Chemical Elements and Compounds

As	Arsenic
Ba	Barium
BTEX	Benzene, toluene, ethylbenzene, xylene
Cd	Cadmium
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cr	Chromium
Cu	Copper
Fe	Iron
H_2S	Hydrogen Sulphide
Hg	Mercury
HNO_3	Nitric Acid
KCl	Potassium Chloride

MEG	Mono Ethylene Glycol
Mn	Manganese
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NPD	Naphthalenes, phenanthrenes and dibenzothiophenes
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PHB	Pre Hydrated Bentonite
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
Zn	Zinc

Abbreviations

A	Autumn
AA LDHI	Anti Agglomerate Low Dosage Hydrate Inhibitors
AAC	Absolute Area Coverage
ACG	Azeri Chirag Guneshli
ACQUIRE	Access, Quality, and Use in Reproductive Health
AFFF	Aqueous Film Forming Foam
AGT	Azerbaijan Georgia Turkey
AIOC	Azerbaijan International Oil Company
AMEA	Academy of Sciences of Azerbaijan
AMSA	Australian Maritime Safety Authority
ANAS	Azerbaijan National Academy of Sciences
AR-AFFF	Alcohol Resistant Aqueous Film Foaming Foam
ATA	Amec-Tekfen-Azfen
AZE	Alliance for Zero Extinction
AzerNIIRKH	Azerbaijan Scientific Research Institute of the Fishing Industry
AZN	Azeri Currency (manats)
AzRDB	Azerbaijan Red Data Book
AzSPU	Azeri Strategic Performance Unit
BC	Before Christ
BDJF	Baku Deep Water Jacket Factory
BGL	Below Ground Level
BIV	Barrier Isolation Valve
BO	Blow Out
BOD	Biological Oxygen Demand
BOP	Blow Out Preventer
BP	British Petroleum
BPEO	Best Practicable Environmental Option
BS	British Standard
BSi	British Standard Institute
BTC	Baku Tbilisi Ceyhan
C&WP	Compression and Water Injection Platform
CA	Central Azeri
CARs	Corrective Action Requests
CCSCP	Condensate and Chemical Spill Contingency Planning
CDV	Canine Distemper Virus
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CHARM	Chemical Hazard Assessment and Risk Management
CHBS	Cultural Heritage Baseline Survey
CICAD	Concise International Chemical Assessment Document
CIIP	Condensate Initially In Place
CIP	Community Investment Programme
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIV	Chemical Injection Valve

COD	Chemical Oxygen Demand
COP	Chirag Oil Project
CPS	Country Partnership Strategy
CSC	Caspian Shipyard Company
CSD	Cutter Suction Dredger
CTZ	Current Transfer Zones
CV	Coefficient of Variation
CVP	Capital Value Process
CWAA	Central Waste Accumulation Area
DBA	Derrick Barge Azerbaijan
DCV	Directional Control Valve
DDT	Dichlorodiphenyltrichloroethane
DEH	Direct Electrical Heating
DMRB	Design Manual for Roads and Bridges
DPRAB	Department on the Protection and Reproduction of Aquatic Bioresources
DSV	Dive Support Vessel
DWG-DUQ	Deep Water Gunashli Drilling, Utilities and Quarters
DWG-PCWU	Deep Water Gunashli Production, Compression, Water Injection & Utilities
E&P Forum	Exploration and Production Forum
E&S	Environmental and Social
EA	East Azeri
EBSAs	Ecologically & Biologically Significant Areas
EC	European Commission
EC_{50}	The statistical estimate of the toxicant concentration that has an adverse effect on 50% of the test organisms after a specific exposure time.
EDTP	Enterprise Development and Training Programme
EIA	Environmental Impact Assessment
EIW	Early Infrastructure Works
EMP	Environmental Monitoring Programme
EMS	Environmental Management System
EMTAG	Environmental Monitoring Technical Advisory Group
EN	East North
ENP	European Neighbourhood Policy
EOP	Early Oil Project
EPS	Environmental Protection Standards
EQS	Environmental Quality Standards
ERA	Environmental Risk Assessments
ERM	Environmental Resources Management
ERMP	Employee Relations Management Plan
ERP	Emergency Response Plan
ES	East South
ESAS	Environmental and Social Advisory Services
ESC	Environmental Sub-Committee
ESD	Emergency Shut Down
ESIA	Environmental and Socio-Economic Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
ESMS	Environmental and Social Management System
ETN	Environmental Technical Note
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
FCG	Flooding, Cleaning and Gauging
FFD	Full Field Development
FGR	Flare Gas Recovery
FOC	Foreign Oil Company
FTA	Flowline Termination Assemblies
GDP	Group Defined Practice
GHG	Greenhouse Gases
GIIP	Gas Initially In Place
GOST	*Gosudarstvennye Standarty* State Standard (Russian standard)
GP	General Practitioner

GRP	Group Recommended Practice
HBV	HIPPS Barrier Valve
HBY	HIPPS Bypass Valve
HIPPS	High Integrity Pressure Protection System
HMCS	Harmonised Mandatory Control System
HOCNF	Harmonised Offshore Chemical Notification Format
HOCNS	Harmonised Offshore Chemical Notification Scheme
HP	High Pressure
HSE	Health, Safety & Environment
HSSE	Health Safety Security and Environment
HUC	Hook-Up and Commissioning
HVAC	Heating, Ventilation and Air-Conditioning
IADC	International Association of Drilling Contractors
IAGC	International Association of Geophysical Contractors
IBAs	Important Bird Areas
ICES	Chartered Institution of Civil Engineering Surveyors
ICG	International Crisis Group
ID	Internal Diameter
IDPs	Internally Displaced Persons
IEMP	Integrated Environmental Monitoring Programme
IFC	International Finance Corporation
IIED	International Institute for Environment and Development
ILE	Institute of Lighting Engineers
ILI	In Line Inspection
IoAE	Institute of Archaeology and Ethnography
IPA	Important Plant Areas
ISO	International Organization for Standardization
IUCN	International Union for the Conservation of Nature
KBAs	Key Biodiversity Areas
KPI	Key Performance Indicator
Laeq	Equivalent average sound level
LAO	Linear Alpha Olefin
LC_{50}	Lethal Concentration 50%. The concentration of a chemical which kills 50% of a sample population
LCAR	Living Conditions Assessment Report
LCM	Loss Control Materials
LMF	Labour Management Forum
LoD	Limit of Detection
LoF	Life of Field
LOMS	Local Operating Management System
LP	Low Pressure
LTFV	Lifting Transportation Freezer Vessel
LTMOBM	Low Toxicity Mineral Oil Based Mud
LTOBM	Low Toxic Oil Based Mud
LTV	Lifting Transportation Vessel
LWA	Sound Power Level
MARPOL	International Convention for the Pollution of Prevention by Ships, 1973, as modified by the Protocol of 1978
MChS	Ministry of Emergency Situations
M&E	Monitoring and Evaluation
MEG	Mono Ethylene Glycol
MENR	Ministry of Ecology and Natural Resources
MIA	Ministry of Internal Affairs
MoCT	Ministry of Culture and Tourism
MODU	Mobile Oil Drilling Unit
MPC	Maximum Permissible Concentration
MPE	Maximum Permissible Emissions
MPN	Most Probable Number
MRS	Mud Recovery Systems
MSD	Marine Sanitation Device

MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
Mt	Mount
MTP	Marine Transport Police
MW	Megawatt
N/A	Not Applicable
NCRs	Non-conformance reports
NDT	Non Destructive Testing
NF	Northern Flank
NGL	Natural Gas Liquids
NGO	Non Government Organisation
NICO	Naftiran Intertrade Company
NMVOC	Non-methane Volatile Organic Compounds
Non GHG	Non Greenhouse Gases
NPL	National Physics Laboratory
NRV	Non Return Valve
NT	Near Threatened
OAO	Open Joint-Stock Company
OCNS	Offshore Chemical Notification Scheme
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment of the North East Atlantic
OSRL	Oil Spill Response (Ltd)
OSRP	Oil Spill Response Plans
PAH	Poly Aromatic Hydrocarbons
PBC	Piggyback Cable
PBU	Pressure Build Up
PCA	EU-Azerbaijan Partnership and Cooperation Agreement
PCDP	Public Consultation and Disclosure Plan
PEC	Predicted Environmental Concentration
PHB	Pre Hydrated Bentonite
PIMS	Pipeline Integrity Management System
PLBG	PipeLay Barge
PLONOR	Presenting Little Or No Risk to the Environment
PNEC	Predicted No-Effect Concentration
POB	Persons on Board
POSVCM	Pipeline Oil Spill Volume Estimation Model
PSA	Production Sharing Agreement
PSVs	Pressure Safety Valves
PW	Produced Water
PWD	Produced Water Disposal
Q1	Quarter One (of year)
Q3	Quarter Three (of year)
QA	Quality Assurance
QC	Quality Control
RAMSAR	Convention on the, Protection of wetlands of international importance
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RMS	Root Mean Square
RO	Reverse Osmosis
ROV	Remotely Operated Vehicle
RoW	Right of Way
SB	Seine Boat
SBM	Synthetic Based Mud
SCE	Committee of the Azerbaijan Republic on Ecology
SCM	Subsea Control Module
SCP	South Caucasus Pipeline
SCPx	South Caucasus Pipeline Expansion
SCS	Solids Circulation System
SD	Shah Deniz
SD1	Shah Deniz Stage 1
SD2	Shah Deniz Phase 2

SDA	Shah Deniz Alpha
SDB	Shah Deniz Bravo
SDB-PR	Shah Deniz Bravo Production and Risers Platform
SDB-QU	Shah Deniz Bravo Quarters and Utilities Platform
SEE	State Ecological Expertise
SEM	Subsea Electronics Module
SMA	State Marine Administration
SME	Small and Medium Enterprises
SOCAR	State Oil Company of Azerbaijan Republic
SOFAZ	State Oil Fund of Azerbaijan
SP	Spring
SPS	Shelfprojectsroi
SPS	Subsea Production System
SSES	Stakeholder and Socio-Economic Survey
SSIVs	Subsea Safety Isolation Valves
ST	Sangachal Terminal
STB-01	Name of a transportation and installation barge
STP	Sewage Treatment Plant/Package
SUM	Summer
SVOC	Semi-Volatile Organic Compounds
SWRP	Subsea Well Response Project
TAC	Total Allowable Catch
TACIS	Technical Assistance to the Commonwealth of Independent States
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TPAO	Turkish Petroleum Corporation
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
UCM	Unresolved Complex Mixture
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNPFA	United Nations Population Fund
URS	URS Corporation Limited
US$	United States Dollars
US$M	United States Dollars (Millions)
USAID	United States Agency for International Development
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USSR	Union of Soviet Socialist Republics
UV	Ultra Violet
VNIRO	Russian Federal Research Institute of Fisheries and Oceanography
VOC	Volatile Organic Compounds
VU	Vulnerable
W	Winter
WAF	Water Accommodated Fraction
WB	World Bank
WBM	Water Based Mud
WF	Western Flank
WHO	World Health Organisation
WHR	Waste Heat Recovery
WHRU	Waste Heat Recovery Units
WRA	Water Resource Associates
WS	West South
WTNs	Waste Transfer Notes
ZAP	Closed Joint-Stock Company

Glossary

Aarhus Convention
An international legal agreement which promotes access to information, public participation in decision making and access to justice in environmental matters.

Abandonment
Final plugging of wells and/or permanent dismantling of a production platform or other installation.

Accidental Events
Incidents or non-routine events that have the potential to trigger impacts that would otherwise not be anticipated.

Amphipod
A small crustacean of the order Amphipoda having a laterally compressed body with no carapace.

Annelid
Any of various worms or wormlike animals of the phylum Annelida, characterised by an elongated, cylindrical and segmented body.

Annulus
The space between two concentric objects, such as between the wellbore and casing or between casing and tubing.

Anode
A positively charged electrode (associated with a battery, electronic device or electrical equipment).

Anticline
An arch-shaped fold in rock in which the rock layers are upwardly convex.

Anthropogenic
Relating to humans.

Associated Gas
Natural gas found as part of or in conjunction with other constituents of crude oil. This may be dissolved in the crude oil or found as a cap of free gas above the oil.

Azerbaijan Manat (AZN)
Currency of Azerbaijan.

Background Level
The concentration of a substance or energy intensity level (such as noise or light) that is characteristic of the surrounding environment.

Ballast
Water taken aboard a vessel to maintain stability and to distribute load.

Barite
A very heavy substance used as a main component of drilling mud to increase its density (mud weight). Chemical name is barium sulphate.

Barrels
The traditional unit of measure of oil volume, equivalent to 159 liters (0.159 m^3) or approximately 35 imperial gallons (42 US gallons).

Base Case Design
Project design as described and assessed within the ESIA.

Basel Convention
An international legal agreement that primarily deals with transboundary hazardous waste movement and other hazardous waste management.

Bathymetry
The measurement of the depth of bodies of water.

Benthos
The collection of organisms attached to or resting on the bottom (benthic) sediments and those which bore or burrow into the sediments.

Berm
An engineered (earth) bank forming a raised barrier separating two areas.

Best Practicable Environmental Option (BPEO)
Procedure which results in identification of the option that causes least damage to the environment at acceptable cost.

Biocide
A chemical agent that can be added to fluids for the purpose of selectively preventing or limiting the growth of bacteria and other organisms.

Biodegradable
Susceptible to breakdown into simpler compounds by microorganisms in the soil, water and atmosphere. Biodegradation often converts toxic organic compounds into non- or less toxic substances.

Biodiversity
The number of plant and animal species in a given area.

Biological Oxygen Demand (BOD)
The amount of oxygen required by aerobic microorganisms to decompose the organic matter in a sample of water, such as that polluted by sewage. It is used as a measure of the degree of water pollution.

Biomass
The total mass of living matter within a given quantity.

Birth Rate
Childbirth per 1,000 people per year.

Bivalve
A marine or freshwater mollusc having a laterally compressed body and a shell consisting of two hinged valves.

Black Water
Human generated wastewater containing fecal matter and urine.

Blowout
Uncontrolled or uncontrollable release of downhole pressure upward through the wellbore or casing.

Blow Out Preventer (BOP)
Hydraulically operated device used to prevent uncontrolled releases of oil or gas from a well.

Borehole
A hole in the ground made by drilling; the uncased drill hole from the surface to the bottom of the well.

Bowsers
A vehicle tanker containing fuel or water.

Bund
Containment around a storage tank to contain the contents in case of rupture or spillage.

Buy Back
A system to allow the use of gas from a gas export line, when fuel gas is unavailable on the platform.

Caisson
A steel cylindrical chamber extending from a drilling rig or platform that may be used for uptake or discharge.

Caravanserai
An inn built around a large court for accommodating caravans along trade routes in central and western Asia.

Casing
The steel piping used to line a well for protection against collapse of the well borehole and unwanted leakage into or from the surrounding formation.

Cathodic Protection
A method of neutralising the corrosive static electric charges in a submerged steel structure.

Cement
A powdery substance that acts as a binder that hardens (sets) after mixing with water. Cement is often used to bind aggregate materials (such as sand and gravel) together, to form concrete.

Chal-Meadow
Vegetation community that is linked to the temporary retention of surface water following rainfall, this community is dominated by *Tamarix meyeri* scrub and usually occurs in depressions and along drainage lines.

Chemical Oxygen Demand (COD)
The amount of oxygen consumed by organic compounds in a sample of water. It is used to indirectly measure the amount of organic compounds in water.

Circulation
The passage of fluids, primarily drilling mud, down the interior of the drill stem and back to the surface via the annulus.

Coalescer
A device used to change material from a liquid to a thickened curd-like state by chemical reaction.

Coliform
Of or relating to the bacteria that commonly inhabit the intestines/colons of humans and other vertebrates.

Commissioning
Preparatory work comprising system testing of the process systems, prior to full production.

Communities
A social group whose members reside in a specific locality, share government and often have a common cultural and historical heritage / an ecological unit composed of the various populations of micro-organisms, plants, animals that inhabit a particular area.

Completion
The work of preparing a newly drilled well for production.

Completion Fluid
Chemical mixture present in the well during the placement of production tubing and perforation of the well.

Compression
The raising of pressure within a substance.

Condensate (Gas Condensate)
Light hydrocarbon fractions produced with natural gas which condense into liquid at normal temperatures and pressures associated with surface production equipment.

Conductivity
A measure of the ability of a substance to transmit heat, electrical charge or sound through a medium without noticeable motion of the medium itself.

Conductor Section
Casing string that is usually hammered into the well at the seabed, to prevent the sides of the hole from caving into the wellbore.

Consequence
The resultant effect (positive or negative) of an activity's interaction with the legal, natural and/or socio-economic environments.

Consortium
An association or grouping of institutions, businesses, or financial organisations, usually set up for a common purpose.

Consultation
A formal process which aims to obtain the views and opinions from stakeholders about a project.

Continental Plate
A tectonic plate that forms part of one of the Earth's continents.

Continental Slope
Connects the continental shelf and the oceanic crust and is part of the continental margin.

Contract Area
Area of the sea that has been sub-divided and licensed/leased to a company or group of companies for exploration and production of hydrocarbons.

Control Fluid
A type of hydraulic fluid and the medium by which power is transferred in hydraulically operated systems. For the SD2 Project it is water-based fluid used as the energy source in the subsea control system to operate the hydraulically actuated valves.

Convergent Plate Boundary
An actively deforming region where two (or more) tectonic plates or fragments of lithosphere move toward one another and collide.

Copepod
Any member of a large family of the phylum Arthropoda, including many crustaceans, living in freshwater and marine water. Some copepods are parasitic and others are free living.

Corrosion
The eating away of metal by chemical or electrochemical action. The rusting and pitting of pipelines, steel tanks, and other metal structures is caused by a complex electrochemical action.

Crude Oil
An unrefined mixture of naturally-occurring hydrocarbons with varying densities and properties.

Crest
Highest point of a geological structure.

Ctenophore
Any of various marine animals of the phylum Ctenophora, having transparent, gelatinous bodies bearing eight rows of comblike cilia used for swimming. Also known as comb jelly.

Culvert
A man made structure used to channel water.

Cumulative Impact
Environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities, result in a larger /more significance impact(s).

Cuttings
See drill cuttings.

Daphnia
Small planktonic invertebrate, cladoceran, varying in length from 0.2 to 5 mm.

Decibel (dB)
A unit used (one tenth of a bel) used in the comparison of two power levels relating to sound intensities.

Decommissioning
Shutdown and dismantling of any facilities.

Degasser
A separator which removes entrained gas from the returned mud flow. Also any process which removes gases of various kinds from an oil flow.

Dehydration
Removal of water.

Desertification
The transformation of arable or habitable land to desert, due to a change in climate or destructive land use.

Dewpoint
The temperature to which a given parcel of air must be cooled, at constant pressure, for water vapour to condense into water.

Disclosure
Release of ESIA information into the public domain.

Dispersant
Specially designed oil spill products that are composed of detergent-like surfactants in low toxicity solvents. Dispersants do not remove oil from the water but break the oil slick into small particles, which then disperse into the water where they are further broken down by natural processes.

Domestic waste
Solid waste, composed of garbage and rubbish, which normally originates from a residence/living quarters.

Downhole
Area within the drilled bore of an oil or gas well.

Drainage Catchment
The shape of the land which naturally forms different areas such that water falling as rain on the ground will drain into the lowest parts of the area.

Drill Bit
A drilling tool used to cut through rock.

Drill Cuttings
Small fragments of rock produced as the result of drilling that are brought to the surface by the flow of the drilling mud as it is circulated.

Drilling Mud
A special clay mixed with water or oil and chemical additives, pumped downhole through the drill pipe (string) and drill bit. The mud cools the rapidly rotating bit, lubricates the drillpipe as it turns in the well bore, carries rock cuttings to the surface and serves as a plaster to prevent the wall of the borehole from collapsing. Also known as drilling fluid.

Drill String
Lengths of steel tubing screwed together to form a pipe connecting the drill bit to the drilling rig. It is rotated to drill the hole and delivers the drilling fluids to the cutting edge of the bit.

Early Oil Project
The first large-scale oil project in the Caspian Sea. It commenced in 1994 and involved a consortium of companies who invested to extract oil from the Azeri, Chirag and Guneshli wells.

Earthenware Sherds
A fragment of pottery.

Ecosystem
The interrelationships between all living organisms in a given area, and their relationships to non-living materials.

Effluent
Waste emitted as a liquid by an operation or process.

Embankment
A raised mass of earth or stone built to hold back water or to support a roadway.

Emergency
An unplanned activity e.g. due to equipment failure, loss of containment, operator error, unexpected well conditions or design error.

Endemic
Present within a localised area or peculiar to organisms in such an area.

Emulsion
A mixture of two or more immiscible liquids, with one being dispersed in another.

Environment for Europe
A partnership of member states, including Azerbaijan, and other organisations within the UNECE region.

Environmental and Socio-economic Impact Assessment (ESIA)
Systematic review of the environmental or socio-economic effects that a proposed project may have on its surrounding environment.

Environmental Aspect
An element of an organisation's activities, products or services that can interact with the environment.

Environmental Impact
Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.

Environmental Impact Management Process
A full life-cycle process that seeks to identify and understand a project's environmental impacts, to avoid, minimise, mitigate and remediate the impacts.

Environmental Management System
A system established to plan, manage and document an organisation's activities and processes and resultant environmental impacts.

Environmental Receptors
Any of various organisms that are directly or indirectly affected by environmental impact.

Ephemeral
Something living or lasting for a brief time, such as the flow of a river during certain months of the year.

Espoo Convention
A regional legal agreement to promote environmentally sound and sustainable economic development through the application of ESIA.

Ethnography
The study of customs and the cultural heritage of separate ethnic and human groups and tribes.

Eurasian
The extended landmass of Europe and Asia and specifically the large indeterminate region where the two continents join.

Exploration Well
A well drilled in search of an undiscovered reservoir or to greatly extend the limits of a known reservoir.

Fertility Rate
The average number of children that would be born to a woman in a certain area over her lifetime.

Filter Feeder
A variety of organisms living mostly on detritus or on plankton, whose feeding mechanism comprises a filter and a means of creating a current carrying particles through the filter.

Flaring
Controlled disposal of surplus combustible hydrocarbons by igniting their vapours.

Flash
The sudden release of gases and/or vapours due to an instantaneous reduction in temperature and/or pressure.

Float Over
The launch or loading out of jackets or other structures for installation offshore on a flotation barge or other vessel.

Flora/fauna
Plants/wildlife that occur within a defined geographical area.

Flowline
The pipe through which oil/gas travels from the well to the offshore platform processing facilities.

Fluvial
Of or relating to rivers or streams or produced by the action of a river or stream.

Footprint
The spatial impact/impression on the land from a facility, building or disturbed area.

Formation
A rock deposit or structure of homogenous origin and appearance.

Fugitive Emissions
Release of small volumes of gas due to filling, emptying and "breathing losses" from tanks and small losses from fittings that cannot be practically recovered in capture systems

Galley Waste
Organic food waste originating from a vessel's galley (or kitchen).

Gastropod
Any of the various molluscs of the class Gastropoda such as the snail.

Greenhouse Gas (GHG)
Atmospheric gases considered to contribute to the greenhouse effect by absorbing and emitting radiation within the thermal and infrared range. GHG primarily include carbon dioxide and methane.

Grey Water
Wastewater from wash basins, showers and laundry use.

Groundwater
Water that collects or flows beneath the Earth's surface, filling the porous spaces in soil, sediment, and rocks. Groundwater originates from rain and from melting snow and ice and is the source of water for aquifers, springs, and wells.

Grout
A material that is used for filling voids and sealing joints.

Habitat
An area where particular animal or plant species and assemblages are found, defined by environmental parameters.

Harmful Substances
Those substances that are identified as marine pollutants in the IMDG Code.

Hazard
The potential to cause harm, including ill health or injury; damage to property, plant, products or the environment; production losses or increased liabilities.

Heavy Metals
A subset of elements that exhibit metallic properties with high atomic weights, and which include the transition metals and a number of metalloids, lanthanoids, and actinides. Examples include mercury, chromuim, cadmuim, arsenic and lead.

Heritage
Valued objects and qualities such as cultural traditions, unspoiled countryside, and historic building that have been passed down previous generations.

Hook Up
The activity following plant installation during which all connections and services are made operable for commissioning and 'start-up'.

Hydrate
These are molecules of natural gas, typically methane, which are trapped in ice molecules. Hydrates can form in pipelines and in gas processing facilities at reduced temperatures and high pressures. Hydrates can plug the pipelines and significantly affect production operations.

Hydrocarbon
Organic chemical compounds of hydrogen and carbon atoms. There are a vast number of these compounds and they form the basis of all petroleum products. They may exist as gases, liquids or solids, examples being methane, hexane and paraffin.

Hydrology
The science dealing with the occurrence, circulation, distribution, and properties of water.

Hydrotesting
The checking of the integrity of a container (e.g. tank or pipe) by filling it with water under pressure and testing for any loss of pressure.

Impermeable
Not allowing the passage of a fluid.

Infiltration
The flow of water from the land surface into the subsurface.

Inert Gas
Chemically unreactive gases used to flood compartments in a vessel or platform when there is fire or imminent danger of fire.

International Finance Corporation
Organisation that is a member of the World Bank, and promotes sustainable private sector investment in developing countries.

Internally Displaced Persons
People who are forced to flee their homes, but unlike refugees, remain within their country's borders.

Intervention Activities
Any operation or work carried out on an oil or gas well or subsea production system during, or at the end of its productive life (e.g. replacement of components, altering the state of the well and/or well geometry).

Invertebrates
Any animal lacking a backbone, including all species not classified as vertebrates.

ISO 14001
An evolving series of generic environmental management system standards developed by the International Standards Organisation that provides business management with a structure for managing environmental impacts.

Isopod
A type of peracarid crustacean.

Istiglal
A semi-submersible mobile drilling rig used to drill predrill wells.

Jacket
The structure of an offshore steel platform, which supports the topside facilities.

Landfill
Disposal of waste materials by burial.

Larvae
An immature free-living form of animal that develops into a different form through metamorphosis.

Late Middle Ages
In Azerbaijan, the Late Medieval Period extends from the 15th century to the 18th century.

Law on Normative-Legal Acts
Azerbaijani legislation that stipulates that acts in force prior to independence, not subsequently cancelled or contradictory to the Constitution, remain in force.

Law on the Protection of the Environment
Azerbaijani legislation that addresses use of natural resources, the rights and responsibilities of the State and its citizens, ecological requirements for economic activities, ecological emergencies and disaster zones, etc.

Lay down area
Temporary storage area for supplies and materials.

Likelihood
The possibility that an activity or effect will occur.

Macrobenthos or Macrofauna
Organisms that live on/in sediment at the bottom of a water column. Relatively larger than other benthos with a size range of approximately 20 cm to 0.5 mm.

Manifold
Assembly of pipes, valves and fittings which allows fluids from more than one source to be collected together.

Mammal
A class of air-breathing warm-blooded vertebrates, Mammalia, having mammary glands in the female.

Material Safety Data Sheet (MSDS)
An information sheet used by chemical suppliers to summarise properties of products, including health, safety and environmental aspects.

Meteorological Dynamics
The study of those motions of the atmosphere that is associated with weather and climate.

Microplate
Any small lithospheric (Earth's crust and upper mantle) plate.

Migration
Movement of people to a new area or country in order to find work or better living conditions / any regular animal journeys along well-defined routes, particularly those involving a return to breeding grounds.

Milli Mejlis
Azerbaijan Parliament.

Mitigation
The measures put forward to prevent, reduce and where possible, offset any adverse environmental or socio-economic effects.

Module
A separate section or box-like compartment of the topside of a platform, as far as possible self-contained, designed to be connected to other modules offshore.

Nagorno-Karabakh
A landlocked region in the South Caucasus which is mostly mountainous and afforested. It is within the national boundary of Azerbaijan, but governed by the internationally unrecognised Nagorno-Karabakh Republic and is currently occupied by Armenia.

Neutralised Seawater
A process to chemically alter seawater to make its pH level nearer neutral, to enhance its effectiveness for drilling mud.

Non Destructive Testing (NDT)
Methods of inspecting and testing the quality or integrity of vessels or equipment which do not involve the removal or testing to destruction of representative sections.

Oceanography
The study of the ocean, including marine ecosystems, ocean currents, waves, and physical and chemical changes.

Oligochaete
Any of various annelid worms of the class Oligochaeta, including the earthworms and a few small freshwater forms.

Operator
The company responsible for conducting operations on a concession on behalf of itself and any other concession-holders.

Overpressure
Subsurface pressure that is abnormally high, exceeding hydrostatic pressure at a given depth.

Packer
Device that can be installed into a drilled well that expands to seal the wellbore.

Particulates
Tiny particles of solid or liquid suspended in a gas or liquid.

pH
A scale of alkalinity or acidity, running from 0 to 14 with 7 representing neutrality, 0 maximum acidity and 14 maximum alkalinity.

Phytoplankton
Microscopic photosynthetic organisms which float or drift in the surface waters of seas and lakes, e.g. diatoms, dinoflagellates.

Pipelay Barge
A vessel designed for welding together pipelines and laying them on the seabed.

Producer Well
A drilled hole through which oil and gas is extracted.

Productive Zone
Most populated zone of the ocean (usually the top layer).

Pig (train)
A bullet shaped, cylindrical or spherical capsule which is inserted into a pipeline flow and travels along with the fluid in the pipeline. Its primary purpose is to scrape the pipeline clean from rust, wax or other deposits. More sophisticated pigs, called intelligent pigs, carry instrumentation used in pipeline inspection.

Pigging
The process of cleaning or measuring internally the pipeline whereby a "pig" is sent though the line to clean/ measure the inside of the pipeline.

Piling
A heavy beam of timber, concrete, or steel, driven into the earth as a foundation or support for a structure.

Pilot Hole
A smaller hole drilled into a material prior to a larger hole being drilled, widening the hole to the desired width.

Pipe Dope
Lubricating grease which seals pipe joints to prevent damage to threads.

Pipeline Landfall
Location where an offshore pipeline reaches the coast.

Pipe Rack
Where stands of drill pipe are stacked vertically in a derrick ready for use.

Plankton
Tiny plants (phytoplankton) and animals (zooplankton) that drift in the surface waters of seas and lakes. They are of high ecological importance as they provide a source of food to larger marine organisms such as fish.

Platform
A large structure offshore which has facilities to drill, extract, process and temporarily store hydrocarbons.

Plug
To seal a well or part of a well.

Pollution
The introduction by man, directly or indirectly, of substances or energy to the environment resulting in deleterious effects such as harm to living resources; hazards to human health; hindrance of marine activities including fishing and impairment of the quality for use of seawater and reduction of amenities.

Polychaete
Any of various annelid worms of the class Polychaeta, including mostly marine worms such as the lugworm, and characterised by fleshy paired appendages tipped with bristles on each body segment.

Polycyclic Aromatic Hydrocarbons (PAH)
Hydrocarbons whose carbon atoms form a ring or rings.

Polymer
Two or more molecules of the same kind, combined to form a compound with different physical properties.

Potable Water
Water that is suitable for human consumption.

Pour Point
The lowest temperature at which a liquid will pour or flow under prescribed conditions.

Precipitation
The product of atmospheric water vapour condensation that falls to the Earth's surface under gravity. The main types of precipitation are: drizzle, rain, sleet, snow and hail.

Predrill
Drilling activities taking place to accelerate early production once offshore facilities are in place.

Preservation Chemicals
Chemicals used to prevent corrosion and inhibit bacteria growth in seawater used for hydrotesting.

Pressure Maintenance
The process of keeping reservoir pressure at the optimum level during production, usually by water or gas injection to replace the extracted fluids.

Produced Water
Water that naturally accompanies produced oil/condensate. Also known as produced formation water.

Producer Well
A drilled hole through which oil and gas is extracted.

Production
Extraction of hydrocarbon from the reservoir.

Production Fluid
The fluid mixture of oil, gas and water in formation fluid (naturally occurring liquids and gases contained in geologic formations) that flows to the surface of an oil well from a reservoir.

Production Sharing Agreement (PSA)
Type of contract signed between a government and a resource extraction company (or group of companies).

Public Participation
Process where the affected public are informed about the planned activities.

RAMSAR Convention
An intergovernmental treaty that provides designations to sites that are considered internationally important wetlands.

Receptor
The aspect of the environment (air, water, ecosystem, human, fauna, etc.) that is affected by/interacts with an environmental or socio-economic impact.

Recycling/Recovery
The conversion of wastes into usable materials and/or extraction of energy or materials from wastes.

Red List / Red Book
A list comprised of rare or endangered species of plants and animals / the book containing Red List species.

Reedbed
Tall plants that grow in large groups in shallow water or on ground that is always wet and soft.

Reservoir
A porous, fractured or cavitied rock formation with a geological seal forming a trap for producible hydrocarbons.

Reservoir Pressure
The pressure at reservoir depth in a shut-in well.

Residual Impacts
Residual impacts are impacts that remain after mitigation measures, including those incorporated into the project's Base Case design and those developed in addition to the base design, have been applied.

Resilience
A measure of how a biological, ecological or human receptor is affected by an identified stressor.

Reuse
The use of materials or products that are reusable in their original form.

Richter Scale
The scale for expressing the magnitude of an earthquake.

Rig
A collective term to describe the equipment needed for drilling a well.

Riser
A pipe through which fluids flow upwards.

Risk
The product of the chance that a specified undesired event will occur and the severity of the consequences of the event.

Sail-away
The process of transporting equipment from onshore to its offshore location by vessel.

Salinity
Total amount of salt dissolved in an aqueous solution usually expressed as parts per thousand.

Scale Inhibitor
Substances added to minimise deposition of solids such as calcium carbonates and sulphates in equipment, pipework or casings.

Scoping
Early stage in the ESIA process which appraises the likely key issues requiring detailed assessment.

Scouring
A form of erosion; removal by hydrodynamic forces of granular bed material in the vicinity of structures, such as roads and railway lines.

Screening
The process by which it is decided if an ESIA is required to be carried out for a project.

Sediment
Solid fragments of inorganic or organic material that come from the weathering and erosion of rock and are carried and deposited by wind, water, or ice.

Seismic
The characteristics (e.g. frequency and intensity) of earthquake activity in a given region.

Semi-submersible Rig
A type of floating offshore drilling rig which has pontoons or buoyancy chambers located on short legs below the drilling platform.

Separator
A process vessel used to separate gases and liquids in a hydrocarbon stream.

Shale Shaker
Screen for extracting rock cuttings from circulating drilling mud.

Shrub
A woody plant of relatively low height, having several stems from the base.

Significant Wave Height
The average wave height (trough to crest) of the 1/3 largest waves.

Slurry
A mix of cement and waste.

Solids Circulation System
A device that separates SBM/LTMOBM from cuttings via a series of shale shakers, a vacuum degasser and centrifuges.

Spoil
Material generated during clearance /excavation works.

Stakeholder
A person, group and/or organisation with an interest in a project.

Stinger
A support boom that extends outwards from the stern of a lay-barge and used to lay pipes.

Stockholm Convention
An international legal agreement requiring Governments to reduce the release of persistent organic pollutants.

Storm Surge
An offshore rise in water level associated with a low pressure weather system. Usually caused by strong winds pushing the surface of the water body.

Strata
Distinct, usually parallel beds of rock.

Surfactant
An additive that reduces surface tension e.g. a detergent or emulsifier.

Suspension Fluids
Fluids used in the well during well suspension to maintain the integrity of the well.

Swim Bladder
Buoyancy organ possessed by most bony fish.

Taxon
Plural -Taxa. A taxonomic category or group, used to classify organisms.

Thermal desorption
A non-oxidising process using heat to desorp oil from oily wastes.

Thermocline
Temperature differential in the water.

Topside
Part of a rig which includes the upper deck, mezzanine deck, cellar deck and underdeck.

Toxicity
Inherent potential or capacity of a substance to cause adverse effects on living organisms.

Toxicity Test
Procedure that measures the toxicity produced by exposure to a series of concentrations of a test substance. In an aquatic toxicity test, the effect is usually measured as either the proportion of organisms affected or the degree of effect shown by the organism.

Transboundary impact
An impact which crosses any boundaries between two geopolitical boundaries (i.e. a border).

Treated Seawater
Seawater which is treated with preservation chemicals to reduce potential corrosion and biofouling.

Turbidity
The cloudiness or haziness of a fluid caused by individual particles. It is used as a test of water quality.

Umbilical
Tube or line that connects the subsurface to the surface of the sea.

Venting
The release of uncombusted gases to the atmosphere.

Vienna Convention
An international legal agreement regarding the protection of the Ozone Layer.

Viscosity
The resistance of a fluid to flow due to the mutual adherence to its molecules.

Wadi
A river valley which may be ephemeral and flow only after heavy rain, or during certain periods of the year.

Wastewater
Water contaminated with domestic and production wastes.

Water Based Muds (WBM)
Drilling fluid based on suspension of solids in water.

Water Injection
The injection of water into a reservoir or well.

Wax
Wax is a constituent of crude oil that often requires special treatment to allow the oil to flow freely at surface conditions.

Weathering
Processes related to the chemical action of air, water and organisms. Weathering results in evaporative loss of light hydrocarbons and it is commonly accompanied by biodegradation and water washing.

Well Clean Up
Ridding the borehole of spent fluid. This returns the well to an original state and drains back into the borehole where it is pumped or circulated out, leaving the hole clean.

Wellhead
Top of a casing and the attached control and flow valves. The well head is where the control valves, testing equipment and take-off piping are located.

Well Testing
Flowing of well fluids to provide information on how hydrocarbon will flow from the reservoir, well productivity and the reservoir properties.

Wetland
An area of land whose soil is saturated with moisture either permanently or seasonally.

Wind Rose
A diagram with radiating lines showing the frequency and strength of winds from each direction affecting a specific place.

Well Workover
Operations on a producing well to restore or increase production. A workover may be performed to stimulate the well, remove sand or wax from the wellbore, to mechanically repair the well, or for other reasons

Workover Fluid
A well-control fluid, typically a brine, that is used during workover operations.

Zooplankton
Plankton that consists of animals such as corals and jellyfish, usually small and often microscopic.

1. Introduction

Contents

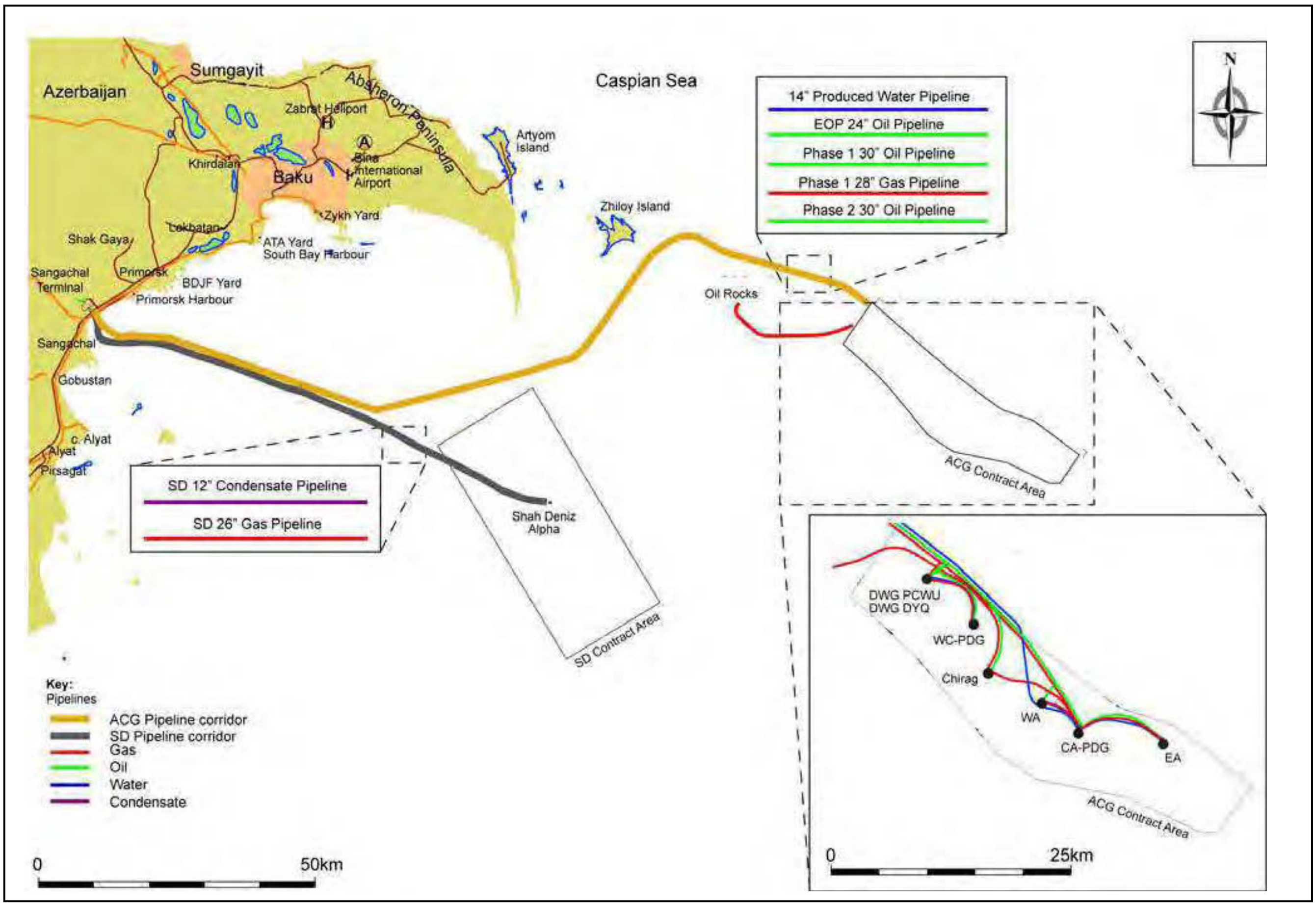
List of Figures

List of Tables

1.1 Introduction

This Environmental and Socio-Economic Impact Assessment (ESIA) has been prepared for the proposed Shah Deniz 2 (SD2) Project. The project aims to deliver 16Bcma of gas sales, with peak condensate rates of 85Mbd through the installation of additional wells within the high pressure gas-condensate Shah Deniz (SD) Contract Area (see Figure 1.1).

Figure 1.1 Location of Shah Deniz (SD) Contract Area and Existing SD and ACG Oil and Gas Offshore Facilities



The ESIA has been conducted in accordance with the legal requirements of Azerbaijan as well as BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy as described in Chapter 2: Policy, Regulatory and Administrative Framework. The scope and assessment methodologies used in this ESIA have been informed through a consultation process, as described in Chapter 8: Consultation and Disclosure. Stakeholders consulted have included, among others, the Azerbaijan Ministry of Ecology and Natural Resources (MENR), the State Oil Company of Azerbaijan Republic (SOCAR), National Academy of Sciences of Azerbaijan (AMEA), BP's Azerbaijan Georgia Turkey (AGT) Region representatives and the SD2 Project Design Team.

1.2 SD and ACG Development to Date

1.2.1 Shah Deniz Production Sharing Agreement

The SD Production Sharing Agreement (PSA) was signed on 4th June 1996 between the State Oil Company of Azerbaijan Republic (SOCAR) and a consortium of Foreign Oil Companies (FOC) to develop and manage the reserves of the SD gas-condensate field, herein after termed the “Contract Area”. BP Exploration (Shah Deniz) Limited have been appointed Operator of the PSA on behalf of the consortium partners. The consortium partners of SD are as follows:

- BP 25.5%
- Statoil 25.5%
- SOCAR 10.0%
- TOTAL 10.0%
- Lukoil 10.0%
- NICO 10.0%
- TPAO 9.0%

1.2.2 Shah Deniz 1 Gas Export Project

The SD Contract Area lies approximately 100km south east of Baku (refer to Figure 1.1). Full Field Development (FFD) of the SD Contract Area is being pursued in stages. The Shah Deniz Stage 1 development is located in the north eastern portion of the field and commenced production in 2006. The development included:

- A fixed platform (denoted SD Alpha) with drilling and processing facilities limited to primary separation of gas and liquids; and
- Two marine export pipelines to transport gas and condensate to onshore reception, gas-processing and condensate facilities located at Sangachal Terminal (ST), approximately 60km south west of Baku.

1.2.3 ACG Development

Development of the Azeri Chirag Guneshli (ACG) Contract Area has been pursued in phases in parallel with the SD Contract Area under a separate PSA (refer to Figure 1.1 for the location of the ACG Contract Area). To date the development phases have included:

- Early Oil Project (EOP);
- ACG Phase 1;
- ACG Phase 2;
- ACG Phase 3; and
- Chirag Oil Project (facilities under construction)

The Produced Water Disposal (PWD) project includes onshore facilities at ST to treat separated produced water to a standard suitable for transfer back offshore via a dedicated marine pipeline to the Central Azeri Compression & Water injection Platform (CA C&WP) for reinjection into the ACG reservoir for reservoir pressure maintenance. The PWD project commenced operation in the fourth quarter of 2008.

1.2.4 Existing Export Pipelines

Oil and gas are currently exported from ST following stabilisation and dehydration respectively via three main export pipelines:

- The Baku-Tblisi-Ceyhan (BTC) Pipeline transports oil from ST through Azerbaijan, Georgia and Turkey to the Ceyhan Terminal located on the Turkish coast of the Mediterranean Sea. From Ceyhan the oil is distributed to international markets. The pipeline covers a distance of 1,768km and has eight pump stations along the route with the head pump station installed at ST.
- The Western Route Export pipeline is 829km in length and transports oil from ST to the Supsa Terminal located on Georgia’s Black Sea coast.
- The South Caucasus Pipeline (SCP) transports gas from ST to Azerbaijan, Georgia and Turkey. It became operational late 2006 and on 30 September, 2006 began transporting gas to Turkey from the Shah Deniz Stage 1 project. The SCP is 691km in length and runs parallel to the BTC Pipeline to the Turkish border where it is linked with the Turkish gas distribution network.

1.3 Shah Deniz 2 Project

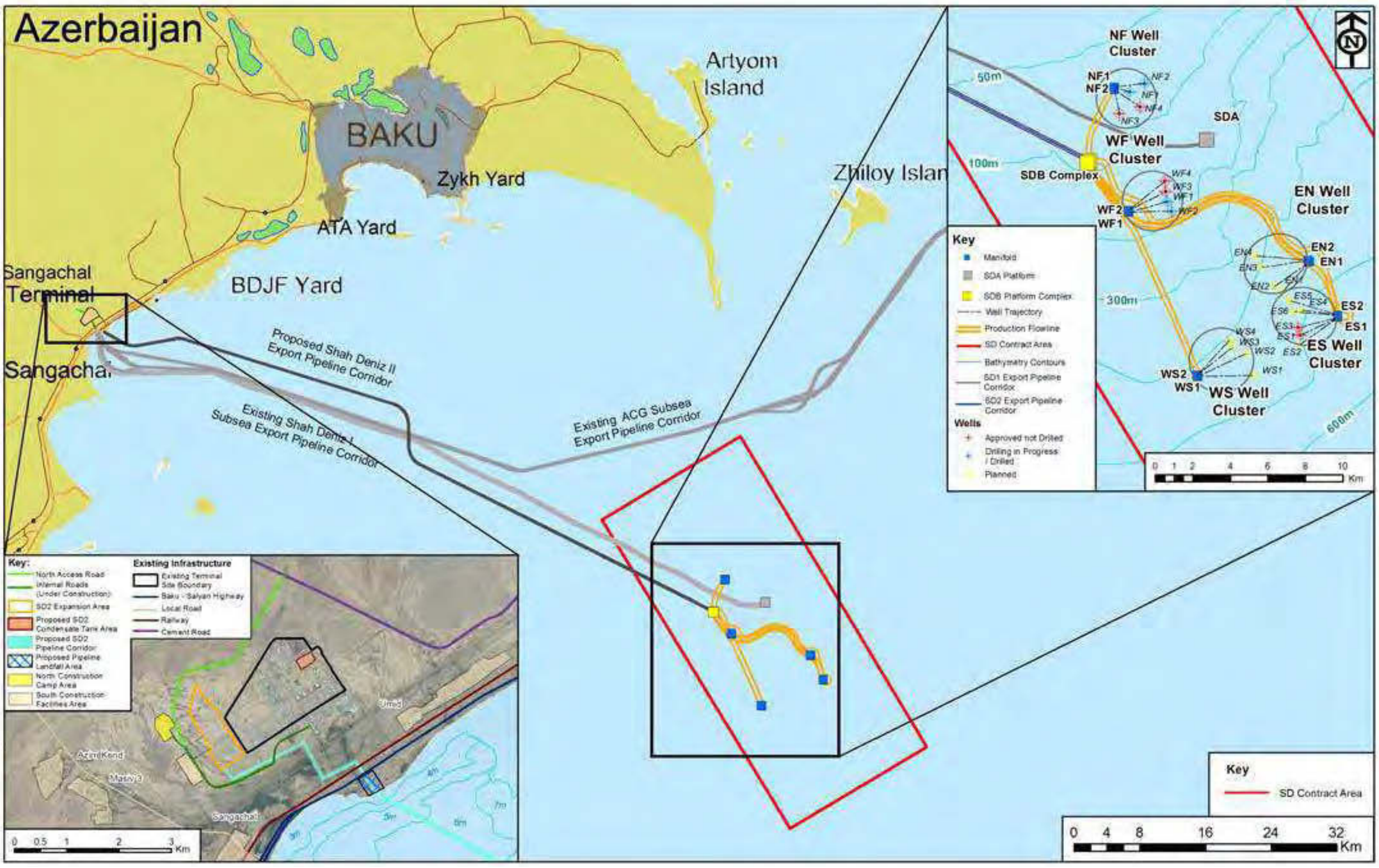
The SD2 Project represents the second stage of SD field development and is planned to comprise:

- A fixed SD Bravo (SDB) platform complex including a Production and Risers platform (SDB-PR) and a Quarters and Utilities (SDB-QU) platform, bridge linked to the SDB-PR;
- Subsea manifolds and associated well clusters, tied back to the fixed SD Bravo (SDB) platform complex by flowlines; and
- Subsea export pipelines from the SDB-PR platform to ST and a dedicated monoethylene glycol (MEG) import pipeline from ST to the SDB-PR platform.

In addition it is planned to expand ST to provide processing facilities for the SD2 Project. To accommodate the additional sales gas associated with the SD2 Project it is proposed to expand the existing SCP pipeline capacity. The SCP midstream facilities (downstream of ST) are not included in the SD Production Sharing Agreement (PSA) and will be developed and financed separately as the SCP Expansion (SCPx) Project. The SD2 Project includes the design and construction of the export compression, metering and associated utilities for SCPx Project at ST. All other SCPx facilities and activities are excluded from the SD2 Project scope.

Figure 1.2 shows the location of the offshore and onshore SD2 facilities, location of the BDJF and ATA construction yards, the approximate well locations, subsea infrastructure layout and the routing of the subsea SD2 pipelines between the SDB platform complex and ST.

Figure 1.2 Scope of the SD2 Project



To date four environmental permission documents have been submitted to and approved by the Ministry of Ecology and Natural Resources (MENR) to cover early activities:

- NF1 Environmental Technical Note (ETN) – scope included drilling of the NF1 well within the northern flank of SD Contract Area;

- WF1 ETN – scope included drilling of the WF1 well within the western flank of SD Contract Area;
- SD2 Predrilling Project ETN – scope included drilling eight wells (denoted as WF2, WF3, WF4, NF2, NF3, NF4, ES2, and ES3) in the western, northern and eastern flanks of the SD Contract Area;
- SD2 Infrastructure ESIA – scope included:
  - New access road from the Baku-Salyan highway to ST (and associated facilities);
  - Clearance and terracing of the SD2 Expansion Area, located immediately to the west of the existing ST;
  - Construction and fit out of the construction camp and construction facilities;
  - Installation of storm water drainage and surface water/flood protection berms;
  - Installation and operation of a sewage treatment plant; and
  - Levelling of the SD2 Pipeline Landfall Area[1].

Permission has therefore been obtained for drilling ten of the proposed 26 wells and for the preparation works at ST.

The aim of this ESIA is to assess the environmental and socio-economic impacts associated with all remaining onshore, subsea and offshore components of the SD2 Project that have not been assessed to date.

1.4 SD2 Project Environmental and Socio-Economic Impact Assessment

1.4.1 Objectives

The overall objective of the SD2 Project ESIA process is to identify, minimise and effectively manage any potential adverse environmental or socio-economic impacts arising from proposed works.

The purpose of the ESIA is to:

- Ensure that environmental and socio-economic considerations are integrated into project design and operation;
- Ensure that previous experience is acknowledged and where appropriate, integrated into the project design;
- Ensure that environmental and socio-economic impacts are identified, quantified and assessed and appropriate mitigation measures proposed;
- Ensure that a high standard of environmental and socio-economic performance is planned and achieved for the project;
- Ensure that applicable legal, operator and PSA requirements and expectations are addressed;
- Consult with relevant stakeholders throughout the project and address their concerns; and
- Demonstrate that the project will be implemented with due regard to environmental and socio-economic considerations.

Within the impact assessment, activities and potential receptor interactions are evaluated against existing environmental and socio-economic conditions and sensitivities, and the potential impacts are ranked. The assessment of potential impacts takes account of existing and planned controls and monitoring and mitigation measures developed as part of earlier ACG and SD Projects.

[1] The Early Infrastructure Works (EIW) contractor's scope of works has changed following the submission of the SD2 Infrastructure ESIA with a significant number of elements of the works associated with construction of buildings and facilities passed to the main SD2 Project contractor. The works anticipated to be completed by main SD2 Project contractor are described and assessed within this ESIA.

1.4.2 ESIA Team and Structure

The details of the SD2 Project ESIA Team are provided in Table 1.1.

Table 1.1 SD2 Project ESIA Team

Team Member	Role
URS	ESIA Project Manager and Lead Authors
Environmental and Social Advisory Services (ESAS)	Socio-Economic Specialists
The Social Consultancy	
Synergetics	Local Socio-Economic Specialists
ERM	Cultural Heritage
WRA	Hydrology Specialist
Genesis	Offshore Discharge and Oil Spill Modelling
Ilyas Babayev	Bird Specialist
Tariel Eybatov	Caspian Seal Specialist
Alun Lewis	Oil Spill Specialist
Mehman M. Akhundov	Fish Specialist
Peter Ward	Underwater Noise Specialist
KBR and JP Kenney	Project Engineering and Project Management Services Contractors
BP	SD Contract Area PSA Operator on behalf of SD PSA Partners

Table 1.2 provides a summary of the SD2 Project ESIA structure and content.

Table 1.2 Structure and Content of the ESIA

Section/Chapter		Content
Executive Summary		A summary of the ESIA
Units and Abbreviations		A list of the units and abbreviations used in the ESIA.
Glossary		A glossary of terms.
1	Introduction	An overview of SD2 Project, ESIA objectives, details of ESIA team members and ESIA Report structure.
2	Policy, Regulatory and Administrative Framework	A summary of applicable requirements from the SD PSA, ratified international conventions, International Petroleum Industry Standards and Practices, applicable national legislation and guidance, BP's Health Safety Security and Environment (HSSE) Policy and BP Group Define Practice (GDP) and Group Recommended Practice (GRP).
3	Impact Assessment Methodology	A description of the methodology used for the impact assessment.
4	Options Assessed	A description of the alternative concept options assessed for the SD2 Project. A summary of the initiatives and options assessed which aimed to avoid or reduce negative environmental and social impacts.
5	Project Description	A detailed description of the SD2 Project.
6	Environmental Description	A description of onshore, nearshore and offshore environmental conditions.
7	Socio-Economic Description	A description of onshore, nearshore and offshore socio-economic conditions.
8	Consultation and Disclosure	An overview of consultation activities undertaken during the ESIA programme and the issues and concerns raised.
9	Drilling and Completion Environmental Impact Assessment, Monitoring and Mitigation	An assessment of potential environmental impacts associated with drilling and completion SD2 Project activities.
10	Construction, Installation and HUC Environmental Impact Assessment, Monitoring and Mitigation	An assessment of potential environmental impacts associated with onshore, nearshore, subsea and offshore construction, installation and HUC SD2 Project activities.
11	Operations Environmental Impact Assessment, Monitoring and Mitigation	An assessment of potential environmental impacts associated with the operations phase of the SD2 Project.
12	Socio-Economic Impact Assessment, Monitoring and Mitigation	An assessment of potential socio-economic impacts associated with each phase of the SD2 Project activities.
13	Cumulative and Transboundary Impacts and Accidental Events	An assessment of potential cumulative and transboundary impacts and accidental events associated with the SD2 Project activities.
14	Environmental and Social Management	A summary of the environmental and social management system associated with the SD2 Project activities.
15	Residual Impacts and Conclusions	A summary of the residual impacts and conclusions arising from the ESIA process.
	Appendices	

2 Policy, Regulatory and Administrative Framework

Contents

List of Figures

List of Tables

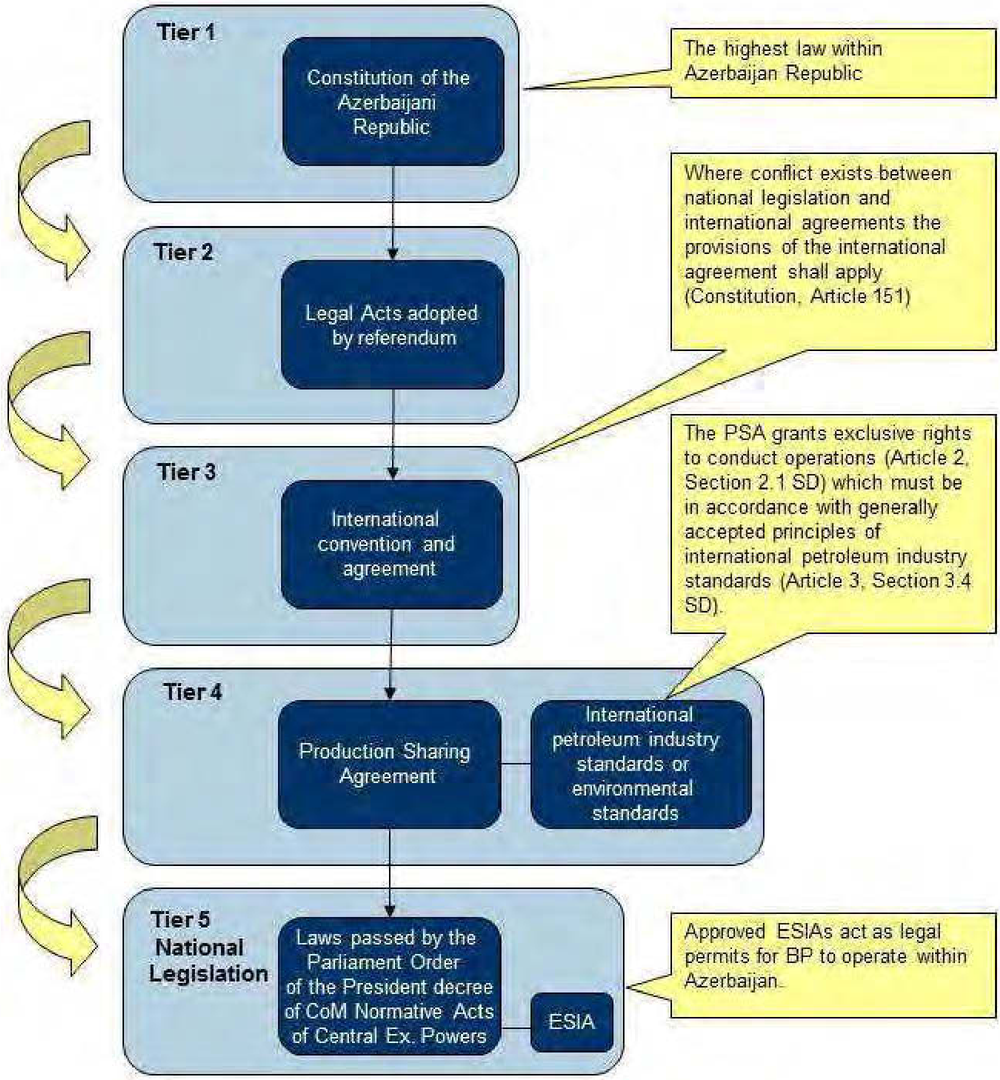
2.1 Introduction

This section provides an overview of the agreements, legislation, standards and guidelines which are applicable to the Shah Deniz 2 (SD2) Project including the following:

- SD Production Sharing Agreement (referred to herein as the "PSA");
- Applicable national legislation;
- Applicable requirements of international conventions ratified by the Azerbaijan government;
- International petroleum industry standards and practices; and
- BP's Health Safety Security and Environment (HSSE) Policy.

The legal hierarchy applicable to the SD2 Project is illustrated in Figure 2.1.

Figure 2.1 Azerbaijan Legal Hierarchy



In addition to the applicable legal requirements, the SD2 Project will be undertaken in accordance with BP Group, Segment and Regional standards. An overview of these is provided in Chapter 14.

2.2 The Constitution

The Constitution is the highest law in the Azerbaijan Republic and prevails over national legislation and international agreements. It stipulates the basic rights of people to live in a healthy environment, to have access to information on the state of the environment and to obtain compensation for damage suffered as the result of a violation of environmental legislation.

2.3 Production Sharing Agreement

The PSA establishes the legal regime for the joint development and production sharing of the Shah Deniz field. This agreement, signed by BP and its co-venturers as Contractor Parties (collectively referred to as the "Contractor") and the State Oil Company of Azerbaijan Republic (SOCAR) was entered into in Baku in June 1996. It was subsequently enacted into the law of the Republic of Azerbaijan after ratification by the Parliament on 17th October 1996. BP Exploration (Shah Deniz) Limited is acting as the Technical Operator for and on behalf of SD PSA participants in accordance with a Joint Operating Agreement and the Operator Services Agreement.

Article 26.2 of the PSA states:

"Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with the Environmental Standards to minimise any potential disturbance to the general environment, including without limitation the surface, subsurface, sea, air, lakes, rivers, animal life, plant life, crops, other natural resources and property".

Article 26.1 of the PSA states:

"Contractor shall develop jointly with SOCAR and the State Committee of the Azerbaijan Republic on Ecology and Control over the Use of Natural Resources ("SCE") safety and environmental protection standards and practices appropriate for the relations of Petroleum Operations"[1].

Article 26.1 also requires that in developing relevant standards and practices, environmental quality objectives, technical feasibility and economic and commercial viability must also be taken into account (refer to Appendix 2A for SD PSA extract) and further states:

"*Subject to the first sentence of Article 26.4 the standards, which shall apply to Petroleum Operations from Effective Date shall be the standards and practices set out in part II of Appendix 9 until substituted by new safety and environmental protection standards devised and agreed between Contractor, SOCAR and SCE on a date between the Parties and SCE and from such date such agreed standards and practices shall have the force of law as if set out in full in the Agreement".*

In response to the requirement under Article 26.1 of the PSA, SD specific Environmental Protection Standards (EPS) have been developed for production activities by a working group which included representatives from the Milli Majlis of Azerbaijan Republic, the Cabinet of Ministers of Azerbaijan Republic, experts from the Azerbaijan National Academy of Sciences, SOCAR and MENR. These were formally approved via signed letters from SOCAR and the MENR in 2008. The protocol for their entrance into legal force has been signed by BP on behalf of the SD partners and SOCAR, but has yet to be signed by the MENR. The following SD EPS documents for production activities have been developed:

- **SD EPS: Approval and Permitting** – details the permitting and approval process for SD projects and activities resulting in potential environmental impacts.

[1] The PSA defines petroleum operations as: "*all operations relating to the exploration, appraisal, development, extraction, production, stabilisation, treatment (including processing of natural gas), stimulation, injection, gathering, storage, handling, lifting, transporting petroleum to the delivery point and marketing of petroleum from, and abandonment operations with respect to the Contract Area*".

- **SD EPS: Environmental Planning and Environment** – provides an overview of environmental management requirements for SD projects.
- **SD EPS: Environmental Risk Assessment and Management** – details the EPS to be complied with by the Operator for the purposes of conducting Environmental Risk Assessments (ERA) associated with the execution of SD projects.
- **SD EPS: Standards for Environmental Quality** – details the preliminary Maximum Permissible Concentration (MPC) of pollutants which will be used as the basis for deriving EPS which will be applied to discharges and emissions to the environment.
- **SD EPS: Discharges and Emissions** – describes the EPS to be complied with by the Operator and all contractors involved in the execution of SD projects for the purpose of controlling emissions and discharges to the environment.
- **SD EPS: Chemical Selection and Management** – details the EPS to be complied with for the purposes of chemical selection and management by the Operator and all contractors involved in the execution of SD projects.
- **SD EPS: Condensate and Chemical Spill Contingency Planning** – details the EPS to be complied with by the Contractor and all Subcontractors involved in the execution of SD projects for the purposes of condensate and chemical spill contingency planning (CCSCP).
- **SD EPS: Waste Management** – details the EPS to be complied with by the Operator and all contractors involved in the execution of SD projects for the purposes of waste management to ensure waste will be managed in an environmentally safe manner from the site of waste generation to the point of final disposal.

Accordingly, until the protocol, on entrance into legal force of the Production Standards, has been signed by all of the parties, the standards and practices set out in part II of Appendix 9 to the PSA shall continue to apply to production activities.

Article 26.4 of the PSA requires “Contractor” (BP Exploration (Azerbaijan) Limited) to: *“ …comply with present and future Azerbaijani laws or regulations of general applicability with respect to public heath, safety and the protection and restoration of the environment, to the extent that such laws and regulations are no more stringent than the Environmental Standards”.*

Appendix 9 of the PSA describes the standards and practices common for international petroleum industry that were in existence when the PSA was signed.

2.4 International and Regional Environmental Conventions

Azerbaijan is signatory to numerous international and regional conventions that oblige the government to prevent pollution and protect specified habitats, flora and fauna. Those of relevance to the SD2 Project are listed in Tables 2.1 and 2.2.

Table 2.1 Summary of International Conventions

Convention	Purpose	Status
Bern Convention	Conservation of wild flora and fauna and their natural habitats.	In force in Azerbaijan since 2002.
UNESCO Convention on Wetlands of International Importance especially as Waterfowl Habitat / RAMSAR Convention	Promote conservation of wetlands and waterfowl. In addition, certain wetlands are designated as Wetlands of International Importance and receive additional protection.	Azerbaijan signed the Ramsar Convention in 2001.
Stockholm Convention on Persistent Organic Pollutants	Reduction in releases of dioxins, furans, hexachlorobenzene and PCBs with the aim of minimisation or elimination.	Azerbaijan acceded in 2004.
International Convention for the Prevention of Pollution from Ships/ Vessels (MARPOL), 1973 as amended by the protocol, 1978	The legislation giving effect to MARPOL 73/78 in Azerbaijan is the Protection of the Sea (Prevention of Pollution from Ships) Act 1983. Preventing and minimising pollution of the marine environment from ships - both accidental pollution and that from routine operations.	Azerbaijan acceded in 2004.
UN Convention on the Protection of the Ozone Layer (Vienna Convention)	Framework for directing international effort to protect the ozone layer, including legally binding requirements limiting the production and use of ozone depleting substances as defined in the Montreal Protocol to the Convention. Supported by the Montreal Protocol and amendments (see below).	Azerbaijan acceded in 1996.
Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	Specific requirements for reductions in emissions of gases that deplete the ozone layer. Amended four times: London 1990, Copenhagen 1992, Montreal 1997 and Beijing 1999.	Azerbaijan acceded in 1996.
United Nations Framework Convention on Climate Change, 1992	Seeks to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, within a sufficient time frame to allow ecosystem to adapt naturally, protect food production and enable sustainable economic development.	Azerbaijan acceded in 1992 and not formally required to meet specific reduction targets.
Kyoto Protocol, 1997	Follow on from the Framework Convention on Climate Change.	Azerbaijan acceded in 2000.
UN Convention on Biological Diversity, 1992	Conservation of biological diversity including the sustainable use of its components and the fair and equitable sharing of benefits.	Azerbaijan became party to the Convention in 2000.
International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990	Seeks to develop further measures to prevent pollution from ships.	Azerbaijan acceded in 2004.
FAO Plant Protection Convention	A treaty to prevent the spread and introduction of pests of plants and plant products and to promote measures for their control.	Entered into force in Azerbaijan in 2000.
Convention to Combat Desertification	To combat desertification and mitigate the effects of drought.	Entered force in Azerbaijan in 1998.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Controls trade in selected species of plant and animals.	Entered into force in Azerbaijan in 1999.
Convention for the Protection of the Archaeological Heritage of Europe	Requires each state party to support archaeological research financially and promote archaeology, using public or private funding.	Azerbaijan ratified in 2000.

Convention	Purpose	Status
Basel Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposals	Seeks to control and reduce transboundary movements of hazardous wastes, minimise the hazardous wastes generated, ensure environmentally sound waste management and recovery practices and assist developing countries in improving waste management systems.	Azerbaijan ratified in 2001.
UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions	Promotes participants' right to formulate and implement their cultural policies and to adopt measures to protect and promote the diversity of cultural expressions and to strengthen international cooperation.	Azerbaijan acceded in 2010.

Table 2.2 Summary of Regional Conventions

Convention	Purpose	Status
Aarhus Convention*	To guarantee the rights of access to information, public participation in decision-making and access to justice in environmental matters.	Azerbaijan acceded in 2000.
Espoo Convention*	To promote environmentally sound and sustainable development through the application of ESIA, especially as a preventive measure against transboundary environmental degradation.	Azerbaijan acceded in 1999 and at the time of writing, Azerbaijan had not signed a related protocol on Strategic Environmental Assessment.
Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Convention)*	To prevent, control or reduce transboundary impact resulting from the pollution of transboundary waters by human activity.	Azerbaijan acceded in 2002.
UN Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposals	Regulates the transboundary movements of hazardous wastes and provides obligations to its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner.	Azerbaijan ratified in 2001.
Protocol on Water and Health*	To protect human health and well-being by better water management and by preventing, controlling and reducing water-related diseases.	Azerbaijan acceded in 2003.
UNECE Geneva Convention on Long-range Transboundary Air Pollution*	Provides a framework for controlling and reducing transboundary air pollution.	Entered into force in Azerbaijan in 2002. Has been extended by 8 protocols, none of which at the time of writing have been ratified by Azerbaijan.
International Carriage of Dangerous Goods by Road*	Provides requirements for the packaging and labelling of dangerous goods and the construction, equipment and operations of transportation vehicles. Annexes provide detailed technical requirements.	Entered into force in Azerbaijan in 2000.
Convention on the Transboundary Effects of Industrial Accidents*	To prevent industrial accidents that may have transboundary effects and to prepare for and respond to such events.	Azerbaijan acceded in 2004.
Tehran-Caspian Framework Convention	Ratified by all five littoral states and entered into force in 2006. Requires member states to take a number of generic measures to control pollution of the Caspian Sea. Four protocols have been drafted which will, when adopted, form the basis for national legislation and regulations.	Convention is ratified, but protocols are at the time of writing still in draft form and do not therefore at present provide a binding basis for the development of legislation.

* A UNECE agreement; Azerbaijan became a member of the UNECE in 1993. The major aim of the UNECE is to promote pan-European integration through the establishment of norms, standards and conventions.

2.5 National Environmental Legislation

The Azerbaijan Government has committed to a process to align national environmental legislation with the principles of internationally recognised legislation, based on EU environmental legislation. As this process is on-going, the SD2 Project will comply with the intent of current national legal requirements where those requirements are consistent with the provisions of the PSA, and do not contradict, or are otherwise incompatible with, international petroleum industry standards and practice.

The framework for national environmental legislation in Azerbaijan is provided by the Law on the Protection of the Environment (1999), which addresses the following issues:

- The rights and responsibilities of the State, the citizens, public associations and local authorities;
- The use of natural resources;
- Monitoring, standardisation and certification;
- Economic regulation of environmental protection;
- State Ecological Expertise (SEE);
- Ecological requirements for economic activities;
- Education, scientific research, statistics and information;
- Ecological emergencies and ecological disaster zones;
- Control of environmental protection;
- Ecological auditing;
- Responsibility for the violation of environmental legislation; and
- International cooperation.

According to Article 54.2 of the Law on Protection of the Environment, EIAs are subject to SEE, which means that the environmental authority (MENR) is responsible for the review and approval of EIA reports submitted by developers. The Law establishes the basis for the SEE procedure, which can be seen as a “stand-alone” check of compliance of the proposed Project with the relevant environmental standards (e.g. for pollution levels, discharges and noise). In addition the law determines that projects cannot be implemented without a positive SEE resolution.

The SEE approach requires state authorities to formally verify all submitted developments for their potential environmental impacts. Current internationally recognised practice emphasises a proportionate, consultative and publicly accountable approach to assessing impacts.

Table 2.3 provides a summary of the key national environmental and social laws.

Table 2.3 Key National Environmental and Social Laws[2]

Subject	Title	Date	Description / Relevance to SD2 Project ESIA
General	Law of Azerbaijan Republic on the Protection of the Environment No. 678-IQ.	08/06/1999 (last amendment 30/09/2009)	Establishes the main environmental protection principles and the rights and obligations of the State, public associations and citizens regarding environmental protection (described above).
	Law of Azerbaijan Republic on Ecological Safety No. 677-IQ.	08/06/1999 (last amendment 07/12/2007)	One of two keystone laws of the country's environmental legislation (along with the *Law on the Protection of the Environment*). Its purpose is to establish a legal basis for the protection of life and health, society, the environment, including atmospheric air, space, water bodies, mineral resources, natural landscapes, plants and animals from natural and anthropogenic dangers. The Law assigns the rights and responsibilities of the State, citizens and public associations in ecological safety, including information and liability. The Law also deals with the regulation of economic activity, territorial zoning and the alleviation of the consequences of environmental disasters.
Ecosystems	Law of the Azerbaijan Republic on Specially Protected Natural Territories and Objects No. 840-IQ.	24/03/2000	Determines the legal basis for protected natural areas and objects in Azerbaijan.
	Law of Azerbaijan Republic on Fauna No. 675-IQ.	04/06/1999	Defines the animal world, property rights over fauna and legal relationships between parties. It also describes issues of State inventory and monitoring, and economic and punitive regulations.
Water	Water Code of Azerbaijan Republic (approved by Law No. 418-IQ).	26/12/1997	Regulates the use of water bodies, sets property rights and covers issues of inventory and monitoring. The Code regulates the use of water bodies for drinking and service water and for medical treatment, spas, recreation and sports, agricultural needs, industrial needs and hydro energy, transport, fishing and hunting, discharge of waste water, fire protection and specially protected water bodies. It provides for zoning, maximum allowable concentrations of harmful substances and basic rules of industry conduct.
	Law of the Azerbaijan Republic on Water Supply and Wastewater No. 723-1Q.	28/10/1999	Applicability limited to onshore operations. Restricts industrial waste releases into the sewage system; requires segregation of stormwater and industrial wastes from sewage, and requires legal entities to acquire permissions to operate sewage treatment plant.
	Rules of Referral of Specially Protected Water Objects to Individual Categories, Cabinet of Ministers Decree No. 77.	01/05/2000	The Caspian Sea is a specially protected water body. This resolution requires special permits for disposal if there are no other options for wastewater discharge. The resolution allows for restrictions to be placed on the use of specially protected water bodies, and for further development of regulations related to these water bodies. It requires consent from MENR for activities that modify the natural conditions of specially protected water bodies, and includes provisions for permitting of any discharges to water that cannot be avoided. There are also special requirements for the protection of water bodies designated for recreational or sports use (which includes the Caspian).

[2] This table is compiled from a variety of sources including: United Nations 2004, Environmental Performance Reviews Series No. 19 – Azerbaijan; Currie & Brown, 2008, Integrated Solid Waste Management System for the Absheron Peninsula Project, and Popov 2005, Azerbaijan Urban Environmental Profile (an ADB Publication).

Subject	Title	Date	Description / Relevance to SD2 Project ESIA
	Rules for Protection of Surface Waters from Waste Water Pollution, State Committee of Ecology Decree No. 1.	04/01/1994	Under this legislation the *Permitted Norms of Harmful Impact Upon Water Bodies of Importance to Fisheries* require discharges to meet several specified standards for designated water bodies in terms of suspended solids; floating matter; colour, smell and taste; temperature; dissolved oxygen; pH; Biological Oxygen Demand (BOD) and poisonous substances. Limits are based on Soviet era standards and are to be achieved at the boundary of the facility (specific "sanitary protection zone limits") rather than "end-of-pipe" limits. End of pipe limits are defined in facility-specific "eco-passports" and are established with the intent to ensure compliance with applicable ambient standards.
Air	Law of Azerbaijan Republic on Air Protection No. 109-IIQ.	27/03/2001	Establishes the legal basis for the protection of air, thus implementing the constitutional right of the population to live in a healthy environment. It stipulates the rights and obligations of the authorities, legal and physical persons and non-governmental organisations (NGOs) in this respect, sets general requirements for air protection during economic activities, establishes norms for mitigating physical and chemical impacts to the atmosphere, establishes rules for the State inventory of harmful emissions and their sources and introduces general categories of breaches of the Law that will trigger punitive measures.
	Methodology to Define Facilities' Hazards Categories Subject to Hazardous Substance Emissions Levels and Need to Develop Projects' Maximum Permissible Emissions (MPEs).	04/09/1990	Under this methodology the maximum permissible concentrations of harmful substances and their hazard classes are provided. Limits are based on Soviet era standards.
Waste	Law of Azerbaijan Republic on Industrial and Domestic Waste No. 514-IQ.	30/06/1998	Describes State policy in environmental protection from industrial and household waste including harmful gases, waste water and radioactive waste. It defines the rights and responsibilities of the State and other entities, sets requirements for the design and construction of waste-treatment installations, licensing of waste generating activities, and for the storage and transport of waste (including transboundary transportation). The Law also encourages the introduction of technologies for the minimisation of waste generation by industrial enterprises. There is a general description of responses to infringements. This law is specified by Resolutions of the Cabinet of Ministers on the rules of certification of hazardous wastes, state strategy on management of hazardous wastes in Azerbaijan and by Instructions on the Inventorisation Rules and Classification System of the Wastes generated by Industrial Processes and In the Field of Services approved by the MENR.
Subsurface	Law of the Azerbaijan Republic on Subsurface Resources No. 439-IQ.	13/02/1998	Regulates the exploitation, rational use, safety and protection of subsurface resources and the Azerbaijani sector of the Caspian Sea. The Law lays down the principal property rights and responsibilities of users. It puts certain restrictions on the use of mineral resources, based on environmental protection considerations, public health and economic interests.
Information	Law of the Azerbaijan Republic on Access to Environmental Information No. 270-IIQ.	12/03/2002	Establishes the classification of environmental information. If information is not explicitly classified "for restricted use" then it is available to the public. Procedures for the application of restrictions are described. Law aims to incorporate the provisions of the Aarhus Convention into Azeri Law.
Community Heath & Safety	Law on Sanitary-Epidemiological Services (authorised by Presidential Decree No. 371).	10/11/1992	Establishes sanitary and epidemiological requirements for industrial entities to be met at design, construction and operational stages, and for other economic activities. Aims to protect the health of the population. It addresses the rights of citizens to live in a safe environment and to receive full and free information on sanitary-epidemic conditions, the environment and public health.
	Law of the Azerbaijan Republic on Protection of Public Health No. 360-IQ.	26/06/1997	Sets out the basic principles of public health protection and the health care system. The Law assigns liability for harmful impact on public health, stipulating that damage to health that results from a polluted environment shall be compensated by the entity or person that caused the damage.

Subject	Title	Date	Description / Relevance to SD2 Project ESIA
	Law of the Azerbaijan Republic on Public Radiation Safety No. 423-IQ.	30/12/1997	Includes requirements for ensuring radiation safety in industrial entities. The Law establishes the main principles of government policy on radiation safety, as well as environmental norms protecting the safety of employees and populations in areas potentially affected by the use of radioactive sources. The Law provides for compensation for damage to health, property and life due to accidents.
	Rules of Filing and Consideration of Applications for Withdrawal of Plots of Land, Allocation of Plots of Land for State and Public Purposes, Resolution No. 42 on Certain Normative-Legal Acts related to the Land Code of the Azerbaijan Republic.	15/03/2000	Identifies process of applying for withdrawal and allocation of plots of land for state and public purposes, including construction of industrial facilities and pipelines.
	State Standard for Stationary Equipment State Committee of Metrology and Standardisation of USSR as GOST 27409-87- from 1987-07-01.	01/07/1987	Includes noise level limitations for the operation of stationary equipment.
Liability	Law on Mandatory Insurances.	24/06/2011	Identifies requirements for the mandatory insurance of civil liability for damage caused to life, health, property and the environment resulting from accidental environmental pollution.
Permitting	A System of Standards for the Environment Protection and Improvement of Natural Resources Utilisation. Industrial Enterprise Ecological Certificate Fundamental Regulations, GOST 17.0.0.04-90.	01/07/1990	The MENR issues ecological documents on the impact on the environment of potentially polluting enterprises. The documents include maximum allowable emissions, maximum allowable discharges, and an "ecological passport." The last item is specific to countries of the Former Soviet Union and contains a broad profile of an enterprise's environmental impacts, including resource consumption, waste management, recycling, and the effectiveness of pollution treatment. Enterprises develop the draft passport themselves and submit it to MENR for approval.
Cultural heritage	Law on the Protection of Historical and Cultural Monuments.	1998	Specifies the responsibilities of state and local authorities, and lays down principles for the use, study, conservation, restoration, reconstruction, renovation and safety of monuments. The Law declares that cultural objects with national status, historical and cultural monuments, cultural goods stored in state museums, archives, libraries, as well as the territories where they are situated, are not subject to privatisation. Requires archaeological studies prior to construction works in areas with archaeological significance.

2.5.1 National EIA Guidance

Guidance on the EIA process in Azerbaijan is provided in the Handbook for the Environmental Impact Assessment Process in Azerbaijan. The Handbook introduces the main principles of the 'western'-type EIA process and details:

- The EIA process, i.e. the sequence of events and the roles and responsibilities of applicants and Government institutions;
- The purpose and scope of the EIA document;
- Public participation in the process;
- Environmental review decision (following its submission to the MENR, the ESIA document is reviewed for up to three months by an expert panel); and
- The appeal process.

A summary of the guidance provided in the Handbook is given in Table 2.4 below.

The approval of an EIA by the MENR establishes the compliance framework, including the environmental and social standards that an organisation should adhere to.

Table 2.4 Summary of Guidance on the EIA Process in Azerbaijan[3]

Screening	The developer is required to submit an Application (containing basic information on the proposal) to MENR to determine whether an EIA is required.
Scoping	Requirement for a Scoping Meeting to be attended by the developer, experts and concerned members of the public, and aimed at reaching a consensus on the scope of the EIA.
Project Description	Full description of technological process and analysis of what is being proposed in terms of planning, pre-feasibility, construction and operation.
Environmental Studies	Requirement to describe fully the baseline environment at the site and elsewhere, if likely to be affected by the proposal. The environment must be described in terms of its various components – physical, ecological and social.
Consideration of Alternatives	No requirement to discuss Project alternatives and their potential impacts (including the so-called "do-nothing" alternative), except for the description of alternative technologies.
Impact Assessment and Mitigation	Requirement to identify all impacts (direct and indirect, onsite and offsite, acute and chronic, one-off and cumulative, transient and irreversible). Each impact must be evaluated according to its significance and severity and mitigation measures provided to avoid, reduce, or compensate for these impacts.
Public Participation	Requirement to inform the affected public about the planned activities twice: when the application is submitted to the MENR for the preliminary assessment and during the EIA process. The developer is expected to involve the affected public in discussions on the proposal.
Monitoring	The developer is responsible for continuous compliance with the conditions of the EIA approval through a monitoring programme. The MENR undertakes inspections of the implementation of activities in order to verify the accuracy and reliability of the developer's monitoring data. The developer is responsible for notifying the MENR and taking necessary measures in case the monitoring reveals inconsistencies with the conditions of the EIA approval.

[3] Source: based on a review of the EIA Handbook and "EIA in the New Oil and Gas Projects in Azerbaijan", Parviz, 2005.

2.6 Regional Processes

2.6.1 European Union

EU relations with Azerbaijan are governed primarily by the EU-Azerbaijan Partnership and Cooperation Agreement (PCA) and the European Neighbourhood Policy (ENP).

The PCA entered into force in 1999. Under Article 43:

"The Republic of Azerbaijan should endeavour to ensure that its legislation will be gradually made compatible with that of the Community".

As part of the PCA an EU assessment of Azerbaijan's environmental legislation against EU Directives identified a number of recommendations for the approximation of national legislation with EU Directives[4]. Based on this, a draft national programme was developed that emphasises a flexible approach to amending national legislation to take account of institutional capacity and cost[5].

Following the enlargement of the European Union, the EU launched the ENP and Azerbaijan became part of this policy in 2004. The current National Indicative Programme for implementing the ENP[6] includes a commitment to support legislative reform in the environmental sector, including:

- Approximation of Azerbaijan's environmental legislation and standards with the EU's;
- Strengthening management capacity through integrated environmental authorisation;
- Improved procedures and structures for environmental impact assessment; and
- Development of sectoral environmental plans (waste and water management, air pollution, etc.).

2.6.2 Environment for Europe

Environment for Europe[7] is a partnership of member states, including Azerbaijan, and other organisations within the UNECE region. Under the auspices of the Environment for Europe a series of ministerial conferences on the environment have been held that have resulted in the establishment of the UNECE conventions described in Section 2.4.

2.7 International Petroleum Industry Standards and Practices

SD related activities are required to comply with national legislation with respect to public health, safety and protection and restoration of the environment where it is no more stringent than the Environmental Standards (SD PSA Article 26.4). Industry standards including those of the Oil Industry International Exploration and Production Forum (E&P Forum), the International Association of Geophysical Contractors (IAGC) and the International Association of Drilling Contractors (IADC) were specifically mentioned in the SD PSA.

The Convention for the Protection of the Marine Environment of the North-East Atlantic[8] (the "OSPAR Convention) is of relevance to SDII offshore activities and in particular to the regulation of chemicals.

4 Mammadov, A. & Apruzzi, F. (2004) Support for the Implementation of the Partnership Cooperation Agreement between EU-Azerbaijan. Scoreboard Report on Environment and Utilisation of Natural Resources. Report prepared for TACIS.

5 SOFRECO (undated) Support for the Implementation of the PCA between EU-Azerbaijan, Draft Programme of legal Approximation.

6 NIP (2007) European Neighbourhood and Partnership Instrument, Azerbaijan National Indicative Programme.

7 UNECE (2008) Environment for Europe (http://www.unece.org/env/efe/welcome.html).

8 Formed by 5 regions – Arctic Waters, Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, and the Wider Atlantic: http://www.ospar.org/content/regions.asp?menu=00020200000000_000000_000000.

2.7.1 OSPAR Guidelines

The Convention for the Protection of the Marine Environment of the North-East Atlantic[9] (the "OSPAR Convention") was developed from the 1972 Oslo Convention on dumping waste at sea and the 1974 Paris Convention on land-based sources of marine pollution. It was signed on 22 September 1992 by all of the Contracting Parties to the original Oslo or Paris Conventions and by Luxembourg and Switzerland. After ratification it entered into force on 25 March 1998 at the Ministerial Meeting of the parent Conventions.

2.7.2 Harmonised Mandatory Control System and REACH

The OSPAR Decision 2000/2 on the Harmonised Mandatory Control System (HMCS) for the Use and Reduction of the Discharge of Offshore Chemicals is the basis for regulating the use of chemicals by the North Sea offshore oil and gas industry.

The common framework outlined in OSPAR Decision 2000/2 has been incorporated into the national legislation of the contracting parties to OSPAR and each country has its own regulatory scheme to implement OSPAR Decisions and Recommendations.

In addition to the OSPAR Decisions and Recommendations, in 2006 the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) (EC 1907/2006) Regulation came into force. The OSPAR and REACH systems will initially run in parallel, with the HMCS gradually being harmonised with the obligations of the REACH Regulation[10].

2.7.3 Harmonised Offshore Chemical Notification Format

The HMCS requires the completion of a standard form known as the Harmonised Offshore Chemical Notification Format or HOCNF, which is described in Recommendation 2010/4.

The HOCNF requires details of the chemical composition, the environmental properties of the products including toxicity to aquatic organisms and the fate and effects of component substances, together with how the chemical will be applied with information on the quantities to be used and discharged.

Only substances which appear on the PLONOR List (Pose Little Or NO Risk to the environment and their environmental effects are considered to be well known) are not required to be tested as described above.

Once the HOCNF is submitted, the data are evaluated against the Pre-Screening Scheme, which is designed to eliminate, or require the substitution of chemicals which are highly persistent, highly toxic, or which have high bioaccumulation potential.

CHARM provides a standardised methodology for assessing the environmental hazard of a product. A hazard quotient is calculated, which is based on the ratio of:

- the predicted environmental concentration of a product or substance at a distance of 500m from a discharge (PEC) to:
- the predicted no-effect concentration (PNEC) for that product or substance, derived by applying a safety factor of 10 (for short duration discharges) or 100 (for continuous releases) to the 'most sensitive' results of toxicity testing.

[9] Formed by 5 regions – Arctic Waters, Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, and the Wider Atlantic: http://www.ospar.org/content/regions.asp?menu=00020200000000_000000_000000.
[10] https://www.og.decc.gov.uk/environment/reach/reach_reg.htm

2.7.4 Ecotoxicological Hazard Assessment

BP has adopted the OSPAR principles as the basis for chemical selection and discharge evaluation in its Caspian operations. The principles have been embedded in:

- The Draft SD EPS: Standards for Environmental Quality and Emissions and Discharges (refer to Section 2.4 above); and
- Routine assessment of chemicals and discharges associated with the SD and Azeri-Chirag-Gunashli (ACG) Projects.
- BP AGT procedures for chemical selection and environmental risk assessment.

The selection of chemicals is restricted to those which have passed the OSPAR screening process (i.e., those which are already on a national approved list, or which have been separately and independently subjected to the screening process)

The process implemented by BP is more location-specific and application-specific than the OSPAR/CHARM approach:

- Toxicity tests are conducted, preferably using Caspian species, and Caspian seawater;
- To complement the HOCNF data available for the components of candidate products, these tests are conducted on the whole, formulated product rather than on the component substances;
- Each release or discharge scenario is subject to site-specific dispersion modelling, and on detailed release scenarios;
- The limit of the mixing zone is determined by the point at which the hazard quotient equals 1 i.e., the ‘point of protection’ (in contrast, the OSPAR/CHARM process accepts hazard quotients of >1); and
- The significance and acceptability of the estimated mixing zone is assessed using detailed information on the characteristics and sensitivity of the receiving environment in the vicinity of the release.

The results of hazard assessments form the basis on which the national regulatory authorities are informed and consulted, and the basis on which many discharge approvals have been granted.

3 Impact Assessment Methodology

Contents

List of Figures

List of Tables

3.1 Introduction

This Chapter presents a description of the Environmental and Socio-Economic Impact Assessment (ESIA) process adopted for the Shah Deniz 2 (SD2) Project and the methodology used to assess impact significance.

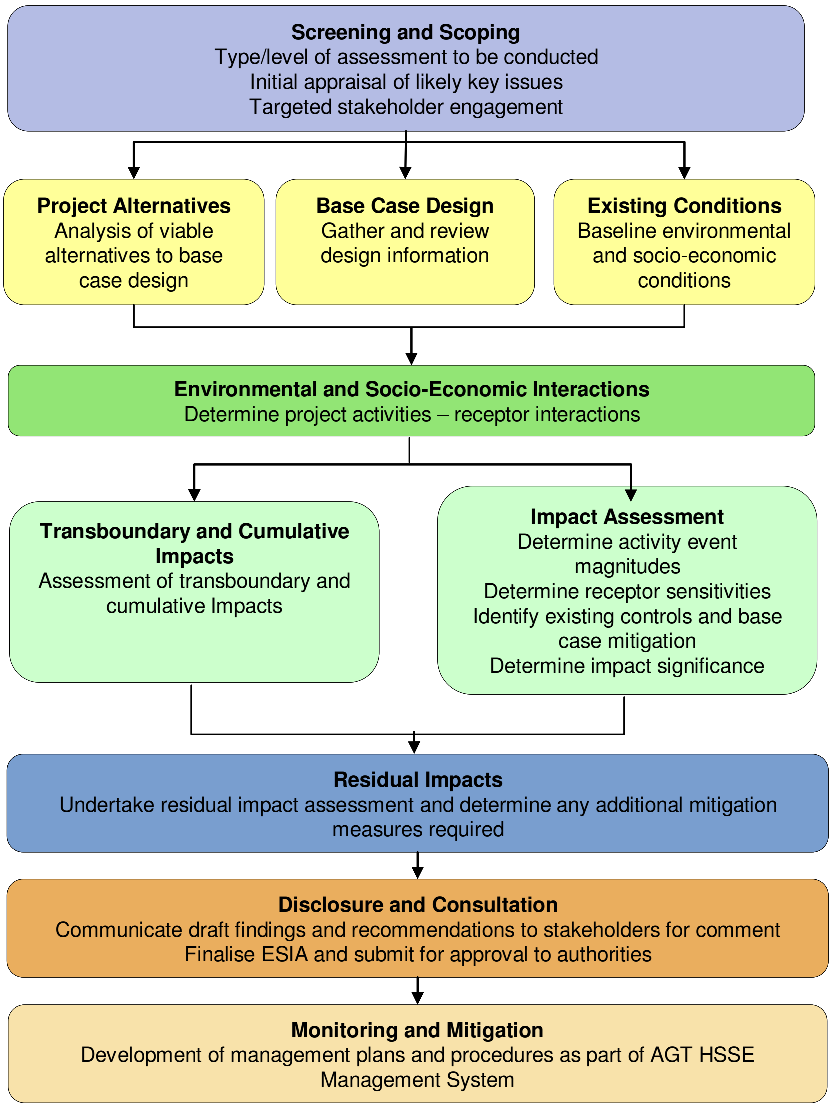
3.2 ESIA Process

The ESIA process constitutes a systematic approach to the evaluation of a project and its associated activities throughout the project lifecycle. The process (refer to Figure 3.1) includes:

- Screening and Scoping;
- Project Alternatives and Base Case Design;
- Existing Environmental and Socio-Economic Conditions;
- Impact Assessment;
- Residual Impact Identification;
- Disclosure and Stakeholder Consultation; and
- Mitigation and Monitoring;

The purpose of stakeholder consultation is to obtain the views and opinions of potentially affected people and other interested parties. Stakeholder feedback was used to focus the impact assessment and, where appropriate, influence project design and execution.

Figure 3.1 The ESIA Process



3.2.1 Screening and Scoping

Screening is the first step in the assessment process. It confirms the need (or otherwise) for an ESIA by appraising the type of project and its associated activities throughout the project lifecycle in the context of its biophysical, socio-economic, policy and regulatory environments.

Given the location, scale and planned activities associated with the SD2 Project, it was agreed with the Ministry of Ecology and Natural Resources (MENR) that the project should be subject to an ESIA, and the ESIA should take account of applicable national and international legislation, SD Production Sharing Agreement (PSA) and BP standards as detailed in Chapter 2: Policy, Regulatory and Administrative Framework.

Scoping is a high level assessment of anticipated "interactions" between project activities and environmental "receptors". Its purpose is to focus the assessment on key issues and eliminate certain activities from the full impact assessment process based on their limited potential to result in discernable impacts. To arrive at a conclusion to 'scope out' an activity/event, a mixture of expert scientific judgement based on prior experience of similar activities and events and, in some instances, scoping level quantification/numerical analysis (e.g. emission and discharge modelling) is used.

The SD2 Project Scoping process has included:

- Review of existing environmental and socio-economic data and reports relevant to the project activities; and
- Liaison with the SD2 Design Team to gather data and to formulate an understanding of project activities.

Based on the findings and results of these reviews, investigations and consultations, the following were identified:

- Potential project related environmental and socio-economic impacts based on likely interactions between SD2 Project activities and environmental/socio-economic receptors; and
- Gaps where the extent, depth and/or quality of environmental, socio-economic and/or technical data is insufficient for the SD2 Project ESIA process, thus identifying the additional work required to complete the ESIA.

3.2.2 Project Alternatives and Base Case Design

3.2.3.1 Project Alternatives

The initial step in defining a project is to identify, at a conceptual level, viable alternatives to the project so that a SD2 Base Case Design may be realised. Consideration of project alternatives occurs at two levels:

- To the development as a whole, including the "no development" option, and
- Engineering alternatives within the selected project's concept design definition.

Project alternatives were defined during the early conceptual design of the SD2 Project and were compared on financial, technical design, safety, environmental and socio-economic criteria. The alternative that represented the best balance with regard to criteria was taken forward to the subsequent detailed design stage.

Chapter 4: Options Assessed presents a summary of the alternative designs considered and options evaluated for the SD2 Project.

3.2.3.2 Project Design

The SD2 ESIA Team worked with the SD2 Design Team to gather and interpret relevant information for the ESIA. This dialogue between the teams identified where additional project design definition, in terms of existing controls and additional mitigation measures, was required in the SD2 Base Case Design to minimise impacts. Opportunities identified for environmental and socio-economic enhancements were considered by the teams and incorporated into the SD2 Base Case Design where appropriate and practicable.

The SD2 Base Case Design, on which the SD2 Project ESIA is based, is presented in Chapter 5: Project Description.

3.2.3 Existing Conditions

In order to identify potential impacts to receptors, an understanding of the existing conditions was established prior to execution of project activities. The SD2 Project ESIA Scoping exercise determined that the project will likely result in impacts on the following receptor groups:

- Biological/Ecological;
- Physical Receptor/Feature;
- Soil, Ground Water and Surface Water Quality; and
- Socio-Economic/Human.

A number of environmental and socio-economic surveys have been undertaken within the SD Contract Area, along the proposed SD2 pipeline corridor, within Sangachal Bay and in vicinity of the Sangachal Terminal to support the preparation of the previous Azeri-Chirag-Guneshli (ACG) and SD ESIAs. Monitoring has also been undertaken from 2004 as part of the Environmental Monitoring Programme (EMP).

Onshore environmental surveys completed in the vicinity of the Terminal include noise, odour, visual context and light surveys, dust, a contamination survey, wetland characterisation survey, geotechnical, hydrological and cultural heritage baseline surveys. Meteorological and hydrological data was provided by the Baku State University National Hydrometeorological Department, and the Institute of Geography at the National Academy of Sciences of the Azerbaijan Republic, respectively.

The following reviews were completed in liaison with Azerbaijani academics from the Azerbaijan National Academy of Sciences to provide additional data:

- A literature review of migratory/overwintering birds for the Absheron-Pirallahi coastline;
- A review of fishing activities within the Azerbaijan sector of the Caspian Sea; and
- A review of published studies on the activity and distribution of Caspian Seal within the Caspian Sea.

Data on national and regional socio-economic conditions was obtained from a review of secondary data provided by the State Statistical Committee and Garadagh District Executive Power. Data on local socio-economic conditions was taken from a Stakeholder and Socio-Economic Survey (SSES) completed in 2011 within communities located in the vicinity of the Terminal (Sangachal Town, Azim Kend, Masiv 3 and Umid).

The results of the environmental and socio-economic surveys were used to prepare Chapter 6: Environmental Description and Chapter 7: Socio-Economic Description presented in this ESIA.

3.2.4 Impact Significance Assessment

An impact, as defined by the international standard ISO14001:2004 is:

"Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects"

Where *"environmental aspect"* is defined as:

"Element of an organisation's activities or products or services that can interact with the environment".

An impact is defined where an interaction occurs between a project activity and an environmental receptor. The ESIA process ranks impacts according to their "significance" determined by considering project activity "event magnitude" and "receptor sensitivity". Determining event magnitude requires the identification and quantification (as far as practical) of the sources of potential environmental and socio-economic effects from routine and non-routine project activities. Determining receptor environmental sensitivity requires an understanding of the biophysical environment.

The sections below set out the methodology for both environmental and socio-economic impact assessment.

3.2.5 Environmental Impacts

3.2.5.1 Method for Determining Event Magnitude

Event magnitude is determined based on the following parameters, which are equally weighted and are each assigned a rating of "1", "2", or "3":

- **Extent** / **Scale**: Events range from those affecting an area:

    1 – Up to 500m from the source or an area less than 50 hectares; to
    2 – Greater than 500m and up to 1km from the source or an area between 50-100 hectares; to
    3 – Greater than 1km from the source or an area greater than 100 hectares.

- **Frequency**: Events range from those occurring:

    1 - Once; to
    2 - Up to 50 times; to
    3 - More than 50 times or continuously.

- **Duration**: Events range from those occurring for:

    1 – Up to one week; to
    2 - More than one week and up to one month; to
    3 - Periods longer than one month to permanent.

- **Intensity**: Concentration of an emission or discharge with respect to standards of acceptability that include applicable legislation and international guidance, its toxicity or potential for bioaccumulation, and its likely persistence in the environment. Degree/permanence of disturbance or physical impact (e.g. disturbance to species, loss of habitat or damage to cultural heritage). Ranges from:

    1 - A low intensity event; to
    2 - A moderate intensity event; to
    3 - A high intensity event.

Overall event magnitude is scored from low (1) to high (12) by adding the individual parameter scores:

Resulting individual ratings are summed to give the overall event magnitude ranking. Table 3.1 presents the score ranges for magnitude rankings of "Low", "Medium" and "High".

Table 3.1 Event Magnitude Rankings

Event Magnitude	Score (Summed Parameter Rankings)
Low	4
Medium	5-8
High	9-12

3.2.5.2 Method for Determining Receptor Sensitivity

Receptor sensitivity is determined based on the following parameters, which are equally weighted and are each assigned a rating of "1", "2", or "3":

- **Biological/Ecological Receptors:**

  – ***Presence***: Ranges from:

    3 - Routine, regular or reliably predictable presence of any species which is, in reverse order, a unique, threatened or protected species; to
    2 - Regionally rare or largely confined to the SD2 Project area or sensitive to industry emissions /disturbances; to
    1 - A species which is none of the above and is therefore assessed at the community level only.

  – ***Resilience (to the identified stressor)***: Ranges from:

    1 - Species or community unaffected or marginally affected; to
    2 - Species undergoing moderate but sustainable change which stabilises under constant presence of impact source, with ecological functionality maintained; to
    3 - Substantial loss of ecological functionality (e.g. loss of species in key groups, substantially lower abundance and diversity).

- **Human Receptor:**

  – ***Presence:*** Ranges from:

    3 - People being permanently present (e.g. residential property) in the geographical area of anticipated impact; to
    2 - People being present some of the time (e.g. commercial property); to
    1 - People being uncommon in the geographical area of anticipated impact.

  – ***Resilience (to the identified stressor):*** Ranges from:

    1 - People being least vulnerable to change or disturbance (i.e. ambient conditions (air quality, noise) are well below applicable legislation and international guidance); to
    2 - People being vulnerable to change or disturbance (i.e. ambient conditions (air quality, noise) are below adopted standards); to
    3 - Most vulnerable groups (i.e. ambient conditions (air quality, noise) are at or above adopted standards).

- **Physical Receptor/Feature:**

  – ***Presence (to the identified stressor):*** Ranges from:

  3 - Presence of feature any species which has, in reverse order, national or international value (e.g. state protected monument); to
  2 – Feature with local or regional value and is sensitive to disturbance; to
  1 - Feature which is none of the above.

  – ***Resilience (to the identified stressor):*** Ranges from:

  1 – Feature/receptor is unaffected or marginally affected i.e. resilient to change;
  2 – Undergoes moderate but sustainable change which stabilises under constant presence of impact source, with physical integrity maintained; and
  3 – Highly vulnerable i.e. potential for substantial damage or loss of physical integrity.

- **Soil, Ground Water and Surface Water**

  – ***Presence:*** Ranges from:

  3 – Receptor is highly valued e.g. used extensively for agriculture, used as a public water supply; to
  2 – Receptor has moderate value e.g. moderate/occasional use for agriculture purposes; to
  1 – Receptor has limited or no value.

  – ***Resilience (to the identified stressor):*** Ranges from:

  1 – No or low levels of existing contamination (well below accepted standards) and receptor is unaffected or marginally affected i.e. resilient to change; to
  2 – Moderate levels of mobile contamination present which are vulnerable to physical disturbance; to
  3 – High levels of mobile contamination present which are highly sensitive to physical disturbance.

Overall receptor sensitivity is then scored on a spectrum from low (1) to high (6) by adding the individual parameter scores:

Table 3.2 presents the score ranges for sensitivity rankings of ”Low”, ”Medium” and ”High”’.

Table 3.2 Receptor Sensitivity Rankings

Receptor Sensitivity	Score (Summed Parameter Rankings)
Low	2
Medium	3-4
High	5-6

3.2.5.3 Method for Determining Environmental Impact Significance

Impact significance, as a function of event magnitude and receptor sensitivity is subsequently ranked as “Negligible”, “Minor”, “Moderate” or “Major” as presented in Table 3.3 below. Impacts can be “positive” or “negative”.

Table 3.3 Impact Significance

		Receptor Sensitivity		
		Low	Medium	High
Event Magnitude	Low	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	High	Moderate	Major	Major

Any impact classified as "Major" is considered to be significant and where the impact is negative, requires additional mitigation. Impacts of negligible, minor or moderate significance are considered as being mitigated as far as practicable and necessary, and therefore, do not require further mitigation.

3.2.6 Socio-Economic Impacts

The socio-economic impact assessment will use a semi-qualitative assessment approach to describe and evaluate impacts. Factors taken into account to establish impact significance will include probability, spatial extent, duration and magnitude of the impacts in addition to the sensitivity of receptors (e.g. the groups of people or populations most likely to be affected and, in particular, whether impacts are likely to be disproportionately experienced by vulnerable groups).

Indirect socio-economic impacts (i.e. induced effects) will also be assessed using the same approach.

3.3 Transboundary and Cumulative Impacts

Transboundary impacts are impacts that occur outside the jurisdictional borders of a project's host country. Potential SD2 Project transboundary impacts are considered to include:

- Socio-economic issues surrounding the sourcing of labour, goods and services from the international market; and
- Greenhouse gas (GHG) emissions to air.

Cumulative impacts arise from:

- Interactions between separate project-related residual impacts; and
- Interactions between project-related residual impacts in combination with impacts from other projects and their associated activities.

These can be either additive or synergistic effects, which result in a larger (in terms of extent or duration) or different (dependent on impact interaction) impacts when compared to project-related residual impacts alone.

The cumulative assessment presented in Chapter 13: Cumulative and Transboundary Impacts and Accidental Events, initially considers the potential for impact interaction and accumulation in terms of the following:

- **Temporal Overlap** – the impacts are so close in time that the effect of one is not dissipated before the next one occurs; and
- **Spatial Overlap** – the impacts are so close in space that their effects overlap.

At the time of writing the following new projects are proposed or are under construction in the vicinity of the Sangachal Terminal:

- Qizildas Cement Plant – new 5,000 tonne capacity cement plant located approximately 4km north of the Terminal;
- SD1 Flare Project – replacement of an existing ground flare and surrounding enclosure located within the existing Terminal boundary, with a new elevated flare package;
- Garadagh District Umbaki (Jeyildagh) Jailhouse – this development comprises a prison which holds up to 1,500 people;
- New Baku Port – the location of the new port is close to Alyat settlement, 25km to the south of the Terminal. The port covers an area of 400 hectares and includes the construction of two bridges for ferry boat movements, three freight bridges for container vessels, provision of infrastructure for the movement of roll-on and roll-off cargo, and a large dry cargo storage area;
- Baku Shipyard Company – this development is located 23km from the Terminal adjacent to an existing deep water plant and comprises a modern shipyard facility;
- SOCAR Petrochemical Complex – to be located within the Garadagh district and comprising a gas processing plant, oil refinery and petrochemical plant; and
- Navy and Military camp for Navy Officers – located close to Sahil settlement, this development aims to provide residential housing for officers' families.

In addition it is understood that, a result of an expected significant increase in traffic flows due to industrial development to the north (towards Sahil) and to the south (at Alyat), it is planned to expand the Baku-Salyan Highway along its length to 4 lanes in each direction.

Where there is potential for impact interaction, the project is sufficiently defined and sufficient data is available, a quantitative assessment is undertaken. Where insufficient data is available a qualitative assessment is presented (refer to Chapter 13).

3.4 Mitigation and Monitoring

The iterative and integrated nature of the ESIA and project planning processes means that the majority of proposed additional mitigation measures and strategies have been incorporated into the project Base Case (as provided within Chapter 5: Project Description) and integrated into the design. Those additional mitigation and monitoring initiatives detailed in this document will be incorporated into the management plans that will be used during the construction and operational phases.

4 Options Assessed

Contents

List of Figures

List of Tables

4.1 Introduction

The design options assessment process has been aligned with the BP's Capital Value Process (CVP) to allow consistency across all major projects within BP's portfolio. Figure 4.1 illustrates the key requirements for each CVP stage.

Figure 4.1 BP Capital Value Process

Appraise:	Select:	Define:	Execute:	Operate:
• Determine project feasibility & alignment with business strategy; • Understand project drivers; and • Identify viable opportunities to pursue.	• Perform technical definition and evaluation of prioritised project options; • Develop initial cost and schedule estimates for the options; • Compare options by focusing on uncertainties, risks, flexibility and associated economic criteria; • Recommend preferred option and further develop technical definition, cost schedule and production estimates.	• Develop the selected option to an appropriate level of detailed technical definition and planning required to freeze the scope of the project; and • Confirm cost, schedule and production estimates.	• Produce an operating asset consistent with scope, cost and schedule, including; • Detailed engineering; • Procurement; • Follow-on engineering; • Site support; and • Project management services.	• Evaluate asset to ensure performance is to specification including; • Feedback of facilities availability; and • Production performance.

As Figure 4.1 demonstrates, conceptual design options are analysed in terms of their feasibility during the Appraise stage of the CVP. Recommended design options then pass onto the Select stage during which the preferred option for development is further studied and selected. During the Define stage, the scope of the preferred option is more fully defined and final design decisions are made.

The key options assessed during the SD2 Project design development have focused on:

- Concept definition;
- The selection of the offshore strategy to exploit the SD reservoir; and
- Identification of technically and economically feasible design options to reduce, and where possible avoid, adverse environmental impacts, primarily associated with:
  - Discharges to the marine environment;
  - Emissions to atmosphere;
  - Onshore noise; and
  - Waste.

Throughout the CVP to date, environmental evaluation of the project options has been undertaken alongside technical and economic evaluation and consultation with stakeholders including SOCAR and SD partners[1].

This Chapter presents a summary of the options that have been assessed to support the current design base case which is defined as follows:

- Subsea development concept incorporating 26 wells;
- Fixed standalone offshore SDB Platform Complex comprising Production and Risers Platform (SDB-PR) and Quarters and Utilities Platform (SDB-QU) bridge linked to SDB-PR located in shallow water to the north of the Contract Area;

[1] Chapter 8: Consultation and Disclosure provides details of the consultation undertaken and proposed specifically with regard to the SD2 Project ESIA

- Receiving and processing facilities at Sangachal Terminal (ST); and
- New subsea gas, condensate and chemical pipelines between the onshore receiving facilities and the SD Contract Area.

The decision to include new subsea gas and condensate export pipelines as well as additional facilities at the ST for SD2 facilities was made at the project outset as there is insufficient capacity within the existing SD1 export pipelines and SD1 onshore facilities to accommodate the predicted throughput associated with the SD2 Project.

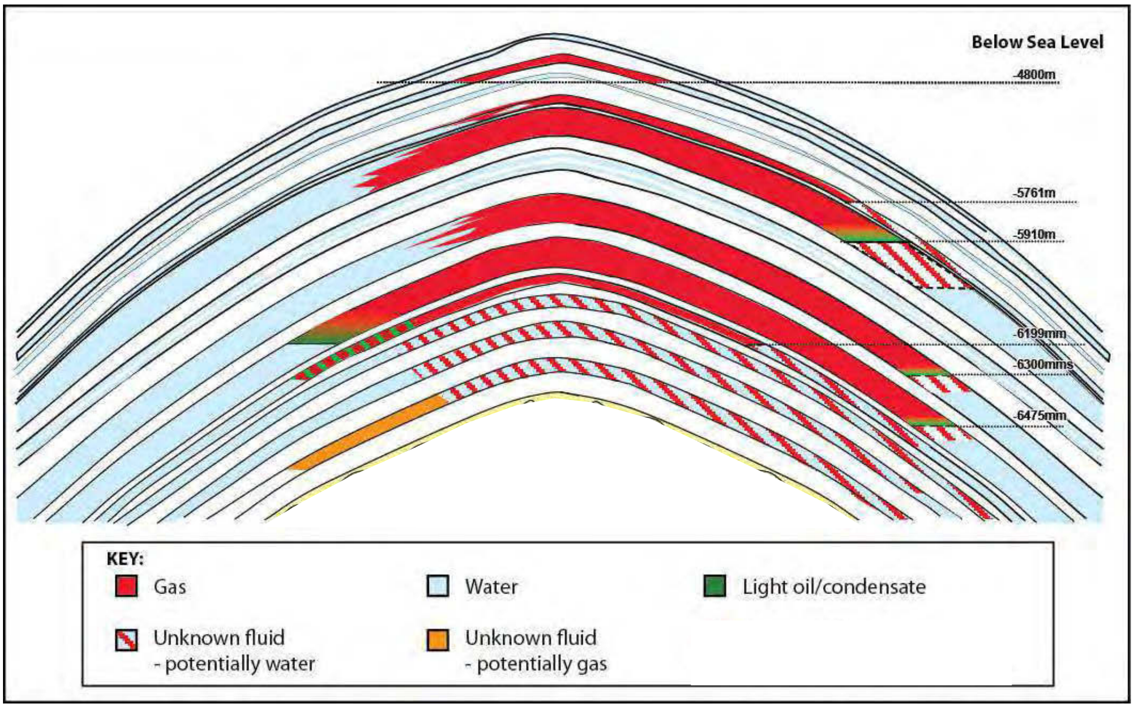
The option of not developing the SD2 Project has also been considered. The decision to not proceed would result in a reduction of potential revenues to the Azerbaijan government with a resultant inability to deliver the associated benefits to the Azerbaijan economy. Pursuing the SD2 Project will result in employment creation for national citizens during both the construction phase and operational phase of the development, as well as increased use of local facilities, infrastructure and suppliers. The option of not proceeding was therefore disregarded when considered against these socio-economic benefits.

4.2 Concept Selection: Multiple Platforms versus Subsea Development

During the Appraise stage, a number of development concepts were identified for assessment including a number of deepwater platforms, platform drilling options, multiphase tie-back to shore and subsea development concepts. The options assessment was primarily informed by drilling conditions, seabed depths and reservoir characteristics across the Contract Area:

- Drilling conditions - The geological structure of the Contract Area rises to a crest or "anticline" through its centre, restricting where wells can be located (refer to Figure 4.2). Due to the abnormally high pressures present in the crest of the structure, drilling and cementing is extremely difficult. Experience from elsewhere in the world has shown that drilling crestal wells has led to rock fracturing and downhole drilling fluids losses. Therefore the single option which included crestal drilling was rejected during the Appraise stage. Options which considered drilling directional wells from the flanks of the crest structure were retained.

Figure 4.2 Cross-Section Through SD Crest Structure



- Reservoir characteristics - Anticipated reservoir characteristics informed the number and location of wells required to achieve the planned production rate for the SD2 Project. An analysis was then undertaken to determine the feasibility of drilling these wells from fixed platforms as opposed to drilling from a mobile rig and subsequent subsea tie-in. The analysis took into account the maximum step out anticipated for platform wells (assumed to be approximately 5km) and for subsea wells (assumed to be approximately 3km) and water depths and the number of wells per subsea manifold (assumed to be four) and concluded that, for the planned production rates, platform drilling concepts were not economically feasible.

- Seabed depths - Minimum water depths across the Contract Area vary from approximately 60m to the north-east to a maximum of almost 700m in the south-east. Due to the perceived technical risks and associated high costs, options which included platforms within the southern part of the Contract Area (i.e. deepwater platforms) were rejected at the Appraise stage.

Further analysis of the reservoir characteristics indicated the potential requirement for offshore compression to achieve the planned production rates for both SD1 and SD2.

Based on the considerations above, the concept taken into the Select stage comprised:

- Subsea development concept incorporating 24 wells;
- Fixed SDB production and quarters facilities located in shallow water to the north of the Contract Area; and
- An offshore compression platform (denoted SDC), tied in to both the SD1 and SD2 offshore facilities.

From an environmental perspective, the subsea concept has the following advantages over the multiple platforms option:

- Reduction in materials required for jacket and topside construction and associated reduction in potential construction waste, emissions and discharges; and
- Increased opportunity for optimisation of production facilities and utilities, as compared to multiple production facilities and utilities on different platforms, resulting in lower waste, emissions and discharges.

4.3 Offshore Compression

Early in the Select stage, a study was undertaken to consider an “Offshore Compression” concept (with the SDC platform providing compression for both SD1 and SD2) and an alternative “No Offshore Compression” concept with the compression facilities located onshore.

Comparison of these two concepts showed that the “No Offshore Compression” case delivers a similar gas sales profile to the “Offshore Compression” case and has the following key benefits:

- Reduces the total offshore topsides installation weight by approximately 12,000 tonnes;
- Significantly reduces the offshore system complexity and improves overall system operability by transfer of offshore compression to the onshore terminal;
- Removes all safety and project delivery risk associated with the construction, installation, operation and decommissioning of the SDC platform after first gas;
- Eliminates the production shutdown (60-80 days) required for the future installation of the SDC platform;
- Minimises the Stage 1 offshore brownfield modification scope by removing the need for offshore gas interconnector pipelines. This eliminates a 35-day shutdown of SD-A;
- Total compression duty is reduced by ~35 Megawatts (MW) by more efficient utilisation of the hydraulic capacity of the marine gas pipelines at the end of field-life;
- Eliminates additional seabed disturbance; and

- Provides an opportunity to improve overall energy efficiency due to potential for heat and power integration onshore.

On this basis, the SD2 Project adopted the "No Offshore Compression" concept into the SD2 Base Case design.

4.4 Hydrate Management

During the design development, assessments were undertaken to establish the preferred options to manage hydrate formation in the SD2 subsea facilities. The three options identified during the Select stage to manage the potential for hydrates forming in the SD2 subsea production system (SPS), flowlines and risers were:

- Continuous mono ethylene glycol (MEG) injection (Option 1);
- Continuous injection of Anti Agglomerate low Dosage Hydrate Inhibitors (AA LDHI) (Option 2); and
- Direct Electrical Heating (DEH) (Option 3).

Due to the significant quantities of salty MEG, which would require a plant more than 10 times (by volume) the size of the SD1 MEG treatment plant at the Terminal, Option 1 was eliminated from further assessment.

The use of AA LDHI chemicals was not found to be effective for the anticipated water cut rates. In addition, the resultant hydrate slurry would require processing at the offshore facilities, which poses risks as the technology options to process the slurry are immature and would require a large scale test programme to prove the technology.

Option 3 (DEH) was therefore adopted as the primary means of hydrate management. This technology involves direct heating of the flowlines to maintain the temperature of the production fluids above that where hydrates form (approximately 26°C).

From the environmental perspective, the DEH option offers the following key benefits when compared with a chemical management approach:

- Minimising the offshore chemical inventory and waste streams; and
- Minimising flaring and associated emissions due to quicker recovery from shutdowns.

Further details of the DEH system and associated MEG system adopted within the SD2 Base Case are provided within Chapter 5 Section 5.11.2.

4.5 Power

4.5.1 Power from Shore

At the start of the Select stage, the SD2 Base Case assumed that onshore and offshore power would be generated by two separate independent systems. In May 2011, an assessment was undertaken to investigate an option for a single system based onshore, providing power to the onshore and offshore facilities via subsea cabling.

Both High Voltage Direct Current and Alternating Current options were considered. The options were evaluated against five key criteria; capital cost, operating cost, production availability, environmental impact and technical risk. The assessment showed the option to provide the Power from Shore did not offer significant operating cost benefits to offset the significantly increased capital costs (3–5 times more than separate independent systems) and increased technical risk.

Modelling of greenhouse gas (GHG) (as CO_2) and NO_X emissions and fuel usage for the options over the Life of Field (LoF) was completed to evaluate environmental benefits. The study showed a slight reduction in GHG emissions and fuel gas usage for the Power from

Shore option (by ~1%) as compared to the Base Case. NO_X emissions for the Power from Shore option, however, were more than 88% greater than for the Base Case.

On the basis of the technical, cost and environmental criteria assessed the Power from Shore option was not adopted. Separate onshore and offshore power generation systems have been retained as the Base Case for SD2.

4.5.2 Onshore Power and Heat Generation

4.5.2.1 Process and Utilities Power

To meet the SD2 onshore power demand for utilities and process systems, a number of power generation options and configurations were considered. These included a standalone power generation system for SD2 with one main and one spare gas turbine, and a system integrated with the existing ST facilities.

These options were assessed on the basis of technical feasibility, availability, efficiency and capital cost. For all the criteria considered, the integrated option was shown to be the best option with increased availability and efficiency, resulting in lower fuel use and hence lower emissions. The integrated power generation and distribution system is designed to provide power for the SD2 process plant and utilities, with SD2 power provided by a single 28MW ISO machine and back-up power provided by the existing gas turbines at the Terminal and/or the national grid.

4.5.2.2 Compression Power

In addition to the power demand for process and utilities systems, power is also required for the gas export compression system.

The project Base Case of using 3 x 50% gas turbines to drive the gas export compressors was compared with an option of using electric drives. A comparative assessment of CO_2 and NO_X emissions was undertaken using industry standard emissions estimating software, PI Forecaster. The estimates showed that the Base Case (direct drives) was expected to result in slightly lower GHG (as CO_2) and NO_X emissions when compared with the electric drive option (by ~2% and ~8% respectively). The assessment therefore supported the project Base Case of using dedicated turbines to drive the export compressors.

4.5.3 Onshore Heat Integration

At the start of the Select stage, the Base Case assumed use of hot oil heaters to provide the heat demand for the SD2 onshore facilities. An assessment, using the PI Forecaster software, was undertaken to consider whether use of waste heat recovery to provide the heat demand would result in lower GHG (as CO_2) and NO_X emissions. The following scenarios were investigated:

- Two 40MW fuel gas fired Hot Oil Heaters and one spare (3x50%);
- Waste Heat Recovery Units (WHRUs) on all Gas Turbines;
- WHRUs on all Compression Gas Turbines; and
- WHRUs on Power Gas Turbine only.

The assessment showed the greatest reduction in emissions, as compared with hot oil heaters, was obtained assuming WHRUs on all Gas Turbines (a reduction of 23% in CO_2 emissions and 5% in NO_X emissions). However, given that the SD2 power gas turbine will be part of the ST integrated power system and as such will be used as a back-up machine in certain operating scenarios, it was not considered feasible to fit this turbine with a WHRU.

As a result, the option of WHRUs installed on the Compression Gas Turbines was adopted as the SD2 Base Case. This option showed a reduction of CO_2 and NO_X emissions of 19% and 4% respectively when compared with using hot oil heaters.

4.5.4 Offshore Power

To determine the optimal generator size and configuration for offshore power generation, a total of six generator types were selected for assessment. The assessment criteria included:

- Technology suitability and lessons learned;
- Weight and layout considerations; and
- Target machine loading[2].

The assessment concluded that the 15MW ISO machines were preferable based on the technical criteria considered.

A further assessment using production and power profiles over the LoF as well as performance curves for the selected generators, was completed to compare the predicted GHG (as CO_2) and NO_X emissions for the preferred option and alternatives.

The results showed that, while the difference between the CO_2 emissions for the options considered was marginal, 15MW ISO turbine resulted in significantly lower NO_X emissions compared to the other options assessed.

Based on technical and environmental assessments, the 15MW ISO option was subsequently adopted as the SD2 Base Case.

4.6 Flare

4.6.1 Ground versus Elevated Flare

During the Select stage, an assessment was undertaken to identify the Best Practicable Environmental Option (BPEO) for the SD2 flare design at the Terminal from the options identified by the Project. The two types of flare systems, i.e. ground and elevated flare, were assessed based on the following categories:

- Environmental – noise, air quality, light and visual intrusion;
- Legal and policy compliance;
- Process Safety;
- Operability; and
- Capital cost.

The results of the assessment were as follows:

- Environmental (Noise) – Noise modelling studies were undertaken for both the elevated and ground flare using anticipated flaring scenarios and vendor noise data specific to the flaring scenarios. The flaring scenarios, which were developed by the SD2 Project Team, included expected events (e.g. trips, plant upsets leading to flaring), flaring flowrates, frequency and the duration of flaring per event. Predicted noise levels at the community receptors surrounding the ST (Sangachal Town, Umid, Azim Kend and Masiv 3) for each scenario were compared for the two options. The modelling predicted that the ground flare would be marginally noisier than the elevated flare at flaring rates up to moderate flaring rates (by up to four dB(A)). However, the elevated flare would be marginally noisier for the emergency depressurisation scenario (by up to three dB(A). Overall, however, it was concluded that there was no significant differentiation between the two flare options;
- Environmental (Air Quality) – An air dispersion modelling screening study was undertaken for both the elevated and ground flare for average and emergency depressurisation flaring scenarios. The study focused on predicting the NO_2 concentrations at the community receptors surrounding the ST. The modelling showed

[2] Turbines should have a minimum loading of 50% during normal operation and a minimum of two generators should be in operation at one time.

that for both modelling scenarios there was an insignificant difference between predicted annual average NO_2 concentrations at all modelled receptors for both the elevated and ground flare options. It was therefore concluded that there was no preference with regards to the two flare options;

- Environmental (Light/Visual Intrusion) – A screening assessment was undertaken to establish the visibility of the ground and elevated flares from the area surrounding the Terminal. The screening assessment, which took into account the proposed height and location of the flare options, was undertaken using viewshed analysis, in which the likely visibility of an object from selected viewpoints can be determined (taking into account topography but not existing structures or buildings). The assessment showed that the elevated flare would be significantly more visible, particularly under non routine flaring conditions, than the ground flare at the community receptors, although significant visual impacts were not anticipated given that the existing Terminal facilities already dominate the view from the local communities. Significant light impacts were also not anticipated although they were predicted to be less from the ground flare as the ground flare enclosure would screen the flare from the surrounding receptors. The ground flare option was therefore shown to be preferable with regards to light and visual intrusion.
- Legal and Policy Compliance – Noise modelling results for both flare options were compared to the applicable project noise limits[3]. No difference between the elevated and ground flare options in terms of the number and duration of noise limit exceedances was predicted. It was shown that noise limits would be met for at least 95% of the time per year for all years, which is in compliance with the project requirements. In addition air quality modelling showed that relevant air quality limits[4] were predicted to be met for both the ground and elevated flare options. Both the elevated and ground flare options were shown to be in compliance with applicable legal and policy requirements and no difference between the options was identified.
- Process Safety – A preliminary review of process safety including the size of the radiation sterile area and consequences of flare upsets was undertaken for both flare options. The review concluded that the elevated flare is preferable from the process safety perspective due to due to reduced risks of ignited release and issues associated with ground level radiation.
- Operability – A comparison between operability aspects associated with the two options considered planned and unplanned maintenance and reliability. It concluded that the elevated flare is the preferred option.
- Capital Cost – Vendor cost data, obtained for both flare options, showed that capital costs were lower for the elevated flare option.

Based on the assessments undertaken, the elevated flare option was therefore identified as the BPEO recommendation on safety, operability and cost grounds. This option was therefore incorporated into the SD2 Base Case design as discussed in Chapter 5 Section.

4.6.2 Offshore Flare Gas Recovery

The SD2 onshore flare system will be provided with a flare gas recovery (FGR) system. FGR is proposed for the HP system to handle blowdown and control valves discharges. For the low pressure (LP) system FGR is proposed for tank breathing from all large tanks and MEG regeneration. The option of incorporating offshore FGR was also investigated, taking into account technical feasibility, operability/maintenance, cost, safety and environmental considerations. It was concluded that, while the FGR option was feasible and had the potential to further reduce GHG emissions by approximately 85 ktonnes over the LoF, the FGR package would add 37 tonnes to the platform weight and introduce additional safety risks. In addition, the associated costs indicated that offshore FGR was not economically feasible. Offshore FGR was therefore not incorporated into the SD2 Base Case design.

[3] 55dB daytime limit (07:00 to 22:00) and 45dB nightime limit (22:00 to 07:00) to be achieved 95% of the time that plant is operating, calculated as a proportion of annual operating hours.
[4] NO_2 annual average limit of 40 µg/m^3 and 1 hour limit (not to be exceeded more than 18 times per year) of 200 µg/m^3.

4.7 Produced Water

A number of options were considered for the disposal of produced water during the initial stages of SD2 planning. The options not taken forward for further assessment during the initial stages of SD2 planning included:

- Offshore and onshore separation and treatment of produced water and re-injection of water into subsurface formations within the offshore SD Contract Area. Residual water recovered onshore would be routed back offshore to the SD Contract Area and re-injected. This was not adopted for the following reasons:
    - HSSE risks associated with high pressure water injection in the challenging subsurface conditions found within the SD Contract Area
    - Uncertainties associated with the availability of a suitable reliable subsurface injection target; and
    - Capital and operational costs for drilling a dedicated water injection disposal well, and the need for additional produced water treatment process plant at the Terminal to support re-injection offshore.
    - The delay to ramp up production well delivery whilst drilling water injection wells

- Offshore and onshore separation and treatment of produced water and disposal of water into the Caspian Sea at the SDB platform complex location. This was not adopted for the following reasons:
    - HSSE risks associated with acquiring and maintaining permissions to discharge treated produced water to the Caspian on a continuous basis;
    - Technical challenges and space/weight limitations associated with offshore treatment and limited experience of operating an offshore treatment unit capable of treating to an appropriate standard; and
    - Capital and operational costs associated with additional produced water treatment process plant at the Terminal to support re-injection offshore.

A number of support studies, including trials of produced water treatment at third party (i.e. external non BP company) offsite treatment contractor facilities, treatability trials of SD2 water using the existing ACG produced water treatment plant and assessment of pond design and pre-treatment options were completed during the final selection process of produced water handling options. In order to mitigate risks associated with disposal of produced water the SD2 Project has adopted the following produced water handling hierarchy:

1. First Option: Utilise ACG produced water treatment and disposal options when available
2. Second Option: SD2 produced water will be sent off site for treatment and disposal at a third party treatment contractor site
3. Third Option: During emergency situations, when option 1 and 2 are not available and there is no produced water tank storage capacity at Sangachal including the new SD2 produced water storage tank, SD2 produced water will be sent to a new storage pond.

4.8 Subsea Pipeline Pre-Commissioning

Following pipelay, all pipelines and flowlines will undergo pre-commissioning comprising cleaning, hydrotesting, inspecting and dewatering. These activities will be completed using seawater, treated with chemicals to prevent biological growth and corrosion within the pipelines and flowlines. Following each pre-commissioning activity, treated seawater will either be discharged at a temporary subsea pig trap in the vicinity of the SDB platform complex or via the SDB-PR open drains caisson (refer to Chapter 5 Sections 5.8.4 and 5.9.4 for anticipated volumes discharged). If the SD2 Project were to adopt the same approach as used for the SD1 marine subsea pipelines, the SD2 pipelines would be dewatered by propelling a pig through them using the product that would be ultimately transported through the lines (e.g. gas, condensate or MEG), followed by a MEG conditioning pig train, designed to remove any remaining water in the lines. The pigs would be launched from the Sangachal

Terminal to the offshore facilities. This approach requires the offshore facilities to be operational prior to dewatering.

It is anticipated that some of the SD2 subsea pipelines may be mechanically complete more than 2 years before the SDB platform complex is installed and commissioned. The chemicals within the treated seawater will be qualified for a minimum protection period of 2 years. After this period it will be necessary to empty and refill the pipelines with treated seawater. When the dewatering does take place there would be requirement to contain and ship to shore large quantities of MEG used for final conditioning for treatment and/or disposal.

The project has therefore considered an alternative whereby dewatering will be accomplished by propelling air through each line (which will dry the line) following which the dried lines will be filled with inert nitrogen gas. Fluids used to hydrotest the shore approach and onshore sections of the export and MEG subsea pipelines will be recovered and removed by tanker for disposal off-site; this will avoid any risk of discharges to Sangachal Bay and nearshore waters. The approach, which minimises the volume of MEG for disposal and is expected to reduce the potential for refilling of pipelines due to degradation of the preservation chemicals, has been adopted as the SD2 Base Case.

4.9 Subsea System Decisions

While there are numerous subsea production systems globally, the SD2 subsea production system will be the first in the Caspian Sea and one of the largest in the world.

The key decisions with respect to the selection of the subsea control systems were:

- Hydraulic versus electrical actuation of production control valves: the valves which control the flow of production fluids could be opened and closed either by hydraulic pressure, or by electrically-operated solenoids;
- For hydraulic control: open versus closed loop systems; in an open system, the control fluid is discharged to sea when valves operate, while in closed loop systems the fluid flows to the platform via return lines; and
- Selection of control fluid: after considering the relative merits of the options, laboratory studies were carried out to select the most environmentally benign control fluid.

4.9.1 Hydraulic versus Electrical Control Systems

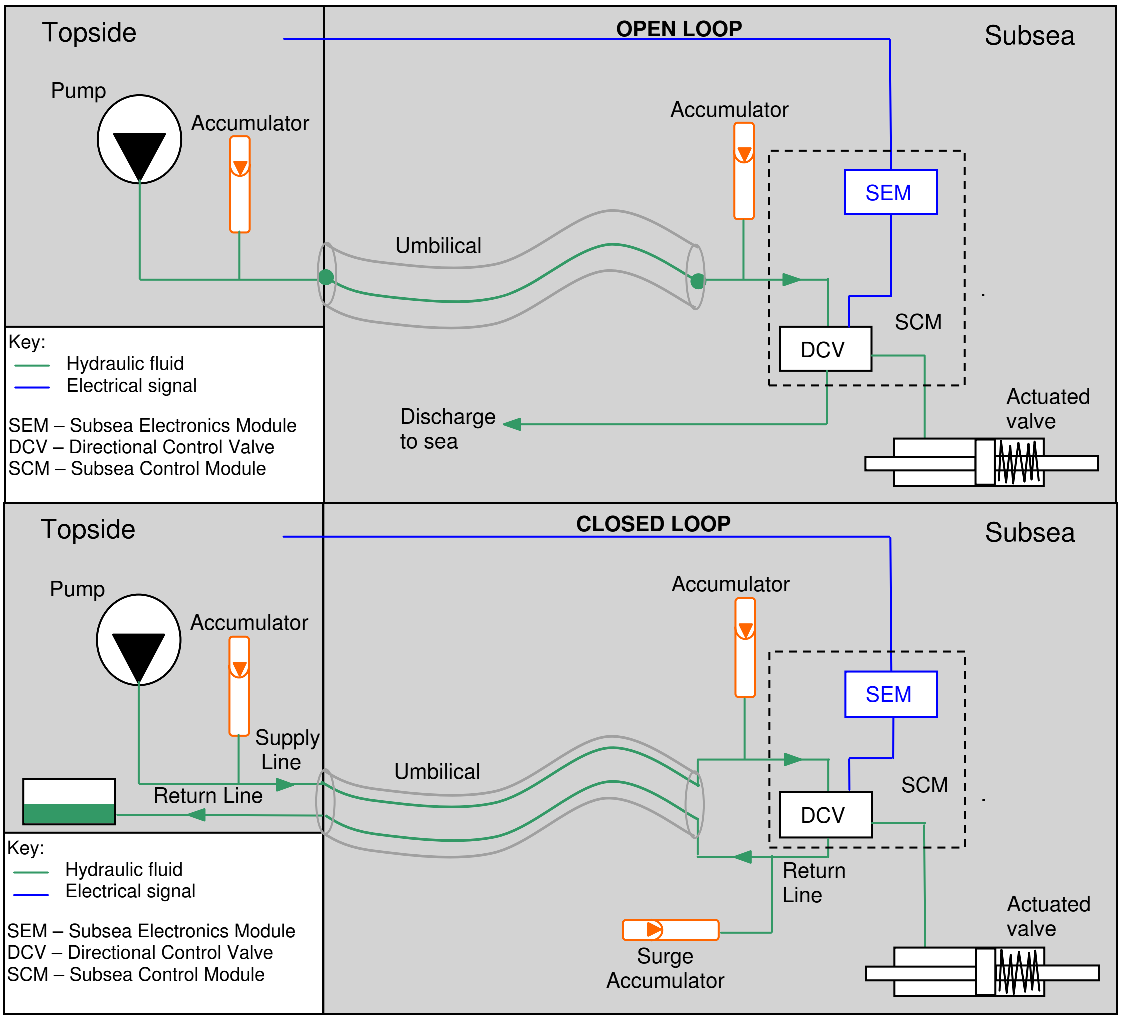
In an electrical system, electric power rather than hydraulic control fluid is used as the energy source to operate the well and manifold valves. While a number of manufacturers have developed electric control systems, the reliability of these systems has not been proven and they have not previously been used in the Caspian Sea. It is understood that an electrical High Integrity Pressure Protection System (HIPPS), which is the Base Case overpressure safety measure for SD2, has never been installed anywhere worldwide.

Analysis showed that no “all electric” system has yet been developed. A hydraulic system would still be required to operate downhole safety valves associated with the production wells. While discharges from such a system would be lower when compared with a hydraulic control system, overall technical feasibility could be affected due to increased complexity (i.e. additional umbilicals/controls required for the electrical and hydraulic systems). This option was therefore discounted.

4.9.2 Open and Closed Loop Hydraulic Systems

The key feature of a subsea open loop hydraulic system is that the control fluid is discharged to the marine environment when any subsea actuated valves are closed or when chokes used to regulate flow are stepped. Figure 4.3 shows a typical flow path for open and closed loop control systems.

Figure 4.3 Typical Open Loop and Closed Loop Hydraulic Systems



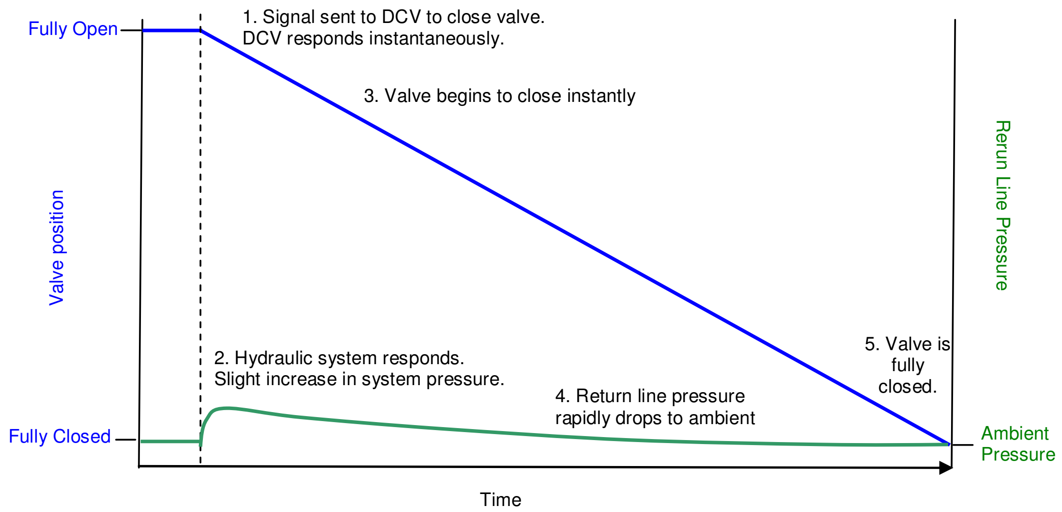
In an open loop system, discharge to sea occurs when the spring within the actuated valve returns the valve to the closed position, forcing the control fluid to discharge to sea. In a closed loop system hydraulic fluids are not discharged but are transferred back to the topside via return lines. In addition to the hydraulic fluid return line, the closed loop system also includes a surge accumulator; the function of which is to limit pressure build up in the return line.

A variation to the closed loop hydraulic system, in which a pump is integrated into the closed loop design to drive the returned control fluid from the valve when closed, was also considered. The purpose of the technology is to improve the response time for the valves within the closed loop system. However, the technology is in the earlier stages of development (used at only a few installations to date) and is proprietary to one supplier. On the basis of unproven reliability this option was therefore discounted.

4.9.2.1 Operability and Response Times

The operability of the open and closed loop systems was determined by comparing valve response time characteristics. Figure 4.4 shows how the pressure in the open loop system changes and the valve responds once the signal to close has been received.

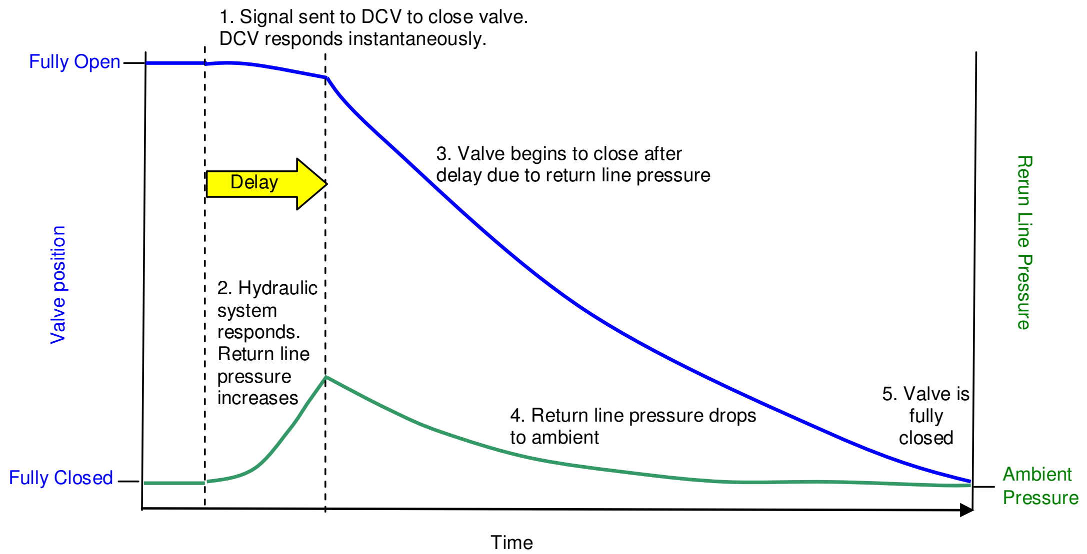
Figure 4.4 Indicative Valve Closure and Pressure Changes in an Open Loop System



The figure shows that when the valve is operated there is an initial slight build up of back pressure within the system, which rapidly dissipates as the control fluid is discharged to sea. Modelling of the activities required to close the safety critical HIPPS valve showed that a closure time in the order of six seconds could be achieved for the open loop system.

Figure 4.5 shows how the valve responds once the signal to close has been received within the closed loop system.

Figure 4.5 Indicative Valve Closure and Pressure Changes in a Closed Loop System



In the closed loop system, back pressure builds up in the system which has the effect of delaying the closure time. This is because the control fluid is being forced through the return line, which restricts the fluid flow. While the system includes a surge accumulator to relieve this effect, the delay cannot be avoided. Modelling of the HIPPS valve showed that a closure time in the order of 250 seconds would be expected for the closed loop system. This is greater than the 30 seconds maximum response time determined from the project safety criteria. The 30 second response time represents the 15 second HIPPS design closure time with a safety margin.

In addition, one of the major disadvantages of a closed loop system is the requirement for the system to return the fluid back to the surface. For developments in shallower waters this is generally a simple operation; however, for longer and deeper developments there is insufficient energy to push against the tube restriction and/or additional hydrostatic head (water pressure). There are two options to resolve this issue:

- Increase the spring strength in actuators. This, however, pushes up the required control system pressures and increases the valve opening times; or
- Increase the diameter of return lines as this will help to reduce the tubing restrictions. This is not considered an option for SD2 as it makes it infeasible to manufacture, transport to and install the SD2 subsea control system components in the SD Contract Area using the vessels and transportation routes available, which is a project requirement.

The option of a hybrid system involving an open loop system for the HIPPS valves and a closed loop system for all the other valves was also investigated. However, this was not considered feasible as:

- The valve reaction time for the closed loop valves is much slower than for the open loop HIPPS valves. As a result, when all the well and manifold valves are instructed to close a pressure build up would occur between the well and the HIPPS. This would affect the reliability of the HIPPS and as such the hybrid system would not meet the safety criteria required; and
- Manufacturing, installation and transportation of the return lines are infeasible, as for the closed loop system.

4.9.2.2 Reliability

Both the open and closed loop systems are considered reliable, proven technology. However, the closed loop control fluids, which are synthetic based, are considered to be more sensitive to potential contamination, in particular from seawater and particulates, resulting in poor performance. The open loop system fluids, which are water based, are not affected by seawater in the same way and particulate build up is avoided as a proportion is discharged with the fluids.

4.9.2.3 Logistics and Installation

The subsea umbilicals, which include all chemical, hydraulic and electrical supplies from the platform to the manifolds and wells, are manufactured under controlled conditions, and are shipped as continuous fabrications on carousels. The closed loop system requires both supply and return hydraulic lines within the subsea umbilicals and therefore the size and weight of the closed loop umbilicals is greater than for the open loop. The only practicable method of importing the umbilicals is via the canal system. Transportation vessels are therefore limited by width and weight restrictions. It is anticipated that it is unlikely the closed loop system umbilicals can be transported through the canal system.

4.9.2.4 Environmental Issues

For the open system, water-based control fluids would be discharged to sea as a result of:

- Valve actuator movements or choke operations required for flow control of the wells. Choke operations account for the majority of the control fluid discharged. Under normal operating conditions, the closed loop system is not designed to discharge control fluids;
- Directional control valve (DCV) discharge – In addition to discharges associated with valve/choke movements, discharges would also occur on a continuous basis from the DCVs. To maintain the integrity of the production system, it is necessary to select highly reliable valves that will continue to function for the duration of the project.

HIPPS is an integral part of the subsea control system to ensure the safety criteria are met and to minimise the potential for uncontrolled releases of hydrocarbons to the marine environment. A maximum response time of 30 seconds (including safety margin) has been determined for the HIPPS. Note that the HIPPS design closure time is 15 seconds. As demonstrated in the analysis of the open and closed loop systems, the closed loop system is unable to meet this criterion.

4.9.2.5 Summary

The key reasons for the selection of an open loop hydraulic control system are provided below:

- A hydraulic system has been selected for SD2 because electrical systems are unproven and therefore the risks of system failure are unacceptably high;
- The closed loop system does not meet safety criteria for critical valve closure times to ensure isolation and containment of the reservoir fluids within the subsea production system, avoiding spillages and over pressure events on the new offshore platform; and
- Transportation and installation logistics render closed loop umbilicals infeasible due to the limitations on importing material through the canal system to the Caspian Sea as well as the limitations of the offshore installation vessels available within the Caspian.

4.9.3 Open Loop System Control Fluid Selection

To support the decision of an open loop system, work was completed to select a control fluid with the least environmental impact. Four candidate fluids that are accepted by OSPAR countries, within the Gulf of Mexico and in Australia, were considered:

- Castrol Transaqua HC10;
- Castrol Transaqua HT2;
- Niche Products Pelagic 100; and
- MacDermid Oceanic HW760R.

All fluids are classified 'Gold'[5] under the UK regulatory system and approved for discharge to sea, indicating they have least environmental impact. Based on fluid composition data provided by the vendor, screening was undertaken to ensure that the products did not contain any components which were:

- Bioaccumulative;
- Persistent; or
- Likely to cause specific or chronic effects.

All candidate fluids successfully passed this screening process, and were therefore included in a preliminary programme of toxicity testing. Caspian species were used to conduct the toxicity tests which are directly comparable to the OSPAR algal and herbivore species[6] (Table 4.1). All tests were carried out in conjunction with the same quality assurance (QA)/quality control (QC) procedures as are used for OSPAR tests. The design and execution of the tests differed from OSPAR tests only in the species used, and in the use of Caspian seawater; test conditions, equipment and duration were otherwise consistent with OSPAR procedures.

Table 4.1 Summary of Caspian Toxicity Test Species

Test Species	Type	OSPAR Equivalent	Test Temperature (ºC)	Test Duration
Calanipeda aquae dulcis	Herbivore	*Acartia tonsa*	20 (+/- 2ºC)	48h
Chaetoceros tenuissimus	Alga	*Skeletonema costatum*	20 (+/- 2ºC)	72h

5 Hazard Quotients are assigned to 1 of 6 categories and "GOLD" is the least hazardous category.
6 Refer to Chapter 2 for an explanation of the OSPAR ecotoxicity testing procedure.

The four candidate products were tested concurrently on three separate occasions to ensure the reliability of the results. Test results are summarised in Table 4.2.

Table 4.2 Toxicity Test Results

Fluid	Zooplankton 48h LC50[1] (mg/l)				Phytoplankton 72h EC50[2] (mg/l)			
	1	2	3	Average	1	2	3	Average
HC10	6,199	6,160	6,373	6,244	2,694	2,732	2,460	2,629
HT2	6,496	6,306	6,553	6,452	2,836	2,414	2,256	2,502
100C	3,642	3,803	3,434	3,626	607	659	581	616
HW760R	5,244	5,943	6,306	5,831	582	678	640	633

Notes
1. LC50 - Lethal Concentration 50 is the estimated concentration of a substance required to cause death in 50% of the test organisms in a specified time period.
2. EC50 - Effective Concentration 50 is the concentration of a substance that has a specified non-lethal effect on half of the test organisms within a specified period of time. Effects measured are often the number of young produced, time to reproduction, etc.

Table 4.2 indicates that the HC10 and HT2 products were of similar, and consistently lower, toxicity. Based on the toxicity test results and the technical performance of the product, HC10 was selected as the control fluid for the SD2 subsea control system.

The results of the toxicity tests were used to carry out an ecotoxicological risk assessment. An initial step in the risk assessment process was to confirm the no-effect concentration of the control fluid.

The no-effect concentration for the selected fluid was estimated by applying safety factors to the toxicity test results. A factor of 100 was used for the continuous DCV discharge. For intermittent actuator valve discharges, a safety factor of 10 was used, to reflect the short duration of the events (maximum 45 seconds) in relation to the test duration (48-72 hours). The application of these safety factors provided the basis for estimating the degree of fluid dilution required to avoid biological harm.

To support the ecotoxicological risk assessment, control fluid discharge scenarios were defined, and fluid dispersion was modelled. This included both continuous discharge (from DCVs) and intermittent discharge (from events in which the tree and manifold actuator valves are operated). The modelling output was expressed as the linear dimension and volume of the 'plumes' at the no-effect dilution.

The ecotoxicological risk assessment demonstrated that:

- For DCV discharge (combining all DCVs for a single tree or manifold) the plumes were too small to visualise graphically and that the maximum volume was approximately $5m^3$. This is equivalent to a radius of just more than one metre. The assessment is based on the assumption of constant exposure; the small size of the plume and the presence of a concentration gradient within the plume mean that in practice the radius of potential effect will be less than one metre from the point of discharge.
- For the actuator valve discharges, the maximum plume volume was $84m^3$, and the maximum plume persistence at concentrations above the no-effect level was approximately 18 minutes. Short-duration toxicity tests (0.5h) indicated that, for this duration of persistence and exposure, toxicity was 4-5 times lower than over the standard (48-72h) test durations, and therefore that a more realistic estimate of the maximum volume would be less than approximately $20m^3$.

The risk assessment concluded, on the basis of these results, that the discharge of water-based control fluid would have minimal environmental impact within a very small distance from the discharge locations (DCVs and actuator valves).

4.10 Drilling

Well tests are undertaken to evaluate well performance characteristics and are considered only when identified as necessary by the project. The duration of the well tests will be dependent upon how well the various sand layers are connected to each other. A cleanup flow period will be performed first to remove any “slugs” of drilling fluid and perforation debris. The well will then be flowed at a steady state through a range of chokes at various rates for a period of time. The well will then be “shut-in” for a pressure build up period. The time taken for the Pressure Build Up (PBU) will indicate how well connected the reservoir sands are and give an indication of what impact the “Fault Feature” has on the reservoir performance.

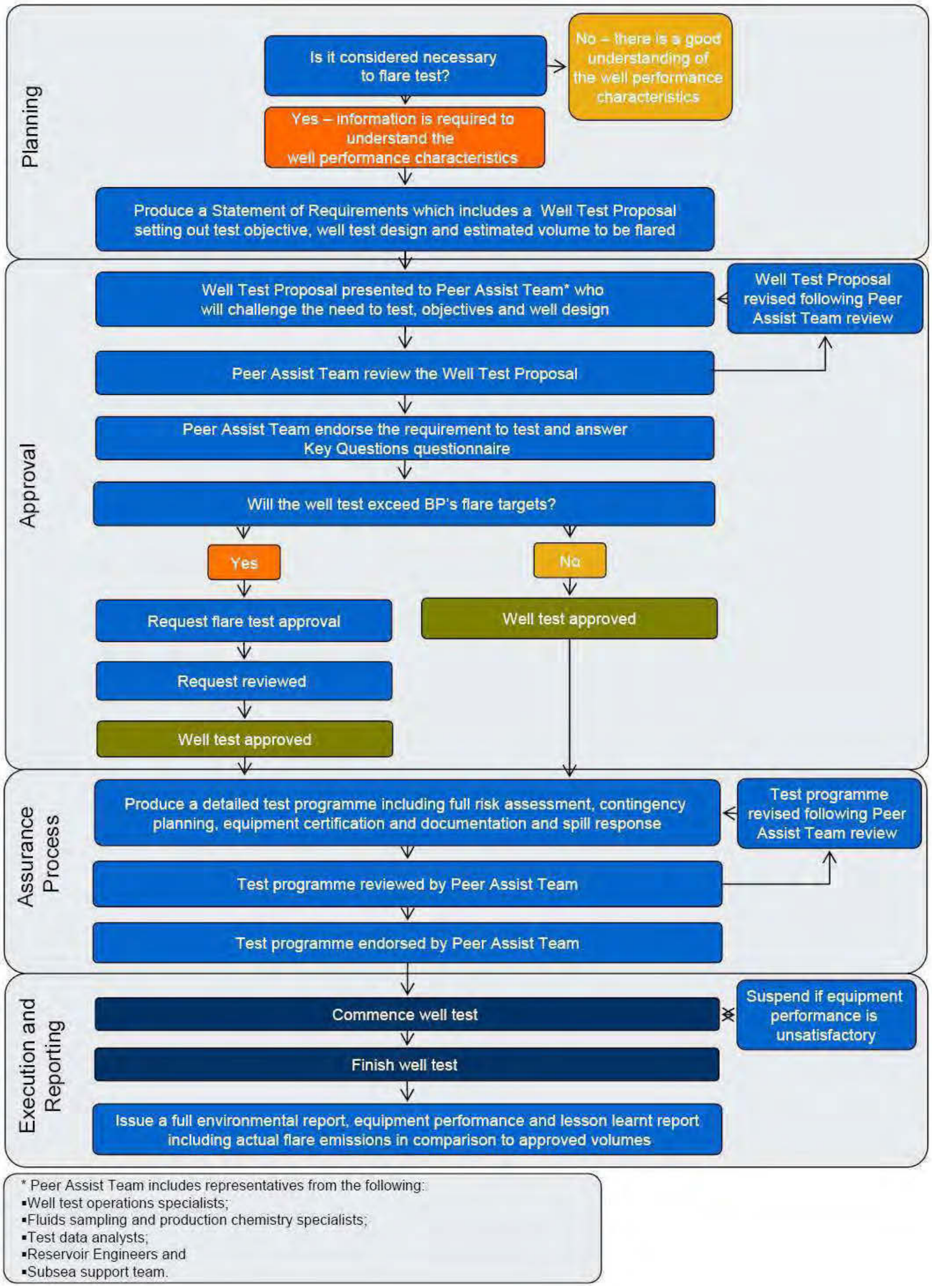
In addition to obtaining reservoir productivity and sustainability data, fluid samples will be taken to study wax formation temperatures. This will potentially affect the design of the subsea equipment.

The majority of the well test period is associated with PBU. However, flaring of reservoir fluids will be undertaken following each PBU period. Alternatives to flaring are not considered feasible as the reservoir fluids will be predominantly gas. Flaring is therefore the most technically practicable and safest means of disposing of the reservoir fluids.

BP has committed to minimise well test flare emissions globally. This commitment has been considered during well planning for the SD2 Project. Well testing will be undertaken in accordance with the Well Testing Assurance Process as shown in Figure 4.6.

There are four key stages to the Well Testing Assurance Process which aims to minimise flare emissions while maximising the value of the well test data. BP has set target well test emission levels and if a test is planned to flare more than these targets, then the approval process must be followed to ensure that a robust review by an internal expert team (known as the Peer Assist Team) is undertaken to test the justification for exceeding the emission targets. The process aims to ensure that well testing is planned and undertaken efficiently, with emissions minimised.

Figure 4.6 Well Testing Assurance Process



4.11 Base Case Optimisation

The design of the SD2 facilities will be further optimised during the Define stage of the project. It is not anticipated, however, that there will be any significant changes to the current design Base Case.

Should the optimisation result in a change to the SD2 Base Case design as assessed within this ESIA, the SD2 Management of Change Process will be followed as detailed within Chapter 5 Section 5.16.

5 Project Description

Contents

List of Figures

List of Tables

5.1 Introduction

This Chapter of the Environmental and Socio-economic Impact Assessment (ESIA) describes the construction and operational activities associated with the Shah Deniz Stage 2 (SD2) Project. The description presents the technical design basis for the project facilities and associated planned activities for the following project phases:

- MODU drilling and completion activities;
- Onshore construction and commissioning of Terminal facilities;
- Onshore construction and commissioning of offshore and subsea facilities;
- Platform installation, hook up and commissioning;
- Installation, hook up and commissioning of subsea export and MEG pipelines;
- Subsea infrastructure installation, hook up and commissioning;
- Offshore operations and production;
- Subsea operations;
- Onshore operations and production; and
- Decommissioning.

Estimated emissions, discharges and wastes from the SD2 Project are presented for each project phase; emission estimate assumptions are provided in full within Appendix 5A.

This Chapter provides the basis for the ESIA as presented in Chapters 9-12 and was prepared during the 'Define' stage of the project. During later stages of the SD2 Project, there may be a need to change a design element. The Management of Change Process that will be followed should this be required is presented in Section 5.16 of this Chapter.

The Base Case design of the SD2 Project (refer to Figure 5.1) includes:

- A fixed SD Bravo (SDB) platform complex including a Production and Risers (SDB-PR) and a Quarters and Utilities (SDB-QU) platform, bridge linked to the SDB-PR;
- 10 subsea manifolds and 5 associated well clusters, tied back to the fixed SDB platform complex by twin 14" flowlines to each cluster;
- Subsea pipelines from the SDB-PR platform to the Terminal comprising:
  - Two 32" gas pipelines (for export to the Terminal);
  - One 16" condensate pipeline (for export to the Terminal); and
  - One 6" mono ethylene glycol (MEG) pipeline (for supply to the SDB platform complex).
- Onshore SD2 facilities at the Terminal located within the SD2 Expansion Area.

The SD2 Project comprises up to 26 producer wells. The activities associated with the drilling 10 of the wells were assessed within the NF1, WF1 and SD2 Predrill ETNs[1]. Drilling of the additional 16 wells and completion of all 26 wells are described in this Chapter.

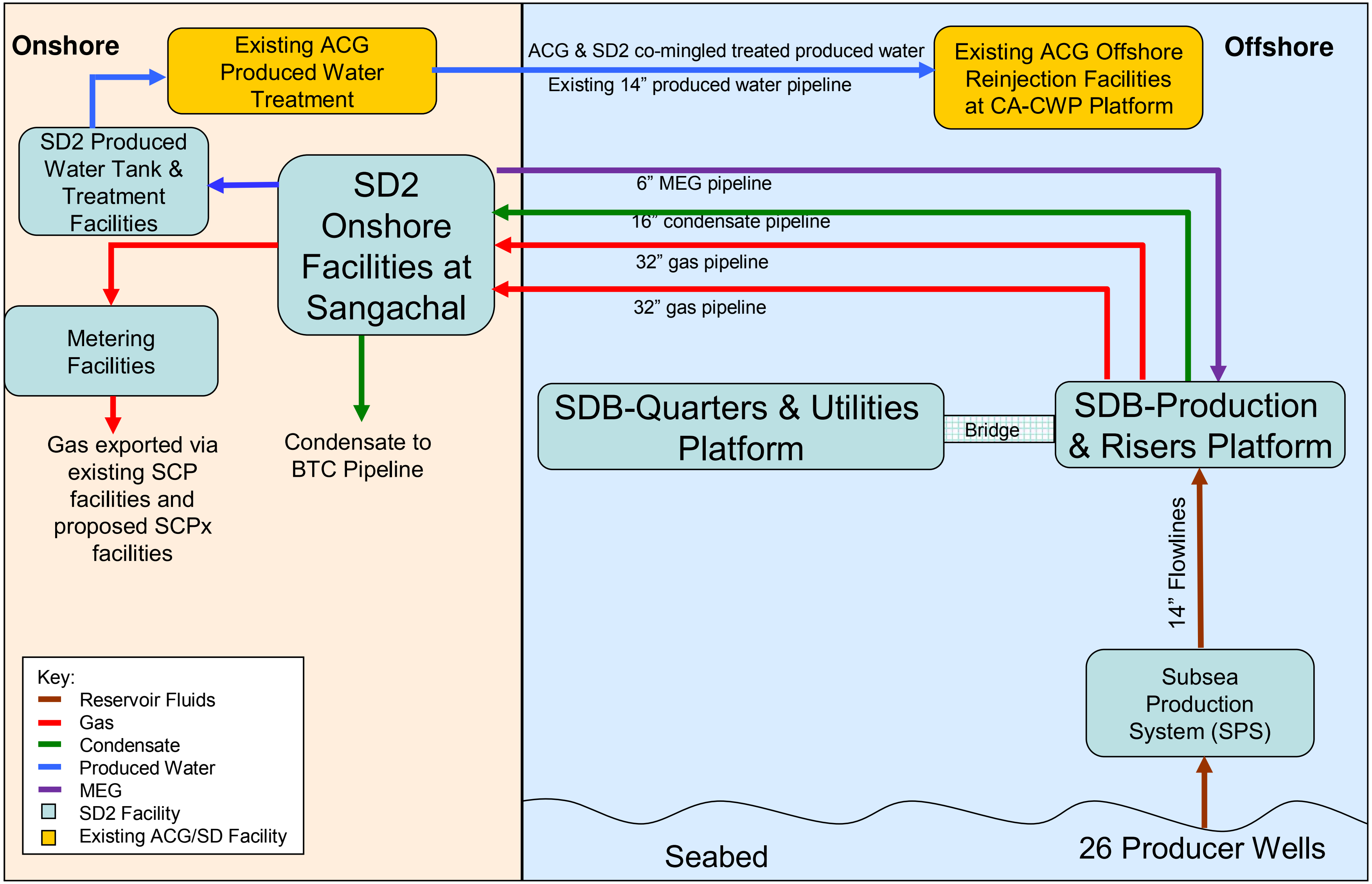
The Early Infrastructure Works (EIW)[2] (currently ongoing) to be completed at the Terminal prior to installation of the SD2 onshore facilities include:

- A new access road;
- Clearance and terracing of the SD2 Expansion Area; and
- Installation of storm water drainage and surface water/flood protection berms.

It is currently anticipated that a number of the EIW elements will be passed to and become the responsibility of the Main SD2 Construction Works contractor. These works are described within this Section 5.5 of this Chapter.

[1] NF1 Environmental Technical Note (ETN) (2009), WF1 ETN (2011) and SD2 Predrill ETN (2012)
[2] Assessed within the SD2 Infrastructure Project ESIA (2011)

Figure 5.1 Overview of SD2 Project

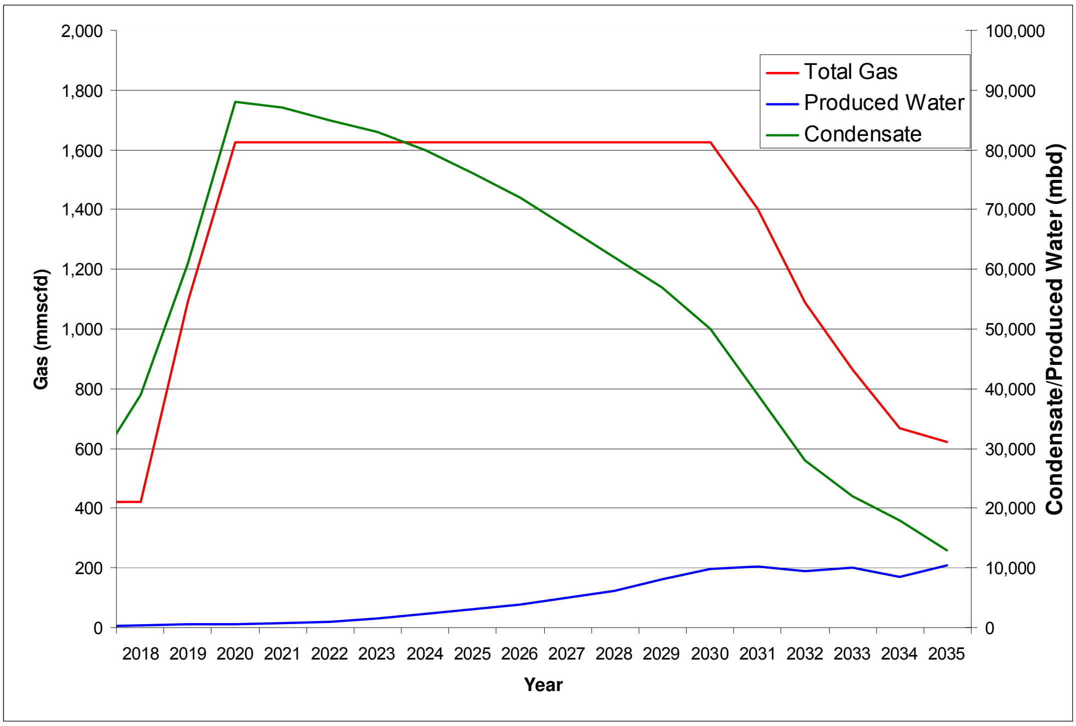


Planned first gas for the SD2 Project is 2018 following the tie in of the wells in the north flank (NF) to the SDB platform complex. The wells in the remaining four flanks (WF, ES, EN and WS) will be tied in sequentially. Peak production is anticipated in 2020. The SD2 field contains estimated 33.1Tcf gas initially in place (GIIP) and 2.4Bstb of condensate initially in place (CIIP). The SD2 Project aims to develop the known appraisal reservoir intervals (Balakhany VIII through to Fasila D) across the SD field. The SD2 Project facilities have been designed to process up to:

- 1,800 million standard cubic feet per day (MMscfd) gas to provide an export gas rate of 1,777MMscfd;
- 107 thousand barrels per day (Mbd) of condensate; and
- 25 thousand barrels per day (Mbd) of produced water.

Figure 5.2 illustrates the estimated SD2 gas, condensate and produced water production profile over the Production Sharing Agreement (PSA) period.

Figure 5.2 Estimated SD2 Project Production Profiles Across the PSA Period

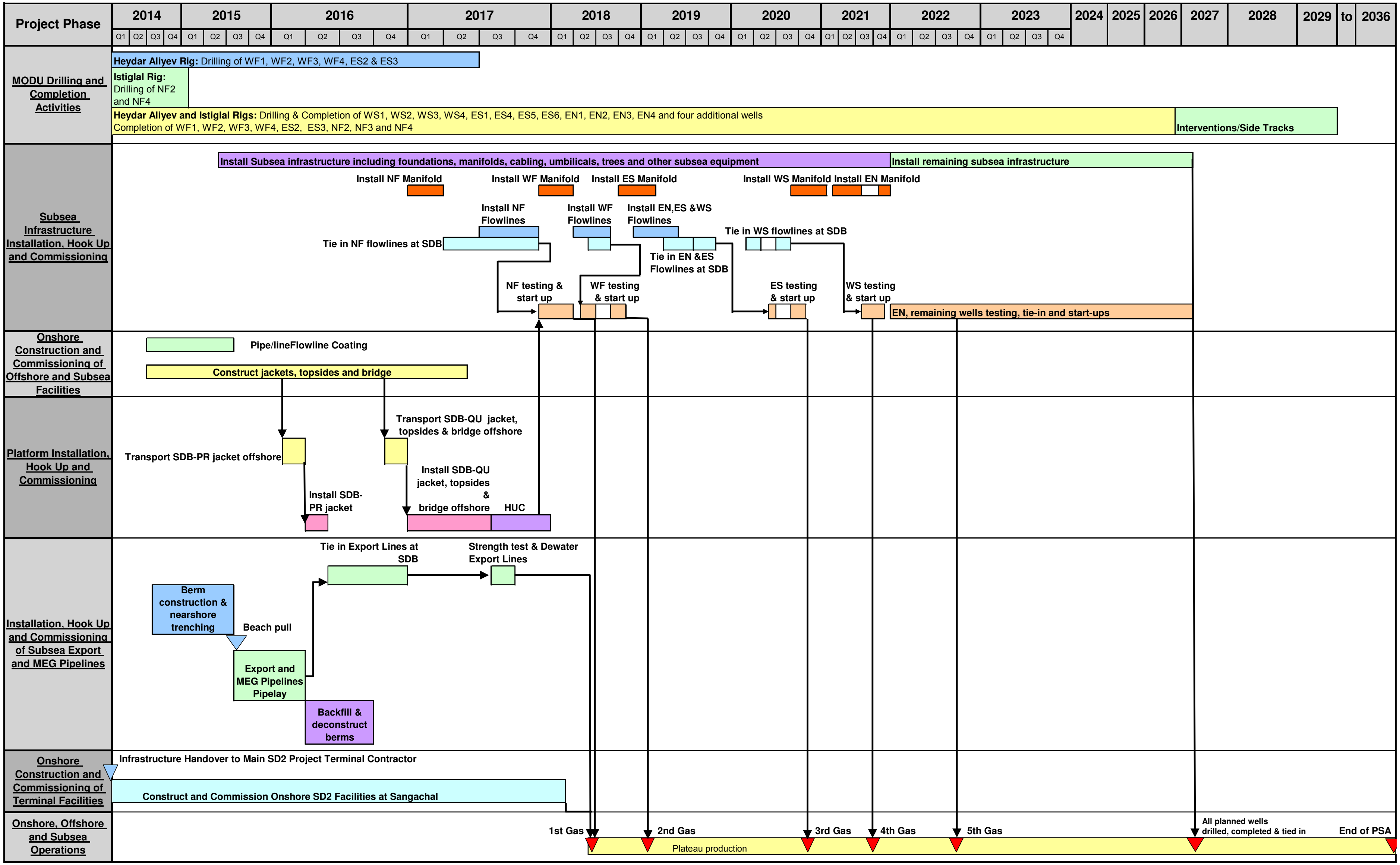


5.2 Project Schedule

Key SD2 Project activities and milestones are shown in Figure 5.3, which is based on the best available knowledge at the time of writing. The timing for each will be finalised when the final investment decision is made in 4Q 2013.

The following sections discuss key activities associated with each phase of the project.

Figure 5.3 Indicative SD2 Project Schedule



5.3 Logistics and Material Supply

Prior to commencing works, equipment and materials will be transported to the ST and the topside, subsea facilities, pipeline and jacket construction yards.

Preference will be given to source equipment (such as plant and construction vehicles) and materials which meet the required project specifications from Azerbaijan wherever possible. Where international procurement is required, materials and equipment will arrive by road, rail, sea and air using the transportation routes established for the previous ACG and SD construction programmes.

Goods arriving via sea can travel by two main routes. From the Mediterranean and Black Sea, vessels must pass through the Don-Volga canal system. Cargoes following the Baltic Sea route, would be transhipped at St. Petersburg and travel along the Baltic-Volga system. These routes are not available during the ice season (November - April). Rail links are available from Poti in Georgia and Riga in Latvia. Deliveries by road from Europe would be through Turkey and Georgia and via Iran.

5.4 MODU Drilling and Completion Activities

5.4.1 Mobile Drilling Rig Activities

It is anticipated that the SD2 Project wells will be drilled using two semi-submersible rigs:

- “Istiglal”; and
- “Heydar Aliyev” (previously known as the “Maersk Explorer”).

The Istiglal mobile drilling rig (MODU) has been used on all of BP’s pre-drilling activities in the SD Contract Area.

It is planned to drill a total of 26 wells in the SD Contract Area. Approval has already been obtained for 10 of these wells (within the northern, western and eastern south flanks of the Contract Area). 12 of the remaining wells will be located on the following flanks and at the following approximate depths below sea level:

- Western south flank: WS1, WS2, WS3, WS4 - approximate depth of 390 - 470m;
- Eastern south flank: ES1, ES4, ES5 and ES6 - approximate depth of 490 - 530m; and
- Eastern north flank: EN1, EN2, EN3, and EN4 – approximate depth of 395 – 480m.

The locations of the final four wells has not yet been confirmed. Their location will be determined once additional well performance and subsurface information becomes available. A Letter of Information will be sent to the MENR confirming the locations of the wells when known.

In the event that problems are encountered while drilling the surface hole, the well may be re-drilled within 50m of the original seabed location. In addition, if there is uncertainty around the geotechnical properties of the surface rocks, up to 4 geotechnical holes may be drilled within each flank where drilling has not been completed to date (in close proximity to the planned wells) to confirm geotechnical properties. A lower pilot hole may also be drilled in the same locations from bottom of the 28” liner to a depth of 1400m to obtain additional geological and log data.

5.4.1.1 MODU Positioning

Support vessels will tow each MODU to the drilling location and move the MODU into position prior to anchoring using 8 anchors at each location. The positioning and set up of each MODU is expected to take up to 4 days and a further 4 days per well to demobilise the rig at the end of the drilling programme. A mandatory 500m exclusion zone will be established around the rigs while drilling is in progress.

5.4.1.2 MODU Logistics and Utilities

In addition to the MODU, vessels will be required throughout the drilling and completion programme to supply consumables such as drilling mud to the MODU and ship solid and liquid waste to shore for treatment and disposal. Table 5.1 summarises the MODU and support vessel utilities. The estimated number and function of the vessels is provided in Appendix 5F.

Table 5.1 Summary of the MODU and Vessel Utilities

<table>
<tr><th>Utility/Support Activity</th><th>Heydar Aliyev Description</th><th>Istiglal Description</th></tr>
<tr><td>MODU Power Generation</td><td>• Main Power provided by 4 Wartsila 16CV W200 diesel engines rated at 2800kW
• Emergency diesel generator rated at 750kW</td><td>• Main Power provided by 4 Wartsila 12CV W200 diesel engines rated at 2400kW
• Emergency diesel generator rated at 635kW</td></tr>
<tr><td>MODU and Support Vessels Grey Water and Sanitary Waste</td><td colspan="2">• Grey water will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable
• Under routine conditions black water will be treated within the MODU sewage treatment system to MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine as low as practicable.
• Under non routine conditions when the MODU sewage treatment system is not available black water will be managed in accordance with the existing AGT plans and procedures and reported to the MENR as required
• Sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.</td></tr>
<tr><td>MODU and Support Vessels Galley Waste</td><td colspan="2">Depending on the availability of the system, galley food waste will either be:
• Contained and shipped to shore for disposal; or
• Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge.</td></tr>
<tr><td>MODU Seawater/ Cooling Water Systems</td><td>• Seawater used onboard within the engine and compressor systems (for cooling)
• 6 seawater lift pumps, but typically 2 used which are designed to lift up to 960m^3/hr from a depth below sea level of between 17.5 and 19.5m
• Design incorporates a Wilson Taylor Antifouling System for Cathodic protection and corrosion control system
• Cooling system:
○ Designed to typically discharge up to 960m^3/hr at a depth below sea level of between 10.9 and 12.9m; and
○ Based on the results of thermal plume dispersion modelling for cooling water discharge undertaken for similar facilities, the temperature at the edge of the cooling mixing zone (assumed to be 100m from discharge point) will be no greater than 3 degrees more than ambient water temperature</td><td>• Seawater used onboard within the engine and compressor systems (for cooling)
• Seawater lift pumps designed to lift up to 230m^3/hr from a depth below sea level of 9.8m
• Design incorporates anodic biofouling and corrosion control system
• Cooling system:
○ Designed to discharge up to 630 m^3/hr and at the depth below sea level of 12.5 m (depends on drilling draft); and
○ Based on the results of thermal plume dispersion modelling for cooling water discharge undertaken for similar facilities, the temperature at the edge of the cooling mixing zone (assumed to be 100m from discharge point) will be no greater than 3 degrees more than ambient water temperature.</td></tr>
<tr><td>MODU/ Vessel Fresh Water</td><td colspan="2">• Fresh water supplied from shore by supply vessels and stored onboard for use.</td></tr>
<tr><td>MODU Drainage</td><td colspan="2">• Deck drainage and wash water will be discharged to sea as long as no visible sheen is observable.
• Rig floor runoff, including WBM spills, collected via rig floor drains will be recycled to mud system or if not possible for technical reasons, diluted and discharged to sea (>60cm from sea surface) in accordance with applicable PSA requirements i.e. there shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.
• In the event of a spill, main MODU deck drainage will be diverted to hazardous drainage tank for spills including LTMOBM, oil/diesel/cement and oily water. Contents of hazardous waste tank will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.
Onboard the Heydar Aliyev rig:
• Waste oil collected from the drainage system will be sent to waste oil tank. The contents of the tank will be incinerated using the rig's incinerator.
• Bilge water will be sent to an oily water separator. Treated bilge water with an oil content less than 15ppm will be discharged to sea.
• Drains within the drilling area are connected to the mud system. If it is not possible to send runoff including mud to the mud system it will be directed to a zero discharge centrifuge. Treated water from the centrifuge with an oil content less than 15ppm will be discharged to sea. Separated sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures and separated oil sent to the waste oil tank.</td></tr>
<tr><td>MODU Ballast System</td><td colspan="2">• The MODU Ballast System will be operated so that ballasting, which uses untreated seawater, will be undertaken daily to maintain stability of the MODU for effective drilling.</td></tr>
<tr><td>Support Vessel Drainage</td><td colspan="2">• Oily and non oily drainage and wash water will be segregated.
• Non oily drainage (deck drainage and wash water) may be discharged as long as no visible sheen is observable.
• Oily water will either be treated to 15ppm or less oil in water content and discharged or contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.</td></tr>
<tr><td colspan="3">Notes: 1. For the Istiglal the sewage treatment system comprises a Hamworthy Membrane Bioreactor. The Heydar Aliyev rig currently have two Hamworthy Super Trident Sewage Treatment Units. It is planned to install a Hamworthy Membrane Bioreactor system to replace the existing unit 4Q 2013. The Membrane Bioreactor system will be designed to MARPOL 73/78 Annex IV MEPC. 159 (55) standards - total suspended solids- 35 mg/L, BOD5 - 25 mg/l, COD- 125 mg/L, pH- between 6 and 8.5, thermotolerant coliforms (faecal coliforms) - 100 thermotolerant coliforms/100 ml. No chlorination of the effluent will be required.</td></tr>
</table>

Estimated volumes of waste and greenhouse gas (GHG) and non GHG gas atmospheric emissions generated during the drilling programme are summarised within Section 5.4.9 below.

Consumables such as drilling mud and diesel will be provided to the MODUs by vessel from the existing onshore facilities previously used during ACG and SD pre-drilling programmes and which also supply the operational ACG and SD platforms.

5.4.2 Drilling Operations and Discharges

Mobile drilling rig activities during the SD2 Project drilling programme include:

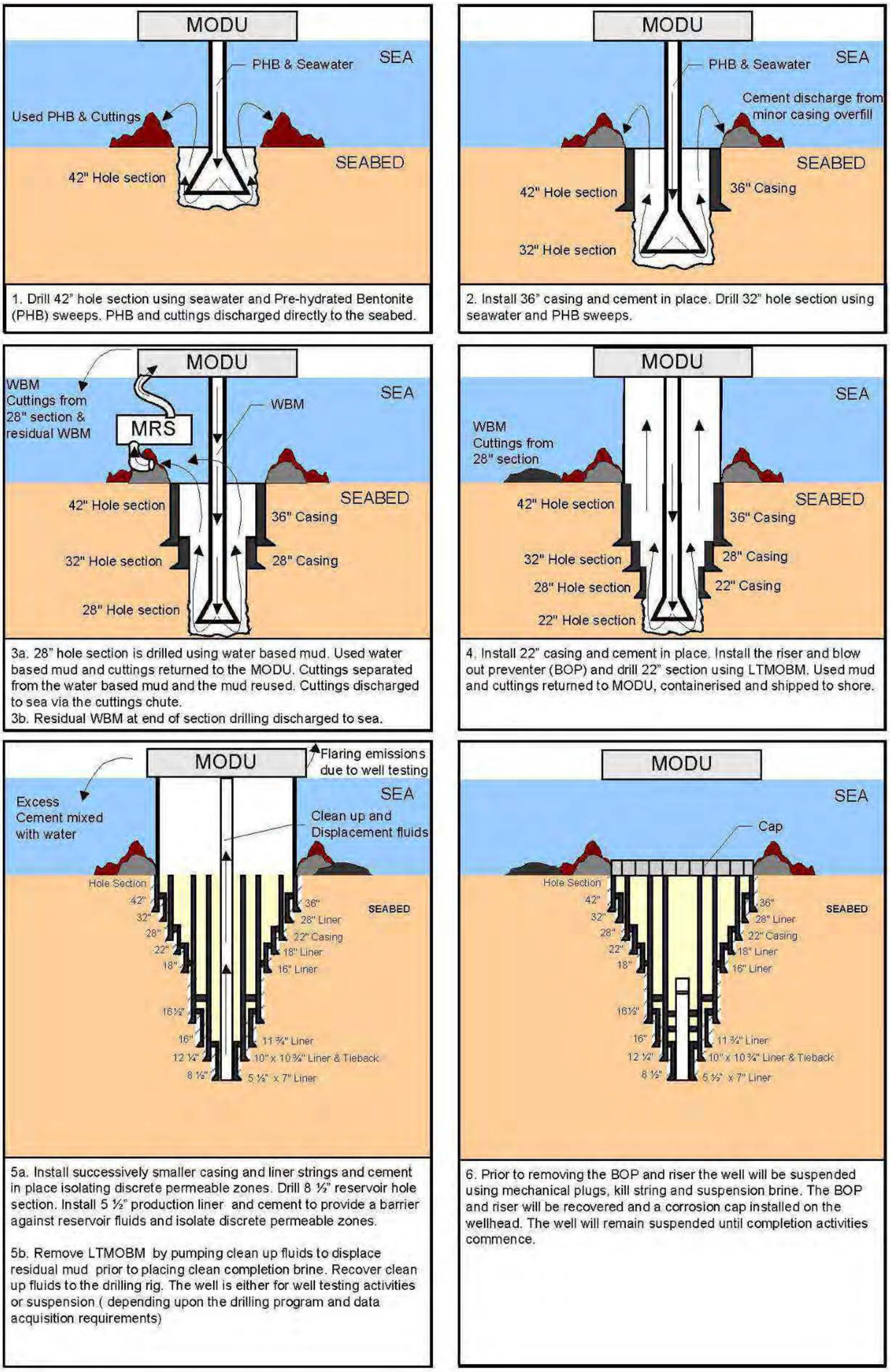
- Preparation of drilling equipment;
- Drilling of geotechnical holes (if required);
- Drilling of conductor, surface and lower well hole sections;
- Installing and cementing casings;
- Cleaning and testing; and
- Well suspension.

The activities associated with well re-entry and completion are discussed in Section 5.4.7 below. A summary of discharge types and the associated discharge scenarios associated with drilling activities is provided in Table 5.2. The SD2 drilling activities associated with the producing wells are illustrated in Figure 5.4 below.

Table 5.2 Summary of Drilling Discharge Types and Scenarios

Step (as per Figure 5.4)	Activity	Composition	Discharge Scenario
-	Application of pipe dope to drilling equipment joints	Pipe dope	Discharge very small amount of pipe dope with seawater/PHB sweeps/WBM when drilling geotechnical holes and prior to riser installation (42", 32" and 28" hole sections).
-	Drilling of geotechnical holes	Cuttings with water based mud (WBM)	Discharge WBM and cuttings directly to seabed.
-	End of drilling each geotechnical hole	WBM	Residual WBM remaining in the rig mud system after drilling each geotechnical hole that cannot be recovered will be discharged to sea via the MODU cuttings chute in accordance with PSA requirements[1,2].
1 and 2	Drilling of upper hole sections (42" and 32")	Cuttings and seawater with pre-hydrated bentonite (PHB) sweeps	Discharge seawater/PHB sweeps and cuttings directly to seabed.
3a	Drilling of 28" hole section (riserless)	Cuttings with WBM	Return WBM and cuttings to MODU using riserless MRS**,** separate mud from the cuttings. Recovered WBM will be reused whenever possible. Discharge WBM cuttings to the sea via the MODU cuttings chute, in accordance with PSA requirements[1,2]. If as a result of shale hydration the MRS hoses become plugged , then mud may be discharged at the seabed while the well is made safe and the hoses are unblocked.
3b	End of drilling 28" hole section	WBM	Residual WBM remaining in the rig mud system after completion of 28" hole section drilling that cannot be recovered will be discharged to sea via the MODU cuttings chute in accordance with PSA requirements[1,2].
4 and 5	Drilling of lower hole sections (22", 18" 16.5" 16" 12.25" & 8.5") (with riser)	No planned discharge	
2, 4 and 5a	Casing cementing	Cement	Discharge small amount of cement, due to slight overfill (required to ensure the casing is fully cemented to the seabed), directly to seabed following cementing of each casing and liner.
5a	End of cementing	Cement	Excess cement remaining in cement system on completion of cementing activities cannot be feasibly recovered and will be mixed with water and discharged to sea via the MODU cuttings chute[2].
5b and 6	Well clean up/ displacement, well testing and well suspension	No planned discharge	
Notes: 1 There shall be no discharge of drill cuttings or drilling fluids from the MODU if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water. 2 The MODU cuttings chute may be fitted with a hose, extending to the seabed, used to avoid cuttings and cement being deposited in locations where it is planned to install SD2 subsea equipment.			

Figure 5.4 Summary of Drilling Activities and Discharges



1. Drill 42" hole section using seawater and Pre-hydrated Bentonite (PHB) sweeps. PHB and cuttings discharged directly to the seabed.

2. Install 36" casing and cement in place. Drill 32" hole section using seawater and PHB sweeps.

3a. 28" hole section is drilled using water based mud. Used water based mud and cuttings returned to the MODU. Cuttings separated from the water based mud and the mud reused. Cuttings discharged to sea via the cuttings chute.
3b. Residual WBM at end of section drilling discharged to sea.

4. Install 22" casing and cement in place. Install the riser and blow out preventer (BOP) and drill 22" section using LTMOBM. Used mud and cuttings returned to MODU, containerised and shipped to shore.

5a. Install successively smaller casing and liner strings and cement in place isolating discrete permeable zones. Drill 8 ½" reservoir hole section. Install 5 ½" production liner and cement to provide a barrier against reservoir fluids and isolate discrete permeable zones.

5b. Remove LTMOBM by pumping clean up fluids to displace residual mud prior to placing clean completion brine. Recover clean up fluids to the drilling rig. The well is either for well testing activities or suspension (depending upon the drilling program and data acquisition requirements)

6. Prior to removing the BOP and riser the well will be suspended using mechanical plugs, kill string and suspension brine. The BOP and riser will be recovered and a corrosion cap installed on the wellhead. The well will remain suspended until completion activities commence.

5.4.2.1 Well Design and Drilling Fluid Types

All well-bore sections will be drilled using drilling fluids/drilling muds, the primary role of which is to:

- Maintain down-hole pressure to prevent formation fluids entering the well bore;
- Remove drill cuttings generated by the drill bit as it bores through the rock strata and transport these to the surface;
- Lubricate and provide cooling to the drill bit and the drill string; and
- Seal the wall of the well-bore in order to provide stabilisation.

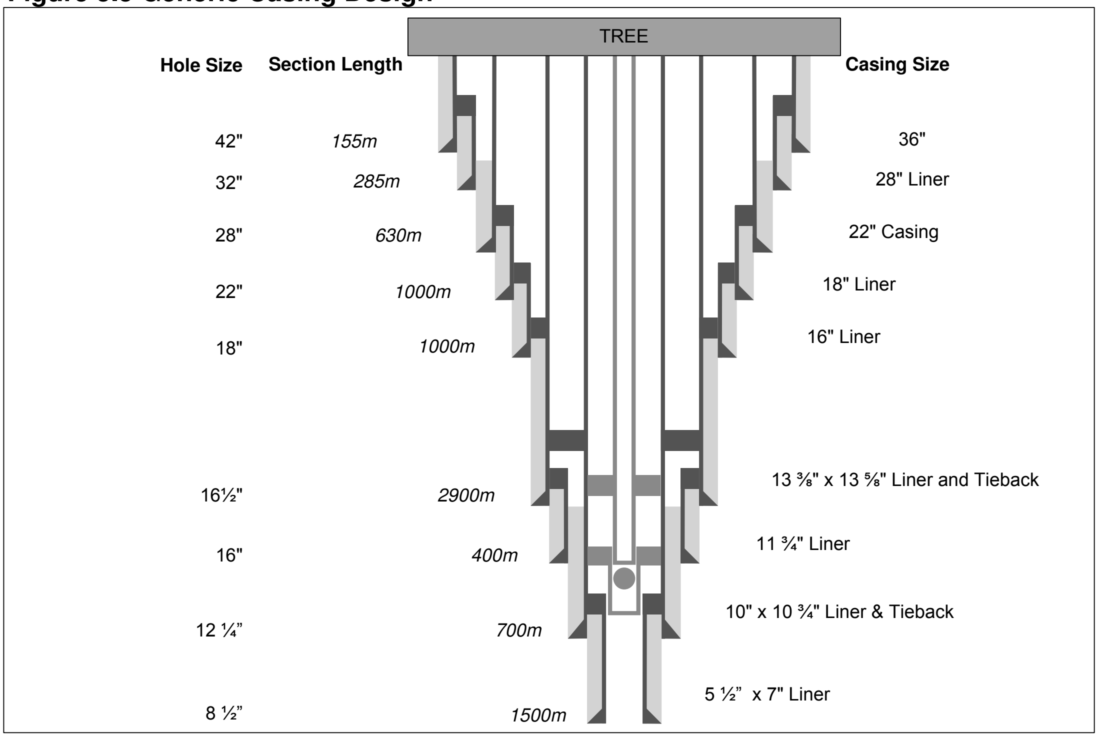
If required each geotechnical hole will be drilled to a depth of approximately 585m below seabed. Up to 4 holes may be drilled.

The generic design for the wells is presented in Table 5.3 and illustrated in Figure 5.5**.** The casing design for the wells will be similar to the existing SD well designs. It should be noted that the section lengths shown in Figure 5.5 are generic and will be relevant to all wells although there will be small fluctuations in length between well locations. Section lengths may vary depending upon where they are drilled in the field and will be optimised based upon the most current geological and reservoir data.

Table 5.3 SD2 Project Generic Well Design

Casing Size (in)	Hole Size (in)	Section Length (m)	Mud System	Disposal Route of Drilling Muds/Cuttings
36"	42"	155	Seawater PHB Sweeps	Discharge to sea at seabed.
28"	32"	285		
22"	28"	630	WBM	Discharge to sea via rig cuttings discharge chute or to seabed via hose.
18"	22"	1000	LTMOBM	Ship to shore.
16"	18"	1000		
$13^3/_8$/ $13^5/_8$"	$16^1/_2$"	2900		
$11^3/_4$"	16"	400		
10" X 10 $^3/_4$"	$12^1/_4$"	700		
$5^1/_2$" X 7"	$8^1/_2$"	1500		

Figure 5.5 Generic Casing Design



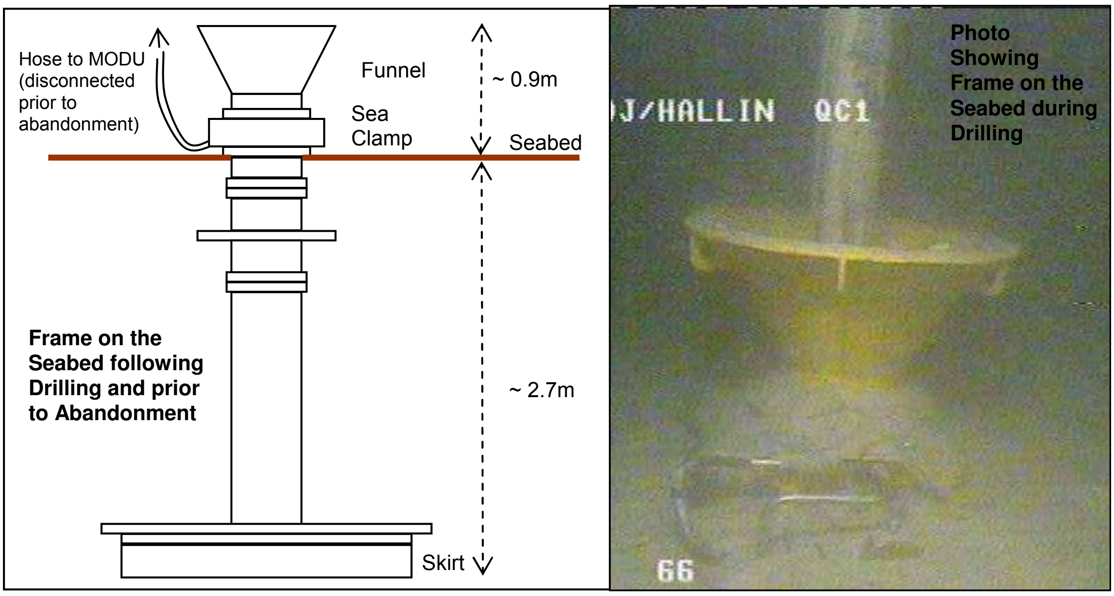
5.4.2.2 Drilling String Lubrication

Prior to the start of any drilling activities, the rig crew will apply pipe dope to the internal surfaces of the drilling string joints to prevent thread damage. Pipe dope is a lubricating grease which prevents the joints from becoming stuck together under high torque conditions. It is anticipated that BESTOLIFE 3010 Ultra (OCNS Category E) or a similar heavy metal free dope will be primarily used for this purpose with a small volume of heavy metal dope (e.g. Weatherford Lube Seal (UK)) used for certain operations, including tubing connections and associated completions for reliability and safety reasons. It is expected that trace amounts of pipe dope will be discharged to sea when drilling surface and top holes with seawater and PHB sweeps (42” and 32” hole sections) and with WBM cuttings (geotechnical holes and 28” hole section).

5.4.2.3 Geotechnical Seabed Frame

Prior to drilling the geotechnical holes in each flank, it is planned to install a frame, made of steel, on the seabed to guide the drill string during drilling as illustrated in Figure 5.6. Once in place, the frame will be static with the exception of the sea clamp, which will be operated from the rig via a hose filled with seawater. A small discharge of seawater to sea is anticipated when drilling is completed and the hose is disconnected**.**

Figure 5.6 Geotechnical Seabed Frame



Following completion of geotechnical drilling, the frame will extend approximately 0.9m above the seabed. It is planned to leave the frame in-situ upon completion of the geotechnical drilling work. The frame is made of steel and therefore inert. It contains no components that will result in discharges of chemicals. Due to the frame penetrating into the seabed and the associated suction forces of the seabed sediments, removal of the frame would require jetting of the seabed sediments using high pressure water hoses, resulting in further seabed disturbance. Leaving the frame in-situ is therefore considered the preferred option from an environmental perspective.

5.4.2.4 Drilling Fluids and Cutting Generation

Pilot and Geotechnical Holes and Upper 42”, 32” and 28” Hole Sections

If required the pilot and geotechnical holes will be drilled using a WBM system which will be pumped down the drill string, forcing the cuttings back up the borehole to the seabed. Drill cuttings will be discharged directly to the seabed. The holes will then be displaced using a weighted WBM. If necessary water based kill mud will also be used to control the fluids within the holes.

The 42" and 32" hole sections of each well will be drilled using a seawater system with drill cuttings discharged directly to the seabed. While drilling, the borehole will be cleaned out using high viscosity sweeps of PHB. The 36" and 28" diameter casings will be installed following drilling of the 42" and 32" hole sections respectively. Following drilling of the 32" hole section it is planned to pump a weighted WBM to the well to control the well during the installation of the 28" casing. The 36" and 28" casings are designed to support the load from the subsequent casing strings.

Following installation of the 36" and 28" casings, the 28" hole section will be drilled using a different weighted, WBM system, designed to stabilise the borehole and allow an increase in the pressure on the borehole wall.

For the pilot and geotechnical holes and the upper sections of the wells, it is proposed to use PHB sweeps and a WBM of the same specification and environmental performance as used for previous SD wells (refer to Chapter 9 for environmental performance/toxicity details). If there is a requirement to change the sweeps/drilling mud composition or to select different drilling fluids for commercial or technical reasons, the Management of Change Process (see Section 5.16) will be followed.

Table 5.4 presents a summary of the total expected chemical composition of the pilot hole, geotechnical hole and 42", 32" and 28" hole section drilling fluids to be used per hole section.

Table 5.4 Estimated Use of WBM Drilling Chemicals Per Hole – Pilot Hole, Geotechnical Hole and 42", 32" and 28" Sections [1,2]

Chemical	Trade Name	Function	Estimated Use per Hole (tonnes)[1]					Hazard Category[3]
			Pilot	Geo	42"	32"	28"	
Chemicals common to seawater/PHB sweeps and WBM								
Barite	Barite	Weighting Agent	648	1200	116	289	1826	E
Bentonite	Bentonite	Viscosifier	30	90	35	54		E
Soda Ash	Soda Ash	Alkalinity Control	3	7	1	0.7	2	E
Chemicals associated with WBM only								
Poly Anionic Cellulose	Polypac UL	Water soluble polymer designed to control fluid loss	6	12	2.1	3.5	19	E
Xanthan Gum	Duovis	Viscosfier	4	6	0.35	0.85	5	E
Nut Shells	Nut Plug	LCM/Pipe scouring	3	3	0.7	1.4		E
Salts (KCl)	Potassium chloride	Borehole stabiliser / shale inhibitor					325	E
Poly Ether Amine/Poly Ether Amine Acetate Blend	Ultrahib	Shale Inhibitor					96	GOLD
Aliphatic Terpolymer	Ultracap	Anti-acretion additive					7	GOLD
Ester/Alkenes C15-C18 Blend	Ultrafree	Shale Encapsulator					92	GOLD
Polyproplene Fibres	Super Sweep	Hole cleaning agent					2	GOLD
Magnesium oxide	Magnesium oxide	pH control			6			E

Notes:
1. A full list of chemicals potentially discharged can be found in Appendix 5B
2. Volumes will depend on the actual subsurface conditions encountered as such these volumes are best estimates based on previous experience.
3. Two methods of hazard assessment are used in accordance with internationally recognised practice - CHARM and Non CHARM. The CHARM Model is used to calculate the ratio of predicted exposure concentration against no effect concentration (PEC:NEC) and is expressed as a Hazard Quotient. Hazard Quotients are assigned to 1 of 6 categories and "GOLD" is the least hazardous category. Those chemicals that cannot be modelled by CHARM are assigned to a category (A to E) based on toxicity assessment, biodegradation and bioaccumulation potential. Category E is the least harmful category. Source: CEFAS, Offshore Chemical Notification Scheme - Ranked Lists of Notified Chemicals, Updated August 2010. Full details of the determination of hazard categories can be found in Appendix 5C.

Used WBM and cuttings from the 28” hole section will be returned to the MODU via a riserless Mud Recovery System (MRS). The riserless MRS consists of a subsea pump located on the seabed with a wellhead adapter which allows the attachment of hoses to the wellhead outlet valves. The seabed pump sucks WBM from the wellhead and returns it, along with cuttings to the MODU via a series of hoses. The mud and cuttings will then be treated in a solids control unit, separating mud from the cuttings onboard the MODU. However, mud / cuttings from the 28” hole section may be discharged directly to the seabed if required due to technical practicalities or safety issues.

The MRS does not seal the wellhead; it is open to allow the drill bit and drillstring access to the wellbore. To prevent excess mud being pumped out of the top of the wellhead, the pump rate of the subsea pump and rig mud pumps must be consistent. This is managed using a camera system which is installed on top of the MRS to monitor the mud level in the wellhead; the operator of the subsea pump and the driller will communicate to maintain consistent pump rates.

However, if, as a result of shale hydration, the MRS hoses become blocked then excess mud will be pumped out of the top of the wellhead and discharged at the seabed, similar to the 42” and 32” hole sections. Discharge at the seabed may also occur if there is a sudden flow of sands or fluids from the well onto the seafloor, known as shallow flow. This would be controlled by pumping mud at a high rate down the well causing the discharge of excess mud at the seabed. This would be undertaken for safety reasons as the MRS system does not have a well control capability[3].

The intention is not to routinely discharge WBM at the seabed, but if a blockage of the MRS hoses occurs, then WBM will be discharged while the hoses are cleared. It is not possible to shut down the MRS while the blockage is cleared as it is necessary for any rock cuttings in the hole to be removed to avoid the drillstring becoming stuck.

It is anticipated that it will take 10-15 minutes to restore the MRS and depending on the stage of drilling, the discharge volume would vary between 13-62m^3.

WBM cuttings will be discharged below the sea surface from the Istiglal and Heydar Aliyev in accordance with applicable PSA requirements[4]. WBM cuttings from the MODU can alternatively, be discharged directly to the sea bed using a hose fitted to the MODU cuttings chute.

It is not possible to preserve the separated WBM to allow for shipping to shore or other drilling rigs/platforms upon completion of drilling the geotechnical holes and the 28” hole sections. When drilling of the geotechnical holes and the 28” hole sections is completed excess mud will be discharged to sea in accordance with PSA requirements[4]; the total quantities for the SD2 Project are summarised in Table 5.6 below.

Depending on the drilling schedule, it is possible that batch setting may be undertaken. This involves drilling and casing the top hole sections (42” and 32”) of a number of adjacent wells, then temporarily suspending them with WBM treated with magnesium oxide before returning to drill the 28” and lower hole sections of the wells. The treated WBM would be discharged to sea from the top hole sections. During suspension the well would be isolated from the environment using a corrosion cap.

Lower 22”, 18” $16^{1}/_{2}$” 16” $12^{1}/_{4}$” & $8^{1}/_{2}$ Hole Sections

To improve well bore stability, ensure appropriate lubrication, inhibit potential reactions with the shale sequence present in the Contract Area and minimise the risk of stuck pipe, it will be necessary to change to a Low Toxic Mineral Oil Based Mud (LTMOBM) for the 22”, 18” $16^{1}/_{2}$” 16” $12^{1}/_{4}$” & $8^{1}/_{2}$ lower hole sections. The density of the drilling mud system will be monitored and adjusted by the addition of chemicals according to the down-hole conditions.

[3] Well control equipment is not installed at this stage to mitigate against weak formation.
[4] There shall be no discharge of drill cuttings or drilling fluids from the MODU if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

The density and chemical composition of the LTMOBM will be dependent on the actual well conditions encountered during drilling operations.

Table 5.5 presents the typical composition and estimated volumes of LTMOBM expected to be used per hole.

Table 5.5 Estimated Use of LTMOBM Drilling Chemicals Per Hole –22", 18" 16$^1/_2$" 16" 12$^1/_4$" & 8$^1/_2$ Lower Hole Sections

Chemical	Trade Name	Function	Estimated Use per Well (tonnes)[1]	Hazard Category[2]
			All lower hole sections	
Barite	M-I-Barite	Weighting Agent	4150	E
Base Oil	Escaid 110	Mineral Oil base fluid	2522	C
Organophyllic Clay	VG Plus	Viscosfier	79	E
Graphite & Lignite	Versatrol M	Fluid Loss Control	72	E
Calcium hydroxide	Lime	Alkalinity control	36	E
Emulsifier	SUREMUL PLUS	Mud Stability	131	D
SBM Polymer	Ecotrol RD	Fluid Loss Control	9	E
Calcium Chloride	Calcium Chloride	Borehole Stabiliser	339	E
Polyamide/Ethanol	EMI-1005	Viscosfier	10	*
Acrylic Graft Polymer	EMI-2223	Anti-accretion	10	*
Calcium Carbonate	Safecarb Z4	Lost Circulation and seepage control	100	E
Calcium Carbonate	Durcal 130	Lost Circulation and seepage control	85	E
Graphite	G Seal Plus	Lost Circulation and seepage control	85	E

* Not currently listed into UK OCNS Ranked Lists of Notified Products
Notes as per Table 5.4

Used LTMOBM and associated cuttings will be returned to the MODU via the marine riser, installed after the 22" diameter casing has been cemented in place. Onboard the MODU, mud and cuttings will pass through the MODU Solids Circulation System (SCS) that separates LTMOBM from cuttings via a series of shale shakers, a vacuum degasser and centrifuges, which in turn, separate increasingly smaller cutting particles from the mud. Separated LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. LTMOBM associated drill cuttings will be contained in dedicated cuttings skips on the rig deck for subsequent transfer to shore for treatment and final disposal. It is not planned to release any LTMOBM or associated cuttings into the marine environment.

5.4.2.5 Summary of Mud and Cuttings

Table 5.6 presents the estimated quantities of waste drilling fluids and cuttings for each geotechnical hole (if required) and each well hole section (based on the experience of the project engineers and the diameter and length of each well section) and the planned disposal route.

Table 5.6 Estimated Well Cuttings and Mud Volumes Per Hole

Hole Size (Drill Bit Diameter)	Description	Estimated Fluids Discharged (Tonnes)[1,2]	Estimated Cuttings Discharged (Tonnes)	Estimated Cuttings Shipped to Shore (Tonnes)	Estimated Fluids Shipped to Shore (Tonnes)	Drilling Fluid/ Mud System	Cuttings and Mud Disposal	Duration of Discharge (hours)
12 1/4"	Pilot hole	1,015	50	0	0	WBM	At seabed	60
9"	Geotechnical hole	1,930	75	0	0			576
	Residual Mud (following geotechnical hole drilling)	495	n/a	0	0	WBM	To sea via rig cuttings caisson	6
42"	Conductor and Surface Holes	1,339	443	0	0	Seawater & PHB sweeps	At seabed	60
32"		1,339	442	0	0			60
28"	Surface Hole	522	729	0	0	WBM	To sea via rig cuttings caisson or hose. Plan to use MRS to recover mud.	50
	Residual Mud at end of WBM drilling	943	n/a	0	0		To sea via rig cuttings caisson	48
18" 16.5" 16" 12 1/4" 8.5"	Lower Holes	No planned discharge		2,823	Up to 5,062[3]	LTMOBM	Ship to shore.	

Notes:
[1]The WBM chemical usage includes water. Currently WBM is not stored for reuse. Untreated WBM is not stable over extended periods without additions of viscosifier and biocide.
[2] Note that estimates of WBM discharged is not equivalent to the estimated volumes of chemical used as per Table 5.4. This is because allowance is made for mud volumes left behind in casings.
3 Estimated volume of LTMOBM shipped to shore is conservative as it excludes mud volumes left behind in the well following casing, attached to the cuttings shipped to shore and the LTOBM returned to shore for reuse on subsequent wells.

5.4.2.6 Casing and Cementing

Once each hole section is drilled, a steel casing string will be installed and cemented into place. The casing provides structural strength for the well, protecting it from weak or unstable formations and is cemented into place by pumping cement slurry into the well bore. The cement passes around the open lower end of the casing and into the annulus between the casing outer wall and the host rock formation in the case of the top-hole conductor. For subsequent casings, the cement passes between the casing outer wall and inner wall of the previous casing. For each surface casing string (42" and 32" hole sections), some loss of cement to the seafloor usually occurs due to the need to slightly overfill the annulus to complete the casing cementing, required to ensure the casing is fully cemented to the seabed to prevent the well and specifically the conductor section from becoming unstable and potentially failing. Cement losses per well are estimated to occur over approximately 1 hour per hole.

The volume of cement used to cement each casing is calculated prior to the start of the activity. Sufficient cement is used to ensure that the casing is cemented securely and necessary formations isolated so that this safety and production critical activity is completed effectively while minimising excess cement discharges to the sea. However, at the end of cementing each casing string excess cement will remain in the MODU cement system. It is not technically practicable or safe to recover this.

Excess cement remaining in the cement system will be mixed with seawater and discharged to the marine environment following the cementing of each casings. The discharge will take approximately an hour at a rate of 8 barrels per minute. Excess cement from well cementing will be discharged using a hose located below the sea surface, for both the Istiglal and Heydar Aliyev. Dry cement will not be discharged to the marine environment under routine conditions.

Table 5.7 below presents the estimates of the worst-case volume discharged to the seafloor during casing cementing and from the drilling rig to sea during wash out of the cement unit. The estimated discharges of each cement chemical and the associated hazard categories are presented in Appendix 5B.

Table 5.7 Estimated Discharge of Well Cement Chemicals per Hole During Cementing and Cement Unit Wash Out

Activity	Discharge Route	36" Casing	28" Liner	22" Casing	18" Liner	16" Liner	13 3/8" X 13 5/8" Casing	11 1/4" Liner	10" X 10 3/4" Liner & Tieback
		Estimated Discharge per Casing/Liner (tonnes)[1]							
During casing/ liner cementing	To seafloor	60.0	57.2	48.7	6.5	6.38	9.0	4.4	8.6
During cement unit wash out[1]	To sea (via hose)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Note 1. Discharge comprises cement and water.

Following drilling and cementing, seabed levelling work may be required at the well locations to remove any accumulation of drill cuttings and cement, involving either mechanical excavation or jetting with seawater, prior to subsea installation works.

5.4.2.7 Drilling Hazards and Contingency Chemicals

A number of contingency chemicals will be retained for use in the event that hazards are encountered during drilling, predominantly associated with downhole mud losses. These are a risk due to the relationship between the pore pressure and the rock strength. Well paths are deliberately chosen to avoid zones of excessive pore pressure, where the pore pressure approaches the fracture pressure of the rock. The mud weight required to stabilise the borehole effectively fractures the rock and results in downhole losses. To prevent this, Loss Control Materials (LCM) can be added to the mud system. In addition magnesium oxide is also retained on the rig should batch setting be undertaken as described in Section 5.4.2.4 above.

Table 5.8 lists the anticipated chemicals intended to be stored on the rigs, used in the event of contingencies when drilling with WBM and subsequently discharged with the WBM either to the seafloor or from the MODU. By definition the use of contingency chemicals cannot be predicted with accuracy, although their use will be minimised to the extent practicable in accordance with operational needs.

Table 5.8 Estimated Usage of WBM Drilling Contingency Chemicals per Hole

Chemical Trade Name	Function	Estimated use per Hole (tonnes)[1]	Hazard Category[2]
STARCARB	Sealing/Bridging Agent	15	E
STEELSEAL	Sealing/Bridging Agent	15	E
EZ SPOT	Spotting Fluid	2.3	*
STARCIDE	Biocide	1.3	GOLD
OXYGON	Oxygen Scavenger	0.3	E
SOURSCAV	H_2S Scavenger	1.9	GOLD
Bentonite	Viscosifier	5	E
Sodium Bicarbonate	Alkalinity Control	1	E
Magnesium Oxide	pH Control	6	E

* Not currently listed into UK OCNS Ranked Lists of Notified Products
[1]Notes as per Table 5.4

The majority of contingency chemicals are planned to be used during lower hole drilling and will be recovered with the LTMOBM and shipped to shore for disposal. Contingency chemicals required during drilling of the 42”, 32” and 28” hole sections will be discharged with the seawater/PHB sweeps to the seabed or with the WBM cuttings via the rig cuttings chute.

5.4.3 Well Displacement

Displacement of the SD2 Project wells will be achieved by circulating a number of fluid slugs or “pills”. The function of the displacement pills (lighter synthetic mud sweeps) is to displace any LTMOBM from the well. During well displacement, displacement pills will be circulated back to the MODU with the LTMOBM and either be reused/recycled or will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures. Displacement chemicals or fluids will not be discharged to the marine environment under routine conditions. Solids collected within the MODU separator during well displacement will be collected and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

5.4.4 Blow Out Preventer (BOP) and Wellhead Brace

5.4.4.1 BOP Operation

A blow out preventer (BOP) will be installed on all wells to control pressure in the well prior to installation of the well production facilities. The BOP control system uses hydraulic fluids to actuate the BOP valves. The response time between activation and complete function is based on the BOP valve closure and seal off time. For subsea installations, the BOP control system should be capable of closing each ram BOP in 45 seconds or less. Closing times should not exceed 60 seconds for annular BOPs. In order to comply with these response times, it is necessary to discharge small volumes of hydraulic fluid to sea; this design and practice is used in all BOP installations worldwide.

The BOP fluid comprises a proprietary control fluid (Stack Magic ECO Fv2), propylene glycol and water. The active components of Stack Magic ECO Fv2 and the typical proportions of this product, propylene glycol and water in the BOP fluid as a whole are summarised in Table 5.9.

Table 5.9 Percentage Composition of Stack Magic and BOP Fluid

Control Fluid	Percentage	BOP Fluid	Percentage (%)
Ethylene glycol	10-**30**	Control Fluid	3-**5**
Monoethanolamine	1-**10**	Propylene glycol	5-**25**
Triazine	1-**5**	Water	**70**-90
Triethanolamine	1-**10**		
Water	**45**-87		

It is anticipated that BOP testing will take place weekly for each well from when the BOP is installed to the end of completion activities (approximately 210 days for each well). On alternate weeks, either function testing (one pod) or full function/pressure testing (two pods) will be carried out. Table 5.10 summarises individual discharge events and the estimated volume discharged per event for two pod full function/pressure testing. Discharges from single-pod flushing will be 50% of the volumes and durations indicated in Table 5.10.

Table 5.10 Summary of BOP Fluid Discharge Events Per Well – Two Pods

BOP Function	Volume (litres)	Duration (min)	Depth	Frequency
Upper Annular	654	3.00	Depends on well location: WS: 410m ES: 530m WF: 165m EN: 470m NF: 70m	Fortnightly – 2 pod test
Lower Annular	644	3.00		
Upper Pipe Ram	260	1.16		
Middle Pipe Ram	264	1.16		
Lower Pipe Ram	70	1.16		
Upper Outer Choke (U.O.C) line	20	0.57		
Upper Inner Choke (U.I.C) line	20	0.57		
Lower Outer Choke (L.O.C) line	20	0.57		
Lower Inner Choke (L.I.C) line	20	0.57		
Upper Outer Choke (U.O.K) line	20	0.57		
Upper Inner Kill (U.I.K) line	20	0.5		
Lower Outer Kill (L.O.K) line	20	0.5		
Lower Inner Kill (L.I.K) line	20	0.5		
Total	**2,052**	**13.8**		

5.4.4.2 Wellhead Brace Installation

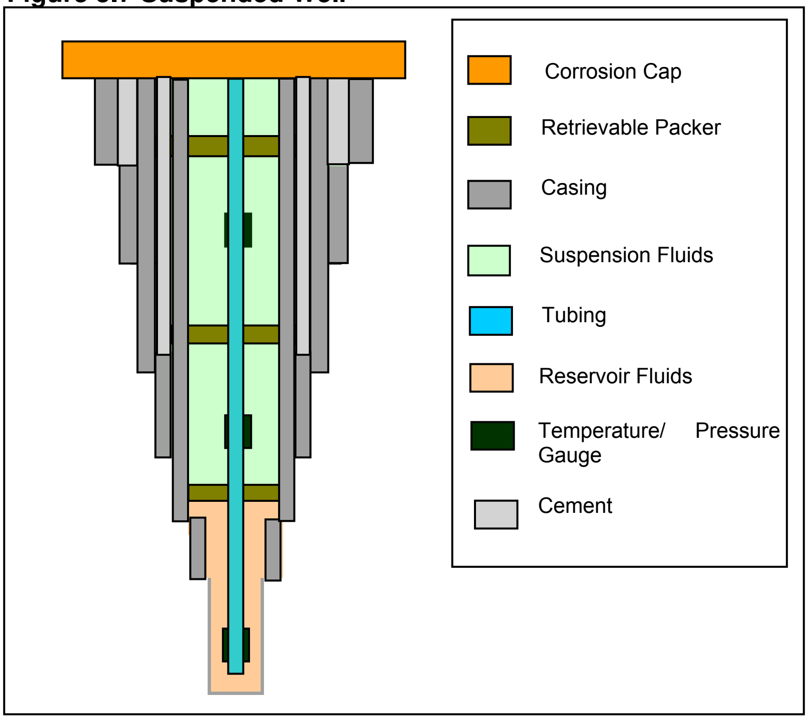
To support the wellhead during installation of the BOP and production tree it is planned to install a wellhead brace at each well location. The purpose of the brace is to minimise wellhead fatigue caused by the weight of the combined BOP and production tree. It is planned to install the bracing frame over the wellhead on the sea floor, temporarily supported by mudmats and subsequently secured using three piles. The frame and wellhead will then be connected, potentially using a grouted connection, which may result in a small discharge of cement to the seabed in the immediate vicinity of the wellhead.

5.4.5 Well Suspension

Following drilling, casing, cementing and displacement, the well is temporarily suspended by filling it with treated brine, which will protect it from any pressurised formations. It is anticipated that either calcium bromide, calcium chloride or sodium chloride brine will be used, depending on the downhole conditions of each well. Well suspension fluids will not be discharged to the marine environment under routine conditions.

The well will be isolated using mechanical packers, which isolate the zones within the well and a corrosion cap is installed on the subsea wellhead. The purpose of the cap is to cover the well until the production tree is installed. Figure 5.7 shows the suspended well.

Figure 5.7 Suspended Well



5.4.6 Well Re-entry and Completion

Well re-entry and completion activities will be undertaken for all 26 SD2 wells from either the Istiglal or Heydar Aliyev MODU. Following removal of the corrosion cap, the production tree will be installed and brines (as described within Section 5.4.5) will be circulated in the well to remove any remaining solids. Completion activities required to make the well ready for production will then commence. The intermediate completion will involve installation of a lubricator valve and packers into the wells to allow the well to be perforated in the presence of the brine such that perforated section remains isolated below the valve. The perforation gun assembly will be withdrawn through the valve and the well cleaned up using surfactant sweeps and clean brine.

Production tubing and associated down-hole tools (e.g. pressure gauges and down-hole safety valves) will then be installed and freshwater and MEG circulated within the well. The well will then undergo final clean up. It is planned to circulate all completion and clean up fluids back to the MODU, where they will be contained and shipped to shore for disposal. It is not planned to discharge any completion fluids.

During clean up as fluids flow to the MODU, it is anticipated that up to 500mmscfd (250mmscfd on average) will be flared on the MODU per well for up to 2 days.

5.4.7 Well Testing

The current base case assumes that well testing of one well in the WS flank and one well in EN flank will be undertaken. Well tests comprise flowing of formation fluids to the surface where pressure, temperature and flow rate measurements are made to evaluate well performance characteristics. The flow test, expected to last for up to 150 hours in total, will result in flaring of up to approximately 250mmscf of gas per well.

During the tests, gas and condensate will flow up the drilling string to the MODU where they will be separated, analysed and then flared at the rig flare boom. Solids collected within the MODU separator during flaring will be collected and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures. It is estimated approximately 400kg of solids (comprising mostly sand and rock) will be collected per well.

Estimated volumes of atmospheric emissions associated with potential well testing are provided in Table 5.11 below. Further details associated with flare testing including an overview of the BP Well Test Assurance Process, designed to minimise flaring through effective well planning, are provided in Chapter 4 Section 4.10 of this ESIA

5.4.8 Well Workover and Intervention Activities

In order to maintain production it will be necessary to re-enter the SD2 wells from a MODU to undertake workover and intervention activities. These will include logging activities, circulating chemicals to remove build up of solids, re-perforations and replacement of tubing as well as drilling of sidetracks to improve flow from the SD2 wells. It is anticipated that there could be up to a total of 160 separate intervention events following well start up with each event requiring up to 9 days of MODU support per year. It is estimated that approximately half of the anticipated intervention events will result in flaring of up to 80MMscfd for one day. Solids collected within the MODU separator during flaring will be collected and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures. During intervention events all workover and intervention fluids will be circulated back to the MODU, where they will be contained and shipped to shore for disposal. It is not planned to discharge any workover and intervention fluids.

5.4.9 MODU Drilling and Completion Emissions, Discharges and Waste

5.4.9.1 Summary of Emissions to Atmosphere

Table 5.11 summarises the GHG (i.e. CO_2 and CH_4[5]) and non GHG emissions predicted for the SD2 Project MODU drilling and completion activities. Key sources include:

- MODU engines and generators;
- MODU support/supply vessel engines; and
- Non routine flaring associated with well testing, clean up and intervention/workover activities.

Table 5.11 Estimated GHG and Non GHG Emissions Associated with Routine and Non Routine Drilling, Completion and Intervention Activities

	MODU	Support Vessels	Flaring	TOTAL
CO_2 (ktonnes)	229.6	546.5	619.8	**1,395.9**
CO (tonnes)	1,123.8	1,284.4	1,483.2	**3,891.4**
NO_x (tonnes)	3,577.1	9,392.5	265.6	**13,235.2**
SO_x (tonnes)	287.0	1,276.6	2.8	**1,566.3**
CH_4 (tonnes)	10.8	42.9	9,961.8	**10,015.5**
NMVOC (tonnes)	41.4	385.3	1,106.9	**1,533.6**
GHG (ktonnes)	229.8	547.4	829.0	**1,606.2**

Refer to Appendix 5A for emissions estimate assumptions.

5.4.9.2 Summary of Discharges to Sea

Table 5.12 provides a summary of the total estimated routine and non routine drilling fluid, cuttings and cement discharges to sea across the SD2 Project programme associated with planned activities.

Table 5.12 Total Estimated Drilling Fluids and Cement Discharges to Sea

Discharge	Frequency	Location	Estimated Volume (tonnes)	Discharge Composition
Seawater, PHB sweeps and cuttings	During 42" and 32" hole section drilling	Seabed	14,160 cuttings and 42,848 drilling fluids	Refer to Table 5.4
WBM and cuttings	During pilot hole drilling	Seabed	200 cuttings and 4060 WBM on cuttings	Refer to Table 5.4
	During geotechnical hole drilling	Seabed	300 cuttings and 7,720WBM on cuttings	Refer to Table 5.4
	During 28" hole section drilling	To sea (via cuttings chute)	11,664 cuttings and 8,352 WBM on cuttings	Refer to Table 5.4
Cement and cement chemicals	During each casing cementing	Seabed	3,206	Refer to Appendix 5B
Residual WBM	At end of geotechnical hole and 28" hole drilling	To sea (via cuttings chute)	17,068	Refer to Table 5.4
Residual cement	At the end of each casing section	To sea (via cuttings chute)	256	Refer to Appendix 5B

Note 1. Should the MRS fail or it becomes technically impractical or unsafe to use it, WBM and cuttings from the 28" hole section will be discharged directly to the seabed.

Discharges of hydraulic fluids to sea due to testing of the BOP are detailed in Section 5.4.4.1 above.

[5] To convert to CO_2 equivalent the predicted volume of CH_4 is multiplied by a global warming potential of 21.

5.4.9.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste generated during the SD2 Project drilling programme are provided in Table 5.13. Waste quantities have been estimated based on operational data from the drilling programmes of the previous SD wells using the Istiglal rig.

All waste generated during MODU drilling and completion activities will be managed in accordance with the existing AGT waste management plans and procedures. The planned destination of each waste stream is provided within Section 5.14.2 below.

Table 5.13 Drilling and Completion Activities Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Cement	2,521
		Domestic/Office waste	2,155
		Metals - swarf	802
		Paper and cardboard	12
		Wood	547
		Total (Non-hazardous)	**6,037**
Hazardous	Solid wastes	Batteries - dry cell	3
		Batteries - wet cell	5
		Clinical waste	4
		Contaminated materials	642
		Drilling muds and cuttings SOBM	84,171
		Explosives	1
		Filter bodies	15
		Lamps	1
		Oily rags	318
		Toner or printer cartridges	2
	Liquid wastes	Bentonite	381
		Completion fluids	21
		Drilling additives	1,393
		Drilling muds and cuttings WBM - contaminated	7,598
		Drilling muds and cuttings SOBM	9,808
		Oils - fuel	1,418
		Paints and coatings	12
		Sewage - untreated	124
		Solvents, degreasers and thinners	61
		Water - oily	19,181
		Well suspension fluids	114
		Total (Hazardous)	**125,270**

5.5 Onshore Construction and Commissioning of Terminal Facilities

5.5.1 Introduction

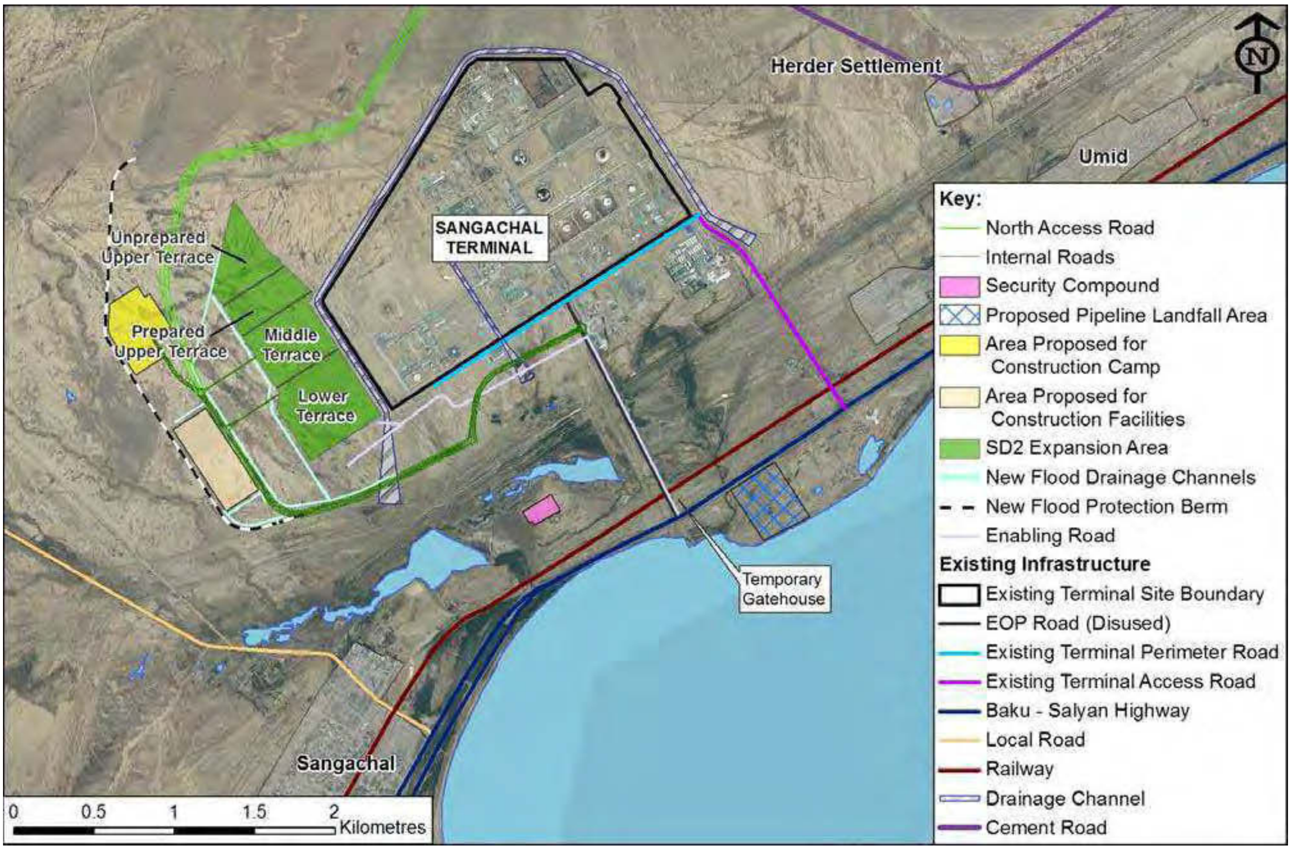
The onshore SD2 processing facilities and associated utilities will be located within the SD2 Expansion Area at the ST, immediately to the west of the existing SD1 facilities and within the current Terminal land ownership boundary.

As outlined in Section 5.1 above the SD2 EIW at the ST are ongoing. It is anticipated the following works will be undertaken as part of the SD2 EIW contractor's scope prior to handover to the SD2 Project contractor during 2Q 2014 (refer to Figure 5.8):

- Construction of access roads (temporary and permanent) to the SD2 Expansion Area and the associated construction areas;
- Construction of a flood protection berm, storm drainage channels and improvement works to the existing drainage in the Terminal vicinity; and
- Profiling of the ground levels across the SD2 Expansion Area.

These activities are assessed within the SD2 Infrastructure ESIA[6]. In addition, a new access road will be constructed between the Baku-Salyan Highway and the SD2 Expansion Area to the north of the Terminal.

Figure 5.8 Scope of SD2 Early Infrastructure Works

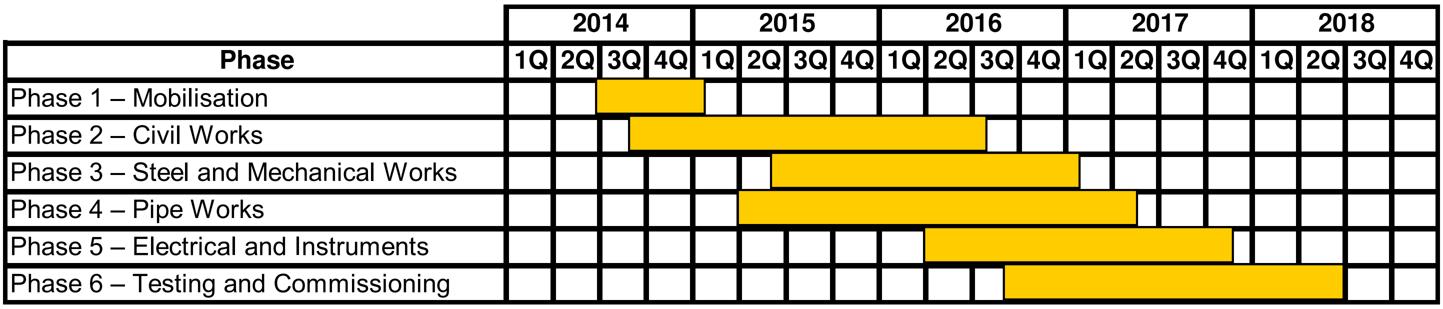


Any residual elements of the SD2 EIW which are not completed by the SD2 EIW contractor will be passed to and become the responsibility of the SD2 Project contractor.

The anticipated schedule for the SD2 Terminal construction and commissioning activities is shown in Figure 5.9.

[6] SD2 Infrastructure ESIA (2012)

Figure 5.9 Expected SD2 Terminal Construction Works Schedule



The key activities associated with each phase are described in Section 5.5.2 below. The facilities and utilities planned to be used to support the SD2 Terminal construction works are described in Section 5.5.3.

5.5.2 Terminal Construction and Commissioning Activities

5.5.2.1 Phase 1 – Mobilisation

Phase 1 of the works (mobilisation) is planned to include the completion of the preparation works at the Terminal not completed by the SD2 EIW contractor. In addition to completing any site clearance, access road and profiling work, these are expected to include:

- Construction and fit out of construction camp comprising:
  - Accommodation;
  - Laundry;
  - Communications and information technology facilities;
  - Washrooms;
  - Security facilities;
  - Lockers; and
  - Welfare and dining facilities.

- Construction and fit out of construction support facilities including:
  - Offices;
  - Warehouses;
  - Workshops;
  - Laydown areas;
  - Fabrication areas;
  - Laboratory;
  - Cylinder and fuel store;
  - Vehicle maintenance;
  - Dining facilities;
  - Maintenance and radiographics facilities;
  - Medical, welfare and changing facilities.
  - Brownfield site offices within the terminal property boundary to the north east of the current open drains tank and produced water plant; and
  - Car parking facilities.

  Security facilities, site entry and egress systems and site boundary fencing will also be provided. It is planned to locate the construction camp and facilities areas between the new flood berm and the new internal access roads shown in Figure 5.8. All structures are expected to be no more than 10m high once assembled.

- Utility works to connect the construction camp and construction facilities to mains power and water[7]. There are no planned connections to the municipal sewage

[7] It is anticipated that works associated with diversion of overhead and underground power cables required in the vicinity of the SD2 Expansion Area will be completed during the EIW. It is intended that the works will be designed and completed by the power line owner, who will be responsible for managing the works including possible interruptions to power supply.

network. Some of the site telecommunication systems will be tied to public systems. Telephones will be connected to Public Main Fibre Optic Cable. Connections with the mains water supply will be managed in liaison with the utility owner. It is anticipated that pipework associated with the construction camp drainage system will also be installed, leak tested and may be superchlorinated. Effluent from the pipework testing and chlorination that meets the applicable sewage and oil water performance and monitoring standards presented in Table 5.14 will either be used for irrigation and/or dust control or discharged. Out of spec effluent will be collected by road tanker, handled as liquid waste and removed from site.

Table 5.14 Oil Water and STP Discharge Standards

Parameter	Units	Limit Value
Oil Water Standards		
Oil in water (monthly average)	mg/l	10
Oil in water (daily maximum)	mg/l	19
STP Design Standards		
pH	-	6-9
Residual Chlorine	mg/l	<1[1]
		<0.2[2]
BOD	mg/l	20
COD	mg/l	100
Total Suspended Solids (TSS)	mg/l	30
Total Coliforms	MPN/100ml	<400

Notes: 1. Applicable to treated sewage used for irrigation or dust control. 2. Applicable to treated sewage discharged to the environment.

- Construction and commissioning of a modular type Sewage Treatment Plant (STP) sized to accommodate sewage generated from:

  - North construction camp and south construction facilities; and
  - SD2 Terminal Expansion Area;

  The STP will be designed to treat domestic water (including grey and black water) to applicable performance and monitoring standards in Table 5.14. During construction of the SD2 onshore facilities, sewage will be routed to the new STP when operational or collected by road tanker, handled as liquid waste and removed from site.

  Under routine conditions it is planned that treated sewage from the new STP will be either:

  - Discharged to the Shachkaiya Wadi; or
  - Used for irrigation purposes or for dust control where practicable and required.

  Sewage sludge will be transported off site for disposal to an appropriately licensed facility. Sumps will be used to provide contingency storage when the STP requires maintenance or is not available. Waste water from the sumps will be collected by road tanker, handled as liquid waste and removed from site.
- Construction of a central waste accumulation area (CWAA) for use during SD2 onshore facilities construction where waste will be segregated and stored prior to transport offsite.
- Construction of a dedicated vehicle refuelling facility (approximately 300m^2) for vehicle refuelling. The area will include lined concrete bunds, sized to contain 110% of the stored fuel capacity. Drainage within the refuelling facility will be routed to an oil water separator system. The refuelling facility oil water separators will be tested on a daily basis to confirm the total oil content is less than 19mg/l daily average and 10mg/l monthly average. Wastewater from the refuelling facility that does not meet the applicable discharge standards and separated oil will be collected by road tanker,

handled as liquid waste and removed from site. Once the refuelling facility is operational it is intended that plant and vehicles associated with the SD2 Infrastructure Project will either be refuelled at the facility or in the location where they are operating via mobile fuel bowsers.

- Construction of a vehicle wash facility. Wastewater from the vehicle wash facility will either be reused or discharged following treatment via an oil water separator. The vehicle wash facility oil water separators will be tested on a daily basis to confirm the total oil content is less than 10mg/l. Wastewater from the vehicle wash facility that does not meet the applicable discharge standards and separated oil will be collected by road tanker, handled as liquid waste and removed from site.
- Construction of a potable water plant designed to treat mains water to potable water standards.

While not included within the Base Case Design, space has been allocated for a concrete batching plant and an associated area for materials and precast storage.

The drainage system within the construction camp and construction facilities area will be designed to:

- Route wastewater from the vehicle wash and refuelling facilities for reuse or discharged after treatment using oil water separators. The oil water separators will be designed to treat wastewater from the vehicle wash facility to applicable oil water standards of 19 mg/l daily average and 10 mg/l monthly average. The separators will be tested on a daily basis to confirm the total oil content daily and average standards are met. Wastewater from the vehicle wash and refuelling facilities that does not meet the applicable discharge standards will be collected by road tanker, handled as liquid waste and removed from site.
- Route canteen waste water to the STP via a dedicated system to separate fats, oil and grease to minimise potential fouling of the STP. The contents of the traps will be collected by road tanker, handled as liquid waste and removed from site.

It is expected that high level lighting, designed in accordance with international standards e.g. ILE requirements, will be erected at the construction camp and construction facilities areas.

5.5.2.2 Phase 2 – Civil Works

Following mobilisation, construction works are planned to commence with civil works comprising:

- Piling – Piling will be undertaken across the lower, middle and upper terraces to support the majority of the foundations across the SD2 Expansion Area. A total of approximately 10,000 piles are planned, varying between 450-900mm in diameter and 10-15m in length. Piling is anticipated to last approximately 390 days with 25 piles installed per day;

  Underground pipework - This will comprise pipework associated with clean storm water drainage, open (contaminated) drainage, closed drainage and firewater networks within the SD2 Expansion Area;

- Pile Caps and Foundations – Following piling it is planned to install pile caps and ground beams and lay the foundations for all main structures including :
  - Off Specification Condensate Tank;
  - Condensate Storage Tank (located within the existing Terminal boundary);
  - Rich MEG Storage Tank;
  - Lean MEG Storage Tank;
  - Produced Water Storage Tank;
  - Open Drains Holding Tank; and
  - Fire Water Holding Tank.

The current base case design for the bund floors and berms for these tanks (with the exception of the Fire Water Holding Tank) assumes that the clay available on site can be re-compacted to provide a liner of sufficiently low permeability, in conjunction with a continuous High Density Polyethylene liner. Compaction trials are planned to confirm the suitability of the compacted clay for this purpose, in the event the clay is found to be unsuitable an alternative lining system will be selected; and

- Road and Site Civils – It is planned to construct a network of permanent internal roads within the SD2 Expansion Area. These will connect with the internal roads and the access road constructed as part of the EIW.

5.5.2.3 Phase 3 - Steel and Mechanical Works and Phase 4 - Pipe Works

Phase 3 will involve the fabrication and erection of pipe racks and structural steel work in addition to the installation of mechanical equipment (i.e. pre fabricated process and utility equipment and associated components) and Non Destructive Testing (NDT). All steelwork will have been grit blasted and painted prior to arrival on site. Assembly of the steel structures will be undertaken on site with minor repairs to paintwork damaged during erection undertaken in the field. It is anticipated that control rooms and administration buildings will be erected at the same time as the mechanical equipment.

Pipe will be welded together in situ. Pipework associated with spool fabrication will be painted offsite whereas the majority of straight pipe sections are expected to be painted on site. Pipework will also be installed to tie in the existing Terminal facilities and the new SD2 facilities where required.

5.5.2.4 Phase 5 – Electrical and Instruments and Phase 6 - Testing and Commissioning

Installation of electrical systems and control systems (Phase 5) will take place after completion of the mechanical systems as most control equipment needs to be fully integrated with mechanical or process equipment.

Following mechanical completion and testing of the electrical and control systems, all equipment will be first pre-commissioned (tested in isolation from other equipment) and then commissioned together with directly associated equipment. It is intended that the following equipment will be hydrotested:

- All process and utility lines;
- Storage tanks; and
- Civil basins / structures (including sumps, manholes and drainage systems).

For each test the system will be filled with freshwater and then emptied. An estimated 212,000m^3 of freshwater will be used. If possible and where practical, the hydrotest water will be temporarily stored and reused. Following the completion of testing the hydrotest water will either be discharged to the site drainage system if it conforms with oil content of less than 19mg/l daily average and applicable project sewage wastewater discharge standards (refer to Table 5.14) or collected by road tanker, handled as liquid waste and removed from site.

Final commissioning and testing activities are planned to comprise:

- Testing of the turbine for SD2 power generation – it is planned to test the power generation turbine over a 21 day period over a range of power loads from idle to full load. Gas will be supplied from the existing SD1 facilities during these tests with power generated exported to the Azeri grid.

- Testing of export gas compression turbines – each gas compression turbine is expected to be run for up to 24 hours. Gas will be supplied from the existing SD1 facilities
- Diesel user testing – it is planned to test the following diesel users for a maximum of 24 hours:
  - Air compressor package; and
  - Firewater pumps.
- Leak testing of vessels and major plant– final leak testing will be completed using inert gas (i.e. nitrogen or nitrogen/helium);
- Open drains treatment system flushing – The open drains treatment system will be flushed using freshwater to remove any debris within the system prior to start up. Prior to flushing of the complete drainage system, water samples from all drainage sumps will be tested to confirm the oil content. If the oil content of the water in the sumps exceeds 19mg/l daily average[8] the contents of the sump will be collected by road tanker, handled as liquid waste and removed from site. If the total oil content of the water in the sumps is lower than 19mg/l, the sump content will be discharged to the storm drainage channels.
- Produced water system – It is planned to send produced water from the SD2 produced water treatment system which meets the relevant inlet specifications to the ACG produced water treatment facilities. Off spec produced water during commissioning will be sent to the SD2 produced water holding tank and either recycled to the SD2 produced water treatment system and then sent to the ACG produced water treatment facilities (if inlet specifications are met) or tankered off site.

5.5.3 SD2 Terminal Facilities Construction Utilities and Support

5.5.3.1 Utilities

Utilities will include:

- Power – the majority of power at the north construction camp and south construction facilities will be provided from the Azeri grid. Emergency back-up by diesel generators will be provided at the construction camp and the construction camp facilities. Diesel generators will also be used across the SD2 Expansion Area during construction and commissioning for temporary power supply prior to completion of electrical system tie in works. When required, the generators will be refuelled from the dedicated refuelling facility by mobile bowsers (see below); and
- Water – potable and non potable water will be available at the north construction camp and south construction facilities. Water for general use within the SD2 Expansion Area (including dust suppression when needed) will be supplied by bowsers as required.

5.5.3.2 Waste

It is planned to route the waste generated during Terminal construction works to a new CWAA (refer to Section 5.5.2.1 above), where it will be segregated and stored prior to transportation offsite. Section 5.5.4 below details the types of waste expected and how waste will be managed across the Terminal construction phases.

5.5.3.3 Fuel Storage and Refuelling

It is intended that plant and vehicles associated with the SD2 Project will either be refuelled at the new SD2 dedicated vehicle refuelling facility or in the location where they are operating via mobile fuel bowsers. Hazardous fuels, oils and chemicals will be securely stored in clearly marked containers in a contained area to prevent pollution.

[8] Note monthly average oil water criteria is not applicable as discharges will be intermittent and of short (~hours) duration.

5.5.4 Terminal Construction Works Emissions, Discharges and Waste

5.5.4.1 Summary of Emissions to Atmosphere

Table 5.15 summarises the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during the SD2 Terminal construction and commissioning activities from key sources which include:

- Onsite construction plant, vehicles and generators (refer to Appendix 5F); and
- SD2 plant and utilities during commissioning.

Table 5.15 Estimated GHG and Non GHG Emissions Associated with SD2 Terminal Construction and Commissioning Activities

	SD2 Terminal Construction	SD2 Terminal Commissioning	TOTAL
CO_2 (ktonnes)	383.6	6.8	**390.4**
CO (tonnes)	2,081.6	7.4	**2,089.0**
NO_x (tonnes)	5,827.2	33.9	**5,861.0**
SO_x (tonnes)	239.8	0.03	**239.8**
CH_4 (tonnes)	20.2	2.3	**22.5**
NMVOC (tonnes)	936.7	0.1	**936.8**
GHG (ktonnes)	384.0	6.8	**390.8**

See Appendix 5A for detailed emission estimate assumptions.

5.5.4.2 Summary of Discharges to Sea

Routine and non routine discharges to the sea during SD2 Terminal construction and commissioning activities comprise:

- Discharge from pipework and chlorination testing (refer to Section 5.5.2.1);
- Discharge from the new STP (refer to Section 5.5.2.1);
- Drainage from the vehicle refuelling area, vehicle wash facility, parking areas and fuel storage areas (refer to Section 5.5.2.1);
- Hydrotest water ((refer to Section 5.5.2.4); and
- Open drains system flushing (refer to Section 5.5.2.4).

5.5.4.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non-hazardous and hazardous waste generated during the SD2 Terminal construction and commissioning activities are provided in Table 5.16.

Table 5.16 Onshore Terminal Construction and Commissioning Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Domestic/office waste	8,555
		Waste electrical and electronic cables	121
		Waste electrical and electronic equipment	0.1
		Paper and cardboard	114
		Plastics – recyclable (HDPE)	11
		Metals - swarf	2,796
		Tyres	97
		Wood	3,212
	Liquid wastes	Oils - cooking oil	17
		Total (Non-hazardous)	**14,923**
Hazardous	Solid waste	Adhesives, resins and sealants	2
		Contaminated materials	55
		Contaminated soils	4
		Oily rags	2
		Toner or printer cartridges	1
	Liquid waste	Oils - lubricating oil / Oils - fuel	11
		Paints and coatings	213
		Solvents, degreasers and thinners	13
		Water - oily	66
		Water treatment chemicals	1,417
		Total (Hazardous)	**1,783**

Waste produced during each phase of the SD2 Terminal Construction and Commissioning works will be segregated and temporarily stored onsite prior to transportation to the existing Sangachal Terminal CWAA or the new SD2 CWAA once complete. All waste generated during each phase of the SD2 Terminal construction and commissioning works will be managed in accordance with the existing AGT waste management plans and procedures. The planned destination of each waste stream is presented in Section 5.14.2 below.

5.6 Onshore Construction and Commissioning of Offshore and Subsea Facilities

5.6.1 Introduction

It is planned to undertake fabrication of the SDB jackets and topsides in Azerbaijan. It has been assumed for the purposes of this ESIA, that a combination of the following construction yards may be used:

- Baku Deep Water Jacket Factory (BDJF) yard[9]: Used extensively during the ACG Projects. It is planned that the jackets and elements of the subsea equipment will be constructed at the BDJF yard;
- Construction yards located on the western fringe of the Bibi Heybet oil field: Either in the South Dock[10] or the yard previously used to construct the ACG DWG-PCWU and Central Azeri Compression and Water Injection (CA-CWP) offshore facilities[11] ; and
- Pipe coating and storage yard.

5.6.2 Yard and Vessel Upgrade Works

The SD2 Project construction activities will require a number of minor upgrade works to be undertaken at the selected construction yards. The scope of the upgrades is dependant on which elements of the offshore facilities and subsea equipment are undertaken at each yard. The scope of potential upgrades includes:

- Extensions of the yard real estate to allow for equipment storage and fabrication;
- Ground improvement work to increase the weight bearing capacity – e.g. piling work, backfilling and ground compaction;
- Electrical system upgrades;
- New piping fabrication shop;
- New or refurbishments of the existing site support facilities, electrical systems, material storage areas, sewage treatment plant and waste handling facilities;
- New painting and blasting facility areas and waste handling facilities; and
- Upgrading on of the onshore skidway and quayside within the jackets yard.

In addition to yard upgrades, upgrades to the following vessels will be required:

- “Israfil Guseinov” pipelay barge;
- STB-1 transportation barge;
- Derrick Barge Azerbaijan (DBA) crane vessel; and
- Diving Support Vessel (DSV).

During reactivation, the vessels’ fire fighting foam systems will be tested. If vessels use biodegradable alcohol resistant aqueous film foaming foam (AR-AFFF) or aqueous film foaming foam (AFFF) products they will be discharged to sea. Non biodegradable foams will not be discharged but will be collected by road tanker, handled as liquid waste and removed from site.

9 Referred to in previous ACG Project ESIAs as Shelfprojectsroi (SPS).
10 Operated by the Caspian Shipyard Company (CSC).
11 Formally known as the Amec-Tekfen-Azfen (ATA) yard.

5.6.3 Subsea Facilities and Pipelines

Materials to fabricate the elements of the subsea facilities to be constructed in country will be received at the selected onshore subsea component fabrication facility. Planned fabrication activities include flame/plasma cutting, welding, grit blasting, painting and insulating, Once complete each element will undergo non destructive testing (NDT) and hydrotesting. Each element will then be appropriately stored until required for offshore installation. A number of subsea elements will be imported and may undergo non destructive testing (NDT) and hydrotesting at a selected yard. All hydrotest fluids from the subsea equipment fabrication and testing yards will be contained, collected by road tanker, handled as liquid waste and removed from site.

5.6.4 Jackets and Piles

The SD2 jackets, comprising two 8 legged, braced, steel structures, will support the topsides. The jacket structures will be approximately 110m tall, extending approximately 15m above the sea surface. The top of the jackets will be a “twin tower” configuration to enable “float over” installation of the topside deck. The design of the base will incorporate 3 pile sleeves at each of the 4 corners into which the 12 foundation piles will be driven.[12]

To construct the jackets, steel plate received at the fabrication yard, will be cut and shaped as required and then welded together with any prefabricated elements that are not constructed in country, to form the various sectional pieces. Section and weld joints will be integrity tested using NDT prior to grit blasting in preparation for painting.

The majority of grit blasting and anti corrosion painting of jacket and pile components will be undertaken in a paint shop with a fume extraction and grit recovery system in place. Grit blasting and anti corrosion painting of sections which are too large are to be accommodated within a paint shop will be undertaken within a temporary enclosure. Waste grit and paint will be collected and disposed of in accordance with the Waste Management Process (see Chapter 14). Cathodic protection will be provided by zinc-aluminium sacrificial anodes. The jacket sections will then be transferred to the assembly skidway, where they will be crane lifted into position and welded to other jacket sections to form the complete structure.

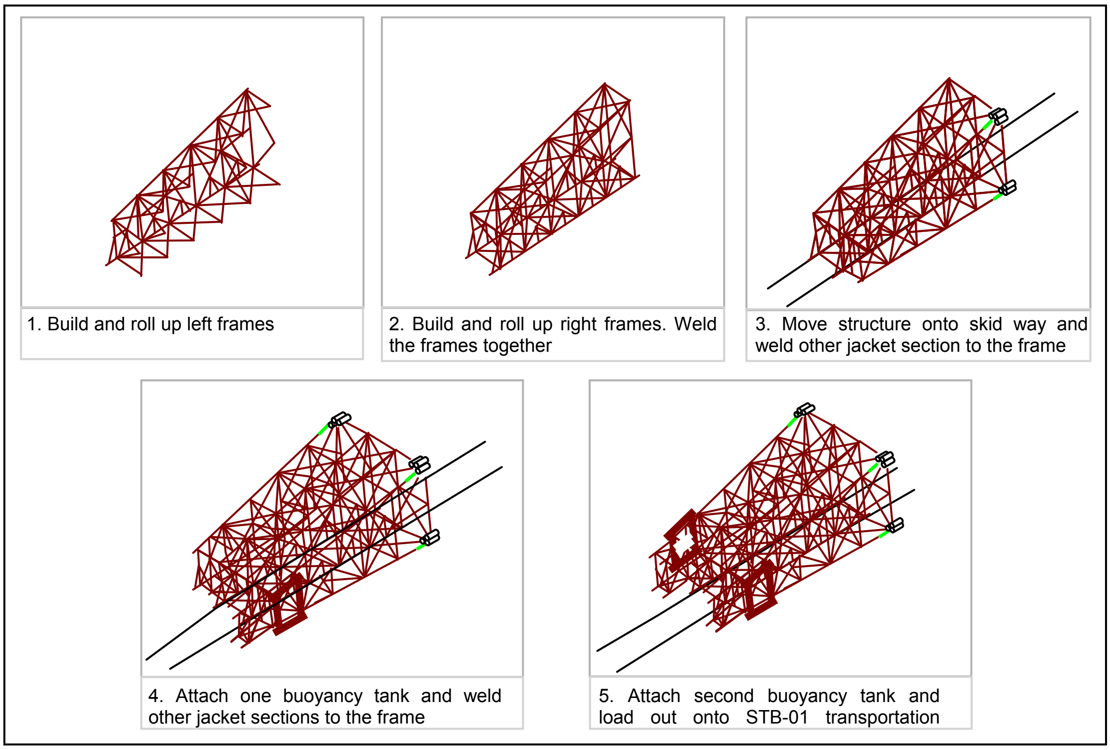
Two buoyancy tanks will be placed on either side of the jacket. The current plan is to reuse the ACG Phase 2 tanks for the SDB-QU jacket (slightly modified) and construct new buoyancy tanks for the SDB-PR jacket. Both sets of tanks will be cleaned and integrity checked using ultrasonic inspection at lift points on the tank walls. Figure 5.10 shows the various stages of jacket fabrication.

For the SDB-PR jacket, it will be necessary to pre-ballast a number of compartments on the buoyancy tanks prior to jacket load-out, to ensure stability of the jacket during installation using approximately 750m^3 of seawater dosed with the same hydrotest chemicals as used on the subsea pipelines and flowlines to protect the tanks from corrosion (refer to Sections 5.8.4 and 5.9.4 for chemicals and proposed concentrations). Upon installation of the jacket the buoyancy tanks will be towed back to the shore for re-use or disposal. The treated water within the tanks will be discharged at the jacket location to ensure stability of the tanks during transportation to shore.

The 12 foundation piles (each 96” diameter and approximately 137m in length) and the four pin piles will be assembled, inspected and tested at the construction yard in a similar manner to the jacket.

[12] Refer to Appendix 5D for the SDB platform seismic design details.

Figure 5.10 Jacket Fabrication Process



5.6.5 Topsides

The SDB topsides will be steel structures erected from steel girders, steel stanchions, trusses and cross beams, which form and enclose decks and modules. Equipment, both electrical and mechanical will be installed into the topside modules. The topsides will comprise a number of decks including an upper deck, weather deck, mezzanine deck, cellar deck and under deck. The main components of the two topsides will be:

SDB-QU:

- Living Quarters
- Power generation and distribution system
- Direct Electrical Heating system
- MEG bulk storage ($560m^3$) and distribution system
- Subsea hydraulic power system
- Subsea controls interface
- Chemical injection system including methanol
- Utilities, platform support systems and infrastructure

SDB-PR:

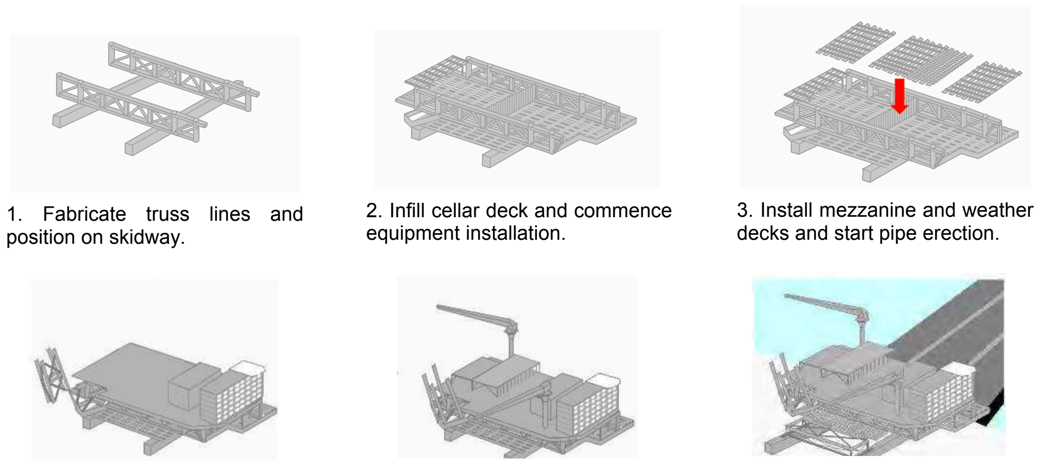
- Flow line reception facilities including pig launchers and receivers
- Production and test manifolds
- HP, Test and LP Separation system
- Offline Seawater Wash Facility
- Flash Gas Compressors
- Condensate Export Pumps
- Flare system and boom
- Fuel gas and marine pipeline gas buy-back systems
- Condensate and gas export systems
- MEG import system

The two topsides will be linked together offshore by a bridge, also constructed from steel trusses and cross beams. It is planned to construct the bridge at the same yard as the SDB-PR topside.

The main topside structures (including the bridge) and decks will be fabricated at the selected topside construction yard. Prefabricated and imported components and modules will either be transported from international fabrication yards or fabricated in other Baku construction yards (refer to Section 5.6.1 above). It is anticipated that the topsides will be constructed simultaneously.

Steel plate will be cut, shaped and welded to form the topside structural elements. The sections will then be grit blasted and painted with anti-corrosion paint. Prefabricated utility and process equipment will be lifted into place using cranes, installed into the structural frame, secured and then fitted with power and piping connections as required. A single flare boom structure, comprising a steel lattice frame structure, will be attached to the SDB-PR deck in the construction yard. All deck frame and component weld joints will be tested using NDT methods. Figure 5.11 shows the general topside construction approach.

Figure 5.11 Topside Construction Process (SDB-QU Topside)



1. Fabricate truss lines and position on skidway.

2. Infill cellar deck and commence equipment installation.

3. Install mezzanine and weather decks and start pipe erection.

4. Install living quarters and power generation.

5. Complete equipment, piping and cable installation.

6. Jack up and install loadout and installation frame ready for loadout onto barge.

5.6.6 Testing and Pre-Commissioning

The topside module elements including processing equipment and utilities will be tested onshore and where practicable, pre-commissioned. Testing will include hydrotesting of pipework and/or pressurised gas tests (using nitrogen with a 1% helium trace for detection). Onshore hydrotesting of the topside will be performed using potable water. On completion of the pressure test, the water will be reused where possible or used for dust suppression on site. If the water cannot be reused on site it will be collected by road tanker, handled as liquid waste and removed from site.

5.6.7 Topside Commissioning

Commissioning activities in the yards associated with the SDB topsides are planned to take place over a 10 month period including full commissioning of the SDB-QU topside utilities and partial commissioning (comprising system testing) of the platform process systems where possible, including:

- Fuel gas system;
- Condensate export system;
- Flare system;
- Flash gas compression system;
- Chemical systems;
- Methanol system; and
- MEG System.

These systems will be fully commissioned once in place offshore.

5.6.7.1 Seawater System

During onshore commissioning, seawater will be supplied to the topsides via a temporary seawater lift system from the quayside. The seawater system will be designed to operate at a flow rate of approximately 600m^3/hr for a period of up to 6 months and will be of a similar design to that approved for previous ACG projects. Seawater will be abstracted from the construction yard quayside and discharged back to the sea after use. The temperature difference between the seawater intake and discharge will be constant and independent of season as the energy demand on the seawater cooling system when in use will be constant.

Two treatment packages will be used for the temporary cooling water system to inhibit biological growth and corrosion within the seawater system:

- A chlorine/copper anti fouling system, which involves pulse dosing of abstracted seawater at concentrations of 50 ppb chlorine and 5ppb copper; and
- A continuous dosing system, which involves injection of sodium hypochlorite into the abstracted seawater at a concentration of 2mg/l. Prior to discharging the cooling water, a neutralising agent (sodium thiosulphate) will be added. Neutralisation agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l.

5.6.7.2 Freshwater System

The freshwater supply system, with a total volume of approximately 160m^3, is planned to be filled with freshwater dosed with sodium hypochlorite. To ensure that the entire system is adequately sterilised, approximately 2 - 3m^3 will be expelled via taps and drains, collected and analysed. The system will be sealed once it is confirmed that the target concentration of hypochlorite has been achieved throughout the system.

After sterilisation, the contents of the freshwater supply system will be neutralised to reduce the chlorine content to less than 1mg/l and either used for dust suppression; discharged to the Caspian Sea; or collected by road tanker and handled as liquid waste and removed from site.

5.6.7.3 Diesel Users

The main platform power generation system comprises four 15 MW generators. Onshore commissioning of the generators using diesel is planned to include:

- Each generator run separately and intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%; and
- Synchronisation tests of 8 hour duration, running 3 of the 4 generators together at a maximum load of approximately 26%.

During commissioning of the compression system and topside utilities, the intention is to run the platform generators separately and intermittently for approximately 6 months. The diesel powered emergency generator, firewater pumps and platform pedestal cranes are also planned to be commissioned onshore.

It is expected that up to two air compressors with air drier packages and two 400V15Kva temporary generators will be used at the selected topside construction yard(s) for the duration of the commissioning activities.

5.6.8 Load Out and Sail-away

When completed, the jackets and topsides will be loaded onto the upgraded STB-01 barge for transportation to the SDB platform complex location.

The jackets will each be manoeuvred onto the STB-01 barge and sea fastened by welding members from the jacket to the barge deck. The barge will be ballasted and trimmed to sea-tow condition. The transportation barge will be assisted by 3 attendant support vessels during sail-away. Figure 5.12 shows the DWG-DUQ jacket on the transportation barge ready for sail-away.

Figure 5.12 DWG-DUQ Jacket During Loadout

Each topside will be installed with a loadout and installation frame, which can then be moved onto the STB-01 barge. As for the jackets, the barge will be assisted by 3 support vessels during sail-away. Figure 5.13 shows the East Azeri (EA) platform topside on the transportation barge.

Figure 5.13 EA Platform Topside Onboard STB-01 Barge

It is planned to load the bridge onto the STB-01 barge using a self-propelled modular transporter, seafasten it to the deck and transport it offshore to the SDB platform location. The jacket piles will be transported to site by “wet float”, that is, towed in the water behind a support or supply vessel.

5.6.9 Onshore Construction and Commissioning Emissions, Discharges and Waste

5.6.9.1 Summary of Emissions to Atmosphere

Table 5.17 summarises the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during onshore construction and commissioning from key sources which include:

- Construction yard engines and generators (including plant, cranes and on site vehicles);
- Volatile materials used during construction (e.g. paint and solvents);
- Temporary generators (during commissioning);
- Platform crane and emergency generator (during commissioning); and
- Platform main generators (during commissioning).

Table 5.17 Estimated GHG and Non GHG Emissions Associated with Routine and Non Routine SD2 Onshore Construction and Commissioning Activities

	Jacket and Bridge Construction	Topsides Construction	Topside Commissioning	TOTAL
CO_2 (ktonnes)	24.5	22.8	11.6	**58.9**
CO (tonnes)	88.2	83.9	5.5	**177.6**
NO_x (tonnes)	355.2	336.4	55.7	**747.3**
SO_2 (tonnes)	30.6	28.6	14.5	**73.6**
CH_4 (tonnes)	1.1	1.0	0.1	**2.2**
NMVOC (tonnes)	11.6	11.0	1.3	**24.0**
GHG (ktonnes)	24.5	22.9	11.6	**58.9**

See Appendix 5A for detailed emission estimate assumptions.

5.6.9.2 Summary of Discharges to Sea

Planned routine discharges to the sea during SD2 onshore construction and commissioning will be associated with the cooling water system. In total, approximately 600m^3/hr of neutralised seawater is estimated to be discharged to sea during the 6 month commissioning period (See Section 5.6.7.1). In addition discharges of AR-AFFF or AFFF products from fire fighting system testing during during vessel reactivation are also anticipated (see Section 5.6.2).

At the construction yards there will be 3 categories of drainage water:

- Black and grey water – black and grey water generated at the construction yard(s) will be collected in on site sewer pipes and sumps and then either transferred by road tanker or by sewer pipes to a municipal sewage treatment plant for treatment and disposal. If the construction yard has an operational sewage treatment plant that discharges treated effluent to the environment, the yard operator will be responsible for agreeing the discharge standard with the MENR and maintaining the discharge permit conditions stipulated by the MENR;
- Hazardous area drainage – Drainage water from areas in the construction yard(s) in which hazardous materials are stored and routinely used will be contained and will be collected by road tanker, handled as liquid waste and removed from site. If the yard operator has an agreement with the MENR for discharge of drainage from areas where hazardous materials are storage or used, they will be responsible for maintaining the discharge permit conditions stipulated by the MENR;[13;] and
- Storm/rain water drainage - uncontaminated rainwater will be discharged directly to the onshore or marine environment to prevent flooding and ponding of water on site.

[13] For discussion regarding spills refer to Chapter 14.

5.6.9.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated during onshore construction and commissioning are provided in Table 5.18. These have been estimated based on the waste records for construction of the previous ACG platforms, taking into account the scope of onshore construction associated with the SD2 Project.

All waste generated during onshore platform and subsea infrastructure construction and commissioning activities will be managed in accordance with the existing AGT management plans and procedures.

Table 5.18 Offshore Facilities Construction and Commissioning Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Domestic/office wastes	10,234
		Grit blast	1,989
		Metals - swarf	7,813
		Paper and cardboard	81
		Plastic	30
		Wood	890
	Liquid wastes	Oils - cooking oil	49
		Total (Non-hazardous)	**21,085**
Hazardous	Solid wastes	Batteries - wet cell	7
		Clinical waste	5
		Contaminated materials	82
		Contaminated soil	3
		Filter bodies	0.2
		Lamps	16.8
		Oily rags	2
		Pressurised containers	6
		Toner or printer cartridges	5
	Liquid wastes	Oils - fuel	23
		Oils - lubricating oil	64
		Paints and coatings	420
		Sewage - untreated	1,484
		Sewage sludges	4,523
		Solvents, degreasers and thinners	169
		Water - hydrotest water	22
		Water - oily	1,140
		Total (Hazardous)	**7,972**

5.7 Platform Installation, Hook Up and Commissioning

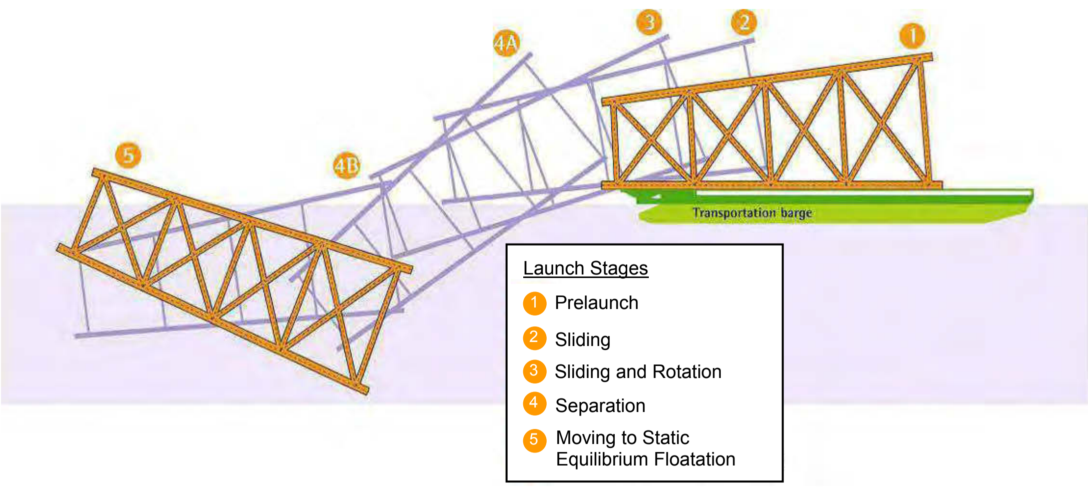
5.7.1 Pre Installation Survey and Seabed Works

Prior to any installation works, a seabed survey will be undertaken using a remotely operated vehicle (ROV), controlled from a support vessel. The survey will utilise multibeam sonar and video imaging. This will confirm that there are no obstacles present in the platform location. While not expected, if any obstacles are present they will be removed using a DSV. It also anticipated that localised excavation works will be required to prepare the area where the jacket gripper jacks and pin piles will be located.

5.7.2 Jacket

Installation of the SDB jackets, scheduled to take approximately 49 days, will follow similar methods as employed for the previous ACG projects. The two jackets will be installed concurrently using the same method. The process followed to unload and position the jacket is shown in Figure 5.14. Ballasting and use of the jacket buoyancy tanks will allow the jacket to be accurately positioned.

Figure 5.14 Jacket Installation



Once in position, the jacket will be attached to the anchored DBA crane[14] and set down onto four pre-installed pin piles. Hydraulic gripper jacks will secure the jacket until permanent piling is completed.

The pin piles are installed as temporary foundations for each jacket, until such time that the main piles are installed and grouted. Each pile is 140m long and will be towed to site and installed using the DBA. If the piles gain insufficient self weight penetration it will be necessary for the DBA to laterally support the top of each pile temporarily within a frame on the side of the vessel, whilst a vibratory driver is used to advance the pile in a controlled manner through the hard sand layers. Once sufficient penetration is achieved, the DBA will detach itself from the pile and a hydraulic hammer will then be used to drive it to its target penetration of approximately 100m. The residual ~37m length of each pile will then be cut subsea and removed.

An alternative method under consideration is to adopt a larger hammer and drive to ~138m penetration which will avoid the need for subsea cutting. Once all pin piles are installed, a full dimensional survey will be performed to allow the pin pile receptacles to be correctly positioned within each jacket, whilst under construction

The buoyancy tanks will be removed by a combination of seawater ballasting and lifting with the DBA crane, then drained and towed back to the onshore fabrication site for reuse.

[14] The DBA anchoring system comprises 8 anchors each attached to electrically driven hydraulic mooring winches. Up to 3 vessels are planned to assist with DBA anchor handling during jacket and topside installation.

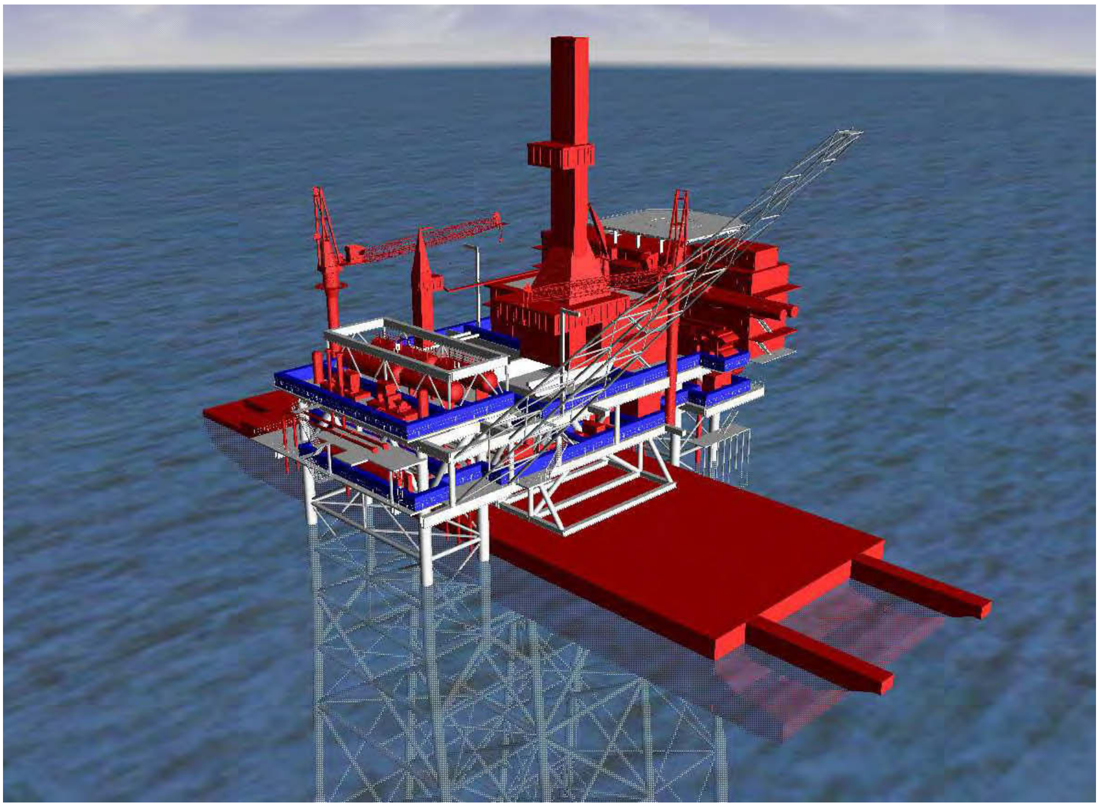
The treated pre-ballast water within the SDB-PR buoyancy tanks will also be discharged to sea over a period of approximately 8 hours.

12 main foundation piles will secure each of the jackets. The piles will be driven using an underwater hydraulic hammer and grouted to the jacket pile sleeves. Grout will be supplied via flexible hoses from the DBA to the grout manifold panel located on the side of the jacket; and pumped down into the annulus between the pile and pile sleeve. A passive mechanical seal will ensure that the grout material is retained inside the pile sleeve annulus. A high strength cement will be used for the grout operation. Discharge of excess cement will be minimised as far as possible. However, approximately 50m^3 of excess cement may be discharged as the grouting operation is completed for each jacket.

5.7.3 Topsides

The topsides are designed for the “float-over” method of installation, as employed for the previous ACG Phases. For each topside the STB-01 transportation barge is manoeuvred between the two jacket towers such that the topside is positioned above the intended installation position on the jacket as illustrated in Figure 5.15. The mating operation (i.e. the process of connecting the topside to the jacket) is executed by ballasting the barge such that the topside engages with shock absorbers in the jacket legs and the load is transferred. Sand jacks are then used to lower the topside until steel faces mate and are ready for welding. It is estimated that approximately 35m^3 of sand will be released from the 8 sand jacks during this process and discharged to the sea. Topside installation is scheduled to take approximately 15 days for the SDB-QU platform and approximately 20 days for the SDB-PR platform (including bridge installation).

Figure 5.15 Topsides “Float-Over” Installation Method



5.7.4 Bridge

The bridge will also be loaded onto the STB-01 transportation barge and towed to the SDB complex location offshore. The barge will be moored alongside the DBA, which will lift the bridge and position it between the SDB-PR & SDB-QU platforms using rigging and guides. Once in position the rigging will be removed and the temporary installation guides will be removed. The bridge will be welded in place to the platform at one end, with the other end fitted to allow natural movement during operation.

5.7.5 Topside Hook Up and Commissioning

Once the topsides and bridge are installed, a number of offshore hook up activities will need to be completed on the topside prior to start up. These will include:

- Installation of the SDB-QU firewater and seawater lift pumps and caissons;
- Installation of the hazardous open drains caisson pump;
- Tie-ins to all risers; and
- Connection of all umbilicals (including subsea cabling).

Commissioning will commence with living quarters and utility systems including the main power generators. The systems will then be started up over a 5 month period, allowing workers to inhabit the platform during commissioning and start up of the process facilities.

The current Base Case assumes that power during commissioning will be provided by the main platform generators, using diesel until fuel gas is available from onshore SCP facilities via the two SD2 32” marine export gas pipelines. To establish initial life support before the main platform generators are available it is planned to use one 1MW temporary diesel generator. It is anticipated that the temporary generator will be used for 6 months and the main platform generators will be run on intermittently diesel for 6-8 months during the commissioning period.

Commissioning of the deluge and foam systems is predicted to result in approximately 200 litres of seawater and approximately 20 litres of aqueous film forming foam (AFFF) (mixed with 140m^3 of seawater) discharged via the SDB-PR open drains caisson to the sea at 52m below sea level.

5.7.6 Installation, Hook Up and Commissioning Vessels

A number of vessels will be used to support the SDB platform installation, hook up and commissioning (HUC) activities, including the DBA, two anchoring handling vessels, the STB1 installation barge and support vessels. Table 5.19 summarises the vessel utilities.

Table 5.19 Installation, Hook Up and Commissioning Vessel Utilities

Utility	Description
Power Generation (DBA)	• Main Power provided by 6 diesel engines rated at 4080 kW
Sanitary Waste	• Grey water will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable. • Depending on the availability of the system, black water will either be: - Contained onboard for transfer to shore; - Once onshore, black water will be managed in accordance with the existing AGT management plans and procedures; Or - Black water will be treated to applicable MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine as low as practicable. • Sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.
Galley Waste	Depending on the availability of the system, galley food waste will either be • Contained and shipped to shore for disposal; or • Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge.
Drainage/Water	• Deck drainage and wash water discharged to sea as long as no visible sheen is observable. • Oily bilge water, tank sludges, untreated oily water and waste oil will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

It is planned that crew changes will be by vessel through the SD2 platform installation, hook up and commissioning phase. Helicopters will be used for emergencies only.

5.7.7 Platform Installation, Hook Up and Commissioning – Emissions, Discharges and Waste

5.7.7.1 Summary of Emissions to Atmosphere

Table 5.20 summarises the GHG (i.e. CO_2 and CH_4) and non GHG routine emissions predicted to be generated during platform installation, hook up and commissioning from key sources which include:

- Jacket installation vessel engines and generators;
- Topside installation vessel engines and generators;
- Support vessels engines during HUC; and
- Power during commissioning.

Table 5.20 Estimated GHG and Non GHG Emissions Associated with SD2 Project Platform Installation, Hook Up and Commissioning

	Jackets Installation	Topsides & Bridge Installation	HUC Support Vessels	Commissioning	TOTAL
CO_2 (ktonnes)	11.0	5.3	2.1	40.3	**58.7**
CO (tonnes)	27.5	13.3	5.3	11.6	**57.7**
NO_x (tonnes)	202.5	98.2	38.9	170.1	**509.8**
SO_x (tonnes)	27.5	13.3	5.3	50.4	**96.5**
CH_4 (tonnes)	0.9	0.4	0.2	0.4	**2.0**
NMVOC (tonnes)	8.2	4.0	1.6	3.7	**17.5**
GHG (ktonnes)	11.0	5.3	2.1	40.3	**58.8**

See Appendix 5A for detailed emission estimate assumptions and Appendix 5F for vessel numbers and duration of use.

5.7.7.2 Summary of Discharges to Sea

Routine discharges to the sea during platform installation, hook up and commissioning comprise:

- Ballast water during jacket installation (refer to Section 5.7.2);
- Minor cement losses during jacket grouting (refer to Section 5.7.2);
- Sand from topside jacking activities (refer to Section 5.7.3);
- Seawater and AFFF from deluge and foam system testing (refer to Section 5.7.4); and
- Installation and support vessel discharges as described within Table 5.19.

5.7.7.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated during SD2 platform installation, hook up and commissioning are provided in Table 5.21. These have been calculated using data gained during the previous ACG Phases.

All waste generated during platform installation & HUC will be managed in accordance with the existing AGT management plans and procedures.

Table 5.21 Offshore Facilities Installation, Hook-up and Commissioning Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Domestic/Office waste	1,839
		Grit blast	133
		Metals - swarf	1,290
		Waste electrical and electronic cable	5
		Paper and cardboard	69
		Plastics - recyclable (HDPE)	31
		Wood	169
	Liquid wastes	Oils - cooking oil	0
		Total (Non-hazardous)	**3,535**
Hazardous	Solid waste	Batteries - dry cell/Batteries - wet cell	1
		Clinical waste	1
		Contaminated materials	104
		Lamps	1
		Oily rags	12
		Toner or printer cartridges	1
	Liquid wastes	Oils – lubricating oil	5
		Paints and coatings	27
		Solvents, degreasers and thinners	4
		Tank bottom sludges	30
		Water - hydrotest water	3,841
		Water - oily	2,365
		Water treatment chemicals	1
		Total (Hazardous)	**6,392**

5.8 Installation, Hook Up and Commissioning of Subsea Export and MEG Pipelines

5.8.1 Introduction

To enable gas and condensate to be exported from the SDB platform complex to the Sangachal Terminal, the following subsea export pipelines will be installed:

- Two 32” diameter Gas Export Pipelines; and
- One 16” diameter Condensate Export Pipeline.

In addition a 6” diameter MEG Pipeline will be installed to import MEG from onshore to the SDB platform complex. All four pipelines will be approximately 90.3km in length and laid within the same pipeline corridor. To ensure adequate support, the MEG pipeline will be clamped to the offshore section of the condensate pipeline (known as “piggybacking”). Figure 5.16 illustrates the routing of the SD2 subsea pipeline corridor from the offshore SDB platform complex to the onshore Sangachal Terminal.

5.8.2 SD2 Subsea Pipeline Integrity and Design

The SD2 subsea pipelines will be constructed of carbon steel and will be designed to ensure that they are suitable for the environmental conditions including seawater properties and geo-hazards.

All the pipelines will be protected by a coating together with a sacrificial anode cathodic protection system. In addition, corrosion-inhibiting chemicals will be added to the hydrocarbon product before it passes through the pipeline to minimise internal corrosion.

The pipelines will be designed for a 30 year design life. The gas and condensate pipelines will be provided with a reinforced concrete weight coating with a thickness of between 40 and 100mm along the majority of the length to provide the required level of negative buoyancy. The concrete weight coating where applied also affords protection from the mechanical impact of a dropped object.

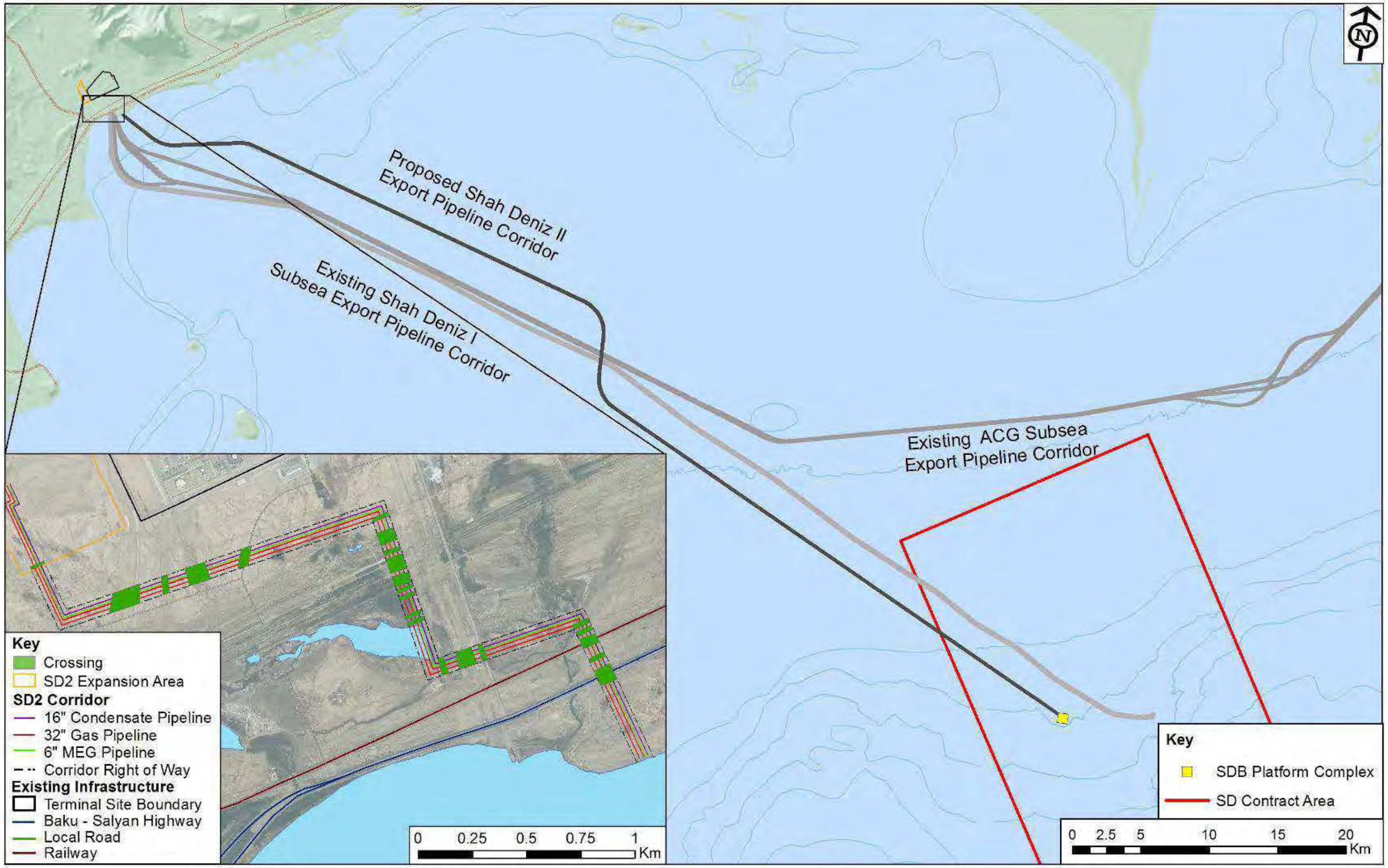
The subsea gas, condensate and MEG pipelines are planned to be routed along a common offshore corridor, which minimises possible interference from anchoring vessels and the risk of damage due to dropped objects. Where a pipeline is planned to cross an existing offshore pipeline(s), the intention is to construct crossing structures to ensure permanent separation between the pipelines.

In addition to the passive protection measures integrated into the SD2 subsea pipelines design described above, pipeline integrity systems will also include the following measures:

- Monitoring (pressure, flow and fluid contaminant concentrations);
- Corrosion protection;
- Inspection;
- Emergency response;
- Management of change (e.g. pipeline system modifications); and
- Assurance.

These form part of the existing Offshore Operations Pipeline Integrity Management System (PIMS) (refer to Chapter 14).

Figure 5.16 Routing of Proposed SD2 Export Pipelines and MEG Import Pipeline



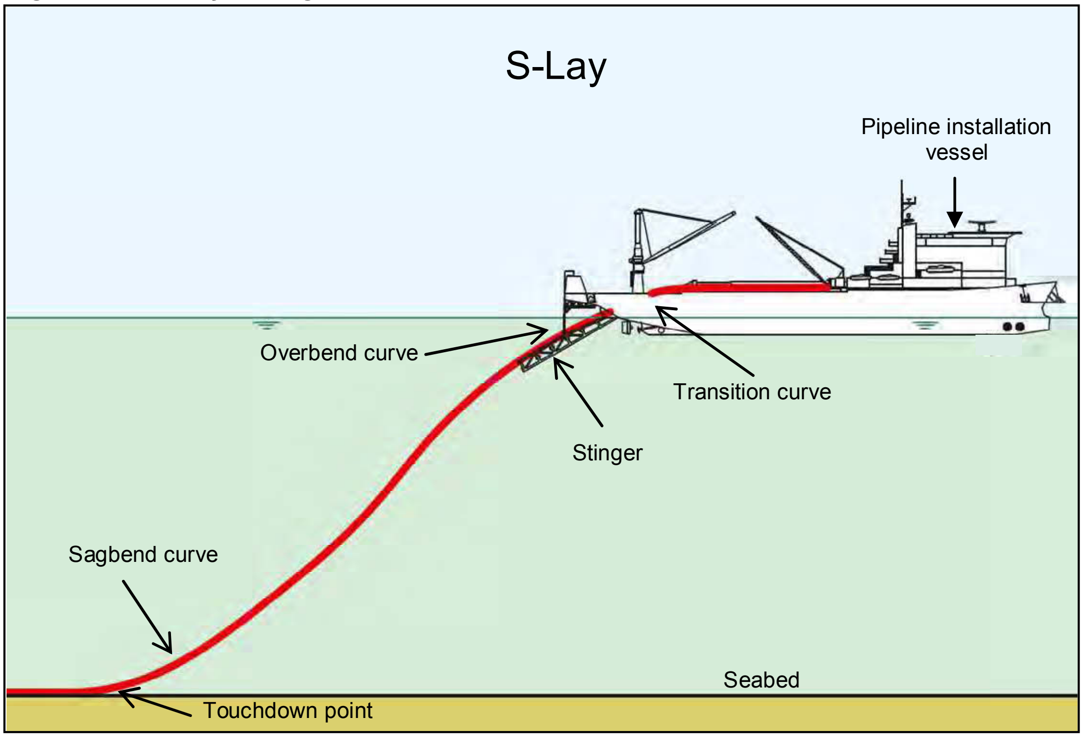
5.8.3 Pipeline Installation

5.8.3.1 Offshore

It is planned to use the pipelay barge "Israfil Guseinov" for the offshore subsea pipeline installation works. The installation methodology will be consistent with the previous ACG Projects. The pipe sections will be delivered to the lay-barge from the onshore coating yards by pipe supply vessels. The lay-barge will be used to install the subsea pipelines from the edge of the nearshore section within Sangachal Bay (from 8m water depth) towards the SDB platform complex.

On the lay-barge, each pipe section will be welded to the preceding one and the welded joints will be visually inspected and integrity tested using NDT techniques. The weld area will then be field-coated for protection with anti-corrosion material. The pipeline will be progressively deployed from the stern of the lay-barge via the "stinger", a support boom that extends outwards from the stern of the barge. The lay-barge lays pipe in an S-Lay configuration meaning that the pipeline lies on the seabed in the horizontal position, rises up through the water column and curves back to the vessel to assume a horizontal position such that pipe joints are added to the pipeline in a horizontal orientation. The tensioning system on the lay-barge maintains a controlled and constant deployment rate, while reducing bending stresses that could threaten the pipeline structure (refer to Figure 5.17)

Figure 5.17 S Lay Configuration



The 16" condensate line and 6" MEG line will be installed simultaneously. The 6" pipeline will be welded separately and the completed sections mechanically attached to the 16" pipeline using straps as it moves off the stern of the vessel.

The pipe-laying operation will be continuous with the barge moving progressively forward as sections of the pipe are welded, inspected, coated on board and then deployed to the seabed. The barge will be held in position by 10 anchors, each creating a depression in the seabed of approximately $20m^2$ and 2m depth, which will naturally back fill over time. As pipe-laying proceeds, the anchors will be periodically moved by 2 anchor handling support vessels to pull the barge forward (with 1 more on standby). The distance of this will vary, but will typically be every 500m to 600m of pipeline length. The lateral anchor spread of the pipe-lay barge will typically be between 600m to 700m either side of the pipeline. Marine installation operations will occur within an exclusion zone that will extend for 500m each side of the pipeline corridor. During installation, exclusion buoys will be placed around the lay-barge installation area to indicate that the area is an exclusion zone and to ensure that other vessels do not encroach upon the area of activity. As pipe-laying progresses, the exclusion buoys will be moved along the route.

The offshore sections of the pipelines will generally be laid directly on the seabed and will not be trenched except in the shore approach area. Stability of the sections that are laid directly on the seabed will be provided by the concrete coating along the majority of the lengths[15]. Grout bags will be used for any required freespan corrections and rock dumping may be used to provide additional support or additional cover if required.

As Figure 5.16 shows, at approximately 38km from Sangachal the SD2 pipelines are planned to cross the existing ACG and SD1 export pipelines and associated services (e.g. cabling). These include:

- SD1 12" Condensate Export Pipeline (SDA to Sangachal) including 4" MEG pipeline;
- SD-1 26" Gas Export Pipeline (SDA to Sangachal);
- SD1 Fibre Optic Cable (Sangachal to SDA);
- AIOC 14" Produced Water Pipeline (ACG to Sangachal);
- AIOC 24" Oil Export Pipeline (ACG to Sangachal);
- AIOC Fibre Optic Cable (Sangachal to ACG);
- AIOC 28" Phase 1 Gas Export Pipeline (ACG to Sangachal);
- AIOC 30" Phase 1 Oil Export Pipeline (ACG to Sangachal); and
- AIOC 30" Phase 2 Oil Export Pipeline (ACG to Sangachal).

At these locations the existing pipelines and services will be flanked on either side by concrete pipe supports (installed either from the DSV or pipelay barge) to ensure minimum separation distances are maintained between the SD2 pipelines and existing pipelines and cables. Crossing angles will be optimised to achieve as close to 90° (where practical) in order to minimise the crossing distance and support dimensions. It is intended that the existing service is protected from impact by mattresses or similar unless there is potential for damage to the existing service through doing this.

5.8.3.2 Nearshore

Prior to commencement of works within the nearshore zone it will be necessary to establish a secure compound within the onshore landfall area and it may be necessary complete marine geotechnical surveys to confirm the seabed conditions along the proposed nearshore route. Marine geotechnical surveys will involve the collection of seabed samples using a corer or a vessel mounted drilling rig that will use and discharge a bentonite mud if required to facilitate sample retrieval. Works associated with the clearance and levelling of the compound are included within the EIW scope. It is anticipated that the following temporary facilities will be established within the compound and used throughout the nearshore pipeline installation activities:

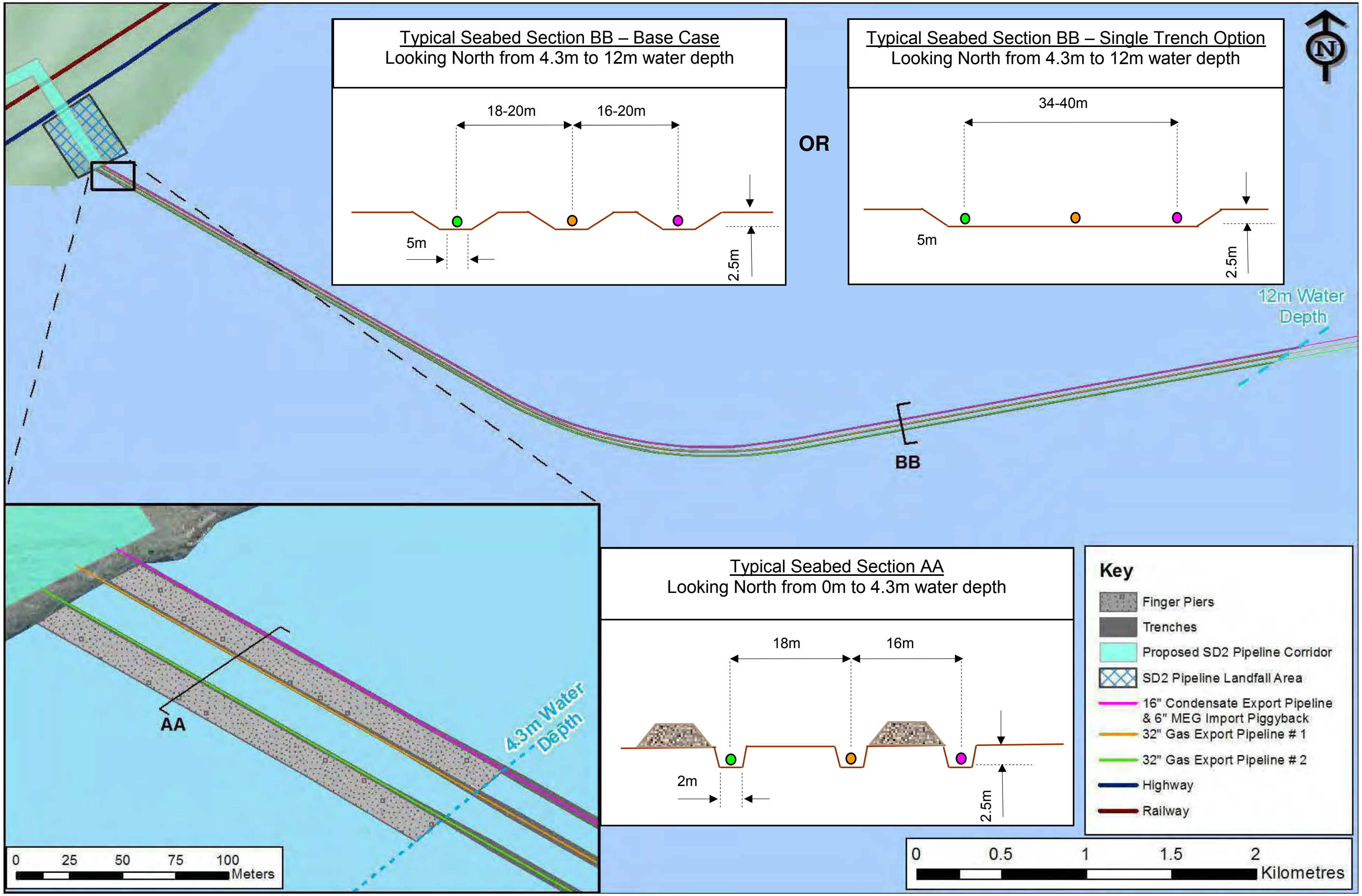
- Temporary offices and welfare facilities;
- Secure area for plant and equipment and fuel bunkering; and
- Area for temporary storage of trenched soils from the finger pier areas (prior reinstatement following the completion of beach pull and hydrotest activities).

In addition a temporary gravel road will be constructed from the Highway to the compound, designed to a standard suitable for lorries and excavators to use.

It is proposed to follow the same nearshore pipeline installation methodology adopted for previous ACG and SD Projects within the nearshore zone. The trenching proposed within the nearshore area is summarised within Figure 5.18.

[15] MEG pipeline will be provided with anti corrosion coating but will not require concrete coating for anti buoyancy as it will be attached to the condensate pipeline.

Figure 5.18 Proposed Nearshore Pipeline Trenching



The works will commence with the construction of two temporary finger piers to allow construction plant access to the nearshore for trenching. The piers will be constructed by dumping aggregate in the shallow marine zone to achieve the required clearance above sea level[16].

The piers will be designed to support vehicle access with an average planned width of approximately 4-5 m (approximately 10m at the base) and will extend out to approximately the 4.3m water depth contour.

It is currently anticipated that excavators using the finger berms will dig temporary channels into the shoreline for both the two 32” and 16” pipelines, which will be allowed to flood. An option to combine the three trenches into one wide trench after finger pier limits is also being considered. The pipelines will be pulled from the pipe-lay barge[17] moored in Sangachal Bay using a shore based winch through the trenches. The trenches will then be backfilled leaving the shoreward end of the pipelines uncovered and creating an earth “cofferdam”. The “cofferdams” will be pumped dry and the shore section of the pipelines will be trenched from the onshore landfall area to meet the end of the pipelines in the cofferdam.

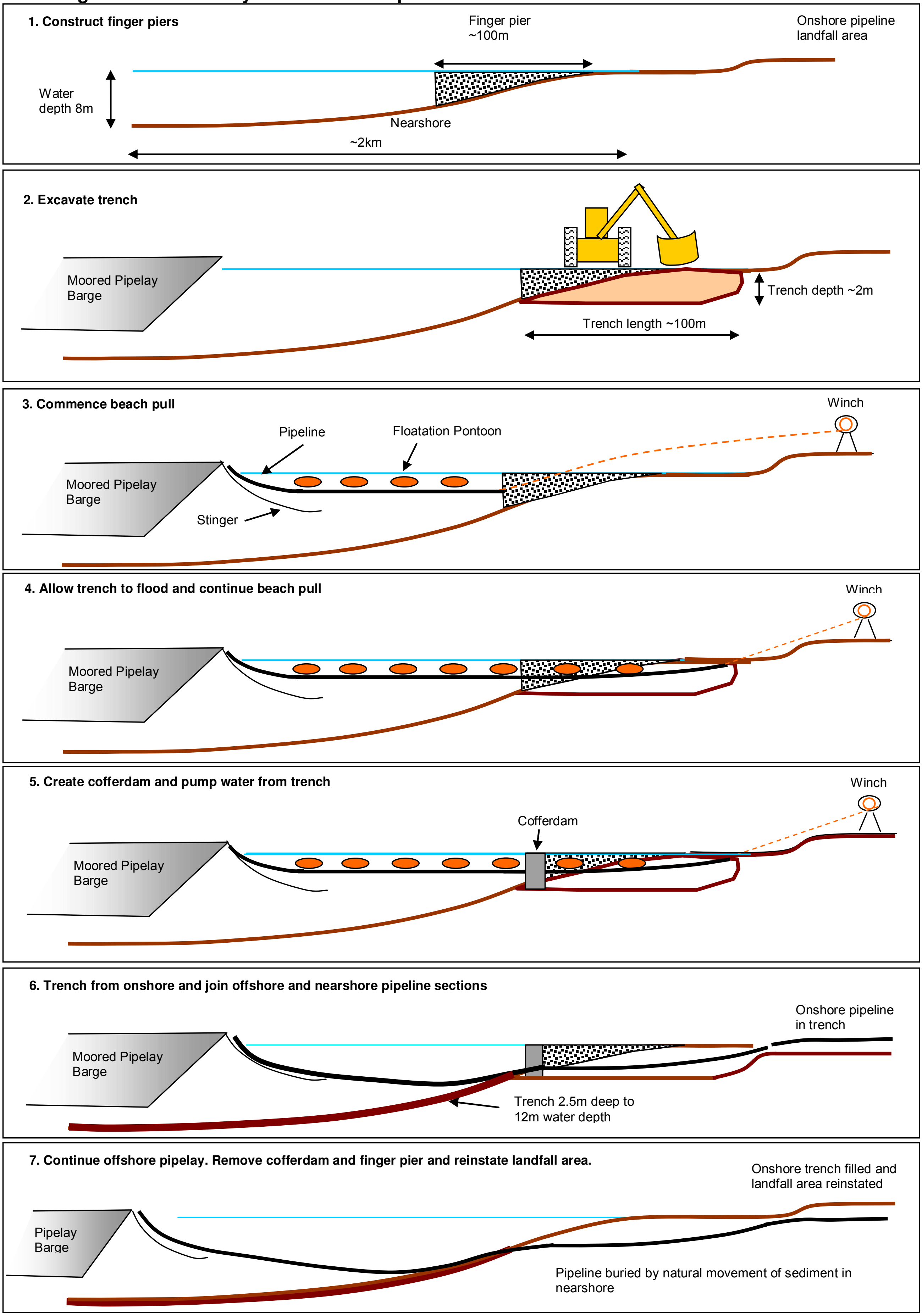
To allow the pull direction to be deflected as the pipeline is pulled onshore a pulley rigging arrangement will be set-up to angle to the pull. The pulley system will most likely be constructed using sheet piles as anchors.

In total it will be necessary to pull the pipelines a distance of approximately 3km from the edge of the nearshore zone (at a depth of 8m) to the onshore landfall area. The pipelines will be kept afloat during the shore-pull exercise by means of floatation pontoons attached to the pipelines. From the end of the piers to a water depth of approximately 12m it is intended to dig three trenches approximately 2.5m deep and 5m wide as shown in Figure 5.18

Figure 5.19 provides a summary of the proposed nearshore pipeline installation activities.

[16] It is planned to source aggregate for finger piers from within Azerbaijan
[17] The draft of the pipe-lay barge restricts the operation of the vessel in shallow water and the lay-barge can only operate in water depths of greater than 8m

Figure 5.19 Summary of Nearshore Pipeline Installation Activities



Based on current information, it is intended to dig the trenches to the 12m water depth contour by dredging the seabed using a cutter suction dredger (CSD). However, if further information obtained through ground truthing surveys to be performed in 2Q 2013 show the seabed and underlying material is not suited to the use of the CSD, alternative approaches may be considered.

The CSD is a stationary dredger consisting of a pontoon, positioned with a spud-pole at the stern, and two anchors at the front. A CSD uses a rotating cutter head to loosen the soil material over the area to be dredged, while a suction intake located within the cutter head sucks up the loosened material through the use of powerful centrifugal pumps.

The cutter head is mounted at the end of a steel structure called a 'ladder' positioned at the front of the vessel. The ladder can be lowered and raised through the use of winches, while the dredger can be moved from side to side via winches connected to the anchors. An anchor handling vessel will be used to move the anchors into their correct locations. As such, during the dredging works the following vessels will be utilised throughout: a CSD, a multicat, a spreader pontoon, a survey vessel and a crew boat.

Subject to a detailed survey, it is estimated that in performing the nearshore pipeline installation, an approximate volume of 1,000,000 m^3 of material will need to be dredged. The material removed by the CSD is typically pumped through a floating pipeline of approximately 500m, resulting in a proposed disposal area 500m away from the trench. The spreader pontoon will be connected to the end of this pipeline in order to dispose the dredged material evenly over this area. With this form of disposal, ridges will be created on the seabed. However, if natural backfilling does not remove this ridge, the material will later be removed by the CSD and used to backfill and cover the pipelines in the trenches. In this way the original seabed will be restored as far as practicable.

Once installation and testing of the pipelines in the nearshore zone is complete, all materials deposited at the area (aggregate, sheets piles and other material) will be managed in accordance with the Waste Management principles detailed in Chapter 14: Environmental and Social Management.

The works are expected to take approximately 16 months in total over a period of 2 year period as shown in Figure 5.3.Beach pull activities are expected to take 10 days for each pipeline and CSD trenching is expected to take 4 months.

5.8.3.3 Onshore

The onshore section of the SD2 pipelines between the onshore landfall area to the tie in within the new SD2 facilities at the Terminal will be approximately 4.1km in length and constructed using open cut and augur bore techniques. It is anticipated that a Right of Way (RoW) (approximately 80m in width) will be established. Temporary laydown areas and pipeline construction offices will be established within the pipeline RoW from the Terminal to the onshore landfall area. For the majority of the route to the Terminal each pipeline will be installed in a trench with sufficient depth to ensure a minimum of cover to top of pipeline of 1m. All soil removed from the trench being excavated will be placed aside and stored so that it may be used for later reinstatement of the route, in order to maintain the environmental characteristics of the area.

As required the pipe, which will be stored at temporary laydown areas along the route, will be laid out along the RoW. Pipe joints will be welded to form a continuous length. Once a trench is excavated, pipe lengths will be lifted by side-booms (or other appropriate machines) and lowered into the bottom of the trench. The trench will then be backfilled.

As shown in Figure 5.16, the onshore pipelines will need to cross the Baku Salyan Highway, the railway and various third party pipelines/service lines. Over 60 crossings of existing utilities and pipelines have been identified. For trenchless crossings, it is currently planned to maintain a minimum separation of approximately 1m from the bottom of the existing service. At each trenchless crossing location it will be necessary to excavate launch and reception pits to enable crossing installation. All soils excavated from the pits will be placed aside and stored so that it may be used for later reinstatement of the route, in order to maintain the environmental characteristics of the area.

Prior to installation, a survey of the route will be conducted to establish where preparatory works may be required. Preparatory works may be required to upgrade access routes to allow transportation of construction loads (materials, equipment and vehicles) to the RoW. Provision of temporary drainage measures may be required within the construction area to control storm water runoff in the vicinity of the construction area. All working areas along the RoW will be clearly marked to ensure the safety of operations and the public.

Once installed the onshore pipelines will connect to the SD2 facilities at the Terminal via a weld downstream (upstream for MEG Pipeline) of the pig traps.

5.8.4 Pipeline Pre Commissioning

Installation of the pipelines will be completed before the offshore facilities are in place. Pre commissioning activities (i.e. cleaning, hydrotesting, inspecting and dewatering) will be completed prior to the introduction of hydrocarbons as described below.

To prevent corrosion and inhibit bacteria growth, seawater used for pre commissioning activities will be chemically treated. A dye will also be added to the water to provide a method of identifying leakage during hydrotesting. The following Base Case chemicals, at the indicated dosage rates, are currently planned to be used:

- 1000ppm Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
- 100ppm Tros Seadye (dye).

In the event that different chemicals are required, the SD2 Project Management of Change Process (see Section 5.16) will be followed. The intent is to use chemicals no more toxic or persistent than the Base Case chemicals.

The pipelines will remain filled within treated seawater until dewatering occurs. During this period each pipeline shall be monitored to ensure systems are being continually protected against corrosion. If preservation chemicals are deemed to be depleting the treated seawater will be displaced to sea and refilled with treated seawater at the dosage rates stated above.

The pre commissioning activities comprise the following:

- Flooding, cleaning and gauging (FCG): The flooding operation will introduce chemically treated filtered seawater into the offshore pipeline sections. The cleaning operation will remove construction debris from the internal pipeline surface. The gauging operation will confirm that there are no pipeline deformations or intrusions. The treated water used to drive the cleaning and gauging pigs will be discharged to the environment at temporary subsea pig trap in the vicinity of the SDB platform complex;
- Hydrotest: The offshore pipeline sections will be pressurised to 1.25 times the design pressure. Upon completion of the hydrotest the volume of treated water that was used to pressurise the pipeline will be discharged to the environment at the temporary subsea pig trap;
- Leak test: The complete pipeline systems (onshore and offshore sections) will be topped up with treated water and hydrostatically leak tested up to 1.1 times the design pressure. Upon completion of the leak test the volume of treated water that was used to pressurise the pipeline will be discharged to the environment via the SDB-PR open drains caisson;
- Pre In Line Inspection (ILI) gauging: The complete pipeline systems from the Pig Launcher and Receiver facilities at the Terminal to the SDB-PR platform will be gauged to ensure that an ILI pig can travel along the pipeline. This will result in the

discharge of the treated water volume from each pipeline to the SDB-PR open drains caisson. For the 16" condensate export pipeline this activity will be performed using dry air as the propelling medium, thus simultaneously dewatering the line;

- ILI operation: Each pipeline will be pigged using an ILI pig, resulting in the discharge of the treated water volume from each pipeline via the SDB-PR open drains caisson. For the 16" condensate export pipeline this operation will be performed using dry air as the propelling medium.
- Dewatering: The entire pipeline system will be dewatered by propelling pigs with dry air. The pig train will contain a fresh water desalination slug. One complete, treated water volume from each pipeline and a fresh water desalination slug will be discharged to sea via the SDB-PR open drains caisson. At this point the dry air in the pipelines will be replaced with nitrogen.

FCG and hydrotesting of the onshore sections will follow the same methodology as described above. It is intended that the treated water used from these activities for the onshore sections will be sent to the offshore pipeline sections and then offshore to be discharged at the temporary subsea pig trap. During final commissioning of the completed pipelines, prior to 1st gas, the nitrogen present in the pipeline systems will be displaced by the hydrocarbons that the pipelines will carry during operations. The only discharge to the atmosphere will be nitrogen gas.

5.8.5 Summary of Pipeline Installation Discharges

Table 5.22 presents the expected volume and location of discharges associated with gauging, hydrotesting, tie-in, testing and dewatering of the SD2 subsea export and MEG import pipelines.

Table 5.22 Estimated Pipeline Gauging, Hydrotesting, Tie-in, Leak Tests and Dewatering Discharges

		Discharge Location	Anticipated Date	Estimated Discharge Volume (m^3)	Discharge duration (hr)	Total Estimated Discharge Volume (m^3)[3]
Gas Pipeline 1	Flood, clean and gauge[4]	-95m below sea level	Q1 2015	9,646	12	201,440 treated seawater 2,181 desalinated freshwater
	Hydrotest[1,4]		Q2 2015	416	12	
	Leak test[1]	-52m below sea level	Q3 2016	365		
	Pre ILI gauging[2]		Q3 2016	49,858	60	
	ILI pigging[2]		Q3 2016	49,858	60	
	Dewater pipeline following full length test (includes 100% contingency)[2]		Q3 2016	93,477	53	
Gas Pipeline 2	Flood, clean and gauge[4]	-95m below sea level	Q2 2015	9,646	12	203,924 (treated seawater) 2,181 desalinated freshwater
	Hydrotest[1,4]		Q2 2015	416	12	
	Leak test[1]	-52m below sea level	Q3 2016	365		
	Pre ILI gauging[2]		Q3 2016	49,858	60	
	ILI pigging[2]		Q3 2016	49,858	60	
	Dewater pipeline following full length test (includes 100% contingency)[2]		Q3 2016	95,962	53	
Condensate Pipeline	Flood, clean and gauge[4]	-95m below sea level	Q2 2015	2,719	6	43,551 treated seawater 615 desalinated freshwater
	Hydrotest[1,4]		Q2 2015	179	12	
	Leak test[1]	-52m below sea level	Q3 2016	157		
	Pre ILI gauging[2]		Q3 2016	14,056	30	
	ILI pigging[2]		Q3 2016	14,056	30	
	Dewater pipeline following full length test (includes 100% contingency)[2]		Q3 2016	12,998	26	
MEG Pipeline	Flood, clean and gauge[4]	-95m below sea level	Q2 2015	367	6	5,876 treated seawater 83 desalinated freshwater
	Hydrotest[1,4]		Q2 2015	23	12	
	Leak test[1]	-52m below sea level	Q3 2016	20		
	Pre ILI gauging[2]		Q3 2016	1,897	30	
	ILI pigging[2]		Q3 2016	1,897	30	
	Dewater pipeline following full length test (includes 100% contingency)[2]		Q3 2016	1,754	26	

Notes: 1. Discharge during hydrotest and leak testing comprises volume of water used to increase pressure to test pressure
2. Estimated discharge volume includes 20% overfill contingency 3. Volumes include spool volumes
4. Includes volume from onshore section testing

The project team is undertaking an evaluation of the options to manage disposal of treated seawater used during pipeline and flowline pre-commissioning to assess the best practical environmental option (BPEO). Upon completion of the BPEO the Project team will update MENR about the selected hydrotest water disposal option and obtain MENR approval.

5.8.6 Installation Vessels and Plant

A number of vessels will be used to undertake the pipelay activities including the Israfil Guseinov pipelay barge, three anchoring handling vessels, four pipe supply vessels, the DSV and various supply and support vessels. Table 5.23 summarises the pipelay barge and support vessel utilities.

Table 5.23 Pipelay Barge and Support Vessel Utilities

Utility	Description
Power Generation (Israfil Guseinov)	• The main power provided by 5 diesel generators rated at 1,600kW each.
Sanitary Waste	• Grey water will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable. • Depending on the availability of the system, black water will either be: - Contained onboard for transfer to shore; - Once onshore, black water will be managed in accordance with the existing AGT management plans and procedures; Or - Black water will be treated to applicable MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine as low as practicable. • Sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.
Galley Waste	Depending on the availability of the system, galley food waste will either be • Contained and shipped to shore for disposal; or • Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge.
Drainage/Water	• Deck drainage and wash water discharged to sea as long as no visible sheen is observable. • Oily bilge water, tank sludges, untreated oily water and waste oil will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

The type and number of onshore construction plant anticipated for the onshore pipeline installation activities are included within Appendix 5F.

5.8.7 Installation of Subsea Export and MEG Pipelines Emissions, Discharges and Waste

5.8.7.1 Summary of Emissions to Atmosphere

Table 5.24 summarises the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during subsea export and MEG import pipeline installation, tie-in and commissioning from key sources which include:

- Pipelay barge and support vessel engines and generators;
- Onshore construction plant; and
- Commissioning plant.

Table 5.24 Estimated GHG and Non GHG Emissions Associated with SD2 Project Installation of Subsea Export and MEG Pipelines

	Offshore and Nearshore Installation	Onshore and Nearshore Installation	Pre-Commissioning	Total
CO_2 (ktonne)	296.2	21.9	47.5	**365.5**
CO (tonnes)	740.4	113.3	150.3	**1,004.0**
NO_x (tonnes)	5,460.5	332.6	721.4	**6,514.5**
SO_x (tonnes)	740.4	43.8	29.7	**813.9**
CH_4 (tonnes)	25.0	1.2	2.5	**28.6**
NMVOC (tonnes)	222.1	50.3	65.1	**337.5**
GHG (ktonnes)	296.7	1.9	47.5	**366.2**

See Appendix 5A for detailed emission estimate assumptions.

5.8.7.2 Summary of Discharges to Sea

Routine and non routine discharges to the sea during pipeline installation, tie-in and commissioning comprise:

- Pipeline cleaning and hydrotest fluids (refer to Section 5.8.4 above); and
- Pipelay and support vessel discharges as described within Table 5.23.

5.8.7.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated during the export pipeline and subsea infrastructure installation, tie-in and commissioning programme are provided in Section 5.9.5.3.

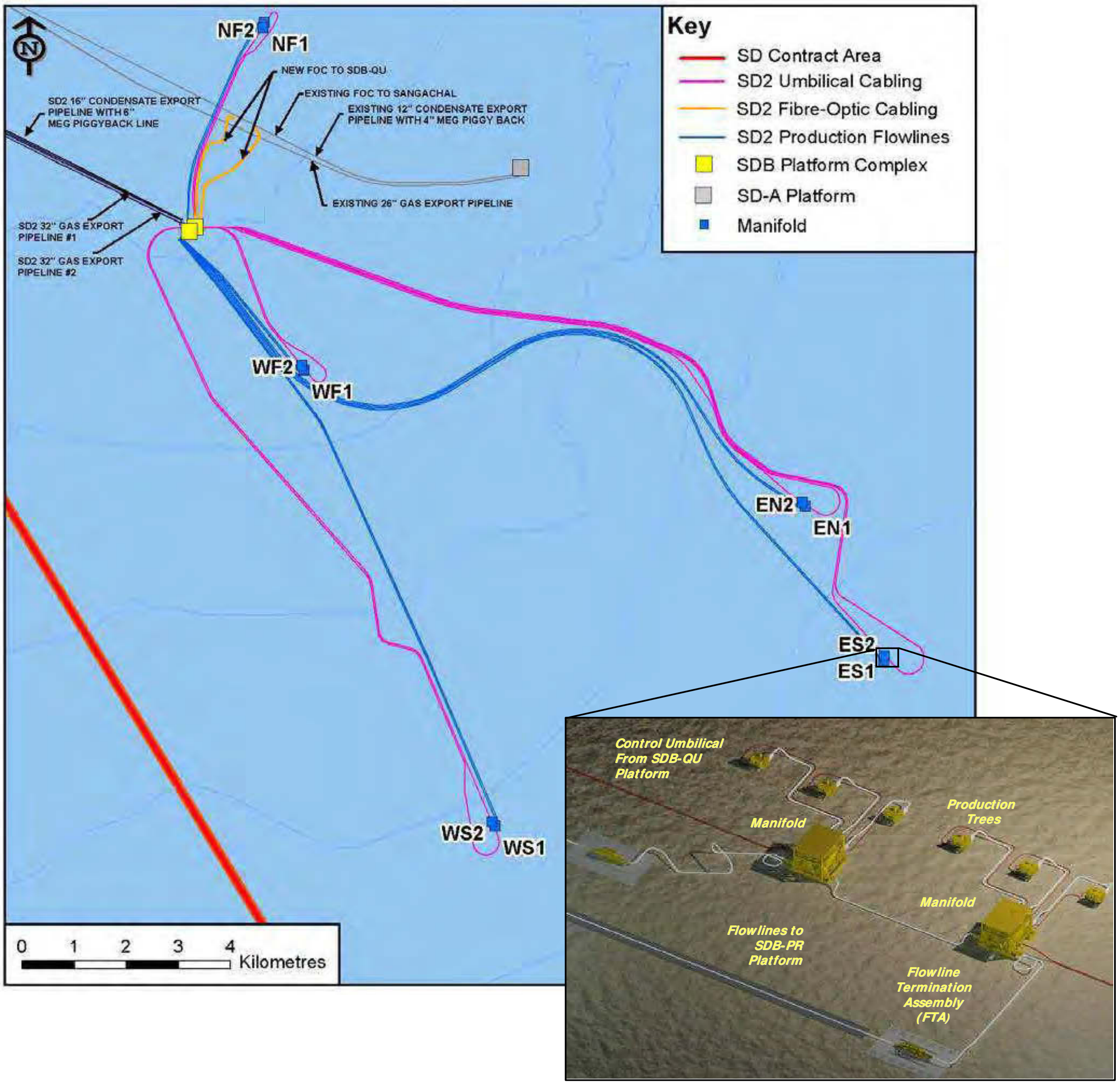
5.9 Subsea Infrastructure Installation, Hook Up and Commissioning

5.9.1 Introduction

The infield subsea infrastructure will be designed to transport the production fluids from the SD2 Project wells to the new offshore SDB platform complex. The elements of the subsea infrastructure to be installed within the SD Contract Area, as shown within Figure 5.20, include:

- 26 subsea production trees;
- 10 subsea production manifolds including a High Integrity Pressure Protection System (HIPPS). Each manifold will be tied to either 2 or 3 wells, located in 5 locations across the Contract Area, forming 5 well clusters;
- 10 production flowlines (two per well cluster) including in-line Direct Electrical Heating (DEH) cables and Subsea Safety Isolation Valves (SSIVs); and
- Subsea controls, chemical distribution (including MEG) and umbilicals.

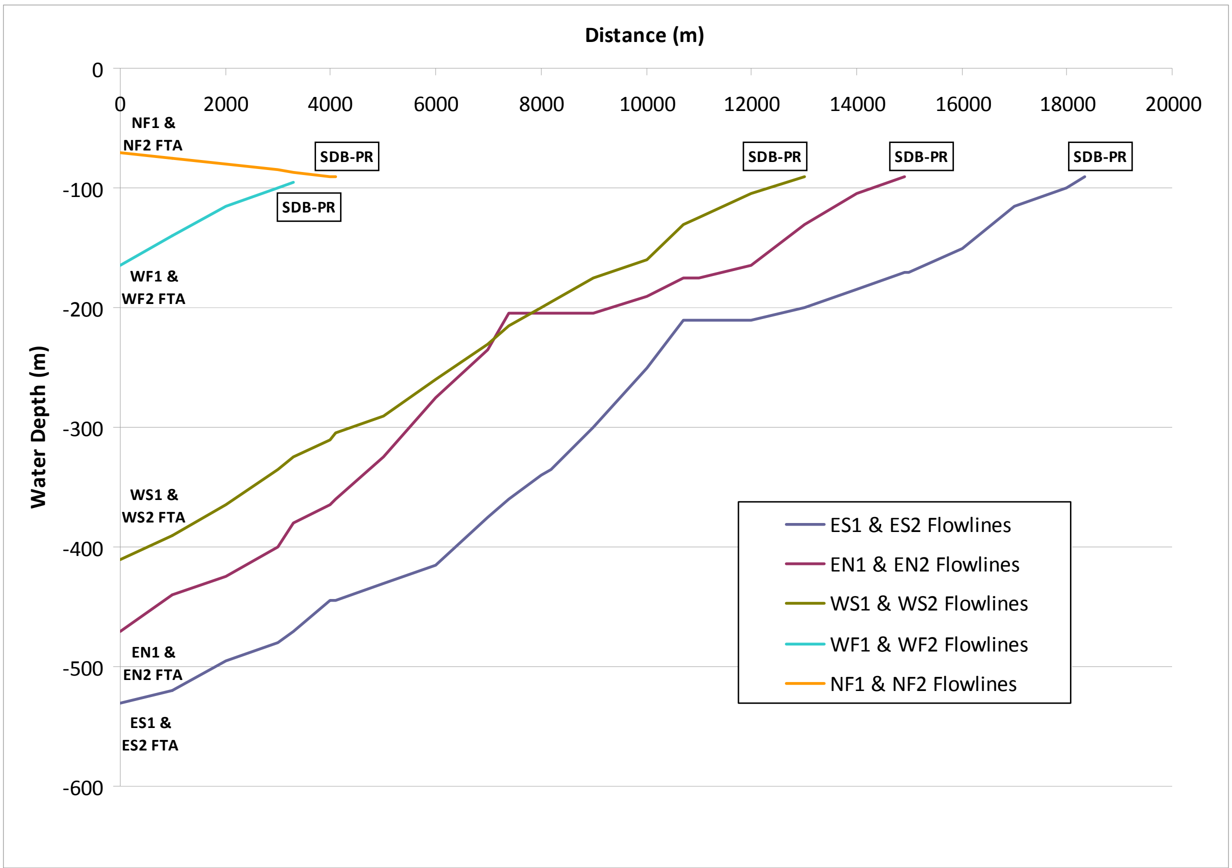
Figure 5.20 Layout of SD2 Infield Subsea Infrastructure



5.9.2 SD2 Subsea Infrastructure Design

The flowlines will be constructed from carbon steel and will incorporate a coating with thermal insulation in addition to a cathodic protection system which is compatible with the DEH system. The approximate flowline lengths and associated indicative seabed profiles are shown in Figure 5.21.

Figure 5.21 Approximate Flowline Lengths and Associated Seabed Profiles



5.9.3 Subsea Infrastructure Installation

The pipelay barge "Israfil Guseinov" will be used to install the flowlines using the same technique as for the export pipelines (refer to Section 5.8.3.1 above). The DEH system cabling will be strapped to the flowlines as they pass through the firing line and are deployed from the back of the pipelay vessel.

The pipelay barge will also be used to install the flowline termination assemblies (FTAs) associated with each cluster and will be used to store the tie-in spools between the platform risers and SSIVs and between the SSIVs and the flowlines prior to final installation by divers. Installation of the other subsea production infrastructure will be completed using the DBA, DSV, pipelay barge and various support and supply vessels. Each of the 9 SSIVs will be secured using 4 piles. The base case assumes the manifolds will be installed onto a foundation structure using suction piles. The utilities associated with the installation vessels are described in Table 5.23 above.

It is anticipated that the production trees, manifolds, associated jumpers and manifold headers are installed pre-filled with MEG. The equipment will be fitted with pressure caps to minimise losses of fluids to sea however it is anticipated that small volumes of MEG (between 10.74 and 13.84m^3 per flank) will be discharged to sea at the seabed during installation in the vicinity of each manifold and the associated production trees.

5.9.4 Flowline Pre Commissioning

Following installation the infield flowlines will be pre commissioned (i.e. cleaned, hydrotested, tied-in, tested and dewatered) using the same methodology adopted for the export pipelines (refer to Sections 5.8.4 above). The flowlines will be filled with treated seawater from a support vessel. It is anticipated that seawater will be dosed with:

- 1000 ppm Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
- 100ppm Tros Seadye (dye).

In the event that different chemicals are required, the SD2 Project Management of Change Process (see Section 5.16) will be followed. The intent is to use chemicals no more toxic or persistent than the Base Case chemicals.

The flowlines will remain filled within treated seawater until they are tied in. During this period each flowline shall be monitored to ensure systems are being continually protected against corrosion. If preservation chemicals are deemed to be depleting the treated seawater will be displaced to sea and refilled with treated seawater at the dosage rates stated above.

Table 5.25 presents the expected volume and location of discharges associated with gauging, hydrotesting, tie-in, testing and dewatering of the SD2 infield flowlines.

Table 5.25 Estimated Flowline Gauging, Hydrotesting, Tie-in, Leak Tests and Dewatering Discharges

		Discharge Location	Anticipated Date	Estimated Discharge Volume (m^3)	Discharge duration (hr)	Total Estimated Discharge Volume (m^3)[3]
NF Flowlines	Flood, clean and gauge	Seabed - 95m below sea level	Q1 2015	484	1	2,512 treated seawater 30 desalinated freshwater
	Hydrotest[1]		Q1 2015	12	12	
	Leak test[1]	SDB Open Drains Caisson -52m below sea level	Q3 2016	11		
	Pre intelligent pigging gauging[2]		Q3 2016	718	3	
	Intelligent pigging[2]		Q3 2016	718	3	
	Dewater flowlines following full length test[4]		Q3 2016	598	2	
WF Flowlines	Flood, clean and gauge	Seabed at SDB location) -95m below sea level	Q2 2015	458	1	2,041 treated seawater 23 desalinated freshwater
	Hydrotest[1]		Q2 2015	9	12	
	Leak test[1]	SDB Open Drains Caisson -52m below sea level	Q4 2016	10		
	Pre intelligent pigging gauging[2]		Q4 2016	560	2	
	Intelligent pigging[2]		Q4 2016	560	2	
	Dewater flowlines following full length test[4]		Q1 2017	467	2	
ES Flowlines	Flood, clean and gauge	Seabed at SDB location) -95m below sea level	Q2 2017	900	1	13,147 treated seawater 134 desalinated freshwater
	Hydrotest[1]		Q2 2017	50	12	
	Leak test[1]	SDB Open Drains Caisson -52m below sea	Q2 2018	46		
	Pre intelligent pigging gauging[2]		Q3 2018	3205	12	
	Intelligent pigging[2]		Q3 2018	3205	12	

		Discharge Location	Anticipated Date	Estimated Discharge Volume (m^3)	Discharge duration (hr)	Total Estimated Discharge Volume (m^3)[3]
	Dewater pipeline following full length test (includes 100% contingency)[2,4]	level	Q3 2018	2670	10	
WS Flowlines	Flood, clean and gauge	Seabed at SDB location) -95m below sea level	Q3 2017	734	1.4	7,011treated seawater 93 desalinated freshwater
	Hydrotest[1]		Q3 2017	35	12	
	Leak test[1]	SDB Open Drains Caisson -52m below sea level	Q4 2019	32		
	Pre intelligent pigging gauging[2]		Q4 2019	2,224	9	
	Intelligent pigging[2]		Q4 2019	2,224	9	
	Dewater flowlines following full length test[4]		Q4 2019	1,853	7	
EN Flowlines	Flood, clean and gauge	Seabed at SDB location) -95m below sea level	Q3 2019	798	2	7,917treated seawater 105 desalinated freshwater
	Hydrotest[1]		Q3 2019	42	12	
	Leak test[1]	SDB Open Drains Caisson -52m below sea level	Q2 2023	36		
	Pre intelligent pigging gauging[2]		Q2 2023	2,522	10	
	Intelligent pigging[2]		Q2 2023	2,522	10	
	Dewater flowlines following full length test[4]		Q2 2023	2,101	8	

Notes:
1. Discharge during hydrotest and leak testing comprises volume of water used to increase pressure to test pressure
2. Estimated discharge volume includes 20% overfill contingency
3. Each event includes volume of the two flowlines, FTAs, SSIVs, spools and risers for each flank.
4. Discharge includes slug of desalinated freshwater

The project team is undertaking an evaluation of the options to manage disposal of treated seawater used during pipeline and flowline pre-commissioning to assess the best practical environmental option (BPEO). Upon completion of the BPEO the Project team will update MENR about the selected hydrotest water disposal option and obtain MENR approval.

5.9.5 Subsea Infrastructure Installation, Hook Up and Commissioning Emissions, Discharges and Waste

5.9.5.1 Summary of Emissions to Atmosphere

Table 5.26 summarises the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during subsea installation, hook up and commissioning from the pipelay barge and support vessel engines and generators.

Table 5.26 Estimated GHG and Non GHG Emissions Associated with SD2 Project Installation of Subsea Infrastructure

	Subsea Infrastructure Installation	Subsea Infrastructure Pre-Commissioning	Total
CO_2 (ktonne)	38.9	20.2	**59.0**
CO (tonnes)	97.2	50.4	**147.6**
NO_x (tonnes)	716.9	371.7	**1,088.6**
SO_x (tonnes)	97.2	50.4	**147.6**
CH_4 (tonnes)	3.3	1.7	**5.0**
NMVOC (tonnes)	29.2	15.1	**44.3**
GHG (ktonnes)	38.9	20.2	**59.1**

See Appendix 5A for detailed emission estimate assumptions.

5.9.5.2 Summary of Discharges to Sea

Routine and non routine discharges to the sea during subsea infrastructure installation, tie-in and commissioning comprise:

- Subsea infrastructure discharges during installation (refer to Table 5.25 above);
- Flowline cleaning and hydrotest fluids (refer to Table 5.26 above); and
- Pipelay and support vessel discharges as described within Table 5.23.

5.9.5.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non-hazardous and hazardous waste generated during the SD2 export pipeline, MEG import pipeline and subsea infrastructure installation, hook up and commissioning activities are provided in Table 5.27. This data are based on waste volumes recorded for similar activities undertaken during the previous ACG Projects.

Table 5.27 Subsea Export Pipelines, MEG Import Pipeline and Subsea Infrastructure Fabrication and Installation Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Domestic/office waste	5,223
		Grit blast	31
		Metals - swarf	4,139
		Paper and cardboard	62
		Plastics - recyclable (HDPE)	3
		Tyres	42
		Waste electrical and electronic cable	9
		Wood	287
	Liquid wastes	Oils – cooking oil	0
		Total (Non-hazardous)	**9,797**
Hazardous	Solid wastes	Clinical waste	0.1
		Contaminated materials	1,057
		Contaminated soil	6
		Oily rags	36
	Liquid wastes	Oils – lubricating oil / Oils - fuel	102
		Paints and coatings	92
		Solvents, degreasers and thinners	8
		Water - oily	5,618
		Water - hydrotest water	95
		Water treatment chemicals	31
		Total (Hazardous)	**7,046**

5.10 Offshore Operations and Production

5.10.1 Overview

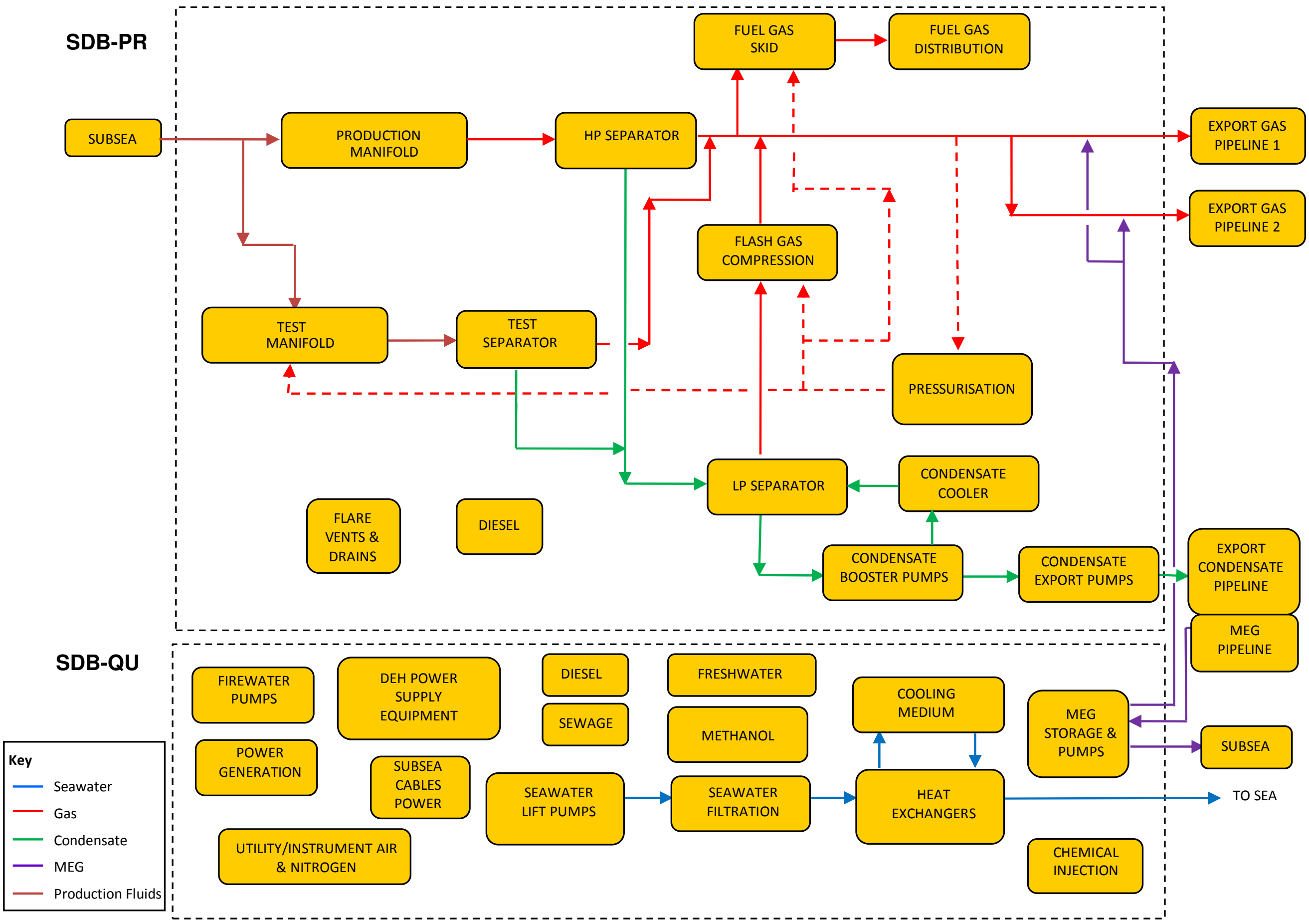
The SDB platform complex comprises the bridge linked SDB-PR and SDB-QU platforms.

Key production activities that will be undertaken on the SDB platforms will include:

- Gas and condensate separation and production;
- Gas export; and
- Condensate export.

Process systems will be located on the SDB-PR platform. Utilities and worker accommodation facilities will be located on the SDB-QU platform. The systems on each platform and relevant interconnections are shown schematically within Figure 5.22.

Figure 5.22 SDB-PR and SDB-QU Process and Utilities Systems



The sections below provide an overview of the key systems shown in Figure 5.22.

5.10.2 Production and Separation

The production fluids from each of the subsea production system flowlines will be routed to one of two production manifolds, or to the test manifold during well testing.

There will be two trains of separation in a 2 x 50% configuration (i.e. two trains designed to operate simultaneously under routine conditions at 50% throughput each). The fluids from the production manifold will be sent to a dedicated 2-phase HP separator. From the HP separator the fluids will be routed to a 2-phase LP separator. The gas from the HP separator will be routed to gas export via a pressure control system.

The test manifold fluids will be routed to a 1 x 100% 3-phase test separator, sized to accommodate the maximum expected operational flows from any one flowline. The test separator will be designed to operate as a production separator in the event that the HP separator is unavailable (e.g. due to maintenance). The LP separators will be sized to handle flow from both HP and test separators.

The HP and test separators will be equipped with a spill offs to flare (via the SDB-PR platform header) for safe disposal of gas during the establishment of gas buy back or during flowline pigging operations.

A pressurisation/depressurisation manifold will be provided to receive fluids from a controlled subsea flowline depressurisation, which will occur prior to planned flowline pigging or if a non routine event occurs which has the potential to reduce flowline temperatures to below 26°C and the primary method of hydrate control is not available (refer to Section 5.11.2.2 below).

It is intended that well clean up, completion, workover and intervention activities will be undertaken by the MODU (refer to Section 5.4 above), minimising the carry over of solids and completion, workover and intervention chemicals to the SD2 offshore facilities. However the platform separation system will be designed to accommodate the small amount of remaining solids and chemicals expected from the production wells during start up, workover and intervention.

5.10.3 Gas Export

The gas from HP production separators, test separator and flash gas compression system will be exported to Sangachal Terminal via the two new 32” dedicated gas export pipelines. A 16” cross over/balance line will be provided between the two export lines, which also provides the primary source of the platform fuel gas. MEG is injected into the gas prior to export to the Terminal.

A three stage flash gas compression system will be provided to continuously recover low pressure gas from the LP production separators for routing to the gas export system. When the flash gas compression system is unavailable (due to trips or testing of pressure safety valves (PSVs)), gas will be routed to flare. These compressors are also used during flowline repressurisation activities (see Section 5.10.6).

5.10.4 Condensate Export

Condensate will be exported to Sangachal Terminal via the new 16” condensate export pipeline. Condensate from the LP Production Separators will be routed to the Condensate Booster Pumps and then to Condensate Export Pumps and 16” Condensate Pipeline.

During start up, the condensate booster and export pumps will be run in recycle mode with the condensate returned to the LP separator. A portion of the recycled condensate stream will be routed through a cooler to prevent the temperature of the combined stream from exceeding 50°C.

5.10.5 Fuel Gas System

The main consumer of the fuel gas will be the power generation system on the SDB-QU platform. In addition, the gas will also be used for purge and pilot in HP and LP flare systems and for storage vessel blanketing.

The normal source of fuel gas will be production gas from the gas export manifolds. An alternative source is buy back gas, which will be supplied from the 32” gas export pipelines. When the normal source of fuel gas is not available, e.g. during platform shutdown and restart, the preferred option is to use buy back gas. This gas is expected to contain some liquid surge volumes, which will be collected within the HP and test separators. To avoid choking the continuous supply of fuel gas to the users, the gas stream from the separators during the initial period of liquid removal will be sent to flare at an estimated rate of 75mmscfd.

5.10.6 Pressurisation System

The pressurisation system will be located on the SDB-PR platform and will be designed to supply heated gas in order to prevent hydrate and ice formation during subsea flowline pressurisation during a platform shutdown or restart. The primary source of pressurisation gas will be buy back gas from the new 32” gas export pipelines.

5.10.7 Flare System

The SDB platforms will be fitted with a flare system, designed to safely dispose of hydrocarbon gases released from the processing facilities during non routine and emergency conditions. Under routine operational conditions, the platform flare system is designed for purge and pilot flaring only.

The HP flare system will be designed to collect hydrocarbon discharges from pressure relief, control and depressurisation valves from equipment with a design pressure at or above 18 barg (with the exception of the flash gas compressor discharge cooler bursting discs which are routed directly to the LP flare drum via a segregated header. In addition, spill-offs to flare will be provided on each of the separators (LP/HP/Test) for use during round trip pigging and gas buy back.

The process equipment items that comprise the HP flare system (including the HP flare drum and heater) will be located on the SDB-PR platform. The SDB-QU platform header will be routed to the HP flare drum on the SDB-PR platform via the bridge. The SDB-PR liquid header will also be routed to the HP flare drum.

The LP flare system, located on the SDB-PR platform, will be designed to collect hydrocarbon discharges from pressure relief, control valves and tank/drum vents from equipment with a design pressure below 18 barg, with the exception of the:

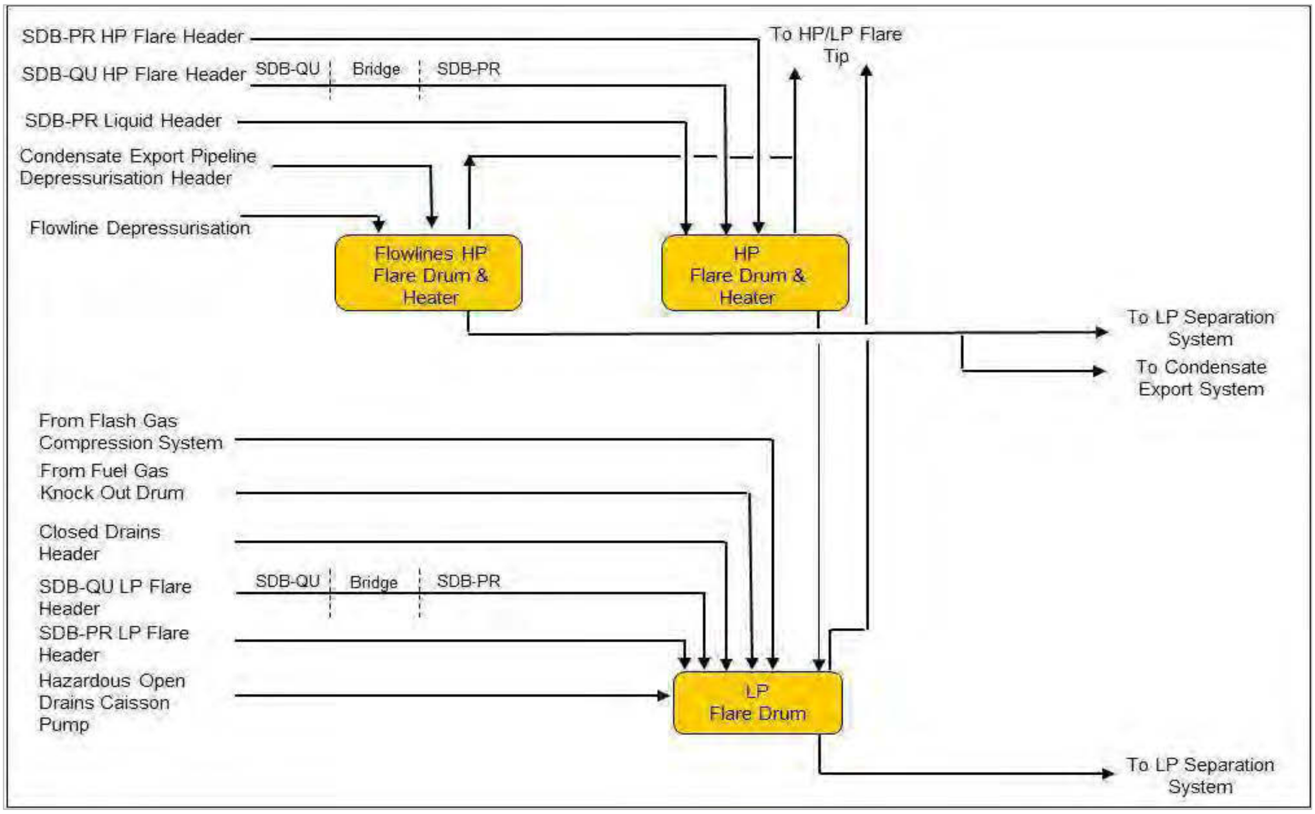
- Flash gas compressor discharge cooler bursting discs which are routed directly to the LP flare/closed drains drum, and
- Cooling medium expansion drum which is routed to the LP flare/closed drum via the SDB-QU and SDB-PR LP flare collection headers.

The LP flare will share the 1x100% HP/LP flare tip package. The flare boom will be located on the south east corner of the SDB-PR platform at 180° to platform north and orientated at 60° to the horizontal. The flare, up to approximately 135m in length, will be designed to achieve a combustion efficiency of 98% and will be of a ‘smokeless design’. Fuel gas will be normally used to continuously purge the flare collection headers/sub-headers to ensure no air ingress while minimising the purge flow.

The SD2 Base Case assumes between 0.2% and 0.8% of the total gas produced will be flared per annum; between 0.1% and 0.3% will be flared offshore and the remainder at the Terminal.

Figure 5.23 shows a simplified flow diagram of the HP and LP flare systems.

Figure 5.23 HP and LP Flare Systems



5.10.8 Power Generation

Main electrical power for the offshore users will be provided by four gas turbine driven generators, each rated at 11.9MW (at 35°C). The generators will be dual fuel type, normally operating on fuel gas, switching to diesel when fuel gas is not available. Under routine conditions it is anticipated the offshore power demand will be 13MW (pre plateau production) rising to 19.1MW (plateau to end of PSA) and this demand will be met by 2 of the generators. Routine conditions are anticipated to occur typically for 91% of the year during operations.

When fluid flow is low or during upset conditions, it will be necessary to maintain the temperature of the subsea flowlines above a minimum of 26°C to prevent the formation of hydrates. This will be achieved by use of the DEH System (refer to Section 5.11 for further details of the DEH system operation). The electrical power demand has been determined based on two expected DEH modes:

- Keep warm up – where the flowlines are keep warm (at a minimum 26°C) following a production shutdown; and
- Cold start up – where the flowlines are heated from a minimum ambient seabed temperature to 26°C.

The currently anticipated electrical loads for the offshore platforms across the PSA are presented in Table 5.28.

Table 5.28 Anticipated Offshore Electrical Loads Across the PSA

Activity	2018 - 2019 MW (1-3 flowlines)	2020 - -2038 MW (6-10 flowlines)	Duration % Time
Normal Steady State	13	19.1	91
Keep Warm	14.8 - 15.8	27.2 - 33.4	7.5
Cold Start Up (Peak)	21.4 - 22.4	28 - 34.2	1
Planned Shut Down (base load only)	6	6	0.5*

*Estimated to occur once every 2 years.

Emergency power will provided by a diesel generator located on the SDB-QU platform.

5.10.9 Sand Separation System

The processing facilities will be designed to handle the anticipated sand volumes during the initial years of operation. As the rate of produced water from the reservoir increases it is anticipated that online sand removal within the HP and Test separators may be required.

Provision is made within the design for the sand separation package to be located on the SDB-PR platform, and for the ancillary systems to be located on SDB-QU platform.

An offline seawater wash system will be installed for operation from first gas on the HP and Test separators to remove any accumulated sand so the separator vessels can be opened for maintenance/inspection. Liquid and solid waste from the offline seawater wash system will be contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

5.10.10 Platform Utilities

5.10.10.1 Diesel System

The main platform diesel users comprise:

- Cranes;
- Emergency power generator;
- Main power generators (only when both the fuel gas and buy back system is unavailable);
- Firewater pumps; and
- Lifeboats.

Diesel will be transferred from supply boats and offloaded onto each platform by hose, where it will be filtered and stored in the SDB-PR and SDB-QU crane pedestals; one on the SDB-PR and two on the SDB-QU platform, each with a working volume of $123m^3$. The diesel storage tank and transfer pump on SDB-PR will be utilised to top up the SDB-QU diesel storage tanks as and when needed via manual operation.

When required, diesel will be pumped to the diesel users, via the diesel treatment package on the SDB-QU platform, which will remove small amounts of water and particulates that have contaminated the diesel during vessel transfer from the onshore diesel treatment facilities. Water and particulates collected in the diesel treatment system will be sent to the non-hazardous open drains system for disposal.

5.10.10.2 Seawater System

Seawater will be required onboard the SDB platform complex for a number of purposes including:

- Heating, Ventilation and Air Conditioning (HVAC);
- Living quarters ablutions;
- Freshwater maker;

- Fire water ring main pressurisation facility;
- Offline Seawater wash system;
- Cooling for the cooling medium system; and
- Washdown facilities.

The seawater system will be located on the SDB-QU platform with a cross-over line across the bridge to the SDB-PR platform. Seawater will be extracted from 1 of the 2 vertical seawater lift pump caissons at a depth of -75m below sea level. The maximum seawater extraction design flow rate per pump will be approximately 2,173m^3/hr. The design of the seawater intake caissons on the platform will incorporate a mesh of 200mm diameter.

Lifted seawater will be electrochlorinated in an antifouling package and dosed with 50 ppbv of chlorine and 5 ppbv copper; and then filtered to remove any particles that are above 50 microns in diameter. After use, part of the seawater (up to 2,124m^3/hr) will be returned to the Caspian, via the seawater discharge caisson (at a depth of -54.5m below sea level).

The design and operation of the seawater/cooling water system has been reviewed and confirmed that the temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees more than the ambient water temperature**.**

5.10.10.3 Cooling Medium System

The SDB-QU platform will be equipped with an indirect cooling medium system. The cooling medium (20% by weight MEG) will be cooled against seawater and will be circulated within a closed loop to users on both the SDB-QU platform and the SDB-PR platform (via the bridge).

In the event that the cooling medium becomes degraded and requires replacement, the used cooling medium will be drained from the system, containerised and will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures. The system will then be recharged with fresh cooling medium.

5.10.10.4 Chemical Injection Systems

The production process requires the addition of certain chemicals to facilitate production, aid the separation process, protect process equipment from corrosion and protect equipment, pipelines and the subsea production system from hydrate formation. There will be three separate chemical systems located on the SDB-QU platform which will supply both the SDB-QU and SDB-PR (via a bridge crosslink):

- Main chemical injection system;
- MEG injection system; and
- Methanol injection system.

Main Chemical Injection System

The Main Chemical Injection Package will provide chemicals primarily for the production and export systems. Chemicals will be supplied to the platform in transportable tote tanks located on a dedicated chemical lay down area above the storage tanks. These tote tanks will be decanted into the 1 x 100% storage tanks for each of the injection systems. For large inventories (exceeding the maximum tote tank size of 30 m^3) the chemicals will be delivered by supply boats and offloaded directly into the respective storage tanks. Transfer lines for chemicals from supply boats shall be fitted with slam shut valves. Storage tanks shall be sized to provide 14 days of chemicals at the maximum dosage rate.

The anticipated chemicals will be injected into the process streams as required and will be transported to the SD2 onshore facilities, co-mingled with the gas and condensate, via the SD2 gas and condensate subsea export pipelines.

The pumps associated with the main chemical injection package will be provided with integral drip trays or pans. Minor spills contained with the drip pans or trays will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

MEG

The MEG injection system will be used to suppress hydrate formation during low temperature conditions in the following cases:

- Continuous injection into the gas export pipelines during routine operations;
- Intermittent injection into the production flowlines/subsea production system, riser and SSIV area, for fluid displacement during a production shutdown;
- Intermittent injection into the production flowlines/subsea production system during start-up/restart of high pressure wells.

MEG will be supplied to the SDB platform complex via the dedicated 6" import pipeline from Sangachal Terminal. Lean MEG storage will be provided on SDB-QU platform, sized for a total working volume of 560m^3. This is based on the volume of MEG required to displace the risers and SPS for the five flanks of the subsea production system during a shutdown plus 60 m^3 for normal injection to gas export pipelines.

Minor spills from the MEG system will be contained in drip trays. The contents of the drip trays will be manually removed by hose, contained and will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

Methanol

The purpose of the methanol system is to prevent ice/hydrate formation during flowline re-start, flowline depressurisation, gas buy back operations, HP and test separation and fuel gas system start-ups, as well as gas export pipeline manual depressurisation. The system will also be used for ice/hydrate remediation of flowline production risers and pipework, topsides production systems and subsea production system.

Methanol will be delivered by supply boats and offloaded directly to the 250m^3 methanol storage tank. During early years of production methanol will be supplied to the offshore facilities by tote tank only.

The methanol system will be located within a dedicated kerbed area and methanol pumps trays equipped with drip trays. For safety reasons, methanol spillage from the kerbed area will be routed overboard, while methanol pump drip trays (which may contain lube oil) will be routed to the SDB-QU hazardous area open drains system.

5.10.10.5 Drainage System

Open Drains

The SDB-PR and SDB-QU platforms will be provided with separate self-contained open drains systems (see Figure 5.24).

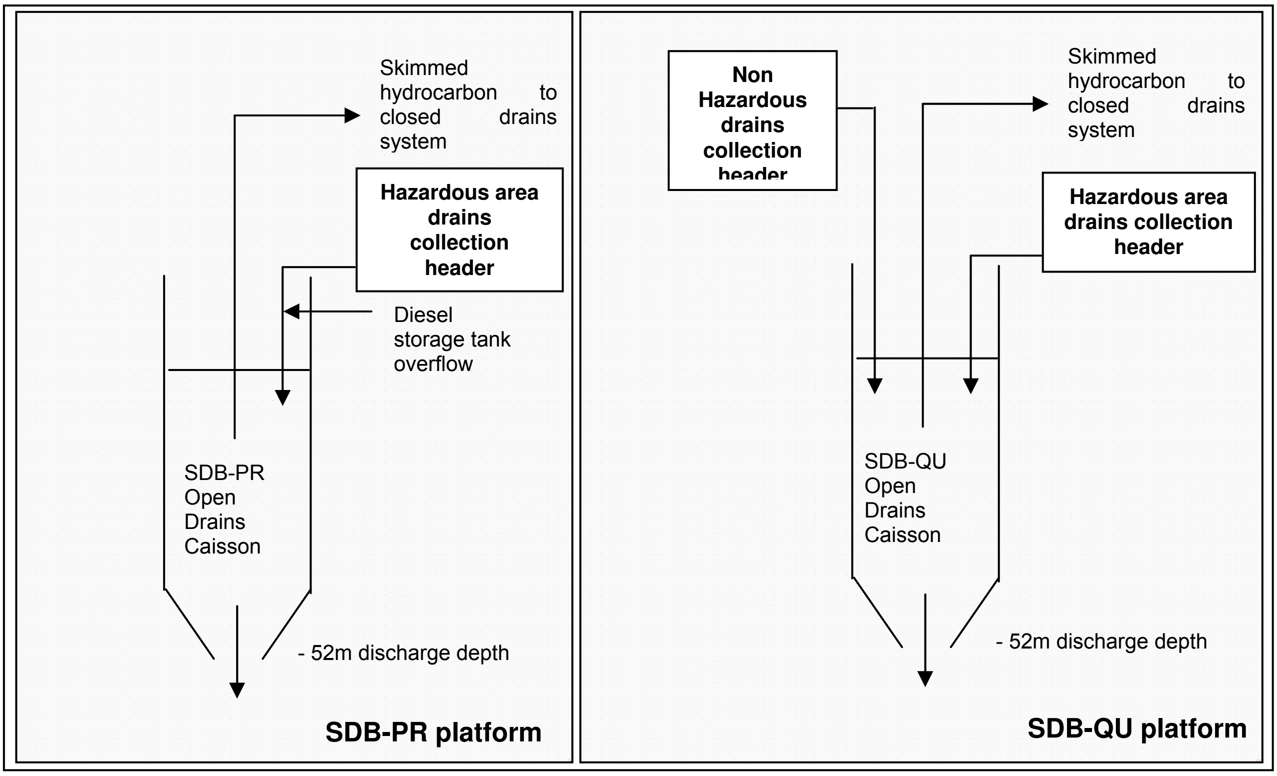
The SDB-PR platform will be provided with a hazardous area open drains system. The purpose of the hazardous area open drains system is to route drainage from rainwater, wash down water, firewater deluge, spillages and equipment drains/leakages from all the deck levels in the hazardous area of the platform to the SDB-PR open drains caisson.

The SDB-QU platform will be provided with two separate systems; a hazardous area drains system and a non-hazardous area drains system. The two systems will be segregated to prevent migration of gas or vapour from the hazardous to non-hazardous areas of the platform. Effluent from both hazardous and non-hazardous area open drains will be routed to the SDB-QU open drains caisson.

Under routine conditions it is not planned to route minor spills of production chemicals or MEG to the SDB-QU open drains caisson. However in the event of a production chemical tank overfilling or a significant spill or leakage, production chemicals and/or MEG spills/leaks will be sent to the SDB-QU non hazardous drains for safety reasons.

Both the SDB-QU and SDB-PR open drains caissons are designed to ensure that there is no visible sheen on the sea surface and to discharge at a depth of 52m below sea level. Any oil in the open drains caissons will be routed to the LP flare/closed drains drum on the SDB-PR platform. Deluge from deck drain boxes shall be routed directly overboard for safety reasons.

Figure 5.24 SDB-QU and SDB-PR Platform Open Drains Systems



Closed Drains

The function of the closed drains system is to collect hydrocarbon liquids/hazardous fluids from process equipment and instruments during maintenance operations. The contents of closed drain systems on the both the SDB-QU and SDB-PR platforms will be routed to the LP flare/closed drains drum on the SDB-PR platform. The gaseous hydrocarbons collected in the drum will be routed to flare and the liquid phase routed to the LP separators.

5.10.10.6 Instrument Air and Inert Gas System

Both the instrument and plant air systems and the inert gas system will be located on the SDB-QU platform, with lines across the bridge to the SDB-PR platform for the supply of air and inert gas to users.

5.10.10.7 Freshwater

Freshwater will be produced on the SDB-QU platform from seawater (taken from the seawater system) in the freshwater maker. The freshwater maker system will utilise a reverse osmosis (RO) process to desalinate seawater. Freshwater for potable use will be produced from an ultra violet (UV) sterilisation unit. Saline effluent from the freshwater maker will be returned to the Caspian via the SDB-QU sewage discharge caisson (at -16.2m below sea level).

5.10.10.8 Fire Systems

The platforms will be equipped with a firewater distribution system, which will be supplied by two diesel powered firewater pumps located on the SDB-QU platform. The firewater pumps will be tested on a weekly basis for an hour with seawater circulated through the firewater system and discharged via the SDB-QU seawater discharge caisson.

A foam concentrate system will be provided to enhance the effectiveness of water spray protecting the separator module and the flowlines HP flare drum area, where there is potential for hydrocarbon pool fires. Following commissioning (see Section 5.7.5), foam will be discharged during annual testing. Foam system chemicals of the same specification and environmental performance as those used in existing SD and ACG platform foam systems will be stored on the platform for emergency use[18].

5.10.10.9 Black and Grey Water

Black water and grey water from living quarters will be collected via the sewer system and treated in a sewage treatment package on the SDB-QU platform, sized to accommodate up to 240 Persons On Board (POB) (anticipated during commissioning).

It is intended that the sewage treatment package will be a membrane bioreactor fitted with jet aeration. Treated effluent will be discharged to sea via the SDB-QU platform sewage caisson (16.2m below sea level).

The sewage treatment package will be designed:

- In accordance with PSA requirements i.e. sanitary waste may be discharged from a U.S. Coast Guard certified or equivalent Marine Sanitation Device (MSD) to meet USCG Type II standards of total suspended solids of 150mg/l and faecal coliforms of 200MPN (most probable number) per 100ml;
- To ensure that a high proportion of the biodegradable surfactants present (greater than 90%) degrade prior to discharge of the treated effluent; and
- To allow mechanical removal of sludge, which will be contained in dedicated tote tanks and shipped to storage for disposal.

[18] The SD2 Project Management of Change Process (Section 5.16) will be followed should alternative chemicals be required.

Laundry grey water will be discharged to sea (without treatment) in accordance with applicable PSA requirements via the SDB-QU sewage caisson (16.2m below sea level) i.e. domestic wastes and grey water may be discharged as long as no floating solids are observable.

The sewage treatment package buffer tank will be sized to accommodate an additional day's black water above the normal operating capacity. In the event that the sewage treatment package is unavailable, all grey water (from living quarters and laundry) will be routed directly to the sewage caisson to maximise the storage volume available for black water.

5.10.10.10 Galley Waste

Organic food waste originating from the platform galley will be macerated to less than 25mm in accordance with MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships requirements and discharged to the SDB-QU sewage caisson.

5.10.11 Pipeline and Flowline Maintenance

Maintenance of the gas and condensate export pipelines, the MEG import pipeline and the infield flowlines will include periodic pigging. The condensate pipeline will be routinely pigged primarily to manage wax accumulation. All export/import pipelines and flowlines will undergo periodic inspection pigging to confirm integrity.

5.10.11.1 Export and MEG Import Subsea Pipelines

It is anticipated that the condensate export pipeline will be pigged approximately every three days. Pigging of the gas export pipelines will be infrequent and is expected to occur when flowrates drop below 350MMScfd.

Throughout the PSA, pigging will be undertaken in the direction of flow i.e. from the pig launchers located on the SDB-PR platform to the Terminal.

Each pigging event will require the associated condensate or gas export pipeline pig launcher on the SDB-PR platform to be depressurised with the resulting gas sent to flare.

For the MEG pipeline, pigging (expected to be undertaken infrequently) will be undertaken in the direction of flow i.e. from the pig launchers located on the Terminal to the SDB-PR platform. Contaminated MEG from pigging will be contained and shipped to shore, where it will either be regenerated or sent offsite for disposal in accordance with the existing AGT waste management plans and procedures.

5.10.11.2 Flowline Pigging

A pig launcher/receiver will be provided on the SDB-PR platform for each of the ten flowlines, which will be tied back to the platform in pairs to enable round trip pigging. It is anticipated that each flowline will be pigged every 3 years. Each pigging event will comprise 4 pig runs, propelled by gas at a rate of up to 50mmscfd. The hydrocarbon stream from the flowlines during pigging will be sent to the HP or Test separators via the dedicated pig receivers and the gas stream subsequently sent to flare. The pig receivers will be equipped with drip tray to collect solids/drips which will be contained and shipped to shore for appropriate disposal.

5.10.12 Supply and Logistics

Consumables such as diesel, chemicals and supplies will be transported to the platform by vessels, normally every 7-14 days, depending on requirements. Personnel will be transferred to the platform by vessel (up to two vessels per week during normal operations). Helicopter transfer may be used for contingency (i.e. for emergencies). There will be no helicopter or vessel refuelling facilities on the platform complex.

5.10.13 Offshore Operations Emissions, Discharges and Waste

5.10.13.1 Summary of Emissions to Atmosphere

Table 5.29 shows the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during SD2 start up and offshore production from key sources across the PSA period. These sources include:

- Main power generators;
- Emergency diesel generator;
- Firewater pump;
- Platform cranes;
- Flare; and
- Crew change helicopters/vessels and supply vessels.

Table 5.29 Predicted GHG and non GHG Emissions Associated with Routine and Non Routine SD2 Offshore Operations and Production Activities

	CO_2 (ktonne)	CO (tonne)	NOx (tonne)	SO_2 (tonne)	CH_4 (tonne)	NMVOC (tonne)	GHG (ktonne)
TOTAL	3,642.5	4,875.4	13,262.1	511.2	3,920.9	786.9	3,724.8

See Appendix 5A for detailed emission estimate assumptions.

5.10.13.2 Summary of Discharges to Sea

Planned discharges to sea from SD2 offshore operations comprise:

- Platform cooling water (refer to Section 5.10.10.2);
- Platform drainage (refer to Section 5.10.10.5);
- Platform freshwater maker returns (refer to Section 5.10.10.7);
- Platform black and grey water (refer to Section 5.10.10.9); and
- Platform galley waste (refer to Section 5.10.10.10).

5.10.13.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated by the SD2 offshore operations during the PSA period are provided in Table 5.30. These have been estimated based on the waste records for the Shah Deniz Alpha platform.

All waste generated during SD2 offshore operations and production activities will be managed in accordance with the existing AGT management plans and procedures.

Table 5.30 Offshore Operations Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Domestic/office wastes	2,759
		Metals - swarf	1,249
		Paper and cardboard	125
		Plastic – recyclable (HDPE)	55
		Waste electrical and electronic cables	28
		Waste electrical and electronic equipment	12
		Wood	770
	Liquid wastes	Oils - cooking oil	31
		Total (Non-hazardous)	**5,029**
Hazardous	Solid wastes	Batteries - wet cell	38
		Clinical waste	1
		Contaminated materials	502
		Contaminated soils	114
		Explosives	0.2
		Filter bodies	36
		Greases	0
		Lamps	6
		Oily rags	477
		Pressurised containers	1
		Tank bottom sludges	115
		Toner or printer cartridges	4
	Liquid wastes	Acids	0.2
		Antifreezes	10
		Oils - fuel	3,292
		Paints and coatings	10
		Sewage sludges	1,029
		Water treatment chemicals	382
		Total (Hazardous)	**6,018**

5.11 Subsea Operations

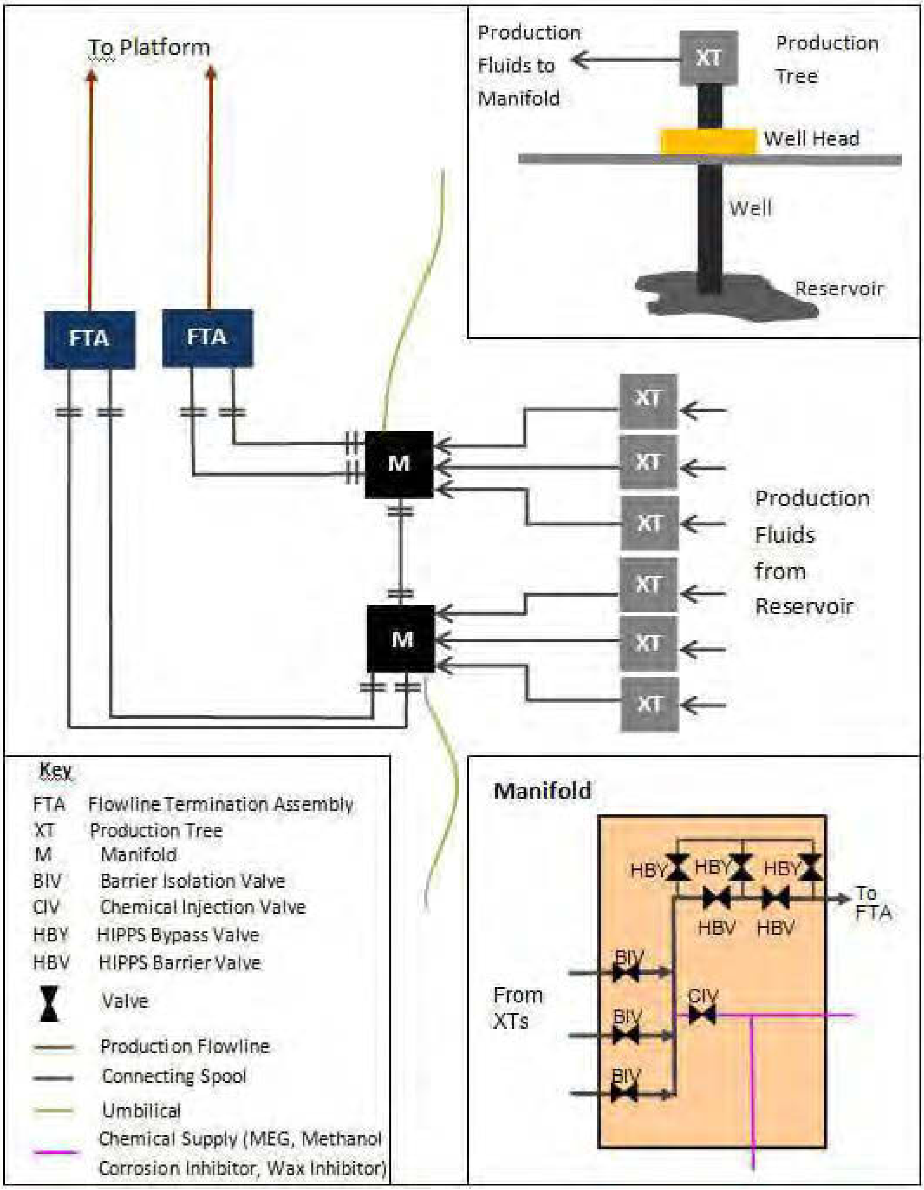
5.11.1 Introduction

Subsea production is planned to commence following the installation and tie-in of the infield subsea infrastructure in the north flank (NF). The infield subsea infrastructure will then be installed in the remaining 4 flanks (WF, ES, EN and WS) and tied in sequentially. The layout of the infield subsea production system, which is grouped into five well clusters, is shown in Figure 5.20. Each cluster comprises:

- Up to six wells, each fitted with a production tree;
- Two production manifolds, each tied to two or three wells, incorporating HIPPS;
- Two looped production flowlines, tied back to the SDB-PR platform, incorporating DEH cabling;
- One SSIV and associated umbilical and controls system per flowline adjacent to the SDB-PR platform;
- Two FTAs; and
- Umbilicals (including fibre optic cables).

Figure 5.25 illustrates the typical layout of the cluster and the valves associated with the manifolds and wellheads (within the production tree).

Figure 5.25 Typical Subsea Production System Layout of Each Cluster



The subsea production system valves will be controlled from the SDB-QU platform using an open loop subsea control system. Chemicals and power required for flow assurance (i.e. wax, scale, corrosion and hydrate management) will be provided from the SDB-QU platform via umbilicals.

5.11.2 Flow Assurance

During routine operations a number of chemicals will be required within the subsea production system to minimise the formation of wax and scale and control corrosion, During non routine conditions including well start up, testing, maintenance and shutdown it will be necessary to minimise the potential formation of hydrates within the subsea production system. This will be achieved using a combination of DEH and MEG. Methanol will also be used, if required, to dissolve hydrates which may form in the subsea equipment.

5.11.2.1 Subsea Flow Assurance Chemicals

A summary of the subsea flow assurance chemicals is provided within Table 5.31. All chemicals will be provided from the SDB-QU platform via umbilicals. It is not planned to discharge flow assurance chemicals to sea during subsea operations during either routine or non routine conditions.

Table 5.31 Subsea Flow Assurance Chemical Requirements

Chemicals	Required For
Corrosion Inhibitor	Corrosion management
Wax Inhibitor	Wax management
Scale Inhibitor	Scale management
MEG	Hydrate management
Methanol	Hydrate remediation

5.11.2.2 DEH Operation

The DEH system is designed to maintain the temperature of the production fluids within the subsea flowlines above 26°C during shutdown (when flow is low or static) to prevent the formation of hydrates and to heat the flowline contents from ambient seabed temperature to 26°C. All DEH cabling is insulated.

The system comprises cabling running from the SDB-QU platform to each flowline via dedicated subsea junction boxes. These are connected to the Piggyback Cable (PBC) and flowline at the near-end Current Transfer Zones (CTZ). The single core PBC runs along the flowline, and has an integrated dropped object protection system which is connected to the flowline, completing the circuit, at the far-end CTZ. The CTZ's are made up of banks of bracelet anodes attached to the flowline which ground the system and allow current to transfer through the water.

It is anticipated that the cable surface temperature of the PBC will not exceed 10°C during DEH system operation. The outer surface of the production flowlines are not expected to be greater than 0.2°C above ambient seawater temperature under both routine conditions and when the DEH is operational.

When activated, an alternating current passes along the cable, heating the flowline due to electrical resistance.

The power required for the DEH system will be provided from the SDB power generation system. The DEH power requirements will be determined by the relevant DEH scenario and number of flowlines to be heated (refer to Section 5.10.8). The two main DEH scenarios can be described as follows:

- **Cold start up** - where the production fluids within the flowlines are heated from ambient temperature to 26°C prior to restart. It is anticipated that this type of scenario will occur 1% of the time during the PSA period;

- **Keep warm** – where the system is used to maintain the production fluids within the flowlines temperature at 26°C after a planned production shutdown. It is anticipated that this type of conditions will occur 7.5% of the time during the PSA.

An electrical field will be generated around the flowlines during DEH operation, reaching approximately 0.18V/m around the 10 flowlines as they approach the platform in parallel and approximately 5V/m immediately adjacent to the CTZ. In both cases the field strength drops very rapidly away from the flowlines. Within 10m of the flowlines approaching the platform field strength is anticipated to halve and within 2m of the CTZ.

5.11.3 Subsea Control System

To control and monitor the flow of production fluids from the reservoir at the wellheads and the manifolds a subsea hydraulic control system will be used. As hydraulic valves are actuated control fluid will be discharged to sea as described below. The system will be constantly supplied with control fluid via the subsea umbilicals.

5.11.3.1 Manifold

The purpose of the manifold is to comingle and then route the production fluids to the SDB platform complex via the production flowlines**.** Each manifold will be equipped with HIPPS. The function of the HIPPS is to provide rapid isolation of the manifold from the flowlines, protecting the flowlines and platform facilities in the event of overpressure in one of the associated wells or caused by the closure of a SSIV at the platform complex.

The function of the hydraulic valves associated with the manifold include:

- **Chemical injection valves (CIV)** – to enable the introduction of wax inhibitor, corrosion inhibitor, MEG and methanol into the production fluids when required;
- **Barrier Isolation Valves (BIV)** – to allow the well slots within the manifold to be isolated;
- **HIPPS Barrier Valves (HBV)** – to stop the flow of production fluids from the manifold; and
- **HIPPS Bypass Valves (HBY)** – to allow differential pressure across the HIPPS barrier valves to be equalised and to enable testing of the HIPPS barrier valves.

The current design provides for up to 25 hydraulically actuated valves and associated DCVs at each manifold**.**

5.11.3.2 Wellhead

The functions of the hydraulic valves associated with each wellhead are:

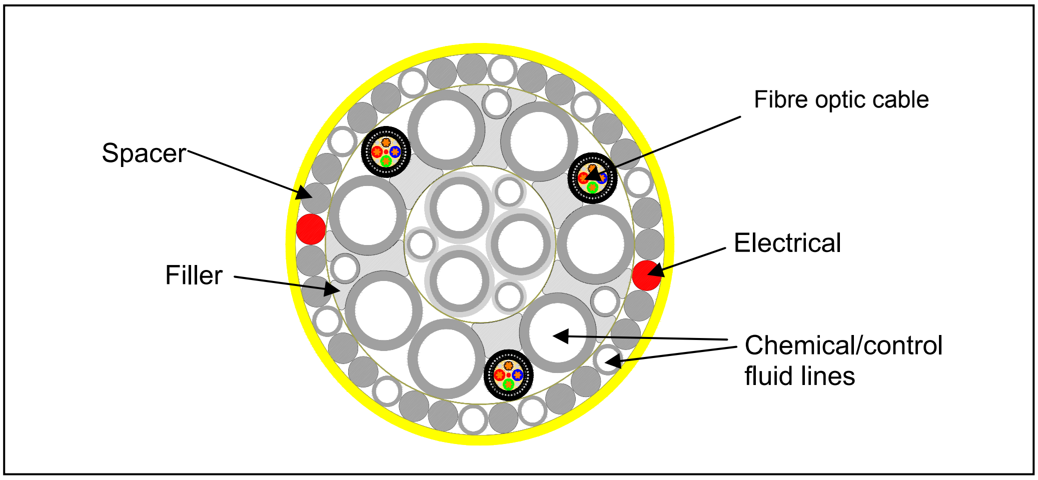
- Provide isolation from the reservoir;
- Manage the flow of production fluids from the well; and
- Enable chemicals (MEG, methanol and scale inhibitor) to be injected into the well where required;

The well control system also incorporates a hydraulically actuated choke, which can be moved in incremental steps to regulate the flow of production fluids. The current design provides for up to 24 actuator valves (including the production choke valve) and associated DCVs at each well.

5.11.3.3 Umbilicals

Chemicals, control fluids and electrical signals will be supplied to each well cluster via umbilicals, constructed of stainless steel**.** Figure 5.26 shows a cross section through a typical umbilical.

Figure 5.26 Typical Umbilical Cross Section



5.11.3.4 Control Fluid

It is planned to use Castrol Transqua HC10 water based control fluid within the SD2 subsea control system. This product has been selected using a thorough assessment process (as detailed within Chapter 4) based on its suitability, environmental performance and low toxicity.

5.11.3.5 Valve Operations During Routine Operations

Operation of the subsea valves across the lifetime of the SD2 Project are expected to occur during the following:

- **Well testing** – involves partial shutdown of each well on 3 occasions per year and a full shutdown once a year to enable the flow characteristics of the well to be tested;
- **Pigging** – integrity pigging of the flowlines as described in Section 5.10.11.2 above is expected to be required on a 3 yearly basis**,** requiring production to be shutdown on the flowline being pigged. This requires the relevant well to be closed in addition to the BIV and CIV manifold valves. The HIPPS valves are designed to remain open during pigging;
- **Field shut down** - full field shutdown is expected to occur once every 4 years; partial field shutdowns involving shutting down of a well cluster or part of cluster is also expected to occur on a 4 yearly basis; and
- **HIPPS testing** – it is anticipated that the HIPPS associated with each manifold will be tested annually. This would require the valves associated with relevant wells to be closed. In addition the HBY and MEG valves would need to be opened and closed approximately 3 times during the test.

The valves associated with the well and manifold are designed to return to the open position within the following times:

- **Well –** 45 seconds; and
- **Manifold –** 20 seconds.

.
Discharge of control fluids occurs as the valves open. The volumes discharged are proportional to the swept volume of the valve, which range from 0.1 to 25 litres.

The design of the hydraulic control system makes allowance for a small continuous DCV discharge. It is anticipated, based on typical rates provided by vendors, that this discharge will approximately 0.03cm^3 per minute per valve on average. The system is designed to route these discharges to a small reservoir. The vent line from the reservoir to sea incorporates check valves set to open at a pressure of 5-10 psi above ambient.

5.11.3.6 Summary of Control Fluid Discharges During Routine Operations

A summary of the anticipated volume of control fluids discharged per year is provided in Table 5.32. These volumes have been based on when each well and manifold is planned to commence operation (refer to Figure 5.3) and the anticipated valve operations and DCV discharge rates presented in Section 5.11.3.5 above.

Table 5.32 Estimated Discharges of Control Fluid due to Valve Operations and DCV Discharges Per Day

Year	Volume In Litres/Day		
	Valve Operations	DCV Discharge	Total
2018	1.3	6.3	7.6
2019	2.7	12.6	15.3
2020	4.5	18.9	23.4
2021	7.0	22.1	29.1
2022	4.7	22.1	26.8
2023	9.2	32.7	41.9
2024	7.3	34.7	42.0
2025	11.7	36.7	48.4
2026	9.5	39.8	49.3
2027	10.6	39.8	50.4
2028	8.5	39.8	48.3
2029	13.7	39.8	53.5
2030	8.5	39.8	48.3
2031	10.6	39.8	50.4
2032	9.5	39.8	49.3
2033	12.7	39.8	52.5
2034	8.5	39.8	48.3
2035	11.6	39.8	51.4
2036	8.5	39.8	48.3

5.11.4 Discharges During Subsea Production System Interventions

During operations it will be necessary to replace a number of subsea production system components. The most frequent replacements (known as interventions) are expected to be the control modules associated with the production trees and manifolds. During replacement activities, the relevant valves will be actuated to isolate the module being replaced, resulting in discharges of control fluids. These are expected to small and included within the control fluid volumes within Table 5.32. Discharges are also anticipated to result from replacement of each production tree choke as detailed in Table 5.33 below.

Table 5.33 Estimated Discharges During Production Tree Choke Interventions

Component	Number	Anticipated Intervention	Fluid Discharged per intervention	Volume Discharged per Intervention (m^3)	Discharge Duration (hrs)
Production tree choke	4 – 471 per tree	Once per tree	MEG	1.3	6

Prior to subsea interventions (not including control modules and production tree chokes) which may result in discharges to sea a risk assessment will be completed and the MENR informed as required.

5.11.5 Subsea Operations Emissions, Discharges and Waste

Emissions and waste associated with all offshore operations including subsea operations are provided in Section 5.10.13.

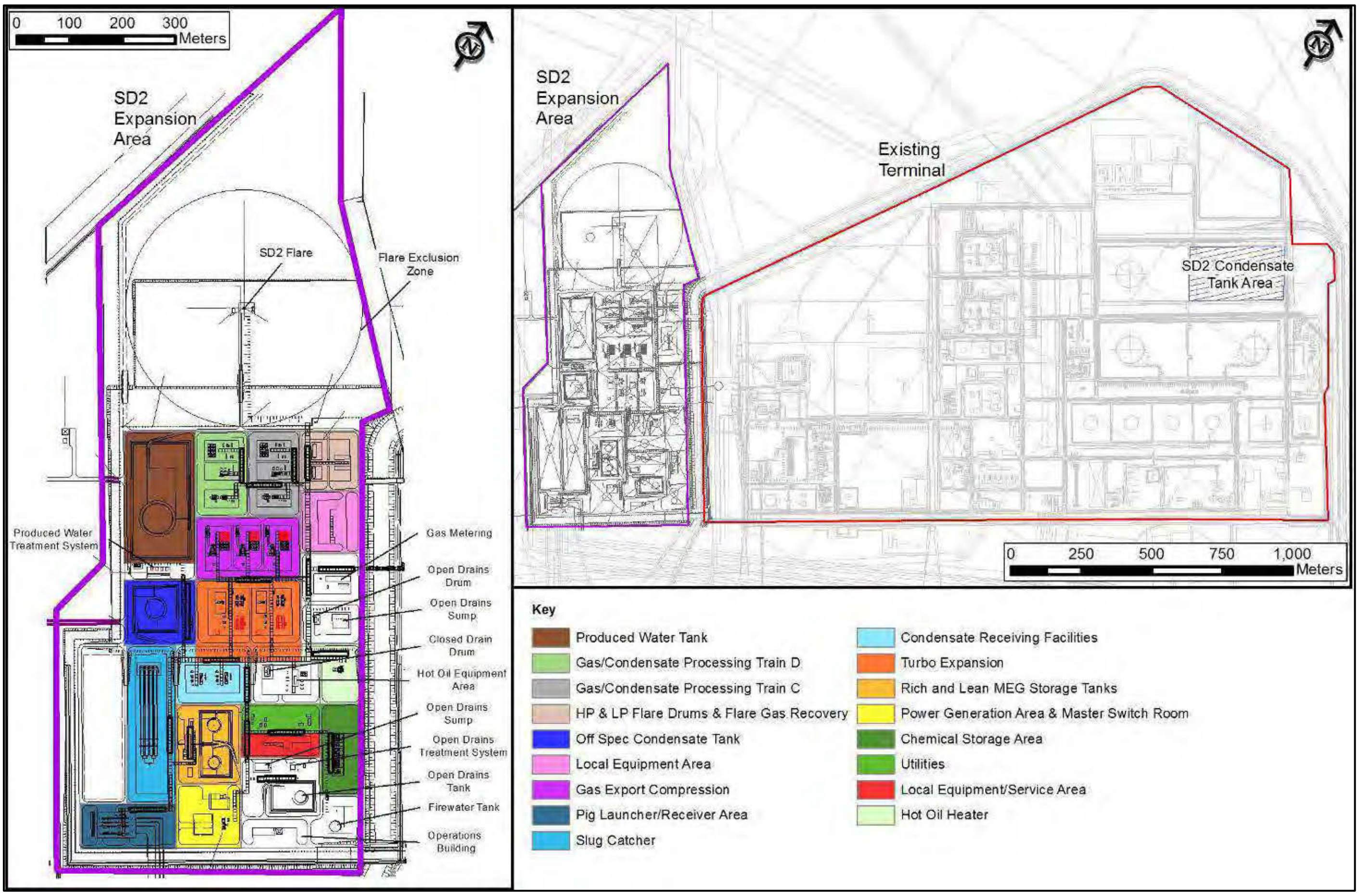
Anticipated discharges associated with subsea operations are summarised within Tables 5.32 and 5.33 above.

5.12 Onshore Operations and Production

5.12.1 Overview

The SD2 onshore process facilities and associated utilities will be located within the SD2 Expansion Area, adjacent to the existing Sangachal Terminal and will be partially integrated with the existing ACG and SD facilities. Figure 5.27 shows the proposed layout of the SD2 onshore facilities.

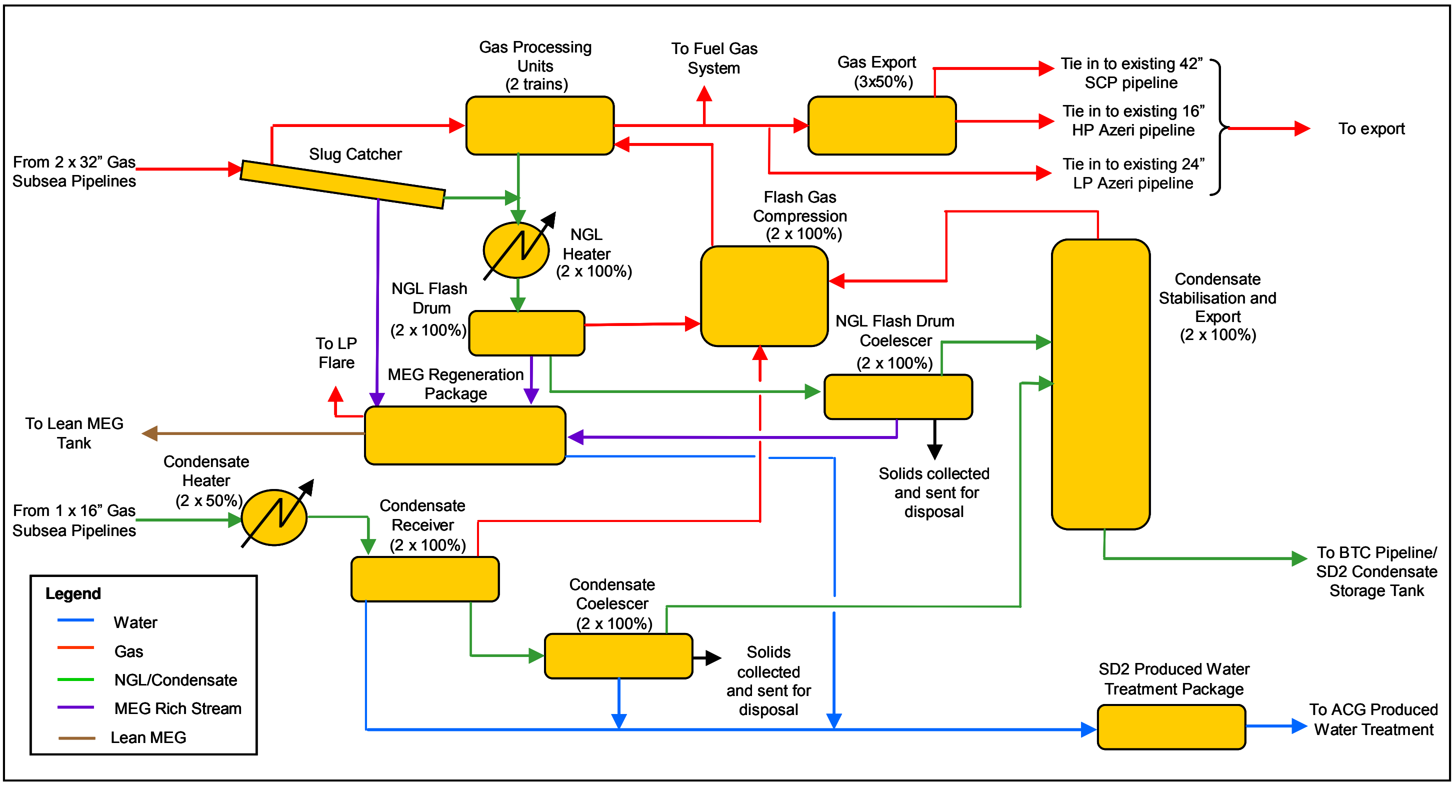
Figure 5.27 Layout of SD2 Onshore Facilities and Utilities



The primary purpose of the onshore SD2 facilities is to receive the hydrocarbon streams via the SD2 gas and condensate subsea export pipelines and process the fluids to obtain gas and condensate at a quality suitable for export (via the SCP and BTC facilities respectively)[19]. Figure 5.28 shows a simplified flow diagram of the SD2 onshore processes.

[19] The condensate will be comingled with the oil exported via the BTC facilities.

Figure 5.28 SD2 Onshore Process Schematic



The SD2 onshore facilities are designed to incorporate two gas and condensate processing trains.

The sections below provide an overview of the SD2 onshore process and utility systems.

5.12.2 Gas Processing and Export Facilities

The SD2 onshore facilities will be designed to receive gas from the SD2 offshore facilities via the two 32" gas pipelines at a pressure of 75 barg and at a temperature of between 2 and 25°C.

The gas will be delivered to the SD2 gas processing facilities via a slugcatcher.

Gas recovered from the slug catcher will be routed to 2 x 50% gas conditioning trains comprising heat exchangers, scrubbers, turbo expanders, separators and ancillary equipment. These facilities are designed to remove liquid vapour from the gas received from the slugcatcher and from the flash gas compression system such that the dewpoint specification for export is achieved.

The liquid stream from the gas processing trains will be routed to the natural gas liquids (NGL) Heaters. A portion of the gas will be routed to the SD2 fuel gas system.

The NGL heaters will also receive hydrocarbon liquid stream from the slugcatcher. From the heaters, the NGL stream will be sent to the NGL flash drums (1 x 100% per train) and NGL coalescers, designed to separate the streams into:

- A gas stream, which will be sent to the gas processing trains for further treatment and conditioning;
- A MEG rich aqueous stream, which will be routed to the MEG Regeneration Package for further treatment or to the Rich MEG Tank when the regeneration package is not available; and

- A hydrocarbon liquid stream which will be routed to the condensate stabilisation and export facilities via the NGL flash drum coalescers (1 per processing train). Coalesces will be used to remove solids and water from the hydrocarbon liquid stream. Solids will be managed in accordance with existing AGT waste management plans and procedures.

Conditioned gas will be compressed and cooled in 3x50% trains. The gas will be analysed and metered before delivery to the existing SCP, LP Azeri and HP Azeri pipelines.

The gas export compression facilities will comprise 3 x 50% gas export compressors driven by gas turbines with a total capacity of 1,777 MMscfd. Waste Heat Recovery Units (WHRU) will be installed on these gas turbines to recover the heat from the turbine flue gas for the heating medium system.

During start up it is planned to use gas from the existing SD1 and SCP facilities to pressurise the SD2 onshore facilities and to provide gas to the SDB offshore facilities via the two 32" subsea gas pipelines.

5.12.3 Condensate Processing, Storage and Export

The SD2 onshore condensate facilities, comprising 2 processing trains, will be designed to receive condensate via the 16" condensate pipeline at a pressure of 15barg and a temperature between 5 and 25°C.

The condensate from the offshore pipeline will be routed to condensate receivers, via heaters designed to raise the condensate temperature to 65°C. Flash gas will be routed to the 1st stage flash gas compressor suction scrubber. Condensate will be sent to the condensate stabilisation system via the condensate coalescers (1x100% per processing train) for water removal. The treated condensate will then be sent to the condensate stabilisation system. The recovered water will be routed to the SD2 produced water treatment package.

The purpose of the condensate stabilisation facilities is to heat the condensate and remove the "light end" components that have the potential to vaporise under ambient conditions during storage. The gas from the stabilisation facilities will be sent to the flash gas compression system. The stabilised condensate will be sent to the BTC export facilities. Should there be any restriction to the BTC pipeline, the condensate will be sent to the SD2 condensate storage tank and re-routed back to the BTC pipeline via the condensate storage tank pump. The tank, to be located within an existing bund adjacent to the exiting ACG crude oil tanks, will have a capacity of 500,000bbls and will be of a floating roof design.

If the condensate from the stabilisation facilities does not meet the BTC export facility inlet specifications, the condensate will be sent to the off spec condensate storage tank and then recycled back to the condensate processing facilities. The tank will be of domed roof design and will be provided with a fuel gas blanketing system and will have a capacity to maintain the peak condensate production rates for 12 hours for 2 trains and to manage transient flows from the condensate pipeline, particularly during pigging.

During offshore start up and re start of wells completion fluids, salty MEG and methanol will be routed onshore. These will either be routed to the off-spec condensate tank then transferred to a road tanker for appropriate offsite treatment and disposal or, if demonstrated to be of acceptable composition for treatment by the onshore SD2 facilities will be sent to one of the following locations:

- Produced water storage tank / treatment package;
- SD1 rich MEG tank (for MEG recovery); or
- SD2 rich MEG tank (for MEG recovery).

During start up of the SD2 onshore facilities, it is planned to route stabilised condensate from the SD1 facilities to the SD2 condensate receivers via the SD2 off spec condensate tank.

5.12.4 SD2 Onshore Utilities

5.12.4.1 MEG Regeneration and Storage

MEG will be used at the onshore and offshore SD2 facilities to prevent hydrate formation in equipment and flowlines under low flow/low temperature conditions.

The purpose of the MEG regeneration system is to separate the water and other impurities from the rich MEG stream to produce a supply of lean MEG for re-use. The system comprises a rich MEG storage tank (equipped with hydrocarbon skimming facilities), a flash drum, a regenerator, charcoal filters, a pump and heat exchangers. The separated water stream will be sent to the SD2 Produced Water Treatment Package. The lean MEG stream will be sent to the lean MEG Storage tank. From here, it will be pumped to onshore users, when required, and will supply the offshore MEG storage tank via the 6” MEG pipeline.

The onshore lean and rich MEG storage tanks will be of dome roof design and supplied with hydrocarbon gas blankets, routed to the LP Flare. To top up the MEG system, fresh MEG will be supplied as required from ISO tanks delivered to the Terminal by truck.

5.12.4.2 Produced Water

The SD2 Project has adopted the following produced water handling hierarchy:

1. First Option: Utilise ACG produced water treatment and disposal options when available. The SD2 onshore Base case design includes the following facilities to support this option:
    a. A produced water treatment package, designed to treat SD2 water to achieve inlet water specification for the ACG produced water treatment facility
    b. A produced water storage tank of domed roof design, equipped with hydrocarbon skimming facilities

    Hydrocarbons recovered from the treatment package and the produced water storage tank will be re-routed to SD2 processing facilities via the SD2 closed drains system. The treated produced water that meets the required specifications will be sent to the ACG produced water treatment facilities where it will be comingled with the ACG produced water, treated to the relevant specifications and sent offshore to the reinjection facilities on the Compression and Water-injection Platform (CWP) at Central Azeri (CA).

    Waste from the SD2 produced water treatment package will be managed in accordance with the existing AGT waste management plans and procedures.

2. Second Option: SD produced water will be sent off site for treatment and disposal at a third party treatment contractor site. Treatment trials will be completed with potential 3rd party treatment contractors at their facilities. Either the existing tanker loading facility will be used or a new facility loading will be used will be used to transfer the PW to tankers for offsite treatment.

3. Third Option: During emergency situations, when option 1 and 2 are not available and there is no produced water tank storage capacity at Sangachal, SD produced water will be sent to a new storage pond.

The pond design will include a sloped floor for drainage, composite liner of a type particularly suited to produced water, a gas-venting system to prevent gas build-up and ballooning of the liner, and an automatic leak detection system with a manual back-up. A risk assessment will be completed to confirm the need and specification of a produced water pre-treatment package to treat the water prior to storage in the pond to ensure risks associated with health and nuisance issues (e.g. odour) are managed and appropriate mitigation is incorporated into the design. BP will submit to the MENR for review and approval prior to construction of the pond:

a. The design of the emergency produced water storage pond;
b. A comprehensive monitoring system to detect potential leakage from the produced water storage pond; and
c. A waste management plan that will detail the waste characterisation methodologies and treatment and disposal techniques for any waste products associated with the pre-treatment and storage of produced water in a pond.

5.12.4.3 Fuel Gas System

The fuel gas system will be designed to provide LP and HP fuel gas to the following;

- Gas turbine driven power generator;
- Export compressor drivers;
- Blanketing gas for condensate pipeline fluids, rich MEG, lean MEG, produced water storage and off spec condensate storage tanks;
- Seal gas for flash gas compressors; and
- Pilot gas within the HP and LP flare systems.

The supply to the system, which will comprise scrubbers, superheaters, and filters, will be taken from the gas processing trains. Under routine conditions the average daily fuel gas demand is estimated as 13.6MMscfd. During start-up it is planned to supply fuel gas to the system from the existing SCP facilities.

5.12.4.4 Power Generation

The power supply for the SD2 onshore facilities will be provided from a new 110kV system, located within the SD2 Expansion Area. Power will be routinely supplied from the existing generation system at the Terminal with back up provided by a single open cycle gas turbine driven power generator, rated at 23MW, located within the SD2 Expansion Area and connected to the new 110kV system via an 11/110kV unit transformer. Back up power will also be available from the Azeri national grid. During start up, fuel gas for power generation will be sourced from the existing SCP gas pipeline

5.12.4.5 Heating System

Under routine conditions the SD2 onshore heating requirement will be provided by three WHRUs installed on the 3 x 50% export compressor turbines. The heating system will be designed to provide 24MW of heat from each WHRU.

During start up or when one of the WHRUs is not available, e.g. during maintenance, heat will be supplied by a 50MW direct fired oil heater.

It is anticipated that the oil heater will be used for up to 6 weeks during start up. Following start up, the WHRU system is designed to be available for 98-99% of the time based on the anticipated turbine availability.

5.12.4.6 Flare System

The SD2 onshore facilities include a flare system, which is required for operational and safety reasons. Under routine operating conditions, the onshore SD2 flare system is designed to undertake pilot flaring only.

However, non routine flaring will occur due to equipment trips e.g. loss of a compressor train or during emergency depressurisation. These events will occur for periods of between 5 days (at a low rate of 1.1mmscfd) to 1 hour (at a rate of 890mmscfd) periodically across each year. Emergency depressurisation (planned to occur no more than once or twice over the PSA) at the design rate of the flare is expected to occur over an hour.

The SD2 onshore flare system is currently under design.

The current design criteria that have been adopted by the project are as follows:

- Elevated HP and LP flare systems;
- HP flare gas recovery on both HP and LP flare systems to minimise hydrocarbon inventory to the flare stacks during normal operations;
- Flare gas ignition based on continuously lit pilot burners supplied with LP fuel gas;
- Continuous purge using either nitrogen or LP fuel gas (depending on safety considerations);
- Sequential or controlled blowdown system design to minimise the HP flare design flow-rate and reduce stack height.

For the purposes of the ESIA it is assumed that the HP and LP flare tips will be located on a single elevated stack of height 107m and the maximum design flowrate for the HP flare will be 1810MMscfd.

5.12.4.7 Diesel Supply

Diesel will be supplied from the EOP diesel system and stored in day tanks to be used for the firewater pumps and diesel air compressor package when required.

5.12.4.8 Chemical Injection System

The production process requires the addition of certain chemicals to facilitate production, aid the separation process and protect process equipment from corrosion and hydrate formation. Two separate chemical systems will be provided:

- Main Chemical Injection Package; and
- Methanol injection system

The Main Chemical Injection Package will provide production chemicals from storage tanks, sized to provide 14 days of chemicals at the maximum dosage rate or 1.5 times the normal tote tank volume (whichever is greater).

The Methanol injection system will comprise a storage vessel (1 x 100%) and pumps (2 x 100%). The vessel will be inert gas blanketed and its storage volume will be determined by continuous injection for 24 hours at the largest individual continuous injection rate or 50m^3 (whichever is greater).

Spill containment measures within the chemical injection area will include paving, kerbing and bunding. Drainage from this area will be routed to the open drains treatment system.

5.12.4.9 Drainage Systems

Open Drains System

Routing of open drains effluent can be classified into the following:

- Clean storm water is water run off from roads, roofs, unpaved areas and certain areas of concrete paving outside of process areas where no contamination from hydrocarbons or other sources can occur. Storm water is collected in concrete channels and independently discharged from each of the three proposed terraces to the existing Flood Protection channel.
- Contaminated water is collected from concrete paved areas, generally located within process and utility areas, where possible contamination by hydrocarbons and chemicals may occur. This run off is unsuitable for disposal into clean watercourses without treatment and is thus routed via the open drains system for treatment, as described below.

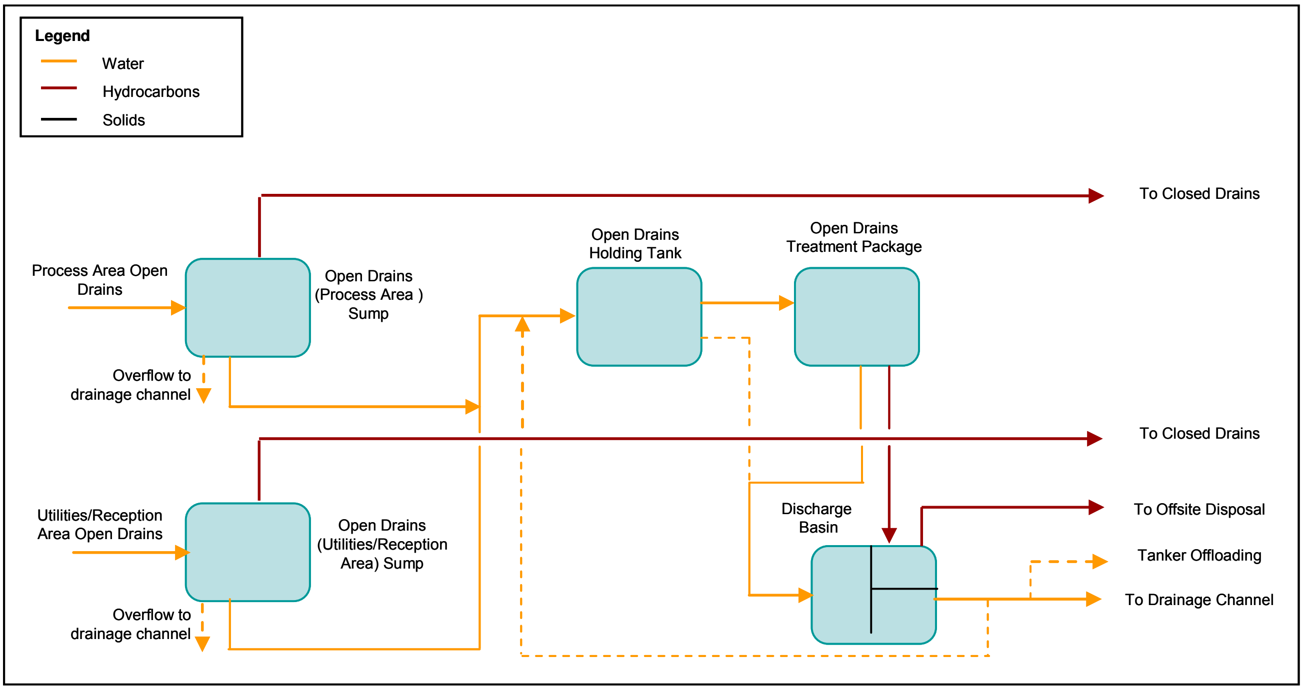
Drainage will be routed from paved process and utility areas to the open drains holding tank via two sumps (refer to Figure 5.29). The holding tank is sized to accommodate the maximum anticipated daily rainfall accumulation in addition to re-processing of off-spec open drains water from the open drains treatment package.

The sumps each sized to provide a residence time of 40 minutes at peak rainfall intensity of 25mm/hour, will include two chambers divided by an underflow weir. Separated hydrocarbons collected within the first chamber will be removed from the surface of the water and routed to the closed drains system.

From the open drains holding tank, the effluent will be routed to the open drains treatment package, designed to treat water to the applicable oil in water standards (i.e. less than 10 mg/l as a monthly average and less than 19 mg/l on a daily basis). Treated water will then be discharged to the drainage channel via the discharge basin. Hydrocarbons from the open drains treatment package will be routed to the oil containment chamber within the discharge basin, from where they will be pumped out and subsequently sent offsite for disposal in accordance with the existing AGT waste management plans and procedures.

Off spec treated drainage will be returned to the open drains holding tank for retreatment or, removed via tanker if the treatment facilities are not available.

Figure 5.29 SD2 Open Drains System



Note: Dotted lines represent routing under non routine conditions e.g. maintenance, start up

Closed Drains

The closed drains system will be provided primarily to collect process liquids when draining equipment and piping for maintenance. The system will comprise two closed drains drums and associated pumps. One drum will serve the lower terrace users and one will serve the middle and upper terrace users. The drums will be vented to the flare gas recovery system and the collected liquids will be returned to the SD2 processing facilities.

The closed drains drums will be located in dedicated concrete pits, equipped with pit pumps to intermittently to remove any groundwater or rain that may have accumulated in the pit and sent it to the open drains system.

5.12.4.10 Instrument and Plant Air and Inert Gas System

An instrument air system will be designed to provide plant and instrument air for use in process and maintenance. The system will be equipped with a diesel driven air compressor to maintain air pressure in the instrument air system during power outages. It is anticipated that the air compressor will be tested weekly for 1 hour during operations.

Inert gas (nitrogen) will be generated on demand by a membrane package using dry compressed air.

5.12.4.11 Freshwater

Freshwater will be supplied to the SD2 onshore facilities via a connection with the existing ST freshwater distribution system.

5.12.4.12 Fire Systems

The SD2 firewater system will comprise two dedicated diesel driven pumps, a firewater holding tank (5,000m^3 capacity) and tie ins to the existing Terminal firewater system to provide back up supply and pressurise the system prior to use.

It is anticipated that the firewater pumps will be tested weekly for 1 hour using freshwater which will be subsequently sent to the open drains system.

A foam system will be used to protect the SD2 condensate storage tank and any other areas where there is significant liquid hydrocarbon risk. SD2 will use foam system chemicals of the same specification and environmental performance as those currently used at the Terminal. No routine testing of the foam system is planned.

5.12.4.13 Export and MEG Pipeline Maintenance

Maintenance of the gas, condensate and MEG pipelines between the SDB platforms and the Terminal will include periodic pigging.

The gas and condensate pipelines will be pigged from the offshore platform complex to the dedicated pig receivers at the Terminal whereas the MEG pipeline will be pigged in the opposite direction. Gas within the condensate and gas pipeline pig receivers will be sent to the flare gas recovery system. Liquids collected within the pig receivers will be sent to the condensate processing facilities. The condensate pig receiver will be equipped with a heater to melt the wax collected in the receiver. Solids collected in the receivers will be collected and disposed of in accordance with the Waste Management Process (see Chapter 14). It is anticipated that the condensate export pipeline will be pigged approximately every three days. Pigging of the gas export pipelines is expected to occur approximately once every five days when flowrates are less than 400MMscfd. No pigging is anticipated at flowrates greater than 400MMscfd other than for infrequent integrity checks.

The MEG import line between the SD2 onshore and offshore facilities will also be pigged with resulting liquids routed to the contaminated MEG drains drum.

5.12.5 Onshore Operations Emissions, Discharges and Waste

5.12.5.1 Summary of Emissions to Atmosphere

Table 5.34 shows the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during SD2 onshore production from key sources across the PSA period. These sources include:

- Main power generator and compressor drivers;
- Diesel users (i.e firewater pumps and the diesel air compressor package during tests); and
- Non routine flaring.

Table 5.34 Predicted GHG and non GHG Emissions Associated with Routine and Non Routine SD2 Onshore Operations and Production Activities

	CO_2 (ktonne)	CO (tonne)	NOx (tonne)	SO_2 (tonne)	CH_4 (tonne)	NMVOC (tonne)	GHG (ktonne)
TOTAL	**6062.5**	**7391.6**	**25631.0**	**29.2**	**4190.1**	**297.9**	**6150.5**

See Appendix 5A for detailed emission estimate assumptions.

5.12.5.2 Summary of Discharges

Planned discharges from SD2 onshore operations comprise:

- Rainwater runoff from normally uncontaminated areas (refer to Section 5.12.4.9); and
- Treated open drains effluent (refer to Section 5.12.4.9).

5.12.5.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated by the SD2 onshore operations during the PSA period are provided in Table 5.35. These have been estimated based on the waste records for the operational SD1 facilities.

Solid waste collected in the pig receiver will be managed in accordance with existing AGT waste management plans and procedures.

Table 5.35 Onshore Operations Waste Forecast

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non-hazardous	Solid wastes	Domestic/office wastes	1,100
		Metals - swarf	238
		Paper and cardboard	4
		Plastic - recyclable (HDPE)	8
		Waste electrical and electronic cables	7
		Wood	143
	Liquid wastes	Oils - cooking oil	0
		Total (Non-hazardous)	**1,500**
Hazardous	Solid wastes	Contaminated materials	11
		Contaminated soils	371
		Filter bodies	17
		Lamps	0.1
		Oily rags	37
		Pigging wax	4
		Toner or printer cartridges	0.3
	Liquid wastes	Completion fluids	1,743
		Water - oily	181
		Total (Hazardous)	**2,364**

5.13 Decommissioning

In view of the operational lifetime of the SD2 development, it is not possible to provide a detailed methodology for the potential decommissioning of the onshore, subsea and offshore facilities. In accordance with the PSA, BP will produce a field abandonment plan one year before 70% of the identified reserves have been produced.

5.14 Summary of Emissions and Waste

5.14.1 SD2 Project Emissions

Table 5.36 presents an estimate of the total GHG and non GHG emissions associated with the SD2 Project, assuming operations continue until the end of PSA in 2036.

Table 5.36 Estimated GHG and non GHG Emissions Associated with the SD2 Project

	Emissions to Atmosphere						
	CO_2	CO	NO_x	SO_x	CH_4	NMVOC	GHG
	ktonnes	tonnes	tonnes	tonnes	tonnes	tonnes	ktonnes
Drilling & Completion	1,396	3,891	13,235	1,566	10,016	1,534	1,606
Onshore construction and commissioning of Terminal facilities	390	2,089	5,861	240	23	937	391
Onshore construction and commissioning of offshore and subsea facilities	59	178	747	74	2	24	59
Platform Installation and Commissioning	59	58	510	96	2	18	59
Installation, hook up and commissioning of subsea export and MEG pipelines	366	1,004	6,514.5	813.9	28.6	337.5	366.2
Installation, hook up and commissioning of subsea infrastructure	59	148	1,089	148	5	44	59
Offshore Operations	3,642	4,875	13,262	511	3,921	787	3,725
Onshore Operations	6,062	7,392	25,631	29	4,190	298	6,150
Total	**12,033**	**19,634**	**66,849**	**3,478**	**18,184**	**3,979**	**12,415**

See Appendix 5A for detailed emission estimate assumptions.

5.14.2 SD2 Project Hazardous and Non Hazardous Waste

Table 5.37 presents a summary of the forecast hazardous and non hazardous waste generated by the SD2 Project.

Table 5.37.Hazardous and Non Hazardous SD2 Waste Forecast

Classification	Physical form	Typical examples of waste stream	Estimated quantity (tonnes)							
			Drilling and completion activities	Onshore terminal construction and commissioning	Offshore facilities construction and commissioning	Offshore facilities installation, hook-up and commissioning	Subsea export pipelines, MEG import pipeline and subsea infrastructure fabrication and installation	Offshore operations phase	Onshore operations phase	Totals
Non-hazardous	Solid wastes	Domestic/office waste	6,037	14,906	21,036	3,535	9,797	4,998	1,500	**61,809**
		Metals - swarf								
		Paper and cardboard								
		Plastics								
		Wood								
	Liquid wastes	Oils - cooking oil	0	17	49	0	0	31	0	**97**
		Total (Non-hazardous)	**6,037**	**14,923**	**21,085**	**3,535**	**9,797**	**5,029**	**1,500**	**61,906**
Hazardous	Solid wastes	Adhesives, resins and sealants	86,441	63	127	119	1,099	1,295	440	**89,584**
		Batteries – wet/dry cell								
		Clinical waste								
		Contaminated materials								
		Contaminated soil								
		Drilling additives								
		Drilling muds and cuttings SOBM								
		Filter bodies								
		Greases								
		Oily rags								
	Liquid wastes	Acids	38,851	1,720	7,845	6,273	5,947	4,723	1,924	**67,283**
		Antifreezes								
		Bentonite								
		Drilling muds and cuttings WBM - contaminated								
		Drilling muds and cuttings SOBM								
		Oils - fuels								
		Oils – lubricating oil								
		Paints and coatings								
		Solvents, degreasers and thinners								
		Water - oily								
		Water treatment chemicals								
		Total (Hazardous)	**125,270**	**1,783**	**7,972**	**6,392**	**7,046**	**6,018**	**2,364**	**156,867**

The current destinations of waste streams that are predicated to be generated during SD2 project and the currently used destinations by BP are provided within Table 5.38. BP may change the waste destination and disposal technique if more efficient alternatives become available that conform with applicable BP and national legislation requirements.

Currently there is one waste stream that SD2 will produce that do not currently have BP AGT approved destination: waste lamps. BP will continue to assess options in order to find an acceptable disposal solution for this waste stream.

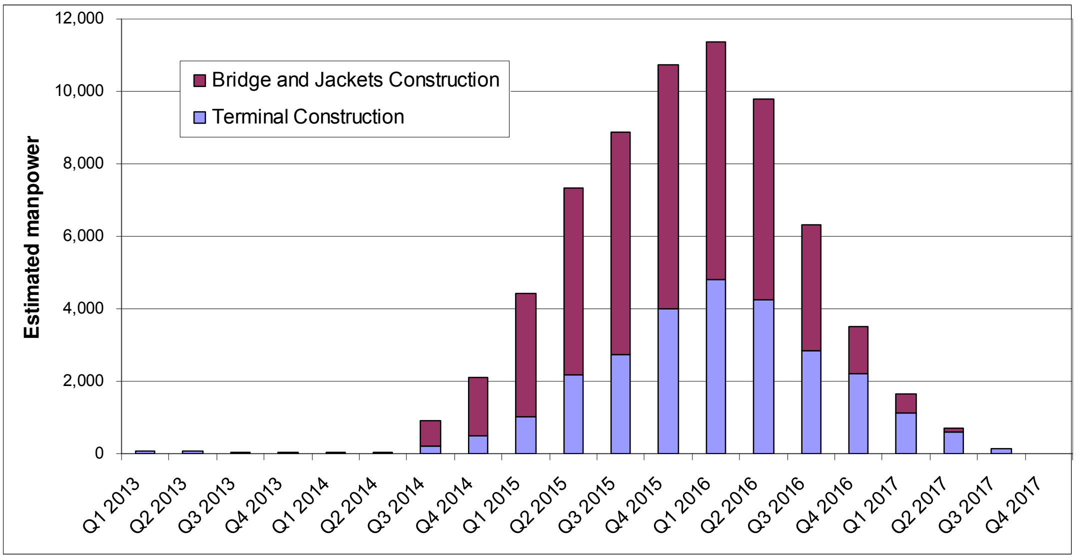
Table 5.38 Current Planned Destination of SD2 Principal Project Waste Streams

Category	Sub Category	Destination/Technique
Non hazardous non recyclable waste	Domestic/office wastes	Non-hazardous landfill – current facility has been designed and constructed to EU standards
Recyclable wastes	Oils - cooking oil	Recycling contractors[1]
	Waste electrical and electronic cables	
	Cement	
	Grit blast (uncontaminated)	
	Paper and cardboard	
	Plastics – recyclable (HDPE)	
	Tyres	
	Waste electrical and electronic equipment	
	Wood	
	Metals - swarf	Sent to SOCAR
Solid hazardous wastes	Adhesives, resins and sealants	Treatment/disposal by licensed AGT Region approved contractor or storage pending availability of appropriate techniques/contractor
	Clinical waste	
	Contaminated materials	
	Contaminated soils	
	Paints and coatings (cured)	
	Explosives	
	Grit blast (contaminated)	
	Filter bodies	
	Oily rags	
	Pressurised containers	
	Toner or printer cartridges	
	Batteries - dry cell	Sent to SOCAR
	Batteries - wet cell	
Non-water based drill cuttings	Drilling muds and cuttings LTMOBM	Cuttings will be treated by the indirect thermal desorption unit at Serenja or by alternative disposal options. Recovered base oil from thermal desorption unit may be reused if it meets the reuse specification or it will be either disposed as a liquid waste. Solid process residuals from the thermal desorption unit will either be disposed or used as cover material at a hazardous or non-hazardous landfill depending on its characterisation. One of current alternative disposal options for non-water based cuttings is bioremediation, however the BP will continue working on alternative long term reuse options, that may add additional disposal routes non-water based drill cuttings and associated treatment process residuals.
	Drilling muds and cuttings SOBM	
	Drilling muds and cuttings WBM - contaminated	
Hazardous liquid wastes	Acids	Treatment and disposal/recovery by licensed AGT Region approved contractor or storage pending availability of appropriate techniques/contractor
	Alkalis and bases	
	Antifreezes	
	Bentonite	
	Completion fluids	
	Drilling additives	
	Oils - fuel	
	Greases	
	Laboratory chemicals and testing reagents	
	Oils - lubricating oils	
	Solvents, degreaser and thinners	
	Surfactants	
	Tank bottom sludges	
	Paints and coatings (uncured)	
	Water - oily	
	Water treatment chemicals	
	Well suspension fluids	
Notes: 1. Currently recyclable waste is received by SOCAR or, if SOCAR reject the waste for any reason, alternative recycling/reuse contractors.		

5.15 Employment

Figure 5.30 shows the estimated employment associated with terminal construction and the construction of the jackets at the onshore construction yards. The figure shows that it is estimated that employment associated with the SD2 construction works at the Terminal will peak at approximately 4,800 during 2016, while the employment at the onshore jacket construction yards is expected to peak at 6,700 during 2015.

Figure 5.30 Estimated Manpower Associated with SD2 Onshore Terminal Construction Works and Onshore Jacket Construction



In addition it is estimated that a peak workforce of approximately 1,500 will be employed at the topside onshore construction yard and approximately 2,000 will be employed for marine subsea works. It is expected that onshore and offshore operations will require a workforce of more than 100.

5.16 Management of Change Process

During the 'Define', 'Execute' and 'Operate' stages of the SD2 Project, there may occasionally be a need to change a design element or a process. The SD2 Project intends to implement a formal process to manage and track any such changes, and to:

- Assess their potential consequences with respect to environmental and social impact; and
- In cases where a new or significantly increased impact is anticipated, to inform and consult with the MENR to ensure that any essential changes are implemented with the minimum practicable impact.

All proposed changes, whether to design or process, will be notified to the Project HSE team, who will review the proposals and assess their potential for creating environmental or social interactions.

Changes which do not alter existing interactions or impacts, or which give rise to no interactions or impacts, will be summarised and periodically notified to the MENR, but will not be considered to require additional approval. This category will include items such as minor modification of chemical and drilling fluid systems, where the modification involves substitution of a chemical with equal or less environmental impact than the original.

If internal review and assessment indicates that a new or significantly increased impact may occur, the following process will be applied:

- Categorisation of the impact using ESIA methodology;
- Assessment of the practicable mitigation measures;
- Selection and incorporation of mitigation measures; and
- Re-assessment of the impact with mitigation measures in place.

In practical terms, the changes that will require prior engagement and approval by the MENR are those that:

- Result in a discharge to the Caspian that is not described in the SD2 Project ESIA;
- Increase the quantity discharged as detailed in the SD2 Project ESIA by more than 20%[20,21;]
- Result in the discharge of a chemical not referenced in the ESIA and not currently approved by the MENR for use in the same application by existing AGT Region operations; or
- Create or increase noise, light or other disturbance above applicable thresholds to human populations living in the vicinity of the SD2 Project activities.

Once the changes (and any appropriate mitigation) have been assessed as described above, a technical note will be submitted to the MENR describing the proposal and reporting the results of the revised impact evaluation. Where appropriate, this may include the results of environmental testing and modelling (e.g. chemical toxicity testing and dispersion modelling). Following submission of the technical note, the Project team will engage in meetings and communication with the MENR in order to secure formal approval. Once approved, each item will be added to a register of change. The register will include all changes, including those non-significant changes notified in periodic summaries, and will note any specific commitments or regulatory requirements associated with those changes.

[20] For the discharges detailed in the ESIA, an increase of 20% in volume would result in a 3-4% increase in the linear dimension of the mixing zone. For instance, a mixing plume 100m by 20m by 20m would increase by less than 2m in each dimension. Taking into account the actual size of the predicted mixing zones, this magnitude of increase is considered to make no material difference to the physical extent of the impacts. In practical terms, this would apply to increases of more than 20% (the value was selected to be conservative).
[21] Unless increase is deemed to have no material effect on the associated impact(s).

6 Environmental Description

Contents

List of Figures

List of Tables

6.1 Introduction

This Chapter describes the terrestrial and marine environments associated with the Shah Deniz Stage 2 (SD2) Project. Four geographic zones are defined:

- Terrestrial: Vicinity of the Sangachal Terminal (including the area between the Terminal and the Baku-Salyan Highway);
- Coastal: The zone between the Baku-Salyan Highway and the Caspian Sea shoreline, including the Azerbaijan coastline for relevant regional coastal aspects e.g. birds;
- Nearshore: Sangachal Bay from the Caspian Sea shoreline to a water depth of approximately 12m; and
- Offshore**:** From the 12m water depth within Sangachal Bay, along the proposed SD2 subsea export pipeline corridor to the SDB Platform Complex and subsea infrastructure locations within the Shah Deniz (SD) Contract Area.

Figure 6.1 presents the key terrestrial, coastal, nearshore and offshore locations associated with the SD2 Project.

6.2 Data Sources

Between 1994 and 2004, environmental surveys focused on investigating baseline conditions for terrestrial and marine flora and fauna, air quality, noise and contamination. Since 2004, the Environmental Monitoring Programme (EMP) has collected data on:

- Ambient air quality at selected receptors in the vicinity of the Terminal;
- Soil, groundwater and surface water conditions from boreholes and surface water sampling points in the vicinity of the Terminal;
- Terrestrial flora, fauna and soil stability within the Terminal surrounds;
- Ongoing bird surveys in and around Sangachal Bay;
- Marine benthic flora and fauna; and
- Water quality and plankton surveys.

The primary aim of the EMP is to develop reliable and consistent time series data for each location within a clearly defined survey area to enable long-term trends to be identified.

Offshore baseline benthic and water column surveys have been undertaken across the SD Contract Area since 1998. The initial benthic survey, undertaken in 1998, in support of the exploration drilling ESIA, has been followed by more than 20 surveys between 2000 and 2011[1].

Under the SD Production Sharing Agreement (PSA), responsibility for the preparation and approval of environmental surveys associated with the EMP rests with the Environmental Sub-Committee (ESC), which carries out an annual review of planned survey activities. The ESC comprises representatives of key stakeholders such as the State Oil Company of Azerbaijan (SOCAR), the Council of Ministers, the Ministry of Ecology and Natural Resources (MENR) and the Azerbaijan National Academy of Sciences (ANAS). Practical supervision and review of ongoing activities is delegated to the ACG & SD Environmental Monitoring Technical Advisory Group (EMTAG), which comprises environmental specialists representing these organisations.

In addition to the ongoing EMP surveys, a number of specific surveys for the SD2 Project have been undertaken to gather additional environmental data. These include noise, odour, visual context, light, dust, hydrology, soil and groundwater, wetland and cultural heritage surveys, as well as offshore benthic and water column surveys at all manifold locations and the SDB Platform Complex.

[1] Results of the baseline survey associated with SD2 Project are discussed in Section 6.7 below.

A list of all relevant surveys completed since 1996 is provided in Table 6.1[2].

Table 6.1 Relevant Terrestrial/Coastal, Nearshore and Offshore Surveys and Studies, 1996-2012

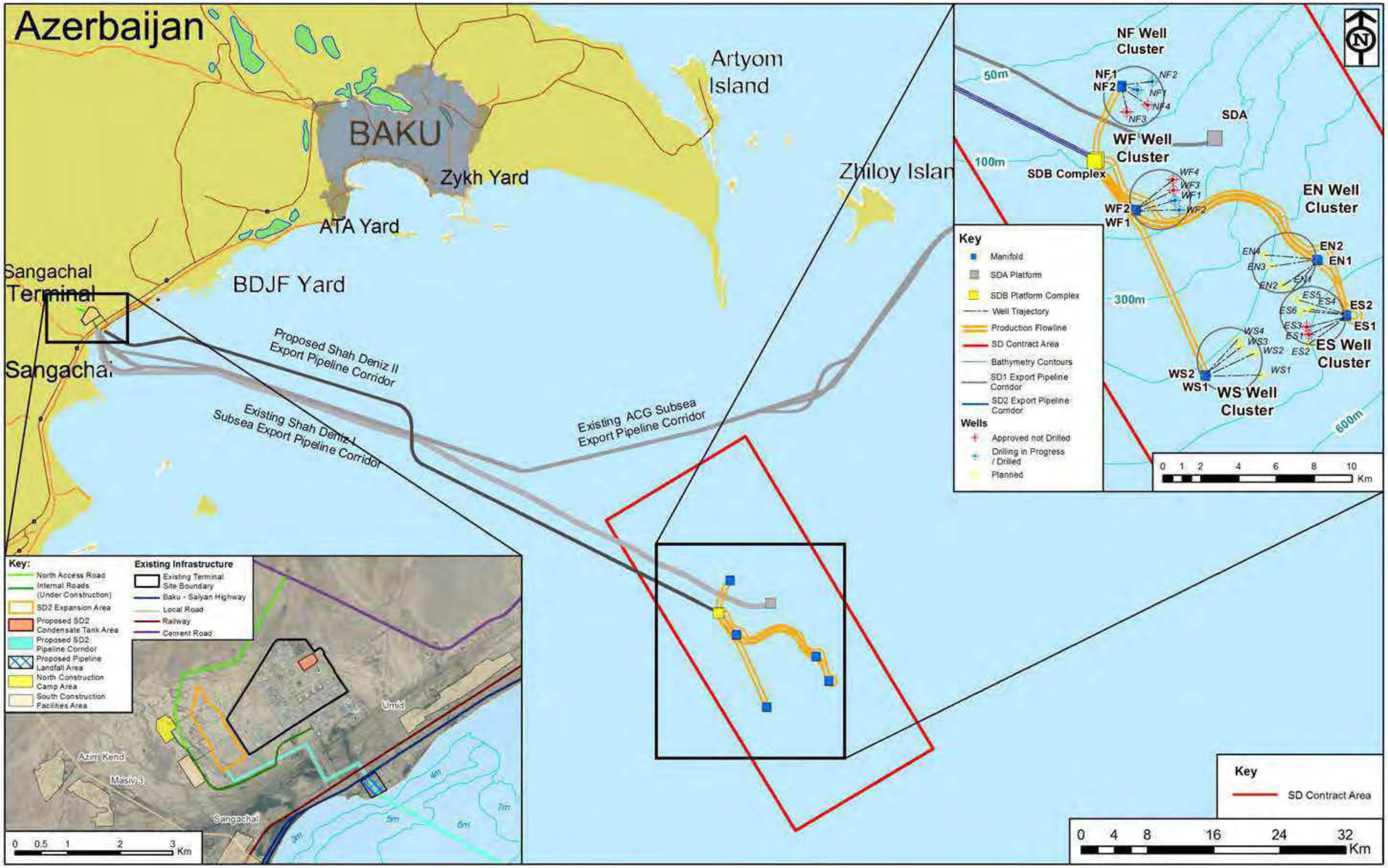
Date	Title of Survey	Survey ID.
Terrestrial/ Coastal Surveys		
1996	EOP Sangachal Terminal Survey	TS001
1996	Sangachal Coastal Environmental Survey	TS002
2000	Sangachal Coastal Environmental Survey	TS003
2001	Terrestrial Soil and Groundwater Survey	TS004
2001	Phase 1 Terrestrial Survey	TS005
2002	Phase 2 Terrestrial Survey	TS006
2003	Sangachal Terminal Watershed Analysis	TS007
2003	Sangachal Wetlands Survey Summer/Autumn 2002	TS008
2003	Overwintering Bird Survey, Absheron to Kura	TS009
2004	Overwintering Bird Survey, Absheron to Kura	TS010
2004	Breeding Bird Monitoring Survey Sangachal	TS011
2004	Winter Waterfowl Monitoring Study, Absheron to Kura	TS012
2004	Integrated Terrestrial Ecosystem Monitoring Survey - Spring	TS013
2004	Integrated Terrestrial Ecosystem Monitoring Survey – Autumn	TS014
2005	Integrated Terrestrial Ecosystem Monitoring Survey - Spring	TS015
2005	Integrated Terrestrial Ecosystem Monitoring Survey – Autumn	TS016
2005	Breeding Bird Survey, Sangachal	TS017
2005	Winter Waterfowl Monitoring Study, Absheron to Kura	TS018
2006	Winter Waterfowl Monitoring Study, Absheron to Kura	TS019
2006	Sangachal Terminal Ambient Air Quality Monitoring	TS020
2006	Sangachal Terminal Terrestrial Monitoring Survey - Spring	TS021
2006	Sangachal Terminal Terrestrial Monitoring Survey - Autumn	TS022
2006	Ambient Ground and Surface Water Monitoring	TS023
2006	Onshore Ambient Monitoring (Sangachal): Hydrology & Hydrogeology – Phase I	TS024
2006	Noise Monitoring Report. Sangachal Environmental Team	TS025
2007	Sangachal Terminal Ambient Air Quality Monitoring	TS026
2007	Sangachal Terminal Terrestrial Monitoring Survey - Spring	TS027
2007	Sangachal Terminal Terrestrial Monitoring Survey - Autumn	TS028
2007	EMP onshore ambient monitoring (Sangachal): Hydrology & Hydrogeology Analysis & Monitoring System Phase I	TS029
2008	Sangachal Terminal Bird Survey Report	TS030
2008	Sangachal Terminal Ambient Air Quality Monitoring	TS031
2008	Onshore Ambient Monitoring (Sangachal): Hydrology & Hydrogeology – Phase II	TS032
2008	Sangachal Terminal SD2 Expansion Area Flora and Fauna Survey	TS033
2008	Sangachal Terminal – Surface and Subsurface Water and Landscape Management Study	TS034
2008, 2009	Hydrological Survey Report	TS035, TS036
2009	Sangachal Terminal Bird Survey Report	TS037
2009	Sangachal Terminal Ambient Air Quality Monitoring	TS038
2009	Onshore Ambient Monitoring (Sangachal) Bird Monitoring Survey Report	TS039
2009	Terrestrial Monitoring Survey Report - Spring & Autumn	TS040
2010	Sangachal Terminal Bird Survey Report	TS041
2010	Soil & Vegetation Survey Report - Spring & Autumn	TS042
2010	Sangachal Ambient Air Quality Monitoring	TS043
2010	Sangachal Terminal Baseline Noise Survey	TS044
2010	Sangachal Terminal Light Baseline Survey Report	TS045
2010	Sangachal Terminal Odour Assessment	TS046
2010	Sangachal Terminal Visual Context Baseline Survey Report	TS047

[2] While EMP surveys were completed during 2012 the survey results are not yet available.

Date	Title of Survey	Survey ID.
2010	Sangachal Terminal Phase 2 Expansion: Additional Surface Water Studies	TS048
2010	EMP Onshore Ambient Monitoring (Sangachal): Bird Monitoring Survey Report	TS049
2010	Wetland Survey Report (AMC) – Water & Sediment Analysis	TS050
2010	Soil Bore and Groundwater Monitoring Well Installation, Sampling and Surveying Report	TS051
2010	Monthly Water Level of Monitoring Wells at Sangachal Terminal	TS052
2010	Sangachal Surface and Groundwater Monitoring 2010 1st Round Report	TS053
2010	Sangachal Surface and Groundwater Monitoring 2010 2nd Round Report	TS054
2010	Sangachal Terminal Wetland Flora and Faunal Survey 2010 – *Report in Progress*	TS055
2011	Interpretive Report Geotechnical Investigation SD2 Project Sangachal Terminal	TS056
2011	March 2011 Noise Surveys In Sangachal Terminal Vicinity	TS057
2011	June/July 2011 Noise Surveys In Sangachal Terminal Vicinity	TS058
2011	Traffic Survey in the Vicinity of Sangachal Terminal	TS059
2011	Wetland Characterisation Survey Report	TS060
2011	Cultural Heritage Baseline Surveys Report	TS061
2011	SD2 Early Infrastructure Work Contaminated Land Risk Assessment	TS062
2011	SD2 Early Infrastructure Work Dust Baseline Report	TS063
2011	Sangachal Groundwater and Surface Water Monitoring. Piezometer Installation and Monitoring Report	TS064
2011	Sangachal Terminal Ambient Air Quality Monitoring – *Report in Progress*	TS065
2011	Monitoring on Birds around the Sangachal Terminal – *Report in Progress*	TS066
2011	Sangachal Terminal Wetlands Faunal Survey – *Report in Progress*	TS067
2011	Soil and Vegetation Survey Report Spring Autumn 2011 – *Report in Progress*	TS068
2012	Wetlands Area Soil and Water Contamination Assessment for Land Adjacent to Sangachal Terminal	TS069
Nearshore Surveys		
1996	Pipeline Landfall Survey: Sediments and Macrobenthos	CS 001
2000-2005	Sangachal Fisheries Monitoring Programme	CS 002
2000	Sangachal Repeat Survey (Baseline)	CS 003
2000	*In situ* Biomonitoring: Baseline Studies in the Laboratory and at Sangachal Using the Bivalve Mollusc *Mytilaster lineatus* (Gmelin)	CS 004
2001	Sangachal Seabed Mapping Survey	CS 005
2002	Repeat Sea Grass and Red Algae Studies in Sangachal Bay	CS 006
2003	Biomonitoring at Sangachal (Sept-Dec 2003)	CS 007
2003	2003 Sea Grass Studies in Sangachal Bay	CS 008
2003	Sangachal Seabed Survey	CS 009
2004	Sangachal Offshore Survey	CS 010
2004	Sangachal Metocean Study	CS 011
2004	Biomonitoring at Sangachal (May-Sept-Dec 2004)	CS 012
2004	Monitoring the Impact of Pipeline Trenching Operations in Sangachal Bay	CS 013
2004	Trenching Monitoring	CS 014
2005	Fish Monitoring Sangachal Bay 2005	CS 015
2006	Sangachal Bay Benthic Survey	CS 016
2006	Mapping of Sea Grass in Sangachal Bay, Azerbaijan Using Drop-down Video and Acoustic Remote Sensing	CS 017
2008	Mapping Sea Grass in Sangachal Bay, Azerbaijan	CS 018
2008	Sea Grass Taxonomy and Weight Analysis Report: Based on Ninel Karavera (Botany Institute Specialist) Reports	CS 019
2008	Sangachal Bay Sediment and Plankton Survey	CS 020
2008	Mapping Sea Grass in Sangachal Bay, Azerbaijan	CS 021
2008	Fish Monitoring Sangachal Bay	CS 022
2009	Fish Monitoring Sangachal Bay	CS 023
2010	Sangachal Bay Environmental Survey	CS 024
Offshore Surveys - SD Contract Area		
1998	SD Contract Area Baseline Benthic Survey	MS 001
2000	SDX-1 Well Post-drilling Benthic Survey	MS 002
2001	Shah Deniz Stage 1 Platform and Baseline Survey	MS 003
2001	SD Contract Area Pipeline Benthic Survey	MS 004

Date	Title of Survey	Survey ID.
2001	SD Alpha Platform Location Baseline Benthic Survey	MS 005
2002	SDX-3 Post Well Monitoring Survey	MS 006
2005	SDX-4 Baseline Benthic Survey	MS 007
2005, 2007	SD Alpha Platform Benthic Survey	MS 008 MS 009
2005, 2007	SD Contract Area Regional Water Quality/Plankton Survey	MS 010 MS 011
2006	SDX-5 Baseline Benthic Survey	MS 012
2008	SDX-6 (NF1) Baseline Benthic Survey	MS 013
2008	Shah Deniz Regional Environmental Survey	MS 014
2009	WF1 Baseline Survey	MS 015
2009	Shah Deniz Regional Environmental Survey Report 2009	MS 016
2011	Environmental Survey around Shah Deniz Stage 2 East South Manifold Location	MS 017
2011	Environmental Survey around the SD2 Bravo Platform Complex – *Report in Progress*	MS 018
2011	Environmental Survey around the SD2 East North Manifold Location – *Report in Progress*	MS 019
2011	Environmental Survey around the SD2 West South Manifold Location – *Report in Progress*	MS 020
Offshore Surveys - Pipeline		
2006	ACG Pipeline Post Installation Survey	MS021
2008	ACG Pipeline Survey	MS022
2010	ACG Pipeline Survey	MS023

Figure 6.1 Key Onshore and Offshore Locations Associated with the SD2 Project



6.3 Physical Environment

6.3.1 Seismicity

The Caspian region, which is part of the Eurasian continental plate, has a convergent plate boundary with the Arabian and Indian continental plates. This has led to the destruction of an ocean (Tethys), which lay, between Eurasia to the north with Africa and India forming its southern shores. The mountain chains of the Alps, Caucasus and the Karakorum/Himalayas are composed of upthrusted rocks formed in, and around, this ancient ocean. Convergent plate movements are associated with relatively high levels of seismic activity and typically accompanied by earthquakes and volcanism.

The Southern Caspian area is defined by the Scythian microplate, as part of the Russian plate, the Turanian, Iranian and small Caucasian plates, as well as the South Caspian microplate. Current neotectonic (more recent) processes are leading to convergent movements of these plates of 1.8cm/year in the Caspian[3]. Convergent plate movements are generally associated with relatively high levels of seismic activity. Five earthquakes with a magnitude greater than 6.0 on the Richter scale have occurred in Azerbaijan since 1842 with the most recent, measuring 6.5, on 25th November 2000 with an epicentre 30km east-north east of Baku.

6.3.2 Climate

Climatic data, with the exception of wind and rainfall data, for the period 1977 to 2000 has been collected from the meteorological station at Alyat which is located approximately 25km south of Sangachal.

6.3.2.1 Temperature

The onshore Sangachal area is classified as being warm, semi-arid steppe, with an annual mean air temperature of 14.4 degrees Celsius (°C). July is the warmest month of the year with a 23-year mean average air temperature of 26.4°C between 1977-2000. January is the coldest month with an average of 0°C. Temperature extremes of –16°C and 41°C have been recorded historically in January and July, respectively.

6.3.2.2 Precipitation

The onshore Sangachal area is one of the driest in Azerbaijan. Rainfall data is collected from Alyat, Baku and Mashtaga. Mean annual rainfall in Baku from 1992 to 2006 was 263mm. The highest monthly rainfall from 2002 to 2006 was 184mm in December 2002. October to February are wet months which receive an average of 41 to 79mm rain/month, with drier months occurring from July to August which receive an average of 1 to 5mm rain/month.

Table 6.2 presents average monthly rainfall data from the meteorological station at Baku from 2002 to 2006.

Table 6.2 Average Monthly Rainfall Data (Baku) 2002 to 2006

	J	F	M	A	M	J	J	A	S	O	N	D
Average monthly rainfall (mm)	41	43	25	31	20	10	5	1	24	46	46	79

6.3.2.3 Wind

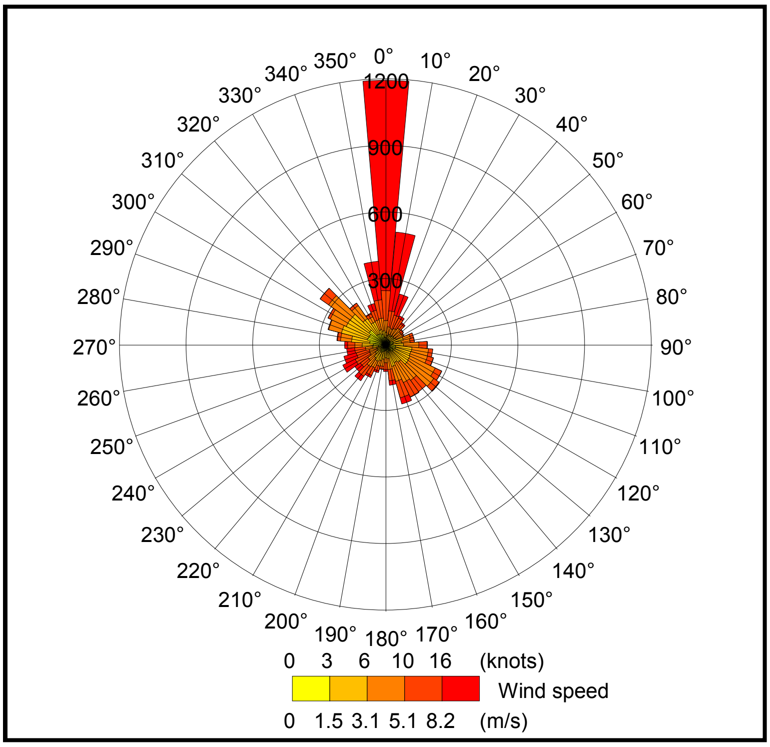
The wind regime in Sangachal Bay is generally consistent with that for the Absheron Peninsula, although it is recognised that there is a local thermally driven wind system. The effects of the local system are most noticeable offshore within the Bay, resulting in a slight (1m/s to 2m/s) offshore wind during the early hours of the morning, which reduces and becomes a stronger onshore wind as the land heats up during the warmer months of the year. This thermal influence,

[3] Karabanov, Institute of Geology, *pers comm.*

coupled with the meteorological dynamics of the region, can result in strong winds occurring with little forewarning.

Figure 6.2 shows a wind rose compiled from data collected during 2007 at Baku Airport[4]. The predominant wind direction is north, occurring approximately 15% of the year. North-north-westerly and north-north-easterly winds account for approximately 10-12% of other winds. Wind speeds typically range from 0.5m/s to 12m/s with approximately 30% of winds being greater than 8m/s.

Figure 6.2 Annual Wind Rose (Baku Airport), 2007



6.4 Terrestrial Environment

6.4.1 Setting

The existing Terminal, occupying an area of approximately 5.5km^2, is sited on a plain sloping gently towards the south east and to the Caspian Sea. The elevation of the Terminal site is around 15m to 20m below Mean Sea Level (MSL) (the mean level of the Caspian Sea is about 27 to 28m below MSL). There are a number of steeper hills to the north and north east of the Terminal rising to over 300m to the north and 400m around Mount (Mt) Qaraqush, a large mud volcano, which last erupted in 2000. The nearest hills lie to the northwest with a mean height of 70m to 85m above MSL.

There are four main settlements in the vicinity of the Terminal (Figure 6.1), the largest being Sangachal Town located approximately 2.5km southwest. Umid lies less than 1km to the southeast of the Terminal, and Azim Kend and Masiv 3 are located approximately 2.7km to the west.

Umid and Sangachal Town are adjacent to the Baku-Salyan Highway, a four lane hard-surfaced road that runs parallel to the Caspian Sea coastline. A raised railway line (2m to 4m above ground level) runs parallel to the highway, between the highway and the Terminal. Multiple underground and aboveground pipelines (oil, water and gas pipelines) also run parallel to the highway between the railway and Terminal within a third-party pipeline corridor.

[4] The anemometer is located 10m above ground level.

Other nearby industrial development includes the state-owned power station located between the Terminal and Sangachal Town which started operation at the end of 2008. The Sangachal Power Station has been designed to produce electricity using generators powered by gas combustion with the option of using heavy fuel oil.

Watercourses in the Terminal vicinity include:

- Shachkaiya Wadi - Flows from the Shachkaiya hills north of the Terminal and passes to the west of the Terminal area towards the Caspian Sea; and
- Umid Wadi - Located east of the Terminal.

A wetland area is located between the Terminal and the Baku-Salyan Highway.

A drainage channel has been constructed around the northern, western and eastern perimeters of the Terminal to protect it from potential flooding. The channel diverts floodwaters into existing natural drainage lines which exist between the Terminal and the Caspian Sea.

The coastal zone, between the Baku-Salyan Highway and the Caspian Sea shoreline, comprises a platform of layers of limestone and marine sediments. The landward slope has been quarried away for sand/aggregate. To the seaward, there is a limestone platform sloping down to the water's edge, with small areas of exposed finer material.

The SD2 Early Infrastructure Works (EIW) which comprise the civil works at the Terminal required to expand the Terminal for the SD2 Project, are currently underway.

It is assumed that at the time of the handover to the Main SD2 Construction Works contractor, the following EIW activities will be completed:

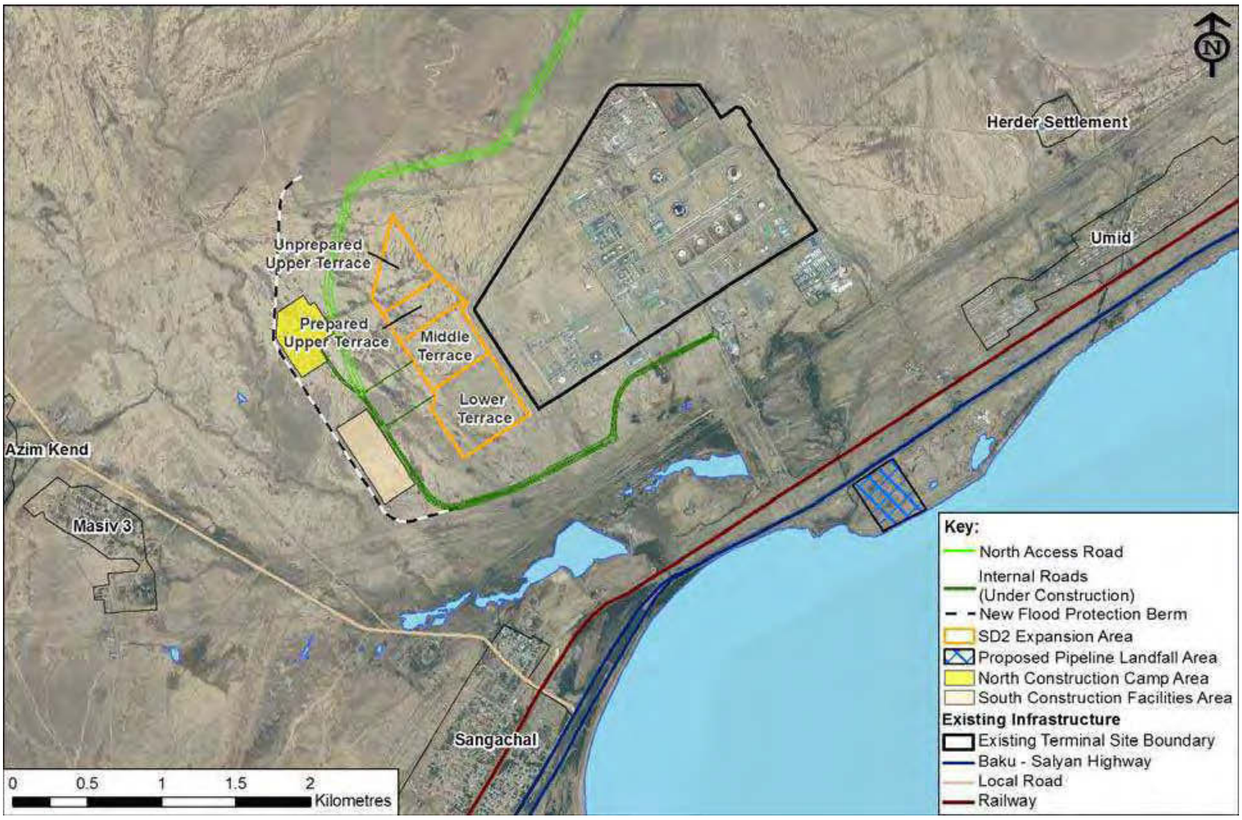
- Clearing and levelling of the terraces in the SD2 Expansion Area;
- Construction of a new access road;
- Construction of a flood protection berm; and
- Installation of a storm drainage system between the flood berm and the SD2 Expansion Area.

The impacts associated with these activities were previously assessed with the SD2 Infrastructure Project ESIA[5]. Figure 6.3 shows the scope of the SD2 EIW as assessed.

In addition to the works above, it is expected that the majority of the area between the flood protection berm and the SD2 Expansion Area would have been disturbed throughout the EIW and it is likely that the areas for the construction camp and construction facilities will have been cleared and levelled.

[5] SD2 Infrastructure Project ESIA (2012)

Figure 6.3 Scope of the SD2 EIW as Assessed within the SD2 Infrastructure ESIA

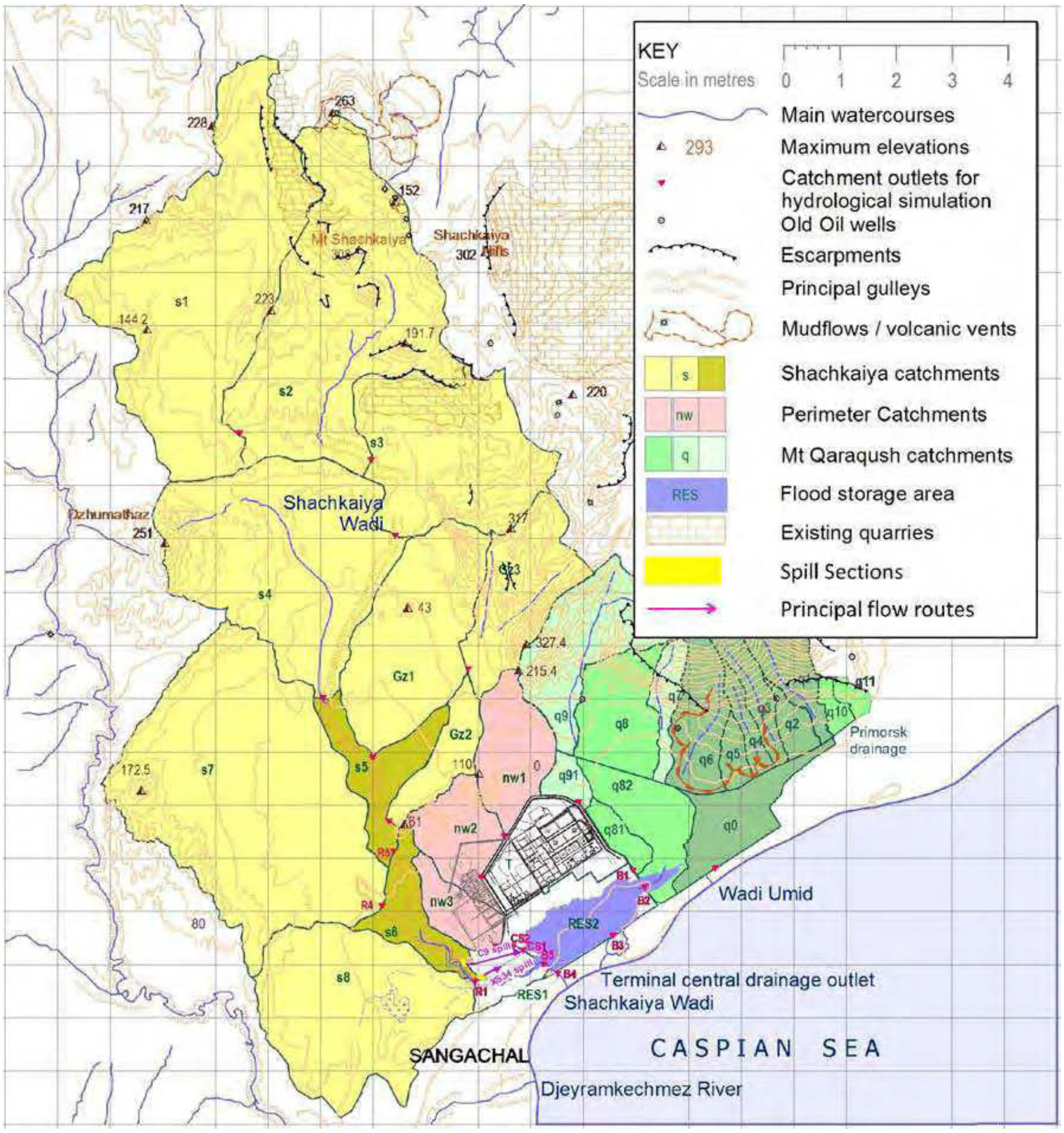


6.4.2 Hydrology

The hydrology in the vicinity of the Terminal area is complex due to its position within a number of drainage catchment areas (refer to Figure 6.4) which are:

- Shachkaiya catchment areas (the Shachkaiya Wadi and its western tributaries);
- Northern and western perimeter catchment areas;
- Flood storage areas between the Terminal and railway embankment;
- Mt Qaraqush catchment areas which comprise:
  - Western Qaraqush slopes and north east perimeter channel;
  - Central Qaraqush slopes and Umid Wadi outlet; and
  - Eastern Qaraqush slopes and rubbish dump draining towards Primorsk.

Figure 6.4 Main Drainage Catchment Areas in the Vicinity of the Terminal



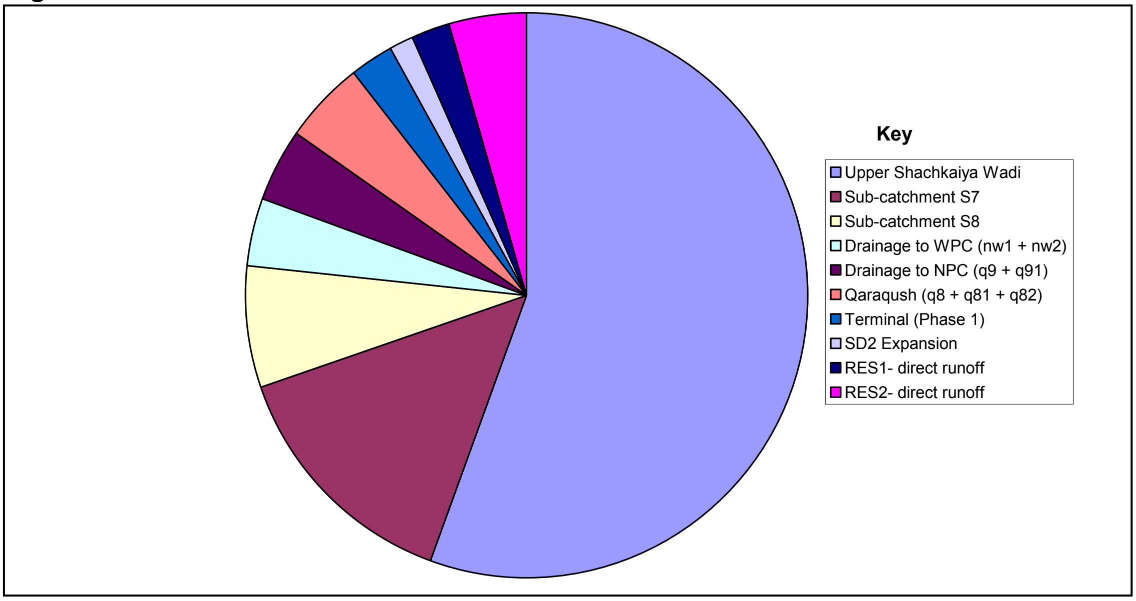
© Water Resource Associates Ltd. Based on Soviet mapping at 1:50,000 scale, with WRA data added.

The catchment area within the vicinity of the Terminal (and the SD2 Expansion Area) is 135km^2 which includes low-lying areas to the south east along the third-party pipeline corridor. The catchment area has two outlets which pass through the railway embankment and coastal highway:

- Bridge 'B4' under the railway and culvert B6 under the highway to the south close to Sangachal Town; and
- Bridge 'B3' under the railway and culvert B9 beneath the highway midway between Sangachal Town and the current Terminal access road.

The Shachkaiya Wadi catchment accounts for 78% of the contributing flow area, upstream of the main coastal railway embankment. The wadi is followed in most part by the main haul road, leading from the quarries in the Shachkaiya Hills, to the north of the Terminal area. The remainder of the water entering the wetlands south of the Terminal is derived from catchments to the north of the existing Terminal. For the 100 year flood event, Figure 6.5 shows the relative proportion of total runoff volume contributed by each grouping of sub-catchments.

Figure 6.5 Relative Contributions of Sub-Catchment Areas to 100 Year Flood Volume



Source: Water Resource Associates (2011).

There are two key flood water storage areas south of the Terminal which flow into the Caspian Sea:

- RES1 (Shachkaiya storage area) - Outflow from this area is controlled by the dimensions of two openings: the proposed B8 box culverts beneath the new access road, and the railway bridge, B4. Storage in this area was estimated to be 0.751Mm^3 at -15m MSL.
- RES2 (central storage area) - The central flood storage area acts as a large, flood attenuation lake. Although the third-party pipeline corridor and associated surface pipes, trenches and bunds act as partial obstacles, they effectively cause dispersal and convergence of flow entering the storage area, and also divert outflow from the Terminal and perimeter channels along the more northerly of the Shachkaiya overspill routes at C9 and XS34. Storage in this area was calculated to be 1.848Mm^3 at -17m MSL.

Hydrological modelling was undertaken taking into account the EIW as assessed within the SD2 Infrastructure Project ESIA (i.e. including the works described in Section 6.4.1 and structures within the North and South Camp and Facilities areas) and the onshore project elements which form part of the SD2 Project (referred to hereafter as SD2 Terminal expansion). Both normal flow conditions and a major flood event (once in 100 years)[6] were considered. It was found that the works associated with the SD2 Terminal expansion would result in the following key changes to the flood regime:

- Normal Flow Conditions - Additional flows into the Shachkaiya Wadi would occur due to increase in runoff. The change to the runoff area compared to the total runoff area that drains to Shachkaiya Wadi would be less than 1%.
- Major Flood Event - Flood waters will be directed to preferentially flow to the flood storage area to the south of the Terminal east of the new access road (RES2). The flow to the east of the new access road will be reduced. The redirection of flow will reduce flood risk in the area south of the Terminal to the east, but will increase the overall area that experiences flooding from a major flood event.

[6] SD2 Infrastructure Project ESIA (2012).

Sensitivity

The key sensitive receptors susceptible to flooding around the Terminal are:

- Sangachal Town;
- Sangachal Power Station;
- The Caravanserai[7];
- The railway; and
- Baku-Salyan Highway

The hydrological modelling completed for the SD2 Terminal expansion showed that Sangachal Town and Sangachal Power Station are at low risk of flooding and the SD2 Terminal expansion would not affect the flood risk at either receptor. The Caravanserai is located in an area at existing risk of flooding. Modelling showed that, while no change to the risk of flooding under normal flow conditions following the SD2 Terminal expansion was predicted, the level of flooding is expected to marginally increase by 2mm during a major flood event due to Terminal expansion works. Under existing conditions the modelling showed that sections of the railway and highway are currently at risk of flooding during a major flood event. However, the modelling showed that the SD2 Terminal expansion would not increase the likelihood or severity of the existing flood risk in these locations. Overall, the risk of flooding at key receptors was shown to either marginally reduce or remain largely unchanged following the SD2 Terminal expansion works.

6.4.3 Geology and Soils

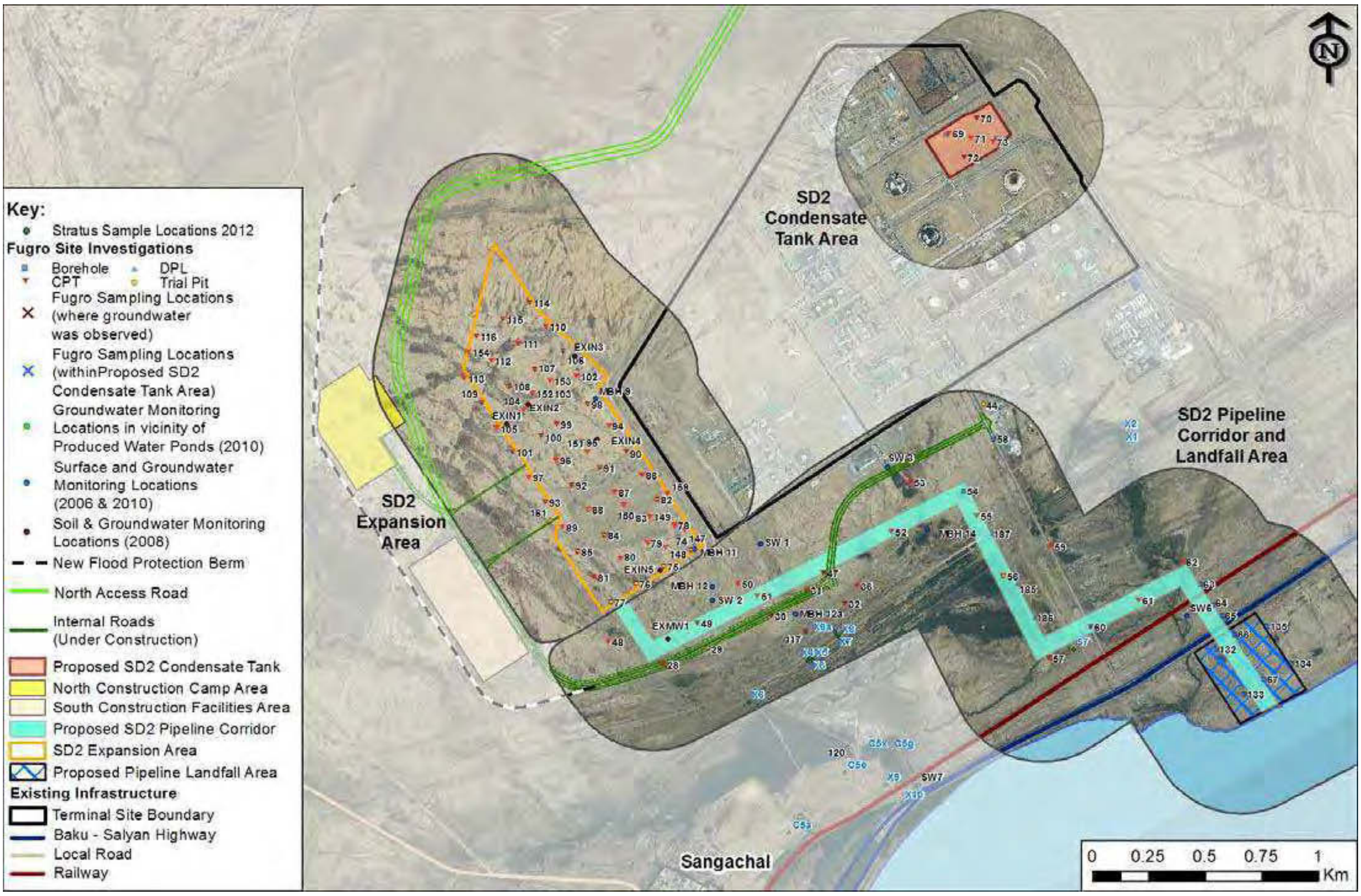
6.4.3.1 Geological Setting

This section focuses on the geology and soil conditions within the three areas of the SD2 Project onshore areas, namely, the SD2 Expansion area, the SD2 Pipeline Corridor and Landfall area and the SD2 Condensate Tank area (Refer to Figure 6.6).

Geological surveys have shown that superficial geology is relatively consistent across these areas and the wider vicinity, generally comprising surface deposits overlying variably weathered sedimentary bedrock units of the Absheron Group (termed Units 2, 3 and 4).

[7] State Protected Monument.

Figure 6.6 Soil and Groundwater Monitoring Locations

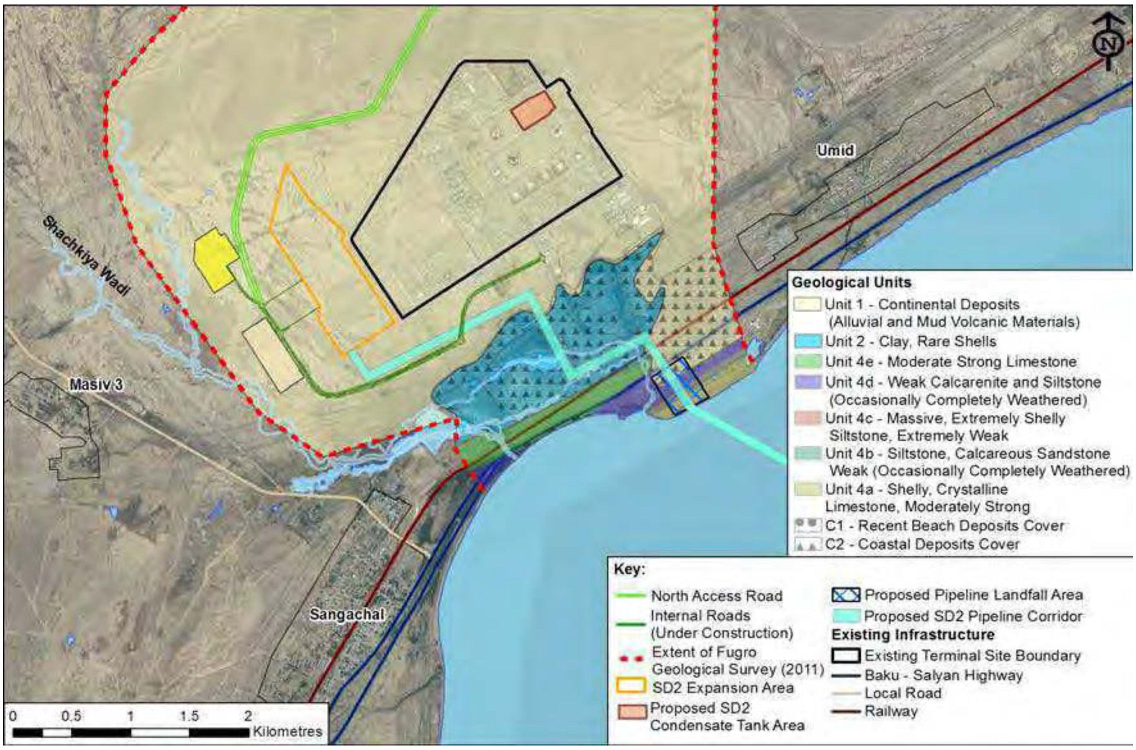


The following geological sequences have been encountered within the exploratory boreholes shown in Figure 6.6 (refer to Figure 6.7 for geological conditions):

- In the north, low permeability alluvial and mud volcanic deposits (Unit 1) are present at ground surface, overlying clayey deposits of Unit 2, which, in turn are, underlain by low permeability Unit 3 deposits. This sequence is encountered within the SD2 Expansion Area, the SD2 Condensate Tank Area and the northern portion of the proposed SD2 Pipeline Corridor;
- Further south, towards the Caspian Sea, a thin cover of coastal deposits (Unit C2) is generally present. These mainly comprise sandy silt and silty sand with shells and gravel but also include fine-grained sediments. Unit C2 mostly overlies Unit 2 deposits but the latter are exposed at surface where the coastal deposits have been eroded away. In the south eastern corner, Unit 1 deposits of volcanic origin remain beneath Unit C2. These conditions are encountered within the central portion of the proposed SD2 Pipeline Corridor; and
- Immediately adjacent to the Caspian Sea, superficial deposits are not present and bedrock geology is dominated by Unit 4 strata (limestones and siltstones). These conditions are encountered within the proposed SD2 Pipeline Landfall area.

With the exception of the SD2 Pipeline Landfall area, therefore, shallow geology within the SD2 Project onshore areas is dominated by low permeability deposits, with occasional thin lenses or layers of higher permeability materials. Regional evidence indicates that these low permeability strata continue to a depth of at least 50m, although drilling within and in the vicinity of SD2 Project areas has only proven them to a depth of 20m. These ground conditions result in soils and any underlying groundwater having a low vulnerability to near-surface releases of contamination.

Figure 6.7 Superficial Geological Conditions in the Vicinity of the Terminal



6.4.3.2 Soil Quality

The monitoring locations associated with soil surveys within and in the immediate vicinity of the SD2 Project onshore areas are shown in Figure 6.6. Inorganic and organic composition data obtained from the surveys are summarised in Tables 6.3 and 6.4, respectively.

Table 6.3 Soil Composition Data Within and Adjacent to the SD2 Project Onshore Areas – Inorganic and General Analytes

Analyte	Unit	Pipeline Landfall and Corridor			SD2 Condensate Tank			SD2 Expansion Area		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Aluminium	mg/kg	3900	19312	34700	18100	23984	31500	14500	22305	28800
Arsenic	mg/kg	0.21	10	19.3	5.7	10	18.7	6.1	12	20.2
Barium	mg/kg	54.8	218	1200	130	162	192	80.9	186	578
Cadmium	mg/kg	0.14	0.46	1.40	0.06	0.18	0.71	0.16	0.44	0.68
Chromium	mg/kg	7.6	31	61.6	22.2	48	65.9	19.2	33	107
Copper	mg/kg	4.5	24	40.7	18.6	31	42.3	21	29	54.9
Iron	mg/kg	28900	28900	28900	ND	ND	ND	30100	36867	50800
Mercury	mg/kg	0.010	0.038	0.090	0.03	0.05	0.08	0.02	0.05	0.12
Manganese	mg/kg	385	685	1850	559	697	862	454	756	7895
Nickel	mg/kg	6.4	27	44.8	19.8	31	38.5	22.1	28	44.8
Lead	mg/kg	4.2	13	113	9.7	13	17.3	9.7	12	23.4
Lithium	mg/kg	9.1	37	55.7	39.2	46	54.4	28.3	47	470
Thallium	mg/kg	10.4	12	**15.6**	7.8	10	14	10.1	12	13
Vanadium	mg/kg	13.2	53	102	40.5	60	78.7	42.8	56	79.4
Zinc	mg/kg	12.6	55	89.5	53.4	67	83.5	45.5	61	113
TOC	mg/kg	<1000	3259	30400	1850	2739	4530	1150	2289	6580

ND = Not Determined.
Mean values are the arithmetic mean of all data points above the analytical limit of detection (LoD).
Values shown in bold are above applicable limit values – refer to Appendix 6E

Table 6.4 Soil Composition Data Within and Adjacent to the SD2 Project Onshore Areas – Organic Analytes

Analyte	Unit	Pipeline landfall and corridor			SD2 Condensate Tank			SD2 Expansion Area		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
TPH										
Sum TPH	mg/kg	<2	26.4	403	<2	10	49	<2	30	611
Aliphatic EC6-8	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic EC8-10	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic EC10-12	mg/kg	<1	<1	<1	<1	10	11.9	<1	<1	<1
Aliphatic EC12-16	mg/kg	<1	1.7	5.7	<1	13	16.2	<1	2	2.3
Aliphatic EC16-35	mg/kg	<1	33.8	317	<2	5.2	14.9	<1	12	94.9
Aromatic EC5-7	mg/kg	<0.1	0.53	1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatic EC7-8	mg/kg	<0.1	0.37	0.67	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatic EC8-10	mg/kg	<0.1	0.60	1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatic EC10-12	mg/kg	<2	2.5	10.8	<2	<2	<2	<2	<2	<2
Aromatic EC12-16	mg/kg	<2	13.6	67.6	<2	<2	<2	<2	4	4.2
Aromatic EC16-21	mg/kg	<2	<2	<2	<2	<2	<2	<2	8	7.8
Aromatic EC21-35	mg/kg	<2	<2	<2	<2	<2	<2	<2	16	15.9
BTEX										
Benzene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sum xylenes	mg/kg	<0.02	<0.02	<0.02	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
PAHs										
Naphthalene	mg/kg	<0.5	1.8	8.2	<0.5	0.9	3.1	<0.5	1.6	9.5
Acenaphthylene	mg/kg	<0.5	1.0	2.6	<0.5	<0.5	<0.5	<0.5	2.0	2.8
Acenaphthene	mg/kg	<0.5	1.0	2.8	<0.5	1.4	2.8	<0.5	3.3	14.5
Fluorene	mg/kg	<0.5	4.2	18.2	<0.5	4.9	25.7	<0.5	10.0	53.1
Phenanthrene	mg/kg	<0.5	5.4	21.6	<0.5	2.5	17.8	<0.5	9.9	281
Anthracene	mg/kg	<0.5	4.5	23.7	<0.5	<0.5	<0.5	<0.5	14.4	84.3
Fluoranthene	mg/kg	<0.5	1.7	4.9	<0.5	1.1	2.5	<0.5	4.3	68.3
Pyrene	mg/kg	<0.5	2.7	8.4	<0.5	1.6	7.2	<0.5	3.7	64.9
Benzo(a)anthracene	mg/kg	<0.5	1.9	9.2	<0.5	0.7	1.1	<0.5	7.5	29
Chrysene/Triphenylene	mg/kg	<0.5	6.3	**24.3**	<0.5	2.8	7.7	<0.5	11.2	**322**
Benzo(b+j+k)fluoranthene	mg/kg	<0.5	5.4	19.9	<0.5	2.9	10.7	<0.5	5.1	56.3
Benzo(a)pyrene	mg/kg	<0.5	1.6	5.8	<0.5	0.9	1.5	<0.5	2.8	**15.7**
Indeno(1,2,3-cd)pyrene	mg/kg	<0.5	1.5	4.6	<0.5	1.0	2.8	<0.5	1.4	13.8
Benzo(ghi)perylene	mg/kg	<0.5	3.1	11.2	<0.5	1.8	8.9	<0.5	2.0	17.7
Dibenzo(ah)anthracene	mg/kg	<0.5	1.4	4.6	<0.5	1.0	3.2	<0.5	1.0	6.7
Sum EPA 16 PAH	mg/kg	<0.5	24.8	102	4.5	13.8	32.7	<0.5	36	941
Phenols										
Sum phenols	mg/kg	<0.03	0.3	0.6	<0.03	1.7	6.6	<0.03	1.1	5.0

Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Table 6.3 shows that metal and metalloid concentrations in the soils are consistent across the SD2 Project onshore areas. Further analysis showed the results are also consistent with soil and dust composition data collected more widely across the region. While a number of the recorded concentrations in the SD2 Project onshore areas are considered relatively high (i.e. arsenic and iron) this is considered to be due to the weathering of minerals within the natural geological units and not the result of contamination.

Organic contamination has not generally been recorded in soil within the SD2 Project areas but elevated concentrations of total petroleum hydrocarbons (TPH), including polycyclic aromatic hydrocarbons (PAHs), have been detected in a small proportion of soil samples.

In the SD2 Condensate Tank Area, TPH was recorded at low concentrations in the majority of samples, reaching a maximum of 40mg/kg in BH69 at 1m below ground level (bgl). PAH, benzene and toluene ethylbenzene and xylene (BTEX) concentrations were very low. Phenol concentrations ranged from non-detectable to 3.3mg/kg. The source of these organic contaminants is believed to be historic leakage of water from the produced water ponds in and adjacent to this area, although the distribution of this will have been limited by geological conditions.

Elsewhere, TPH concentrations are low with only two samples recording a total greater than 100mg/kg: BH84 at 1-2m bgl within the SD2 Expansion Area and MBH25 at 2-8m bgl within the SD2 Pipeline Corridor area. The hydrocarbon in these areas is of high molecular weight (suggesting weathering of historic contamination) and highly localised. Therefore, the potential for distribution of this contamination is considered low.

Given the data, it is considered that unknown local areas of historic hydrocarbon contamination may be present in subsurface soils within SD2 Project onshore areas but that these are unlikely to be extensive or significantly mobile.

Sensitivity

Surveys have shown that metal and metalloid concentrations within the SD2 Project onshore areas are typical for the region.

Concentrations of organic analytes indicate no widespread contamination. However, elevated concentrations of hydrocarbon from historical contamination are present within highly localised areas of soil. Although contaminant distribution is constrained by low permeability of the soils, it could potentially be mobilised by physical disturbance.

Surface soils are considered to be of low general quality supporting little vegetation, which is utilised by livestock. The wetland area through which the proposed SD2 Pipeline Corridor passes has some limited value for grazing (refer to Section 6.4.5.1 for habitat characteristics).

6.4.4 Groundwater and Surface Water Quality

6.4.4.1 Groundwater

Superficial strata generally comprise a significant thickness of low permeability estuarine and mud volcanic clays (Units 1 to 3) through which water permeation is low. Shallow groundwater is therefore only expected to be present in small quantities in occasional seams or lenses of higher permeability materials present within these strata and is likely to be discontinuous.

The absence of a widespread shallow groundwater body is confirmed by monitoring data across the SD2 Project onshore areas and the wider vicinity, with monitoring wells (locations shown in Figure 6.6) generally recording either no or intermittent groundwater presence.

Groundwater was not encountered within boreholes installed in the SD2 Expansion Area. These boreholes generally extended 8-15m below ground level (bgl) into Unit 2 soils, although some were advanced to approximately 40m bgl and penetrated into Unit 3 soils.

Within the proposed SD2 Pipeline Corridor area, groundwater was only encountered in near-surface Unit 2 and/or beach deposit soils that were subject to recharge from surface water within the wetland area. The depth to groundwater in this location was shallow (1-3m bgl). Elsewhere within the proposed SD2 Pipeline Corridor area groundwater was not encountered in boreholes, some of which extended to greater than 40m bgl. Discrete groundwater was, however, present within the Unit 4 deposits investigated within the SD2 Pipeline Landfall area. This is considered to be in hydraulic connectivity with the Caspian Sea, i.e. water levels are mainly controlled by sea level.

Within the SD2 Condensate Tank area, monitoring showed there are waterlogged Unit 1 and upper Unit 2 soils and some discrete groundwater considered to be a result of historical leakage from existing produced water holding ponds in the vicinity, which have been subsequently repaired. Where groundwater levels can be measured, these have generally been recorded at between 2 and 4m bgl. Consistent with the low permeability geological conditions, there is no evidence that this water has migrated more widely.

Inorganic and organic composition data for groundwater within the SD2 Project onshore areas are shown in Tables 6.5 and 6.6, respectively. This data relates to the shallow groundwater within the SD2 Condensate Tank Area and the SD2 Pipeline Landfall and Corridor only as no groundwater was encountered in the SD2 Expansion Area.

Table 6.5 Groundwater Composition Data Within and Adjacent to the SD2 Project Onshore Areas – Inorganic and General Analytes

Analyte	Unit	Pipeline Landfall and Corridor			SD2 Condensate Tank		
		Min	Mean	Max	Min	Mean	Max
pH	---	6.1	6.7	7.3	ND	ND	ND
Conductivity	mS/cm	21.5	75.2	193	ND	ND	ND
Salinity	‰	12.2	47.0	115	ND	ND	ND
Chloride	g/L	0.46	30.2	66.8	ND	ND	ND
Sulphate	g/L	0.27	2.7	6.7	ND	ND	ND
Fluoride	mg/L	<0.025	0.24	1.8	ND	ND	ND
Aluminium	mg/L	<0.02	173.1	902	ND	ND	ND
Arsenic	mg/L	<0.002	**0.18**	**0.86**	**380**	**380**	**380**
Barium	mg/L	0.017	1.0	6.6	ND	ND	ND
Cadmium	mg/L	<0.001	**0.01**	**0.01**	ND	ND	ND
Chromium	mg/L	<0.0005	**0.21**	**1.1**	0.003	0.003	0.003
Copper	mg/L	0.0008	**0.48**	**2.8**	**0.05**	**0.05**	**0.05**
Iron	mg/L	67.5	67.5	67.5	ND	ND	ND
Mercury	mg/L	<0.00001	**0.00084**	**0.0049**	ND	ND	ND
Manganese	mg/L	0.003	3.7	19.6	ND	ND	ND
Nickel	mg/L	0.002	**0.17**	**1.4**	ND	ND	ND
Lead	mg/L	<0.002	0.07	**0.16**	0.01	0.02	0.02
Lithium	mg/L	0.28	1.5	5.5	ND	ND	ND
Selenium	mg/L	<0.005	0.004	0.004	ND	ND	ND
Thallium	mg/L	<0.002	0.029	0.051	0.15	0.15	0.15
Vanadium	mg/L	<0.01	**0.60**	**1.67**	ND	ND	ND
Zinc	mg/L	<0.0007	**0.24**	**1.69**	0.002	0.002	0.002
TOC	mg/L	<0.25	8.5	35	ND	ND	ND

ND = Not Determined.
Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Table 6.6 Groundwater Composition Data Within and Adjacent to the SD2 Project Onshore Areas – Organic Analytes

Analyte	Unit	Pipeline Landfall and Corridor			SD2 Condensate Tank		
		Min	Mean	Max	Min	Mean	Max
TPH							
Sum TPH	µg/L	20	**266**	**2366**	ND	ND	ND
Aliphatic EC6-8	µg/L	1.9	3.1	5.5	ND	ND	ND
Aliphatic EC8-10	µg/L	0.35	2.6	16.7	ND	ND	ND
Aliphatic EC12-16	µg/L	12.5	94.5	501	ND	ND	ND
Aliphatic EC16-35	µg/L	11.0	177.3	1860	ND	ND	ND
Aromatic EC8-10	µg/L	0.06	2.0	5.4	ND	ND	ND
BTEX							
Benzene	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toluene	µg/L	<0.05	0.35	0.57	<0.05	<0.05	<0.05
Ethylbenzene	µg/L	<0.05	0.09	0.09	<0.05	<0.05	<0.05
Sum xylenes	µg/L	<0.05	0.55	0.58	<0.05	<0.05	<0.05
PAHs							
Naphthalene	µg/L	<0.01	1.03	**5.1**	ND	ND	ND
Acenaphthylene	µg/L	<0.01	0.07	0.12	ND	ND	ND
Acenaphthene	µg/L	<0.01	0.42	0.75	ND	ND	ND
Fluorene	µg/L	<0.01	0.65	2.1	ND	ND	ND
Phenanthrene	µg/L	<0.01	0.85	4.0	ND	ND	ND
Anthracene	µg/L	<0.01	0.07	**0.11**	ND	ND	ND
Fluoranthene	µg/L	<0.01	**0.13**	**0.22**	ND	ND	ND
Pyrene	µg/L	<0.01	0.32	1.1	ND	ND	ND
Benzo(a)anthracene	µg/L	<0.01	0.06	0.11	ND	ND	ND
Chrysene	µg/L	<0.01	**0.20**	**0.37**	ND	ND	ND
Benzo(b+j+k)fluoranthene	µg/L	<0.01	**0.21**	**0.21**	ND	ND	ND
Benzo(a)pyrene	µg/L	<0.01	**0.20**	**0.2**	ND	ND	ND
Indeno(1,2,3-cd)pyrene	µg/L	**<0.01**	**<0.01**	**<0.01**	ND	ND	ND
Benzo(ghi)perylene	µg/L	**<0.01**	**<0.01**	**<0.01**	ND	ND	ND
Dibenzo(ah)anthracene	µg/L	<0.01	<0.01	<0.01	ND	ND	ND
Sum EPA 16 PAH	µg/L	<0.01	2.4	13.2	ND	ND	ND
Phenols							
Phenol	µg/L	<0.02	0.04	0.09	ND	ND	ND
2-methylphenol	µg/L	<0.01	0.05	0.07	ND	ND	ND
3&4-methylphenols	µg/L	<0.01	0.02	0.02	ND	ND	ND
2,4-Dimethylphenol	µg/L	<0.01	0.04	0.04	ND	ND	ND
3,4-Dimethylphenol	µg/L	<0.01	<0.01	<0.01	ND	ND	ND

ND = Not Determined.
Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

The data shows that the salinity and inorganic chemistry of the groundwater within the proposed SD2 Pipeline Corridor area is consistent with a coastal environment. Metal and metalloid concentrations are generally low, although individual samples show notably elevated manganese and iron concentrations, which may reflect local mineralogy, redox hydrochemistry and/or anthropogenic sources. Concentrations of organic contaminants are more variable with the majority of samples showing non-detectable or very low concentrations but a small proportion having moderately elevated concentrations. Of the latter, samples from BH41 and BH56 recorded respective TPH concentrations of 2,366 and 219µg/L and sum PAH concentrations of 13.2 and 7.8 µg/L. These samples were collected in groundwater within the wetland areas impacted by surface hydrocarbon spills (refer to Section 6.4.4.2).

Very few wells within the SD2 Condensate Tank area contained sufficient water to sample and therefore only very limited analysis has been possible. The few results available do not show significant contamination with those metals, metalloids or BTEX components analysed. However, samples close to (but outside) the SD2 Condensate Tank area have shown moderately elevated concentrations of TPH, PAHs and BTEX. This is considered to be due to historical leakage from an adjacent produced water holding pond. Given this, localised historic hydrocarbon contamination may be present in groundwater within the SD2 Condensate Tank area.

Sensitivity

Groundwater was only found to be present within the proposed SD2 Pipeline Corridor and Landfall area and the SD2 Condensate Tank area. Groundwater within the proposed SD2 Pipeline Corridor was considered to be typical of a coastal environment. It is considered likely that the groundwater encountered is in hydraulic connectivity with the Caspian Sea.

Moderate levels of hydrocarbon contamination may be present locally in the vicinity of the SD2 Condensate Tank area and within wetland areas historically impacted by third-party releases. Although the distribution is constrained by geological conditions, contamination could potentially be mobilised by physical disturbance.

There is no evidence to suggest that groundwater is abstracted and utilised by the local community for consumption or for industrial use and therefore it is of limited value. It may however, provide an intermittent baseflow to the wetlands areas and surface watercourses.

6.4.4.2 Surface Water

This section specifically discusses the chemical quality of water and sediments associated with watercourses and permanent and temporary wetlands within and around the SD2 Project onshore areas.

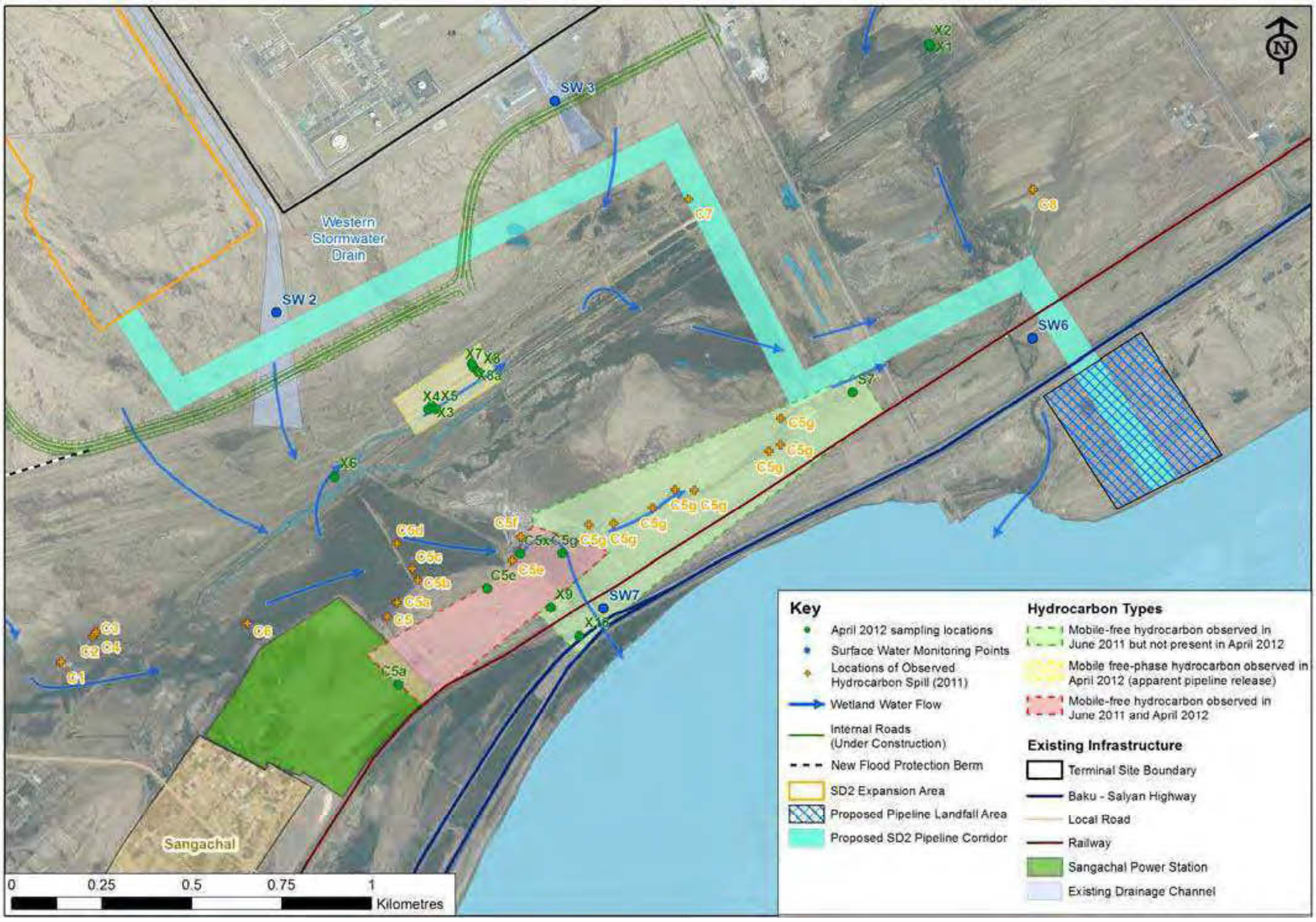
Walkover Surveys

In addition to sampling surveys, visual evidence collected over time provides information on the sources and distribution of contamination, as well as any changes.

Localised hydrocarbon contamination within wetland areas and surface waters downstream of the wetland area have been previously observed but in June 2011 a focused survey was undertaken. This involved a detailed wetland walkover survey during which a number of discrete areas of significant hydrocarbon contamination were identified and recorded. All of these appeared to be associated with the release of oil from third-party sources. The majority of the contamination appeared to originate from a large release at location RES1 (refer to Figure 6.4), which was distributed with surface water flow through area RES2 to the outfall at location B3. Other localised spills were observed in the vicinity of the third-party pipelines but no ongoing leaks were visible.

A follow-up walkover survey and sampling exercise was undertaken in April 2012. This examined changes to contaminant distribution since the June 2011 survey and included both permanent and temporary (seasonal) areas of wetland within the third-party pipeline corridor to the south of the existing Terminal. Areas of observed significant contamination in June 2011 and April 2012 are shown in Figure 6.8.

Figure 6.8 Wetland Sample Locations and Contamination Observations 2011 and 2012



In April 2012, an area of weathered free-phase oil contamination was present in the wetland area immediately adjacent to the eastern boundary of the Sangachal Power Station, as had been the case in June 2011. This contamination appeared to have been distributed by wetland flow to the east and south with accumulations evident around culvert entries and areas of dense reed growth and entrapment within sediment, which in some places had been buried by clean, freshly deposited sediments. Samples from further downstream did not show evidence of significant residual contamination.

A separate, discrete area of free-phase oil contamination was observed in April 2012 within part of the northern portion of the third-party pipeline corridor, which is believed to have resulted from a release from an adjacent third-party pipeline. The area was relatively dry at the time of the survey but residual standing water pools remained, suggesting that the area would be waterlogged during periods of prolonged rainfall.

Chemical Data

For clarity, given the visual observations, chemical data has been subdivided into those samples collected from permanent and temporary wetland areas and those collected from general watercourses in the SD2 Project onshore areas. Sampling locations are shown on Figure 6.8.

Analytical data from general surface watercourse samples are presented in Tables 6.7 and 6.8. These samples have low salinity and exhibit low concentrations of potential inorganic contaminants and of BOD_5. Within the SD2 Pipeline Corridor area, elevated concentrations of TPH were recorded in the samples from location SW2 collected in 2006 but not that collected in 2008; similarly, elevated TPH concentrations were recorded in sample SW6 collected in November 2010 but not those collected in 2008 or July 2010.

Table 6.7 Surface Water Composition Data for General Watercourses Within and Adjacent to the Proposed SD2 Pipeline Corridor and Landfall Area– Inorganic and General Analytes

Component	Units	Pipeline Landfall and Corridor		
		Min	Mean	Max
pH	---	8.0	8.1	8.1
Conductivity	mS/cm	1.5	1.8	2.0
Salinity	‰	0.70	0.85	1.0
TDS	mg/L	956	958	960
BOD-5	mg/L	0.7	1.0	1.2
COD	mg/L	5.6	11.1	16.5
Bicarbonate	mg/L	180	182	184
Aluminium	mg/L	0.04	0.05	0.05
Arsenic	mg/L	<0.002	0.01	0.01
Cadmium	mg/L	<0.001	<0.001	<0.001
Chromium	mg/L	<0.0005	0.003	0.003
Copper	mg/L	<0.0008	**1.5**	**3.0**
Iron	mg/L	<0.01	0.04	0.05
Mercury	mg/L	<0.00001	**0.014**	**0.014**
Manganese	mg/L	<0.002	0.001	0.001
Nickel	mg/L	<0.001	0.001	0.001
Lead	mg/L	<0.002	<0.002	<0.002
Selenium	mg/L	<0.002	<0.002	<0.002
Zinc	mg/L	<0.0007	0.002	0.002

ND = Not Determined.
Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Table 6.8 Surface Water Composition Data for General Watercourses Within and Adjacent to the Proposed SD2 Pipeline Corridor and Landfall Area – Organic Analytes

Component	Units	Pipeline Landfall and Corridor		
		Min	Mean	Max
Sum TPH	µg/L	51.0	174	**297**
BTEX				
Benzene	µg/L	<0.05	<0.05	<0.05
Toluene	µg/L	<0.05	<0.05	<0.05
Ethylbenzene	µg/L	<0.05	<0.05	<0.05
Sum of Xylenes	µg/L	<0.05	<0.05	<0.05
Sum BTEX	µg/L			
Naphthalene	µg/L		0.01	
Acenaphthylene	µg/L		<0.01	
Acenaphthene	µg/L		<0.01	
Fluorene	µg/L		<0.01	
Phenanthrene	µg/L		<0.01	
Anthracene	µg/L		<0.01	
Fluoranthene	µg/L		<0.01	
Pyrene	µg/L		0.01	
Benzo(a)anthracene	µg/L		<0.01	
Chrysene	µg/L		<0.01	
Benzo(b+j+k)fluoranthene	µg/L		<0.01	
Benzo(a)pyrene	µg/L		<0.01	
Indeno(1,2,3-cd)pyrene	µg/L		**<0.01**	
Benzo(ghi)perylene	µg/L		**<0.01**	
Dibenzo(ah)anthracene	µg/L		<0.01	
Sum EPA 16 PAH	µg/L		0.04	

ND = Not Determined.
Mean values are the arithmetic mean of all data points above the analytical LoD.
Only 1 set of data is available for PAHs within the SD2 Pipeline Landfall and Corridor area.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Analytical data for water and sediment samples collected from permanent and temporary wetland areas were obtained in April 2012. These samples were all collected from the proposed SD2 Pipeline Corridor area and were targeted at areas of visible gross contamination and the surrounding non-visibly contaminated areas. Sediment samples underwent both total and leachable analysis to ascertain relative mobility of sediment-associated contamination. Results for wetland water samples taken in April 2012 are presented in Table 6.9 and those for sediment samples in Tables 6.10 and 6.11.

Table 6.9 Summary of Wetland Surface Water Analytical Data, 2012

Parameter	Unit	Non-visibly Contaminated Areas			Areas Of Gross Contamination			
					Release Area Adjacent to Sangachal Power Station		Pipeline Release Area Adjacent to Third-Party Pipeline	
		Min	Mean	Max	Min	Max	Min	Max
TPH (sum)	µg/L	<80	<80	<80	1.2E6	7.4E7	1.8E6	2.1E6
PAHs (sum)	µg/L	<0.16	1.5	4.4	1399	1.4E6	8365	181000
Benzene	µg/L	<0.40	0.40	0.42	<0.4	**15.4**	<0.4	10.3
Toluene	µg/L	<0.3	4.5	25.2	<0.3	**124**	<0.3	**226**
Ethylbenzene	µg/L	<0.2	0.5	2.0	<0.2	1.9	<0.2	9.0
Xylenes (sum)	µg/L	<1.0	3.0	12.8	<1.0	**437**	1.1	**140**
Phenols	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COD	mg/L	9	94	433	4050	634000	296000	313000

Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Table 6.10 Summary of Wetland Sediment Analytical Data for Total Contaminant Concentrations, 2012

Parameter	Unit	Non-visibly Contaminated Areas			Areas Of Gross Contamination			
					Release Area Adjacent to Sangachal Power Station		Pipeline Release Area Adjacent to Third-Party Pipeline	
		Min	Mean	Max	Min	Max	Min	Max
Arsenic	mg/kg	0.2	11.1	13.0	9.3	13.3	10.5	11.4
Cadmium	mg/kg	0.14	0.18	0.22	0.14	0.20	0.04	0.16
Chromium	mg/kg	32.8	43.7	46.0	34.8	51.4	44.7	48.2
Copper	mg/kg	0.04	25.7	32.8	22.8	30.6	24.3	26.3
Lead	mg/kg	13.1	15.3	19.3	11.6	17.5	13.3	14.7
Mercury	mg/kg	0.03	0.04	0.04	0.04	0.05	0.05	0.14
Zinc	mg/kg	64.6	80.4	109.1	83.3	88.2	66.6	72.1
Organic Analytes								
TPH (sum)	mg/kg	<16	<16	<16	5142	65100	6309	16800
PAHs (sum)	mg/kg	0.015	0.068	0.165	2.0	93.6	2.32	3.03
Benzene	mg/kg	0.26	0.37	0.47	0.37	0.41	0.43	0.54
Toluene	mg/kg	0.10	1.38	2.45	2.4	2.7	1.13	17.0
Ethylbenzene	mg/kg	0.03	0.08	0.22	0.07	0.11	0.02	23.0
Xylenes (sum)	mg/kg	0.08	0.16	0.39	0.09	0.31	1.84	**236**
Phenols	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Table 6.11 Summary of Wetland Sediment Analytical Data for Leachable Contaminant Concentrations, 2012

Parameter	Unit	Non-visibly Contaminated Areas			Areas Of Gross Contamination		
		Min	Mean	Max	Min	Mean	Max
Arsenic	mg/kg	0.0002	0.0056	0.0184	0.0003	0.0007	0.0010
Cadmium	mg/kg	0.0001	0.0004	0.0007	0.0000	0.0000	0.0001
Chromium	mg/kg	0.0000	0.0012	0.0025	0.0001	0.0004	0.0008
Copper	mg/kg	0.0010	0.0058	0.0150	0.0009	0.0026	0.0060
Lead	mg/kg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Mercury	mg/kg	0.0003	0.0073	0.0199	0.0007	0.0021	0.0038
Zinc	mg/kg	0.0000	0.0003	0.0007	0.0000	0.0001	0.0002
Organic Analytes							
TPH (sum)	mg/kg	<1.67	<1.67	<1.67	<1.67	<1.67	<1.67
PAHs (sum)	mg/kg	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Benzene	mg/kg	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Toluene	mg/kg	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Ethylbenzene	mg/kg	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (sum)	mg/kg	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Phenols	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Mean values are the arithmetic mean of all data points above the analytical LoD.
Values shown in bold are above applicable limit values – refer to Appendix 6E

Visual observations in both June 2011 and April 2012 demonstrated that third-party hydrocarbon releases have taken place in the permanent and temporary wetland areas including areas through which the SD2 Pipeline Corridor is proposed to run. This has resulted in areas of free-phase oil contamination within the wetland surface water and associated sediments, with oil burial beneath clean sediment taking place in some stretches. While free-phase oil can be distributed by surface water flow, low permeability ground conditions will otherwise limit migration.

Chemical data shows that hydrocarbon components (including PAHs and BTEX) were present at non-detectable to very low concentrations in wetland surface water outside the areas containing free-phase oil (Table 6.9).

In sediments, metal and metalloid concentrations did not differ between oil-contaminated and uncontaminated areas (Table 6.10) and were consistent with soils data from across the SD2 Project onshore areas (Table 6.3). Organic contaminant concentrations were very low in samples collected outside areas of visible contamination. All sediments showed very low concentrations of leachable components, even when gross oil contamination was present (Table 6.11).

While the proposed SD2 Pipeline Corridor area encroaches upon the eastern end of the contamination area seen in June 2011 there was no significant residual contamination during the walkover inspection of the same area in April 2012 and the results for soil sample S7 (refer to Figure 6.8) indicated only a residual concentration of hydrocarbon contamination with low mobility. It is, therefore, likely that the contamination in this specific area had largely been removed by third-party clean-up activities and/or natural attenuation processes.

It is possible that unknown localised areas of buried historical hydrocarbon contamination may be present in shallow subsurface soils within SD2 Project onshore areas associated with the wetland areas.

Sensitivity

Walkover surveys in 2011 and 2012, supported by sediment and surface water sampling, have indicated that significant contamination, comprising free-phase oil, is present within permanent or temporary wetland areas as a result of historic third-party contamination. While this is not widely distributed, there is evidence that it can be mobilised by high flow conditions and it could potentially be mobilised along surface water flow pathway by physical disturbance.

The wetland areas are of limited value, supporting some local grazing for livestock. The ecological value of the wetland habitat and the flora and fauna present is discussed in Section 6.4.5 below.

6.4.5 Terrestrial Ecology

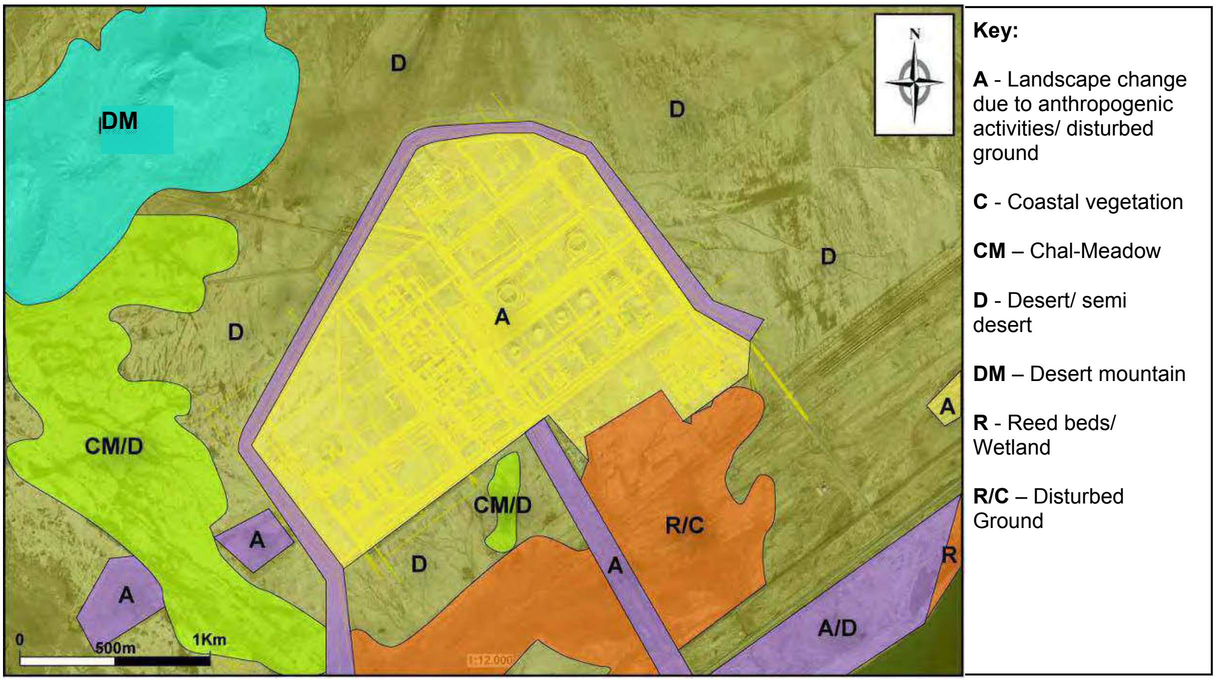
A number of habitat surveys have been undertaken in the vicinity of the Terminal since 2001. The methodology, monitoring locations and species included in the surveys has varied. Since 2006, annual spring and autumn flora surveys of the terrestrial areas surrounding the Terminal have been undertaken to identify change using ecosystem indicators.

This section provides an overview of the ecology of the area in which the Terminal is located which may be affected by the SD2 Project activities and then focuses on the area of the proposed SD2 Pipeline Corridor and SD2 Pipeline Landfall area south of the Terminal.

6.4.5.1 Habitats

Areas of disturbed ground are prevalent south of the Terminal (which includes the proposed SD2 Pipeline Corridor and Landfall area) and includes desert/semi-desert and wetland habitats (refer to Figure 6.9).

Figure 6.9 Approximate Distributions of Plant Community Types (Habitats) Around the Terminal, 2009



In 2005 and 2006, areas of disturbed ground within the Terminal vicinity were included within the terrestrial survey monitoring. Surveys were undertaken to establish the extent of re-vegetation of the areas in the period between the surveys. It was shown that regrowth was focused in locations which were previously subject to surface water ponding and, more recently, in areas where heavy machinery had been used and where rainwater had collected in the indentation left in the ground by the machinery.

The survey indicated that the rate of natural regeneration was generally low, with some areas featuring zero regrowth. Observations made during a site walkover in May 2011 indicated that the rate of natural regeneration within the disturbed/bare soil areas remains low with sparse growths of *Salsola nodulosa* and *Poa bulbosa*.

The dominant habitats south of the Terminal are described below (refer to Figure 6.9).

Desert/semi-desert - This habitat type comprises a variety of elements including:

- Exposed silt/bare soil;
- Silt with a growth of lichens and algae (a microbiotic crust);
- Sparse growth of perennial shrubs (desert vegetation); and
- Patches of perennial shrubs with a closed cover of grasses and annual species (semi-desert vegetation).

The main vegetation assemblages in the vicinity of the Terminal are dominated by low perennial shrubs (*Salsola nodulosa*, *Salsola dendroides, Suaeda dendroides*, *Salsola ericoides* and *Artemisia lerchiana*) including coastal zone variants and others in association with grasses. None of the species present identified within the desert/semi-desert habitats area is included in the Azerbaijan Red Data Book (AzRDB) or classified as vulnerable/threatened by the IUCN. The survey noted that the desert habitats in the vicinity of the Terminal are generally well grazed.

Wetland – the primary wetland area is located to the south of the Terminal. The wetland appears to be primarily fed by ephemeral watercourses including the Shachkaiya Wadi, together with other surface water runoff and some contribution from leakages in water pipes and discharges from the Sangachal Water Pump Station Baku Water Channel Department. Wetland surveys recording habitats, flora and fauna present were undertaken in 2002 (as reported within the ACG Phase 1 ESIA[8]), 2010 and 2011.

In general, the wetlands are considered to comprise a complex mixture of habitats, which developed following construction of the Baku-Salyan Highway, adjacent railway line and the third-party pipeline corridor between the railway line and the Terminal. The wetlands experience high rates of siltation which has resulted in an impeded water flow that causes water to be retained across a series of topographical depressions (see Section 6.4.4). Variations in topography determine the boundaries of the wetland and the vegetation types occurring.

The main surface-water dependent habitats within the wetlands are tall reedbeds (*Phragmites australis*), which occur along the edge of the wetland closest to Sangachal, within the third-party pipeline corridor and in other locations where deeper water occurs. In shallower permanent water, stands of reedmace (*Typha angustifolia*) and extensive marshes dominated by sea rush (*Juncus maritimus*) and sea club-rush (*Bolboschoenus maritimus*) are prominent. At the edges of the swamp/marsh areas, a scrub of Tamarisk (*Tamarix meyeri*) with alhagi (*Alhagi pseudoalhagi*) typically occurs, together with areas of mudflat, frequently colonised by glasswort (*Salicornia europaea*).

Additional habitats which occur in the wetlands include wadi channels with flat terraces that support vegetation which is similar to that of chal-meadow and includes Tamarisk shrubs (*Tamarix meyeri*) and low growing grasses (e.g. *Poa bulbosa*) and herbaceous species. Permanent pools also occur in certain locations, with vegetation such as Charophytes (aquatic multicellular algae) and water buttercup (*Ranunculus* sp.) which require permanent water.

Sensitivity

The terrestrial monitoring surveys completed to date (between 2006 and 2011[2]) have focused on identifying potential changes and trends in floral species present and vegetation cover.

With regard to desert/semi-desert vegetation assemblages, no significant change in their distribution or status over time has been observed. Disturbed ground has shown a poor level of natural recovery with faster re-vegetation observed in areas where temporary surface water has been present after rainfall events.

[8] ACG Phase 1 ESIA, (2002).

The surveys do indicate that there has been a change in vegetation cover within the area surrounding the Terminal. In general, the extent of plant cover appears to be increasing and there appears to be a decrease in the number of sites which have a measurable microbiotic crust. The reason for the decline in the abundance of microbiotic crust is not known, but it may be related to difficulty in observing the crust, given recent increases in grass cover.

Some deterioration in vegetation cover has been observed in the immediate vicinity of the Terminal where diverted runoff and construction/other activities have been ongoing during the time period covered by the surveys.

With the exception of physical activities, such as earthworks, there have been no observed changes to the habitats south of the Terminal as a result of the Terminal operations. In addition, from observation, the contaminated areas within the wetland areas (see section 6.4.4.2), do not appear to have had a significant adverse affect on the wetland habitats.

No unique habitats have been identified in the Terminal vicinity.

6.4.5.2 Flora

A number of species which are included in the AzRDB or classified as vulnerable/threatened by the IUCN, were previously recorded by the 2004 terrestrial survey including:

- *Ferula persica* (AzRDB) - a herbaceous perennial plant of the Family Apiaceae which grows in arid climates, typically occurring on lower habitats;
- *Cladochaeta candidissima* (IUCN, Indeterminate) – which occurs within coastal sands, rubbly places, dry stream beds and in plains;
- *Glycyrrhisa glabra* (AzRDB) - (European licorice) shrub/semi-shrub in arid habitats;
- *Nitraria schoberii* (AzRDB) – a wood shrub perennial; and
- *Ammochloa palaestina* (AzRDB) – which is found at sandy, arid habitats.

The following two species have been recorded in the vicinity of the Terminal:

- *Astragalus bakuensis* (AzRDB) - Shrub/semi-shrub coastal recorded in the 2001 Baseline Report survey report and 2006 Pipeline Landfall Monitoring Report; and
- *Iris acutiloba* (AzRDB) - Arid, sandy habitats recorded in the 2001 Baseline report survey and the 2005, 2008 and 2009 flora surveys. The 2009 and 2011 survey recorded this species at monitoring location SS1-2 which lies to the north east of the Terminal.

None of the above species were recorded during the EMP vegetation survey undertaken in 2011 south of the Terminal. It is considered highly unlikely that colonisation of these species would have occurred within the area since this date.

Sensitivity

While the results of previous surveys have indicated the presence of floral species included in the AzRDB or IUCN lists within the regional area, the latest 2011 data indicates that none of these species are located south of the Terminal. Local vegetation is therefore characterised by floral species which are typical for the area and are neither rare nor threatened.

6.4.5.3 Fauna

Terrestrial and wetland faunal surveys in the Terminal vicinity have been undertaken between 2001 and 2011.

During the 2002 wetland survey, three species of amphibians were recorded: European green toad (*Bufo viridis*), European tree frog (*Hyla arborea*) and lake frog (*Rana ridibunda*) and one reptiles species, the European pond turtle (*Emys orbicularis*). All three amphibian species have been assessed against IUCN criteria and have been categorised as Least Concern. The European pond turtle is classified as Near Threatened by the IUCN. None of these species are included in the AzRDB. Another wetland survey was undertaken in 2010 and Table 6.12 lists the fauna species recorded during the survey.

Table 6.12 Summary of Sangachal Wetland Fauna Survey Results 2010

Scientific Name	Common Name	Number
Bufo viridis[1]	European Green Toad	11
Microtus socialis[1]	Social Vole	10
Rana ridibunda[1]	Marsh Frog	134
Eremias velox[3]	Rapid Racerunner	1
Natrix tessellata[1]	Tessellated water Snake	9
Emys orbicularis[2]	European Pond Turtle	2

Notes:
[1] IUCN Least Concern - Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent or Near Threatened.
[2] IUCN Near Threatened - Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable.
[3] Not Evaluated - A species is Not Evaluated when it is has not yet been assessed against the IUCN criteria.

During the 2005 fauna survey for the area surrounding the Terminal the presence of the following species were identified:

- Sunwatcher agama (*Phrynocephalus helioscopus*);
- Spur-thighed tortoise (*Testudo graeca*);
- Small five-toed jerboa (*Allactaga elater*);
- Grey hamster (*Cricetulus migratorius*);
- Marbled polecat (*Vormela peregusna*); and
- Wolf (*Canis lupus*).

The sunwatcher agama, small five-toed jerboa, grey hamster and wolf have been assessed against the IUCN criteria and have been categorised as Least Concern. The spur-thighed tortoise and marbled polecat are listed as Vulnerable by the IUCN and are included in the AzRDB. The small five-toed jerboa is also included in the AzRDB.

The 2008 survey for the same approximate area identified three species of reptile, rapid racerunner lizard (*Eremias velox*), snake-eyed lizard (*Ophisops elegans*) and Caspian bent-toed gecko (*Cyrtopodion caspium)*. The Caspian bent-toed gecko has been assessed against the IUCN criteria and has been categorised as Least Concern. The rapid racerunner and snake-eyed lizards have not yet been evaluated against the IUCN criteria.

Table 6.13 lists the mammal and herpetofauna species recorded during the 2011 Terminal survey.

Table 6.13 Summary of Sangachal Terminal Mammals and Herpetofauna Survey Results 2011

Scientific Name	Common Name	Observed	Signs
Crocidura gueldenstaedti[4]	Gueldenstaedt's Shrew	1 (trapped)	
Meriones libycus[1]	Libyan Jird	4 (trapped)	44
Eremias arguta[4]	Steppe Runner Lizard	8	-
Ophisops elegans[4]	Snake-Eyed Lizard	26	-
Vulpes vulpes[1]	Red Fox	2	6
Rana ridibunda[1]	Marsh Frog	98	-
Eremias velox[4]	Rapid Racerunner Lizard	55	-
Vipera lebetina[4]	Blunt–Nosed Viper	1	-
Bufo viridis[1]	European Green Toad	26	-
Lepus europaeus[1]	European Hare	3	24
Emys orbicularis[2]	European Pond Turtle	1	1
Hierophis schmidti[1]	Schmidt's Whip Snake	2	
Testudo graeca[3,5]	Spur-Thighed Tortoise	1	1
Hystrix indica[1]	Indian Crested Porcupine	-	1
Allactaga elater[1]	Small Five-Toed Jerboa	-	17
Mus musculus[1]	House Mouse	-	1
Microtus socialis[1]	Social Vole	-	13

Notes:
[1] IUCN Least Concern - Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent or Near Threatened.
[2] IUCN Near Threatened - Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable.
[3] IUCN Vulnerable – A species is Vulnerable when it is not Critically Endangered or Endangered but is facing extinction in the wild in the medium-term future.
[4] Not Evaluated - A species is Not Evaluated when it is has not yet been assessed against the IUCN criteria.
[5] AzRDB

Sensitivity

While fauna surveys have been undertaken over a number of years, it is not yet possible to identify trends in relation to populations or geographical distribution. This is mainly due to species variation and perceived low populations found to date, but also to a small extent due to some identification issues in earlier years. There is no evidence, however, to suggest that the activities at the Terminal have had a significant impact on fauna. The presence of a number of species included within the IUCN and/or AzRDB lists have been recorded. However, these have generally been limited to a single survey. The exception is the spur-thighed tortoise (which is an IUCN Red list Vulnerable and AzRDB listed species).

While spur-thighed tortoise have been consistently recorded in the area surrounding the Terminal, their precise distribution has not been determined. The likely reason for the consistent records of this species is due to the relocation programme undertaken prior to and following the previous ACG and SD projects in which spur-thighed tortoise were collected prior to the works and then reintroduced away from the Terminal once the works were completed.

Table 6.14 presents a summary of the faunal sensitivity including the expected presence in the SD2 project areas, protection status and seasonal sensitivity.

Table 6.14 Summary of Faunal Sensitivity

Species	Status	Observed	Signs	Presence Anticipated	Seasonal Sensitivity											
					J	F	M	A	M	J	J	A	S	O	N	D
Amphibians																
Bufo viridis (European green toad)	IUCN LC	✓		Possible - SD2 pipeline corridor												
Rana ridibunda (marsh frog)	IUCN LC	✓		Possible - SD2 pipeline corridor												
Hyla arborea (European tree frog)	IUCN LC	✓		Possible - SD2 pipeline corridor			■	■	■	■						
Reptiles																
Emys orbicularis(European pond turtle)	IUCN NT	✓	✓	Possible - SD2 pipeline corridor			■	■	■	■						
Eremias velox(rapid racerunner)	Not evaluated	✓		Possible - SD2 pipeline corridor												
Natrix tessellata (tessellated water snake)	IUCN LC	✓		Possible - SD2 pipeline corridor							■	■	■			
Phrynocephalus helioscopus (sunwatcher agama)	IUCN LC AzRDB	✓		Possible - all SD2 project areas												
Testudo graeca (spur-thighed tortoise)	IUCN V AzRBD	✓	✓	Yes - all SD2 project areas				■	■	■	■	■				
Ophisops elegans (snake-eyed lizard)	Not evaluated	✓		Possible - all SD2 project areas												
Cyrtopodion caspium (Caspian bent-toed gecko)	IUCN LC	✓		Possible - all SD2 project areas			■	■	■	■	■	■				
Eremias arguta (Steppe runner lizard)	Not evaluated	✓		Possible - all SD2 project areas												
Vipera lebetina (Blunt–nosed viper)	Not evaluated	✓		Possible - all SD2 project areas												
Hierophis schmidti (Schmidt's Whip Snake)	IUCN LC	✓		Possible - all SD2 project areas					■	■	■					
Mammals																
Cricetulus migratorius (grey hamster)	IUCN LC	✓		Possible - all SD2 project areas				■	■	■	■	■	■	■		
Vormela peregusna (marbled polecat)	IUCN V AzRBD	✓		Possible - all SD2 project areas			■	■	■	■						
Canis lupus (wolf)	IUCN LC	✓		Possible - all SD2 project areas						■	■	■				
Crocidura gueldenstaedti (Gueldenstaedt's shrew)	Not evaluated	✓		Possible - all SD2 project areas												
Meriones libycus (Libyan Jird)	IUCN LC	✓	✓	Possible - all SD2 project areas	■	■									■	■
Vulpes vulpes (Red Fox)	IUCN LC	✓	✓	Possible - all SD2 project areas			■	■	■							
Lepus europaeus (European Hare)	IUCN LC	✓	✓	Possible - all SD2 project areas	■	■	■	■	■	■	■	■				
Hystrix indica (Indian Crested Porcupine)	IUCN LC		✓	Possible - all SD2 project areas		■	■									
Allactaga elater (Small Five-Toed Jerboa)	IUCN LC		✓	Possible - all SD2 project areas												
Mus musculus (House Mouse)	IUCN LC		✓	Possible - all SD2 project areas			■	■	■	■	■	■	■	■		
Microtus socialis (Social Vole)	IUCN LC	✓	✓	Possible - all SD2 project areas	■	■	■	■	■	■	■	■	■	■	■	■

■ Breeding Period

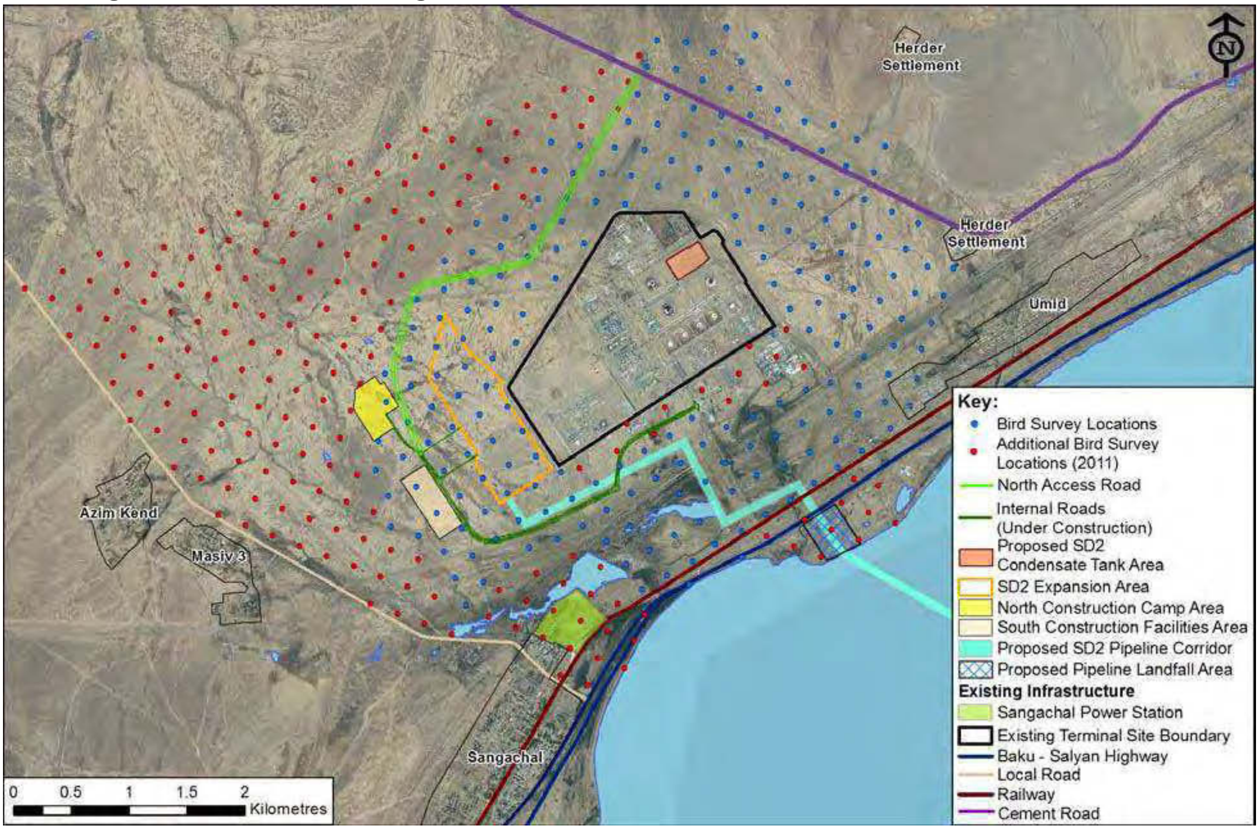
Notes:
IUCN Categories:
LC – Least concern – Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent or Near Threatened.
NT – Near Threatened – Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable.
V- Vulnerable – A species is Vulnerable when it is not Critically Endangered or Endangered but is facing extinction in the wild in the medium-term future.
Not evaluated - A species is Not Evaluated when it is has not yet been assessed against the IUCN criteria.

AzRBD – Azerbaijan Red Data Book list

6.4.5.4 Birds

Breeding bird surveys have been undertaken in the Terminal vicinity since 2001 with the most recent surveys completed in 2008, 2009, 2010 and 2011. The sampling locations used during the later surveys, which used a fixed-point sampling grid and point sampling techniques, are shown in Figure 6.10.

Figure 6.10 Bird Monitoring Locations Around the Terminal



Over the period 2008 to 2011, bird surveys have recorded 139 species with 25 species (18%) recorded as resident (i.e. species that normally remain within the Sangachal area throughout the year). The remaining 114 species were migratory species. This pattern of a larger number of migratory species and a limited number of resident species is reflected in the earlier survey results from 2005 onwards.

The most widespread species occurring during these surveys (recorded at more than 25 recording locations) included common swift (*Apus apus*), common quail (*Coturnix coturnix*), house martin (*Delchion urbica*), barn swallow (*Hirundo rustica*), and Isabelline wheatear (*Oeanthe isabellina*). All these are common breeding birds. They have all been assessed against the IUCN criteria and categorised as Least Concern and are not included in the AzRDB.

Of the bird species recorded during the 2008 and 2009 surveys in the Terminal vicinity, a total of 23 species are considered to be resident. The 2010 and 2011 bird surveys recorded a similar number species, 86 and 88, respectively, with 27% of the bird species recorded as resident.

During the 2010 wetland survey bird species were also recorded during the survey, they include:

- Barn swallow (*Hirundo rustic*a);
- Snowy plover/Kentish plover (*Charadrius alexandrines*);
- Herring gull (*Larus argentatus*);
- Marsh warbler (*Acrocephalus palustris*);
- European starling (*Sturnus vulqaris*);
- Magpie(*Pica pica*);
- Northern wheatear (*Oenante oenante*); and
- European bee-eater (*Merops apiaster*).

All these species have been assessed against the IUCN criteria and have been categorised as Least Concern.

Table 6.15 lists the bird species which are of conservation significance, recorded in the Terminal vicinity during the 2008-2011 bird surveys.

Table 6.15 Birds Species of Conservation Significance Recorded Within the Vicinity of the Terminal, 2008-2011

Scientific Name	Common Name	Conservation Status	Bird Surveys			
			2008	2009	2010	2011
Anser erythropus	Lesser white-fronted goose	IUCN Vulnerable				✓
Aquila clanga	Greater spotted eagle	IUCN Vulnerable				✓
Circus macrourus	Pallid harrier	IUCN Near Threatened and AzRDB		✓	✓	✓
Coracias garrulous	European roller	IUCN Near Threatened	✓		✓	
Cygnus olor	Mute swan	AzRDB	✓	✓		
Falco cherrug	Saker falcon	IUCN Endangered	✓			
Falco vespertinus	Red-footed falcon	IUCN Near Threatened			✓	✓
Neophron percnopterus	Egyptian vulture	IUCN Endangered	✓			
Pterocles orientalis	Black-bellied sandgrouse	AzRDB			✓	✓

Sensitivity

Table 6.16 presents a summary of the bird species sensitivity including the protection status and seasonal sensitivity.

Table 6.16 Summary of Bird Species Sensitivity

Species	Status	Resident	Breeding	Overwintering	Migrant
Acrocephalus palustris (Marsh warbler)	IUCN LC		✓		
Anser erythropus (Lesser white-fronted goose)	IUCN V				✓
Alectoris chukar (Chukar)	IUCN LC		✓		
Apus apus (Common swift)	IUCN LC		✓		
Aquila clanga (Greater spotted eagle)	IUCN V				✓
Calandrella cinerea (Red-capped lark)	IUCN LC		✓		
Calandrella rufescens (Lesser short-toed lark)	IUCN LC		✓		
Charadrius alexandrinus (Snowy plover/Kentish plover)	IUCN LC	✓			
Circus macrourus (Pallid harrier)	IUCN NT / AzRDB				✓
Coracias garrulus (European roller)	IUCN NT				✓
Coturnix coturnix (common quail)	IUCN LC		✓		
Cygnus olor (Mute swan)	AzRDB				✓
Delichon urbica (house martin)	IUCN LC		✓		
Falco cherrug (Saker falcon)	IUCN E AzRDB				✓
Falco vespertinus (Red-footed falcon)	UCN NT				✓
Galerida cristata (crested lark)	IUCN LC		✓		
Hirundo rustica (Barn swallow)	IUCN LC		✓		
Larus argentatus (Herring gull)	IUCN LC				✓
Merops apiaster (European bee-eater)	IUCN LC		✓		✓
Melanocorypha calandra (Calandra lark)	IUCN LC		✓		
Neophron percnopterus (Egyptian vulture)	IUCN E				✓
Oenanthe isabellina (Isabelline wheatear)	IUCN LC		✓		
Oenanthe oenanthe (Northern wheatear)	IUCN LC				✓
Pterocles orientalis (Black-bellied sandgrouse)	AzRBD	✓			
Sturnus vulgaris (European starling)	IUCN LC	✓			
Pica pica (Magpie)	IUCN LC	✓			

Notes:
IUCN Categories:
LC – Least concern – Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent or Near Threatened.
NT – Near Threatened – Species that have been evaluated against IUCN criteria and do not satisfy the criteria for the Critically Endangered, Endangered or Vulnerable categories. Species do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable.
V- Vulnerable – A species is Vulnerable when it is not Critically Endangered or Endangered but is facing extinction in the wild in the medium-term future.
E- Endangered – A species is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

AzRBD – Azerbaijan Red Data Book list

Birds are most sensitive to disturbance during the breeding season (typically mid-March – end August). Of the species identified since 2008, five[9] are ground nesting, and have been recorded in the semi-desert habitat in the vicinity of Sangachal Terminal and the SD2 Expansion Area. While the field data collected during the 2010 and 2011 surveys indicates whether the birds are nesting or not, the bird location rather than the nest location is recorded. However, the birds do not nest in the same location each year. It is therefore not appropriate to state the number of breeding individuals that use the area around the Terminal as this will vary from year to year. There is no evidence within the surveys completed to date to indicate that the habitat within the area around the Terminal is of unique value to breeding birds.

[9] These include chukar (*Alectoris chukar*), red-capped lark (*Calandrella cinerea*), lesser short-toed lark (*Calandrella rufescens*), Calandra lark (*Melanocorypha calandra*), and crested lark (*Galerida cristata*).

Breeding birds are most sensitive to sudden unexpected and loud noise such as hammering. Studies have shown, however, that birds frequently become habituated to anthropogenic noise including construction noise, with no recorded effect on behaviour or breeding success[10]. Equally, impacts to breeding success due to noise impacts have also been recorded. The survey results obtained within the Terminal vicinity show there has been little change in the richness and number of bird species over time and suggest that the breeding birds are likely to be habituated to the industrial noise from the Terminal, Sangachal Power Station, highway traffic noise and other industrial activities in the area.

6.4.6 Air Quality

Ambient air quality monitoring has been undertaken around the Terminal since 1997, prior to the start of the Early Oil Project (EOP) activities. The monitoring locations, parameters recorded and analytical methodology used have varied across the monitoring surveys. The most recent air quality monitoring surveys for which results are available were undertaken during 2008, 2009, 2010 and 2011. For each survey, NO_2, SO_X, benzene and Volatile Organic Compounds (VOC) were monitored using passive diffusion tubes. Hourly real-time monitoring data was also collected at an automatic monitoring station (station AAQ23) for periods during 2009 and 2010[11].

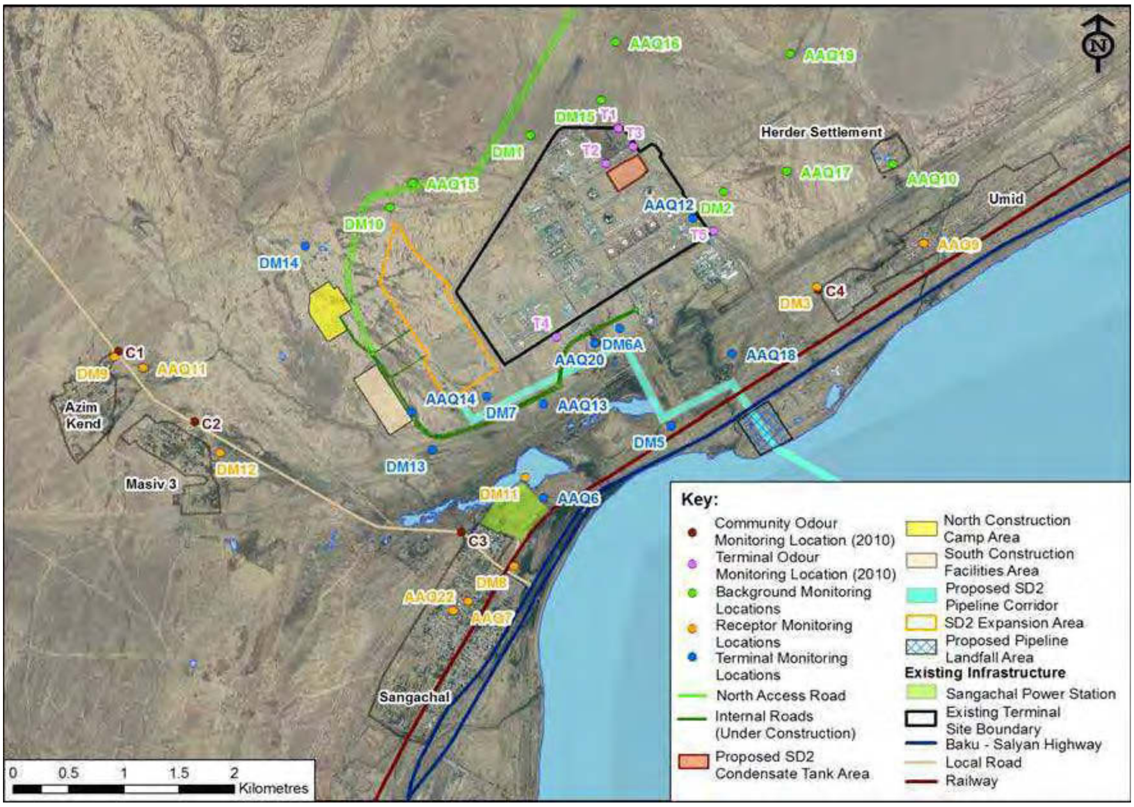
The measured concentrations at the 2008 to 2011 monitoring locations have been grouped and averaged to provide an analysis of pollutant concentrations over time, in relation to potential local sources and in relation to the predominant wind direction (primarily northerly). The three groups comprise:

- Background: locations upwind of the Terminal and away from local communities and major sources (e.g. the Power Station and Highway);
- Terminal: locations around the Terminal and the SD2 Expansion Area, predominantly downwind of the Terminal; and
- Receptors: locations within the local communities i.e. Sangachal, Azim Kend/Masiv 3 and Umid.

Figure 6.11 presents the location of the air quality monitoring stations.

[10] Melissa Anne Lackey, (2009), Avian Response to Road Construction Noise with Emphasis on the Endangered Golden-Cheeked Warbler.
[11] Interruptions to the monitoring station power supply prevented further data from being obtained.

Figure 6.11 Ambient Air Quality (2008 to 2011) and Odour Monitoring Locations (2010)



Measured data for all the monitoring stations is provided in Appendix 6.A. Results obtained from the surveys are compared against relevant ambient air quality standards including International Finance Corporation (IFC)[12], former World Bank[13] and World Health Organisation Guidelines[14] (WHO), and in the case of benzene, the European Union (EU) Guidelines.[15,16,17]

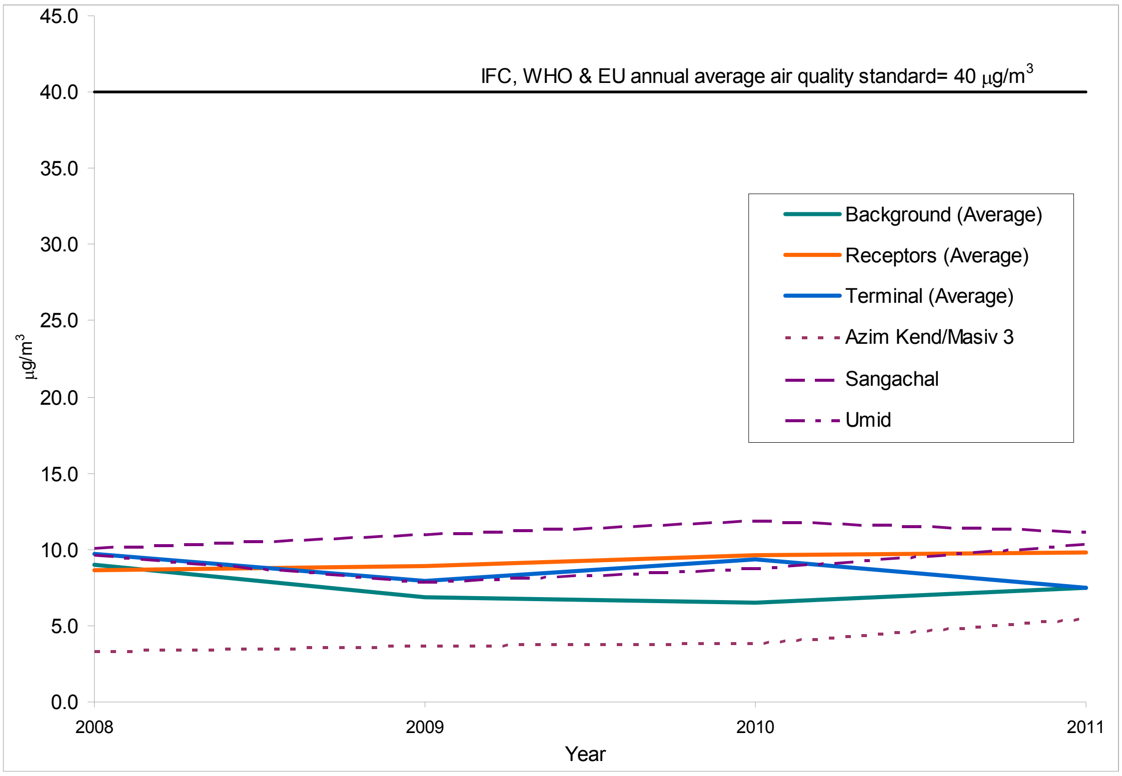
Odour monitoring was also undertaken in 2010 based on a "sniff test" approach as recommended by the UK Environment Agency Guidance[18]. Figure 6.11 also shows the odour survey monitoring locations.

6.4.6.1 NO_2 Concentrations

Annual averaged NO_2 concentrations for the background, terminal and receptor locations are shown in Figure 6.12. The figure also shows the averaged concentrations recorded at Sangachal Town, Azim Kend/Masiv 3 and Umid.

[12] IFC Environmental, Health and Safety Guidelines. General EHS Guidelines: Environmental, Air Emissions and Ambient Air Quality (2007).
[13] World Bank Pollution Prevention and Abatement Handbook (1998).
[14] World Health Organisation Guidelines (1999).
[15] European Union Guidelines (2005).
[16] No guidelines were available for total VOC.
[17] Historically in Azerbaijan ambient concentrations of NO_2, SO_2, CO and PM_{10} have also been assessed against 24-hour and one-hour standards. These standards were not derived using the same health-based criteria as the IFC, WHO and EU guideline values and the standards derived are not widely recognised.
[18] Odour monitoring was undertaken separately to the 2010 air quality monitoring and does not form part of the EMP.

Figure 6.12 Annual Average Measured NO_2 Concentrations, 2008-2011



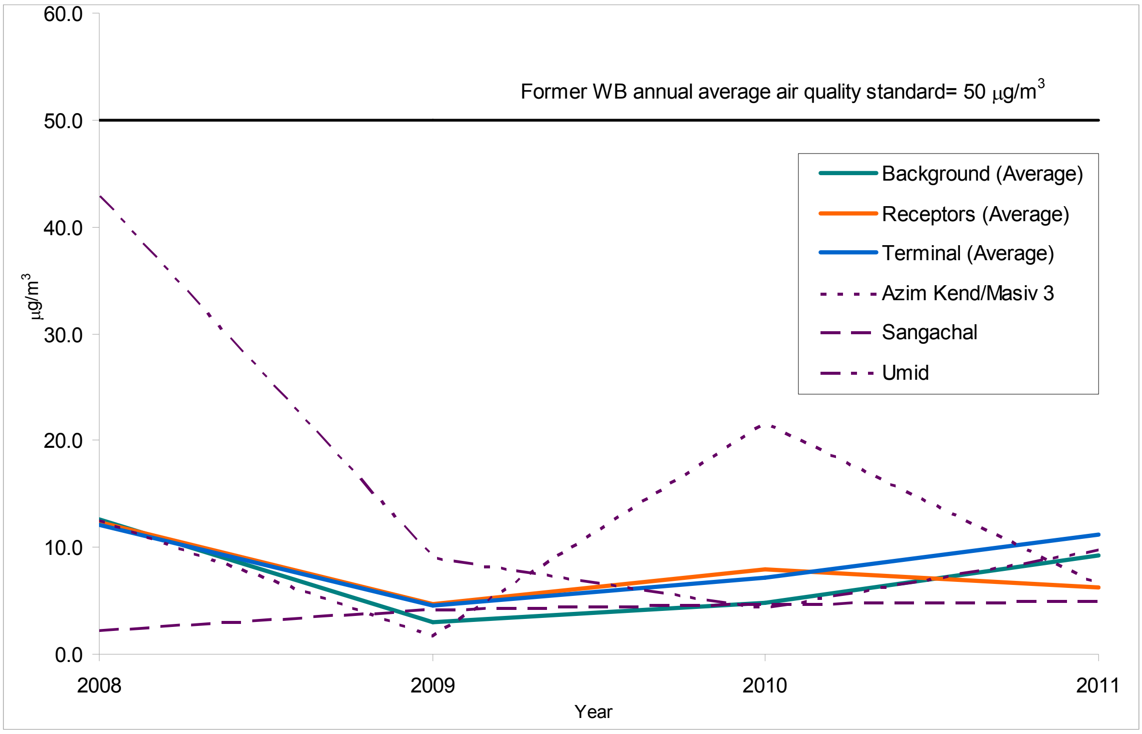
The survey results showed that annual average ambient air quality standard for NO_2 was not exceeded at any of the monitoring stations. Concentrations ranged between 6% and 48% of the annual average standard with the highest concentration reported in 2010 at the monitoring station AAQ13 at a value of 19 $\mu g/m^3$ (immediately downwind of the Terminal).

Averaged one hour concentrations recorded at the automatic monitoring station (located at AAQ23) during 2009 and 2010 did not exceed the relevant IFC, WHO and EU one-hour ambient air quality standard of 200 $\mu g/m^3$. The automatic station was not functioning in 2011. Figure 6.12 shows that highest NO_2 concentrations have been recorded at the receptor and terminal monitoring locations. With regard to specific receptors, concentrations at the Sangachal locations have been consistently highest, with concentrations at Azim Kend/Masiv 3 consistently lowest. The results obtained, however, show that there is not a significant difference between the monitored concentrations (no more than 8 $\mu g/m^3$). Consistently higher concentrations have been recorded at AAQ6 and AAQ13 (immediately downwind of the Terminal). However, similar higher results have also been recorded at AAQ7 and AAQ22 (within Sangachal Town), which may be a result of the adjacent Highway and/or unknown local sources. The results obtained do not show any significant changes over time, indicating that NO_2 concentrations have remained relatively stable between 2008 and 2011.

6.4.6.2 SO_2 Concentrations

Annual averaged SO_2 concentrations for the background, terminal and receptor locations between 2008 and 2011 are shown in Figure 6.12. The figure also shows the averaged concentrations recorded at Sangachal Town, Azim Kend/Masiv 3 and Umid.

Figure 6.13 Annual Average Measured SO_2 Concentrations, 2008-2011



The survey results showed that annual average ambient air quality standard for SO_2 was not exceeded at any of the monitoring stations during the 2008-2011 monitoring periods[19].

Results obtained from the automatic monitoring station (located at AAQ23) during 2009 and 2010 indicated that concentrations did not exceed the relevant IFC and WHO 24 hour ambient air quality standard of 125$\mu g/m^3$.

Figure 6.13 shows that the annual average SO_2 concentrations are slightly higher at the receptor and terminal locations when compared to the background locations (except for 2011), although the difference is very small. For all locations (except Sangachal), SO_2 concentrations appeared to peak in 2008, then drop in 2009. The reason for this is not clear. Neither is the reason for the higher SO_2 concentrations recorded at Umid in 2008 and at Azim Kend/Masiv 3. While there has been a general small increase in SO_2 levels from 2008 to 2011, anomalous higher results have been recorded at a number of locations (refer to Appendix 6A) across the monitoring periods. These may be due to the presence of transient local sources (e.g. trucks) close to the monitoring locations. The small increase (approximately 3-5 $\mu g/m^3$) in SO_2 levels, most noticeable for the Sangachal receptors, may be associated with the Sangachal Power Station, which began operation in 2008.

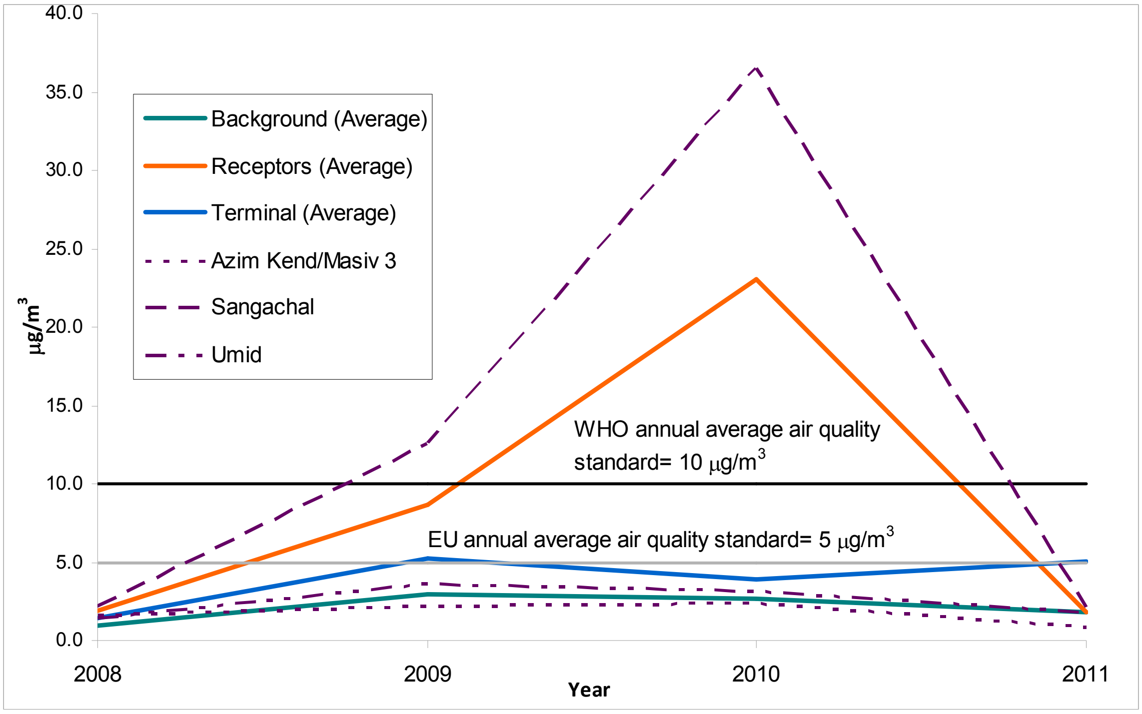
6.4.6.3 Benzene and VOC Concentrations

VOCs comprise a number of organic components including benzene.

Annual averaged benzene concentrations for the background, terminal and receptor locations between 2008 and 2011 are shown in Figure 6.14. The figure also shows the averaged concentrations recorded at Sangachal Town, Azim Kend/Masiv 3 and Umid.

[19] IFC, WHO and EU ambient SO_2 standards are established for 24-hour, one-hour and 10 minute averaging periods. It is not appropriate to compare annual averaged monitoring data to these standards.

Figure 6.14 Annual Average Measured Concentrations of Benzene, 2008-2011

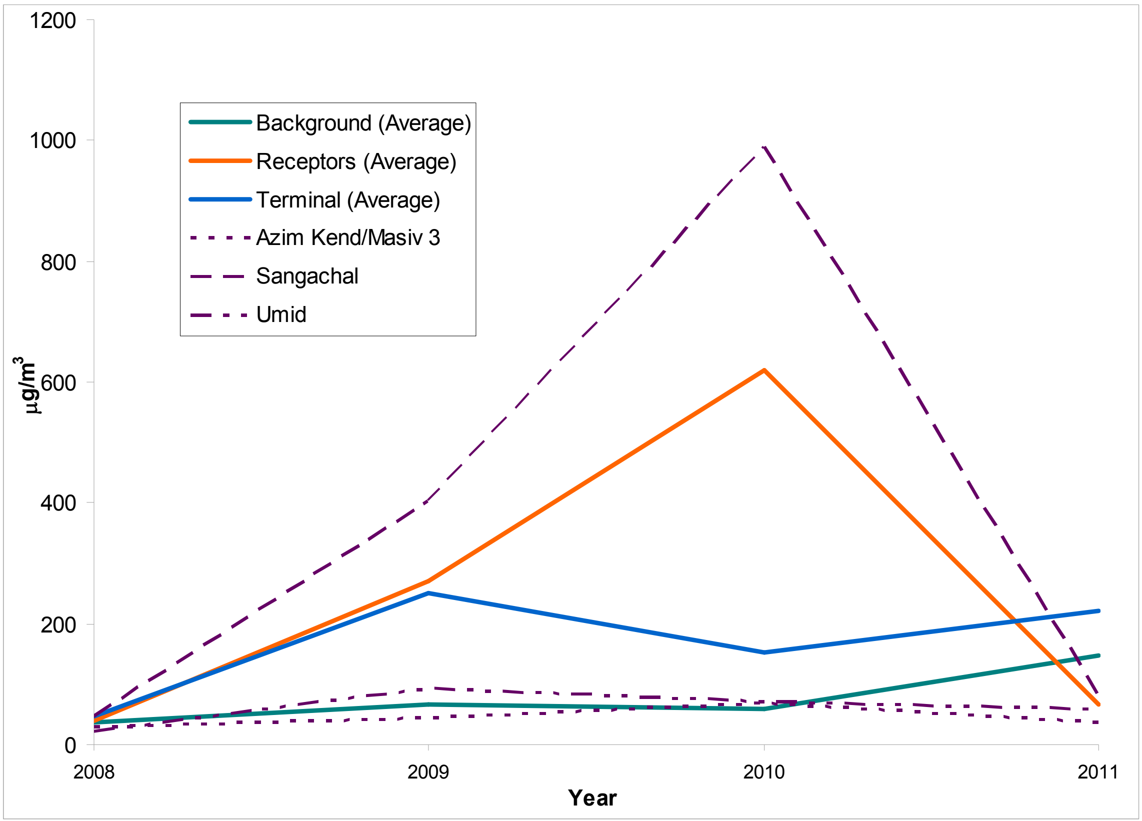


The survey results show that annual averaged measured benzene concentrations do not exceed WHO and EU air quality standards between 2008 and 2011 at background locations. Benzene concentrations at terminal locations comply with these standards in 2008 and 2010 but exceed them marginally in 2009 and 2011. Concentrations measured at receptor locations exceed benzene air quality standards in 2009 and 2010, but both years are skewed by extremely high data values recorded at monitoring station AAQ7 in Sangachal (refer to Appendix 6A). In general, there are no evident trends between years.

At Azim Kend/Masiv 3 and Umid, benzene concentrations have remained close to those recorded at background locations. The results obtained for Sangachal are discussed further below in the context of VOC concentrations.

Figure 6.15 shows the annual average total VOC concentrations for 2008 to 2011.

Figure 6.15 Annual Average Measured Concentrations of VOC, 2008-2011



The results obtained show the same pattern as observed for the benzene concentrations over the same period, including the unusually high data value at monitoring station AAQ7 in 2010. The consistently high concentrations recorded at AAQ7 indicate it is very likely that a local emission source is influencing benzene and VOC results at this location.

In 2008, the National Physics Laboratory (NPL) was commissioned by BP to review the air quality monitoring and modelling at Sangachal Terminal and its surroundings. Based upon this review, a number of recommendations were made including changing the absorbent within the diffusion tubes used to monitor benzene and VOCs. The implementation of the recommendations in 2009 could be a reason for the general increase in VOC and benzene concentrations between 2008 and 2009.

As mentioned above, an odour assessment was undertaken in 2010 along the Terminal boundary and in locations within the four communities surrounding the Terminal (see Figure 6.11). The primary odour detected was a tarry, oily smell from the Terminal produced water ponds, which are located in the north east of the Terminal. The odour was reported to be strong around the produced water ponds (locations T1, T2 and T3) and faintly detectable (under north-easterly wind conditions) at Sangachal Town (location C3). Odours that are associated with nearby farming activities were detected at location C2. It is possible that evaporation of volatile compounds from produced water ponds may contribute to the higher benzene and VOC concentrations recorded downwind of the Terminal.

6.4.6.4 PM_{10} Concentrations

The measured PM_{10} concentrations for 2009 and 2010 are shown in Table 6.17. Results were obtained from the automatic monitoring station (location AAQ23).

Table 6.17 PM_{10} Concentrations 2009 and 2010 (µg/m^3)

Month	PM_{10} Concentrations (µg/m^3)	
	2009	2010
February	102	-
March	52	-
April	26	-
May	115	51
June	-	56
July	-	33
August	-	125
September	-	146
October	-	118
November	-	160
December	-	180
Average	74	109
Applicable Limits	40µg/m^3 (annual average)[1], 50 µg/m^3 (24 hour standard)[2]	
Notes: 1. EU annual average standard. 2. WHO, IFC and EU 24 hour standard.		

The average monthly PM_{10} concentration ranged between 26µg/m^3 in April 2009 and 180µg/m^3 in December 2010, with considerable variance between the months. The average PM_{10} concentration for the four-month monitoring period in 2009 was 74µg/m^3 and 109µg/m^3 in 2010. This exceeds the EU annual average standard. In addition, the PM_{10} results also exceeded the WHO, IFC and EU 24-hour standard of 50µg/m^3 for all months excluding March and April 2009 and July 2010. In semi-arid and arid environments, ambient PM_{10} concentrations often exceed international air quality standards regardless of the presence of local man-made activities due to the natural entrainment of dust in the atmosphere which is typical of dry, windy conditions.

The PM_{10} results recorded in 2009 and 2010 show no clear trend although higher concentrations were recorded during winter months when wind conditions are stronger.

Table 6.18 shows the PM_{10} data obtained from three monitoring stations carried out over two-weekly intervals between 12th March and 4th September 2012 during the SD2 EIW.

Table 6.18 24-Hour Average Gravimetric PM_{10} Concentrations (µg/m^3), 12 March – 4 September 2012

Location	Monitoring Period 1 (13th - 20th March)	Monitoring Period 2 (24th - 31st July)	Average
Background	14.48	47.62	31.05
Terminal	16.87	80.89	48.88
Receptor	29.56	46.00	37.78

On average, the terminal and receptor location PM_{10} concentrations were higher than the concentrations at the background locations. While PM_{10} air quality standards were met at the receptor and background locations, they were exceeded at the terminal locations, and significantly during Monitoring Period 2. This is considered to be due to the high levels of windborne and fugitive PM_{10} in this area, which was being disturbed due to the ongoing SD2 EIW.

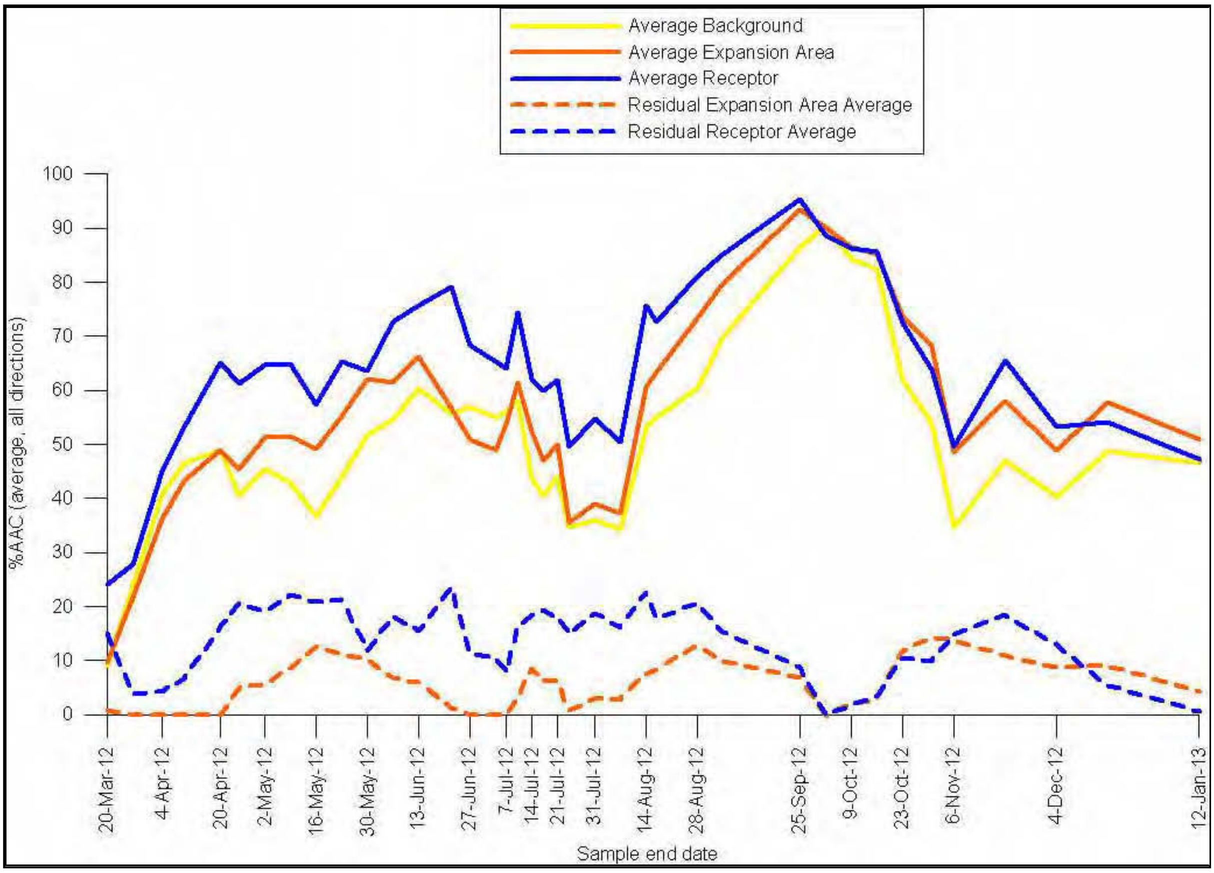
6.4.6.5 Dust

Dust monitoring was initially completed in 2011 and has been continued during the SD2 EIW in 2012. The 2011 baseline survey showed that dust in the vicinity of the Terminal generally travels from the north to south under the influence of the prevailing wind direction and that dust levels were generally higher at monitoring locations to the north of the Terminal than to the south. This suggests that dust originates from areas of open land to the north of the Terminal. A higher variation in directional dust and dust levels were recorded at location DM9, which was immediately adjacent to a poorly surfaced road used by quarry traffic. Single high dust levels were also recorded at locations DM1 and DM2 which are also close to local roads. Field observations suggested that the levels in location DM1, DM2 and DM9 were associated with traffic movements rather than wind blown dust.

Analysis of the deposited dust against samples of exposed surface soil taken at each monitoring location show that mineralogy and metal concentrations of the surface soil and dust samples were found to be broadly similar and consistent with the composition of local soils. Higher calcium levels were recorded at road location DM9, considered to be the result of road wear and spillages of materials from quarry traffic. None of the metals identified in dust are considered to represent a risk to human health at the concentrations recorded.

Figure 6.16 presents the rolling average directional Absolute Area Coverage (%AAC used as a measure of dust deposition rates) at the background, terminal (referred to as SD2 Expansion Area) and receptor sampling locations for 2012.

Figure 6.16 Average % AAC of Dust Recorded at Terminal, Background and Receptor Locations, 12 March 2012 – 12 January 2013



Generally, the trend in measured average dust deposition (expressed as %AAC) is similar for all three groups of sampling locations over the ten-month monitoring period.

Overall, higher deposition rates were reported at the receptor and terminal locations; approximately 5-15% higher than at background locations.

Residual dust deposition rates were calculated by subtracting the recorded concentrations at background locations from the measured terminal and receptor location rates. This gave an indication of the dust likely to originate from sources downwind of the background locations. The results for the terminal (termed SD2 Expansion Area within Figure 6.16) indicated that dust deposition rates associated with these sources (primarily the SD2 EIW that were underway at the time) ranged from zero to 12% average AAC. Residual dust levels at receptor locations were generally higher, ranging from zero to 20%. However, directional dust monitoring showed that the dust was largely originating from other sources and not from the direction of the SD2 EIW. Based on the monitoring to date, it is considered unlikely that fugitive dust levels recorded at the receptor locations are a direct result of the SD2 EIW.

Similar to the 2011 survey, the 2012 survey indicated that much of the directional dust sampled arose from the north and can be associated with propagation from exposed surfaces (especially the poorly-vegetated local soils) by the strong northerly winds. There appeared to be a correspondence between wind speed and dust coverage, and between wind speed, temperature, precipitation and dust loading. Dust levels were highest after a prolonged period of dry weather immediately followed by a period of moderate to strong winds.

Sensitivity

Air quality concentrations have been regularly monitored at locations in the Terminal vicinity since 2006 and the results from 2009, 2010 and 2011 surveys are presented above. While survey locations and methods have varied, it is possible to compare the earlier results to those obtained in 2009, 2010 and 2011. For example, NO_X results at location AAQ07 have ranged between 11 and 13µg/m^3 with the exception of an anomalous result in 2007 during a period when the Terminal was shutdown.

The results for SO_2 concentrations in the same location have varied between 1.6µg/m^3 (in 2007) and 7.6µg/m^3 (in 2009). No trends indicating deteriorating air quality are evident.

With the exception of PM_{10} and benzene, air quality data is consistently below applicable limit values. A slight change in SO_2 levels was observed at Sangachal locations between 2008 and 2009 following the start of operations at the Sangachal Power Station but this change is not considered to be significant in terms of overall air quality. For all species monitored a number of high values were recorded during specific survey rounds. It is considered likely that the intermittent stationary sources and vehicles passing near to the monitoring locations influence the monitoring results to a greater extent than emissions associated with operations at the Terminal and at Sangachal Power Station. Overall air quality has remained relatively stable over the period of Terminal operations.

The results of dust monitoring indicate that dust within the vicinity of the Terminal is predominantly wind blown from open land areas to the north and is heavily influenced by the use of local unsurfaced or poorly surfaced roads. No high concentrations of metals were recorded in dust or the soil samples collected, and dust levels recorded are considered to be typical of a semi-desert environment.

6.4.7 Noise

Ambient noise monitoring surveys have been completed to inform the previous ACG and SD ESIAs. More recently, regular surveys have been completed in 2010 and 2011[20]. The 2010 noise survey included five locations (R1 to R5) which are located adjacent to, or within, Azim Kend, Masiv 3, Sangachal Town and Umid. Additional locations (R8, R11, A1, A3 and A4) also within the local communities were included within the 2011 survey (refer to Figure 6.17).

[20] Surveys were also completed in 2012 during the SD2 EIW. These include the intermittent effect of construction plant operation. As such, they do not represent the baseline conditions and are not reported here.

Figure 6.17 Noise Survey Locations 2010 and 2011

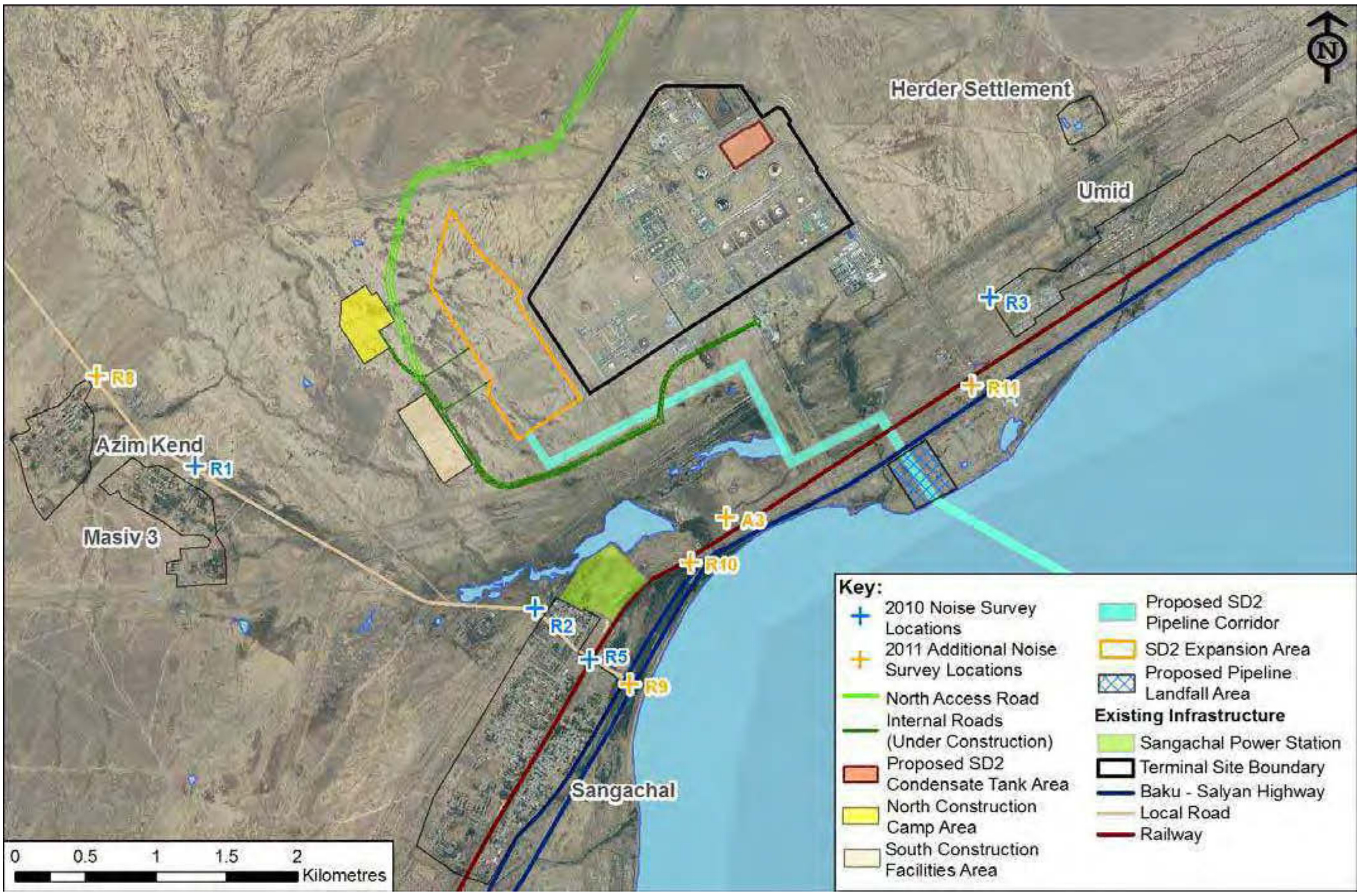


Table 6.19 presents the noise levels recorded (as L_{Aeq}[21]) during day and night time periods at the sensitive receptors.

Measurements were recorded during May 2010 and March 2011. During each survey, weather conditions were fair, with winds predominantly from the north. Monitoring results obtained when winds speeds exceeded 5m/s were excluded as, under these conditions, results are affected by wind noise.

Observations were made throughout the surveys to record the noise sources and identify dominant sources in each location. Operational data was obtained to confirm that the Terminal was operating under normal operations (i.e. there was no emergency flaring or other abnormal noise generating activity at the Terminal).

[21] The average ambient noise level including all potential sources (e.g. the Terminal, Sangachal Power Station, traffic, animals).

Table 6.19 2010 and 2011 Noise Survey Results at Sensitive Receptors

ID	Location	Receptor	2010		2011	
			Measured Ambient Noise Range (Daytime) dB LAeq	Measured Ambient Noise Range (Night Time) dB LAeq	Measured Ambient Noise Range (Daytime) dB LAeq	Measured Ambient Noise Range (Night Time) dB LAeq
Sensitive Receptors						
R1	Masiv 3	Low rise residences	44 – 56	46 – 48	50 - 53	39 - 51
R2	Sangachal	Low and high rise residences	48 – 66	46 – 59	62 - 70	52 - 53
R3	Umid West	Low rise residences	48 – 66	49 – 53	49 - 58	45 - 55
R5	Sangachal Railway Crossing	Shops and low rise residences	62 – 69	49 – 59	55 - 63	*
R8	Azim Kend	Low rise residences	-	-	43 - 50	39 - 49
A3	North of Highway	One residence about 50m north of the highway	-	-	69	*

Notes:
* Night time noise measurements were not undertaken in this location.
- Noise measurement not taken at this location.

Daytime noise levels recorded during the 2010 and 2011 surveys were characterised by a noise associated with the Baku-Saylan Highway and the Sangachal Power Station. Road traffic noise from the use of local roads at Sangachal Town affected noise levels recorded at one location (R2) only. Daytime measurements did not detect noise generated from operation of the Terminal at any of the locations surveyed in 2010 or 2011.

Night time measurements in 2011 detected noise generated from the operation of the Terminal at Azim Kend and Umid West. In addition, a consistent low-frequency noise could be identified at Sangachal Town and Azim Kend/Masiv 3 associated with the Sangachal Power Station. Night time road traffic noise from the Baku-Salyan Highway was audible at all 2010 and 2011 monitoring locations.

Both data sets for the 2010 and 2011 surveys indicate a large range in recorded average noise levels (LAeq) which is typical of surveys influenced by intermittent road traffic noise. Given the range of noise levels recorded at R1 to R5 during daytime and night-time periods, there were no significant differences between noise levels recorded during the 2010 and 2011 surveys.

Sensitivity

The noise environment within the local communities is generally quietest at night, with the lowest noise levels consistently recorded at Azim Kend. During daytime and night time periods, traffic noise (associated with the Baku Salyan Highway) is audible at all locations, with noise levels highest at those locations closest to the highway (e.g. location R2 and A3). Noise from the Sangachal Power Station was significant for receptors R2, R5 and A1. Other noise sources noted during the surveys included helicopters, animal noise and the occasional passing of construction vehicles. Noise from the existing Terminal was not dominant at any of the receptors during the survey periods.

Residential dwellings represent the most sensitive receptors to operational noise. The guidance set out by the IFC sets absolute noise limits for the day and night time noise levels at residential receptors of 45dB and 55 dB (LAeq), respectively. To determine the existing noise levels at the sensitive receptors associated with current Terminal operations, surveys and noise modelling was undertaken (as described within Appendix 11D). This confirmed that current noise levels at receptors associated with current Terminal operations (under routine conditions) are approximately 43dB at Sangachal, 39dB at Azim Kend/Masiv 3, and 43dB at Umid (measured as LAeq), which is below the most stringent night time noise limit of 45dB (LAeq).

6.5 Coastal Environment

6.5.1 Setting

The coastal zone, between the Baku-Salyan Highway and the Caspian Sea shoreline, comprises a platform of layers of limestone and marine sediments. The landward slope has been quarried away for sand/aggregate. To the seaward there is a limestone platform sloping down to the water's edge, with small areas of exposed finer material.

6.5.2 Coastal Habitat

The area previously quarried, as discussed in Section 6.5.1, within the coastal zone supports desert vegetation similar to that of disturbed habitat around the SD2 Expansion Area and is dominated by sparse *Salsola nodulosa*. The limestone platform to the seaward also supports *Salsola nodulosa,* with other species, including *Suaeda* spp, *Artemesia* spp and *Armeria* spp. The area where the previous ACG/SD pipelines were installed has been rehabilitated using live plants. The results of surveys undertaken in 2007 and 2010 indicate that this effort has been successful with up to 57% vegetation cover by perennial species identified in 2010.

Sensitivity

Surveys completed to date show that, following rehabilitation, the disturbed coastal habitat is recovering following the pipeline works completed between 2001 and 2006. There are no rare or threatened species present and habitat is typical of the area within the Terminal vicinity.

6.5.3 Coastal Birds

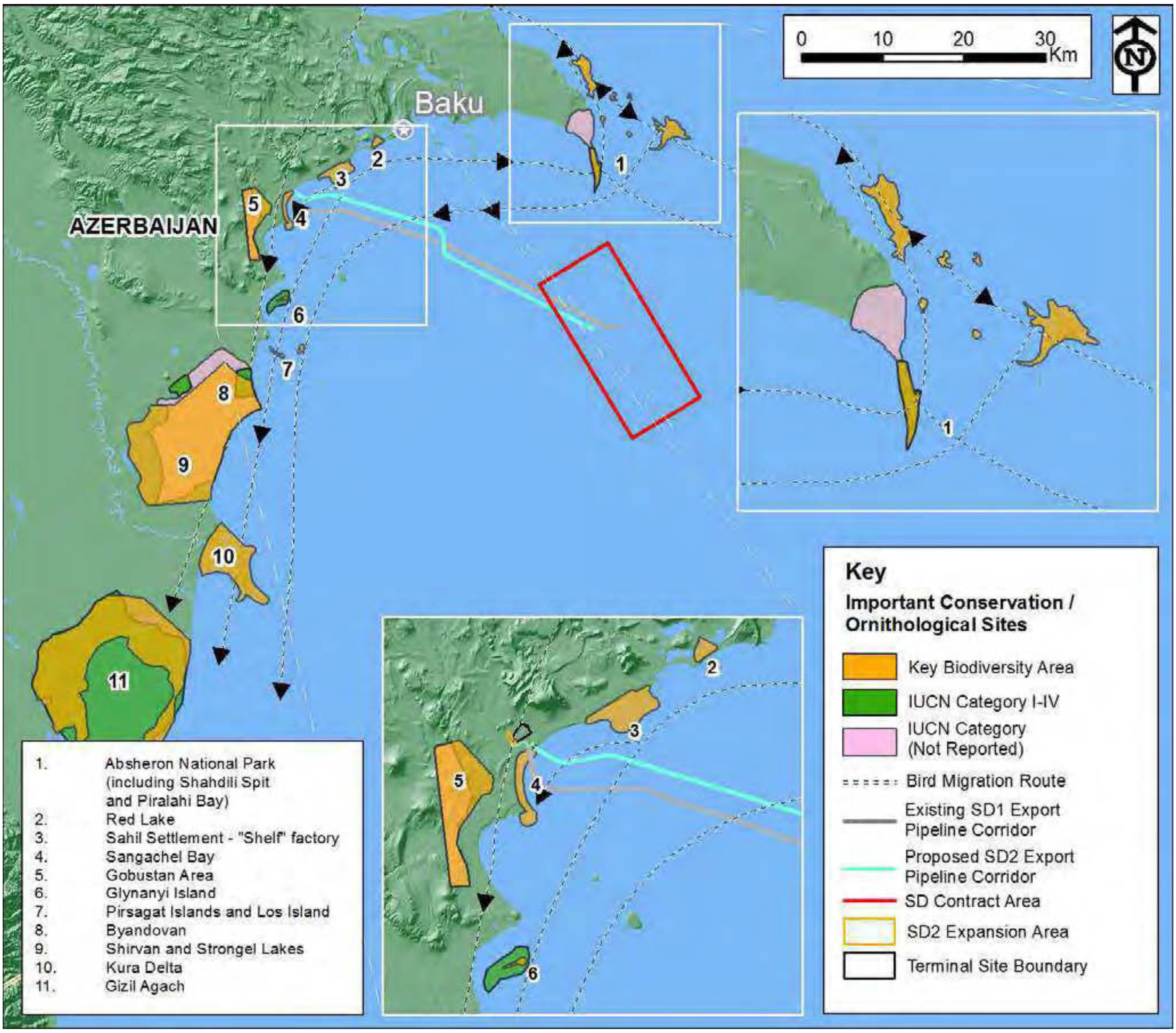
At a regional level, the coastal zone of the Caspian Sea has been identified as an area of ornithological importance as it supports both internationally and nationally significant numbers of migrating and overwintering birds. Bird species of local and international importance are also known to frequent the coastline. Important ornithological sites, located on the Azerbaijan coastline, are listed in Table 6.20 below and shown in Figure 6.18.

Table 6.20 Sites of Ornithological Importance

Sites of Ornithological Importance		Designation	Reasons for Designation
1	Absheron National Park (including Shahdili spit and Pirilahi Island)	KBA[1]/IBA[2] IUCN not reported[3] IUCN IV[4]	KBA/IBA - The area is important for overwintering and migrating bird species. IUCN not reported – Absheron National Park IUCN IV – 46 RDB species occur within and in the surroundings of the national park.
2	Red Lake	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
3	Sahil Settlement – 'Shelf Factory	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and migrating bird species.
4	Sangachal Bay	KBA/IBA	The area is important for overwintering and migrating bird species.
5	Gobustan Area	KBA/IBA IUCN not reported	KBA/IBA - Populations of globally threatened bird species are known to occur here. The area is important for breeding bird species. IUCN not reported – Gobustan State Nature Reserve.
6	Glinyani Island	KBA/IBA IUCN IV	KBA/IBA - The area is important for breeding bird species. IUCN IV – two RDB species occur in the area.
7	Pirsagat Islands and Los Island	KBA/IBA	Populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
8	Byandovan	IUCN IV	49 RDB species known to occur here.
9	Shirvan and Shorgel Lakes	KBA/IBA IUCN not reported IUCN Ia[5]	KBA/IBA - Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and breeding bird species. IUCN not reported – Shirvan Reserve. IUCN Ia – 56 threatened species occur in this area.
10	Kura Delta	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and migrating bird species.
11	Gizil Agach	KBA/IBA IUCN Ia Ramsar Site[6]	KBA/IBA - Important breeding and overwintering area for birds. A large number of globally threatened species occur here. IUCN Ia – Gizilagach State Reserve is located within this area. Fifty nine threatened species occur in this area. Ramsar - A wetland of international importance for migrating and breeding birds.

Notes:
[1] Nationally identified sites of global significance that address biodiversity conservation at a local scale (individual protected areas, concessions and land management units). Key Biodiversity Areas (KBAs) comprise an 'umbrella' which includes globally important sites (e.g. Important Bird Areas (IBAs), Important Plant Areas (IPA), Important Sites for Freshwater Biodiversity, Ecologically & Biologically Significant Areas (EBSAs) in the High Seas, Alliance for Zero Extinction (AZE) sites).
[2] Key sites for the conservation of bird species, identified by BirdLife International. These sites are small enough to be conserved in their entirety, and are different in character or habitat or ornithological importance from the surrounding area.
[3] A nationally protected area as listed by the World database on protected areas, but with an unknown IUCN category, e.g. Gobustan State Nature Reserve.
[4] Protecting a particular species or habitats and management of the reserves prioritises these species or habitats.
[5] Strictly protected areas set aside to protect biodiversity and also possibly geological features, where human visitation, use and impacts are strictly controlled.
[6] Convention on Wetlands of International Importance - ensuring the conservation and wise use of wetlands in national environmental planning; and consulting with other parties in regard to trans-boundary wetlands, shared water systems, and shared species.

Figure 6.18 Important Ornithological Sites Located on the Southwest Caspian Coast and Migration Routes



A literature review was undertaken in January 2010 focusing on the number and species of birds observed in surveys between 2002 and 2006 along the coastlines of the Shahdili spit and Pirilahi Island (refer to Appendix 6B).

The review highlighted that the breeding season of birds on the Shahdili and Pirilahi coastline begins at the end of April/beginning May and continues until mid-July. At the end of July and beginning of August, the birds leave their nesting places and disperse. During the breeding season, 18 species were recorded along the Pirilahi coastline and 16 species along the Shahdili coastline.

During the overwintering surveys between 2002 and 2006 an average of 24,873 waterfowl and 181 coastal birds and 20,004 waterfowl and 198 coastal birds were recorded along the Pirilahi coastline and Shahdili coastline, respectively. Four species recorded along both coastlines exceeded the 1% limit[22] for the provision of Ramsar status and four rare and endangered bird species listed in the AzRDB and the IUCN Red List of Threatened Species were also recorded (refer to Table 6.21).

[22] Criterion 6 of the Ramsar Convention states that a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Table 6.21 Overwintering Birds of Importance Recorded in 2002 – 2006 Surveys

Bird Species	Pirilahi Coastline	Shahdili coastline	Exceeds limit for the provision of Ramsar Status	Red Book of Azerbaijan	IUCN Red List of Threatened Species
Aythya ferina	✓	✓	✓		
A. fuligula	✓	✓	✓		
Cygnus olor	✓	✓		✓	
Falica atra	✓	✓	✓		
Numenius arquata	✓				✓ (NT)
Pelecanus crispus		✓		✓	✓ (VU)
Podiceps cristatus	✓	✓	✓		
Porphyrio porphyrio		✓		✓	

The Shahdili and Pirilahi coastlines are located within a major flyway for migrating waterfowl and coastal birds, who nest in the European parts of Russia, western Siberia, and north-western Kazakstan and migrate to the southern coast of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, southwest Asia and Africa for the winter. The migration routes are indicated in Figure 6.18.

The autumn migration begins in the second half of August and continues until mid-December, with the most active period during November. The spring migration starts in the second half of February and ends in April, with the most active period during March.

Survey work completed between 2002 and 2006, during the spring migration, identified 19 and 29 bird species in the coastal waters of Pirilahi Island and the Shahdili coastline, respectively. In total, nine species recorded between 2002 and 2006 exceeded the 1% limit established for the provision of Ramsar status. During the same period, five endangered species were also recorded (refer to Table 6.22).

Table 6.22 Migrating Birds of Importance Recorded in 2002 – 2006 Surveys

Bird Species	Pirilahi Coastline	Shahdili Coastline	Exceeds 1% Limit for provision of Ramsar Status	Red Book of Azerbaijan	IUCN Red List of Threatened Species
Aythya ferina	✓	✓	✓		
A. fuligula		✓	✓		
A. nyroca		✓			✓ (NT)
Cygnus cygnus		✓	✓		
C. bewickii		✓	✓	✓	
C. olor	✓	✓	✓	✓	
Netta rufina		✓	✓		
Pelecanus crispus	✓	✓		✓	✓ (VU)
Podiceps cristatus	✓	✓	✓		
Phoenicopterus roseus		✓		✓	

Sensitivity

Part of Sangachal Bay, immediately to the south of the proposed SD2 Pipeline Corridor, has been designated as a KBA/IBA as it is used by up to 25,000 migratory and overwintering birds. Unlike the more important bird areas to the south and north (Absheron National Park and Gizil Agach) the area has not been nationally designated. The area of the KBA nearest the Terminal is currently disturbed year round by noise from highway traffic which passes approximately 50m from the shoreline. Birds using the area are therefore likely to be habituated to vehicle noise. The major flyway for migrating waterfowl and coastal birds, which is most active during March and November, passes over the route of the proposed SD2 Pipeline Corridor. Birds using this route are primarily migrating to the southern coast of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, southwest Asia and Africa for the winter and then fly north along the same route during spring.

6.6 Nearshore Environment

6.6.1 Setting

Sangachal Bay is a dynamic shallow water area with a mixture of habitats and sediment types. The seabed slopes gently from the shore and reaches a depth of 10m approximately 3km from the water's edge. In the centre of the Bay there is a slight depression which acts as a sediment sink.

The Caspian Sea is effectively non-tidal and wind and pressure gradients are the driving mechanisms for currents in the sea. Typical pressure induced currents are caused by:

- Freshwater discharges;
- Secondary wind effects (stow-up currents); and
- Thermohaline circulation.

A year long metocean survey was undertaken from 29th May 2003 to 4th June 2004 within Sangachal Bay. Recording current meters were deployed on 29th May at three locations in the nearshore waters adjacent to the Sangachal Terminal. During the course of the survey drifter devices were periodically deployed and tracked to ascertain the directional movement of currents in the nearshore environment.

The results of the survey have determined that the current regime within the Bay is complex, and that it is governed by seabed topology, large-scale water circulation in the Caspian, as well as local and regional wind strength and direction. The main current direction in the nearshore area of Sangachal Bay follows the seabed contours and is to the south west. The maximum current speed measured was 40cm/s, mean speed was between 6 and 9cm/s. No significant seasonal trends in the current velocity data were identified.

Due to the enclosed nature of the Caspian Sea, the predominant waves are wind-blown rather than swell. Waves are a strong feature of this part of the Caspian Sea and wave heights exceed 10m in offshore waters during severe storm conditions. Longer time scale internal waves within the water column give rise to short-term sea level fluctuations. The most marked of these arise from onshore and offshore winds, which cause surges and withdrawals of water along the coast, including the coastal water adjacent to the Terminal.

6.6.2 Nearshore Benthic Flora

Benthic flora species within Sangachal Bay are predominately seagrass and algae. Seagrass surveys were undertaken in Sangachal Bay in 2001, 2002, 2003, 2006 and most recently in 2008. A single species of seagrass (*Zostera noltii*) was recorded during the recent seabed mapping survey. *Z. noltii* was found growing on a number of different sediment types and included shelly mud, coarse shelly sand as well as gravel. Dense beds of seagrass were present close to the shoreline in water depths of 1-3m, which form a coastal band approximately 200-500m wide. A narrow band of seagrass was also found in deeper water (6-7m) nearly 2km from the shoreline, in an area of gravel. Seagrass was not present in areas of fine-grained soft muds and silts or growing on rock outcrops. The results from the survey suggest that at Sangachal neither type of substratum allows the development of *Z. noltii* root networks.

The 2008 survey detected an increase in seagrass throughout Sangachal Bay since the 2006 survey and a fall in the area of algal habitat.

Several species of macroalgae were identified, including six species of red algae. The majority of the macroalgae were found growing on hard substrata such as areas of rock outcrops, mussels, barnacles and dead shell fragments, in water depths of 5-11m.

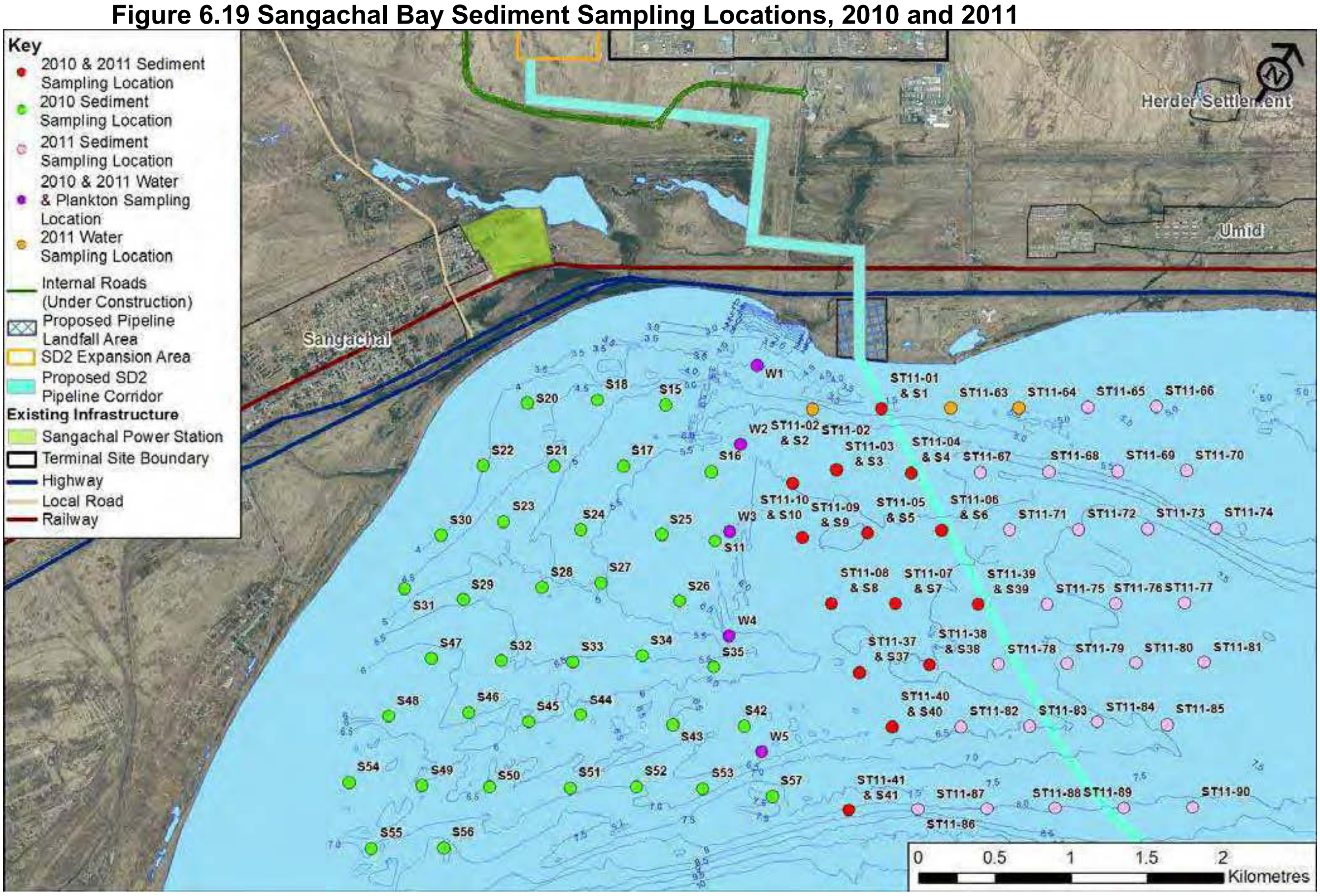
Sensitivity

The species of seagrass and algae, which are neither rare nor threatened, are present throughout Sangachal Bay. Evidence suggests that the seagrass beds are either stable or expanding – the vigour of the seagrass is best indicated by the fact that the thickest beds currently occupy an area which was dry land prior to the sea level rise of the late 20th century. In particular, no significant impacts were identified associated with the previous pipeline construction works within the Bay.

6.6.3 Nearshore Biological, Physical and Chemical Characteristics

Environmental surveys have been conducted in the Sangachal Bay area in 1996, 2000, 2003, 2006, 2008 and most recently in 2010 and 2011. The objective of the surveys is to provide information on the sediment chemistry, physical characteristics, macrobenthic fauna and plankton of Sangachal Bay. The locations of the 2010 and 2011 sampling stations can be seen in Figure 6.19. Stations 1-57 (2008 and 2010) provide coverage of the area of the Bay occupied by the present ACG/SD pipeline corridors and the Azpetrol terminal to the south. The 2011 survey focused further to the north, to cover the area likely to be occupied by the proposed SD2 pipeline corridor; this survey included stations 1-10 and 37-41 from the 2010 survey, and added an array of stations numbered 63-90.

Figure 6.19 Sangachal Bay Sediment Sampling Locations, 2010 and 2011



6.6.3.1 Benthic Invertebrates

The Sangachal Bay benthic survey in 2008 recorded a total of 39 macrobenthic taxa from the 57 samples collected. These included six polychaete taxa, six oligochaete taxa, one Cirripedia taxa, one Cumacea taxa, 15 amphipod taxa, one decapod taxa, three gastropod taxa and thee bivalve taxa. In contrast, only 17 taxa were recorded in the 2010 survey; the principal difference was the absence in 2010 of gastropods and cumacea, and the almost complete absence of amphipods. The 2010 data were similar to those reported in the 2006 survey, and the results therefore illustrate the variable nature of the Sangachal Bay benthos.

In addition to the taxonomic groups, the presence of Demospongiae species *Metschnikowia tuberculata tuberculata*, Bryozoan species *Conopeum seurati* and Hydrozoan species *Bouganvilleia megas* were recorded. The stations with higher numbers of species were found to the east and north-east of Sangachal Bay.

Bivalves were the most abundant taxonomic group in 2008, with a total abundance of 46,070 individuals which represented 71% of the overall abundance, while oligochaetes and polychaetes accounted for 14% and 9%, respectively. Bivalve abundance was greatest to the east and north-east of the Bay, and lowest to the west of the Bay. In 2010, oligochaetes and polychaetes represented 48% and 18% of total abundance, respectively, while bivalves accounted for 23% of total abundance.

A total of 15 amphipod species were recorded in 2008. Abundance and occurrence was generally very low with 10 species being present at only one station. *Cardiophilus baeri* was the most abundant amphipod species and was present at nine stations with a total abundance of 340 individuals. In general, amphipods were present at a small group of stations to the east of the Bay and to the north within 500-100m from the shore. In 2010, only three amphipod taxa with a total of 100 individuals were recorded.

In 2008, only one cumacean species (*Pterocuma pectinata*) was recorded with one individual. Gastropods were present at 12 stations in 2008, with a total of three species being recorded with *Caspiohydrobia gemmata* being the most abundant and prevalent. No cumacea or gastropods were recorded in 2010.

2011 Survey

The purpose of the 2011 survey was to extend the standard monitoring area to include the proposed SD2 Export Pipeline Corridor. A total of 43 stations were sampled, 15 of which were common to the standard survey pattern which was used in 2008 and 2010; the inclusion of these stations provided a basis for identifying any major natural changes between 2010 and 2011. An additional 28 stations were positioned to the north and east of the standard stations; a comparison between these stations and the 16 standard stations provided a basis for determining whether there were any ecologically important differences between the proposed SD2 Export Pipeline Corridor and the established monitoring area.

The 2011 survey recorded 27 taxa, a number intermediate between the 2008 and 2010 survey results. There was a greater number of amphipod and gastropod taxa (nine and four respectively) than in 2010, but cumacea remained completely absent. Both taxonomic groups occurred at only a small number of stations, and in low abundance. Polychaetes were dominant throughout the survey area, accounting for 50% of total abundance at the ‘original’ 15 stations and 45% of total abundance at the 28 ‘new’ stations. Bivalves accounted for 35% and 45% of abundance, and oligochaetes for 14% and 10% of abundance. There were no major or systematic differences in overall community composition between the two groups of stations. A comparison with the 2010 survey results suggests a general overall increase in abundance. While polychaetes remain dominant throughout, the relative abundance of bivalves increased and the relative abundance of oligochaetes decreased.

The results indicate that the area of the Bay in which the proposed SD2 Export Pipeline Corridor is located is biologically similar to the main Bay survey area. No ‘new’ taxa were observed, and the natural variability between stations within the proposed SD2 Export Pipeline Corridor area was similar to that routinely observed within the main survey area. The 2008, 2010 and 2011 surveys also provide a clear indication of temporal variability, with a notable fluctuation in the numbers of amphipod and gastropod taxa. While amphipods and gastropods influence the overall species richness of the area, they occur at low frequency and abundance and therefore are unlikely to represent a significant component of community function.

Sensitivity

The benthic communities are dominated by polychaetes, oligochaetes, and bivalves; most of the biomass is contributed by invasive or introduced polychaete and bivalve species. While there are changes in dominance between successive surveys, there is no persistent trend. Native species of cumacea, amphipod and gastropod (all of which are common in offshore sediments) are occasionally present at a few stations, and in low numbers, but these taxa do not appear to be consistent components of the community or to be present in sufficient abundance to make a significant contribution to community function.

Although benthic community structure show little overall change or trends over a series of surveys, there is, between successive surveys, invariably some indication of changes at individual stations. This is a reflection of the dynamic nature of the Bay; it is a shallow water environment, in which storm wave action will tend to occasionally redistribute sediment within the Bay, and may also occasionally introduce sediment from the adjacent coastal shelf area. Such shallow water areas are generally robust, as the communities are adapted to regular physical disruption. The macrobenthic community is dominated by relatively hardy annelids and bivalves; those taxa likely to be most sensitive to pollution, such as amphipods and gastropods, are a minor and inconsistently present part of the community.

6.6.3.2 Plankton

Phytoplankton and zooplankton characteristics have been recorded by surveys completed most recently in 2008, 2010 and 2011. The results of these surveys are described below.

Phytoplankton – in 2008, a total of 40 taxa were recorded, of which 22 were diatoms (*Bacillariophyta*), seven were dinophytes (*Dinophyta*), 10 were blue-green algae (*Cyanophyta*), and one green alga (*Chlorophita*). The 22 species of diatom were represented by 11 genera, with *Chaetoceros*, *Coscinodiscus* and *Nitzschia* the most diverse of the genera, with *Thalassionema nitzschioides Gru, as* the most abundant taxa. Bacillariophyta, constituted 74% of total phytoplankton abundance followed by Cyanophytes (18%), Dinophytes (7%) and Chlorophyta (1%). In 2010 and 2011, only 27 and 32 taxa were recorded respectively, but with a similar distribution between taxonomic groups.

Zooplankton - Three distinct zooplankton taxa were recorded in samples retrieved during the Sangachal Bay survey in 2008; two copepods *Acartia tonsa* and *Eurytemora minor* and the ctenophores *Mnemiopsis leidyi*. Juvenile life-stages of Copepoda, Cirripedia, Polychaete, and Mollusca were also observed in samples.

The zooplankton community recorded in 2008 was low in abundance and species richness, and was dominated by invasive species: *Acartia tonsa* and *Mnemiopsis leidyi*. Overall, the plankton is dominated by three invasive species: *Pseudosolenia calcar-avis* (key contributor to Phytoplankton biomass), *Acartia tonsa* (key contributor to zooplankton biomass) and *Mnemiopsis leydii* (main predator of zooplankton). All three species are likely to have been introduced over the past few decades in the ballast water of commercial shipping entering the Caspian Sea.

In 2010, the zooplankton was again dominated by *Acartia, Eurytemora,* and *Mnemiopsis*, but three native cladoceran taxa were also present in low abundance. In 2011, the overall dominance was similar, but only one cladoceran species was present. The cyclopid copepod *Halicyclops* was recorded for the first time since 2000, and two species of the genus *Estinostoma* were recorded for the first time. Bivalve and polychaete larvae were also recorded in some samples.

Sensitivity

Plankton within Sangachal Bay is dominated by alien/invasive species. The 2008 survey reports that since 2006, the zooplankton community of *Acartia tonsa* and *Mnemiopsis leidyi* has increased in abundance by nearly eight times. The results of the 2010 survey indicate a continued dominance by these invasive taxa.

6.6.3.3 Physical and Chemical Composition of Nearshore Seabed Sediments

The physical and chemical composition of nearshore seabed sediments has been investigated by routine surveys completed in 1996, 2000, 2003, 2006, 2008 and 2010, and in an additional survey carried out in 2011 to cover the area associated with the proposed SD2 Export Pipeline Corridor. The results indicate that the physical composition of nearshore sediment ranges from very fine silt to coarse sand, with the majority of samples having poorly, or extremely poorly, sorted sediment. Coarser grained sediment was made up of a high proportion of broken down shell material. As sediment depth increases, there is a reduction in silt and clay content and an associated increase in carbonate content.

The results of the 2011 survey indicate that the proposed SD2 Export Pipeline Corridor area is very similar in sediment structure to the rest of the Bay. Median particle diameter at the ‘old’ (i.e. 1996 to 2010) and ‘new’ (i.e. 2011) station samples was 204 and 194 μm respectively, with an overall survey median of 204 μm. Summary statistics for all other physical parameters were equally similar between the two groups of stations.

The result of chemical analysis on nearshore sediments indicates that THC and PAH concentrations are relatively low at the majority of sample locations within Sangachal Bay. Higher concentrations were obtained from samples located to the east of the Bay at a distance of approximately 1.5km from the shoreline, although the relationship between the concentration of THC and PAH is not consistent. The results of the 2011 survey indicated that THC ranged from 17 to 101 μg/g, with a median value of 65 μg/g. Range and median values were similar between the ‘old’ and ‘new’ samples. While the range was similar to that observed in 2010, the 2010 median was considerably lower, at 17.9 μg/g. However, the median for the 15 ‘old’ stations revisited in 2011 was 51 μg/g; this confirms previous observations that, although hydrocarbon concentrations in the Bay are generally low, there is a trend towards higher concentrations in the north and east of the Bay area.

Heavy metal analysis on sediment samples undertaken in 2006 to 2008 indicate consistency between data sets, with the highest concentrations recorded to the west of the Bay. However, the concentration of barium and mercury within sediment is highest in concentration to the east of the Bay. In the 2011 survey, the range and median values for all metals were similar between the ‘old’ and ‘new’ stations, and generally similar to the results of the 2010 survey. Concentrations of barium, iron and manganese were lower in 2011 than in 2010, and there appears to be an overall trend towards lower concentrations of these metals over the period of 2006-2011. Cadmium concentrations in the 2011 survey were lower than in 2010 (medians of 0.26 and 0.36 μg/g, respectively), and the 2011 values were close to those recorded in 2008. The apparent increase in cadmium concentrations between 2008 and 2010 was noted in the 2010 survey report; no obvious explanation was available at the time, but it is clear that there is no permanent or consistent upward trend in cadmium concentrations.

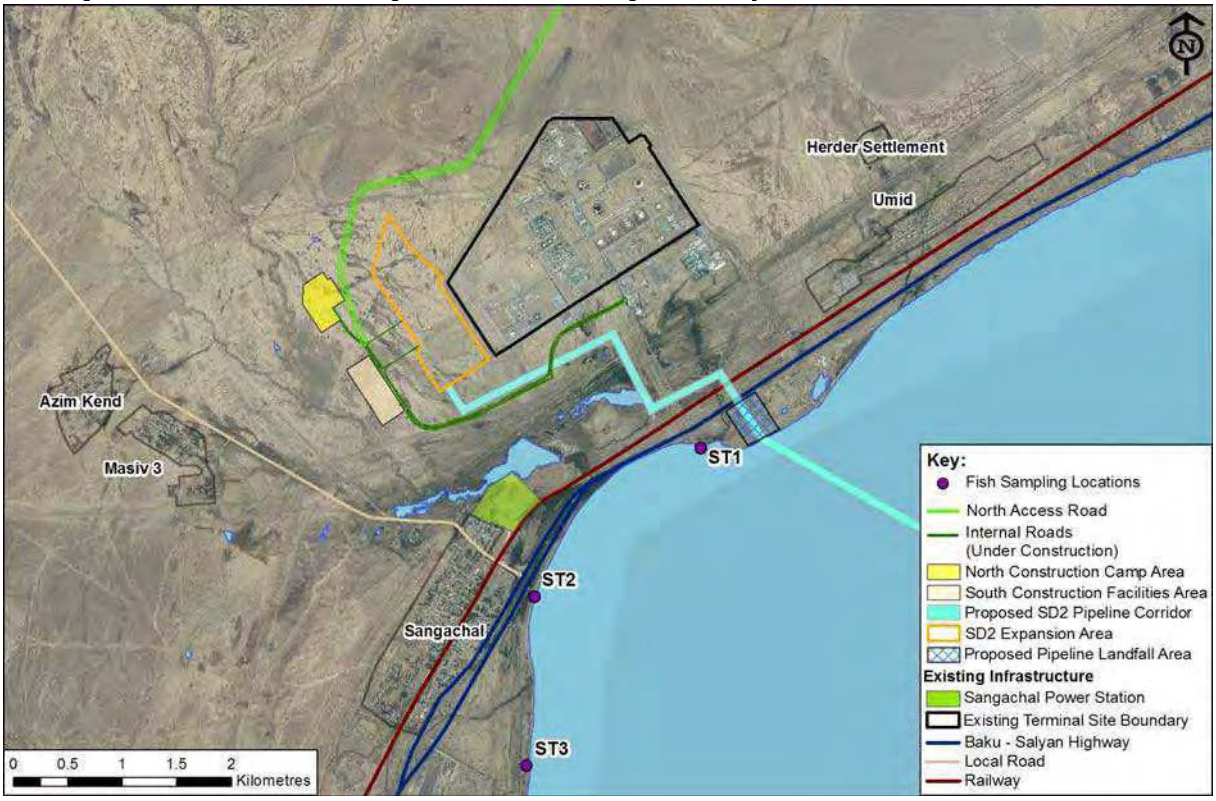
Sensitivity

The area occupied by the proposed SD2 Export Pipeline Corridor is similar in sediment composition to the adjacent, previously-surveyed area of the Bay. Sediments are variable in composition, ranging from silt to sand, and there is no evidence of significant hydrocarbon or metal contamination.

6.6.4 Nearshore Fish and Mammals

As part of the EMP, regular fish monitoring is undertaken in the Sangachal Bay to ascertain the presence, contamination levels and health status of the fish population. The most recent surveys were completed in 2008 and 2009. Fish were collected using a beach trawl net at three locations (Figure 6.20).

Figure 6.20 Fish Monitoring Locations in Sangachal Bay



A total of 11 fish species were caught, identified and enumerated in October 2008, and 10 fish species were identified and enumerated in May 2009. The Sandsmelt (*Atherina boyeri caspia*) and Goby (*Neogobius sp*) were the most abundant species in the Sangachal Bay area from the spring and autumn surveys. Mullet (*Liza saliens Risso*) and Caspian roach (*Rutilus rutilus kurensis*) were most abundant in the autumn surveys. A considerable difference in the number of fish per season was observed with the spring catch being three times greater than the autumn catch. Table 6.23 shows the number of different fish species collected during the 2008 and 2009 surveys.

Table 6.23 Fish Species Found in Sangachal Bay from 2008 and 2009 surveys

Fish Species	Total per Species	
	October 2008	May 2009
Sprat (*Clupeonella cultriventris caspia (Svetovidov)*)	18	11
Caspian Roach (*Rutilus rutilus kurensis (Berg)*)	50	5
Caspian kutum (*Rutilus frisii kutum (Kamensky)*)	4	2
Asp *(Aspius aspius (Linne))*	1	7
Thornback *(Gasterosteus aculeatus Linnaeus)*	65	4
Needlefish (*Syngnathus nigrolineatus caspius Eichwald)*	13	3
Mullet (*Liza saliens Risso)*	60	17
Sandsmelt *(Atherina boyeri caspia (Eichwald))*	121	1,081
Gobies (*Neogobius sp)*	64	112
Total	**396**	**1,242**

Among fish present in the catch, Sprat (*Clupeonella cultriventris caspia*), Caspian roach, Kutum (*Rutilus frisii kutum*), Zherekh (*Aspius aspius*) and Mullet have a commercial value whereas the Sandsmelt and Gobies have no commercial value. However, Sandsmelt and Gobies form part of the diet of valuable commercial fish such as Sturgeon (*Acipenser sp*), Salmon (*Salmo sp*) and predatory herrings.

Catches of Sandsmelt and Gobies, which are permanently resident in Sangachal Bay, have been analysed to monitor their health status and contamination level to perform a check on the impact associated with wastewater effluents discharged by the Terminal. The number of fish used for analytical study was 15 Sandsmelts and 15 Gobies per station. They were analysed for the following:

- Standard physical and biological measurements (weight, length, liver-somatic and gonado-somatic index);
- PAH metabolites in bile;
- Metal concentrations in liver tissue;
- Micronuclei assay of blood cells;
- Histopathology analysis of liver and gill tissue; and
- Cytochrom P-450 in muscle tissue.

In general, the results indicated that the health status of the fish in the survey area is satisfactory although some trends were identified as described below.

The Caspian Seal (*Phoca caspica*) is the only marine mammal in the Caspian Sea basin and is endemic to the area. An aerial survey carried out under the Darwin Initiative project in the North Caspian found that in the past decade the numbers of seals in the Caspian Sea reduced from approximately 400,000 to 111,000. In 2008, the Caspian Seal was listed as ‘Endangered’ on the IUCN red list. No seals are known to currently breed in the Azerbaijani sector of the Caspian Sea and there are no records of seals occurring within Sangachal Bay.

Sensitivity

The analysis of the Sandsmelt and Gobies revealed the following differences when compared with a similar study in 2005:

- Physical measurements indicated the presence of larger individuals in spring than autumn and fish maturity was more than 6.5 times greater and hepato-somatic indices (which provide an indication of energy reserves in an animal) were almost two times higher in spring. Females were numerically dominant within spring catches;
- Increased levels of naphthalene were recorded in spring and autumn studies when compared with 2005 levels;
- The concentration of trace metals in the spring were lower than those recorded in the autumn and it was identified that there was an increase in mercury and lead content and a decrease in chromium and iron concentrations compared to 2005; and
- Histopathology analysis on liver and gills showed generally normal morphological composition of tissue.

Fish present in Sangachal Bay will be especially sensitive during the spawning season which is from April to August.

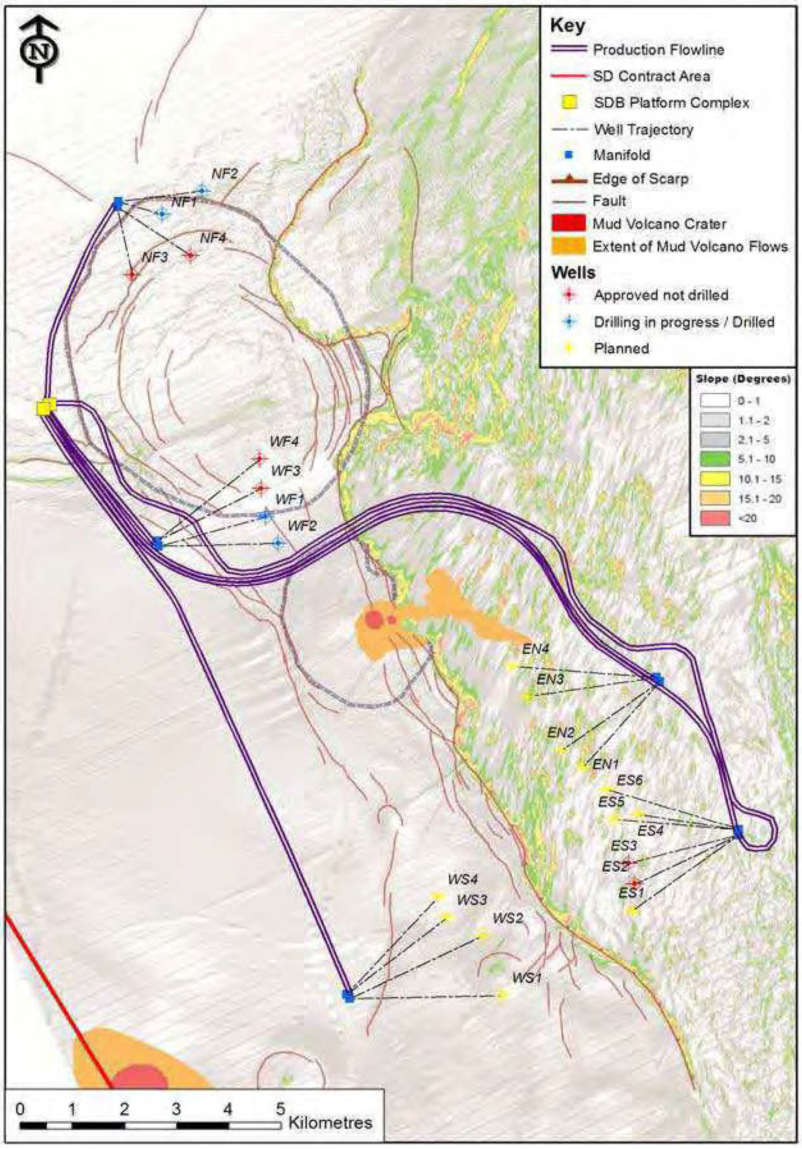
6.7 Offshore Environment

6.7.1 Bathymetry and Physical Oceanography

The Caspian Sea is the largest landlocked water body on earth with a surface area of approximately 371,000km^2. It is fed by numerous rivers; the largest of which is the Volga to the north. The Sea is made up of three basins: the Northern, Central and Southern Basins. The Northern Basin is the smallest (about 25% of the total surface area), but is very shallow. The Central and Southern Basins have similar surface areas, but the Southern is deeper and contains almost twice the volume of water as the Central Basin. The deepest recorded depth is in the Southern Caspian Basin at just over 1,000m.

The SD Contract Area lies within the Central Caspian Basin, and comprises a shelf edge (or escarpment) and a sloped area. The escarpment (a raised anticline or crest) dissects the Contract Area from north-west to south-east (refer to Figure 6.21). The sloped area ranges from a minimum water depth of approximately 60m in the north-east to a maximum of almost 700m in the south-east.

Figure 6.21 Slope Areas and Major Mud Volcano Locations within the SD Contract Area[23]



[23] The locations of the final four wells has not yet been confirmed. Their locations will be determined once additional well performance and subsurface information becomes available.

Figure 6.21 shows the difference in the seabed topography across the Contract Area, where the seabed floor of the escarpment shelf (to the west) is generally even with some faulting, to the east within the slope area where the seabed is very uneven with numerous sharp peaks. This is indicative of slumping and seabed instability created by erosion of the escarpment edge. There are two active mud volcanoes within the Contract Area. The major ring faulting just to the north of the main escarpment that runs through the Contract Area is indicative of a collapsed former mud volcano.

6.7.1.1 Water Temperature

During the winter months, surface water temperatures may fall to 5ºC at the shelf edge and 7ºC over the slope, with the monthly average temperatures at 8ºC and 10ºC, respectively.

During summer, the temperature of the waters in the southern Caspian becomes stratified and a strong thermocline develops that inhibits vertical mixing. Surface water temperatures can reach a maximum of 28ºC in August[24]. Temperatures at depth remain approximately 6ºC all year round[25].

6.7.1.2 Salinity

The average salinity of the Caspian is approximately 12.9‰. The middle and southern areas of the Caspian Sea have very small seasonal and spatial differences. For example, sampling conducted as part of the 2009 SD Regional Environmental Survey found little variation in salinity at the stations sampled, ranging from 11.1-11.6‰[26].

6.7.1.3 Oxygen Regime

Offshore areas of the Caspian, including the Contract Area, are characterised by high oxygenation of the surface water throughout the year. They experience high saturation levels in the spring due to phytoplankton activity. During summer, the water column becomes stratified resulting in decreased oxygen levels below the thermocline.

6.7.1.4 Wave and Current Regime

Storms in the Caspian region blow along a north-westerly/northerly axis, although the Absheron Peninsula shelters the SD Contract Area from the most severe of these. A large gradient in extremes of waves also exists across the region. The 100-year significant wave height in the SD Contract Area is about two-thirds the size of comparable statistics in the open sea to the east of the Peninsula. The largest waves to affect the Contract Area come from the north-easterly sector.

Currents of the region are complicated and are affected by season with lower current speeds measured during summer as compared to winter. The severity of winter also affects current speeds and currents may be strong at both the surface and near the sea bed. For example, the measured mean flow in the SD Contract Area shelf edge region during the relatively benign winter of 2000 - 2001 was just 0.03m/s, while during the relatively severe winter of 2005 - 2006 it was 0.13m/s. More recently, the mean flow was measured at 0.10m/s during the winter of 2008.

The predominant direction of the strong currents is from the north-east. The currents may act from surface to seabed, or surface flows may differ from the deepwater flows whereby strong currents may act in either layer. The currents may be driven directly by local weather events or by distant forcing mechanisms. In the latter case the currents may occur during periods of unremarkable local weather. Approximate expected winter maxima current values are shown in Table 6.24.

[24] OceanMetrix (2009), Shah Deniz Wind, Wave, Surge and Current Criteria V3.1a. Report developed for BP Exploration Operating Company Ltd.
[25] BP, 2002.
[26] AmC, 2010

Table 6.24 SD Expected Winter Maxima Current Values

Location	Water Depth	Current Speed
Shah Deniz Shelf	Near surface	1.0 m/s
Shah Deniz Shelf	Near bottom	0.5 m/s
Shah Deniz Slope	Near bottom (200m)	0.5 m/s
Shah Deniz Slope	Near bottom (400m)	0.4 m/s

The mechanism that drives the current can be traced back to the Northern Caspian basin. Here, very cold winter air temperatures, shallow waters, and large fluvial inputs, lead to rapid ice development and the formation of a reservoir of cold, dense water on the boundary with the Central Caspian basin. The cold water is transported along the western Central basin under the influence of cyclonic winds associated with the winter low pressure trough. A component sinks and flushes the bottom waters of the Central Caspian basin, but in normal years a large volume finds its way over the western section of the Absheron sill and into the Southern Basin where it appears to mix and sink. A counter flow of relatively warm Southern Caspian water along the eastern section of the Absheron sill balances the cold water inflow.

The irregular depth of the Absheron sill complicates the winter seasonal flow further. The sill is deeper on the western side, near Deepwater Gunashli (with a maximum depth over 200m), than on the eastern side (where depths are usually less than 150m). Therefore, the cold water inflow penetrates beneath the level of the warm water outflow. This is thought to cause currents along the continental slope of the eastern sill to flow towards the west.

6.7.1.5 Storm Surges and Waves

Storm surges occur in the Caspian causing temporary rises or falls in sea level. Significant sea level changes occur in the middle basin of the Caspian. These events are associated with persistent strong winds, particularly the strong prevailing regional winds that blow along the axis of the Caspian, from north and north-west or from south and south-east. Strong winds from the north are more frequent and more severe than strong winds from the south. Waves in the Caspian Sea are wind driven and subsequently the windiest months also exhibit the greatest wave action.

Wave height data recorded at Nyeftyanye Kamni/Oil Rocks indicates that the months of July, August and September have the strongest winds and storms, with a greater frequency of wave heights in excess of 2m recorded. The period of October to February, however, shows the greatest number of wave heights between 1 and 2m, reflecting the steady occurrence of strong winds during this period.

South of the Absheron Peninsula, northerly winds will create a fall in sea level while southerly winds result in a rise. In Baku Bay this change can be ±70-80cm. The typical time period for a storm surge is estimated to be 6-24 hours.

The area of greatest wave development extends from the western portion of the Middle Caspian basin, down and across the central section of the Absheron Ridge.

6.7.1.6 Geology and Lithology Overview

The Caspian Basin represents one of the largest continental lake systems in the world. The recent geological sequence is characterised by Fluvial Deltaic sandstones and Lacustrine Shales. Sedimentation rates were rapid with 8km of sediment deposited over six to ten million years. Pliocene deposition in a low gradient, lacustrine basin formed regionally extensive sandstone sheets. Fluctuations in lake level, driven primarily by climate change, allowed rapid large scale avulsion of the Volga Delta and the deposition of laterally continuous lacustrine Shales.

The rapid deposition resulted in compaction disequilibrium and the building of severe overpressures. Tectonic activity at the end of Pliocene resulted in the current structural geometry of the SD field.

6.7.1.7 Physical and Chemical Composition of Seabed Sediments

The physical and chemical composition of seabed sediments in the SD Contract Area have been established through the surveys detailed within Table 6.1. The locations of survey stations are shown in Figure 6.22 below.

Physical Properties

Sampling has shown that sediments in the Contract Area are predominantly fine silts, with a median particle size of six micrometres (μm). Coarser sediments have been recorded at the three stations closest to the SD Alpha (SDA) platform (stations 26, 27 and 29) and at the majority of the SDA specific stations indicating a zone of coarser sediment in the middle of the SD Contract Area. At two of the SDA stations, sediments have become progressively coarser since 1998, and at one SDA station, sediments have changed from fine sand to fine silt in the same period. The SDA locations lie close to an area of smaller mud volcano vents, and it is likely that the margins of this area change with time, leading to changes in sediments at stations which lie close to the margins. With the exception of these ‘marginal’ stations, there has been no detectable change in the physical properties of sediments at the regional survey stations.

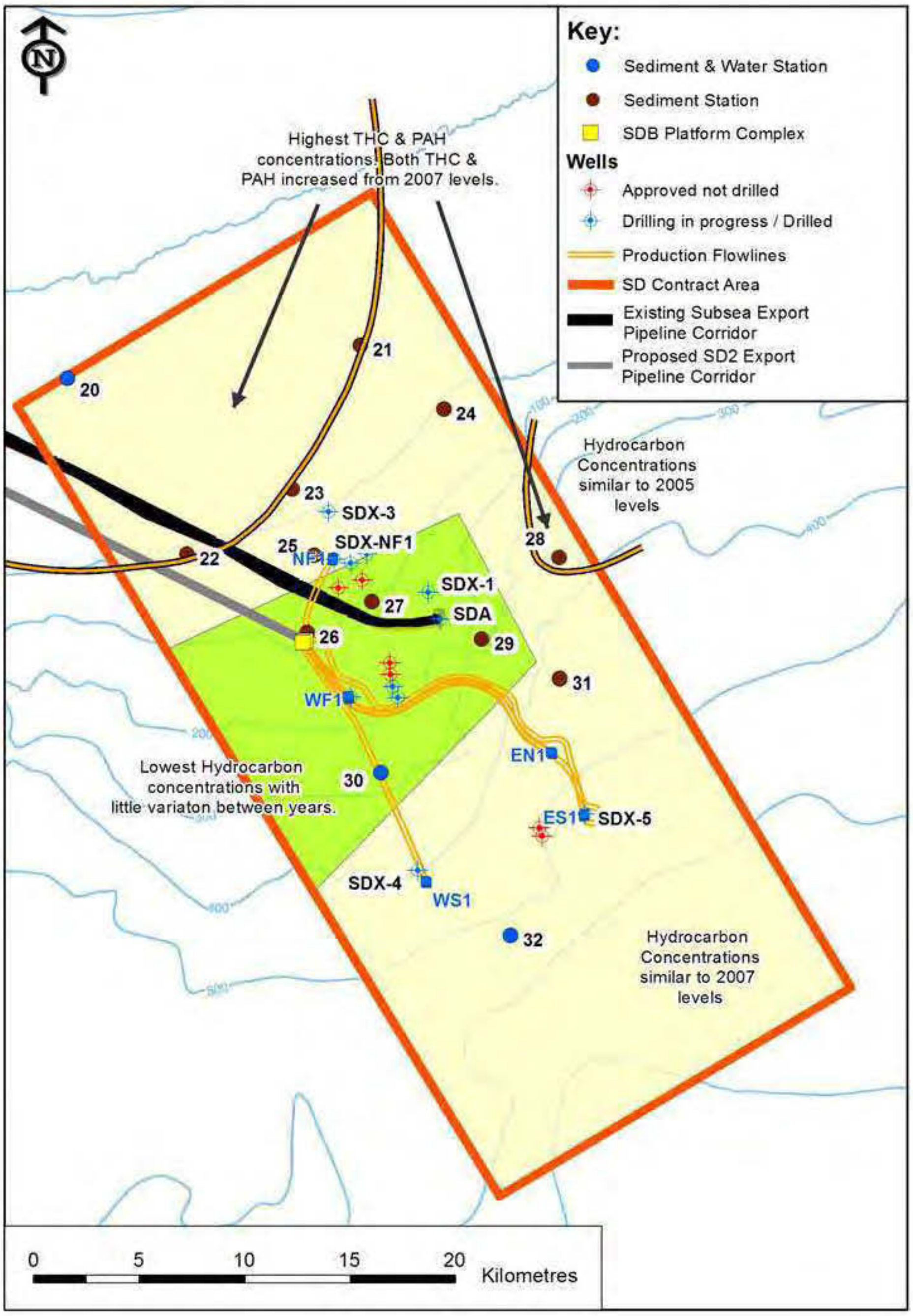
Hydrocarbon Concentrations

THC concentrations within SD Contract Area sediments in 2009 ranged from 11 to 390 μg/g (Table 6.25), with an average value of 133 μg/g. The lowest concentrations were observed in sediments at the stations with the coarsest sediment, with relatively little variation among stations with fine silty sediments. Overall, THC concentrations have decreased progressively by about 70% since 1998. The largest changes have been observed in the deeper water stations in the south of the Contract Area. There has been relatively little change in the shallower water stations in the north of the Contract Area (see Figure 6.22).

Table 6.25 Statistical Summary of Trends in Sediment Hydrocarbon Content in SD Regional Survey 1998 - 2009 (μg/g) – Mean, Minimum and Maximum Concentrations

	THC (μg/g)			UCM (μg/g)			%UCM			Phenol (μg/g)		
	Min	**Mean**	Max	Min	**Mean**	Max	Min	**Mean**	Max	Min	**Mean**	Max
1998	46	**463**	919	35	**396**	807	75	**85**	90			
2000	55	**309**	542	45	**255**	473	57	**81**	88			
2001	36	**258**	544	28	**221**	486	76	**84**	89			
2005	12	**135**	284	7	**108**	247	61	**79**	89	0.94	**3.43**	7.69
2007	7	**86**	176	5	**71**	155	48	**80**	97	0.31	**2.14**	4.97
2009	11	**133**	390	7	**108**	330	61	**79**	86	1.41	**3.42**	6.05
	2-6 Ring PAH (ng/g)			**NPD (ng/g)**			**%NPD**			**USEPA 16 PAH (ng/g)**		
	Min	**Mean**	Max	Min	Min	Min	Min	**Mean**	Max	Min	**Mean**	Max
1998	294	**2310**	4512	160	**1250**	2376	50	**54**	61	51	370	598
2000	297	**1903**	2755	136	**970**	1338	43	**51**	65	45	367	604
2001	336	**1837**	3048	192	**983**	1495	39	**53**	60	61	354	590
2005	59	**782**	1757	24	**348**	778	36	**47**	68	8	144	316
2007	80	**651**	1419	26	**227**	521	28	**36**	49	-	-	-
2009	118	**819**	2035	55	**416**	951	38	**51**	62	28	148	378

Figure 6.22 Summary of Trends in Sediment Hydrocarbon Content, SD Regional Survey 2009



Heavy Metal Concentrations

Heavy metal concentrations vary relatively little across the SD Contract Area and are generally typical of natural fine silts (see Table 6.26). The greatest variation in 2009 was observed for mercury, where concentrations were highest in the shallow water stations in the north of the SD Contract Area, with increases at these stations observed between 1998 and 2000. Fluctuating but consistently moderately high concentrations have been maintained since 2000. A similar temporal trend was observed for cadmium.

Barium concentrations have increased progressively from a regional average of 270µg/g in 1998, to a regional average of 547µg/g in 2007, slightly decreasing to 495µg/g in 2009. In contrast, lead concentrations decreased from a regional average of 40µg/g in 1998 to 20µg/g in 2000; and have remained close to this lower level in subsequent surveys.

Table 6.26 Statistical Summary of Trends in Sediment Heavy Metal Concentrations, SD Regional Surveys 1998 – 2009 (μg/g)

	Arsenic (As)			Barium (Ba) Nitric Acid (HNO_3)			Barium (Ba) Fusion		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
1998	-	**-**	-	176	**270**	403	-	**-**	-
2000	-	**-**	-	287	**446**	705	-	**-**	-
2001	-	**-**	-	347	**497**	669	-	**-**	-
2005	4.7	**10.9**	33.1	8	**369**	820	308	**974**	2032
2007	9.2	**16.9**	30.6	274	**547**	1092	405	**709**	1170
2009	4.1	**10.7**	19.1	255	**495**	872	299	**549**	900
	Cadmium (Cd)			**Chromium (Cr)**			**Copper (Cu)**		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
1998	0.06	**0.09**	0.14	37.8	**61.5**	71.3	17.0	**30.3**	37.6
2000	-	**-**	-	26.0	**51.4**	61.5	20.9	**28.0**	33.8
2001	0.08	**0.26**	0.79	19.1	**50.9**	65.2	9.3	**27.0**	35.6
2005	0.06	**0.10**	0.15	12.3	**77.0**	92.6	4.7	**25.8**	37.7
2007	0.11	**0.18**	0.30	23.1	**76.2**	101.9	4.7	**28.9**	42.5
2009	0.10	**0.15**	0.23	27.6	**71.0**	89.8	6.5	**26.4**	35.5
	Iron (Fe)			**Mercury (Hg)**			**Manganese (Mn)**		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
1998	24,272	**33,700**	38,008	0.05	**0.07**	0.10	-	**-**	-
2000	20,919	**36,100**	41,875	0.05	**0.12**	0.24	-	**-**	-
2001	16,096	**35,600**	44,890	0.01	**0.10**	0.23	456	**602**	784
2005	9,237	**35,178**	41,653	0.01	**0.09**	0.17	-	**-**	-
2007	15,300	**36,800**	46,200	0.03	**0.11**	0.18	507	**718**	986
2009	16,200	**35,611**	43,700	0.02	**0.10**	0.22	466	**697**	953
	Lead (Pb)			**Zinc (Zn)**					
	MIN	MEAN	MAX	MIN	MEAN	MAX			
1998	30.9	**40.1**	44.6	50.7	**85.0**	94.9			
2000	17.3	**20.8**	23.0	53.3	**76.5**	86.7			
2001	14.9	**23.2**	30.5	36.6	**83.2**	98.7			
2005	5.3	**17.6**	25.8	19.6	**76.2**	91.5			
2007	4.1	**18.1**	24.6	27.9	**81.1**	96.1			
2009	7.3	**21.0**	28.4	33.6	**85.2**	103			

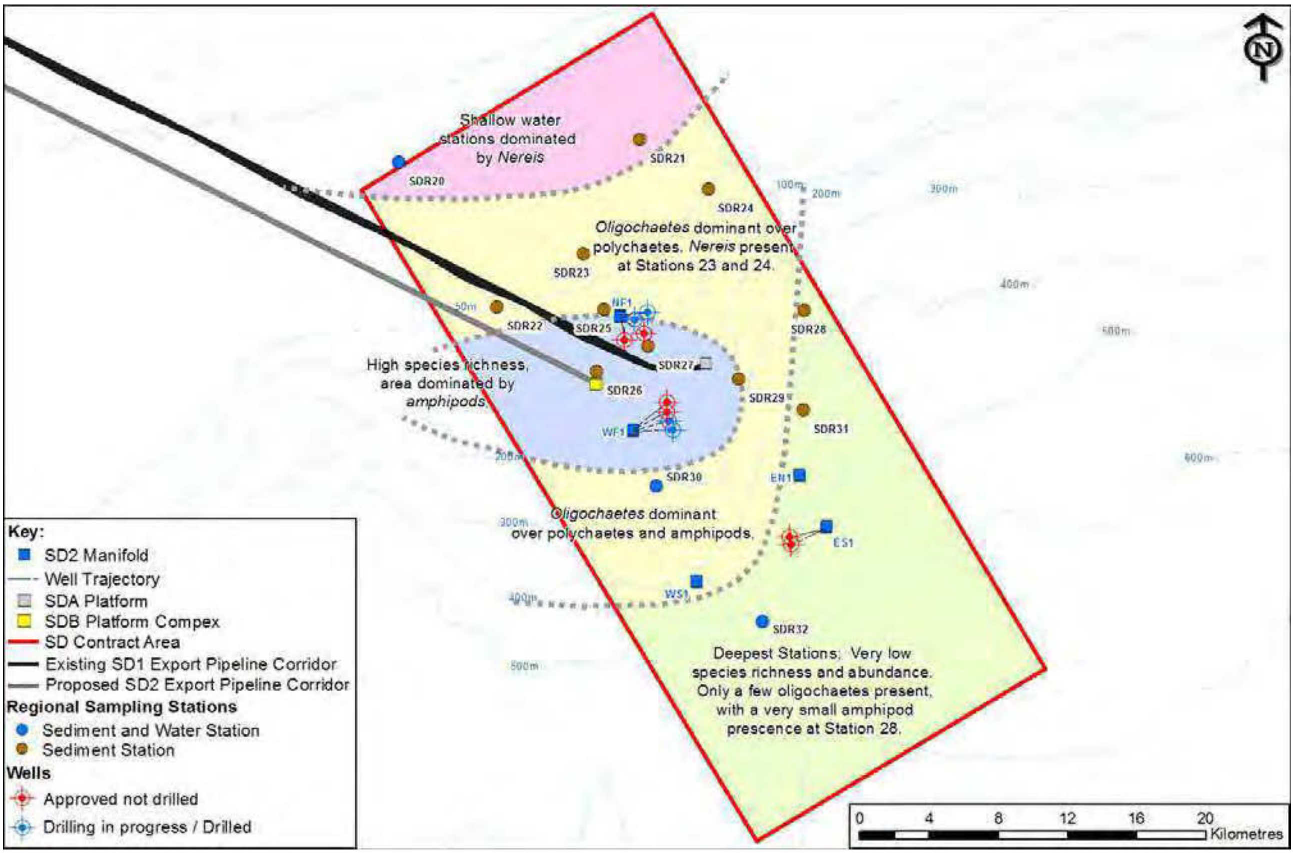
6.7.1.8 Biological Characteristics of Seabed Sediments

A total of 69 taxa were identified in the 2009 SD Contract Area Regional Survey, with 1-51 taxa per station and an average of 13 taxa per station. This is considerably less than the 108 taxa identified in the 2007 SDA Platform Location Baseline Benthic Survey and emphasises the distinctive nature of the area around the SDA location. Amphipods were represented by 30 taxa, and gastropods by 12 taxa during the 2009 SD regional survey, compared to 38 and 29 respectively in the SDA area, observed during the 2007 SDA survey. Amphipod, oligochaete and gastropod species richness has declined moderately over time at the SD regional stations, while the number of polychaete, cumacean and bivalve species has remained fairly constant. There is, however, no consistent trend in average abundance for any taxonomic group.

The total number of species was considerably higher in 1998 (at 90), but has remained relatively constant at between 56 and 62 since 2000. This contrasts with a progressive increase in species richness within the coarser sediments around the SDA platform.

Figure 6.23 summarises the macrofaunal biology spatial trends across the Contract Area in 2009.

Figure 6.23 Macrofaunal Trends across SD Contract Area, 2009



Sensitivity

The benthic environment is dominated by small amphipods, polychaetes and oligochaetes, the majority of which are native or endemic species. These animals are dependent for food on organic material within the sediments, or in particulates immediately above the sediment. The primary forms of potential sensitivity are:

- Chemical contamination of the sediment;
- Smothering of the habitat by solids deposition (such as from deep deposits of drill cuttings); and
- Physical disturbance of the habitat (such as from shallow deposits of drill cuttings).

In the past, water based mud (WBM) cuttings (which do not contain toxic chemical additives) have been discharged to the seabed as part of project activities within the ACG and SD Contract Areas. Extensive monitoring[27] over a number of years at ACG and SD offshore facilities has demonstrated that such discharges do not lead to the contamination of the sediment with harmful, or potentially harmful, chemicals.

Where cuttings deposits are deep (tens of centimetres to metres), the benthic habitat is effectively eliminated. With shallower deposits (less than 10cm, for example), burrowing organisms are capable of re-establishing themselves near the surface quite rapidly. Monitoring has shown that substantial populations can be found in areas of sediment with high barium concentrations (which are the most distinct indication of the presence of shallow drill cuttings deposits).

Alteration of the structure of the habitat by physical events such as cuttings deposition has the potential to interfere with the construction of burrows and with feeding. Extensive monitoring has shown that, even when high barium concentrations indicate the presence of cuttings,

[27] The monitoring surveys form part of the EMP and reported to the MENR within annual EMP reporting.

there is little evidence that the structure of the habitat has been substantially altered. This is likely to be because only cuttings from the top hole sections are discharged, and these consist of poorly-consolidated sediments which are similar in composition to the surficial seabed sediments in which the benthic organisms live.

During periods of discharge, very short-term disruption might occur within a small area, but adaptation will take place rapidly. The dominant benthic infaunal species can produce several generations per year, and can therefore replace short-term losses within weeks or a few months. The period of greatest sensitivity to short-term disruption is likely to be from the end of the breeding season until the beginning of the next breeding season – that is, between autumn and spring. During this period, losses cannot be replenished.

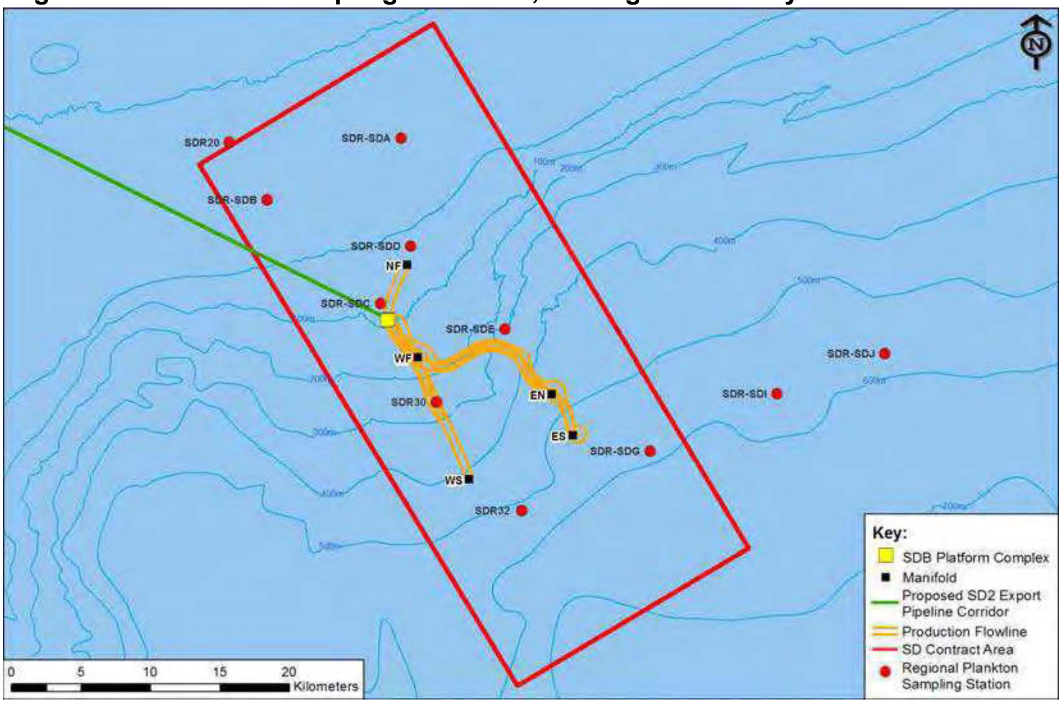
Most offshore biological communities contain one to three native species of filter-feeding bivalves. These organisms are not highly vulnerable to short-term high water turbidity arising from cuttings discharge, as they can close their valves and isolate themselves for several days if necessary. They are, however, effectively immobile and attached to their substrate, and are consequently more vulnerable to smothering from deposits of more than 1-2cm. The presence and abundance of bivalves is very variable at most locations, and they do not therefore form a consistent and permanent component of any local community. This is because they have planktonic larvae, and at any location the persistence of a population depends on a flow of larvae from another location. Larval settlement and recruitment is therefore unpredictable and intermittent, resulting in the occasional development of populations which subsequently decline. Any localised sensitivity to smothering will not effectively alter this pattern of occasional colonisation, although it will have an effect on any populations at other locations which depend on a supply of larvae from the affected site.

6.7.2 Water Column: Biological Environment

6.7.2.1 Plankton

Plankton surveys within the SD Contract Area were undertaken in 2000, 2001, 2005 and 2009[28] with the earlier surveys using a different methodology and sampling locations. Figure 6.24 shows the 2009 regional SD plankton sample locations.

Figure 6.24 Plankton Sampling Locations, SD Regional Survey 2009



[28] Plankton surveys have been regularly undertaken as part of EMP and reported to the MENR within annual EMP reporting.

6.7.2.2 Zooplankton

Zooplankton abundance and diversity were very low in all surveys conducted prior to 2005. The 2005 plankton survey and subsequent surveys used significantly improved equipment and methods. In addition, a greater number of stations were sampled than previously; 10 in total. The most striking aspect of the 2005 results is that, despite methodological improvements and substantially increased sampling effort, the diversity of zooplankton has clearly declined significantly in recent years. These results are supported by similar observations from the SD Contract Area Regional Water Quality/Plankton Surveys conducted in 2007 and 2009.

Over the course of the surveys since 2000, a total of 31 taxa were found, of which 28 were identified to species level (the remaining three were larvae of various types). Three main types of zooplankton were encountered:

- Copepods - small, shrimp-like animals often no more than 1mm long, some native to the Caspian Sea and some introduced from other areas;
- Cladocerans - 'water fleas', often larger than copepods (1 - 5mm long), predominantly native to the Caspian; and
- Ctenophore - 'comb jelly' - one species, which is not native to the Caspian and was first recorded in the Caspian Sea in 1999 (this species may have been transported into the Caspian from the Black Sea via the Azov Sea and the Don canal system).

The most abundant zooplankton species in the surveys between 2000 and 2009 were the native copepods *Eurytemora sp* and the invasive copepod *Acartia sp.* Since 2005, *Acartia sp* has been the dominant copepod species present, but was found in very high abundance in many samples. Native cladocera were represented by very low numbers of only two or three species (10 species were present in the 2001 survey). This data appears to reflect a significant decline in zooplankton diversity, which may be associated with the continued presence of *Mnemiopsis sp*, an invasive species of comb jelly, which has no natural predators and which itself is an effective predator on zooplankton and fish larvae.

6.7.2.3 Phytoplankton

The composition and diversity of the phytoplankton has remained comparatively unchanged. The phytoplankton was of similar diversity to the zooplankton in 2000 and 2001, with a total of 33 species identified in samples collected from three surveys. An additional four species were identified in the 2005 regional survey, bringing the total for the Contract Area to 37 species. With the exception of the July 2000 survey, when only 10 species were present in samples, the number of species found per survey has remained fairly constant at 18 - 21. The diversity and abundance of phytoplankton was lower in 2000 than in 2001, but this difference is probably due to a combination of natural variability and the very limited extent of the surveys. In the 2009 regional survey, a total of 34 species were identified; this is the highest number recorded in any regional survey to date.

Baccillariophyta (which are diatoms) were the most diverse group overall, represented by 15 species. Dinophytes were the next most diverse group, represented by 11 species. Cyanophytes (blue-green algae) were represented by eight species and chlorophytes by six species. Two species of the dinophyte *Prorecentrum (cordata* and *obtusum*) were present in all surveys. The diatoms *Pseudosolenia fragilissima* and *Chaetoceros wighamii* occurred in similar frequency, and often similar abundance, to the two dinophyte species. The cyanophytes *Oscillatoria sp* and *Lyngbya sp* were abundant in all surveys.

Sensitivity

Although phytoplankton and zooplankton are sensitive to chemical contamination at an individual level, this does not mean high sensitivity at the population level. Plankton populations can grow rapidly from just a few individuals (phytoplankton populations can double in 12 hours, copepod zooplankton populations in 2-3 days). This means that populations can re-establish quickly, which is a natural feature of plankton ecology. In some instances, rapid growth can offset the effects of chemical contamination.

Phytoplankton are dependent on light to photosynthesise and are therefore, confined to the upper layers of the water column. Periods of high turbidity, such as those associated with cuttings discharge, can interfere with this process. Cuttings from drilling rigs are usually discharged about 10m below the sea surface. The thermocline (above which the phytoplankton populations grow) is located at a depth of 30-40m in the summer. Consequently, a cuttings 'plume' will only travel 20-30m downwards before crossing the thermocline. Over this distance, the plume will have undergone little dispersion, and the volume of water subject to high turbidity will therefore be small. Even on a local scale, this means that phytoplankton at a population level are not sensitive to cuttings discharge.

Both phytoplankton and zooplankton can be sensitive to aqueous discharges, such as cooling water which has been treated with corrosion control systems. However, dispersion modelling of this type of discharge has demonstrated that sufficient dilution will occur within a short distance so that any impact will be minimal and the viability of local populations will not be affected.

6.7.2.4 Fish

Fish commonly found in the SD Contract Area can be categorised into the three following types:

- Migratory species: This includes sturgeon and shad species whose spawning grounds are the river Kura and other rivers of the south-western and southern Caspian. They will only be present in the Contract Area as individuals passing through;
- Resident species: Several non-commercial species such as gobies are present within the nearshore and, less frequently, in offshore waters of the South Caspian throughout the year. Therefore, individuals may be present within the Contract Area during all seasons; and
- Other species (Semi Migratory): The kilka (herring family) is the most abundant fish in Caspian fisheries. Kilka are plankton feeders and have a wide distribution in the Caspian with important areas in the south and the middle Caspian, which is likely to include the Contract Area. They are themselves important prey for other species such as sturgeon, salmon and the Caspian seal. They have been observed in the Contract Area mostly during the winter. Mullet were introduced from the Black Sea in the 1930s. They normally overwinter in the southern Caspian and they migrate in the spring to feeding grounds in the middle and northern Caspian. Spawning takes place in deep waters between June and September. Mullet can be expected in the Contract Area.

The migration routes and spawning areas of fish species found within the SD Contract Area are shown in Figures 6.25 and 6.26.

Figure 6.25 Herring, Mullet and Sturgeon Migration Routes

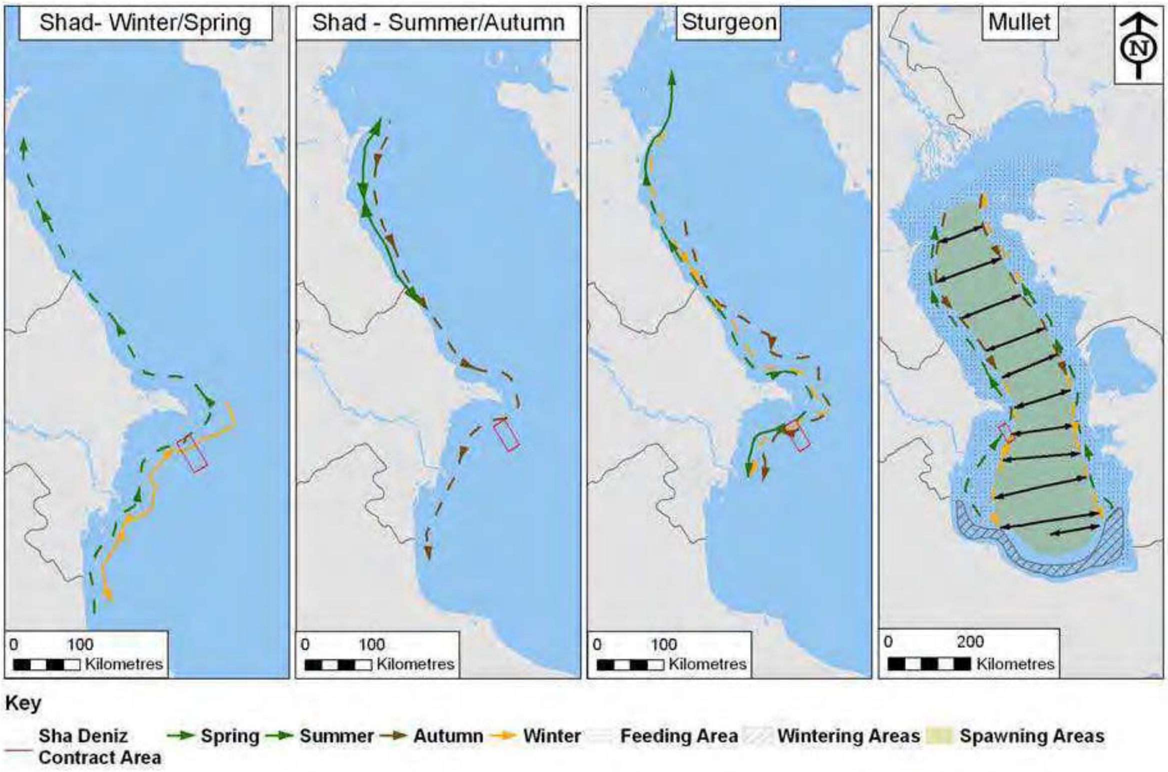


Figure 6.26 Kilka and Beluga Migration Routes

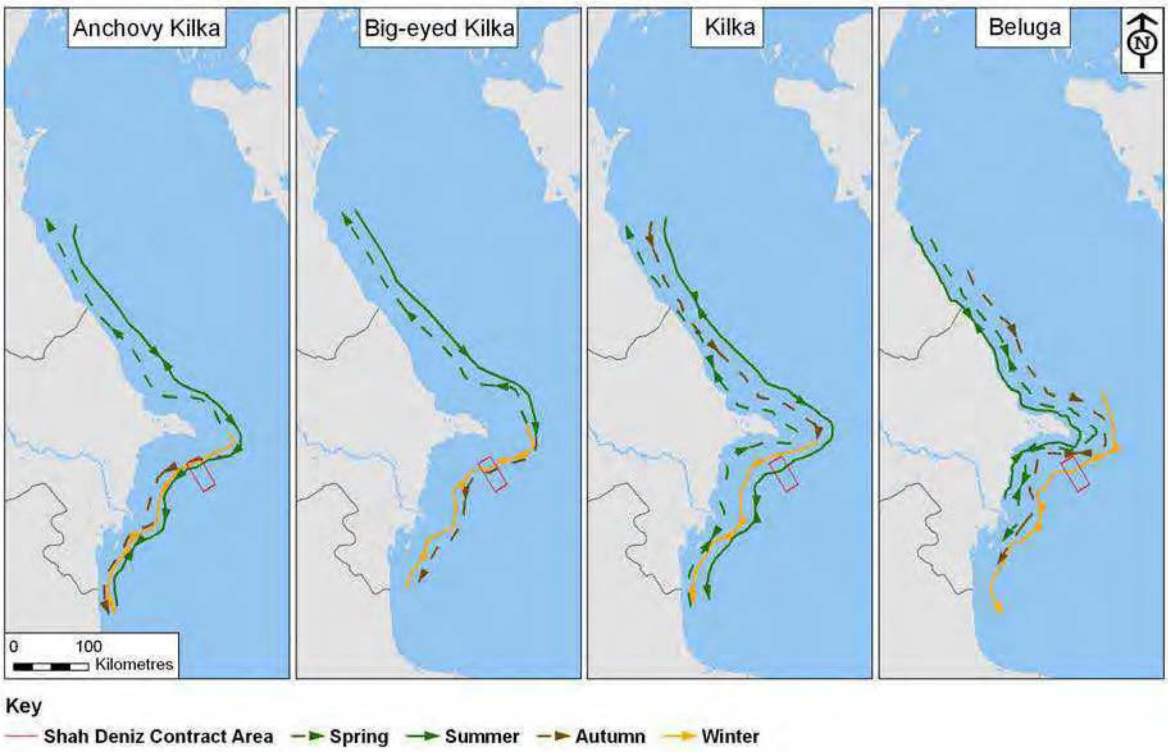


Table 6.27 shows the months when species are likely to be present in the vicinity of the Southern Caspian and SD Contract Area.

Table 6.27 Seasonal Fish Presence in the Vicinity of the Southern Caspian and SD Contract Area

Species	Activity	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Resident Fish e.g. Goby	Feeding												
	Breeding												
Carp/Herring	Feeding												
Sturgeon	Migrating												
Shad	Migrating												
Kilka	Feeding												
	Breeding												
Mullet	Feeding												
	Breeding												

A review undertaken in 2008 of the fish recorded in the SD Contract Area and adjacent areas of the Caspian Sea is summarised in Table 6.28[29].

Table 6.28 Summary of the Review of Fish Species in the SD Contract Area and Adjacent Areas of the Caspian Sea, 2008

Name of Species	Importance	Depth of Occurrence*** (m below sea level)
Acipenseridae family – sturgeons* **		
Beluga – *Huso huso* (Linne)*	IUCN Endangered	Sp/Sum: up to 70m A/W: up to 80-100m
Sturgeon, Russian sturgeon – *Acipenser guldenstadti* (Brandt)*	IUCN Endangered	
Kura (Persian) sturgeon – *Acipenser güldenstädtii persicus natio cyrensis* (Belyaeff) *	IUCN Endangered	
Kura barbel sturgeon – *Acipenser nudiventris* (Derzhav, Borsenko)*	IUCN Endangered	
Kura (South-Caspian) stellate sturgeon – *Asipenser stellatus stellatus natio cyrensis* (Berg) *	IUCN Endangered	Sp/Sum: up to 50m A/W: up to 75-100m
Clupeidae family – Herrings **Clupeonella genus (Kessler) – Kilka ********		
Anchovy kilka – *Clupeonella engrauliformis* (Borodin) *	IUCN Low Vulnerability	Sp/Sum: up to 40m A: up to 60-80m W: up to 100-300m
Big-eyed kilka – *Clupeonella grimmi* (Kessler) *	IUCN Low Vulnerability	Sp/Sum: up to 80m A: up to 80-100m W: up to 130-450m
Caspian common kilka – *Clupeonella delicatula caspia* (Stetovidov)*	IUCN Low Vulnerability	Sp/Sum/A/W: up to 30-40m
Alosa Cuvier genus – herring ******		
Caspian shad – *Alosa caspia caspia (Eichwald)* *	IUCN Least Concern	Sp/Sum/A: up to 30-40m W: Deeper, depth not known
Big-eyed shad – *Alosa brashnikovi autumnalis (Berg)* *	IUCN Least Concern	
Volga shad – *Alosa kessleri volgensis* (Berg)*	IUCN Least Concern	Sp/Sum/A: Depth not known W: Greater than 100m
Black-backed shad – *Alosa kessleri kessleri* (Grimm) *	IUCN Least Concern	
Cyprinidae family – Carps		
Kutum – *Rutilus frisii kutum* (Kamensky)*	IUCN Least Concern	Sp/Sum/A/W: up to 20-50m
Mugilidae family – Gray Mullets ******		
Golden mullet – *Lisa auratus* (Risso) *	IUCN Least Concern	Sp/Sum/A/W: up to 400-500m
Leaping mullet – *Lisa saliens* (Risso) *	IUCN Least Concern	Sp/Sum/A/W: up to 200-300m
Gobiidae family – Gobiids, ********		
Caspian goby – *Neogobius caspius* (Eichwald)	IUCN Least Concern	Sp/Sum/A/W: up to 30-50m Less frequent up to 80-100m
Round goby – *Neogobius melanostomus affinis* (Eichwald)	IUCN Least Concern	
Caspian syrman goby – *Neogobius syrman eurystomus* (Kessler)	IUCN Least Concern	
Monkey goby – *Neogobius fluviatilis pallasi* (Berg)	IUCN Least Concern	
Knipovich long-tailed goby – *Knipowitschia longicaudata* (Kessler)	IUCN Least Concern	
Caspian big-headed goby – *Neogobius kessleri gorlap* (Iljin)	IUCN Least Concern	Sp/Sum/A/W: up to 30-50m
Grimm big-headed goby – *Benthophilus grimmi* (Kessler)	IUCN Least Concern	Sp/Sum/A/W: up to 30-50m
Deepwater goby – *Neogobius bathybius* (Kessler)	IUCN Least Concern	Sp/Sum/A/W: up to 300-500m
Knipowitschia Iljini (Berg)	IUCN Least Concern	Sp/Sum/A/W: up to 300-400m
Mesogobius nonultimus (Iljin)	IUCN Least Concern	
Anatrirostrum profundorum (Berg)	IUCN Least Concern	
Persian Goby - *Benthophilus ctenolepidus* (Kessler)	IUCN Least Concern	

* Have swim bladder
** Sometimes lacking swim bladder depending on species.
*** All species valuable commercial fish
**** All species important food source for other fish and seals.
*** Sp – Spring   Sum – Summer   A – Autumn   W – Winter

[29] Refer to Appendix 6C

Gobies are second only to herring by their number of species in the Caspian Sea; they are present in all regions of the sea, predominantly in shallower areas (up to 30-70m in spring and summer, migrating to greater depths in winter). Based on commercial fishing catch records, kilka is the most abundant fish present (in terms of biomass) in the Caspian and associated river estuaries, accounting for 75% of total fish catch in the Caspian, with sturgeon representing the second highest catch (Refer to Appendix 6C for more details).

Sensitivity

Seasonal sensitivity for fish species is shown in Table 6.28. Fish species that are known to breed in the area include resident fish species, such as gobies, kilka and mullet. Gobies breed between April and July, mullet between June and September, while kilka breed between January and November.

During previous drilling activities undertaken in the SD Contract Area drilling discharges generated turbid plumes of limited duration and dimension. It is anticipated that fish species will avoid these plumes.

As noted in Table 6.28, most of the fish species possess a swim-bladder. The swim-bladder is a gas-filled sac found in most bony fishes of the class Osteichthyes. The swim-bladder performs a number of different functions such as acting as a float which gives buoyancy, as a lung and as a sound-producing organ. In addition, the swim bladder can enhance the hearing capability of the fish species through the amplification of underwater sound. Fish with swim-bladders therefore tend to be more sensitive to sound than those that do not possess such an organ. Subsequently, there is potential for such species of fish to be more susceptible to underwater noise than fish with no swim-bladder.

In Table 6.28 a number of the fish species with swim-bladders have also been classified as ‘endangered’ or ‘near threatened’, such fish include all the sturgeon species.

6.7.2.5 Caspian Seal

The Caspian seal (*Phoca Caspica)* is endemic to the Caspian Sea and has been listed on the IUCN red list as ‘Endangered’ since October 2008[30]. The Caspian seal population has decreased by more than 90% since the start of the 20th century and continues to decline, considered to be due to commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations using nets. Historically, the population of Caspian seals was estimated to have exceeded one million. In 2005, it was estimated that the total population was approximately 111,000[31]. Subsequent surveys[32,33] of Caspian seal pup numbers carried out on the winter ice-field in Kazakhstan territory (the primary breeding ground for Caspian seals) have reported further reductions in population as a result of reductions in pup production[34].

The Caspian seals distribution throughout the Caspian Sea is dictated by migration patterns. Migration routes are illustrated in Figure 6.27. They typically spend the summer months in the Central and Southern Caspian, migrating north-east in the autumn (October–December). Females typically give birth in the early winter (mid-January to late February) on ice at haul out sites in the Northern Caspian and pups enter the water around late March. Migration to the south begins around April to May. It should be noted that the Caspian seal is a transboundary species which migrates throughout the whole of the Caspian over an annual cycle. As such there is no exclusive Azerbaijan population although the species does make

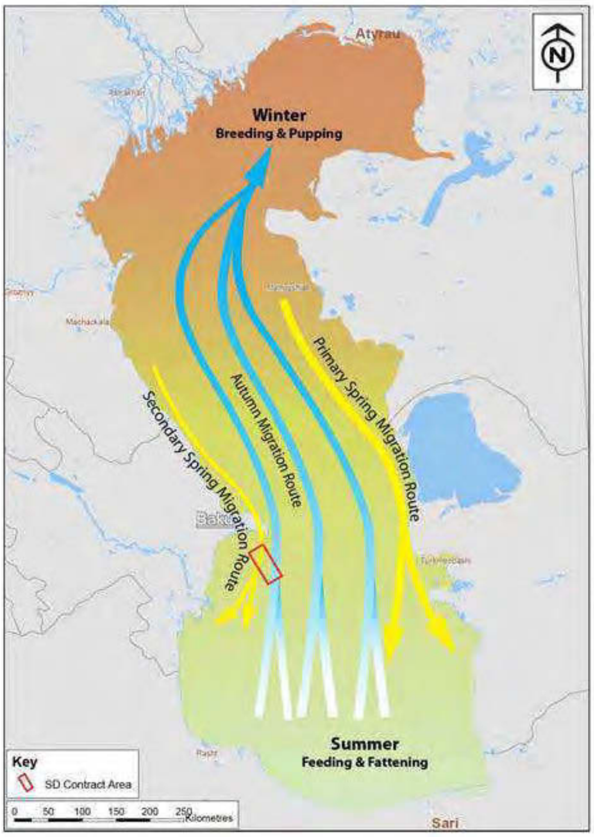
[30] www.iucnredlist.org/apps/redlist/details/41669/0
[31] Caspian International Seal Survey (2005). Population size and density distribution of the Caspian seal (*Phoca caspica*) on the winter ice field in Kazakh waters 2005.
[32] Caspian International Seal Survey (2008). Caspian seal survey 2007 Final Report.
[33] Harkonen, T, Jussi, M., Baimukanov, M., Bignert, A, Dmitrieva, L., Kasimbekov, Y., Verevkin, M., Wilson, S. and Goodman, S. J. (2008). Pup Production and Breeding Distribution of the Caspian Seal (*Phoca caspica*) in Relation to Human Impacts. Ambio Vol. 37, No. 5, 356-361.
[34] The reports from the latest surveys do not provide estimates for the total population of Caspian seals and base their population estimates on pup production only.

use of Azeri waters at different times of the year. Both breeding and migration timings can change by up to a month subject to weather conditions.

Analysis of seal monitoring studies undertaken in 2009 (see Appendix 6D) suggests that the population of seals visiting the Azerbaijani sector of the Caspian Sea includes approximately 10-15,000 individuals. The maximum concentration of seals is observed during spring around the islands of the Absheron archipelago. Their number in this region is estimated to be a minimum of 5,000 individuals[35]. Small groups of seals have also been observed along the shoreline, from Yalama seashore to the Lenkoran coast, during the spring-summer-autumn season[24]. Evidence from Krylov[36] has indicated that approximately 10-15,000 seals remained in the Southern Caspian at the end of the 20th century at the rookeries and in the open sea. Seal activity in the Contract Area is expected to be highest in spring when up to 4,000 seals may migrate towards Iranian Waters to the south. During the migration north in the autumn, numbers are expected to be less (1,000-2,000 individuals), with the seals travelling alone or in small shoals. Small numbers of seals are expected to be present in summer (approximately 500) with only very low numbers present in the winter months.

The diet of Caspian seals is poorly understood, particularly in relation to patterns of spatial and temporal data. There are no up to date comprehensive studies of seal diet at present although a literature review carried out in 1995[37] suggests a large percentage of the total seal population migrates to the middle and southern Caspian between May and June to feed in areas rich in pelagic (deepwater) fish species. During late summer and early autumn, many seals move offshore to feed in deeper waters, which include the SD Contract Area. It is thought they feed here until September when the majority of them migrate to the north. While commercially important species such as herring and kilka are probably eaten by seals, there is little quantitative information available to confirm this.

Figure 6.27 Caspian Seal Migration Routes



[35] Unpublished data collected as part of the Darwin Initiative – due for publication Summer 2010.
[36] Krylov I. V. (1990), Resources and rational use of Caspian Seals in current ecological conditions, pp78-98. In: Some aspects of biology and ecology of Caspian Seal, VNIRO, Moscow, 1990. 100p.
[37] AIOC (1995). Environmental Baseline Study Literature Review, 1995, Woodward Clyde International.

Sensitivity

The main causes of the Caspian seal's population decline are complex but are thought to be associated with hunting, fishing activities, outbreaks of Canine Distemper Virus (CDV), invasive species and pollution (mainly organochlorides such as DDT).

Seals are directly and indirectly sensitive to spills (such as oils or chemicals) and ongoing discharges which contribute to contamination over time. They are most vulnerable during the breeding season and feeding periods (May to November). Seals are dependent on eyesight to hunt and are therefore sensitive to any increases in turbidity which may result from oil and gas activities such as vessel movements, platform operations and installation activities involving disturbance of the seabed sediment.

Although seals are classed as marine mammals they spend considerable periods of time on land. As a consequence, seals are known to hear very well in-air as well as underwater. When diving or swimming, they may be susceptible to impacts arising from high levels of underwater sound. The response to noise is determined by its duration, sound pressure level and frequency and ranges from changes in behaviour to, in extreme instances, fatality. Physical injury or fatalities have been observed to occur at a sound level of 220 dB re. 1μPa and 240 dB re. 1μPa, respectively and auditory damage (temporary and permanent) has been observed at 75dB and 95dB, respectively. Temporary duration is usually assumed to be up to 30 minutes and permanent over eight hours. As with fish, Caspian seals can detect sound at lower sound levels and may adopt an avoidance response. The same impact level criteria as presented above are commonly used to determine avoidance.

Table 6.29 sets out the most sensitive times of the year for the Caspian seals in the Southern Caspian with particular reference to the SD Contract Area.

Table 6.29 Caspian Seal Sensitivity per Season within SD Contract Area

Sensitivity	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Most sensitive period/ expected presence												
Moderately sensitive period/ some presence												
Least sensitive period/ not present												

6.7.3 Water Column: Chemical Environment

Water samples taken at three of the same regional survey stations as the plankton samples (stations 20, 30 and 32 – see Figure 6.24) indicated that water quality was generally good in 2005, 2007 and 2009 (Tables 6.30 and 6.31), with no evidence of significant contamination.

Table 6.30 Hydrocarbon and Phenol Concentrations in Water Samples, SD Regional Surveys 2005, 2007 and 2009

Station	Year	Depth (m)	THC (µg/l)	16 US EPA PAH, (µg/l)	Phenols (µg/l)
20	2009	5	<20	<0.01	-
	2007	5	<20	<0.01	<30
	2005	5	80	<0.01	60
	2009	25	<20	<0.01	-
	2007	25	<20	<0.01	<30
30	2009	5	<20	<0.01	-
	2007	5	<20	<0.01	<30
	2005	20	62	<0.01	<30
	2009	100	<20	<0.01	-
	2007	100	<20	<0.01	<30
	2005	100	53	<0.01	<30
32	2009	5	<20	<0.01	-
	2007	5	<20	<0.01	<30
	2005	10	67.5	<0.01	<30
	2009	100	<20	<0.01	-
	2007	200	<20	<0.01	<30
	2005	200	48.5	<0.01	60

2005 phenol concentrations at locations 20 (at 5m depth) and 32 (at 200m depth) may be anomalous and should be disregarded

Table 6.31 Heavy Metal Concentrations in Water Samples, SD Regional Surveys 2005, 2007 and 2009 (µg/l)

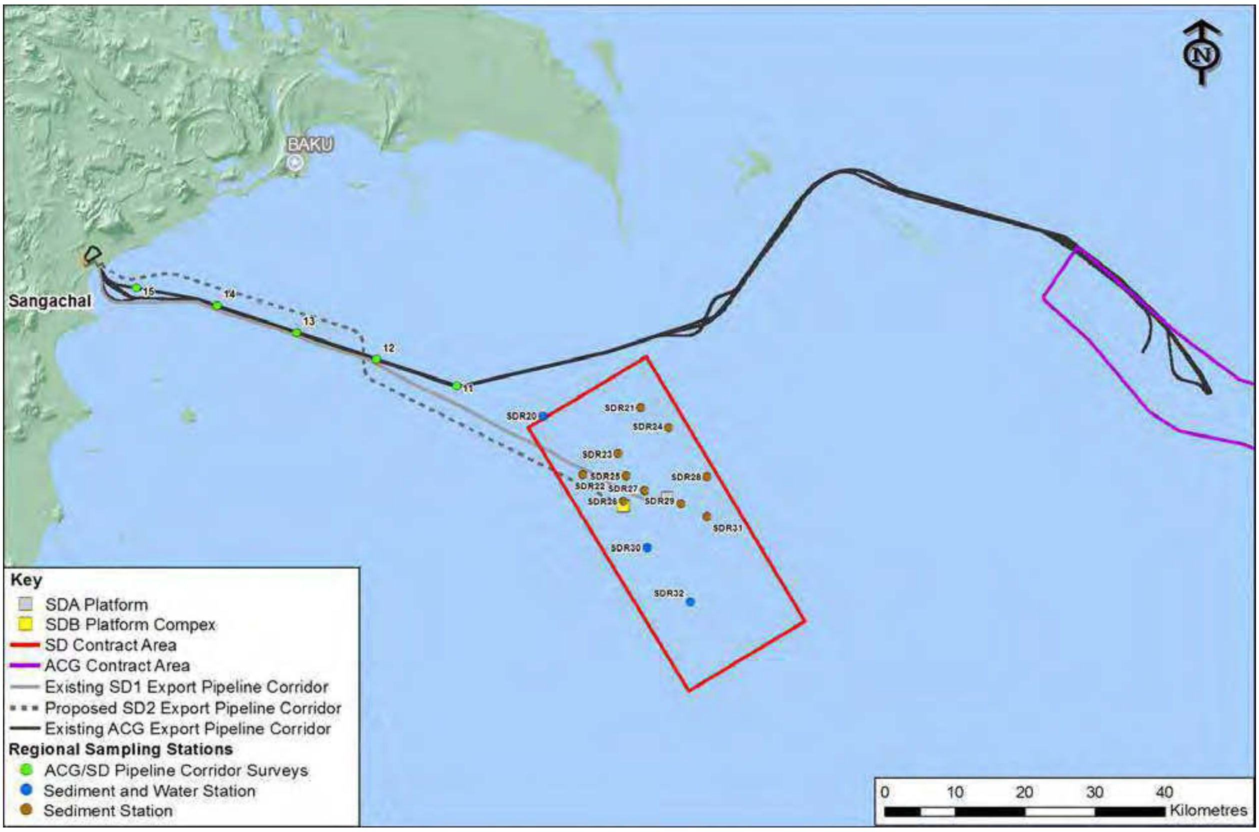
Station	Year	Depth (m)	Iron	Cobalt	Nickel	Copper	Zinc	Cadmium	Lead
20	2009	5	17.8	0.055	1.12	0.93	2.6	<0.02	1.45
	2007	5	<10	0.027	0.93	1.04	3.41	0.18	0.12
	2005	5	<10	0.046	1.08	0.77	1.63	0.02	0.06
	2009	25	37.5	0.055	1.25	0.81	3.28	<0.02	0.21
	2007	25	<10	0.026	0.89	0.98	2.94	0.01	0.10
30	2009	5	2.5	0.050	0.92	0.75	1.99	<0.02	<0.10
	2007	5	<10	0.019	0.76	0.76	0.73	0.01	0.05
	2005	20	<10	0.039	0.99	0.71	3.78	0.02	0.08
	2009	100	8.5	0.026	1.11	0.58	3.54	<0.02	<0.10
	2007	100	<10	0.008	0.79	0.62	0.57	0.02	0.02
	2005	100	<10	0.021	1.01	0.64	2.02	0.02	0.06
32	2009	5	<2.0	0.049	0.92	0.78	1.7	<0.02	0.25
	2007	5	<10	0.019	0.75	0.68	1.09	0.01	0.05
	2005	10	<10	0.032	1.03	0.73	1.43	0.01	0.04
	2009	100	4.6	0.037	1.17	0.70	2.09	<0.02	<0.10
	2007	200	<10	0.006	0.91	0.68	0.79	0.02	0.04
	2005	200	<10	0.008	0.7	0.41	0.8	0.01	0.02

6.8 Offshore Environment Specific to the SD2 Project Locations

6.8.1 SD2 Subsea Export Pipeline Route

The ACG Export Pipeline Corridor accommodates the ACG EOP, Phase 1 and Phase 2 oil and gas condensate pipelines. Environmental surveys have been carried out along this corridor in 1995 (prior to first pipeline installation), and in 2000, 2006, 2008 and 2010 (covering the period during and after the installation of the ACG Phase 1 and 2 pipelines). Sample stations 15, 14, 13, 12 and 11 lie along the route of the proposed SD2 Subsea Export Pipeline. These stations lie in water depths of 13-19m, roughly perpendicular to the Sangachal Bay shoreline, with station 11 located close to the northern edge of the SD Contract Area. In addition, SD regional survey sample stations 20, 22, 25 26 and 27 are located in close proximity to the proposed SD2 Subsea Export Pipeline Route (Figure 6.28).

Figure 6.28 Survey Sample Locations in the Vicinity of the Proposed SD2 Subsea Export Pipeline Route



6.8.1.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

The 2010 survey indicated that sediments found closest to shore at stations 14 and 15 (13-15m water depth) (Figure 6.28) are composed of coarse grained silt with higher carbonate content and lower silt-clay and organic content. At stations 11-13, located further offshore in depths of 16-19m, sediment are classified as fine silt, with higher silt-clay and organic and lower carbonate content. Sediment samples collected from stations 12 and 13 were similar to sediments in the north-western part of the Contract Area at regional stations 20 and 22 (Table 6.32). The sediments of the pipeline route in the vicinity of the proposed SD Bravo (SDB) Platform Complex are distinctive (regional stations 26 and 27). These sediments are composed of medium to fine sands with high carbonate content and low organic and silt/clay content.

Table 6.32 Physical Properties of Sediments, SD Regional Survey Stations, 2009

Parameter	Station Number				
	20	22	25	26	27
Mean diameter µm	9	7	6	231	60
% Carbonate	27	25	25	63	43
% Organic	5.4	7.3	6	2.9	4.6
% Silt/Clay	95	99	99	38	60

Hydrocarbon Concentrations

Data on hydrocarbon concentration in sediments within the SD Contract Area and along the proposed SD2 Export Pipeline route are available from pipeline surveys conducted in 2000, 2006, 2008 and 2010, and a SD Contract Area regional survey conducted in 2009.

ACG pipeline stations all lie in water of less than 20m depth, on the coastal shelf. Hydrocarbon concentrations (Table 6.33) decrease with distance from the coast (from pipeline survey stations 15 to 11), but show some temporal variation. Over the ten-year period covered by the surveys, there has been an overall decline in hydrocarbon concentrations at these shallow-water stations, although concentrations at stations 14 and 15 were higher in 2006 than in 2000. The results of the 2008 and 2010 surveys reported much lower concentrations which were more consistent with the observations at stations 11, 12 and 13.

Table 6.33 Hydrocarbon Concentrations at the ACG Pipeline Sediment Survey Stations, 2002, 2006, 2008 and 2010

Station Number	THC (µg/g)			
	2000	2006	2008	2010
11	453	296	107	69
12	440	435	153	123
13	552	364	149	250
14	465	709	202	215
15	431	1,175	250	206

Within the proposed SD2 Subsea Export Pipeline Route within the SD Contract Area, sediment hydrocarbon concentrations range from 20-37 µg/g at stations 26 and 27, to 140-294 µg/g in the shallower water stations closer to shore (refer to Table 6.34). The higher near-shore concentrations are partly due to proximity to shore-based sources of contamination, and partly because the sediments at these stations contain a high proportion of silt and clay, and therefore adsorb organic compounds to a greater extent than the coarser sediments near the SDB Platform Complex location.

Table 6.34 Hydrocarbon Concentrations within the Proposed SD2 Subsea Export Pipeline Corridor, 2009

Station Number	THC (µg/g)
20	148
22	294
23	145
25	160
26	20
27	37

Heavy Metal Concentrations

The levels of trace metals in the sediment follows the same general pattern of the sediment physical properties along the ACG subsea pipeline route. Arsenic concentrations varied little along the pipeline route, and were typical of Caspian sediment background levels at all stations. Several metals (copper, zinc, chromium, cadmium and iron) exhibited similar trends to arsenic in which concentrations increased slightly along the shelf route, then decreased again at stations 14 and 15.

The pattern for lead differed from other metals, with concentrations following an almost linear gradient from typical offshore levels and increasing towards the coast.

Concentrations of mercury in the shallow-water pipeline stations were consistently 3-5 times higher than typical offshore background levels. It is probable that most of the mercury present at stations 11-15 are a result of historical industrial contamination.

6.8.1.2 Biological Characteristics of Seabed Sediments

The macrobenthic community within the SD Contract Area section of the proposed SD2 Subsea Export Pipeline Route was characterised by a generally low abundance and species richness. Four groups of stations were found to exist within the data and were related to depth and distance from the coast (Figure 6.28).

- Shallow water stations 20, closest to the shore, had low abundance and species richness, with species numerically dominated by the polychaetes *Nereis sp*;
- Stations 22 and 25, also located in shallow water, had generally low abundance and species richness. Oligochaetes were numerically dominant over polychaetes and amphipods; cumacea were either absent or present in very low numbers; and
- Stations 26 and 27 were adjacent to one another and located in the centre of the SD Contract Area. Abundance and species richness were highest at these stations and the communities present were dominated by abundant, diverse populations of amphipods. Station 26 also had a high abundance of cumaceans. However, cumacean abundance at station 27 was low.

The available data indicates that the macrobenthic communities along the proposed SD2 Subsea Export Pipeline Route were influenced by the sediment composition. Table 6.35 summarises the overall trend in terms of numbers of taxa and individual organisms.

Table 6.35 Summary of Species Richness and Individual Abundance, Pipeline Survey, 2006, 2008 and 2010

Station Number	Taxa			Individuals (m^2)		
	2006	2008	2010	2006	2008	2010
11	9	5	9	593	67	243
12	8	3	5	823	427	493
13	7	10	12	2,023	1473	1947
14	5	8	8	2,003	367	1580
15	11	9	7	597	510	2280

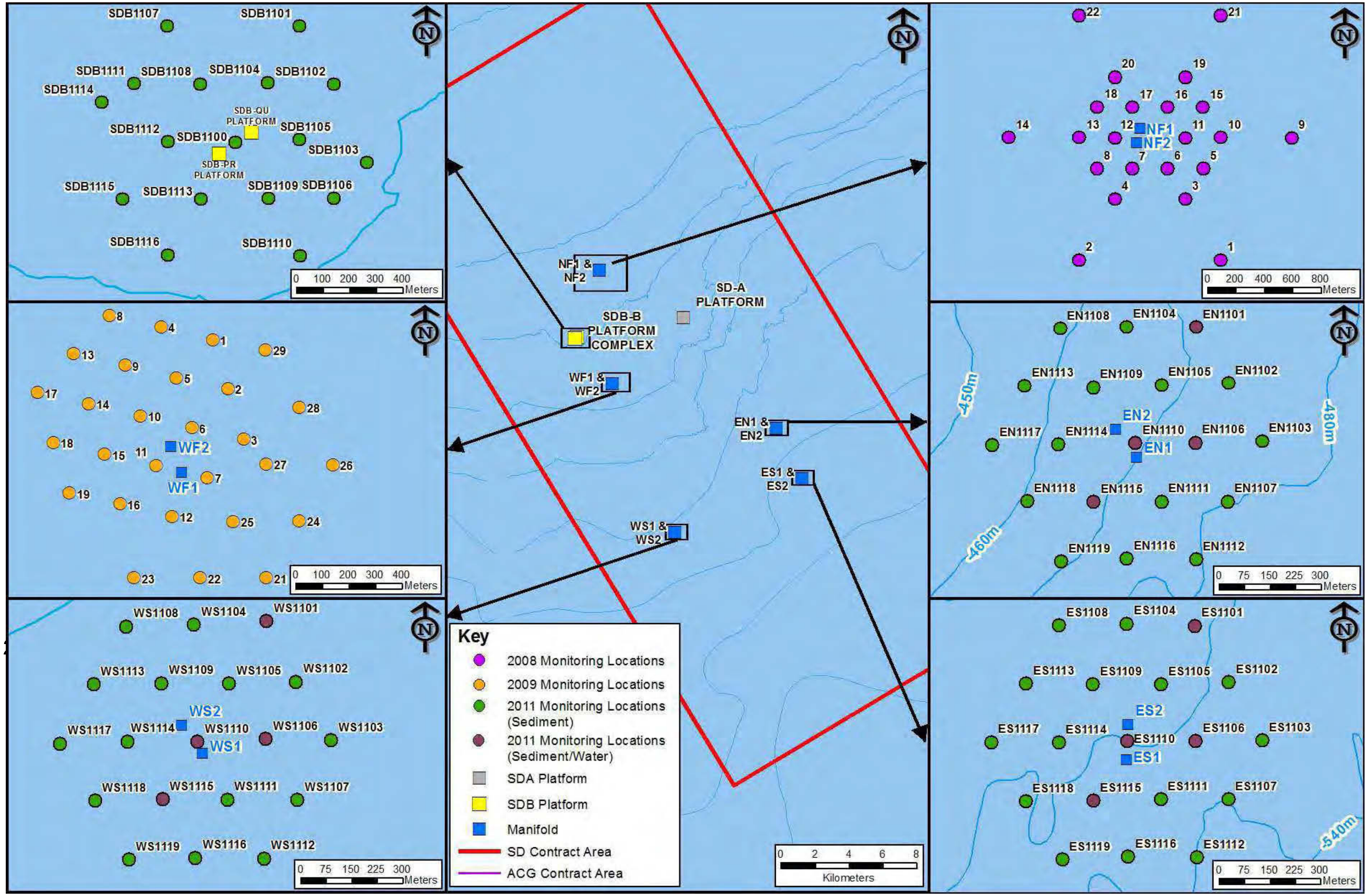
Species richness and abundance were higher in the deeper water locations (68m or more), and then reduced considerably to lower levels at stations 11 and 12.

Species richness and abundance at stations 11-15 vary between years. The communities of stations 11-15 are dominated by a small number of alien or invasive species, with only one typical offshore species (*Hypaniola kowalewskii*) consistently present in abundance. The alien polychaete *Nereis sp* was the dominant or subdominant presence at all stations.

6.8.2 SDB Platform Complex Location

A baseline survey in the vicinity of the proposed SDB Platform Complex location was carried out in 2011. The water depth in this location is approximately 95-99m. Figure 6.29 shows the monitoring survey locations in addition to the monitoring locations in the vicinity of the proposed SD2 manifolds.

Figure 6.29 Survey Sample Locations in the Vicinity of SDB Platform Complex and SD2 Manifold Locations



6.8.2.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

Table 6.36 summarises the physical properties of the sediments at the SDB Platform Complex location. Sediments are predominantly in the range of medium to coarse sand, with low organic content, low silt-clay content, and high carbonate content. These properties are similar to those observed at the SDA and NF locations (refer to Section 6.8.4).

Table 6.36 Average Physical Sediment Characteristics – SDB Platform Complex Location (2011)

	Mean Diameter µm	% Carbonate	% Organic	% Silt/Clay	% Silt	% Clay
Min	229	55	1	11	4	7
Max	1,077	79	4	36	14	22
Median	455	66	2	20	8	13
Mean	499	67	2	22	8	13

Hydrocarbon Concentrations

Table 6.37 summarises the 2011 sediment hydrocarbon concentrations at the SDB Platform Complex location. Concentrations within each sample were low; a characteristic of locations within the central area of coarse sediment within the SD Contract Area.

Table 6.37 Statistical Summary of Sediment Hydrocarbon Concentrations, SDB Platform Complex Location (2011)

	THC (ug/g)	UCM (ug/g)	% UCM	2-6 PAHs (ng/g)	NPD (ng/g)	%NPD	16 EPA (ng/g)
Min	5	4	64	110	65	51	26
Max	56	43	82	414	246	63	125
Median	29	24	79	243	143	58	58
Mean	29	23	78	247	140	57	63
St Dev	11	9	3	62	34	3	21
CV	36	37	4	25	24	5	34

Heavy Metal Concentrations

Table 6.38 provides a statistical summary of the concentrations of metals in sediments at the SDB Platform Complex location. The range of concentrations for each metal was similar to those observed over a number of surveys at the SDA location, and at the NF location. In general, these concentrations reflect the high carbonate and low mineral (silt and clay) content of the sediments.

Table 6.38 Statistical Summary of Heavy Metal Concentrations in SDB Platform Complex Location Sediments (µg/g)

	As	Ba HNO^3	Ba Fusion	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
Min	6	320	385	0.094	22	10	0.023	17,200	479	10	35
Max	17	840	1,085	0.171	51	24	0.076	29,900	751	17	73
Median	11	474	698	0.121	37	18	0.049	22,750	590	12	55
Mean	11	527	720	0.124	37	18	0.047	22,765	592	13	53

6.8.2.2 Biological Characteristics of Seabed Sediments

Table 6.39 summarises the biological characteristics of the SDB Platform Complex location, and compares these to the characteristics of the SDA location, which have been determined over a series of surveys. In the 2011 SDB Platform Complex survey, overall biological diversity was high, with a total of 94 taxa recorded. However, the majority of these taxa occurred infrequently and were present in low abundance: 90% of the total abundance was accounted for by only one-third of these taxa, and overall more than 60% of abundance was accounted for by two genera of amphipods (*Corophium* and *Gammarus*). While in total annelids represented about 10% of overall abundance, no individual species accounted for more than 4% of abundance. The high diversity, accompanied by high dominance of amphipods, reflects a seabed habitat which provides a varied habitat which can be more effectively exploited by more mobile organisms, while providing niches for a broader spectrum of other species.

Table 6.39 indicates that the benthos at the SDB Platform Complex location is similar in composition to that at the SDA location. As noted above, sediment composition and chemistry are also similar at the two locations.

Table 6.39 Comparison of Species Richness and Total Abundance between SDA Location (2001-2009) and SDB Platform Complex Location (2011)

	SDA				SDB
	2001	2005	2007	2009	2011
Class Polychaete Species	6	8	10	8	7
Class Polychaete Individuals	20,324	38,280	26,614	19293	9,210
Class Oligochaete Species	6	6	4	3	4
Class Oligochaete Individuals	5,594	5,407	3,429	3540	4,907
Order Cirripedia (*Balanus*)	48	1,797	2,253	4427	3,350
Order Cumacea Species	10	11	15	10	7
Order Cumacea Individuals	2,256	4,750	5,287	1033	4,550
Order Amphipod Species	32	31	38	35	38
Order Amphipod Individuals	12,616	44,047	36,811	36037	44157

6.8.3 WF Location

The WF location is situated in approximately 163m of water; almost midway between regional survey stations 26 and 30 (see Figure 6.29).

6.8.3.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

Stations 26 and 30 have very different sediment properties; the former has coarse sediment (mean particle diameter of 439μm in 2007), while the sediments at the latter station are very fine silt (mean particle diameter of 6μm in 2007).

The WF location is close to the southern margins of the central area of relatively coarse sediment, and it lies within the depth range of the regional stations within this zone (92 - 250m). During 2009, sediment samples were taken from a total of 29 stations in the vicinity of the WF location (refer to Figure 6.28 for location survey area). Sediments were predominantly in the range of fine to coarse silt, with overall average characteristics as summarised in Table 6.40.

Table 6.40 Average Physical Sediment Characteristics – WF Location (2009)

	Mean Diameter µm	% Carbonate	% Organic	% Silt/Clay	% Silt	% Clay
Min	7	19	2.16	25	9	17
Max	109	41	7.18	96	41	60
Median	19	27	3.63	66	23	41
Mean	26	27	3.89	66	25	41

There was a general trend towards coarser sediment in the north-west of the survey area, and finer sediment in the south-east of the survey area (refer to Figure 6.30).

Hydrocarbon Concentrations

The WF location lies within the area identified in Figure 6.22, within which sediment hydrocarbon concentrations have been consistently low over time.

Sediment THC concentrations were low or very low at most stations, with a median concentration of 11µg/g. Higher concentrations (247-323µg/g) were observed only at stations 20 and 26, to the extreme south and east of the survey area respectively (see Figure 6.30). With the exception of these two stations, THC concentrations ranged from 2.6 to 49µg/g. The concentrations of PAH were proportional to the THC concentrations, and all components were heavily weathered, with no indication of recent fresh inputs. Comparison of the sediment diameter sizes and THC across the WF survey area indicates that, in general, the lowest hydrocarbon concentrations were associated with the coarser sediments.

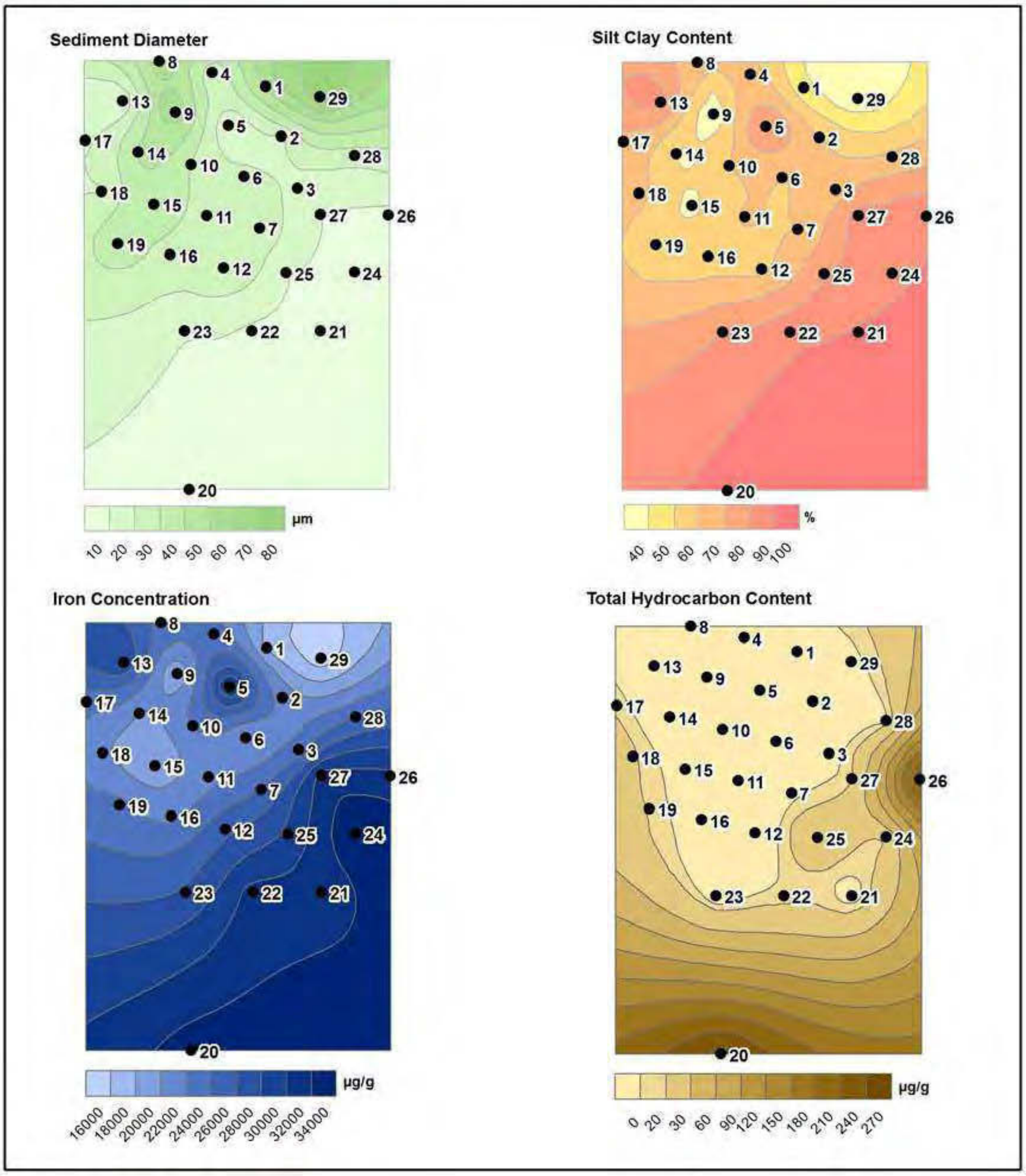
Heavy Metal Concentrations

Table 6.41 presents a statistical summary of sediment heavy metal concentrations. Overall variation between stations was low (coefficient of variation between 6 and 36% of average values), and was particularly low for barium and manganese. However, despite the low variation, there was a distinct pattern of distribution of concentrations for most metals; this pattern is illustrated in Figure 6.30 for iron, but is very similar for chromium, copper, mercury, lead and zinc. As is the case with hydrocarbons, there is a tendency towards higher concentrations in sediment with finer particle size and higher silt-clay content. For barium, manganese and cadmium there was no clear pattern of distribution.

Table 6.41 Statistical Summary of Heavy Metal Concentrations in WF Location Sediments (µg/g)

	As	Ba HNO^3	Ba Fusion	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
Min	4.4	232	386	0.06	32.9	10.7	0.01	16,500	453	5.6	38.6
Max	28.1	416	646	0.18	97.6	35	0.12	39,500	698	24.3	96.9
Median	18	326	482	0.13	57	19.1	0.05	25,300	526	15.6	61.5
Mean	17.8	325	489	0.13	59.7	21.2	0.05	26,371	525	15.9	63.4
St Dev	5.2	37	59	0.03	15.9	6.8	0.02	5,434	34	3.5	14.7
%CV	29	11	12	20	27	32	36	21	6	22	23

Figure 6.30 WF Location Sediment Survey Results



6.8.3.2 Biological Characteristics of Seabed Sediments

A total of 55 valid, discrete, macrobenthic invertebrate taxa were identified in the sediment samples. Species richness ranged from eight at station 26 to 34 at station eight, and total abundance (excluding ostracods) ranged from $177m^2$ at station 20 to $1,413m^2$ at Station 13. The lowest species richness and abundance were associated with the two stations at which particularly high hydrocarbon concentrations were observed. Average species richness and abundance were 17 and $888m^2$, respectively.

Species richness and total survey abundance are compared in Table 6.42 between the WF survey, 2009 and four successive surveys at the SDA location. This indicates that the community at WF location is numerically dominated by oligochaetes (principally of the genera *Isochaetides* and *Psammoryctides*), but that amphipods and gastropods are represented by the largest number of taxa (21 and 13 respectively). Polychaetes are relatively poorly represented both in terms of abundance and of species richness, and bivalves were completely absent. Overall, the benthos of the WF location is less diverse and less abundant than at the SDA location.

Table 6.42 Comparison of Species Richness and Total Abundance between SDA Location Surveys (2001-2009) and WF Survey (2009)

	SDA				WF
	2001	2005	2007	2009	2009
Class Polychaete Species	6	8	10	8	4
Class Polychaete Individuals	20,324	38,280	26,614	19293	1,603
Class Oligochaete Species	6	6	4	3	4
Class Oligochaete Individuals	5,594	5,407	3,429	3540	17,593
Order Cirripedia (*Balanus*)	48	1,797	2,253	25340	23
Order Ostracod Individuals	7,000	6,847	7,000	25340	400,333
Order Cumacea Species	10	11	15	10	8
Order Cumacea Individuals	2,256	4,750	5,287	1033	1787
Order Amphipod Species	32	31	38	35	21
Order Amphipod Individuals	12,616	44,047	36,811	36097	3717
Order Isopoda Individuals	64	287	44	37	3
Class Insect Individuals	490	907	634	497	683
Class Gastropod Species	5	18	28	18	13
Class Gastropod Individuals	554	2,170	4,192	430	120
Class Bivalve Species	7	6	5	4	0
Class Bivalve Individuals	5,802	21,910	3,437	1023	0

A comparison of the WF location benthos with nearby regional survey stations (Table 6.43) indicates that the WF location is more similar to these stations than it is to the SDA location. Although amphipod and gastropod species richness is higher at the WF location in 2009, most of the taxa in both groups are present in very low abundance. However, amphipods are numerically more important at Regional Stations 26 and 27 than at WF location or Regional Station 30.

Table 6.43 Comparison of Species Richness and Average Abundance between Four SD Regional Survey Stations and WF Survey

	Station 26			Station 27				Station 30				WF
	2001	2007	2009	2001	2005	2007	2009	2001	2005	2007	2009	2009
Class Polychaete Species	2	3	5	1	5	2	4	1	2	3	2	4
Class Polychaete Individuals	119	216	1113	502	333	208	47	66	333	522	50	55
Class Oligochaete Species	3	3	3	4	3	3	2	3	2	2	3	4
Class Oligochaete Individuals	208	166	117	684	547	238	53	179	87	454	397	607
Order Cumacea Species	4	5	5	5	3	5	3	3	8	3	1	8
Order Cumacea Individuals	274	214	297	238	43	114	30	343	247	114	7	62
Order Amphipod Species	7	12	27	12	15	10	13	2	2	1	2	21
Order Amphipod Individuals	412	1,056	2377	1,469	2,823	878	527	6	10	54	67	128
Order Isopoda Individuals	0	0	0	0	3	6	3	0	0	0	0	0
Class Insect Individuals	0	6	0	0	3	10	0	30	40	14	0	24
Class Gastropod Species	0	1	7	0	0	1	1	7	1	2	0	13
Class Gastropod Individuals	0	4	43	0	0	2	20	66	3	6	0	4
Class Bivalve Species	2	3	2	3	3	3	0	0	0	0	0	0
Class Bivalve Individuals	195	196	100	119	197	52	0	0	0	0	0	0

There was a weak spatial trend towards higher oligochaete, cumacean and amphipod abundance and species richness in the north and north-west of the survey area. In contrast, polychaete abundance was higher in the south-east of the survey area. Overall, species richness and total abundance was higher in coarser sediments and lower in sediments with the highest silt-clay content.

6.8.4 NF Location

A benthic survey was conducted at the NF location in 2008 during which a total of 23 stations were sampled in water depths ranging from 66 to 80m (see Figure 6.29).

6.8.4.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

The mean particle diameter of sediments ranged from 5 to 1,613µm, with median and average values of 148 and 276µm, respectively. Sediment at most stations was classified as fine to coarse sand; the fine silt which is characteristic of most of the SD Contract Area was encountered at only two stations. The sediments at the NF location appear to be similar to the comparatively coarse sediments found in the area around the SDA location.

Hydrocarbon Concentrations

Sediment TPH concentrations ranged from 10 to 460µg/g with median and mean concentrations of 33 and 67µg/g, respectively. High concentrations were observed at only the two stations where fine silt was present; excluding these stations, total hydrocarbon concentrations were uniformly low and within the range of 12 - 65µg/g. PAH concentrations were closely correlated with total hydrocarbon concentrations. The hydrocarbon in all samples was heavily weathered, indicating that there had been no recent inputs of new material within the survey area.

Heavy Metal Concentrations

Sediment heavy metal concentrations are summarised in Table 6.44. The low coefficient of variation (% CV or the standard deviation as a percentage of the average) indicates that there was little systematic variation across the survey area. Typically, the CV associated with sampling and analytical variation is 15 - 20%. Therefore, values lower than this indicate that the true variation is less than the methodology can measure with precision. Concentrations were similar to, or lower than, concentrations observed at regional survey stations.

Table 6.44 Statistical Summary of Sediment Heavy Metal Concentrations (µg/g) at the NF Location, 2008

Station	As	Ba HNO3	Ba Fusion	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
Min	6.6	280	335	0.05	54.3	21.3	0.14	28,750	519	12.3	66.1
Max	18.5	495	550	0.102	81.7	31.2	0.23	40,350	673	20.6	102.3
Median	11.2	330	410	0.066	65	23.5	0.18	33,050	557	13.6	76.4
Mean	11.5	359	431	0.069	65.2	24.3	0.18	33,224	572	14.4	78.1
St Dev	3	72	66	0.015	7	2.6	0.03	2,929	44	2.1	8.5
%CV	26	20	15	22	11	11	17	9	8	14	11

6.8.4.2 Biological Characteristics of Seabed Sediments

A total of 98 macrobenthic taxa were identified in samples from the 23 stations, with between 43 and 64 taxa per station (excluding the two stations with fine silty sediment). The number of taxa per major group and the total abundance per group are summarised in Table 6.45. This shows that amphipods (the genus *Corophium* in particular) are dominant in terms of both species richness and abundance. Species richness at the NF location is considerably higher overall than was observed in the 2007 regional survey; and is comparable to the consistently high richness observed at the SDA location. The results of the survey therefore confirm previous observations that the coarser sediments of the central zone of the SD Contract Area consistently support a more diverse and abundant benthic community than the rest of the SD Contract Area.

Table 6.45 Summary of the Species Richness and Total Abundance in the 2008 NF Location Survey

Class/Order	Number of Species	Abundance
Turbellaria	1	7
Nematodes	1	1,643
Polychaeta	7	9,160
Oligochaeta	4	7,827
Hirudinea	1	13
Cirripedia	1	26,940
Ostracoda	1	37
Mysidacea	1	30
Cumacea	10	6,793
Amphipoda	47	53,709
Isopoda	1	7
Insecta	1	167
Bivalvia	11	6,683
Gastropoda	11	337

Overall, the NF location is similar to the SDA location in terms of sediment structure, chemistry and biology. Compared to most of the Contract Area, these locations have coarser sediment, with lower levels of hydrocarbons and heavy metals; and with a richer and more abundant benthic biological community.

6.8.5 WS Location

The WS Manifold location is the most southerly within the SD Contract Area and is situated at a water depth of 407-420m. The environmental baseline information for WS presented below is based on surveys carried out at the SDX4 well location in 2005 and at the WS location in 2011. A survey of the SDX4 location was also carried out in 2008. However, the results of the 2008 survey are not included here as they are very similar to the 2005 results in terms of sediment composition, chemistry and biology. This indicates the baseline conditions in this location appear to be relatively stable and that there is no evidence to date of any environmental impact from drilling activities. Figure 6.29 indicates the survey sample locations for the 2011 survey.

6.8.5.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

A benthic survey, undertaken in 2005, for the SDX4 exploration well location comprised five sampling stations. Sediments in all samples were classified as fine silt, and there was very little variation in mean particle size (5-10 μm) and silt-clay content (>99.9%) across the survey area.

The 2011 baseline survey was more extensive, covering 19 stations in a triangular array. Sediments at all stations were classified as very fine silts, with mean particle diameter ranging from 5-6 μm, carbonate content of 22-25%, organic content of 7-9.6%, and silt/clay content of 99.9-100%. The sediments around the WS location are, therefore, very uniform in composition.

Hydrocarbon Concentrations

Table 6.46 presents a summary of the SDX4 2005 and WS 2011 baseline surveys.

Table 6.46 WS Hydrocarbon Sampling Results, 2005 and 2011

	SDX4 2005	WS 2011	SDX4 2005	WS 2011	SDX4 2005	WS 2011	SDX4 2005	WS 2011	SDX4 2005	WS 2011
	THC, µg/g		UCM, %		Total 2-6 ring PAH ng/g		% NPD		USEPA 16 PAH ng/g	
Min.	137	159	72	74	664	784	36	50	129	175
Max.	266	364	77	85	1,623	1,429	43	59	328	350
Median	181	301	75	78	987	1,276	41	55	190	300
Mean	183	295	75	78	982	1,276	41	55	196	297
St. Dev.	36	43	1	3	279	106	2	2	59	25
%CV	20	15	2	3	28	8	5	4	30	8

The homogeneity of the sediments in the SDX4 survey was reflected in a very small degree of variation in hydrocarbon concentrations, with an average THC value of 183µg/g and a coefficient of variation of 20%. UCM concentration was consistently around 75%, indicating that the hydrocarbons were well-weathered and that there had been no recent contaminating inputs. Variation was even lower in the 2011 survey, with a coefficient variation of 15%. Average THC concentrations in 2011 were higher than in 2005, however, at 295 µg/g. Average concentrations of 2-6 ring PAH and USEPA 16 PAH were also higher, although the range of values was very similar between the two surveys, The percentage UCM was similar in both surveys. The percentage of PAH represented by NPDs was higher in 2011 than in 2005, possibly indicating the deposition of some relatively fresh PAH in the interval between surveys, although in both cases the evidence indicates considerable weathering at the time of sampling.

Heavy Metal Concentrations

Table 6.47 presents the summary statistics for sediment heavy metal concentrations in the 2005 and 2011 surveys. Heavy metal concentrations were very uniform, and typical of background ‘crustal’ levels. There was little difference in concentrations between surveys. Arsenic and cadmium concentrations were slightly higher in 2011, while barium and mercury concentrations were slightly lower.

Table 6.47 Statistical Summary of Sediment Heavy Metal Concentrations at WS1 Well Location

		Concentration of Heavy Metals, µg/g									
		As	Ba HNO_3	Ba Total	Cd	Cr	Cu	Fe	Hg	Pb	Zn
Min.	2005	5.9	335	1021	0.14	65	22	27,750	0.08	20	77
	2011	9.9	777	879	0.19	62	35	34,490	0.05	23	88
Max.	2005	9.2	504	5347	0.17	87	39	32,799	0.19	27	90
	2011	11.9	1,090	1,130	0.24	73	41	38,740	0.1	28	96
Median	2005	7.5	404	3,948	0.16	74	24	29,704	0.1	23	84
	2011	10.7	853	925	0.22	68	37	35,775	0.08	23	91
Mean	2005	7.7	415	3,672	0.16	75	28	29,963	0.11	23	83
	2011	10.8	871	950	0.22	68	37	35,829	0.076	24	91

6.8.5.2 Biological Characteristics of Seabed Sediments

A total of nine taxa were identified in the 2005 survey as shown in Table 6.48. These comprised two polychaete species, four oligochaete species, two amphipod species and one cumacean species. Both abundance and biomass were relatively low; polychaetes and oligochaetes represented the bulk of the biomass at all stations.

In the 2011 survey, a total of 10 taxa were recorded, including two species of hydrozoa and one species of bryozoan. A single nematode was recorded. The bulk of the community comprised three species of oligochaete, one species of cumacean, and two amphipod species. Only the oligochaete species were present at all stations and in moderate abundance; the cumacean and amphipod species were represented by single individuals. In 2011, polychaetes were completely absent, as were gastropods and molluscs. In both surveys, the community was sparse and largely dominated by a single species of oligochaete, *Iisochaetides michaelseni*.

Table 6.48 Summary of the Species Richness and Total Abundance in the 2005 WS1 Location Survey

Taxon	Abundance	Frequency of Occurrence (%)
Hypania invalida	537	100
(Hypania invalida juv)	3	20
Hypaniola kowalewskii	7	20
Isochaetides michaelseni	1,310	80
Psammoryctides deserticola	420	100
(Psammoryctides spp indet)	3	20
Tubificidarum spp	3	20
Stylodrilus cernosvitovi	16	40
(Mysidae spp)	72	100
Schizorhynchus eudorelloides	363	60
Gmelina costata	9	60
Niphargoides grimmi	3	20

6.8.6 ES Location

A baseline survey, comprising 13 stations, was undertaken at the SDX5 well location in 2007 which is within the vicinity of the ES location. Water depth ranged from 530m to 557m. Further surveys were carried out in 2010 (SDX5 post-drilling survey, 15 stations) and 2011 (ES baseline survey, 19 stations). Figure 6.29 presents the samples locations in the 2011 ES baseline survey.

6.8.6.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

During the 2007 survey it was found that sediments were uniformly very fine silts, with mean particle diameter of 4-7 µm at all stations, and were very similar to sediments previously sampled during regional surveys at stations of similar depth.

Summary statistics for the surveys undertaken in 2010 and 2011 are presented in Table 6.49 below. This data confirms the observations of 2007, that is, that sediments are generally very fine silts. The range of values for most parameters is larger than in 2007, however; this is attributable to the presence of coarser sediment at a single station in each survey (SDX5-8 and ES-10). With the exception of these stations, sediments were very similar in all three surveys, over the entire area covered by sampling.

Table 6.49 Summary of Physical Properties of Sediments at the ES Location

		Mean diameter Xµm	Carbonate %	Organic %	Silt/Clay %	Silt %	Clay %
Min.	2011	5	19	4.0	95	31	8
	2010	5	14	1.9	82	36	7
Max.	2011	17	33	11.7	100	87	68
	2010	26	35	12.2	100	74	64
Median	2011	5	27	7.7	100	38	61
	2010	6	26	8.7	100	40	59
Mean	2011	6	27	7.8	99	40	59
	2010	7	25	8.3	99	43	55

Hydrocarbon Concentrations

Sediment total hydrocarbon concentrations in 2007 ranged from 109-241 parts per million (ppm), with an average concentration of 160 ppm, and were all highly weathered. There was little systematic variation in concentration across the survey area as can be seen in Table 6.50. Concentrations were, however, 2-4 times lower than in regional survey stations at similar depth.

Maximum concentrations of THC and PAH were higher in 2010 and 2011 than in 2007, and the range of values was also wider. In both surveys, traces of Linear alpha olefin (LAO) drilling fluid were found in a small number of sample replicates, corresponding to those in which coarser sediment was observed.

Table 6.50 ES Location Hydrocarbon Sampling Results, 2007, 2010 and 2011

		THC, µg/g	UCM, %	Total 2-6 ring PAH ng/g	NPD ng/g	% NPD	Phenols µg/g
Min	2007	109	66	525	281	43	0.6
	2010	103	43	528	289	49	0.38
	2011	23	71	103	43	35	0
Max	2007	241	80	1,405	732	54	6.6
	2010	786	77	2,433	1,245	81	3.25
	2011	2,847	88	1,813	707	63	4
Median	2007	155	74	997	485	52	3.4
	2010	236	73	1,581	794	51	1.98
	2011	214	76	839	323	40	2
Mean	2007	160	74	994	499	50	3.5
	2010	269	71	1,489	770	53	1.89
	2011	399	76	954	382	41	2

Heavy Metal Concentrations

Heavy metal concentrations were, at most stations in all surveys, typical of natural silt-clay mixtures, and varied very little between replicates and stations (refer to Table 6.51). In 2010 and 2011, however, extremely high concentrations of barium were observed at the same stations (SDX5-8 and ES-10) in which coarser sediment occurred. These barium concentrations were sufficiently high to suggest that the samples consisted mainly of water-based drilling mud. High barium concentrations were associated with higher cadmium concentrations. With the exception of barium and cadmium, there was little systematic or substantial variation between surveys, although the range for most metals was wider in 2011 than in 2007; the wider range is likely to be attributable to the apparent presence of WBM in some samples, which will have 'diluted' natural sediment to some extent.

Table 6.51 Statistical Summary of Sediment Heavy Metal Concentrations at the ES Location

		Concentration (µg/g)										
		As	Ba HNO3	Ba Fusion	Cd	Cr	Cu	Fe	Hg	Mn	Pb	Zn
Min	2007	8.7	446	658	0.18	51.8	41.8	33,021	0.07	777	22.9	76.5
	2010	2.7	635	778	0.18	11.6	36.1	20,500	0.03	739	24.7	33
	2011	8	414	683	0.01	29	37	28,800	0.04	711	14	49
Max	2007	14.5	643	802	0.27	77.9	46.5	41,674	0.09	934	25.6	88.5
	2010	13.0	24,800	426,000	0.88	70.6	63.3	43,800	0.15	1,740	38.2	115
	2011	13	6,199	169,600	0.88	75	45	45,900	0.21	1160	25	97
Median	2007	11.7	563	751	0.24	67.3	44.2	36,864	0.08	831	24.5	83
	2010	7.0	735	885	0.23	62.9	40.6	39,600	0.10	839	27.7	105
	2011	11	660	937	0.25	72	41	41,150	0.09	790	24	88
Mean	2007	11.4	553	742	0.23	66.1	44.1	37,174	0.08	838	24.4	82.7
	2010	7.0	2,607	33,556	0.27	59.5	41.7	38,269	0.10	893	28.3	99
	2011	11	923	9153	0.25	71	41	40,806	0.09	831	23	87

6.8.6.2 Biological Characteristics of Seabed Sediments

As shown in Table 6.52 only four taxa were recorded during the 2007 survey, all at very low abundance; one species of polychaete, two species of oligochaete, and one amphipod species. This is typical for such deep water stations, and is similar to data from regional survey stations at a similar depth.

Only three taxa were recorded in the 2010 post-drilling survey (refer to Table 6.53), while 12 taxa were recorded in the 2011 survey (refer to Table 6.54). However, five of these taxa were represented by only a single individual, Only ostracods were present in moderate abundance at all stations, and at most stations only one or two taxa were present.

Overall, the three surveys are consistent in indicating that the community at this location and depth is impoverished and marginal.

Table 6.52 Recorded Taxa at SDX5 Well Location in 2007 per m^2

Taxon	Station												
	01	02	03	04	06	07	08	09	11	12	13	14	15
Nereis sp	0	0	0	3	0	0	0	0	0	0	3	0	0
Tubificidae sp.indet	0	0	0	0	3	0	0	0	0	0	0	7	0
Isochaetides michaelseni	16	10	23	3	0	27	33	13	0	57	3	3	10
Niphargoides caspius	0	0	3	0	0	0	0	0	0	0	0	0	0

Table 6.53 Recorded Taxa in SDX-5 Post Drill Survey 2010 per m^2

Taxon	Station												
	01	02	03	04	06	07	08	09	11	12	13	14	15
Isochaetides michaelseni	3	0	7	3	0	3	0	0	0	7	13	3	3
Balanus improvisus	0	0	0	0	0	0	823	0	0	0	0	0	0
Ostracoda spp	13	17	0	0	220	43	0	37	0	0	0	23	0

Table 6.54 Recorded Taxa in the ES Baseline Survey 2011 per m^2

Taxon	Station																		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
Cordylophora caspia						p	p			p	p	p		p	p		p		
Bougainvillia megas			p				p						p					p	
Tubificidae spp.	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balanus improvisus	0	7	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	7
Ostracoda spp	3	33	60	10	7	7	70	7	53	0	17	20	17	3	13	13	10	20	37
Mysidae caspia	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Gammaridae spp.	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus pauxillus	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium spp	0	20	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dreissenidae spp	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mytilaster lineatus	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Conopeum seurati		p	p	p	p	p	p		p	p	p			p	p	p	p	p	p

6.8.7 EN Location

The EN location is situated in a water depth of 456-480m. A baseline survey was carried out in 2011, in which samples were collected from 19 stations. Figure 6.29 presents the sampling locations of the 2011 survey.

6.8.7.1 Physical and Chemical Composition of Seabed Sediments

Physical Properties of Sediments

Table 6.55 summarises the physical properties of sediments. With the exception of one station replicate, all samples were classified as very fine silts, with mean particle diameters of 6-7 µm, consisting of 99-100% silt-clay.

Table 6.55 Summary of Physical Properties of EN Location Sediments 2011

	Mean diameter Xµm	Carbonate %	Organic %	Silt/Clay %	Silt %	Clay %
Min	6	21	7	97	41	49
Max	16	32	11	100	51	59
Median	6	27	9	100	47	53
Mean	7	27	9	100	47	53

Hydrocarbon Concentrations

Table 6.56 summarises the hydrocarbon concentrations in the sediments collected during the 2011 baseline survey. With the exception of phenols, coefficients of variation were very low, indicating that there was no real or systematic variation in concentrations across the survey area. Hydrocarbon concentrations were consistent with those previously observed for very fine, deep-water sediments in the SD Contract Area. Percentage UCM and NPD values indicated that the aliphatic and aromatic components were weathered, with no indication of recent fresh inputs of hydrocarbon material.

Table 6.56 Summary of EN Location Hydrocarbon Concentrations 2011

	THC (ug/g)	UCM (ug/g)	% UCM	2-6 PAHs (ng/g)	NPD (ng/g)	%NPD	16 EPA (ng/g)	Phenols (ug/g)
Min	285	210	71	1,201	662	53	251	0.041
Max	490	388	81	1,616	996	64	351	0.183
Median	351	272	77	1,399	840	60	295	0.079
Mean	356	274	77	1,397	837	60	297	0.088
St Dev	42	38	3	84	66	2	20	0.056
CV	12	14	3	6	8	4	7	64

Heavy Metal Concentrations

Metal concentrations are summarised in Table 6.57. Concentrations were typical of earth crust values, reflecting the high silt and clay content, and showed extremely low variation between stations.

Table 6.57 Summary of Sediment Heavy Metal Concentrations at the EN Location 2011

	Concentration (µg/g)										
	As	Ba HNO3	Ba Fusing	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
Min	10.3	641	727	0.15	63	37	0.089	34,850	707	23	88
Max	16.6	848	947	0.27	75	39	0.113	39,470	1,142	24	99
Median	12.6	802	900	0.24	68	38	0.094	37,200	1,011	24	91
Mean	12.6	799	895	0.24	69	38	0.094	37,165	1,016	24	91

6.8.7.2 Biological Characteristics of Seabed Sediments

The sediments at the EN location were almost abiotic. Only 133 individuals (70 oligochaetes and 63 ostracods) were recorded in the entire survey area.

6.8.8 Summary

Tables 6.58 and 6.59 summarise the physical, chemical and biological characteristics of the sediments at the six locations. These characteristics are influenced by two principal factors – water depth, and sediment coarseness. Although Table 6.59 would seem to indicate that there is a very strong relationship between depth and coarseness, this is partly a coincidence, due to the fact that the NF and SDB Platform Complex locations lie within an area of comparatively coarse sediment in the centre of the SD Contract Area; there are many locations at similar depth elsewhere in the Contract Area where sediments are much finer.

Overall, concentrations of hydrocarbons and heavy metals are higher in the WS, ES and EN sediments and lower in the WF and NF sediments. This reflects the variation in silt and clay content, with concentrations of most parameters higher in the finer, silty sediments. Hydrocarbons at all locations were heavily weathered, and no indication of organic or inorganic chemical contamination was observed at any of the locations.

Macrobenthic invertebrate species richness and abundance were very low in the deepwater WS, ES and EN locations.

Species richness and abundance at the WF location was typical of the central area of the SD Contract Area, and polychaetes, oligochaetes, amphipods and gastropods were well-represented. Species richness and (for some taxonomic groups) abundance was substantially higher at the SDB Platform Complex and NF locations, and were similar to levels routinely observed at the SDA location. NF and SDB Platform Complex locations lie within a central area of relatively coarse sediments, and this area consistently supports a more diverse fauna than the rest of the SD Contract Area. The WF location is intermediate in characteristics between the area of shallow-water coarse sediment occupied by NF, SDB Platform Complex and SDA, and the deepwater, fine sediments of the WS, ES and EN locations.

Table 6.58 Comparison of Sediment Median Particle Size (um), Total Hydrocarbon Concentration (THC, µg/g) and Heavy Metal Concentrations (µg/g)

Location	Depth (m)	Median Particle Size	µg/g											
			THC	As	Ba HNO^3	Ba Fusion	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
SDB	95	455	28	11	474	698	0.12	37	18	0.05	22,750	590	12	55
NF	70	148	33	11	330	410	0.07	65	23	0.18	33,050	557	13	76
WF	163	19	11	18	326	482	0.13	57	19	0.05	25,300	526	15	61
WS	410	6	301	11	853	925	0.22	68	37	0.08	35,775	849	23	91
ES	550	5	214	11	660	937	0.25	72	41	0.09	41,150	790	24	88
EN	475	6	351	12	802	900	0.24	68	38	0.09	37,165	1,016	24	91

Table 6.59 Comparison of Species Richness and Total Abundance

Taxon	SDB	NF	WF	WS	ES	EN
Year of Survey	2011	2008	2009	2011	2011	2011
Water depth (m)	95	70	163	410	550	475
Median particle size (um)	455	148	19	6	5	6
Class Polychaete Species	7	7	4		1	
Class Polychaete Individuals	9,210	9,160	1,603		6	
Class Oligochaete Species	4	4	4	3	2	3
Class Oligochaete Individuals	4,907	7,827	17,593	5,570	206	70
Order Cirripedia (*Balanus*)	3,350	26,940	23	0		
Order Cumacea Species	7	10	8	1		
Order Cumacea Individuals	4,550	6,793	1,787	3		
Order Amphipod Species	38	47	21	2	1	
Order Amphipod Individuals	44,157	53,709	3,717	7	3	
Order Isopoda Individuals	50	7	3			
Class Gastropod Species	1	11	13			
Class Gastropod Individuals	3	337	120			
Class Bivalve Species	4	11				
Class Bivalve Individuals	1,233	6683				
Total number of taxa	65	98	55	10	4	7

6.9 Archaeology and Cultural Heritage

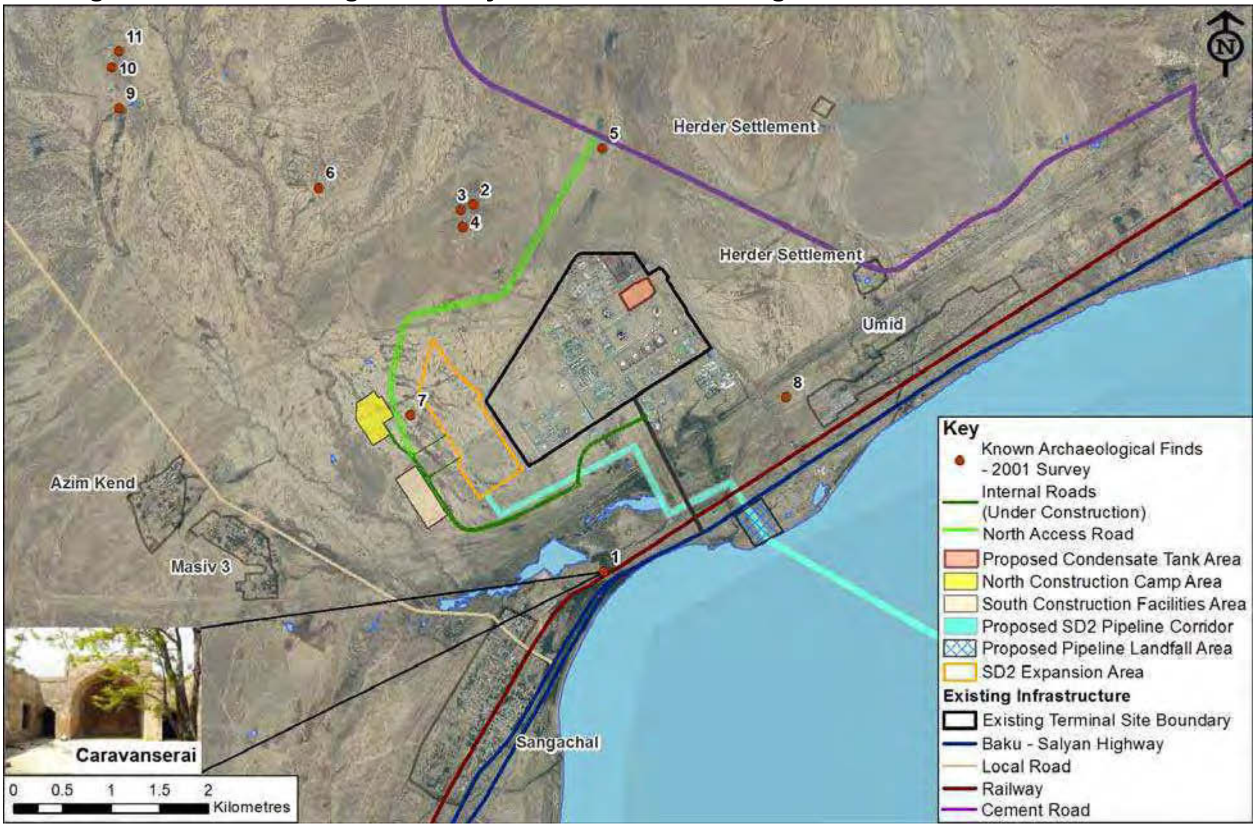
A non-intrusive archaeology and cultural heritage field survey was undertaken in 2001 for the Shah Deniz Stage 1 (SD1) Project[38] and covered an area within a 2.5km radius of the current Terminal. Key finds within the survey area are detailed within Table 6.60 and shown on Figure 6.31. A second survey in 2002 conducted by a team of UK archaeologists confirmed the presence of several archaeological sites (ID2-4 within Figure 6.30) in the area north of the current Terminal.[39]

[38] SD1 ESIA,2002
[39] Desmond et al. 2002

Table 6.60 Summary of 2001 Archaeological Survey Finds/Cultural Heritage Sites

ID	Find/Site	Comment
1	Caravanserai	Medieval inn. Protected state monument.
2	1^{st} and 2^{nd} Sangachal Settlements	Medieval and Antique structural remains and extensive habitation area. Reportedly dating back to 2^{nd} century BC. Rock art found within one rockshelter.
3	3^{rd} Sangachal Settlement	Structural remains noted in 3^{rd} Sangachal Settlement. Glazed and unglazed pottery shards indicating potential medieval settlement of between 2-20 hectares.
4	4^{th} Sangachal Settlement	
5	5^{th} and 8^{th} Sangachal Settlements	This medieval settlement may cover several hectares. Structural remains were recorded in 8^{th} Sangachal.
6	6^{th} Sangachal Settlement	This possible medieval settlement includes the remains of several structures and a variety of domestic ceramics.
7	9^{th} Sangachal	Glazed and unglazed pottery shards indicating potential medieval settlements of between 2-20 hectares.
8	Sangachal Gochdash Memorial	
9,10 & 11	Sangachal cemetery and Sophi-Hamid Sepulcher	Approximately 20 hectares. Reported to contain burials from 13^{th} century towards the north of the cemetery footprint.
n/a	Sand Cave	Cave with man-made interior walls. Protected state monument.

Figure 6.31 Archaeological Survey Finds/Cultural Heritage Sites, 2001



These surveys identified several monuments or archaeological sites in the vicinity of the Terminal that date from the Medieval period. Several of the archaeological sites also date from the Antique period. One of these (ID7 within Figure 6.31) was located in the EIW footprint. This archaeological site is referred to as 9^{th} Sangachal[1].

In 2011, a reconnaissance survey was undertaken covering the following areas:

- SD2 Expansion Area;
- Areas west of the SD2 Expansion Area;
- The proposed SD2 Pipeline Landfall Area; and
- The vicinity of the Caravanserai.

The reconnaissance survey determined that the SD2 Expansion Area had undergone extensive disturbance, including the creation of two spoil heaps, earthen berms, pipelines, fences and roads. Within the SD2 Pipeline Landfall area, approximately 60-80% of the area has been disturbed by quarrying. Even though these areas have been heavily disturbed, they were identified as having potential for archaeological finds and it was therefore recommended that an archaeological baseline survey be undertaken.

Consultation with the Ministry of Culture and Tourism (MoCT) during the survey revealed a Sand Cave adjacent to the pipeline landfall area, listed as a protected State monument. Therefore, the survey also recommended that an architectural baseline survey of the Caravanserai and Sand Cave be undertaken.

In 2011, baseline archaeology and architectural surveys were undertaken with the Institute of Archaeology and Ethnography (IoAE). The archaeology baseline survey area included all SD2 Project elements (including the EIW), and resulted in the identification of 182 Isolated Finds and 13 archaeological sites, the majority of which occurred within or near the EIW project area. No evidence of buried archaeological or other data to indicate the presence of buried archaeological remains was found during the survey.

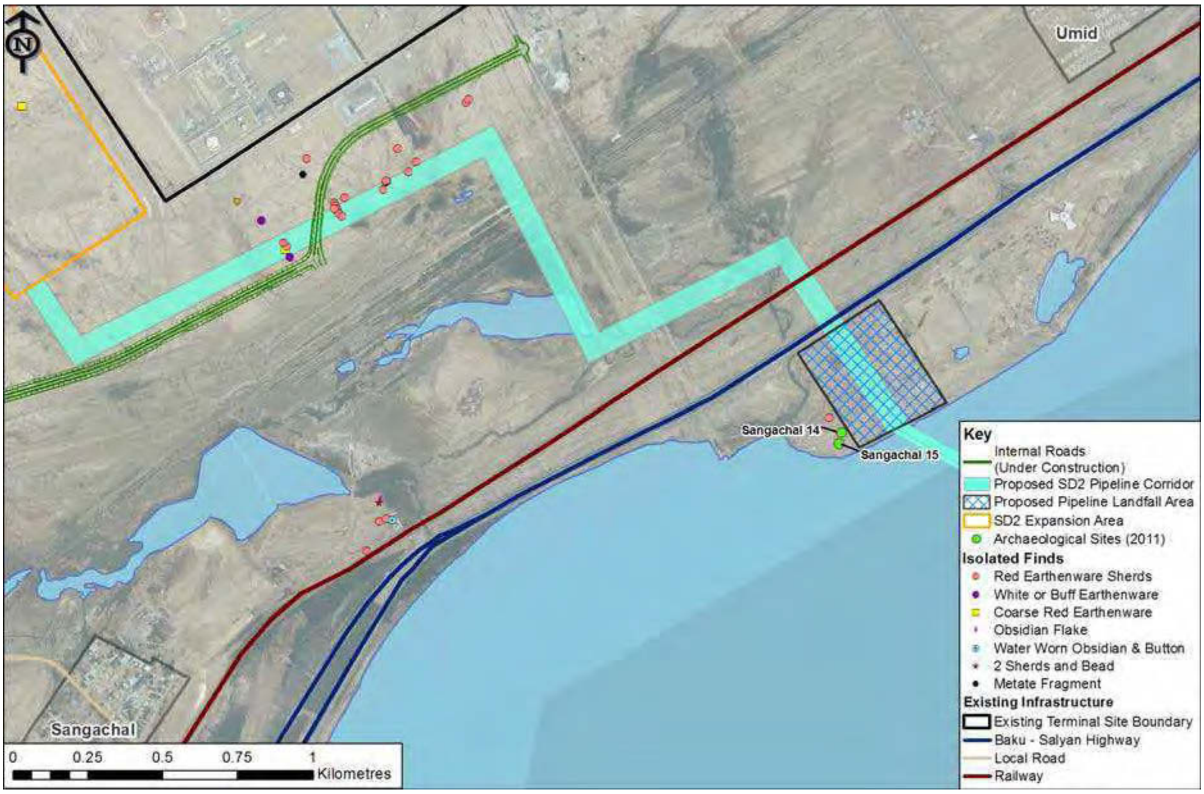
Table 6.61 summarises the finds at the 13 archaeological sites identified during the survey. The survey results indicated that the SD2 Project onshore areas (including the SD2 EIW) did not contain permanent settlements or buried archaeological deposits. Rather, the discovered artefacts were the results of rural seasonal activities in the area during the late Middle Ages, probably representing shepherds or caravan camps.

Table 6.61 CHBS Archaeological Site Summary Data

Site	Site Size (m^2)	Number of Artefacts	Site Type and Characteristics
Sangachal 9	1,386	23	Unknown age. Ceramic scatter
Sangachal 10	2,500	17	$11^{th}/12^{th}$ century A.D. Ceramic scatter
Sangachal 11	1,290	15	Late medieval. Ceramic scatter
Sangachal 12	598	51	$16^{th}/17^{th}$ century A.D. Ceramic scatter
Sangachal 13	525	72	$17^{th}/18^{th}$ century A.D. Ceramic scatter
Sangachal 14	121	31	Unknown age. Ceramic scatter
Sangachal 15	16	11	$17^{th}/18^{th}$ century A.D. Ceramic scatter
Sangachal 16	1,100	42	$16^{th}/17^{th}$ century A.D. Ceramic scatter
Sangachal 17	1,350	95	Late medieval. Ceramic scatter
Sangachal 18	300	15	Unknown age. Ceramic scatter
Sangachal 19	3,325	48	Unknown age. Ceramic scatter
Sangachal 20	507	81	Unknown age. Ceramic scatter
Sangachal 21	2,700	100+	20^{th} century shepherd's campsite

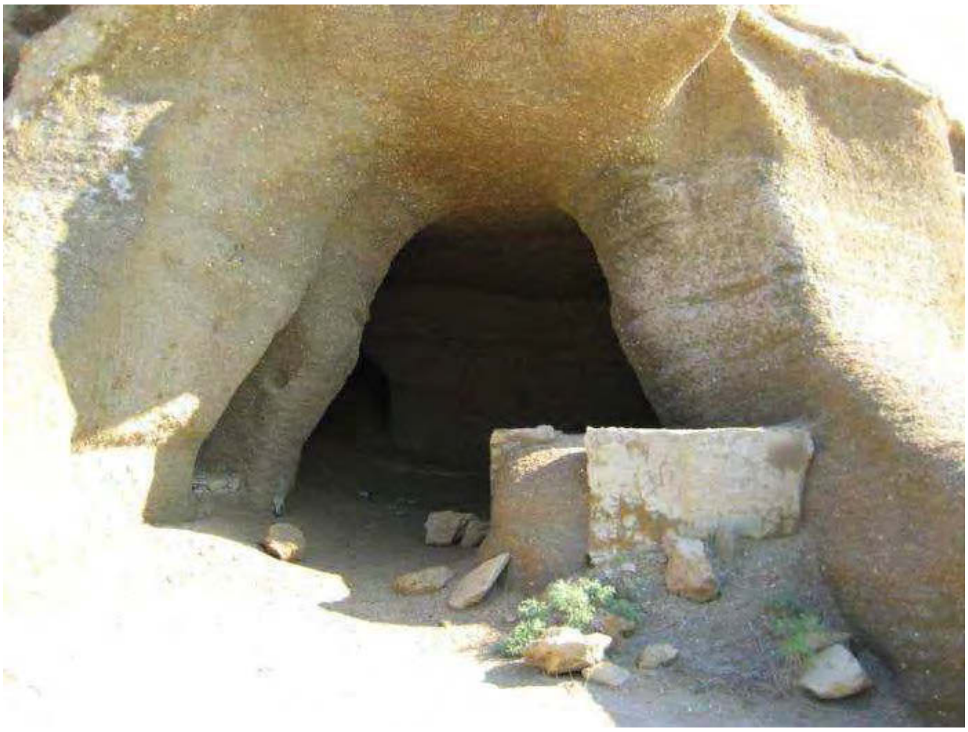
In the area to the south of the Terminal and north of the third-party pipeline corridor, 18 Isolated Finds were identified (Figure 6.32). The majority of these consisted of red earthenware sherds. Adjacent to the proposed SD2 Pipeline Landfall area, one Isolated Find was identified also consisting of red earthenware sherds. Two archaeological sites were also identified. Ceramic scatter was found at Sangachal 14, the age of which is unknown. Sangachal 15 consisted of 17th/18th century A.D ceramic scatter.

Figure 6.32 Archaeological Sites Identified South of the Terminal and Near the Pipeline Landfall Area



The architectural baseline survey determined that the history and significance of the Sand Cave is unclear (Figure 6.33). While the MoCT believe that the feature is naturally-formed and has been present for some time, this could not be confirmed during the survey. If the Sand Cave is a natural formation that has been adapted to human use over an extended period of time, then the resource may possess historical significance for its natural physical characteristics as well as its social associations. The survey revealed the Sand Cave to be in a fair, but fragile condition.

Figure 6.33 Sand Cave Adjacent to the Proposed SD2 Pipeline Landfall Area



An archaeological watching brief programme was established for EIW. As of December 2012, a total of 16 chance finds have been identified, which included:

- Six isolated archaeological finds consisting of individual ceramic sherds of Medieval or undetermined age;
- One piece of cooked bone determined to be an Isolated Find;
- Four artefact scatters comprising 2-3 ceramic sherds dating to the Late Medieval Period;
- One scatter of modern ceramic sherds;
- One natural sinkhole; and
- Three archaeological features.

During the EIW, three archaeological sites identified have been moved, namely, Sangachal 9, Sangachal 11, and Sangachal 18. Ground works within and around these sites were monitored by two watching brief archaeologists. Archaeological monitoring during these works resulted in the identification of the three archaeological features. These features were comprised of red soil stains and associated deposits of charcoal and ash. They have been interpreted as the remains of small campfires of indeterminate age. Two of these features were identified in the immediate vicinity of Sangachal 18; the third was located near Sangachal 11.

The watching brief has identified intact, subsurface features in the archaeological sensitivity zones around two archaeological sites. This suggests there is high potential for encountering additional archaeological deposits or features, which have been adversely affected by physical disturbance. The Sand Cave, which is in a fair but fragile condition, may also be affected by physical disturbance in addition to factors including ground-borne vibration.

7. Socio-Economic Description

Contents

List of Figures

List of Tables

7.1 Introduction

This Chapter describes the socio-economic baseline conditions relevant to the SD2 Project. The scoping process identified the following socio-economic interactions as a result of SD2 Project activities:

- Disruption or restriction of fishing and commercial shipping operations' access to coastal, nearshore and offshore resources;
- Employment creation and de-manning;
- Training and skills development;
- Procurement of goods and services (including construction yard operations and their workers); and
- Offsite construction vehicle movements and an associated increased risk to community health and safety.

The key socio-economic receptors that may be impacted by the SD2 Project are described in this Chapter and include:

- The local communities of Sangachal Town, Umid, Masiv 3 and Azim Kend;
- Recreational, small-scale and artisanal fishermen, commercial fishermen and recreational users of the shoreline;
- Users of regional road infrastructure;
- Local, regional and national businesses and their staff (including the contractors and workers at construction yard operations); and
- Owners and the crew of vessels engaged in commercial shipping operations and local government authorities responsible for regulating such activities.

Where relevant, information is presented at the following geographical levels:

- **National** - relevant to the Republic of Azerbaijan;
- **District** - relevant to the Garadagh District; and
- **Local** - relevant to local communities living in the vicinity of Sangachal Terminal (ST) which are: Sangachal Town, Umid, Azim Kend and Masiv 3.

7.2 Data Sources

Socio-economic data presented in this Chapter have been taken from the following primary and secondary sources:

- **Primary data** - collected during the Stakeholder and Socio-economic Survey (SSES) (undertaken in 2011); and
- **Secondary data** - collected from recognised institutions including the United Nations, International Monetary Fund, Statistical Committee of the Republic of Azerbaijan and the Garadagh ExComm (Table 7.1).

Table 7.1 Relevant Data Sources

Date	Title of Document/Survey
2006	ACQUIRE, Reproductive Health & Services in Azerbaijan 2005: Results of a Baseline Survey in Five Districts, E&R Study #6
2006	USAID, Country Profile
2007	UNDP, Gender Attitudes in Azerbaijan: Trends and Challenges, Azerbaijan Human Development Report
2007	USAID, Country Health Statistical Report Azerbaijan
2008	International Monetary Fund, Republic of Azerbaijan: Statistical Appendix 2007
2008	State Statistical Committee of the Republic of Azerbaijan, Demographic & Health Survey 2006
2009	Garadagh Cement Project New Dry Kiln 6 ESIA 2009
2009	Gizildash (Qizildas) Cement Factory ESIA, NORM, 2009
2010	United Nations Azerbaijan, United Nations Development Assistance Framework 2011-2015
2010	AIOC Chirag Oil Project ESIA,2010
2010	International Crisis Group (ICG) Global 2010 Report
2010	State Statistical Committee of the Republic of Azerbaijan, Socio-economic Development of the Settlements of Baku City
2010	ICG, Azerbaijan: Vulnerable Stability Europe Report No.27
2010	Agents of Change: Reflections on a working partnership between BP Azerbaijan and the International Institute for Environment and Development (IIED)
2011	Data provided to BP from Garadagh ExComm
2011	SD2 Project Stakeholder and Socio-Economic Survey (SSES)

The majority of population and demographic data is provided by the State Statistical Committee of the Republic of Azerbaijan. At the time of preparing the ESIA chapter, 2011 and 2012 statistical data was not always available and in some cases 2010 data has been used.

7.2.1 Stakeholder and Socio-Economic Survey

The SSES addressed three critical gaps in BP's knowledge base in relation to stakeholder relations and socio-economic conditions in the region, and in communities surrounding the Terminal. The data gaps were:

- **Stakeholder information:** The limited information on stakeholder groups' focus areas and activities; operational capacities and resources; and future opportunities for partnership, organisational and capacity development;
- **Socio-economic data:** The lack of quantitative data on local area household composition; housing conditions; household income; expenditure and assets; land ownership and production; economic activities; health; education and other social services; and social organisation; and
- **Attitudinal data:** The limited data on local communities' attitudes and perceptions in relation to industrial operations in the area; BP's community relations and community investment programmes (CIPs); and critical development needs and priorities.

The SSES applied a mixture of quantitative and qualitative data collection methodologies and collected data from a wide range of sources to inform the socio-economic baseline characterisation presented in this Chapter. The SSES involved the following:

- A review of secondary data using official sources, authoritative donor, institutional and academic reports and previous ESIAs prepared for BP and other regional industrial developments;
- 63 semi-structured interviews with key stakeholders representing regional government, business and community interests;
- 200 household surveys conducted in the four local communities: 100 in Sangachal Town, 50 in Umid, 25 in Masiv 3 and 25 in Azim Kend. The household surveys enabled an in-depth evaluation of socio-economic and household conditions within the area to be made, and collected quantitative and attitudinal data on 1,026 household members;
- 12 structured focus group discussions, including meetings with general population, women and youth groups in each of the four local communities. Overall, 141 people participated in the focus groups; 58% were female, 21% had Internally Displaced

Person (IDP) status, 85% had lived in their community for 11 years or more; more than half were unemployed; and

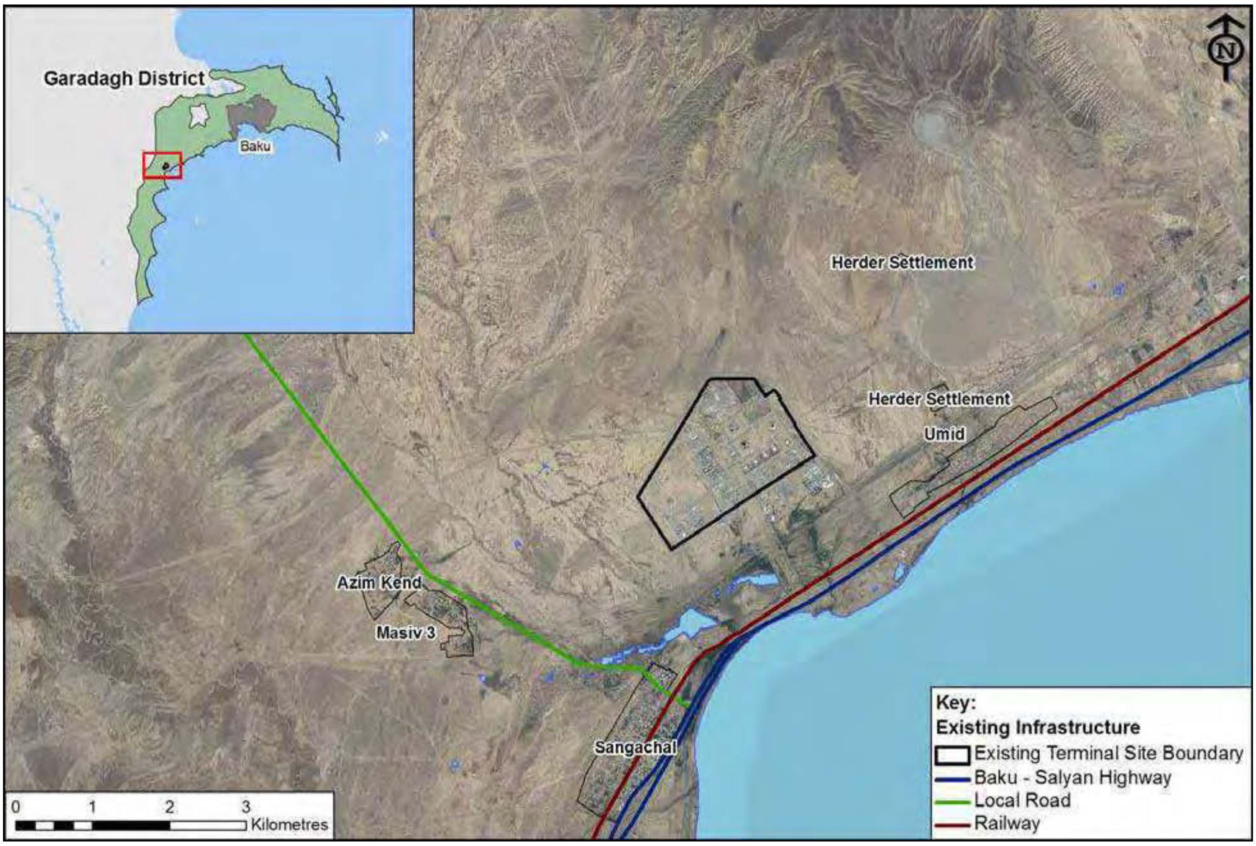
- Site walkover surveys to informally investigate the current status of two herder settlements, and fishing activities occurring in the coastal area between Sangachal Town and Umid.

The findings from the SSES are currently being used by BP to monitor socio-economic impacts associated with BP's current operations and in the design and implementation of BP's CIPs.

7.3 Geographic Context

The SD2 Project is located adjacent to the Sangachal Terminal and lies within the Garadagh District, which includes Baku and then extends south along the Caspian coast to the south of Alyat. The Garadagh District was established in 1923 and comprises five city settlements including Lokbatan which is the District's administrative centre. The four communities in the immediate vicinity of the Terminal (Sangachal Town, Umid, Masiv 3 and Azim Kend), are likely to be the most directly affected by the socio-economic impacts of the SD2 Project, although increased traffic, employment and procurement will affect a larger area. The extent of the Garadagh District and the position of the four local communities in relation to the Terminal are shown in Figure 7.1.

Figure 7.1 Garadagh District, the Terminal and Surrounding Communities



The Garadagh District Executive Committee (Garadagh ExComm) is the authority responsible for administration within the District[1]. Garadagh ExComm manages the Garadagh District's education, culture, and public health and sports institutions. Sangachal Town and Umid are both municipalities and administer their own service provision in relation to housing, roads, electricity, water, sanitation, waste collection, heating infrastructure and gas supply. The community of Masiv 3 falls under the municipality of Sangachal Town. Whilst Azim Kend falls

[1] ERM (2009) Garadagh Cement Project New Dry Kiln 6: ESIA.

under the adjacent Absheron District, residents typically use public infrastructure and services in Sangachal Town. Data from Garadagh ExComm has therefore been used exclusively to compare (benchmark) local socio-economic conditions.

The four communities in the vicinity of the Terminal are located in a predominately rural setting of Garadagh District. The area is becoming increasingly industrialised, however, due to the availability of land and fast access to major transport infrastructure provided by the Baku-Salyan Highway and adjacent railway. Economically-induced internal migration flows identified by the SSES indicated that 45% of surveyed households within the four communities had moved to their present location to seek more favourable economic conditions.

7.4 Socio-Economic Context

Expansion in the oil and natural gas sectors has led to rapid economic growth with the national economy increasing at an average rate of 13.3% between 2001 and 2011[2]. This growth was at least partially driven by previous Azerbaijan International Operating Company (AIOC), BP and partners investments, which started in 1995, and construction of the Baku-Tbilisi-Ceyhan (BTC) pipeline and South Caucasus Gas Pipeline (SCP) which came on stream in 2006. In contrast, the manufacturing sector is small and most of the country's exports and sources of Government revenue are energy-based[2].

Annual inflation is currently 7.9% (October 2012) which has increased from 5.7% in 2010[3]. However, the headline inflation figures disguise some significant variations: for example, the annual increase in food prices recorded in September 2011 was 11.4%, which is likely to have had a significant impact on household welfare, while the cost of non-food items annually decreased by 2.8% and the cost of services annually fell by 4.5%.

There are a number of Government initiatives for economic diversification, including those supported by the World Bank (WB) Group's Country Partnership Strategy (CPS). Current focus areas of the CPS are to:

- Strengthen non-energy sectors by improving business environments, enhance infrastructure and investment in the agricultural sector; and
- Improve the effectiveness of social and community services such as health, education, social protection and water supply with the aim of enhancing human and social capital development.

Economic activities in the Garadagh District are dominated by the industrial sector, primarily oil and gas. There are approximately 180 registered companies, firms and co-operatives in the Garadagh District, including 15 foreign and joint venture companies.

7.5 General Profile of the Local Communities

The four communities in the vicinity of the Terminal are typical of rural Azerbaijan which is characterised by occasional clusters of IDPs, sub-standard local roads and limited public infrastructure and social services. A general profile of each community is provided below.

7.5.1 Sangachal Town

Sangachal Town was originally a location for workers of a small fishing plant linked to the Sangachal Railway station which operated from 1936. After World War II, two military units were stationed at Sangachal Town and a military camp was established for the servicemen's families. From the 1940s, the settlement rapidly grew as people migrated from other areas of Azerbaijan seeking employment and more favourable socio-economic conditions. Following the establishment of the Sangachal Terminal and expansion associated with Azeri Chirag Guneshli (ACG) Phases 1, 2 and 3, and Shah Deniz Stage 1 (SD1), the Sangachal Town

[2] eStandards Forum Country Brief (April 2011) Azerbaijan.
[3] World Bank - Inflation and Consumer Price Indicators as Annual Percentage (2013).

population increased through continued in-migration. This has placed significant pressure on existing public infrastructure.

Sangachal Town is currently the largest community in the vicinity of the Terminal with an estimated population of 5,300[4] and an average household size of 4.9 people. The estimated number of households is 1,081. Military personnel are provided with garrison accommodation and benefit from free utilities (gas and electricity). Military personnel now comprise a relatively small proportion (approximately 15%) of the local population. The main sources of employment are in private industry (including at the Terminal), private enterprise and employment in the public sector.

7.5.2 Umid

Umid has an estimated population of 2,000[4], an estimated 370 households and an average household size of 5.4 people. Umid was established in 1999 as an IDP settlement, subsequently expanded with an influx of Garadagh Cement Plant workers and was awarded administrative status as a municipality in 2000. Similar to Sangachal Town, the recent expansion in population has strained existing public infrastructure and services. The main sources of employment are in private industry and the public sector.

7.5.3 Azim Kend and Masiv 3

Azim Kend is located in the Absheron District and is not an officially registered entity. It has an estimated population of 370[4] and an average household size of 5.7 people, the highest of the four communities neighbouring the Terminal. The estimated number of households is 65. This community currently has no sewage infrastructure, although a piped potable water supply is available.

Masiv 3, part of the Sangachal municipality, has an estimated population of 280[4], an average household composition size of 4.9 people. The estimated number of households is 57. Masiv 3 has the least developed community infrastructure, reflected in the lack of a piped water supply and sewage infrastructure.

It is planned to combine these two settlements into one entity to be named 'Jingirdag' settlement in the near future.

7.6 Overview of Onshore Socio-Economic Conditions

7.6.1 Population, Demographic Structure and Ethnicity

In 2011, the population of Azerbaijan was 9,111,100 with a gender distribution of 49.6% male and 50.4% female[5]. The proportion of the population resident in urban areas has remained relatively constant at around 50% over the past 20 years. There are some indications, however, that the population of urban areas may be under-recorded as many people who move to Baku for employment on a temporary or permanent basis may retain their registration in their place of origin. Authoritative sources have suggested that the greater Baku metropolitan area may be home to approximately three million people, or 35% of the national population[6].

The national age profile and balance between rural and urban populations is shown in Table 7.2. The dependency ratio (the proportion of the population which is not in economically active age groups relative to that which is in economically active age groups), is higher in rural areas (33%) than in urban areas (29%)[6].

[4] Garadagh ExComm (2011)
[5] State Statistical Committee of the Republic of Azerbaijan (2011).
[6] United Nations Development Programme (UNDP) Azerbaijan (2007). Converting Black Gold into Human Gold: Using oil Revenues to Achieve Sustainable Development.

Table 7.2 National Age Profile, Urban and Rural, 2010

	Total		Urban		Rural	
Age Range	**('000)**	**%**	**('000)**	**%**	**('000)**	**%**
0-14 years	1987.9	22%	964.7	20%	1023.2	25%
15-24 years	1839.8	20%	977.3	20%	862.5	21%
25-49 years	3458.1	38%	1903.7	39%	1554.4	37%
50-69 years	1275.7	14%	792.4	16%	483.3	12%
70 years and over	435.9	6%	228.5	5%	207.4	5%
Total	8997.4	100%	4866.6	100%	4130.8	100%

Azerbaijan is characterised by a relatively high birth rate, a population structure dominated by young people, and active (external and internal) migration flows. Between 2004 and 2010, birth rates and the natural fertility rate increased in parallel with a decline in maternal and infant mortality rates[7]. By 2011, average life expectancy was 73.6 years (70.9 years for men and 76.2 years for women) which reflected a significant, positive change since 1990 when average life expectancy was 71.1 years (67.0 for men and 74.8 years for women). Migration patterns have changed from a 20-year period of net outward migration between 1970 and 2007, to a net increase in immigration, which in 2011 was 1,700 persons.

The population of the Garadagh District increased by 10% between 2005 and 2010, although this increase may in fact be higher, given possible under-reporting of residencies in Baku (Table 7.3[8]). This is due to a moderate increase in net-migration, a significant increase in the number of births (31% higher in 2010 compared with 2005) and a correspondingly smaller increase in the number of deaths (5%). The SSES indicated that the population of the four target communities was significantly younger than the national average.

Table 7.3 District Population, In-Migration, Death and Fertility Rates, 2005-2010

	2005	2006	2007	2008	2009	2010
Estimated Population	100,300	101,500	103,300	105,100	106,900	109,400
Registered net migration	82	59	34	116	50	85
Number of Deaths	539	574	618	520	545	563
Number of Births	1,839	2,346	2,323	2,313	2,251	2,410
Birth rate Male (%)	54	53	55	55	54	56
Birth rate Female (%)	46	47	45	45	46	44

The national gender ratio for 2011 births was estimated to be 1.116 which equates to a balance of 54% males to 46% females[7]. After the collapse of the Soviet Union, there was an upsurge in the ratio of boys to girls in Azerbaijan and sex ratios have become increasingly unbalanced in the country[9]. The data for Garadagh District indicates that the gender ratio in 2009 was identical to the national picture, with the gender imbalance increasing further in 2011 with 56% males to 44% females.

In the early 1990s, IDPs were displaced as a result of the conflict with Armenia within the Nagorno Karabakh region of Azerbaijan, which ended with a ceasefire in 1994. It is estimated that there were in 2010 a total of 10,487 IDPs living in Garadagh District[8]. In addition there were 2,400 refugees (i.e. people who had been displaced from areas outside Azerbaijan, generally from Armenia, during the conflict) present in 2010. The number of IDPs in Garadagh District has not changed significantly since 2006 and in 2010 represented approximately 10% of the District population; this is typical of other districts in Azerbaijan.

[7] State Statistical Committee of the Republic of Azerbaijan (2010).
[8] Garadagh Executive Power (2011).
[9] The Economist: The worldwide war on baby girls (2011).

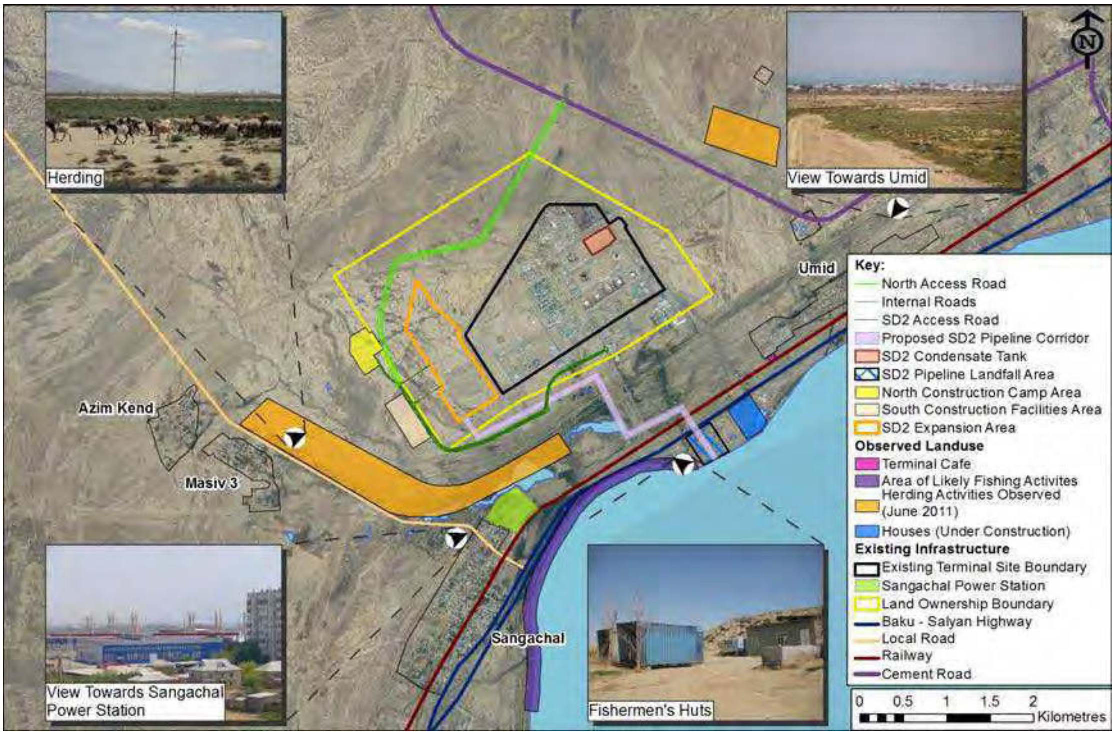
Based on the 2009 census[10] (which provides the latest data available), the majority of the national population (91.6%) is ethnically 'Azerbaijani', with the remaining 8% made up of a range of ethnic groups including: 'Lesgis', 'Armenians', 'Russians', 'Talish', 'Avars', 'Turks', 'Tatars', 'Tats', and 'Ukrainians'.

The religious distribution in Azerbaijan is relatively homogenous, with the majority of the population defined as Muslim. Other religions include Orthodox Christianity, Judaism, Catholicism and Protestantism.

7.6.2 Land Use and Ownership

Land use within the vicinity of the Terminal is dominated by the four local communities, the Baku-Salyan Highway, the railway, the presence of industrial facilities and two herder settlements located to the northeast of the Terminal (refer to Figure 7.2). Open land is generally used for animal herding activities (primarily cattle, goats and sheep) and local roads are mostly unsealed. A distinct wetland area is present near the highway and railway line, south of the Terminal. Along the shoreline area between Sangachal Town and Umid, recreational and commercial fishing activities occur, along with informal use such as recreational walking.

Figure 7.2 Land Use Within the Vicinity of the Terminal



There are significant differences in land ownership and agricultural production between the communities, with 8% of households in Sangachal Town owning a plot of land, compared with 96% in Azim Kend. The majority of households (65%) who have land do not use it for any economic activity. Where households do use their land, 19% keep poultry and 16% keep both livestock and poultry. The main restrictions associated with expanding agricultural activities relate to the presence of poor quality soil and a lack of available land and difficulties associated with installing and maintaining irrigation networks. There are also differences in the density of housing, with Sangachal Town featuring a higher density (with the presence of apartment buildings) than the other three local communities.

Between the coastline and highway to the east of the Pipeline Landfall Area, approximately seven holiday homes are under construction. The majority of the construction sites comprise

[10] State Statistical Committee of the Republic of Azerbaijan (2011).

one, or more, buildings that are partially complete and some that are without roofs or finished walls.

Under the terms of the SD2 Production Sharing Agreement (PSA), the State Oil Company of Azerbaijan Republic (SOCAR) is responsible for land acquisition in connection with ST. Permanent land acquisition associated with the ST Expansion and access road is discussed within the SD2 Infrastructure Project ESIA. In addition, temporary access will be required to an area of approximately 40 hectares along the onshore section of the SD2 pipeline corridor, which, according to data from the Baku Mayor's office, is state land. The Land Acquisition and Access Programme for both the SD2 Early Infrastructure Works (EIW) and the main SD2 Project will be executed in line with relevant PSA requirements and in close coordination with Baku Executive Authorities (via SOCAR).

7.6.3 Infrastructure

7.6.3.1 Road Transport

In some areas across Azerbaijan, local roads are in a poor physical condition. The Baku-Salyan Highway is however, well-maintained and provides a rapid link from Baku to Astara, Iran. Existing traffic flows along the highway are estimated to be from 10,000 to 20,000 vehicles per day[11].

The local roads within the four communities are generally graded and in poor condition. Following heavy rain, local roads typically become impassable. The construction and repair of regional and inter-settlement roads are included in the: *State Programme on Socio-Economic Development of Baku City and its Settlements 2011-2013*[12] (hereafter referred to as the "*Baku City Programme*"). However, the exact scope of the planned construction and repair activities, and whether they include any local roads within the communities near to the Terminal, is unclear.

Data gathered by the SSES indicates that the majority of residents interviewed in Azim Kend and Masiv 3 (88% and 64%, respectively) considers the condition of local access roads as 'poor'. Roads connecting the communities of Sangachal Town and Umid were perceived more favourably by local residents with 75% and 62%, respectively, considering road conditions to be 'good'.

7.6.3.2 Public Transport

There are several bus routes that provide public transport between the local communities and regional centres. With the exception of Sangachal Town, there are no direct bus services to Baku. The Baku to Hajigabul passenger train stops twice per day (9am and 4.30pm) at the Sangachal Train Station.

Data gathered by the SSES indicates that the condition of existing public transport was perceived to be 'poor' with the exception of Umid which was rated as 'excellent' (62%); this may reflect extensive use of bus transport. The main problem associated with public buses was reported to be overcrowding, as buses do not always stop as they are already full.

7.6.4 Local Utilities

7.6.4.1 Access to Electricity, Gas and Telecommunications

Data collected by the SSES indicates that all households surveyed have access to electricity 24 hours a day. However, access to a main gas supply varies with the following levels reported: Sangachal Town (100%); Umid (98%); Masiv 3 (80%); and Azim Kend (8%).

[11] Azerbaijan Highway Authority (2010). Per comms, Head of the Technical Division.
[12] Approved by the Decree No 1940 dated 4 May, 2011 by the President of the Republic of Azerbaijan.

Under the *Baku City Programme*, construction of a piped gas supply is planned in Azim Kend for 2011-2013.

Telecommunications are available within all the communities. This is above the 2010 national household level of 69% and telecommunication infrastructure is scheduled to be upgraded further in Umid during 2012-2013 as part of the *Baku City Programme*.

7.6.4.2 Potable Water and Sanitation

Nationally, there have been a number of recent initiatives to improve water supply and sanitation infrastructure. A World Bank loan of US $230 million was approved in June 2007[13] to build on the Greater Baku Water Supply Project and continue the Bank's long-term support of improvement in the water and sanitation sector. The project focuses on the rehabilitation of water supply and sanitation facilities in urban areas of the country. The project also supports key reforms to modernise sector institutions in order to improve their capacity, institutional and operational effectiveness, and commercial and financial viability.

Table 7.4 shows the current sources of potable water supply in the four communities.

Table 7.4 Source of Potable Water in the Communities within the Terminal Vicinity

Source of Potable Water	Sangachal Town	Umid	Azim Kend	Masiv 3
Water available inside the house	76%	52%	0%	12%
Water available from a distribution point in the yard	24%	48%	88%	72%
Water available from elsewhere (neighbour or other location)	0%	0%	8%	4%
Water purchased in containers from vendors	0%	0%	4%	12%

Potable water is piped directly to all the local communities and is available either from inside the home, or from the yard. However, some households in Masiv 3 (12%) are forced, due to a lack of a household connection, to purchase potable water from vendors who use horse and carts. These households are part of the 1% of households in the Garadagh District in 2011[14] that do not have access to improved drinking water sources[15]. This is reflected in the outcomes of the SSES, in which 68% of respondents in Masiv 3 reported that the reliability of their water supply was 'poor'. In contrast, respondents in Sangachal Town, Umid and, to a lesser degree Azim Kend, considered the reliability of their water supply to be at least 'satisfactory'.

There are long-standing issues associated with the low water pressure of the regional supply network, with some households (particularly in Sangachal Town and Umid) forced to use pumps to increase water pressures.

In terms of water quality, the SSES reported the highest levels of satisfaction with water quality in Azim Kend, where nearly half of all respondents reported that their water quality was 'good'. Between 24% and 36% of respondents in all local communities, however, reported that their water quality was 'poor'.

The proportion of households at a national level with access to a sewage network has steadily increased from 86% in 2002 to 95% in 2010. Within Garadagh District, the percentage of the population who have access to improved sanitation facilities[16] increased from 55% in 2002, to 80% in 2010[15] indicating it has historically been below the national level. In Sangachal Town

[13] World Bank Loan ID P096213 (June 2007).
[14] Garadagh Executive Power (2011).
[15] Defined by the UN as a household connection, public standpipe, borehole, protected dug well, protected spring, or rainwater collection system.
[16] Defined by the UN to comprise flush/pour flush toilets or latrines connected to a sewer; septic tank; or improved pit latrines.

enclosed drainage channels transport sewage to a central collection point near to the Caspian Sea where it is subsequently discharged without treatment. There is no sewage infrastructure at Azim Kend or Masiv 3: sewage is either manually placed into open ditches, or discharged directly into local streets. Existing municipal waste disposal arrangements are also particularly poor in these two communities.

7.6.5 Youth and General Recreational Facilities

There are few youth and recreational facilities available within the four communities. BP and partners previously funded the rehabilitation of a sports facility for Secondary School No. 222 in Sangachal Town which was completed in February 2004; this is currently maintained in excellent condition. Under the *Baku City Programme*, a mini-football stadium and gym in Sangachal Town is planned for 2012-2013. There are no planned developments for recreational facilities within any of the other settlements.

7.6.6 Education and Training

The Azerbaijan education law guarantees the right to education for all its citizens irrespective of race, nationality or gender.

The majority of school age children and teenagers in the Garadagh District attend school, or undertake vocational training/education[17]. Approximately 23,500 children and students study at 22 secondary schools and 3,400 children and students study at five specialist schools. There are 24 primary schools in the Garadagh District and one boarding school with 370 pupils[18]. A total of 28 students from Sangachal Town and 10 students in Umid are studying in higher educational institutions in Baku.

The schools and kindergartens in the vicinity of the Terminal include:

- Sangachal Town: one secondary school (No, 222), two kindergartens (No. 299 and 20);
- Umid: one secondary school (No. 294); and
- Masiv 3 and Azim Kend: one secondary school which serves both communities (the Absheron Aligulugishlag Secondary School).

Data on the ratio of teachers per 10,000 pupils indicate that the education system in Sangachal and Umid (both 153/10,000) is significantly below the 2011 average across Garadagh District of 194/10,000[19]. Average school attendance at Sangachal and Umid is 98%, the same level for the Garadagh District. There are no designated transport arrangements provided to schoolchildren and the poor condition of local roads reportedly reduces school attendance during winter months, especially at Azim Kend secondary school.

Residents surveyed at all four communities placed a high priority on the quality of education provided to their children, indicating that there is strong parental support for school attendance and, potentially, further education if the financial means were available. Kindergarten attendance was low, however, despite 57% of respondents stating that they would like their child to attend.

The secondary school in Sangachal Town completes two shifts of pupils a day due to limited classroom capacity. This school is due to be expanded by 20 new classrooms under the *Baku City Programme.* The secondary school at Umid will also be expanded by 10 classrooms and Kindergarten No. 299 is to be renovated and fitted with new heating systems by 2013.

The gender distribution of secondary school attendance in the Garadagh District for 2010 is 55% female; this is greater than the 2008 national level of 48% female[19]. There were no significant differences reported during the SSES in the proportion of males and females attending school within the four communities, or in the highest levels of education achieved.

[17] Asian Development Bank (2009) Garadagh Cement Project New Dry Kiln 6: ESIA
[18] Garadagh Executive Power (2011).

7.6.7 Health

Azerbaijan has high child mortality rates when compared with other countries in Eastern Europe and the Former Soviet Union,[19] although this gradually improved between 2000 and 2010. The healthcare system was inherited from Soviet times and is gradually being rebuilt from a generally low level of provision, in terms of access and quality. Private healthcare is available in Azerbaijan although is generally prohibitively expensive to the majority of the population.

At a national level, infant mortality has reduced from 16.4 per 1,000 live births in 2000, down to 11.2 per 1,000 live births in 2010[20]. At a district level, infant mortality in 2010 was 5.2 per 1,000 live births which is significantly below the national level[21].

Recent research conducted by Habibov (2011) on the socio-economic determinants of child mortality in Azerbaijan, identified significant regional disparities in the level of utilisation, timing and quality of antenatal care provided to women. The differences were due to the extent of female education and also their socio-economic status.

All residents in the Garadagh District have access to free medical facilities, although specialised diagnostic services and treatment require payment which can be prohibitively expensive. Medical facilities available in the Garadagh District include[22]:

- Seven public hospitals;
- Two General Practitioner (GP) clinics;
- Two emergency medical stations, operating eleven ambulances; and
- Seven first aid posts.

In relation to healthcare staffing, in 2011 there were a total of 381 doctors and 915 paramedic staff working in the medical institutions throughout the Garadagh District. This equates to 34.5 doctors and 82.9 other medical staff per 10,000 people[22] which is slightly above the 2010 national average.

The level of access to healthcare resources at a local level is generally low and features prohibitively high cost of medicines. Healthcare resources, which are available in Sangachal Town and Umid, are also used by residents of Azim Kend and Masiv 3, and comprise[22]:

- Sangachal Town: An outpatient department (No. 23) of Baku City Hospital and an emergency station (No. 20) with one ambulance based in Sangachal Town; and
- Umid: A medical station (No. 23) of Baku City Hospital (No. 20), a pharmacy and a new medical station which is not yet open.

More than 60% of householders surveyed by the SSES felt that their health had recently deteriorated, with only 28% reporting no change in health status and 8% reporting an improvement. The reasons associated with the negative change in health were perceived to be air pollution and poor nutrition intake levels (90% of surveyed households believed that their current nutritional intake levels were inadequate).

The most frequently reported health problems experienced in the four weeks prior to the SSES survey in June 2011 included respiratory, gastrointestinal, cardiological and nervous system disorders. These were similar to the health problems presented more generally in Garadagh District and nationally. In 2010, the most frequent healthcare problems in Azerbaijan were disorders of the respiratory, circulatory (hypertension) and digestive systems[21].

[19] Habibov, N.N (2011) On the socio-economic determinants of antenatal care utilization in Azerbaijan: evidence and policy implications for reforms. 2011 Apr;6(2):175-203.
[20] State Statistical Committee of the Republic of Azerbaijan (2010).
[21] Garadagh ExComm (2011).
[22] Asian Development Bank (2009) Garadagh Cement Project New Dry Kiln 6: ESIA.

There is a lack of healthcare resources available at a local level to provide reproductive health and maternal health services to women. The nearest state hospital is located in Sahil which has a maternity delivery ward, but does not currently provide antenatal care. A specialised maternity hospital is based in Lokbatan, a 30-40 minute drive from Sangachal Town. Data from the SSES, however, indicate that 87% of women who had recently given birth had received some antenatal care and 75% had given birth in a state hospital. Post-natal care is provided through the activities of regional outpatient clinics.

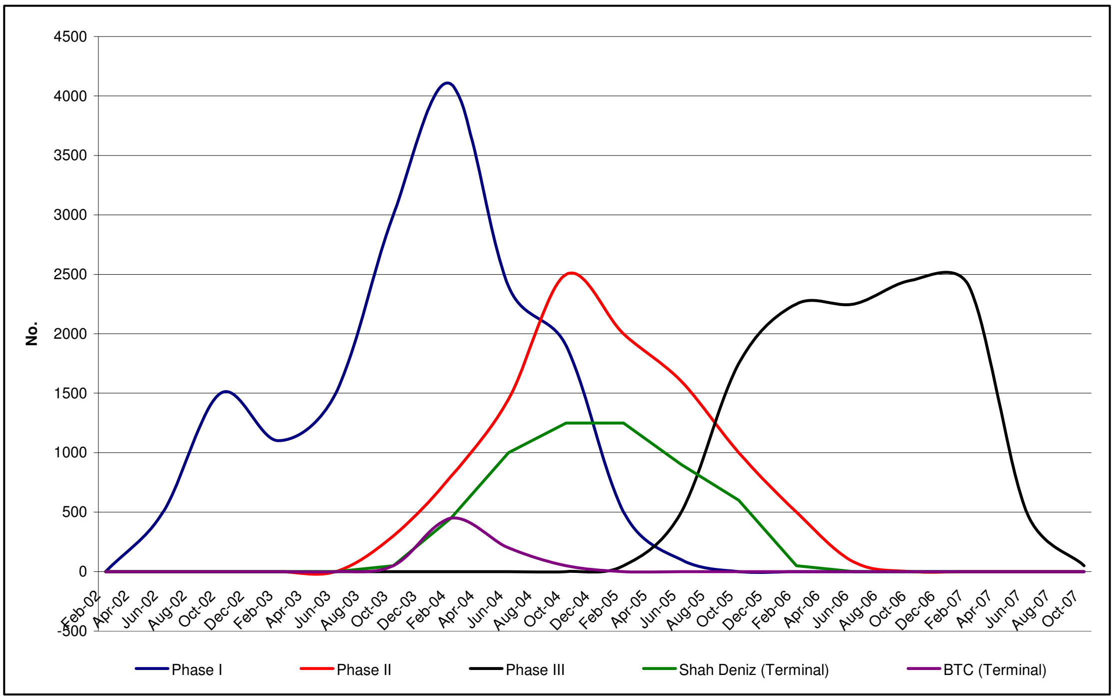
7.6.8 Employment, Unemployment and Livelihoods

7.6.8.1 Previous BP Projects Employment

Historically, BP projects (construction and operations) have had a significant impact on local and regional employment levels[23]. Total construction employment from combined projects peaked at approximately 5,500 workers in mid-2004. Total employment for the ACG Phase 3 project peaked during 2006 with 2,500 jobs (onshore and offshore construction)[24]. Following completion of these previous projects, there has been a significant increase in unemployment. Individuals surveyed by the SSES who had previously worked on BP contracts consistently reported positive experiences, particularly in terms of increasing their household income, developing their skills and improving future career prospects.

Figure 7.3 illustrates the construction workforce for ACG Phase 1, 2 and 3, SD1 (Terminal only) and BTC (Terminal only) projects.

Figure 7.3 BP Projects Construction Workforce, 2002 to 2007



To maximise positive impacts from employment, the ACG Phase 1, 2 and 3, SD1 and BTC construction projects adopted the following measures:

- **Targets:** BP was contractually committed to specific national content targets through each of the projects. By September 2003, 85% of the construction workforce was Azerbaijani;

[23] BP Azerbaijan Sustainability Reports (2006 – 2007).
[24] As reported by the ACG Phase 1-3 construction contractors (2007).

- **Preference in Recruitment:** BP recruitment policy gave priority to local residents in the Garadagh District and by September 2003, 53% of the construction workforce was from the Garadagh District;
- **Information Centres:** Local community information centres were established in Sangachal Town, Umid and Sahil to enable local people to register for employment and the centres developed a database of approximately 18,000 potential employees by September 2003; and
- **Training:** Extensive training programmes were implemented both prior to and during employment of the construction workforce. Training focused on Health, Safely and Environment (HSE), language and computer skills, driving and certified courses including painting, lifting, scaffolding and welding. In one yard alone more than 270,000 training hours of HSE training; more than 244,000 hours of craft training; and nearly 28,000 hours training in management, administration and computing skills were provided. Approximately 1,200 externally recognised qualifications were awarded to the yard's workforce during the period.

It is possible that many of the workforce employed and trained in the ACG Phase 1, 2 and 3, SD1 and BTC construction projects, are now employed elsewhere in Azerbaijan and abroad. Anecdotal evidence suggests that many have used their skills and experience to gain employment in State-run construction yards, in the Baku construction industry, the oil and gas sector in Kazakhstan and elsewhere. This represents a significant benefit in terms of increasing technical skills and experience within the Azerbaijani workforce.

National Level

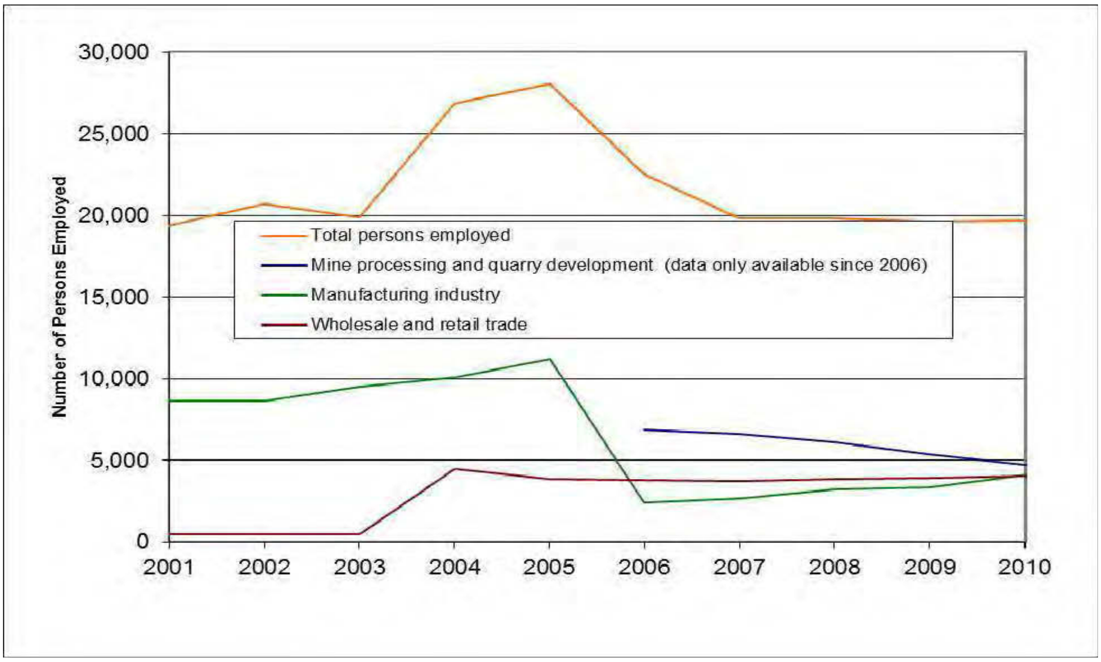
The effective use of labour resources remains a serious problem in Azerbaijan which has relatively high internal flows of workers seeking employment, and particularly high levels of youth unemployment. For example, unemployment in rural areas in 2012 within the age group of 15-19 years was recorded to be 27.3% amongst men and 18.2% amongst women[25]. Informal employment (individuals working without contracts that describe the applicable pay and conditions) is widespread in Azerbaijan and the State is currently taking active steps to legalise unofficial labour relations. Nationally, the unemployment rate declined from 8.4% in 2004 to 6.1% in 2010[26].

Regional Level

The total number of persons employed in Garadagh District and employment levels within the three largest industries is illustrated in Figure 7.4[27].

[25] The State Statistical Committee of the Republic of Azerbaijan (2013).
[26] State Statistical Committee of the Republic of Azerbaijan (2010).
[27] Garadagh ExComm (2011).

Figure 7.4 Type of Employment within the Garadagh District



The figures indicate that the total number of people employed in Garadagh District peaked from 2004 to 2006. This coincided with the peak of BP-related employment in Figure 7.3 and reflects the importance of BP's activities in the region. The number of people employed within the manufacturing industry fell dramatically after 2005, and has since slowly recovered. The numbers employed by fishing and agriculture are very low and have not changed significantly in the past five years. Data obtained from Garadagh ExComm in 2008 indicated that the total number of unemployed persons in the Garadagh region was 400.

Since 2008, it is likely that the employment situation at a regional level has changed significantly as a result of the development of various industrial developments and retail centres (refer to Section 7.8).

Local Level

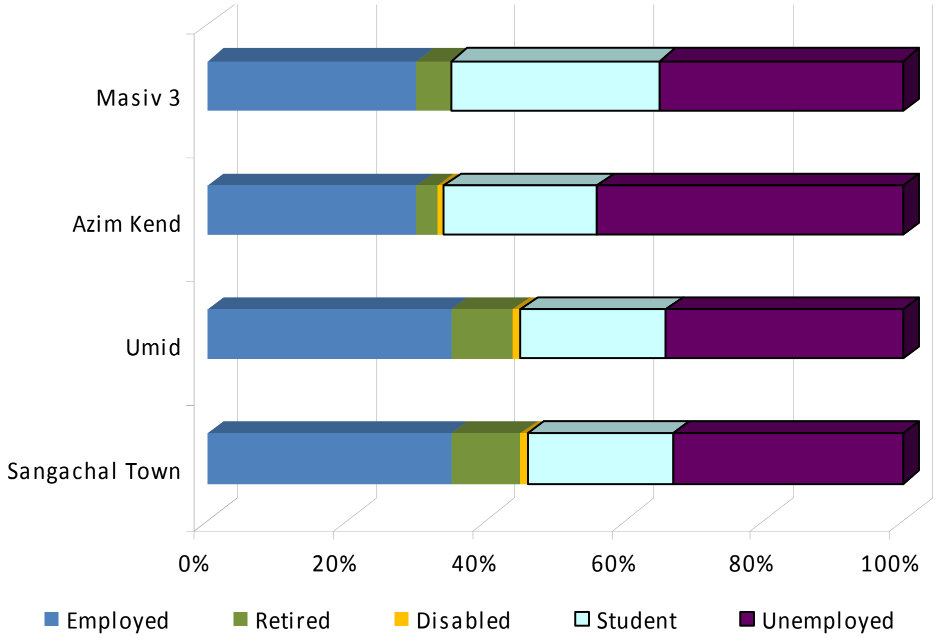
The SSES collected data on employment and livelihood status of household members. In general, the rural location of the four communities provides few employment opportunities to either men or women, which may be exacerbated by limited public transport which reduces access to job markets elsewhere.

The status of employed people varied significantly between the communities: Sangachal Town had the greatest proportion of state employees (59%), followed by Azim Kend (48%) and Masiv 3 (44%). Given that the majority of state employees had completed general secondary and secondary vocational education, there was a clear link between education and employment status. The second largest employment sector in Sangachal Town and Umid was the private sector (17% of those in employment), including the oil and gas sector (10% of employment), services (5%) and livestock raising (2%).

The SSES results indicate that the majority (57%) of people in employment are employed within their community and a further 18% are employed in Sahil. Fewer than 1% were employed in Baku. Only 3% of surveyed household members were currently employed by BP.

The SSES collected unemployment data among surveyed household members in each of the four local communities. These are presented in Figure 7.5.

Figure 7.5 Employment Status of Each Community



The data indicates that unemployment is considerably greater locally than reported at national levels (6% for 2010) and highest at 44% in Azim Kend, reaching 60% within the 18-29 year age group. Unemployment is also higher among women. The result of such high unemployment is that many households do not receive a regular income through paid employment.

There are no significant differences in unemployment levels between households with IDP status and non-IDP households, indicating that the reasons behind high unemployment levels are shared equally among the local population.

There is a strong and consistent expectation that BP should provide local residents with jobs preferentially, to address the lack of jobs locally available.

The SSES suggested a wide range of factors contributing to unemployment in the Survey area. These included:

- A lack of job vacancies in the immediate area of the four communities and limited public transport to enable access to regional job markets; and
- Low level of skills, experience and qualifications among job seekers.

Those who were unemployed reported that they had been out of employment for periods from six months to 15 years. Structural unemployment occurs where the skill-base of labour available locally does not match the local demand for labour, resulting in jobs being filled by individuals located elsewhere. Structural unemployment was mentioned during stakeholder interviews. Local industrial enterprises indicated that they often had to recruit from the broader regional area, as local people did not have the necessary skills to fill the advertised vacancies.

7.6.8.2 Local Livelihoods

Local livelihoods include herding and artisanal fishing. There has been a 22% reduction in the number of registered small farms from 2005 to 2010[28]. In contrast, the number of cattle increased by 21% in the same period. Reasons for this change are not clear, and may reflect

[28] Garadagh ExComm (2011).

a trend by small farms to focus their efforts on producing milk and meat, combined with a general increase in the price of meat which is occurring at a national and global level.

The results of a site walkover survey at the two herder settlements located to the north east of the Terminal revealed the following:

- Herder Settlement 1 is characterised by empty buildings, some of which are occupied during the winter grazing period by a single family. At the time of the survey, they had moved to summer grazing lands to the north. This family were historically resettled by BP within the Terminal vicinity during the previous ACG Phase 1; and
- Herder Settlement 2 is characterised by a number of buildings, some of which are occupied by a family of seven. This family have been granted legal rights to five hectares of surrounding land by the Baku City Executive Committee.

Photos from the two herder settlements (refer to Figure 7.6) indicate buildings (left, from Herder Settlement 1) some of which are in a poor state of repair. A two-storey house is currently under construction (right, Herder Settlement 2).

Figure 7.6 Photos of Herder Settlements

A site walkover was also undertaken along the shoreline area between Sangachal Town and Umid to investigate the status of artisanal fishing activities[29]. The key findings were:

- Fishing activities (both commercial and recreational) were observed on the shoreline to the south of the Terminal and Sangachal Town;
- Approximately 20-30 people are involved in artisanal fishing using small vessels fitted with outboard motors. Some fishermen have a contract with two public companies (Caspian Fish and a Fish-breeding Plant in Sahil) and fishing is their primary source of income. Fish are also, on occasion, sold to local markets;
- Fishing huts and gear were observed along the beach area; and
- Fishing activities tend to decrease during the winter period when weather conditions are less favourable.

Although there appeared to be evidence of some fishing activities in the beach area at the time of the SSES survey, more recent reports suggest that the fishing huts in the area are not currently being used[30]. Further investigation may be required to assess whether livelihood activities are in fact being conducted in this area.

[29] Artisan fishing refers to any kind of small-scale, low-technology, commercial or subsistence fishing practices using traditional techniques such as rod and tackle, throw nets and drag nets, and traditionally designed fishing boats. Artisan fishing contrasts with large-scale modern commercial fishing practices in that it is typically less intensive and less stressful on fish populations.
[30] W Boulton, pers comm. (2013).

7.6.9 Gender Equality

Across Azerbaijan, women enjoy the same legal rights as men although gender discrimination does occur, particularly in rural communities[31]. A 2008 UNICEF Report[32] stated that early marriages were widespread in Azerbaijan and a bill is currently being passed through Parliament to strengthen legislation in this area. Work undertaken by UNICEF indicated that only 3% of girls subjected to early marriage subsequently continued their education, which prevented them from achieving their full economic and social potential.

There is low level of knowledge about women's reproductive health within rural areas of Azerbaijan, with many women not seeking assistance for health complaints which they perceive to be 'unimportant'[33]. There are no designated women's health resources available within the four communities.

National statistical data[34] indicates that there are no significant differences in the gender balance for enrolment in primary or secondary education, given the unbalanced sex ratio. In 2009, the female share of the workforce was 45% in urban areas, and 42% in rural areas. The proportion of seats in Parliament held by women was 12% in 1995 and 11.2% in 2009. 2009 data indicates that there are no differences in the gender ratio of literacy rates or infant mortality.

The status of women in relation to their employment status, level of maximum education attained and participation in society was discussed during women's focus groups held in each community. There were no problems in seeking women to participate in the SSES focus groups from any of the communities, indicating that there are no cultural barriers to joining such events. The results of focus groups indicated that there are currently no organisations dedicated to the interests of women, and that many (80%) women would not know who to approach if their human rights were infringed by harassment or gender-based violence.

Within households surveyed during the SSES, males were more likely to be employed (79%) than women (19%) and this ratio was similar across all four communities. Women were also less likely to be interested in undertaking technical training (82%) compared with men (68%). While there is a general lack of job vacancies available locally, there are particularly few opportunities that are (perceived to be) suitable for women. A lack of available childcare facilities was also mentioned during the SSES to be a significant barrier in obtaining employment.

7.6.10 Living Conditions, Household Income and Expenditure

According to the World Bank (WB) 2010 Living Conditions Assessment Report[35] (LCAR) which uses 2008 data, Azerbaijan has experienced a substantial reduction in poverty and associated improvement in living conditions since 2000. National data[36] indicates that the percentage of the population below the national poverty line gradually decreased from 49% in 2001, to 11% in 2009, and decreased significantly faster in urban areas. However, there is evidence[38] to suggest that in 2009, poverty increased by 1% due to the consequences of the global financial crisis.

The reduction in poverty is linked to strong economic growth and implementation of pro-poor growth and poverty reduction policies that have improved the distribution of wealth. Such policies are outlined in the St*ate Program on Poverty Reduction and Sustainable Development in the Republic of Azerbaijan for 2008-2015*. Policy changes have included an increase in monthly minimum wages from 75 manat (AZN) (2008) to 85 AZN (2011). The Ministry of Labour and Social Protection is expected in 2013, to introduce a minimum monthly wage that will vary depending upon the economic sector of employment.

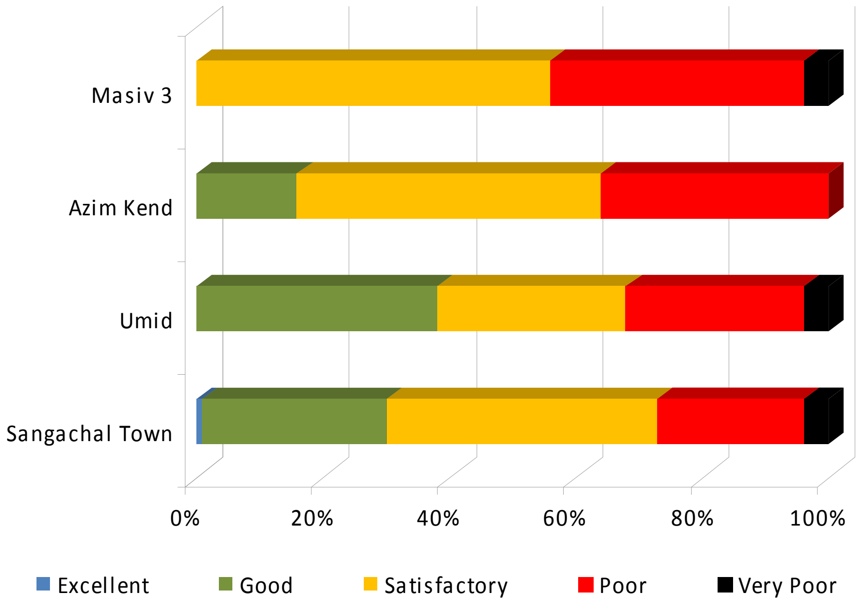
[31] (2007) U.S. Department of State Country Report on Human Rights Practices: Azerbaijan.
[32] (2008) United Nations Children's Fund (UNICEF) Report: Education in Azerbaijan.
[33] UNPFA (2011). Supporting Young People in Azerbaijan.
[34] State Statistical Committee of the Republic of Azerbaijan (2010).
[35] World Bank (2010). Azerbaijan: Living Conditions Assessment Report. Report No. 52801-AZ.
[36] State Statistical Committee of the Republic of Azerbaijan (2010).

Data from LCAR indicates that poverty rates are highest among households which are female-headed, lack basic sanitation infrastructure, have multiple children and include disabled and elderly members. According to LCAR, poverty levels are similar between genders at a national level and are strongly inter-generational. At a district level, poverty levels (and an associated rise in living conditions) have gradually reduced from 47% in 2001; to 26% in 2005; to 9% in 2010[37]. In 2009, the poverty rate in the Garadagh District was 9% which is the same level as recorded nationally. The reduction in poverty has been supported by an increase in social spending by Garadagh District, which has increased in coverage from 3,789 households in 2008, to more than 8,912 households in 2011[39].

7.6.10.1 Local Living Conditions

Data from the SSES indicates that only 6% of surveyed households consider their current living standards to be ‘good’ (Figure 7.7). The lowest rating (‘poor’) was recorded in Masiv 3 (40%) and Azim Kend (36%).

Figure 7.7 Level of Satisfaction Associated with Living Standards



Participants in the household survey from Sangachal Town and Umid stated that their living conditions had significantly improved following BP’s previous intervention in 2004 to install sewage infrastructure within their community, highlighting the link between public infrastructure and living conditions.

The main problems associated with housing included damp caused by leaking roofs, poor conditions of walls and roofs, lack of a sewage infrastructure and the presence of vermin and insects. Damp problems were particularly high from surveyed households located in Sangachal Town and Umid.

7.6.10.2 Household Income

At a national level, household incomes have risen alongside the reduction in poverty and improvement in living conditions. Locally, Sangachal Town and Azim Kend are heavily reliant on public sector employment. Raising livestock is a source of primary and secondary income at Azim Kend and casual earnings from informal employment are important at both Umid and Azim Kend. Secondary income sources include pensions and other social allowances, casual earnings and (for Azim Kend) raising livestock (12%). However, more than half of households did not have a secondary income.

[37] Garadagh Executive Power (2011).

The average household income in Sangachal Town (439 AZN) and Umid (418 AZN) is higher than the average for the Garadagh District (400 AZN). In contrast, average monthly household incomes in Azim Kend (228 AZN) and Masiv 3 (297) are significantly below the District average[38].

Data shows that there are relatively few well-off households with the majority of households clustered in three income groups: 100 to 199 AZN; 300 to 399 AZN; and 400 to 499 AZN. Fifty-four percent of households have a monthly income of 400 AZN or lower; 18% have a monthly household income of less than 200 AZN.

7.6.10.3 Household Expenditure

Information associated with monthly household expenditure patterns (in AZN) is presented in Table 7.5 using data collected by the SSES in 2011.

Table 7.5 Monthly Household Expenditure (AZN)

Monthly Household Expenditure (AZN)	Food	Utilities	Land and/or house rental	Healthcare	Education	Transport
Minimum local level	50	2	1	5	5	2
Maximum local level	750	150	220	800	350	300
Average local level	237	48	27	63	51	57

The data shows that relatively equal proportions of average monthly household expenditure are allocated to utilities, healthcare, education and transport. The average amount spent on food (237 AZN) is relatively high, considering average and median household incomes.

The proportion of surveyed households that go into debt or rely on friends and relatives to purchase food, ranged from 12% in Sangachal Town to a maximum of 32% in Masiv 3. In such circumstances, monthly household income is less than expenditure and there is an inability to meet basic needs.

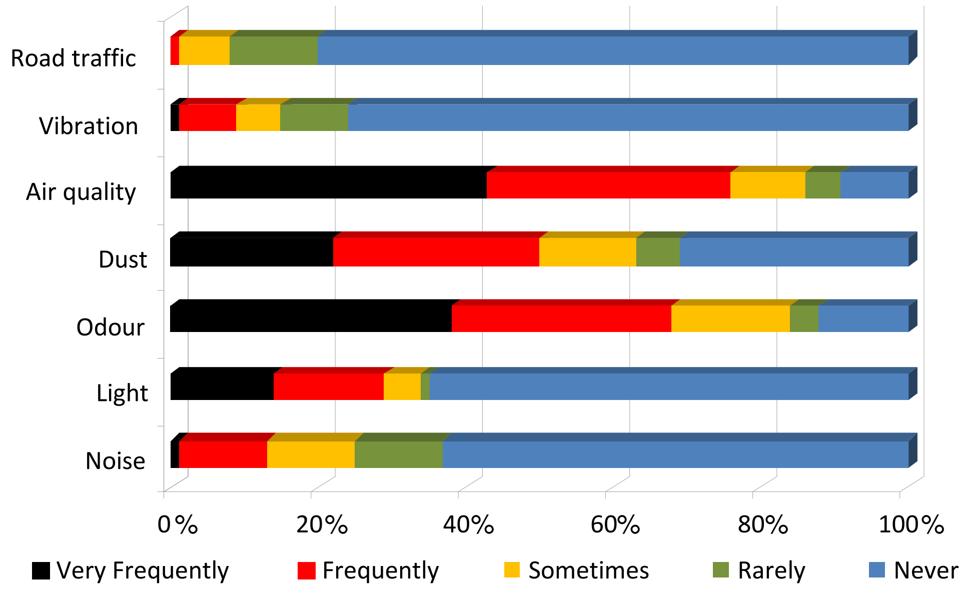
7.6.11 Local Perceptions towards Industrial Operations and BP

The SSES surveyed local perceptions towards third-party industrial operations and BP's activities. When surveyed households were asked to name the main types of industrial enterprises operating in the area, 79% identified Sangachal Terminal in their first response. Other industrial enterprises included Sangachal Power Plant, Garadagh Cement Plant, Sangachal Water Treatment Plant, AzPetrol Terminal and regional quarry companies. The overwhelming majority of respondents (77%) did not see any significant differences in the way in which different industrial enterprises (including BP) operate in the area, generally viewing such activities as a 'single form' of operation.

The perceived environmental impacts from industrial operations are presented in Figure 7.8. When surveyed households were asked specifically about BP's activities, their responses indicated that they did not distinguish between the effects of BP activities and other industrial activities in the area.

[38] ERM (2009) Garadagh Cement Project New Dry Kiln 6: ESIA.

Figure 7.8 Frequency of Perceived Environmental Impacts from Industrial Operations



Public meetings held at Sangachal Town, Azim Kend and Umid during October 2011 associated with the SD2 Infrastructure Project ESIA indicated community concerns about the operation of existing elevated flares at the Terminal. Community members questioned why the flame height varied and whether a change in height represented dangerous conditions at the Terminal. Local community participants also questioned whether flaring at the Terminal could result in negative impacts to health due to the inhalation of emissions, and whether it was the cause of the strong hydrocarbon odours that are known to occur.

As described in Chapter 6 Environmental Description, Section 6.4.6, these odours, which are transported to communities under certain winds conditions, are considered to be due to the produced water ponds at the Terminal. In general, the meetings demonstrated that there were strong negative perceptions associated with existing flaring activities at the Terminal within the communities, with the presence of hydrocarbon odours reinforcing the perception that existing flaring was causing health impacts.

7.6.12 Social Organisation and Local Social Issues

At a national level, the World Bank Country Office in Azerbaijan and State Government jointly support the development of civil society groups through a Civil Society Fund (CSF). Each year a different focus area for new NGOs is chosen; in 2009 the focus was on youth interests and equal opportunities.

There were in 2011 36 officially registered NGOs in the Garadagh District[39], although not all of these were necessarily active. The registered NGOs focused on the following interests:

- The elderly, young, students and families;
- People with disabilities, including the blind, women, children and war veterans;
- The armed forces and war veterans (general);
- The interests of women (includes a female oil workers society);
- Ukrainian and Russian communities;
- Entrepreneurship, science, intellectuals;
- Consumer and free trade associations; and
- Country offices of international organisations such as ‘Red Crescent’ which form part of the International Red Cross humanitarian movement.

[39] Garadagh ExComm (2011).

At a local level, there are three NGOs active in the local communities (one in Sangachal Town and two at Umid). The level of awareness of NGO activities is low. During community focus group discussions, local residents repeatedly expressed their desire to form new groups to address specific problems experienced in their community.

The SSES indicated that there were no significant issues associated with substance abuse or anti-social behaviour within any of the four communities, although this may simply reflect a cultural reluctance to discuss such issues. Minor cases of crime, drug and alcohol abuse were linked during focus groups to high unemployment and poverty. A participant from the Women's Group in Umid linked unemployment to recent increases in family conflicts and crime, which was associated with youths returning from military service who could not find employment.

7.7 Vulnerable Groups

7.7.1 Income-Poor Households

Income-poor households may experience a variety of financial problems which include difficulties in paying utility bills on time, purchasing educational resources (school uniforms and text books), purchasing medicines or paying for specialist diagnostic healthcare. They are also likely to be reliant on informal credit arrangements to purchase essential household items, such as food.

The survey of households' ability to pay public utilities on time revealed that more than half of households make payments without delay (51%) with 30% making payments after a small delay. A proportion of households in Sangachal Town (10%), Umid (12%) and Masiv 3 (16%) make payments after a long delay. Due to the cost of gas and electricity, 12% of households in Azim Kend are forced to use cattle dung as a source of heating fuel and asphalt is used in a few households. Both choices of fuel may reflect fuel poverty in these vulnerable households.

Considering the household expenditure pattern of households surveyed by the SSES, income-poor households will be especially vulnerable to future increases in food prices, utilities (especially heating fuels) and changes in housing condition. Without a rise in household income, the low quality housing conditions experienced by many households will continue as the costs of capital repairs are prohibitively expensive.

7.7.2 Female-Headed Households Living Without Remittances from the Husband

Female-headed households are a vulnerable group as they are more likely to be poor, be reliant on one income (which may pay less than their male counterparts for the same role), and have dependent children. Child benefit payments in Azerbaijan are too small to make a significant difference to single-parent households' expenditure patterns: a single payment of 75 AZN is issued for each newborn child, and the poorest families are entitled to an additional 30 AZN a month until the child's first birthday[40]. The prevalence of poverty within female-headed households has implications for future child development outcomes.

7.7.3 The Elderly and Those Living with Disabilities

The elderly and those living with disabilities comprise a particularly vulnerable group and are likely to have low incomes and be reliant on state transfers. People with disabilities may find difficulties in seeking suitable employment. This group is likely to have greater healthcare demands which in turn increases household expenditure. Households who have disabled children are particularly vulnerable, as they face higher expenditures on healthcare, childcare and educational resources and may experience problems in obtaining the (generally higher) level of social services they need.

[40] Institute for War and Peace Reporting: Plight of Single Mothers in Azerbaijan (2011).

7.7.4 Herders

During archaeological and wetland surveys completed in June and September 2011 within the SD2 Expansion Area, surveyors observed that the area was regularly frequented by herders. The herders are often unaccompanied and male, ranging in age from under 18 to the elderly. It is understood that some herders live in Azim Kend and Masiv 3 and graze animals all year round, even though land in the vicinity of the Terminal is generally considered to be winter pastureland.

Herders may be characterised by low levels of education, low access to healthcare and may comprise a distinct social group within the wider society. Some herders may be IDPs who were involved in animal pastoralist activities before displacement, and continue to use their skills and experience. The herders' legal right to graze animals in the vicinity of the Terminal is unknown and these informal land users may be particularly vulnerable to changes in land access and other external factors, such as the incidence of animal disease, harsh winter conditions that can rapidly reduce headcounts and food price inflation. Herders may also be particularly vulnerable from the expansion of regional, third-party industrial operations (cumulative impacts) which reduce access to grazing areas in the future.

7.7.5 IDPs and Refugees

Across Azerbaijan, more than 586,000 people remain internally displaced due to the Nagorno-Karabakh conflict and the status of many IDPs and refugee groups has never been resolved. Despite a combination of efforts from both State Government and international aid organisations, many IDPs live in dilapidated public buildings, makeshift accommodation or temporary accommodation[41]. The source of their vulnerability is linked to their original displacement, as they no longer have access to their original housing stock, livelihoods (some of which were agricultural-based and dependent on land access rights) and previous social support networks. At a national level, the incidence of poverty within IDP households based in rural areas is higher when compared to any other group in the country[42].

Azerbaijani citizens must register their residence under an internal system known as the *Propiska* regime and many IDPs who moved away from the location where they initially settled, have struggled to re-register themselves at their current location. Typical problems encountered with re-registration include overly-bureaucratic processes and loss of original documentation during the war. Without formal registration, IDPs find it hard to access social allowances specifically designed for this group.

Registered IDPs receive monthly food allowances of 18 AZN per month and do not have to pay for utilities. Since the ceasefire in 1994, many IDPs have had their own children at their new locations. Children of IDP parents only qualify for IDP status (and associated social benefits) if they are either born to parents who both have IDP status, or if their father is an IDP. In the event that only the mother is an IDP then the child does not quality for Targeted Social Assistance (TSA) which increases the probability of them becoming poor[43].

The majority of IDPs in the vicinity of the Terminal have lived in their communities for 11 to 20 years, are based in Umid and Sangachal Town and appear to have integrated into local society. The fact that the majority of IDPs within the four communities live in state-provided housing, may indicate that they are comparatively less at risk from poverty compared to others, who have had to find their own accommodation[43]. However, the quality of IDP housing remains a serious concern. The main developmental priority for IDP households is the condition of housing as many are in poorly constructed buildings. Data from the SSES report indicates that IDPs living in Umid had the highest proportion of housing complaints that were associated with damp and vermin.

[41] Internal Displacement Monitoring Centre (2010). Azerbaijan After some 20 years: IDPs still face barriers to self-reliance.
[42] World Bank (2010). Azerbaijan: Living Conditions Assessment Report. Report No. 52801-AZ.

Focus Groups conducted during the SSES contained a mixture of IDPs and non-IDPs and there was no mention of past conflicts or any emphasis upon social distinctions between these two groups. Instead, there appeared to be a common understanding that residents of the communities faced similar socio-economic conditions, irrespective of their background, and needed to join together to form social organisations to address the challenges of unemployment, poor housing conditions and lack of public transport.

IDPs present within the vicinity of the Terminal have been settled by State Government into accommodation at Umid, which was recently expanded from the presence of workers from the Garadagh Cement Plant at Sahil. IDPs are also present at Sangachal Town. Many IDPs were originally (in their pre-conflict geographical location) involved in agricultural-based livelihoods which were sustained through a combination of good agricultural soil and adequate rainfall patterns. IDPs settling into Umid and Sangachal Town were not automatically granted land access rights and were limited by unfavourable soil conditions. Consequently, some IDPs will have struggled to adjust their livelihoods away from agricultural-based activities, into formal employment within the public or private sector.

There are no significant differences between unemployed household numbers of IDPs and non-IDPs, and access to high-quality educational, healthcare and infrastructure is limited across all of the four communities. Consequently, the vulnerability of IDPs is instead specifically linked to poor housing conditions, gender discrimination in the provision of TSA payments to children and difficulties associated with obtaining registration documentation which provides equal access to economic and social services.

7.8 Regional Industrial Developments

A review of industrial developments that are either currently under construction or have recently started operation across the Garadagh region was completed in October 2012. The aim of the review was to identify, and quantify, where possible, new employment opportunities that could benefit the local communities in the vicinity of the Sangachal Terminal and across the wider Garadagh region in the near future. The review identified that the following industrial developments within the Garadagh region are currently under construction:

- The Khazar development – this project comprises the construction of a mini-city upon coastal land which is extended up to 8km into the Caspian Sea by an artificial island which is to be gradually developed over the next 25 years, with 10% estimated to be completed by the end of 2016[43]. The project covers a total area of 30,000m^3 land allocated for housing, commercial properties, offices, sporting events and entertainment venues. There is no information available associated with predicted employment numbers during the construction and operation phases.
- Qizildas Cement Plant – located approximately 2km north of the Terminal, this plant extracts lime and clay from quarries that are located to the north and west of the plant at a distance of two to 40km[44]. The number of jobs generated by the construction and operational phases of the plant is not known. However, a construction workforce camp is located within the construction site to provide temporary accommodation which may indicate the use of labour from outside the immediate geographical area. Construction works are expected to be completed by 2014.
- Garadagh District Umbaki (Jeyildagh) Jailhouse – this development comprises a prison which holds up to 1,500 people. Construction work started in 2007 and is expected to be complete by December 2013[45].
- New Baku Port – the location of the new port is close to Alyat settlement, 25km to the south of the Terminal, and is being undertaken by the Ministry of Transport. The port covers an area of 400 hectares and includes the construction of two bridges for ferry boat movements, three freight bridges for container vessels, provision of infrastructure for the movement of roll-on and roll-off cargo, and a large dry cargo storage area.

[43] http://khazarislands.com.
[44] Garadagh Cement Project New Dry Kiln 6 ESIA 2009
[45] http://az.trend.az/news/society/1154679.html

Construction works started in November 2012 and are expected to be complete by 2015[46].

- Baku Shipyard Company – this development is located 23km from the Terminal adjacent to an existing deep water plant and comprises a modern shipyard facility. This project is being implemented by SOCAR in partnership with Keppel Offshore and Marine (Singaporean company). Construction works started in 2011 and are due to be complete by 2013[47].
- Navy and Military camp for Navy Officers – located close to Sahil settlement, this development aims to provide residential housing for officers' families and is being undertaken by the Ministry of Defence. Construction works are underway and some housing units have already been built.

The review identified that the following industrial developments within the Garadagh region have recently started operation:

- Development of retail centres – three large retail centres (Bina, Sadarak and Karvansaray) have been constructed close to the settlement of Lokbatan after the existing airport market was relocated. These retail outlets started operation during 2012. There is no information available to reflect the number of jobs created by the operation of these retail centres[48].
- Garadagh Cement Company (now 'Holcim Company') was recently expanded and restarted operations in June 2012 with an enlarged capacity of 1.7 million tonnes per year as a result of the investment[49].
- "Azeri Steel" Metal Construction Factory near Sahil settlement – operation of this new facility, which has a capacity of 1,500 tonnes per month, commenced in July 2012 with a workforce of 120 people. The majority of workers are based in Sahil[50].
- "AAC" Modern Construction Materials Factory – operation of this cement production company, which has a capacity of 600m^3/day and 100 tonnes/day of lime, started in December 2011. The factory is located 10km from the Terminal towards the settlement of Alyat[51].

The results of the review indicate that there are a variety of employment opportunities being generated from the ongoing socio-economic development of the Garadagh District.

7.9 Commercial Fishing Operations

Information presented within this Section is taken from a review prepared by Professor Mehman M Akhundov (Doctor of Biological Science, Azerbaijan National Academy of Sciences) in 2011.

7.9.1 Regulatory Bodies and Licensing

The following regulatory bodies control commercial fishing activity in the Azerbaijan sector of the Caspian Sea:

- State Marine Administration (SMA) - issue documents confirming the official identity and ownership of vessels, crew composition and the country of vessel registration;
- Ministry of Emergency Situations (MChS) - checks the seaworthiness of vessels;
- Department on Protection and Reproduction of Aquatic Bioresources (DPRAB) which forms part of the Ministry of Ecology and Natural Resources (MENR) - issues permits and quotas to Azerbaijani citizens that state the annual, species-specific, total allowable catch (TAC) measured by weight;

[46] http://www.dredgingtoday.com/2012/10/15/azerbaijan-dredging-at-new-baku-port-nears-end/
[47] http://www.ebrd.com/downloads/news/annual_meeting/pres/Azerbaijan_Lawrence_Quah_Presentation_21_May.pdf
[48] Synergetics, pers comm. (2013)
[49] http://www.contact.az/docs/2012/Economics&Finance/071000005057en.htm
[50] http://www.contact.az/docs/2012/Economics&Finance/071000005047az.htm
[51] http://news.lent.az/news/99483

- Marine Transport Police (MTP) which forms part of the Ministry of Internal Affairs (MIA) - enforces the use of sea worthy vessels (only) and whether fishermen are acting in compliance with their license and quotas; and
- Coastguard – responsible for marine security.

All individuals (vessel owners, crew and owners of companies) involved in commercial fishing within the Azerbaijan sector of the Caspian Sea must be Azerbaijani nationals. At the end of each month, the individual holding the commercial fishing permit is required to submit a report to DPRAB that indicates the results of their fishing effort (number of vessels and time spent at sea) and total weight caught.

7.9.2 Companies and Individuals Involved

The companies and individuals who currently hold a licence to fish for 2012 use a variety of vessels registered in five ports and harbours. The largest company involved is "Khazarbalig" which operates five vessels from Lenkoran (refer to Table 7.6).

Table 7.6 Companies and Individuals Who Hold a Commercial Licence to Fish in 2012

Company Name / Individual	Vessel Type and Name	Registered Vessel Harbour
Closed joint-stock company (ZAP) "Khazarbalig"	SB - "Delfin"	Lenkoran
	SB - "Azeri"	Lenkoran
	SB - "Fortuna"	Lenkoran
	LTV - "Dalga"	Lenkoran
	LTV - "Bayaz"	Lenkoran
Closed joint-stock company "Gartal"	LTV - #29	Neftchala
Closed joint-stock company "Caspian Fish Co Azerbaijan"	LTFV - #50 "Shahriyar"	Shuvelyan
Open joint-stock company (OAO) Z. Tagiyev Fish Curing Plant	SB - "Nardaran"	Artyom (Pirallakhi Island)
Individual Agalar Mammadov	LTV - "Kompas"	Bayil
Individual Azer Guliyev	LTV - "Mirmohammed-96"	Bayil
Individual Vilayat Aliyev	LTV - #208	Bayil
Individual Rustam Garakhanly	LTV - "Khazar"	Bayil
Individual Ramiz Hajiyev	LTV - #90	Artyom (Pirallakhi Island)
NOTES: SB = Seine Boat. LTV = Lifting Transportation Vessel. LTFV = Lifting Transportation Freezer Vessel.		

A description of each type of vessel used is provided below:

- **Seine Boat (SB)** – typically has an overall length (LOA) of 8 to 10m (small size vessel) or 14 to 18m (medium size). The use of seine boats to catch anchovy is a popular method in the Caspian Sea and a mid-water pelagic fishing method is commonly used. Two cone-shaped nets are released into the water surrounding the school of fish at a depth of 20 to 90m, and closed by pulling on a string at the bottom of the net (called the purse line) before lifting onto the boat. The nets are fitted with electric lights to attract kilka;
- **Lifting Transportation Vessel (LTV)** – boat length is typically 14 to 18m (LOA) and typically use cone-shaped nets similar to seine boats; and
- **Lifting Transportation Freezer Vessel (LTFV)** – this is similar to an LTV vessel and fitted with an onboard freezer so that fish is processed onboard and immediately transferred into boxes using ice from an onboard ice generating machine.

7.9.3 Direct Employment with Vessel Owners and Crew

All licensed owners of fishing vessels and accompanying crew are of Azerbaijan nationality and male. Crew are typically recruited from the coastal regions of Azerbaijan such as Neftchala, Lenkoran, Astara, Salyan, Garadag, Absheron, Shabran and Khachmaz. Typical crew numbers onboard are, for each type of fishing vessel:

- Seine Boat – four persons;
- Lifting Transportation Vessel – four persons; and
- Lifting Transportation Freezer Vessel – five persons.

Based on the number and types of vessels granted permission to undertake fishing operations in 2012, the maximum total number of crew is estimated to be 53 persons. The average salary of a crew member is 150 to 200 AZN per month, indicating that economic flows from direct employment of vessel crews reach a maximum 9,000 AZN a month.

The majority of crew members work without any formal written contract and are typically paid either in cash, or a mixture of cash and fish for household consumption. During the low season fishermen typically seek alternative sources of income which may include work in the construction, agriculture and retail industry.

There is no formal social organisation established for fishermen.

7.9.4 Commercial Species, Fishing Locations and Seasonal Variation

There has been a rapid decline in fish stocks within the entire Caspian Sea (see Chapter 6 Environmental Description, Section 6.6.4). Historically vessel owners requested permits from DPRAB to catch the following types of commercial species:

- Lamprey;
- Sturgeons;
- Salmon;
- Shad;
- Herring;
- Carps;
- Catfish;
- Gray mullet; and
- Perch.

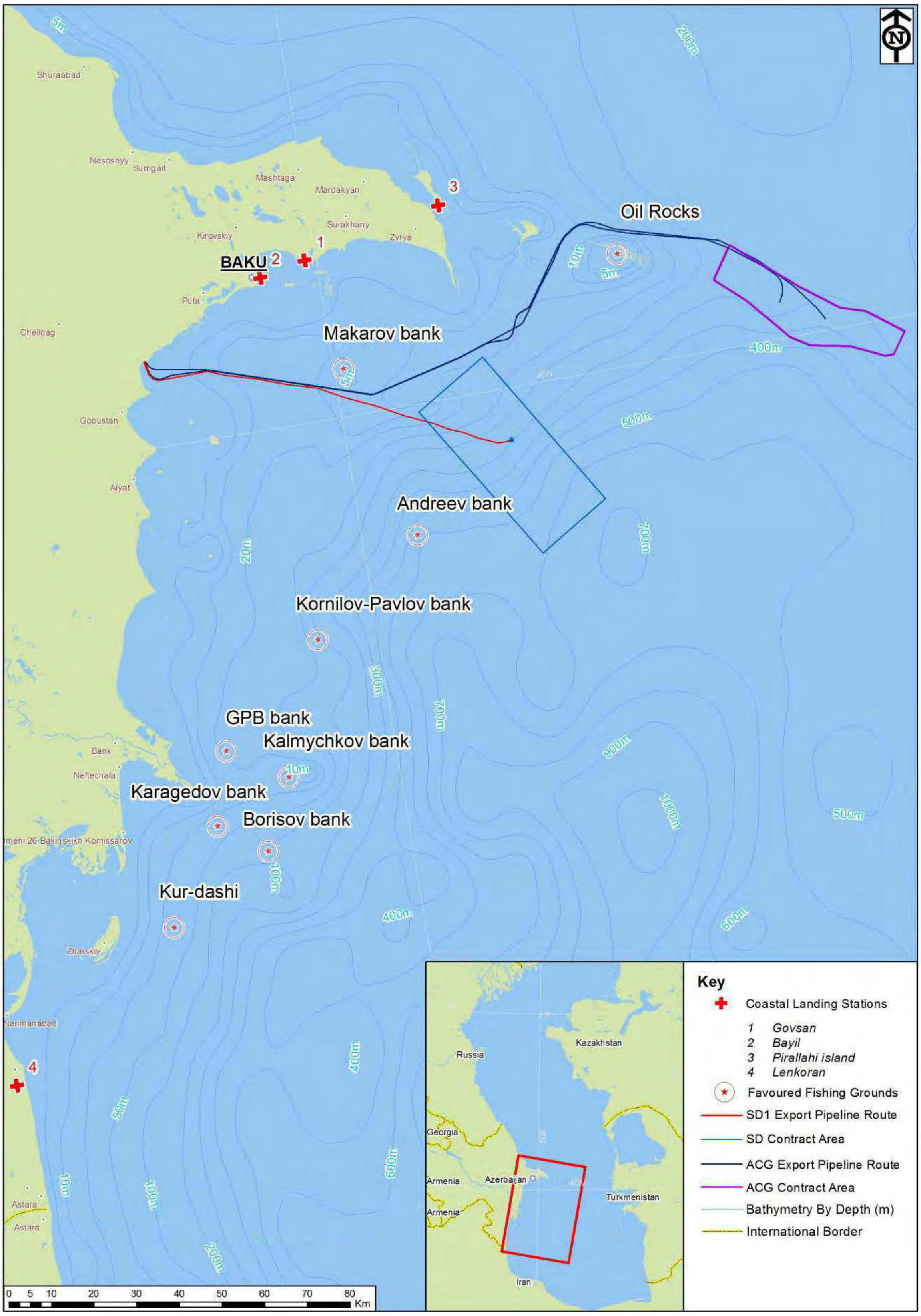
The above species are now listed in the Red Data Book of Azerbaijan (1989) and are illegal to commercially fish. The following types of kilka are targeted as commercial species in the Azerbaijan sector of the Caspian Sea:

- Anchovy kilka – *Clupeonella engrauliformis* (Borodin);
- Big-eyed kilka – *Clupeonella grimmi* (Kessler); and
- Caspian ordinary kilka – *Clupeonella delicatula caspia* (Stetovidov).

The only commercial species currently included in licence quotas issued in 2012 by DPRAB was big-eyed kilka (*Clupeonella grimmi*).

The locations of favoured fishing grounds for 2011 are shown in Figure 7.9. The nearest fishing location is Andreev bank which lies 15 to 20km west of the SD2 Contract Area. The locations of landing ports and harbours for vessels are also illustrated.

Figure 7.9 Locations of Favoured Fishing Grounds and Locations of Landing Ports and Harbours



Source: Professor Mehman M Akhundov (Doctor of Biological Science, Azerbaijan National Academy of Sciences) (2011).

The seasonal variation in commercial fishing activity within the Azerbaijan sector of the Caspian Sea is summarised below:

- **December to February** – low season when 50% of fishing vessels are used due to unfavourable winter weather conditions;
- **March to April** – peak high season with fishing particularly favourable during dull, cloudy weather conditions when electric lighting is particularly effective;
- **May to June** – low season when kilka species are spawning and migrate to the Northern and Middle Caspian Sea; fishing is not productive in this period, as kilka do not swarm to form schools;
- **July to August** – low season period due to clear, cloudless weather; and
- **September to November** – high season.

7.9.5 Recent Trends in Commercial Fishing Operations

Anchovy kilka is the most abundant fish in the Caspian Sea. Scientific research undertaken by Daskalov and Mamedov (2007)[52] calculated relative abundance indices of fish using the results of surveys completed between 1991 to 2004. The data indicates that from 1991 to 2000 anchovy kilka was present in the Caspian Sea in high abundance, sustained by a high number of new young fish entering the fish population annually (level of recruitment) and a high mass of spawning stock. From 2001 to 2004, the abundance of anchovy kilka virtually collapsed with recruitment levels falling to a record-low alongside a significance reduction in total catch weight. The availability of other commercial species in the past 10 years, particularly sturgeon and caviar, has also collapsed. Across the entire Caspian Sea, the decline in kilka has reduced from 271,000 tonnes in 1999 to 54,000 tonnes in 2003, according to Sedov, *et al*. (2004[53]). In addition to a decline in kilka, the species composition of a typical catch has changed from being dominated by anchovy kilka (*Clupeonella engrauliformis*), to the Caspian kilka (*Clupeonella cultriventris*). This change in composition is due to the disproportionate impact the change in near-surface temperature layer of the Caspian Sea has had on different kilka species, affecting the abundance of anchovy kilka to a greater extent when compared with ordinary kilka.

Data from DPRAB indicates that the total quantity of kilka landed in the Azerbaijan Sector of the Caspian Sea has consistently reduced by 96% from 2002 (10,950 tonnes) to 2011 (485 tonnes).

7.9.6 Indirect Employment from Fish Processing Companies

Fish landed at ports and harbours in Azerbaijan is directly sold on to consumers or fish retailers, or processed by the company: “Caspian Fish Co Azerbaijan”. Historically, 2-3 different companies were involved in fish processing with some exported to the Russian Federation. Approximately 100 people are employed by “Caspian Fish Co Azerbaijan” (in 2012) on short-term contracts, with 90% being female workers. Employment levels at “Caspian Fish Co Azerbaijan” are seasonal and follow the fishing season. Monthly incomes of workers are approximately 120 AZN. The maximum monthly economic flows from fish processing (from indirect employment) are 12,000 AZN a month.

7.9.7 Illegal Fishing

Data provided by the DPRAB on the number of people charged with illegal fishing offences show a reduction from 264 persons in 2007 to 54 persons in 2011. The numbers of confiscated vessels and seized catch has also decreased. The decline in illegal fishing may be linked to the general reduction in fish resources within the Azerbaijani Sector of the

[52] Daskalov, G. M., and Mamedov, E. V. 2007. Integrated fisheries assessment and possible causes for the collapse of anchovy kilka in the Caspian Sea – *ICES Journal of Marine Sciences*, 64: 503 – 511.

[53] Sedov, S. I., Paritskiy, Yu. A., Zikov, L. A., Kolosyuk, G. G., Aseynova, A. A., Andrianova, S. B., Kanatiev, S. V. et al. 2004. The states of stocks of Caspian marine fish and prospects for their commercial utilization. In: *Fisheries Researches in the Caspian: Scientific-Research Works Results for 2003*, pp. 360–368. KaspNIRKH Publishing, Astrakhan. 570 pp. (in Russian).

Caspian Sea, increased fishing costs, and DPRAB's greater effectiveness in halting such practices.

7.9.8 Scientific Research

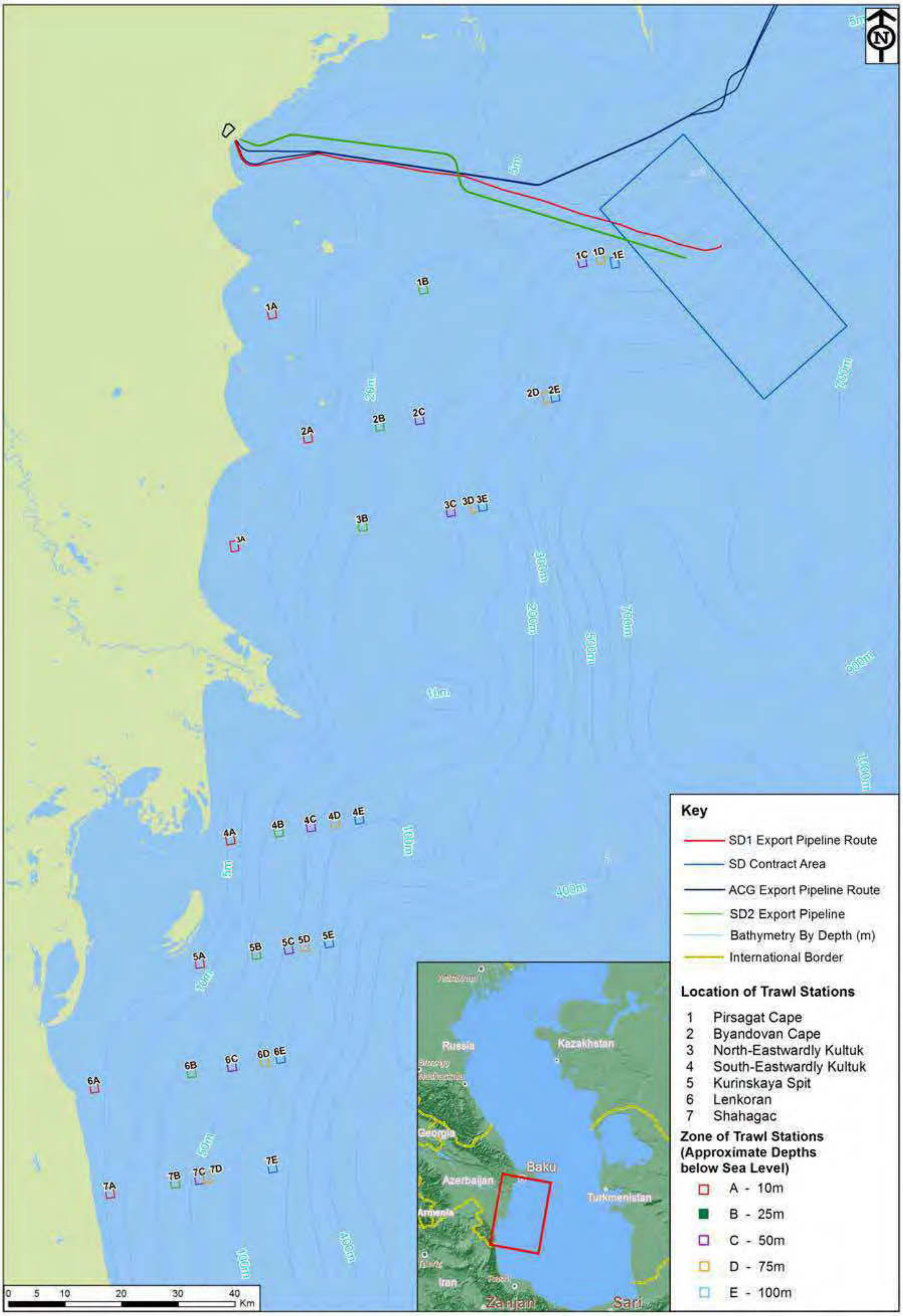
Scientific research of sturgeon (*Acipenseridae*) is undertaken within the Azerbaijani Sector of the Caspian Sea using seven experimental trawling locations (refer to Figure 7.10). In March 2012, BP requested the Ministry of Ecology and Natural Resources (MENR) to relocate experimental trawling locations 1D and 1E outside the SD Contract Area from 01 January 2015 indefinitely. This has subsequently been agreed.

The purpose of ongoing scientific research into the distribution of sturgeon is to:

- Identify changes in recruitment levels and population ratios between sturgeon species while monitoring seasonal change;
- Evaluate the quantity reserves and track their spatial distribution over time; and
- Continue scientific study of their forage base and their prevailing trophic conditions.

Licences issued for catching sturgeon are restricted by DPRAB to scientific research and for broodstock in fish farms, with strict quotas applying to all catches. The areas where aquaculture broodstock are caught lie a significant distance away from the SD Contract Area. Research expeditions are undertaken by the Azerbaijan Scientific Research Institute of the Fishing Industry (AzerNIIRKh).

Figure 7.10 Locations of Scientific Research Trawl Sampling Locations

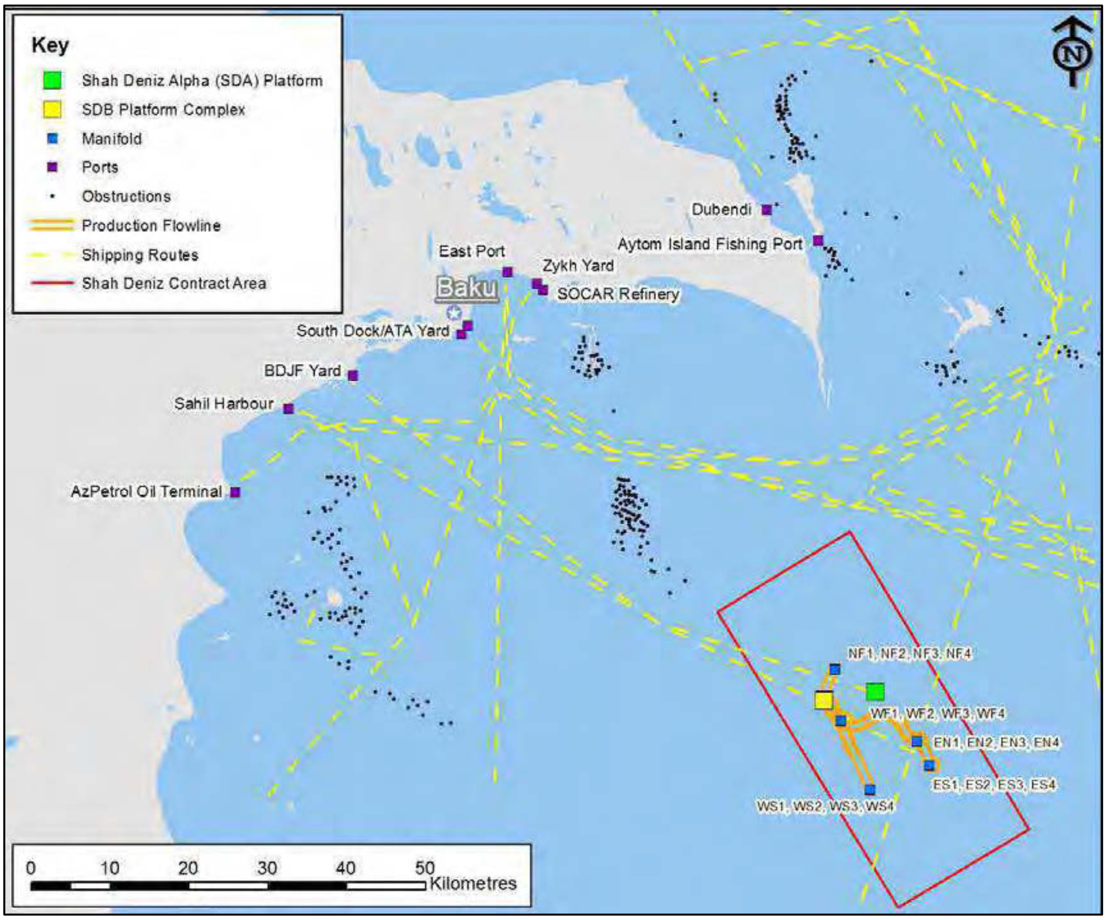


Source: Professor Mehman M Akhundov (Doctor of Biological Science, Azerbaijan National Academy of Sciences) (2011).

7.10 Commercial Shipping Movements

The primary commercial ports of Azerbaijan are situated on the Absheron Peninsula and ports in the vicinity of Baku. Shipping activities in the waters of the Central and Southern Caspian include commercial trade, passenger, scientific and supply vessel operations to the offshore oil and gas industry. The main shipping routes, ports and obstructions are illustrated in Figure 7.11. There are three shipping routes that pass through the SD Contract Area and are associated with supply and scientific vessels which undertake regular scheduled trips to the SD Contract Area.

Figure 7.11 Shipping Routes in the Vicinity of the SD Contract Area[54]



7.11 Construction Yard Operations

The Baku Deepwater Jacket Factory (BDJF) Yard (formally the Shelfprojectsroi (SPS) Yard) was used for onshore construction, assembly and pre-commissioning during the ACG Phases 1, 2 and 3 projects. The yard lies approximately 20km south of Baku on the western coastline of the Caspian Sea. There is no informal use of the land (such as small vendors for example) immediately outside the yard's site boundary.

The Bibi Heybet (former Amec-Tekfen-Azfen (ATA)) Yard was used for platform topside onshore construction and pre-commissioning during the ACG Phases 1, 2 and 3 projects. The yard is located within the Bibi Heybet Oilfield approximately 8km to the south of Baku and is bound to the east and south by the Caspian Sea.

[54] Figure 6.13 is derived from The Caspian Hydrographic Chart No. 32001.

A data gathering questionnaire was submitted to the ATA yard in July 2012 to gather socio-economic data on the existing workforce. The results of the questionnaire indicate the following:

- The workforce at the ATA yard currently comprises a total of 3,690 workers (1,031 professionals and 2,659 non-professionals), of which only 1-2% are temporary workers;
- The total monthly spend on the workforce is approximately 1.9 million AZN [55];
- The majority of workers are aged between 30-55 (92% of males and 75% of females);
- All workers are provided with written employment contracts and the minimum contract duration for new workers is 3 months;
- 95% of the workforce are from the communities within Baku with the remaining 5% from the communities of Alyat, Sahil and Qobustan; and
- No members of the ATA workforce are members of a union.

A Socio-Economic Baseline Study for the Bibi Heybet Yard was prepared in 2003. The survey identified 122 people living within 1.5km of the yard. A site reconnaissance visit undertaken in 2008 (and reconfirmed in June 2011) suggested that there were no longer any residential premises within close proximity to the yard.

7.12 Community Investment Programmes

In 2012, a BP AGT (Azerbaijan, Georgia and Turkey) Community Investment Strategy for 2012-2016 was approved. The strategy includes the provision of support to community development programs, the development of enterprise, energy efficiency initiatives and stakeholder capacity building activities. A variety of national and local institutions will be used to implement the strategy which will be supported by international organisations tasked with transferring technical training and knowledge. The strategy will be implemented alongside a robust Monitoring and Evaluation (M&E) framework to track the progress made and quarterly/annual progress reports will also be prepared.
The Community development initiatives for Azerbaijan focus on the following:

- Improving BP's community relations to involve young people and create effective working relationships with local government, community residents and business representatives;
- Enhancing the capacity of local communities through the provision of support to income and revenue generating activities; and
- Vocational training support to enhance the skill level of local community residents to make them suitable for employment by BP's major construction and installation contractors.

The ACG, SD, BTC, SCP and associated projects have played an important role in social development within the region. In addition to the direct economic benefit gained through local employment and the use of regional (Garadagh district) and other national businesses by BP, these previous projects were implemented in parallel with substantial community development projects. These projects aim to support socio-economic development in the local communities, strengthening civil society through the active participation of local NGOs and community-based organisations, and improve the relationship between local government and local populations.

BP reported a gross social spend in Azerbaijan, by BP and its co-ventures, of approximately US$M 50.1 between 2002 and 2010 (refer to Table 7.7)[56].

[55] The monthly spend on the workforce was calculated by multiplying the numbers of workers under each type of occupation against 75% of the maximum salary band.
[56] BP Azerbaijan Sustainability Reports (2002-2011).

Table 7.7 BP / AIOC Social Spend 2002 to 2011 (US$M)

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
0.60	2.71	8.64	6.29	6.75	7.39	6.43	3.40	4.78	3.12

The BP-led CIP "*The Youth Employment and the Expansion of Economic Opportunities Expansion Initiative*" completed in 2010, covered Sahil, Umid and Sangachal Town and focused on training young people in practical employment skills. The initiative lasted three years. A total of 214 young people completed training courses. From this total, 145 were subsequently employed and 45 were enabled by Jump Start Economic Project grants to set up their own business. The budget of the project was US$439,090.

Participants in SSES focus group discussions stated that their communities relied on BP for socio-economic investment. Stakeholders interviewed supported this view and indicated that BP was the only large industrial enterprise that provided significant support to its local communities.

7.13 Local Content Development Initiatives

BP and it co-ventures` Enterprise Development and Training Programme (EDTP) in Azerbaijan was launched in 2007. Its aim is to help local hydrocarbon sector companies achieve international standards and increase the amount of local content in BP's projects. EDTP activities included market surveys, the identification of potential local suppliers, detailed gap analysis and the creation and implementation of relevant development plans.

A total of 93 companies have completed the programme successfully since 2007 out of some 1,000 companies that have been appraised by the project. More than 360 action plans and gap analyses have been produced to support participating companies in delivering improvements. Since EDTP's inception participating local companies have invested about $8.8 million in new capital equipment and hired approximately 527 employees. The programme has assisted local companies in securing contracts valued at more than $184 million with other local and international companies of which more than $125 million have been with BP in Azerbaijan.

BP and its partners' operations and projects expenditure in Azerbaijan in 2011 is shown in Table 7.8[57]. (Table 7.8). As the table shows direct expenditure with local small and medium enterprises (SME) increased by 73% as compared to 2010.., Spend with state-owned companies increased to $36 million and to $285 million with joint ventures. Indirect local spend through foreign suppliers working in Azerbaijan was $368.5 million in 2011.

Table 7.8 Local Content Spend 2006 to 2011 (US$M)

	2006	2007	2008	2009	2010	2011
Small and Medium-Sized Enterprises (SMEs)	77	111	128	132	147	255
State-Owned Enterprises	60	43	37	29	28	36
Joint Venturers	520	450	408	320	366	285
Foreign Suppliers In-Country	826	891	737	547	486	369
Total	**1,483**	**1,495**	**1,310**	**1,028**	**1,027**	**945**

[57] BP Azerbaijan Sustainability Reports (2004-2011).

8. Consultation and Disclosure

Contents

List of Figures

List of Tables

8.1 Introduction

Stakeholder consultation is an important element of the Environmental and Socio-economic Impact Assessment (ESIA) process. Soliciting, collating and documenting the opinions of potentially affected people and interested parties ensures that project design and the ESIA reflects the collective views of the stakeholder base.

This Chapter presents an overview of the consultation and stakeholder engagement relevant to the Shah Deniz Stage 2 (SD2) Project and the process for ESIA disclosure.

Phased expansion of the Terminal has been undertaken over the past 10 years as part of the Azeri Chirag Guneshli (ACG) Phase 1, 2, 3 and SD Stage 1 Projects (refer to Chapter 1 Section 1.2). For each of these projects, extensive consultation with stakeholders and residents of the local communities was undertaken. Lessons learnt from previous project's consultation has informed the SD2 Project consultation programme.

8.2 Overview of Consultation and Disclosure Process

The SD2 Project ESIA stakeholder engagement and consultation has:

- Made use of the consultation framework and methods established for other BP projects in Azerbaijan;
- Been developed with reference to accepted international guidance on expectations of ESIA consultation and disclosure;
- Considered the extent of consultation and disclosure undertaken in recent years;
- Incorporated recommendations made from a "lessons learned" review of earlier consultation programmes; and
- Acknowledged the requirement to engage with the following during the ESIA process:
    - National state bodies including:
        - The Ministry of Ecology and Natural Resources (MENR);
        - The Ministry of Culture and Tourism (MoCT); and
        - The Institute of Archaeology and Ethnography (IoAE); and
    - The local community and other local stakeholders through a Stakeholder and Socio-Economic Survey (SSES).

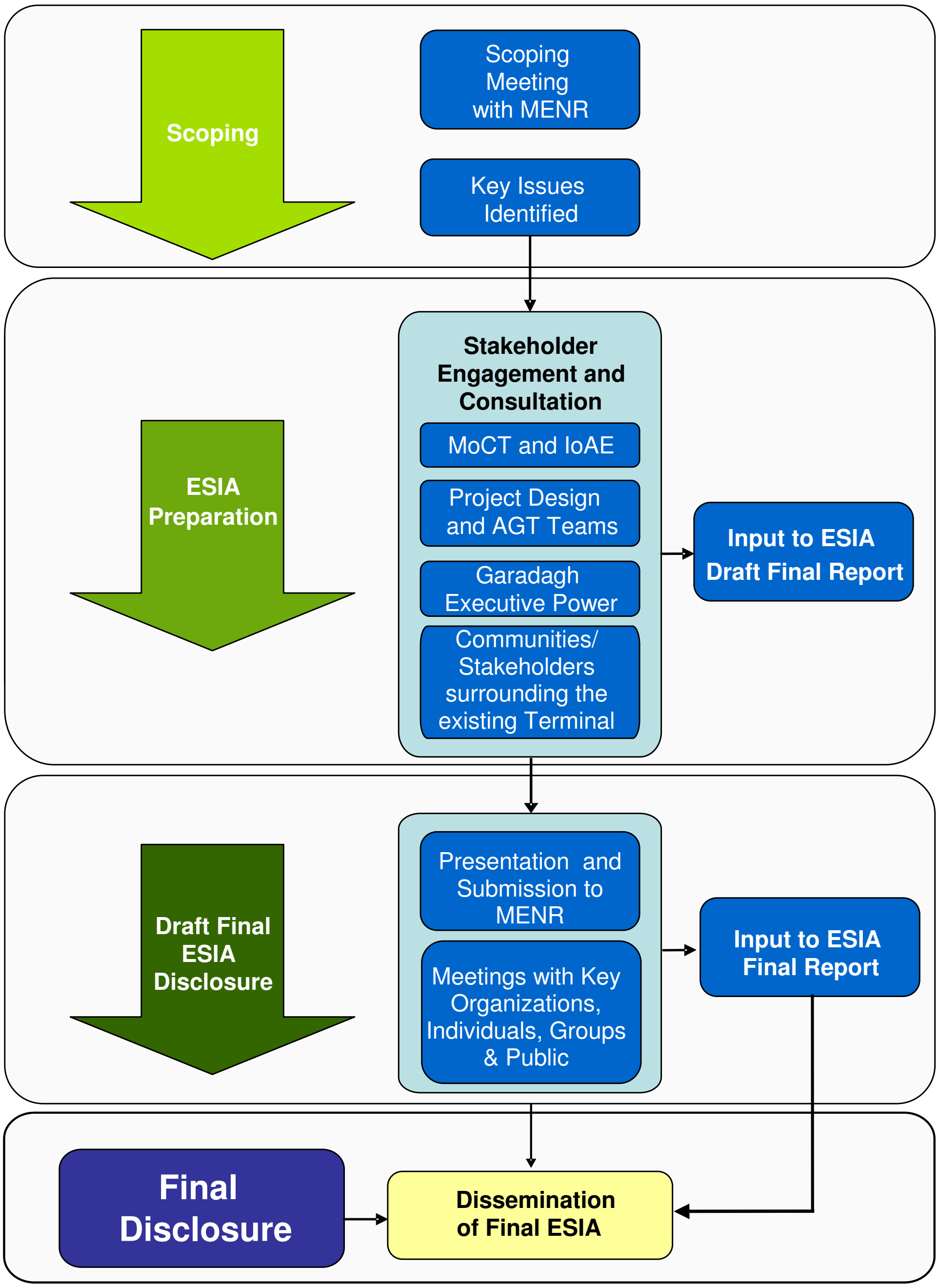
Figure 8.1 below illustrates the SD2 Project ESIA engagement, consultation and disclosure process.

A Public Consultation and Disclosure Plan (PCDP) has been prepared for the SD2 Project. The PCDP outlines the consultation and disclosure objectives and the national and international regulatory regime that project consultation and disclosure will follow, to ensure best practice approaches for the project.

The PCDP also sets out the:

- Process by which stakeholders are identified and consulted;
- Roles and responsibilities of the ESIA team of consultants and BP; and
- Process for lodging and responding to complaints.

Figure 8.1 SD2 Project ESIA Engagement, Consultation and Disclosure Process



8.3 Scoping, Initial Stakeholder Engagement and Consultation

8.3.1 MENR Consultation

Preliminary consultation commenced with MENR in August 2008. A meeting was held on 5 August 2008 to outline the BP Azerbaijan, Georgia and Turkey (AGT) Region's major project plans for the near future and included an overview of the SD2 Project. The presentation included the proposed project scope and schedule for the SD2 Early Infrastructure Works (EIW) and the main SD2 Project.

Regular update meetings have been held throughout the SD2 Project development to keep the MENR informed of the Project progress as well as discuss technical issues such as drilling challenges within the offshore contract area. In addition specific meetings have been held with regard to the four SD2 environment permission documents completed to date (as listed within Chapter 1 of this ESIA). The feedback from these meetings and the comments received from the MENR on the environment permission documents completed to date have been incorporated into the SD2 Project ESIA.

8.3.2 Ministry of Culture and Tourism and Institute of Archaeology and Ethnography

An initial meeting was held with the IoAE on 12th May 2011. This was followed by a meeting on 2nd June 2011 which was attended by MoCT representatives and included a site visit to a number of locations in the Terminal vicinity including the Caravanserai. At both meetings an overview of the proposed SD2 Project activities and areas potentially affected were discussed.

The key issues raised from the meetings were:

- It was agreed that an archaeological walkover survey of the SD2 EIW area should be completed pre-construction to confirm the presence/absence of any archaeological assets following the initial survey completed in 2001;
- The presence of a sand cave (located along the shoreline to the south of Terminal), a known protected monument, was highlighted. Potential project impacts and associated mitigation should be considered; and
- It was confirmed that BP will require MoCT approval for the SD2 Project.

8.3.3 Public Engagement and Consultation

Public engagement and consultation was undertaken in three phases. Phase one and two included two Scoping phase consultation workshops which were held in Baku in September 2008. The third phase of public engagement and consultation included the SSES, which was undertaken in May and June 2011.

The two Scoping phase consultation workshops held in Baku were undertaken as follows:

- 22 September 2008: Chirag Oil Project (COP) ESIA and SD2 Project Consultation Workshop for Scientists, Academics and non-governmental organisations (NGO)s; and
- 23 September 2008: COP ESIA and SD2 Project Consultation Workshop for the General Public.

Academic and scientific institutions invited to the 22 September 2008 workshop included:

- MENR;
- SOCAR;
- Baku State University;
- Caspian Environmental Programme;
- Gipromorneftegas Institute;
- State Oil Company;
- Cabinet of the Minister of the Azerbaijan Republic;
- Azerbaijan National Department of Hydrometeorology; and
- Azerbaijan National Academy of Sciences:
    - Fishery Institute of the Azerbaijan Republic;
    - Institute of Zoology;
    - Institute of Geography; and
    - Institute of Agrochemistry.

NGOs in attendance at the 22 September 2008 workshop included:
- Ecograph;
- Sulh;
- Our House Common;

- Ecoscope;
- Sadr; and
- Azerbaijan Green Movement.

The workshop held on 23 September 2008 took the form of an open Public Meeting, which was advertised in advance in the local press.

Both workshops began with a general presentation of the COP and SD2 Projects. Each workshop concluded with a Questions and Answers session.

The SSES, completed in 2011, during preparation of the SD2 Infrastructure Project ESIA had the following objectives:

- Provide comprehensive and up-to-date socio-economic data for the SD2 Infrastructure Project and SD2 Project ESIAs to enable a credible and technically robust ESIAs to be conducted that meets BP Group and international best practice standards;
- Enable a clear understanding of prevailing demographic and socio-economic conditions; local development needs, capacities, priorities and concerns within the four communities of Sangachal Town, Umid, Azim Kend and Masiv 3;
- Identify the potential for and extent of, physical resettlement and economic displacement associated with the EIW and SD2 Project;
- Enable an assessment of the current and future role local stakeholder organisations could have in relation to BP partnering opportunities and community investment programmes;
- Disclose information associated with the EIW and SD2 Project to enable credible discussion of the impact to local people associated with industrial operations (including Terminal operations); and
- Establish a basis against which to monitor: (i) social change during the lifetime of the SD2 Project; and (ii) the effectiveness of impact management strategies designed during the ESIA process.

The SSES, undertaken by in-country socio-economic specialists, involved the following activities:

- **Household surveys**: Completion of 200 household surveys in Umid (25), Sangachal (100), Azim Kend (25) and Masiv 3 (25). The aim of the survey was to collect socio-economic and perception data directly from project-affected households, and to provide information on family conditions; access to community services and infrastructure; economic activity and livelihoods; and views on BP's historical community relations process;
- **Focus Groups:** Completion of 12 Community Focus Groups (three in each of the four settlements). The topic areas for the Community Focus Groups include:
  - General community issues;
  - Women's issues; and
  - Youth issues.
- **Stakeholder Interviews:** A stakeholder identification process was undertaken to determine potentially affected stakeholders at a local, regional and national level. The SSES included 66 completed interviews with key stakeholders including national and local government, local business and NGOs. The aim of the interviews was to gather information associated with stakeholder roles and capacities and local development needs and priorities. Industrial facilities in the vicinity of the Terminal were also asked to provide details regarding emissions and discharges and future plans for expansion or upgrade.

Information disclosed publicly during the SSES included:

- Displaying posters in Azerbaijani at public information centres, municipality offices and community centres to request attendance at future community briefings;

- Using slide presentations at community briefings held in public buildings in Sangachal, Umid, Azim Kend and Masiv 3; and
- Distribution of community information leaflets to all individuals attending community briefings and those participating in community focus groups and household surveys.

Concerns raised by local people recorded during the SSES were taken into consideration during preparation of the SD2 Project ESIA, where relevant.

8.3.4 Key Issues Raised During Initial Consultation

Key issues raised during the engagement and consultation activities discussed above are listed in Table 8.1 below.

Table 8.1 Key Issues Raised During Engagement and Consultation

Concern	Raised By	Chapter Reference where Addressed
The volume of gas flared and the measures that are in place to prevent, or minimise flaring.	MENR	Chapter 4 Section 4.6.2 and Chapter 5 Sections 5.4.3, 5.4.7, 5.4.8, 5.10.5, 5.10 and 5.12
The potential to dispose of gas by using alternate flaring techniques.		Chapter 4 Section 4.6.1
The volume of greenhouse gas emissions generated.		Chapter 5 Section 5.14.1 and Chapter 13 Section 13.9
Volumes generated and disposal of drill cuttings at the offshore platforms.		Chapter 5 Section 5.14.2
Cumulative impact of future industrial facilities in the vicinity of the Terminal.		Chapter 13 Sections 13.2, 13.4, 13.5, 13.6 and 13.7
Identification of all waste streams generated on site.		Chapter 15 Section 5.14.2
Local community concerns about the generation of dust and odours.	Local resident s as part of the SSES	Chapter 10 Sections 10.2, 10.6.1 and Chapter 12 Section 12.3.4
Creation of employment.		Chapter 12 Sections 12.3.2, 12.3.3, 12.4.2 and Chapter 13 Section 13.6
Poor conditions of local roads.		Chapter 7 Section 7.6.3 & Chapter 12 Section 12.2.1
Local community concerns about the visual impacts and health risks associated with operation of elevated flares.		Chapter 12 Section 12.3.4

8.4 Draft ESIA Report Consultation

As per the UNDP Handbook for EIA Process in Azerbaijan, the Draft ESIA report was submitted to the MENR and simultaneously released to public and stakeholder groups for comment.

The draft ESIA, in English and Azerbaijani, was widely disseminated and was available (along with feedback forms) for a period of 60 days at the following locations and via the Internet:

- BP website;
- BP Energy Centre at Sangachal Terminal;
- BP Offices in Baku;
- Community Centre at Umid (Umid Settlement);
- Public libraries in Sangachal and Sahil (Sahil Settlement E. Guliyev Street, Sangachal Settlement M. A. Sabir Street 1);
- Aarhus Public Environmental Information Centre (MENR, 100 B. Agayev Street, Baku);
- Baku Education Information Centre (40 J. Jabbarli Street, 2nd Floor);
- M.F.Akhundov Central Public Library (29 Khagani Street);
- International Eco-Energy Academy (5 Mammad Arif Street, Baku);
- The Azerbaijan State Oil Academy (20 Azadlig Avenue, Baku); and

- Scientific Library of the National Academy of Sciences (31 H.Javid Avenue).

As part of the Draft ESIA consultation process, public meetings were held in Baku, Sangachal Town and Umid.

The following meetings were held (in addition to meetings with the MES, SOCAR and MES):

- Scientists meeting, Baku, 12th August 2013;
- Public meeting, Baku, 13th August 2013;
- Sangachal community meeting, 15th August 2013; and
- Umid community meeting, 15th August 2013.

Minutes of these meetings are included within Appendix 8B.

Comments received on the Draft ESIA report were collated, analysed and responses issued where relevant. The ESIA was subsequently revised and finalised for MENR approval.

8.5 Consultation Under the Espoo Convention

As a signatory to the Convention on Environmental Impact Assessment in a Transboundary context (i.e. the Espoo Convention), the Azerbaijan Government shall provide early notification to any member country to the convention which it considers may be subject to transboundary impacts.

Potential transboundary impacts, including potential impacts associated with GHG emissions are presented in Chapter 13 of this ESIA and will be discussed with the MENR as part of the ESIA disclosure process.

9 Drilling and Completion Environmental Impact Assessment, Mitigation and Monitoring

Contents

List of Figures

List of Tables

9.1 Introduction

For all phases of the Shah Deniz 2 (SD2) Project, Activities and Events have been determined based on the SD2 Base Case as detailed within Chapter 5: Project Description; and the potential for Interactions with the environment identified.

In accordance with the impact assessment methodology (see Chapter 3), ESIA Scoping has been undertaken to identify selected Activities that may be "scoped out" from the full environmental impact assessment process based on Event Magnitude and the likely receptor Interaction. In addition, existing controls and mitigation have been identified. These include:

- Existing procedures that will be used to ensure that activities are consistent with environmental expectations; and
- Feedback from existing operational and ambient monitoring of environmental performance and/or impacts.

Those Activities that have not been scoped out have been assessed on the basis of Event Magnitude and Receptor Sensitivity, taking into account the existing controls and mitigation, and impact significance determined. Monitoring and reporting activities undertaken to confirm that these controls are implemented and effective, as well as additional mitigation and monitoring to further minimise impacts, are provided.

Assessments of socio-economic, cumulative and transboundary impacts and accidental events have also been undertaken and are provided in Chapters 12 and 13 respectively.

The structure of the impact assessment within this ESIA is provided within Table 9.1 below.

Table 9.1 Structure of SD2 Project Impact Assessment

<table>
<tr><th>Chapter</th><th>SD2 Phase</th><th>Content</th></tr>
<tr><td>9</td><td>• Drilling and Well Completion Activities</td><td rowspan="3">Common contents adopted for sections 9,10 and 11:
• Scoping Assessment of SD2 Activities, Events and Interactions.
• Identification of existing controls, mitigation, monitoring and reporting.
• Environmental impact assessment of SD2 activities based on:
  o Event Magnitude
  o Receptor Sensitivity
• Identification of any additional mitigation measures.</td></tr>
<tr><td>10</td><td>• Onshore Construction and Commissioning of Terminal Facilities
• Onshore Construction and Commissioning of Offshore and Subsea Facilities
• Platform Installation & HUC
• Installation, HUC of Subsea Export & MEG Pipelines
• Subsea Infrastructure Installation & HUC.</td></tr>
<tr><td>11</td><td>• Offshore Operations
• Onshore Operations
• Subsea Operations</td></tr>
<tr><td>12</td><td>All Phases</td><td>Assessment of socio-economic impacts.</td></tr>
<tr><td>13</td><td>All Phases</td><td>Assessment of cumulative and transboundary impacts (including impacts associated with greenhouse gas emissions) and impacts arising from accidental events (including oil spills and spill management).</td></tr>
<tr><td>14</td><td>All Phases</td><td>Description of the SD2 Environmental and Social Management System including waste management plans and procedures.</td></tr>
</table>

9.2 Scoping Assessment

The SD2 Project Drilling and Completion Activities and associated Events that have been scoped out due to their limited potential to result in discernable environmental impacts are presented in Table 9.2 (see Appendix 9A for all SD2 Project Drilling and Completion Activities, Events and Interactions). The scoping process has used judgement based on prior experience of similar Activities and Events, especially with respect to earlier SD or Azeri Chirag Guneshli (ACG) developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 9.2 "Scoped Out" SD2 Project Drilling and Completion Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Dri-R16	Crew change operations	**N/A**	• Crew changes will be made on a regular basis using crew change vessels (approximately 3 trips per week are estimated). • The low volume of emissions released will be dispersed across the entire vessel route and the wider area. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations. • Helicopters will be used infrequently e.g. when vessel transportation is not possible due to bad weather or for emergency crew transportation. Flights will originate from Zabrat heliport. A portion of the flight path will be over residential receptors but at height (>500m). Noise disturbance will be temporary, of short duration and low intensity. • Emissions and noise from crew change operations is expected to result in no discernable impact to human receptors. • **Conclusion:** Emissions and noise from crew change operations is expected to result in no discernable impact to human receptors.
Dri-R17	Waste Management	**5.4.9.3**	• Waste generated during SD2 drilling and completion will be consistent with the type and quantity that have been routinely generated during previous MODU drilling work. • Waste on the MODU will be segregated at source, stored and transported in fit for purpose containers. • The CWAA at the supply base within the BDJF yard will be used as the main reception and consolidation point for solid waste from drilling. • Waste generated during SD2 drilling and completion will be managed in accordance with the existing BP AGT Region management plans and procedures. BP has gained significant operational experience of managing similar waste from 10 years of MODU drilling operations. • Waste management plans have been established for the MODU aligned to the existing BP AGT Region management plans and all waste transfers will be controlled and documented. • **Conclusion:** Waste generated during the SD2 Project will be managed in accordance with the existing BP AGT Region management plans and procedures. No discernable impact to the terrestrial or marine environment expected.
Dri-R18	Fugitive Emissions	**N/A**	• During the transfer dry bulk (primarily cement and barite) from vessel to MODUs silos some losses to the atmosphere of dry bulk may happen through vent lines (the vent lines must be open as part of operational requirements). • The duration of the transfer will be approximately 3-4 hours. • Fugitive emissions resulting from dry bulk transfer are expected to be minimal and will not result in a discernable impact to the marine environment. • **Conclusion:** Fugitive emissions resulting from dry bulk transfer are expected to be minimal and will not result in a discernable impact to the marine environment.
Dri-R19	Seabed Disturbance	**5.4.1.1** **5.4.2.3** **5.4.4.2**	• MODU anchoring will result in disturbance due to positioning of anchors and anchor chains of up to approximately 190,280m^2 in total. • Frames associated with geotechnical holes (up to 4 planned) will be installed and left on the seabed • Wellhead brace will be installed at each well location in order to support the wellhead during installation of the BOP and production tree. The frame will occupy a small area in the vicinity of wellhead • The displacement of sediment will not cause significant levels of mortality in benthic organisms. A small proportion of animals may be buried too deeply to recover to a position near the sediment surface, but the majority of organisms will be able to re-establish themselves once the anchors and chains have been removed and the frame and brace is in position • **Conclusion:** It is considered that impacts are minimised as far as practicable and no discernable impact to the marine environment due to seabed disturbance

The SD2 Project routine and non-routine Drilling and Completion Activities and their associated Events assessed in accordance with the full impact assessment process are presented in Table 9.3.

Table 9.3 "Assessed" SD2 Project Drilling and Completion Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Dri-R1	Tow out and positioning of Mobile Offshore Drilling Units (MODU)	**5.4.1.1**	Other discharges to sea Underwater noise and vibration	Marine Environment
			Emissions to atmosphere (non GHG)	Atmosphere
Dri-R2	Vessel support including supply to MODU and backload to shore	**5.4.1.2 Table 5.1**	Other discharges to sea Underwater noise and vibration	Marine Environment
			Emissions to atmosphere (non GHG)	Atmosphere
Dri-R3	Drilling with seawater/PHB sweeps or water based muds (WBM) (42", 32" and 28" hole sections and geotechnical holes)	**5.4.2.4**	Underwater noise and vibration Drilling discharges to sea	Marine Environment
Dri-R4	Discharge of residual WBM (after 28" hole section and geotechnical hole drilling)	**5.4.2.4**	Drilling discharges to sea	Marine Environment
Dri-R5	Discharge from 28" section due to MRS failure	**5.4.2.4**	Drilling discharges to sea	Marine Environment
Dri-R6	Drilling with non WBM (lower hole section drilling)	**5.4.2.4**	Underwater noise and vibration	Marine Environment
Dri-R7	Cementing discharges to seabed (from cementing casings and from installation of wellhead brace) and excess cement discharge to seabed (following cementing casings)	**5.4.2.6 and 5.4.4.2**	Cement discharges to sea	Marine Environment
Dri-R8	Clean up flaring	**5.4.6**	Emissions to atmosphere (non GHG)	Atmosphere
Dri-R9	Well test flaring	**5.4.7**		
Dri-R10	MODU power generation	**5.4.1.2 Table 5.1**	Emissions to atmosphere (non GHG)	Atmosphere
Dri-R11	MODU seawater lift and cooling discharge	**5.4.1.2 Table 5.1**	Water intake/entrainment Cooling water discharge to sea	Marine Environment
Dri-R12	MODU treated black water/grey water/drainage discharges	**5.4.1.2 Table 5.1**	Other discharges to sea	Marine Environment
Dri-R13	Discharge of excess cement and cement system wash out to sea via MODU cuttings caisson	**5.4.2.6 5.4.4.2**	Cement discharges to sea	Marine Environment
Dri-R14	BOP testing discharges	**5.4.4**	Discharges to sea	Marine Environment
Dri-R15	Flaring during interventions	**5.4.8**	Emissions to atmosphere (non GHG)	Atmosphere

9.3 Impacts to the Atmosphere

9.3.1 MODU Power Generation, MODU Flaring and Support Vessel Emissions

Non greenhouse gas (GHG) emissions to the atmosphere from Drilling and Completion activities will be associated with MODU power generation, flaring events and use of support vessels. GHG emissions associated with the SD2 Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts.

9.3.1.1 Mitigation

Existing controls associated with emissions from MODU power generation, MODU flaring and support vessel operations include:

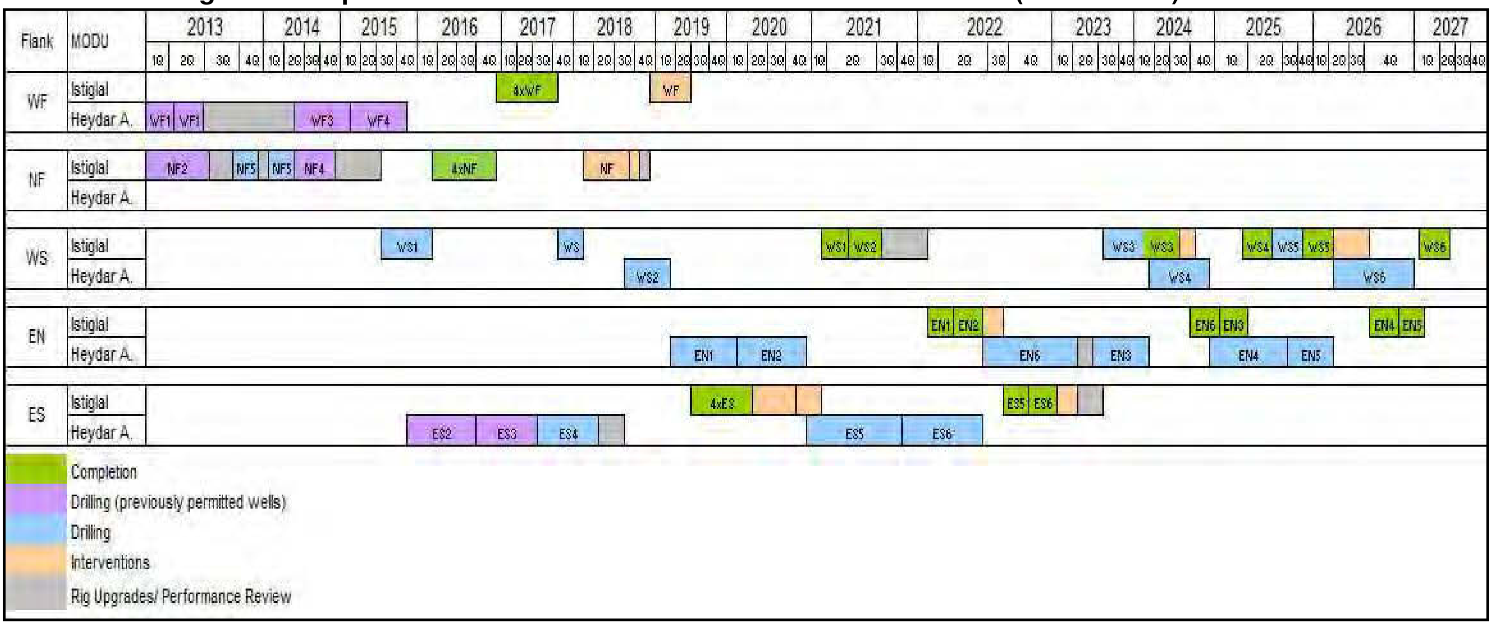
- MODU diesel generators and engines will be maintained in accordance with written procedures based on the manufacturers' guidelines or applicable industry code or engineering standards to ensure efficient and reliable operation;
- Burners will be designed to achieve high burning efficiencies during well testing and well clean up flaring;
- Burners will be operated in accordance with written procedures based on the manufacturers' guidelines or applicable industry code or engineering standard; and
- Well test proposals will be reviewed and challenged through existing BP internal processes.

9.3.1.2 Event Magnitude

Description

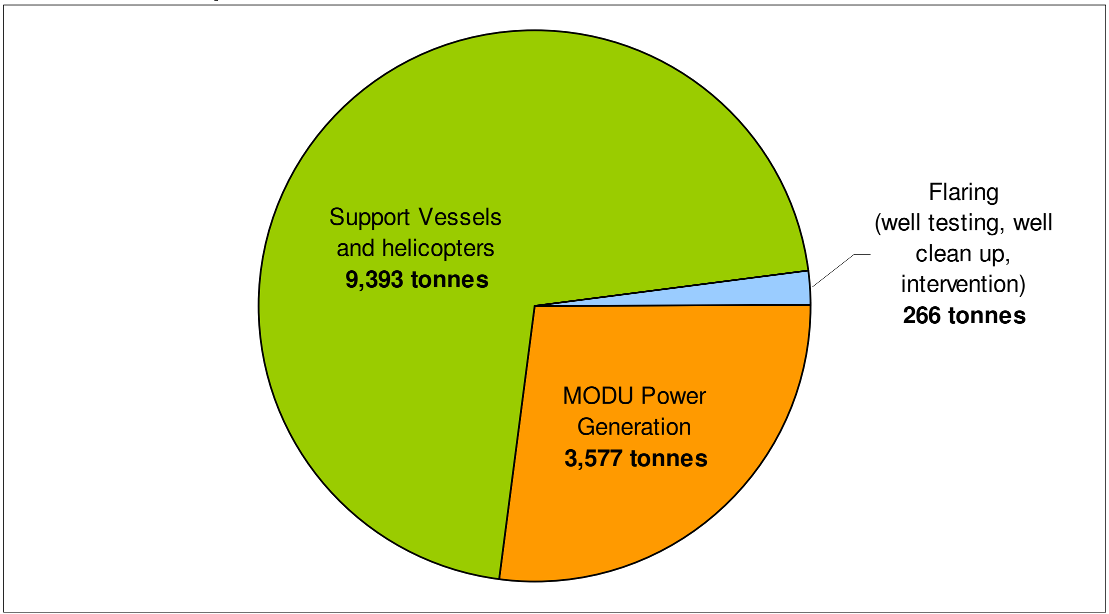
As described within Chapter 5 Section 5.4.1 it is anticipated that two MODU (the Istiglal and Heydar Aliyev rigs) will be used during the SD2 Project drilling and completion programme, resulting in emissions from onboard engines and generators. Figure 9.1 shows the expected use of the two MODU within the five flanks of the SD Contract Area from 2013 to 2027.

Figure 9.1 Expected MODU Activities Within the SD Contract Area (2013 – 2027)



MODU flaring is expected to comprise clean up flaring, well test flaring and flaring associated with well interventions as discussed with Chapter 5 Sections 5.4.63, 5.4.7 and 5.4.8 respectively. In addition emissions will result from the operation of support vessels required throughout the drilling and completion programme as discussed in Chapter 5 Section 5.4.1.2 Figure 9.2 presents the estimated volume of nitrogen dioxide (NO_2) emissions per source during SD2 Project drilling, completion and intervention activities[1].

Figure 9.2 Estimated Volume of NO_2 Emissions per Source During SD2 Project Drilling, Completion and Intervention Activities



Assessment

Modelling undertaken for MODU power generation and MODU flaring is presented in Appendix 9B. The modelling focuses on NO_X (which comprises nitrogen oxide (NO) and nitrogen dioxide (NO_2)) as the main atmospheric pollutant of concern, based on the larger predicted emission volumes as compared to other pollutants (SO_X, CO and non methane hydrocarbons) and its potential to impact upon human health and the environment.

MODU Power Generation

For MODU power generation long term (annual average) NO_2 concentrations were modelled to assess the contribution in the context of the annual EU standard for NO_2 of 40 µg/m^3. This standard is relevant to locations where humans are normally resident (i.e. onshore settlements) and do not apply to commercial locations and workers, which are subject to standards under separate occupational health requirements. The modelling conservatively assumed that, for the long term, all NO_X is converted to NO_2.

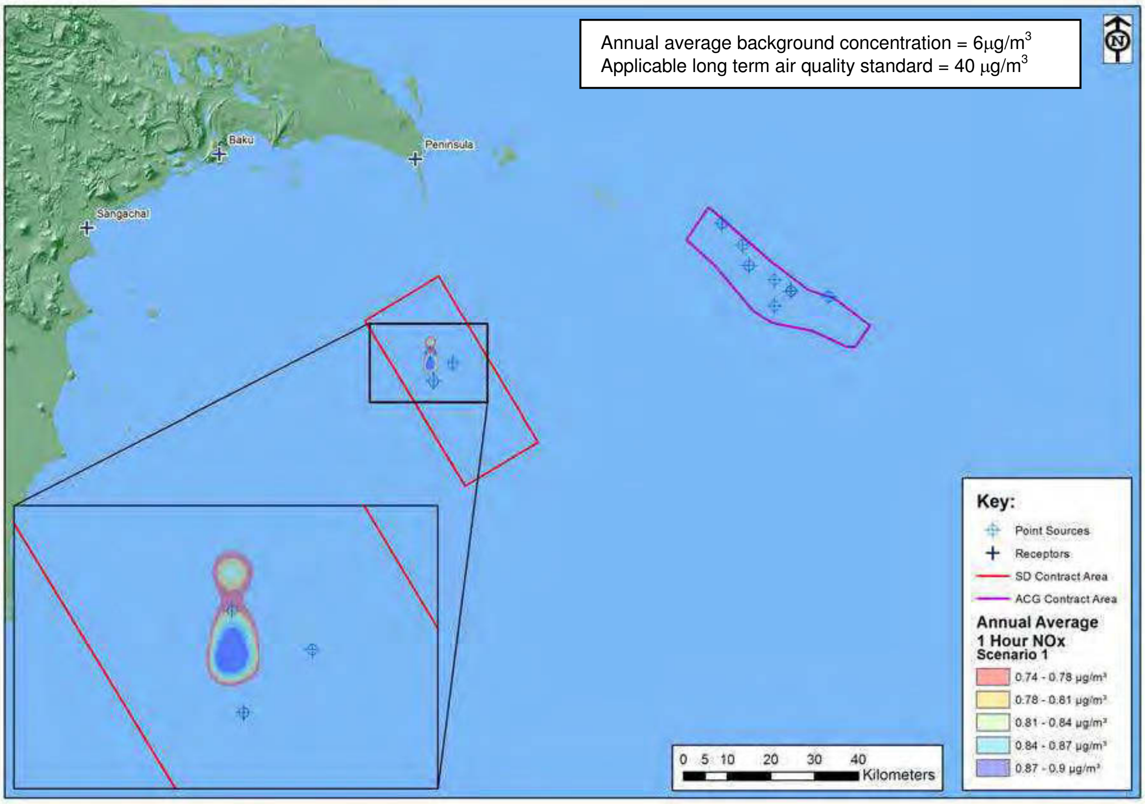
The modelling assessment was carried out assuming a maximum of two wells can be drilled simultaneously using the 'Istiglal' and 'Heydar Aliyev' MODUs as shown in Figure 9.1. The rigs may be located in any of the five well clusters, however based on the prevailing wind conditions, simultaneous operation at flanks NF and WF represent the worst case i.e. the greatest potential for increases in pollutant concentrations onshore.

As shown in Figure 9.3, the results demonstrated that, during routine operation, long term concentrations of NO_2 are predicted to increase by up to 1 µg/m^3 within 10 km of the NF and WF locations. At the coastline of the Absheron Peninsula (at Shahdili Spit) the increase in NO_2 concentrations is expected to be less than 0.1 µg/m^3 onshore. This represents less than

[1] Basis of the estimate is provided within Appendix 5A

0.3% of the air quality standard of 40 µg/m^3 and increase of less than 2% above the existing background concentration of 6 µg/m^3.

Figure 9.3 Predicted Increase in Long Term NO_2 Concentrations Due to MODU Power Generation



No discernable change in pollutant concentrations or exceedances of the long term air quality standards that could impact human health are predicted at any distance from the two MODUs due to the drilling and completion activities[2].

Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel (typically less than 0.05%) and previous experience, routine operation of the MODU engines and generators will not result in plumes of visible particulates from the generator exhausts.

MODU Flaring

As described within Chapter 5 Sections 5.4.6 and 5.4.7 MODU flaring is anticipated to comprise:

- Two well test events in the WS and EN flanks, each at a flowrate of 40MMscfd for up to 150 hours; and
- 26 clean up flaring events following the drilling of each SD2 Project well, each at an average rate of 250MMscfd for up to 2 days.

In addition it is expected that flaring will occur during intervention activities at a rate of 80 MMscfd for a day per event. A total of 80 intervention events involving flaring are anticipated between 2018 and the end of the PSA (2036).

[2] Historically in Azerbaijan ambient concentrations of NO_2, SO_2, CO and PM_{10} have also been assessed against specific 24 hour and 1 hour standards. These standards were not derived using the same health based criteria as the IFC, WHO and EU guideline values and the standards derived are not widely recognised. However, Appendix 9B includes an assessment of expected air quality concentrations against these standards for completeness. The modelling demonstrated that none of these standards would be exceeded during drilling and completion activities.

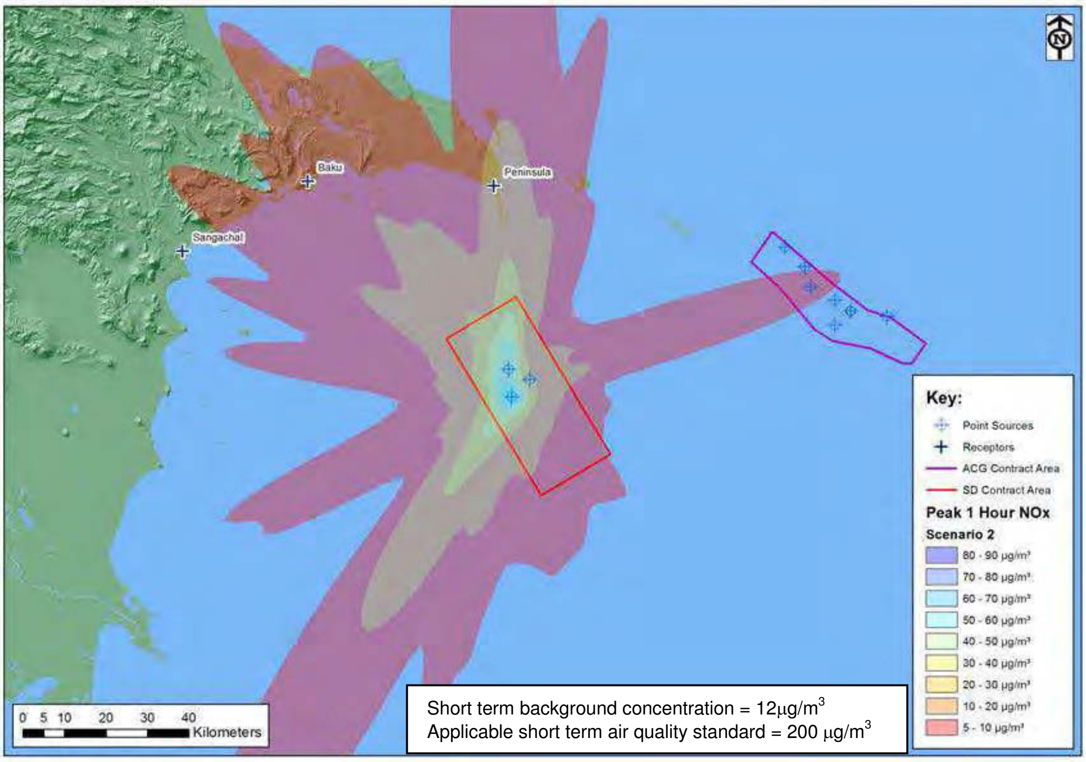
Modelling was undertaken based on the following:

- At any one time a flaring event will only be undertaken on one MODU; the two MODUs will not flare simultaneously;
- The highest flaring rate is for clean up flaring. The assessment for clean up flaring is therefore represents the worst case with regard to MODU flaring events;
- The MODU were located at the NF and WF locations as this represent the worst case in terms of potential air quality impacts to onshore receptors. It was assumed that the MODU flaring event was located at the WF location to represent the worst case scenario; and
- Clean up, well test and intervention flaring events are all short term (i.e. expected to last no more than 7 days per event) and therefore the assessment should focus on assessing the impact relative to short term air quality standards.

Modelling undertaken for MODU clean up flaring is presented in Appendix 9B, focusing on key pollutant species, NO_2. Short term (1 hour peak) NO_2 concentrations were modelled to assess the contribution of emissions from clean up flaring in the context of the EU short term air quality standards for NO_2 of 200 µg/m^3.

The results demonstrated that, during clean up flaring, short term concentrations of NO_2 are predicted to increase by approximately 6.3µg/m^3 onshore, at the Absheron Peninsula and 2.0-2.9 µg/m^3 at Sangachal and Baku (see Figure 9.4). This represents approximately 1-3% of the short term NO_2 standard of 200 µg/m^3 and increase of less than 50% above the existing short term background concentration of 12 µg/m^3.

Figure 9.4 Predicted Increase in Short Term NO_2 Concentrations Due to MODU Clean Up Flaring



No discernable change in pollutant concentrations or exceedances of the short term NO_2 standard are predicted at any distance from either MODU during MODU flaring.

Support Vessels

As stated within Chapter 5 Section 5.4.1.2, vessels will be required throughout drilling, completion and intervention activities to supply consumables (e.g. drilling mud, diesel, chemicals etc) to the two MODU and ship solid and liquid waste to shore for treatment and disposal. The number and type of vessels anticipated to be used are presented in Appendix 5F.

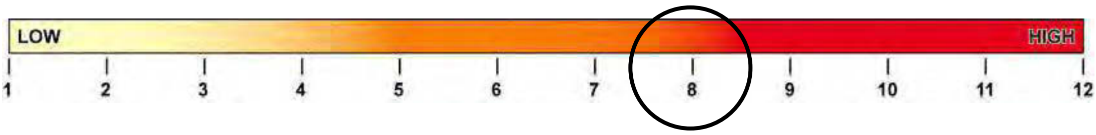
Figure 9.2 shows the total volume of emissions of the key pollutant species relevant to human health, NO_2, for all sources over the entire drilling, completion and intervention programme between 2013 to 2027 (14 years). For the period of drilling activities it is predicted that NO_2 emissions from support vessels will total approximately 9,393 tonnes. This is approximately 2.6 times greater than NO_2 emissions associated with MODU power generation during drilling activities however emissions from vessel movements will occur across a relatively large geographic area and over a long period of time. They are therefore expected to disperse rapidly and are not expected to result in noticeable increases in NO_2 concentrations at onshore locations.

Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel and previous experience, routine operation of the support vessels should not result in plumes of visible particulates from the vessel engine exhausts.

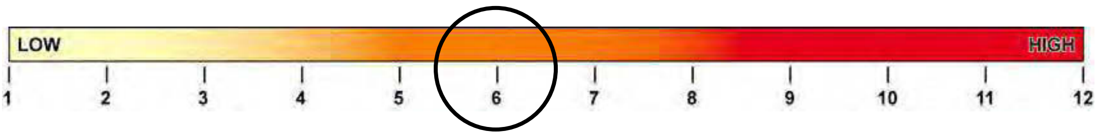
The Event Magnitude associated with emissions from MODU power generation, MODU flaring (during well testing, clean up or intervention flaring) and support vessels is summarised in Table 9.4. In each case a Medium Event Magnitude is predicted.

Table 9.4 Event Magnitude

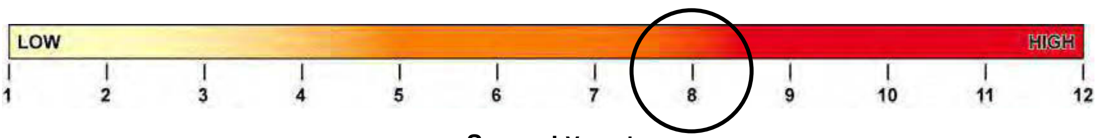
Event Parameter	MODU Power Generation	MODU Flaring	Support Vessels
Extent/Scale	1	1	1
Frequency	3	3	3
Duration	3	1	3
Intensity	1	1	1
Event Magnitude:	**8**	**6**	**8**



MODU Power Generation



MODU Flaring



Support Vessels

9.3.1.3 Receptor Sensitivity

Human Receptors

Table 9.5 presents the justification for assigning a score of 2 to human receptors, which represents Low Receptor Sensitivity.

Table 9.5 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 45km of the nearest SD2 well locations to shore.	1
Resilience	Changes in air quality onshore will be indiscernible. Onshore receptors will be unaffected.	1
Total		2

Biological/Ecological Receptors

Table 9.6 presents the justification for assigning a score of 2 to biological/ecological receptors, which represents Low Receptor Sensitivity.

Table 9.6 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Marine/bird species are mobile and will not be present at one location for long periods of time. Birds found in the area will be transient and not resident.	1
Resilience	Volume of emissions released (including visible particulates) will create a very small increase in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernable to biological / ecological receptors[3].	1
Total		2

9.3.1.4 Impact Significance

Table 9.7 summarises impacts on air quality associated with SD2 Project Drilling and Completion activities.

Table 9.7 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
MODU Power Generation	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
MODU Flaring (well testing, clean up or intervention flaring)	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
Support Vessels	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**

3 Note that ambient air quality standards are not relevant to biological/ecological receptors.

Monitoring and reporting requirements associated with emissions to atmosphere during MODU drilling, completion and intervention activities include:

- MODU diesel usage will be recorded on a daily basis;
- Environmental management system audits of drilling operations including MODU drilling will be undertaken periodically ; and
- The following will be provided to the MENR either within the MODU Annual Emissions Report or the End of Well Environmental Report:
    - Volume of fuel used by each MODU (recorded daily in tonnes and reported monthly);
    - Volumes of gas and condensate flared for each well; and
    - Estimated volumes of emissions generated as a result of fuel used and MODU flaring (calculated using emission factors).

These requirements are incorporated into the Environmental Management System (EMS) for each MODU, which is aligned to the AGT Region EMS as described within Chapter 14 Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4 Impacts to the Marine Environment

9.4.1 Underwater Noise & Vibration

9.4.1.1 Event Magnitude

Description

Underwater noise, resulting from the drilling of the SD2 geotechnical holes and wells and vessel movements during drilling, completion and intervention activities as described with Section 5.4 of Chapter 5, has the potential to impact biological/ecological receptors (specifically seals and fish) in the marine environment.

Assessment

Propagation of underwater noise due to drilling and vessel activities was modelled and a number of acoustic impact criteria were applied in order to estimate distances at which various acoustic impacts on marine species may occur. The bathymetry of the seabed in the vicinity of the SD2 wells was constructed using bathymetry data contained in the ETOPO1 database[4] and was used to undertake modelling as presented within Appendix 9C.

As described within the modelling assessment, (Appendix 9C), thresholds for fatality and physical injury to marine animals have been developed for different species through experiments based on impulsive sound pressure levels. Based on the data available, the assessment used a conservative approach, assuming the same threshold limits for both seals and fish.

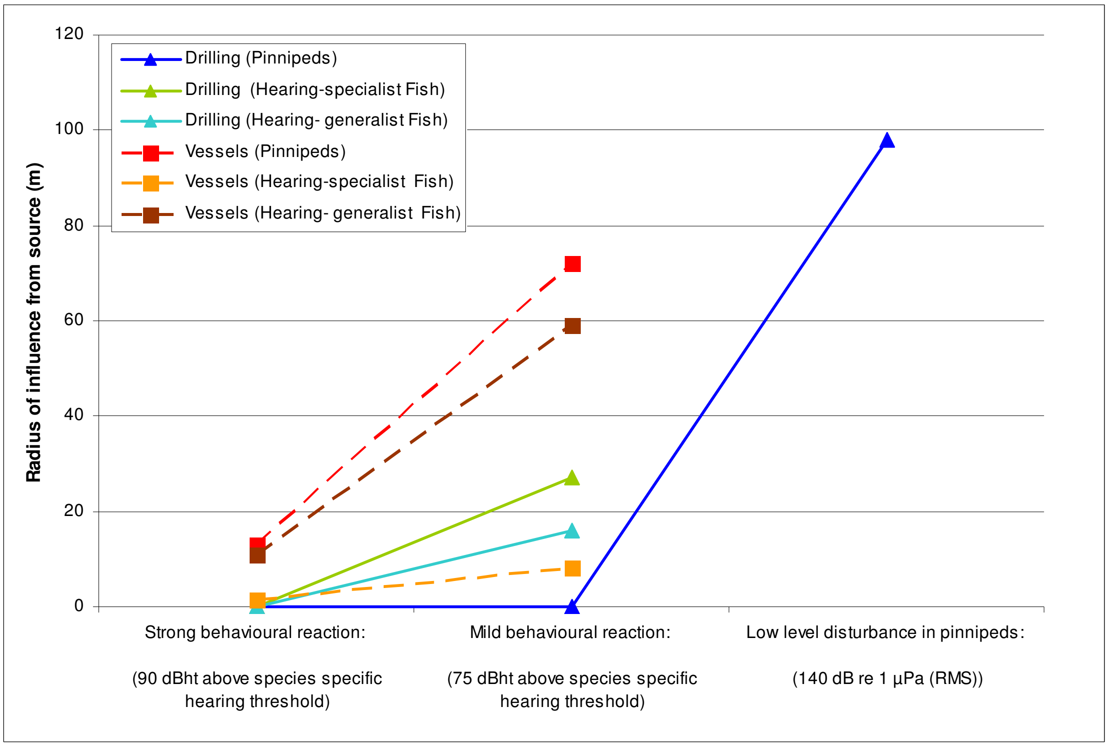
Acoustic impact thresholds are a function of the noise level to which an animal is exposed and vary for different species. Given that data does not exist for many species including Caspian specific species, a generic audiogram approach[5] was adopted to develop representative audiological injury and behavioural thresholds for seals and fish (denoted as either hearing-specialist or hearing-generalist depending on their biology e.g. whether or not they have swim bladders and a physiological connection between the swim bladder and the

[4] Amante, C. and B. W. Eakins,(2009), ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis. NOAA Technical Memorandum NESDIS NGDC-24, 19 pp, March 2009.
[5] Harland E. J., "Measuring Underwater Noise: Perils And Pitfalls", *Proceedings of the Institute of Acoustics*, Vol 30, Pt 5, 2008.

inner ear) based on proxy species. Fish known to be present within the SD Contract Area and adjacent areas of the Caspian Sea which have swim bladders are listed in Chapter 6, Section 6.7.2.4, Table 6.27. These include sturgeon, kura, kilka, shad and some species of goby. Thresholds for acoustic impact criteria are available for pinnipeds covering lethality; physical injury including deafness; and behavioural reactions while for fish, they cover lethality and behavioural reactions only.

The results of the analysis are summarised within Figure 9.5

Figure 9.5 Summary of Effect of Underwater Drilling and Vessel Noise Relative to Audiological Injury and Behavioural Thresholds



For drilling, the source level is below the levels at which lethal injury, permanent deafness, temporary deafness or auditory injury may occur. As Figure 9.5 taking into account behavioural reactions (based on dB_{ht} impact criteria) mild avoidance to drilling noise may be observed up to 16m for hearing generalist fish and 27m for hearing specialist fish with swim bladders. Pinnipeds are not expected to exhibit behavioural reactions at this threshold level.

For vessel noise the analysis showed that the source level associated with the vessels to be used during MODU drilling activities are below the level at which both lethality and direct physical injury might occur. With regard to behavioural impacts the results indicate that hearing-generalist fish may undergo strong avoidance reactions at a distance of 1.4 m from the vessel. Hearing-specialist fish experience the same reactions at 11 m and pinnipeds at 13 m. Mild avoidance reactions to vessel noise may be observed up to 8m for hearing-generalist fish, 59m for hearing-specialist fish and 72m for pinnipeds.

It is common for disturbance distances to vary with season as during the winter months, underwater sound becomes trapped just under the surface within a narrow layer leading to optimal propagation conditions and therefore noise travels further. In summer the noise tends to be directed into the seabed where it undergoes significant losses. Given that the impact ranges extend over relatively short distances, they are, however, insensitive to seasonal variability.

Cumulative impacts due to activities at adjacent well locations are unlikely to arise due to the relatively small acoustic footprint of each noise source.

Table 9.8 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 9.8 Event Magnitude

Parameter	Explanation	Rating
Extent / Scale	Underwater sound emissions are unlikely to result in a significant avoidance response from fish/seals beyond 13m from the noise source.	1
Frequency	Underwater sound emissions occur continuously during the drilling programme.	3
Duration	Underwater sound emissions will last for more than one week (estimated average drilling programme of 265 days per well).	3
Intensity	Taking into account concentration, accumulation and persistence of sound energy in the underwater environment, intensity is low.	1
Total		**8**

9.4.1.2 Receptor Sensitivity

The only relevant biological receptors to underwater noise are seals and fish[6]. Recent data indicates that Caspian seals, an endangered species, migrate through the SD Contract Area (refer to Chapter 6 Section 6.7.2.5 and Appendix 6D). The number varies throughout the year with the maximum numbers of up to 4,000 seals migrating through the Contract Area during the spring months which significantly reduces to individual seals during the winter months.

Sturgeon, another endangered species, are known to migrate through the SD Contract Area in March/April and September to November but are not common and do not use the area exclusively (refer to Chapter 6 Section 6.7.2.4 and Appendix 6C). Shad also migrate through the Contract Area in autumn. Goby species are present throughout the year in the Central and Southern Caspian including the Contract Area, however fish such as kilka and mullet are semi migratory primarily present in the Contract Area during the winter months. No fish species is present exclusively within the Contract Area.

Table 9.9 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

[6] Plankton cannot sense the low frequency sound generated because the wavelength is longer than the organism and benthic invertebrates do not have sophisticated sound-sensing apparatus.

Table 9.9 Receptor Sensitivity (Seals and Fish)

Parameter	Explanation	Rating
Resilience	Possibility that species may be temporarily affected by underwater drilling and vessel noise but effect would be short term and limited and ecological functionality will be maintained.	1
Presence	Both the fish and seals are likely to be present for limited periods of time in the SD Contract Area. However, the SD Contract Area is not exclusively used by these species.	1
Total		**2**

9.4.1.3 Impact Significance

Table 9.10 summarises impacts to seals and fish associated with drilling and vessel movements.

Table 9.10 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Drilling and vessel movements	Medium	(Seals & Fish) Low	**Minor Negative**

The assessment above demonstrates that a Minor Negative impact to seals and fish from drilling and vessel movements is predicted. This is considered to be a conservative assessment, as the modelling demonstrates that underwater sound emissions are unlikely to result in an avoidance response from fish/seals beyond 98m from the noise source.

It is considered that impacts are minimised as far as practicable and necessary and no additional mitigation is required.

9.4.2 Drilling Discharges

Discharges of water based mud (WBM) and cuttings are planned to be consistent with existing SD and ACG drilling practices. As discussed within Chapter 5 Section 5.4.1, 12 of the wells will be located within the following flanks:

- WS flank - four wells at approximate depth of 390 - 470m;
- ES flank - four wells at approximate depth of 490 - 530m; and
- EN flank - four wells at approximate depth of 395 – 480m.

The locations of the final four wells have not yet been confirmed and will be within these flanks or within the NF or WF flanks. Figure 9.1 shows the anticipated drilling programme.

9.4.2.1 Mitigation

Existing controls associated with drilling discharges include the following:

- WBM cuttings will be discharged below the sea surface from the Istiglal and Heydar Aliyev in accordance with applicable PSA requirements. WBM cuttings from the MODU can alternatively, be discharged directly to the sea bed using a hose fitted to the MODU cuttings chute;
- LTMOBM and associated cuttings used for lower hole drilling will be returned to the MODU and separated. Separated LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. LTMOBM associated drill cuttings will be

contained in dedicated cuttings skips on the rig deck for subsequent transfer to shore for treatment and final disposal. It is not planned to release any LTMOBM or associated cuttings into the marine environment;

- During MODU drilling activities, WBM will be separated from cuttings as far as practicable and re-used ;
- WBM additives used during MODU drilling activities will be of low toxicity (UK HOCNS "Gold" and "E" category or equivalent toxicity);
- Batches of barite supplied for use in WBM formulations will meet applicable heavy metals concentration standards i.e. Mercury <1 mg/kg and cadmium <3 mg/kg dry weight (total);
- There will be no planned discharge of WBM or associated drilling cuttings from the MODU with chloride concentration greater than four (4) times the ambient concentration of the receiving water; a PSA standard; and
- For the pilot and geotechnical holes and the upper sections of the wells, it is proposed to use PHB sweeps and a WBM of the same specification and environmental performance as used for previous SD wells. If there is a requirement to change the sweeps/drilling mud composition or to select different drilling fluids for commercial or technical reasons, the Management of Change Process (see Section 5.16) will be followed.

9.4.2.2 Event Magnitude

Description

The anticipated drilling activities resulting in discharges to sea are described within Chapter 5 Sections 5.4.2, 5.4.2.4 and 5.4.2.5. The estimated quantities of seawater and PHB sweeps, WBM and cuttings discharged per hole in tonnes are provided in Table 9.11. Two types of discharge events will occur:

- Seabed discharges during routine drilling of the geotechnical hole (planned at four locations) the 42" and 32" holes, and during failure of the Mud Recovery System when drilling the 28" holes; and
- MODU discharges from the cuttings caisson during routine drilling of the the 28" holes and for discharge of residual mud.

Table 9.11 Summary of Drilling Discharges per Hole

Discharge location	Hole Size	Description	Drilling Fluid/ Mud System	Estimated Fluids (Tonnes)	Estimated Cuttings (Tonnes)	Comment
Seabed	12$^{1}/_{4}$"	Pilot hole	WBM	1,015	50	Planned at 4 locations
	9"	Geotechnical hole		1,930	75	
	42"	Conductor and Surface Holes	Seawater & PHB sweeps	1,339	443	16 wells planned
	32"			1,339	442	
MODU cuttings caisson	28"	Surface Hole	WBM	522	729	
	Residual Mud	At the end of geotechnical hole drilling	WBM	495	0	
		At end of 28" hole drilling		943	0	

The anticipated composition and function of the fluids discharged are provided within Table 9.13 below.

Seabed levelling work may be required at all drilling location to remove accumulation of drill cuttings and cement, involving either mechanical excavation or jetting with seawater. The potential impacts of remedial work are considered to be comparable or less than those impacts described on Section 9.4.2 and 9.4.3 and are not discussed further.

Assessment

The dispersion and deposition of WBM drilling discharges has been comprehensively modelled for a number of previous Shah Deniz Wells. The modelling covers drilling conditions and water depth ranges appropriate to all of the SD2 Project well locations and have informed the assessment of cuttings deposition within this section.

Seabed Discharges

Cuttings discharged directly to the seabed will be subject to the limited influences of water depth and current. Previous modelling has shown that 90% of the cuttings will accumulate in a primary mound within 15-30m of the well head, and that deposition to a depth of more than 10cm would be limited to a radius of less than 40m from the wellhead.

Based on previous modelling undertaken for a similar volume of discharge it is anticipated that the cuttings piles will result in a maximum deposition thickness ranging from 10.6-11.7m, a primary mound formed within 15m, and a maximum extent to the 1mm contour of approximately 95m.

At each location, the wells will be located within 25m of each other and of the manifold. Deposits arising from seabed discharges of fluids and cuttings from each well will therefore overlap to some extent, although the depth of deposit in areas of overlap will be only a few millimetres.

The volume of cuttings discharged during drilling of the geotechnical holes will be small compared to the discharges associated with the tophole sections, and the cuttings will settle within a very small area. The volume of drilling fluid discharges is larger, and similar in magnitude to that generated during drilling of the 42” and 32” sections; the potential impacts of discharge of WBM direct to seabed are discussed in more detail below.

During failure of the MRS, resultant mud discharges at the seabed will require a dilution of 2 fold to meet the PSA salinity requirement and a dilution of 8 fold to reach ambient chloride concentrations.

MODU Discharges from Cuttings Caisson

The water depths in which cuttings and mud discharges will occur range from 66-88m at the NF location to 530-557m at the ES location. To assess the area over which cuttings and mud would be deposited, discharges at both these extremes of depth were modelled. In each case, this included deposition from a single well, and cumulative deposition from the maximum of 6 wells in each cluster. It should be noted, however, that it is not planned to drill all wells sequentially at any cluster. Some wells will be completed, tied in and producing before subsequent wells are drilled, and the cuttings deposited from earlier wells will, if necessary, be levelled to enable subsea infrastructure to be installed.

Modelling was based on the expected discharges from cuttings caisson during 28” hole drilling (522 tonnes of drilling fluid with 729 tonnes of cuttings) and up to 943 tonnes of drilling fluid at the end of the 28” hole section. The results of the modelling at the NF and ES locations for 1 well and 6 well discharges scenarios are presented in Figures 9.6 to 9.9. The results are summarised within Table 9.12.

Table 9.12 Approximate Extent of Cuttings Deposition to 1mm Depth and Maximum Depth of Deposition for NF and ES MODU Drilling Discharges (1 and 6 Well Scenarios)

Drilling Location	Water Depth	Approximate Extent of Cuttings Deposition to 1mm Depth		Maximum Depth of Deposition	
		1 well	6 wells	1 well	6 wells
NF	66-88m	100x100m	100x250m	775mm	1200mm
ES	530-557m	100x150m	200x400m	375mm	900mm

As Figures 9.6 to 9.9 show while the deposition areas increase with greater water depth, the maximum depth of deposition decreases. This effect is partly offset by weaker currents in the southern part of the Contract Area (where ES is located). The modelling shows that the maximum worst case area of impact (to the 1mm depth) is approximately 80,000m^2.

Figure 9.6 Deposition Thickness from MODU Drilling Discharge in NF Location (1 Well)

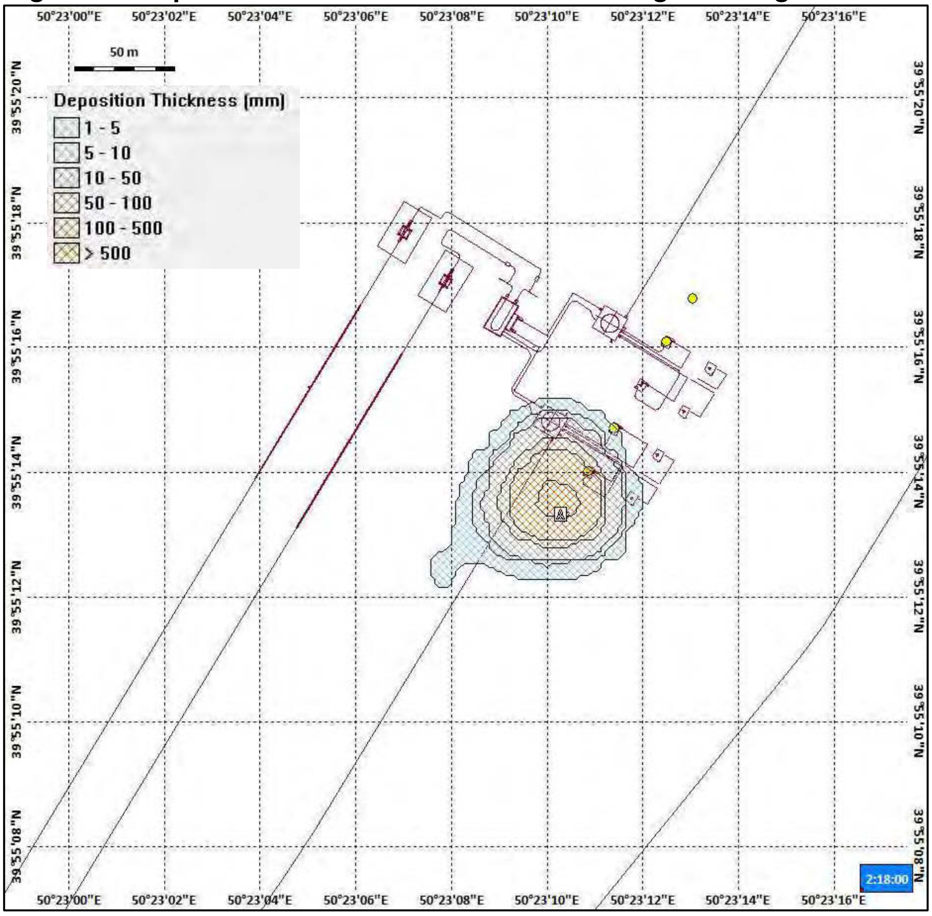


Figure 9.7 Deposition Thickness from MODU Drilling Discharge in NF Location (6 Wells)

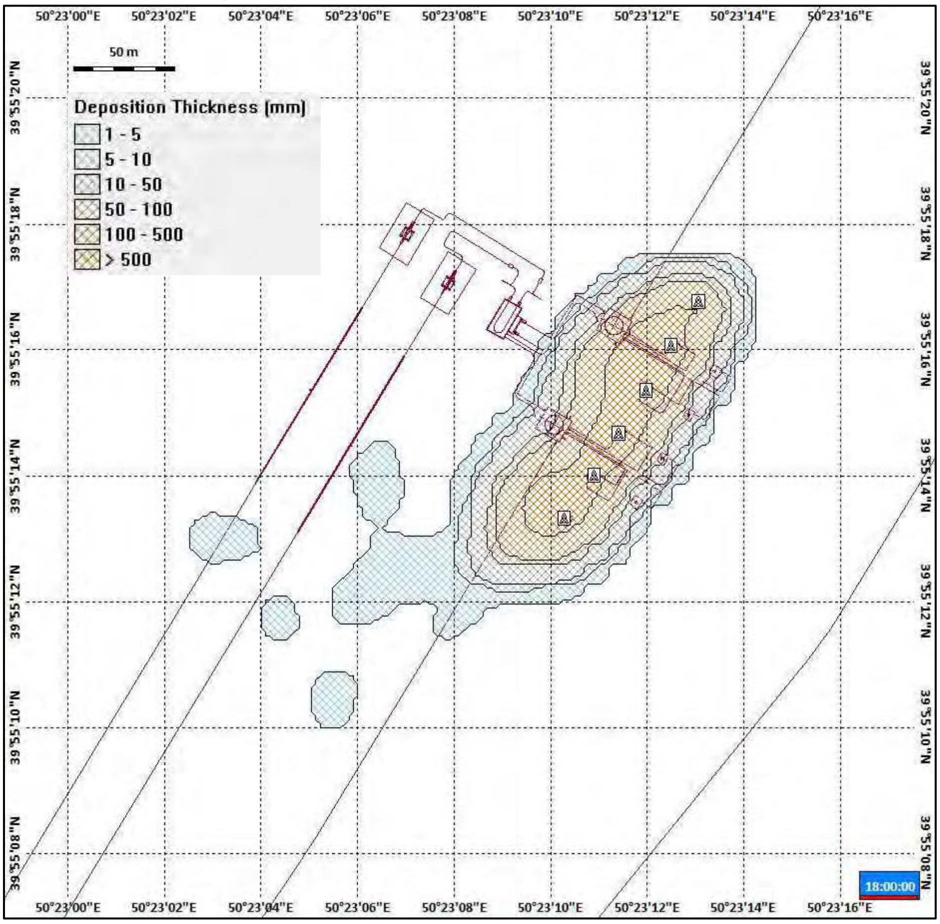


Figure 9.8 Deposition Thickness from MODU Drilling Discharge in ES Location (1 Well)

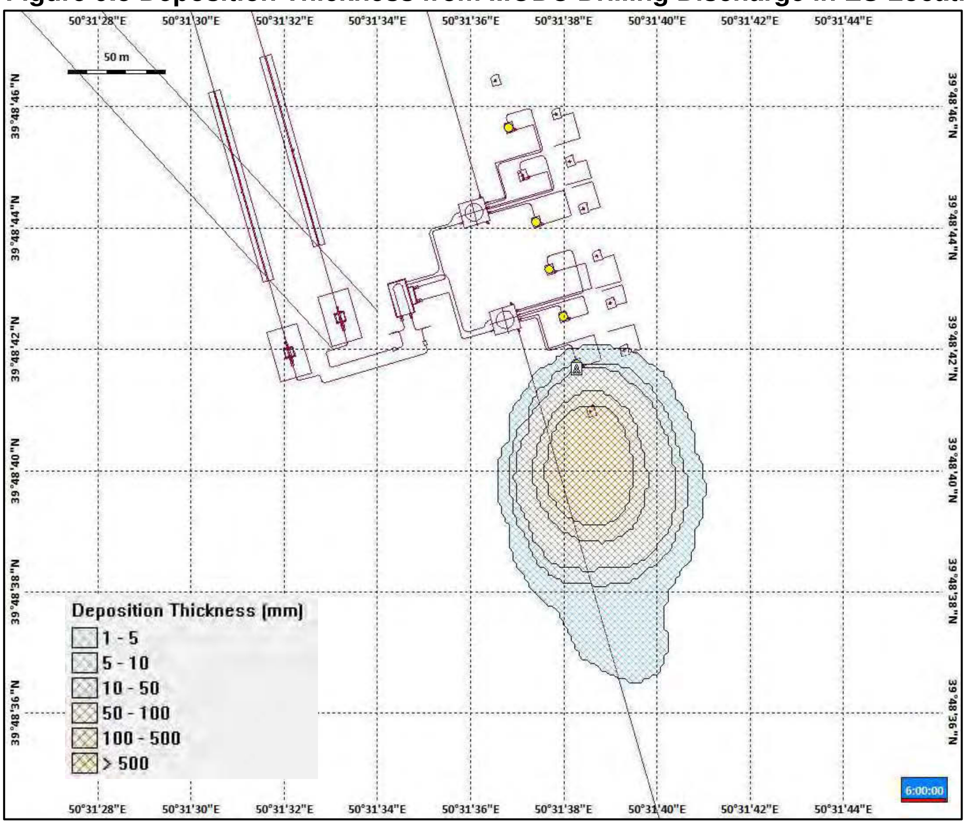
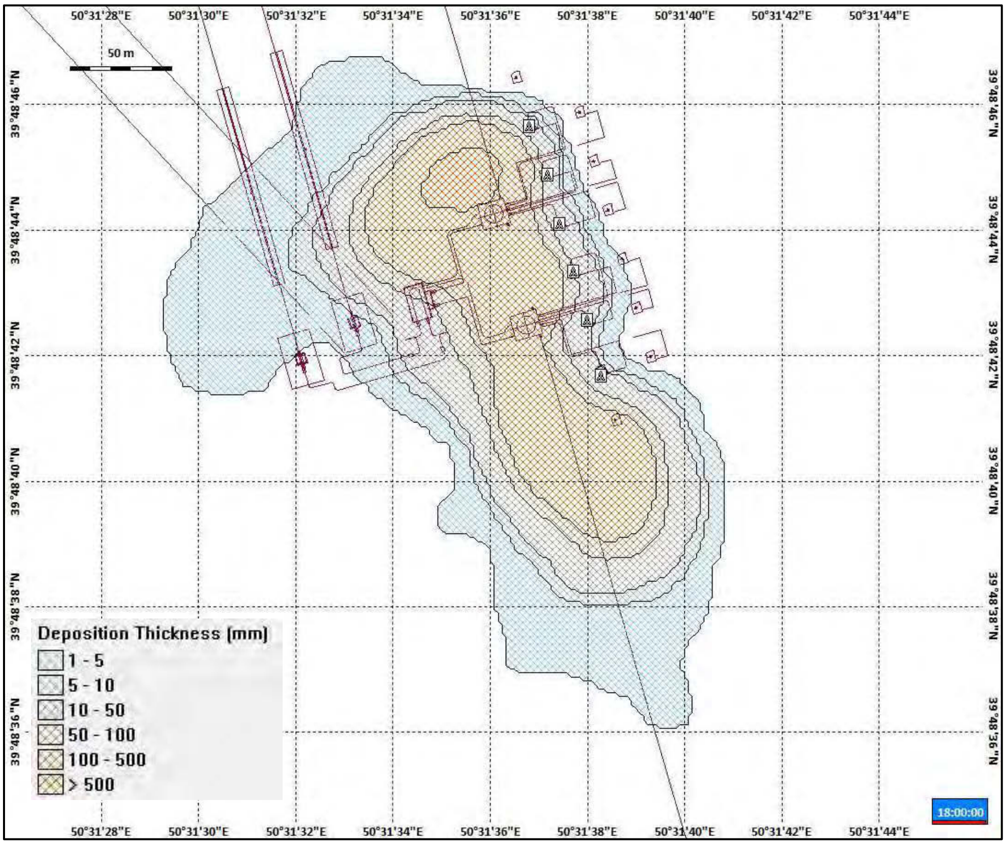


Figure 9.9 Deposition Thickness from MODU Drilling Discharge in ES Location (6 Wells)



Direct Observation and Measurement

BP have accumulated a substantial amount of direct observational data derived from post-drilling environmental surveys conducted around existing operational facilities in both the SD and ACG Contract Areas. These studies provide direct evidence of the environmental effects of discharges arising from the drilling of multiple wells (up to 20 in the case of ACG platforms) at a single location.

In each case, chemical analysis of sediments has shown a detectable barium footprint extending out to approximately 500m from the platforms. This observation is consistent with the modelling predictions which indicated that barite will be transported further than other mud and cuttings components. However, there is no evidence of any ecological effects associated with the barite footprint, and the monitoring evidence available to date indicates that the discharge of WBM-drilled cuttings is not creating any adverse effects on the benthic invertebrate communities at distances of more than 250m from the platforms (for safety reasons, it is not possible to conduct routine environmental surveys within a 250m exclusion radius).

Drilling discharges are assigned an intensity score of 1 for the following reasons:

- A substantial proportion (at least 30%) of the discharges consists of inert geological material (the cuttings);
- The drilling fluid components are inert or of very low toxicity;
- Only the solid, inert components of the drilling mud will settle to the seabed. Low toxicity soluble components, such as potassium chloride and minor additives, will dilute and disperse in the water column and will have neither acute or persistent effects;
- Evidence from monitoring in the vicinity of drilling operations where WBM cuttings have been discharged shows that there is no accumulation of drilling additives and only a

very small effect on the benthos within the 'footprint' of the discharge (up to 500m from the drilling location); and

- The drilling fluids have been the subject of comprehensive testing and assessment and have been approved for use by the MENR for existing operations.

Mud Composition and Toxicity

The approximate composition of the proposed WBM to be used for drilling the SD2 Project wells together with a brief summary of the environmental fate and effects of each component, is summarised in Table 9.13.

Table 9.13 Approximate Composition and Environmental Fate of WBM

Chemical	Function	Hazard Category	Environmental Fate and Effects
Barite	Weighting Agent	E	Dense, fine powder. Will settle to seabed. Not considered environmentally hazardous
Bentonite	Viscosifier	E	Inert clay. Not considered environmentally hazardous
Soda Ash	Alkalinity Control	E	Water soluble. Will disperse in water column. Not considered harmful.
Poly Anionic Cellulose	Water soluble polymer designed to control fluid loss	E	Low toxicity and degradable. Water soluble and will disperse rapidly
Xanthan Gum	Viscosfier	E	Natural substance. Non-toxic and biodegradable. Water-soluble and will disperse in water column.
Nut Shells	LCM/Pipe scouring	E	Natural organic material, not considered environmentally harmful, Will settle slowly to seabed, dispersed over wide area.
Salts (KCl)	Borehole stabiliser / shale inhibitor	E	Natural inorganic substance. Not considered environmentally harmful, will disperse rapidly in water column
Poly Ether Amine/Poly Ether Amine Acetate Blend	Shale Inhibitor	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Aliphatic Terpolymer	Anti-accretion additive	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Ester/Alkenes C15-C18 Blend	Shale Encapsulator	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Polypropylene Fibres	Hole cleaning agent	GOLD	UK HOCNS GOLD classification – low toxicity and inert

Toxicity tests were conducted on the proposed water-based mud formulations in 2007 using Caspian zooplankton, phytoplankton and sediment-dwelling species. Toxicity was assessed in the water column and sediment[7]. The results are summarised in Table 9.14. The estimated acute toxicity levels would require dilution of WBM, discharged from the MODU in accordance with PSA chloride concentration requirements, by a factor of between 31- and 62-fold (depending on the mud composition). The relevant dilution factor would be reached very rapidly following the WBM discharge and the plume of the discharge would be very small, quickly dispersing. The concentrations within Table 9.14 would likely persist only for the duration of each discharge.

[7] The species tested were: Zooplankton: *Calanipeda aquae dulcis;* Phytoplankton: *Chaetoceros tenuissimus* and Sediment: *Pontogammarus maeoticus.*

Table 9.14 Seawater Sweeps and Water Based Mud Toxicity Tests (2007)

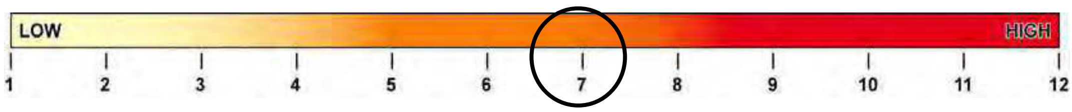
Mud Type	Water Column		Sediment
	ZooPlankton 48h LC_{50} [1] (mg/l)	Phytoplankton 72h EC_{50} [2] (mg/l)	Amphipod 96h LC_{50} [1] (mg/kg)
Seawater sweeps (42" and 32" sections)	>32000	>32000	>32000
KCl mud (28" section)	>10000	>32000	>32000
Ultradril WBM (28" section)	>32000	15591	>32000

Notes
1. LC50 - Lethal Concentration 50 is the estimated concentration of a substance required to cause death in 50% of the test organisms in a specified time period.
2. EC50 - Effective Concentration 50 is the concentration of a substance that has a specified non-lethal effect on half of the test organisms within a specified period of time. Effects measured are often number of young produced, time to reproduction, etc. In the case of phytoplankton, it is the concentration at which growth rate is reduced by 50%.

Table 9.15 presents the justification for assigning a score of 7, which represents a Medium Event Magnitude.

Table 9.15 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Modelling indicates potential for cuttings deposition (from 6 wells in the ES location) over an area of 200 by 400m. Monitoring has shown evidence of cuttings at distances of up to 500m for drilling of other ACG/SD wells.	1
Frequency	Discharges of WBM and associated cuttings will occur once for each hole section.	2
Duration	Total duration of discharge is approximately 800 hours.	3
Intensity	Drilling discharges are considered to be of low intensity due to the composition and evidence from post well surveys of no accumulation of drilling additives and previous toxicity tests.	1
Total		**7**



9.4.2.3 Receptor Sensitivity

Seals and Fish

Drilling discharges will generate turbid plumes of limited duration and dimension, as indicated above. These plumes will not however, generate chemical contamination of the water column and will not occupy a significant proportion of the local water column. It is anticipated that both fish and seals will avoid the plumes.

Table 9.16 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.16 Receptor Sensitivity (Seals and Fish)

Parameter	Explanation	Rating
Resilience	Possibility that species may be temporarily affected by drilling discharges but effect would be short term and limited and ecological functionality will be maintained.	1
Presence	Fish species including kilka and mullet will be present in the Contract Area throughout the year with other species present during migratory periods. However, the Contract Area is not exclusively used by these species and is not considered to be of primary importance for these species.	1
Total		**2**

Plankton

As for fish and seals, the principal potential interaction of drilling discharges with plankton is via the intermittent presence of short-duration turbidity plumes. Discharges from the MODU will normally take place at a depth of 10m, which is within the plankton productive zone present during spring, summer and early autumn. Cuttings will however, sink rapidly and will not impact a large volume of the productive zone. Unlike fish and seals, zooplankton cannot avoid turbidity plumes, but the dimension of the plume is sufficiently small that the "residence time" of individual organisms within the plume will be too short to cause significant harm. None of the plankton species currently present, or historically present, are rare or unique on a regional basis, and there are no observable regional variations across the Contract Area.

Plankton has high reproductive rates during spring, summer and autumn and localised populations tend to develop in patches in response to food availability. The development of patches is limited both by local nutrient availability and by zooplankton grazing. Phytoplankton species are therefore well adapted to rapidly changing conditions. These patches then decline as local food resources are depleted. Consequently, plankton will be highly resilient to the effects of drilling discharges.

Table 9.17 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.17 Receptor Sensitivity (Plankton)

Parameter	Explanation	Rating
Resilience	Species or community unaffected or marginally affected.	1
Presence	Species not rare or unique on a regional basis. Species are assessed at the community level only.	1
Total		**2**

Benthic Invertebrates

The benthic invertebrate communities in the vicinity of the NF and WF manifold locations are very similar to those across the rest of the Contract Area and the Azerbaijan sector of the South Caspian. There are no rare, unique or endangered species present.

The benthic community, at the shallower depth of the NF and WF locations, is dominated by native amphipod, gastropod, polychaete and oligochaete species, most of which have the potential to reproduce several times a year. With the exception of some bivalves, the dominant taxa are deposit feeders which routinely construct burrows to a depth of 10cm or more (this is why field surveys take samples to a depth of 10-15cm). These species are physiologically equipped to construct new burrows through cuttings material deposited in layers of at least similar depth to that which they routinely penetrate during normal burrowing activity. Routine platform monitoring studies undertaken as part of the EMP provides support for the conclusion that burrowing species can penetrate deposited cuttings, by demonstrating the presence of such organisms in samples taken at locations where barite concentrations indicate the presence of significant amounts of cuttings. In addition the cuttings will be of a similar particle size to their natural sediment, and unlike filter feeders, deposit feeders will not suffer from the clogging of feeding appendages.

The benthic invertebrate community at the ES manifold location is, in contrast, very limited in both species diversity and individual abundance. This is, predominantly, a reflection of the water depth at this location (530-557m). The EN and WS locations lie in water depth ranges of 456-480m and 407-420 m respectively. The benthic community at the EN location is, like the ES location, almost abiotic, with only a small number of species and very few individuals. At the slightly shallower WS location, ten taxa were recorded during the baseline survey, but only two species were present throughout the survey area and abundance was extremely low. At the depths at which all three manifold locations are situated, oxygen levels are often much lower than in surface water, and the community is therefore restricted to, and dominated by, oligochaete species which are tolerant of the comparatively stressful conditions.

Table 9.18 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.18 Receptor Sensitivity (Benthic Invertebrates)

Parameter	Explanation	Rating
Resilience	Species or community unaffected or marginally affected.	1
Presence	No rare, unique or endangered species present. Species are assessed at the community level only.	1
Total		**2**

9.4.2.4 Impact Significance

Table 9.19 summarises impacts to biological/ecological receptors associated with drilling discharges to sea.

Table 9.19 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Drilling Discharges to Sea	Medium	(Seals & Fish) Low	**Minor Negative**
		(Plankton) Low	**Minor Negative**
		(Benthic Invertebrates) Low	**Minor Negative**

Based on the findings from the surveys as reported in detail within Chapter 6: Environmental Description, very limited impact on benthic communities has been observed from existing drilling discharges associated with pre-drilling activities and the SD Alpha platform.

Monitoring and reporting requirements associated with drilling discharges to the sea during MODU drilling, completion and intervention activities include followings:

- Should the composition of the mud system be altered during the drilling programme to meet the drilling requirements the Management of Change Process will be followed

(Chapter 5 Section 5.16). As a minimum, tests in accordance with Caspian Specific Ecotoxicity Procedures will be undertaken if the WBM system is changed and the results submitted to the MENR;
- Each batch of barite supplied for use in WBM will be tested by the supplier to confirm cadmium and mercury content;
- When WBM and cuttings are discharged from the MODU the chloride concentrations will be analysed twice a day;
- Volumes and composition of WBM and cuttings discharged at the end of each well section and chloride concentrations will be recorded daily during discharge events;
- Monitoring of potential effects on seabed and benthic communities will be carried out in accordance with the EMP. EMP monitoring results will be submitted to the MENR on an annual basis; and
- The End of Well Environmental Report submitted to the MENR following the completion of activities/well abandonment will include the following relevant to drilling discharges:
  - Volumes of drill cuttings and drilling fluids discharged;
  - Volume of drilling chemicals used;
  - Chloride concentrations of discharged drilling fluids; and
  - Mud type and mud system associated with discharged drilling fluids and associated chemical names and OCNS categories as appropriate.

These requirements are incorporated into the Environmental Management System (EMS) for each MODU, which is aligned to the AGT Region EMS as described within Chapter 14 Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4.3 Cement Discharges

As discussed within Chapter 5 Sections 5.4.2.6 and 5.4.9.2 it is expected that cement will be discharged to the marine environment during the cementing of the all hole sections and during plugging of the geotechnical holes. In addition it is expected that excess cement will be discharged from the MODU following the completion of these activities.

9.4.3.1 Mitigation

Existing controls associated with cement during drilling and completion activities include:

- Cementing chemicals used during MODU drilling activities will be of low toxicity (UK HOCNS “Gold” and “E” category or equivalent toxicity);
- Cement is designed to set in a marine environment preventing widespread dispersion;
- The volume of cement used to cement each casing will be calculated prior to the start of the activity. Sufficient cement will be used to ensure that the casing is cemented securely and necessary formations isolated so that this safety and production critical activity is completed effectively while minimising excess cement discharges to the sea; and
- Periodic ROV surveys will be undertaken during drilling activities including cementing; Excess cement at the seabed will be observed and corrective action will be taken, if required, to ensure cement discharges are minimised.

9.4.3.2 Event Magnitude

Description

Cementing discharges will occur during drilling from two types of activity:

- During the cementing of successive well casings, plugging of geotechnical hole and grouting of wellhead brace, although cement discharges from grouting of wellhead brace is expected to be insignificant.

A riserless MRS will be used following the cementing of the 28” hole section which will enable the majority of excess cement to be returned to the MODU. Cement discharged from the 42” and 32” hole sections will discharged directly to the seabed. The event duration will be approximately one hour per casing; and

- Cement discharges will also occur from wash out activities where cement remaining in the cement unit and associated hoses will be slurrified with water (approximately 10:1 dilution), and will be discharged from each MODU via a hose located below the sea surface. The slurry will be discharged at a rate of approximately 8 barrels (1.3 m^3) per minute, for a period not exceeding one hour per discharge. This rate of discharge is equivalent to approximately 250kg of cement per minute.

Assessment

Cement Discharges to Seabed

Cement discharged at the seabed is not expected to disperse (being designed to set in a marine environment) and will therefore set *in-situ*. It is not anticipated that there will be any chemical releases from the cement, which will be effectively chemically inert. The impact of cement discharge will therefore be limited to a small area immediately around the well.

For each well, a total of approximately 200.78 tonnes will be discharged directly to the seabed. Although this will occur in 3 separate events, the largest potential area of impact can be estimated by assuming that this volume forms a uniform shallow layer. If this layer is assumed to be 30cm deep, then the maximum radius to which the cement would extend would be about 9.5m, and the impact of seabed discharge would therefore be minimal, as this area would lie within the area previously impacted by cuttings discharge from the 42” and 32” hole sections.

Cement Discharges from Wash Out

The composition of the cement is described in detail in Table 2 of Appendix 5B; for all wells and hole sections, the principal component (representing between 63 and 95% of the cement by weight) is Class G cement, which is an environmentally inert solid. Other major components by weight are also inert – principally silicate and haematite. The total quantities of excess cement discharge for each well and hole section are summarised in Chapter 5 Table 5.7.

Discharge of slurry at a rate of 1.3m^3/min will generate a downward plume, initially at a velocity of 30-40cm/s. The discharge will consist only of class G cement, mixed with water.

The discharges will occur after any cement job including 28", 18", 16’’, 11 $^1/_4$", 10”x10$^3/_4$” liner & tieback as well as 36”, 22” and 13 $^3/_8$”x13 $^5/_8$” casing. They will last no more than one hour each, and the discharge and dispersion plumes will therefore be completely separated in time. This is assuming 2 plugs and 2 cement squeezes per well, which results in a total of 12 instances of cement clean-up discharges.

The discharges were modelled in order to establish the extent of any turbidity plume. Figure 9.10a and 9.10b illustrate the plan and elevation view of the plume 2 hours after the start of a discharge. At this point, particulate concentrations within the plume are in the 5-50 mg/l range, and therefore too low to have an adverse turbidity effect. The horizontal and vertical extents of the plume are approximately 150m and 10m respectively. Four hours after the start of the discharge, the modelling indicates that the plume will have completely dispersed to particulate concentrations of less than 5 mg/l.

Figure 9.10a Plan View of Cement Dispersion Plume 2 Hours after Start of Discharge

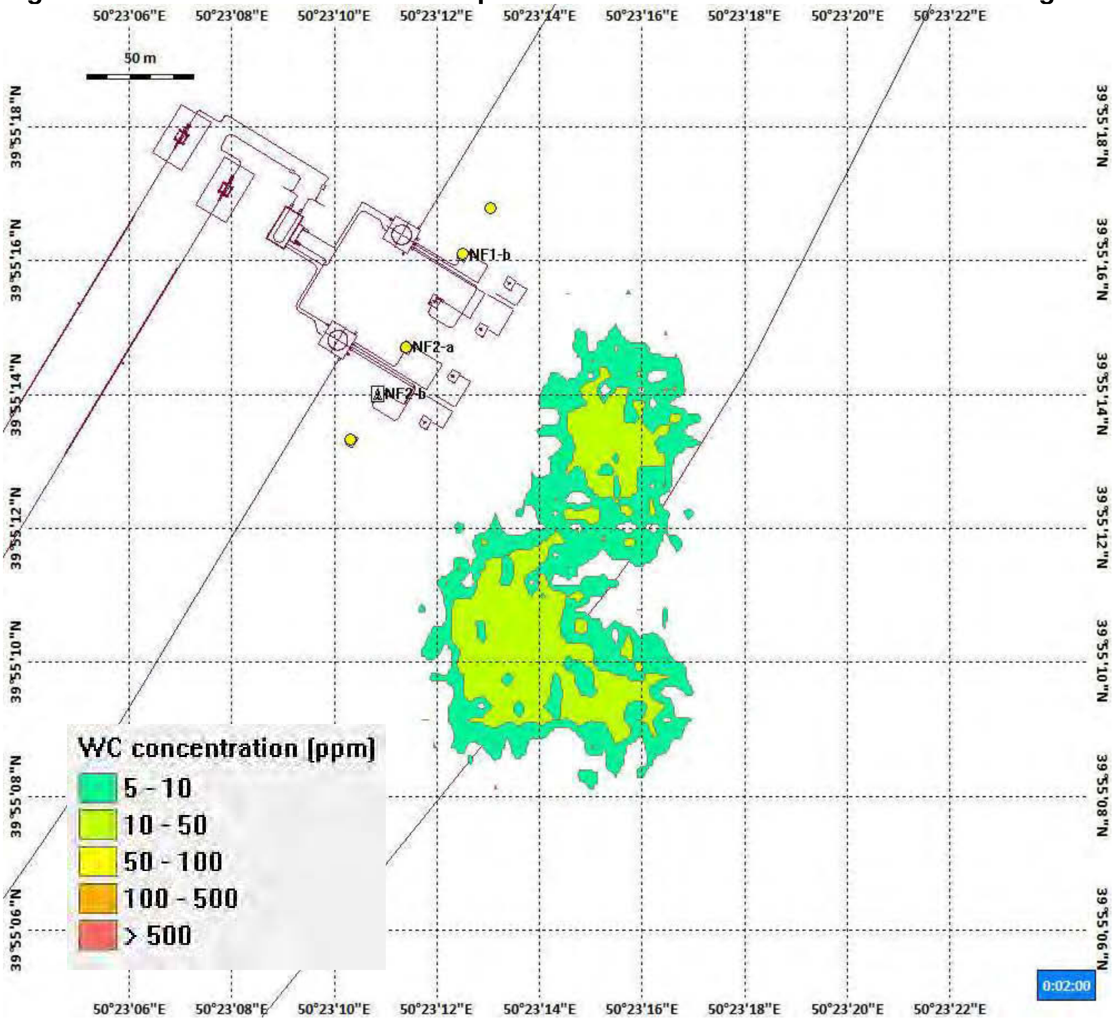
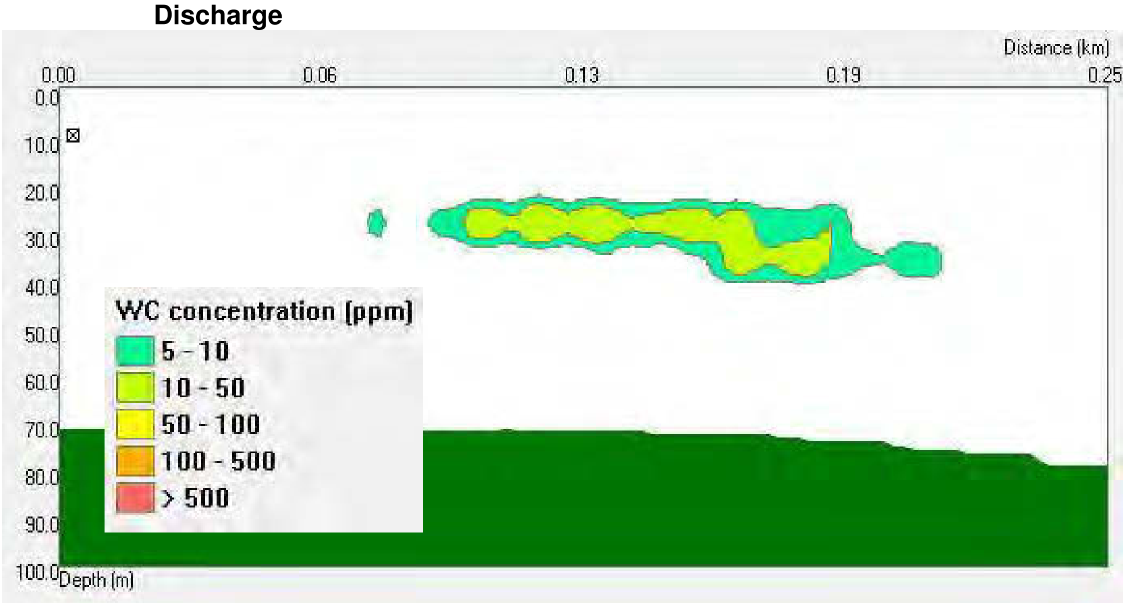


Figure 9.10b Elevation View of Cement Dispersion Plume 2 Hours after Start of Discharge

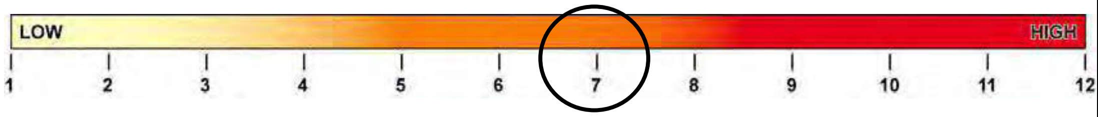


The modelling also indicated that less than 0.1% of the cement solids would be deposited on the seabed within 1.5km of the point of discharge, and that no significant seabed deposition would occur at any location.

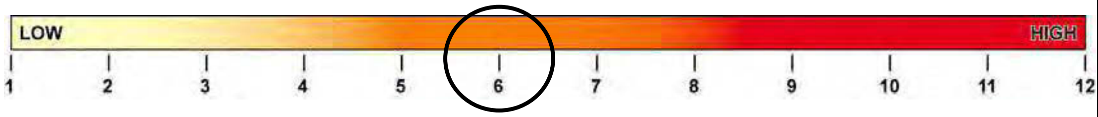
Table 9.20 presents the justification for assigning a score of 7 to cement discharges to seabed and 6 to cement discharges from wash out, which represents Medium Event Magnitudes

Table 9.20 Event Magnitude

Event Parameter	Cement Discharges to Seabed	Cement Discharges from Wash Out
Extent/Scale	1	1
Frequency	3	2
Duration	1	1
Intensity	2	2
Event Magnitude:	**7**	**6**



Cement Discharges to Seabed



Cement Discharges from Wash Out

9.4.3.3 Receptor Sensitivity

With regard to cement discharges to the seabed, these will be confined to a small area of seabed immediately around each well and no chemical releases are anticipated. Consequently, the only biological receptor is the benthic community. The cement deposits will not extend beyond the area occupied by the primary cuttings piles, and will therefore not give rise to any additional impact. The Receptor Sensitivity of all marine organisms to cement discharges is considered to be low and a score of 2 has been assigned in Table 9.21.

Table 9.21 Receptor Sensitivity (Benthic Invertebrates)

Parameter	Explanation	Rating
Resilience	No rare, unique or endangered species at significant risk of exposure, receptor confined to benthic community close to well.	1
Presence	Toxicity and persistence of cement components is low, and cement will set rapidly. Effects will be limited to physical covering of small area of benthos.	1
Total		**2**

With regard to cement discharges associated with wash out, the discharge will form a limited plume extending no more than 150m, comprising settling solids and soluble, low-toxicity chemicals. The quantity of solids is low compared to a WBM discharge, and will not cause significant turbidity or significant deposits on the seabed. The soluble chemical constituents are of low toxicity and low persistence, and will dilute rapidly, with minimal impact on fish and plankton.

Table 9.22 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.22 Receptor Sensitivity (Seals and Fish/ Zooplankton/ Phytoplankton)

Parameter	Explanation	Rating
Resilience	No rare, unique or endangered species at significant risk of exposure.	1
Presence	Toxicity and persistence of cement components is low, and cement will settle (solids) or disperse (soluble components) rapidly. Receptors present only within limited plume which is of limited persistence.	1
Total		**2**

9.4.3.4 Impact Significance

Table 9.23 summarises impacts to benthic invertebrates, seals and fish, zooplankton and phytoplankton associated with cement discharges to seabed and associated with washing of the cement unit.

Table 9.23 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cement discharges to seabed	Medium	(Benthic Invertebrates) Low	**Minor Negative**
Cement unit washing discharges	Medium	(Seals & Fish/ Zooplankton/ Phytoplankton) Low	**Minor Negative**

The assessment has demonstrated that a Minor Negative impact to benthic invertebrates is predicted from cement discharges to seabed and cement unit washing discharges. Cement chemicals are designed to be of low toxicity, chemically inert and to set in a marine environment. Only the seabed in the immediate vicinity of the well will be affected by cement discharges to seabed.

With regard to cement unit washing discharges, the solids within the discharge will settle over a large area, but the quantities are small compared to drilling mud discharges, and will make no observable difference to existing seabed impacts. Effects in the water column will be minor, and will be restricted to within a short distance (less than 150m) from the point of discharge. Both solids and chemical dispersion plumes will disperse rapidly following cessation of discharge, and therefore:

- No single discharge event will have a marked impact; and
- The successive discharge events at any well will not overlap and will not have cumulative Impact.

Mandatory monitoring and reporting requirements associated with cement discharges to the sea during MODU drilling, completion and intervention activities include:

- Monitoring of potential effects on seabed and benthic communities will be carried out in accordance with the EMP. EMP monitoring results are submitted to the MENR on an annual basis; and
- The volume of cementing chemicals used and discharged will be recorded daily and included within the End of Well Environmental Report submitted to the MENR following well drilling and cementing activities/well abandonment.

These requirements are incorporated into the Environmental Management System (EMS) for each MODU, which is aligned to the AGT Region EMS as described within Chapter 14 Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4.4 BOP Testing

9.4.4.1 Event Magnitude

Description

As described with Chapter 5 Section 5.4.4 a blow out preventer (BOP) will be installed on all wells to control pressure in the well prior to installation of the well production facilities. The BOP will be tested weekly for safety reasons, resulting in discharge of control fluids to sea. The anticipated discharges and duration of each event is detailed within Table 5.10. In total a discharge of 2,052 litres of BOP fluid over a period of 13.8 minutes is estimated for each 2 pod test. Single pod testing results in discharges of 1,026 litres. Single and 2 pod tests are undertaken on alternate weeks through the drilling and completion programme.

The BOP fluid comprises a proprietary control fluid (Stack Magic ECO Fv2), propylene glycol and water. The active components of Stack Magic ECO Fv2 and the typical proportions of this product, propylene glycol and water in the BOP fluid as a whole are summarised in Table 5.9. Since the proportions of components can vary, the impact assessment is based on the highest proportions of each (indicated in bold in Table 5.9).

Assessment

An ecotoxicological risk assessment of the discharge has been undertaken. This is based on available data on the aquatic toxicity of the product and of the components of the overall BOP fluid. No data are available for the acute toxicity of either the product or of the whole BOP fluid. Accordingly, two surrogate sources of data have been used:

- Results of chronic tests on the product, conducted to US Environmental Protection Agency (EPA) requirements for the Western Gulf of Mexico; and
- Literature values for the acute toxicity of the individual chemical components.

The US EPA test results (growth tests on mysid shrimp and fish) reported no effect at a whole product concentration of 200 mg/l. These results do not take into account the contribution of propylene glycol to the overall toxicity of the BOP fluid.

In order to estimate overall BOP fluid toxicity, it has been assumed that the product LC_{50} is ten times the chronic no-effect value. This is based on the risk assessment convention of applying a safety factor of 10 to acute toxicity data (for short-duration discharges). Literature data cover a wide range of methodologies and test organisms, and consequently the data used can only be considered to represent the correct order of magnitude. The process of estimating mixture toxicity from individual component values also limits precision, as it is necessary to assume simple additivity of toxicity.

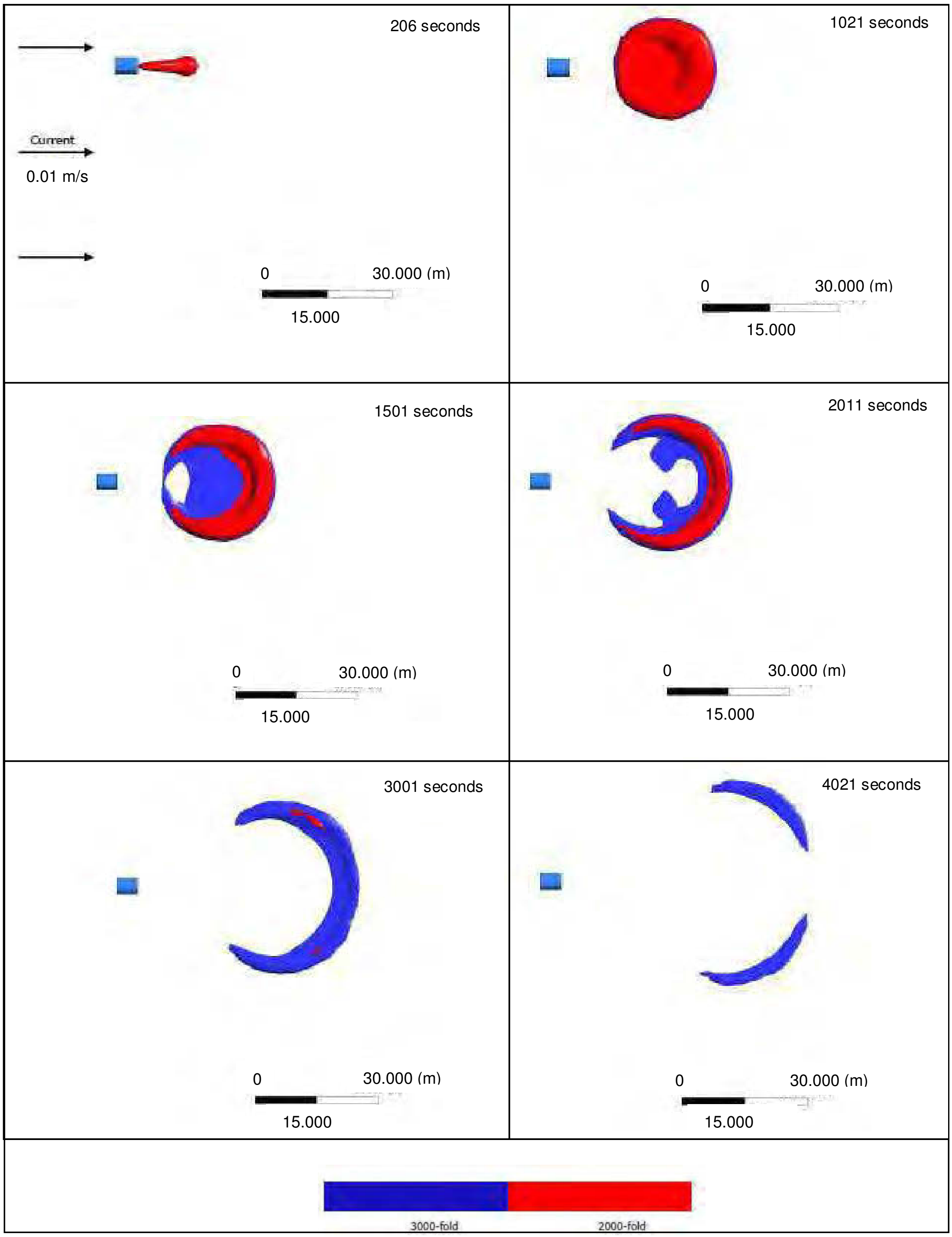
Although propylene glycol is of very low toxicity (LC_{50}s >10,000 mg/l), it can represent a substantial fraction of the BOP fluid (up to 25%, see Table 5.9), and it is estimated that for this reason its contribution to toxicity will be similar to that of Stack Magic ECO Fv2.

Estimated BOP fluid toxicity (LC_{50}) ranged from approximately 18,000 mg/l (based on US EPA and propylene glycol data) to approximately 15,000 mg/l (based on component and propylene glycol data).

For short-duration discharges, the risk assessment convention is to apply a safety factor of 10 to acute toxicity data; consequently, the BOP fluid no-effect concentration is estimated to be between 1,500 and 1,800 mg/l. To reach these concentrations, a discharge would require dilution of between 550 and 650-fold. However, to make allowance for uncertainty in the estimation of toxicity, as a conservative estimate, the required no-effect dilution is assumed to be between 2,000- and 3000-fold.

The dispersion of the discharges in Table 5.10 was modelled, to enable the dimensions and persistence of the dispersion plumes to be quantified and visualised. For the purpose of visualisation, the plumes were modelled and displayed separately. Four scenarios, representing the range of volumes and discharge velocities, were each modelled for two current velocities (0.01 and 0.1 m/s). In practice, the degree of independence of the plumes will depend on the interval between each individual operation; if this interval is less than the persistence time of the plume from the preceding operation, then the plumes will be contiguous. Contiguity of plumes will affect the maximum volume, but will not affect either plume width or maximum displacement from the BOP. Figure 9.11 graphically illustrates the plume development and dissipation for largest discharge i.e. upper annular discharge of 654 litres over 3 minutes.

Figure 9.11 Upper Annular Discharge at Near-Stagnant (0.01m/s) Current Velocity



The assessment concluded:

- For the largest discharge, maximum plume persistence was approximately 77 minutes, with maximum width and length of 51 and 81m respectively, and maximum displacement of 98m;
- For the smallest discharges (20 litres over 0.5 minutes), plume persistence to a dilution of 3000-fold ranged between approximately 3 and 12 minutes, with maximum width and length of 5m and 7m respectively, and maximum displacement of 13m; and

- For the intermediate volume (lower pipe ram discharge of 70 litres over 1.16 minutes), plume persistence was approximately 15 minutes, with maximum width and length of 26m and 37m respectively, and maximum displacement of 37m.

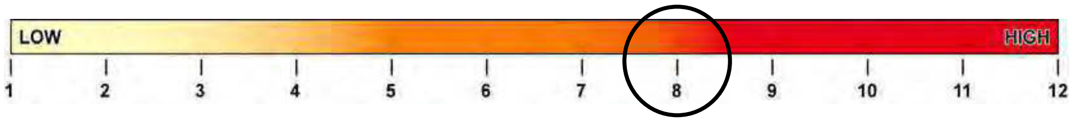
In all cases, plumes were narrower, longer and of shorter persistence at typical (0.1m/s) current velocity than at near-stagnant (0.01m/s) current velocity. For discrete discharges each plume 'detaches' from the BOP and disperses as it is displaced down-current. If the discharges were closely spaced in time, a continuous plume would develop which would only detach after the last operation had been completed. Whilst variation in the dimensions of the plume would depend on the order in which the operations took place, the maximum dimensions indicated above would not be affected. For practical purposes, therefore, the maximum area within which the discharge dilution would transiently be less than 3000-fold would be 51m wide and 98m long, and overall persistence would equal the total duration of the flushing operations plus no more than 1.5 hours.

The components of the control fluid and propylene glycol are all readily degradable, and the product has passed US EPA standards and has been assigned a UK Offshore Chemical Notification Scheme (OCNS) category D (rated A-E where E is the least environmental harmful). As this product has an LC_{50} between 10 and 100ppm, it can be assumed that this product is inherently biodegradable (20-60% in 28 days) and is non-bioaccumulative. The area of potential impact has been very conservatively assessed on the basis of information on toxicity tests which are of much longer duration (2 - 7 days) than the duration of the discharges (up to 17 minutes per BOP). Consequently, and taking into account both the limited area of potential impact and the very short duration of the operations, BOP fluid flushing is considered to be a low intensity activity.

Table 9.24 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 9.24 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Affects an area less than 500m from source.	1
Frequency	Discharge will occur weekly	3
Duration	Discharge will occur for the duration of the drilling programme (9 months).	3
Intensity	Low intensity.	1
Total		**8**



9.4.4.2 Receptor Sensitivity

The discharges will take place approximately 8m above the seabed. No human receptors are present, and seals are not considered at risk of exposure due to the small size of the area of potential impact and the fact that dermal contact at the dilutions modelled would be very limited. Fish and zooplankton are most likely to be exposed, but neither category of organism is likely to be present in abundance at the discharge location during the very short period of discharge and plume persistence. There are no viable phytoplankton communities or macroalgae present at the discharge location.

For horizontal discharges (depending on the rig used, discharges will either be horizontal or vertical), it is possible that one or more plumes might transiently contact the seabed. However, the contact period and area would be insufficient to promote permeation of the sediment by the fluid components, and the exposure of benthic organisms would, overall, be less than the exposure of fish or zooplankton.

Table 9.25 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.25 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	Exposure is low and of short duration, so resilience is, in effect, high.	1
Presence	No significant presence of rare, unique or endangered species.	1
Total		**2**

9.4.4.3 Impact Significance

Table 9.26 summarises the impact of BOP fluid discharge to sea on seals, fish, zooplankton and benthos based on the impact significance criteria presented in Chapter 3: Impact Assessment Methodology.

Table 9.26 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
BOP testing discharges to sea	Medium	(Seals) Low	**Minor Negative**
		(Fish & Zooplankton) Low	**Minor Negative**
		(Phytoplankton & Benthos) Low	**Minor Negative**

The assessment has demonstrated that Minor Negative impacts to seals, fish, zooplankton and benthos are predicted from BOP fluid discharge during the drilling programme.

Monitoring and reporting requirements associated with BOP discharges include:

- A program of BOP fluid sampling every 6 months from each MODU and ecotoxicity testing, involving phytoplankton and zooplankton, will be implemented during the drilling program.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4.5 Cooling Water Intake and Discharge

Cooling water will be continuously uplifted and discharged during MODU drilling activities onboard both MODU.

9.4.5.1 Mitigation

Existing controls related to MODU cooling water intake and discharge include:

- The design and operation of the cooling water system has been reviewed. The temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees above ambient water temperature; and
- The MODU seawater intake design will include the use of a screen mesh to prevent fish entrainment.

9.4.5.2 Event Magnitude

Description

The intake/discharge rate on the Istiglal rig will be up to 630m^3 per hour. Water will be lifted from a depth of 9.8 m and discharged via a caisson 12.5m below sea level (depending on draft) and at a maximum temperature of 30°C (during summer). The Istiglal secondary cooling system is protected by a standard anodic corrosion control system.

The Heydar Aliyev normally operates two seawater pumps, each rated at 480m^3 per hour, at 90-100% capacity.

Assessment

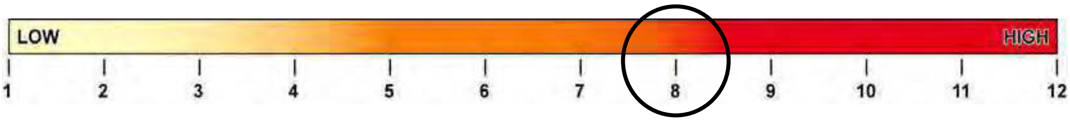
For the Istiglal rig as the intake depth is shallow it is anticipated that the lifted water will be at the same ambient temperature as the receiving water at all times of the year. The discharge temperature will be no more than 4-5°C above ambient temperature. It was concluded that the discharge would require dilution by less than a factor 2 to meet the requirement that the temperature at the edge of a 100m mixing zone does not exceed ambient temperatures by more than 3°C and the requirement would be achieved within 4-5m of the point of discharge.

As a consequence of the higher discharge flowrate associated with the Heydar Aliyev (960m^3/hr in total), the temperature difference between intake and discharge is only anticipated to be approximately 2.8°C and therefore the requirement for the discharge not to exceed ambient temperature by more than 3°C is met at the discharge location.

Table 9.27 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 9.27 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Affects an area less than 100m from source.	1
Frequency	Discharge will occur continuously through drilling and completion activities	3
Duration		3
Intensity	Low intensity.	1
Total		**8**



9.4.5.3 Receptor Sensitivity

For both MODU the cooling water intake velocity will be low and screens installed on the cooling water intake will prevent fish entering the cooling water system. Plankton will however, be entrained due to their small size. The volume flowrate is however, small compared to the water volume in the immediate surroundings of the MODU.

As noted above in Section 9.4.5.2, for the Istiglal MODU, the area and volume of water within which any potentially harmful exposure might occur, is limited to within 4-5m from the point of discharge, meaning the discharge plume would be very small in size. The temperature gradient at the edge of the plume is likely to be reasonably abrupt, provoking an avoidance reaction in fish and seals (although the probability of encounter with the plume for either group is very low based on their expected presence and the plume dimensions).

For all plankton, interaction with the plume depends on entrainment from the surrounding water and the process will ensure that individual plankton organisms do not remain in the discharge plume for more than a few tens of seconds.

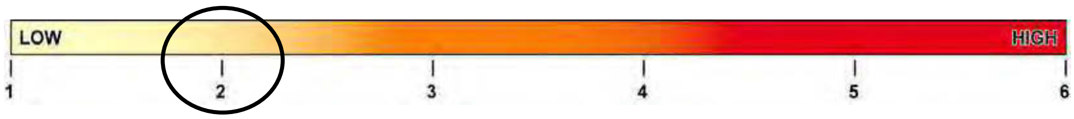
For the Heydar Aliyev MODU due to the small difference between the intake and discharge temperatures, there will be no measurable thermal impact of the discharge.

The cooling water discharge takes place 12.5m below the sea surface for the Istiglal rig and 10.9-12.9m below the sea surface for the Heydar Aliyev and therefore does not have the potential to interact with benthic invertebrates.

Table 9.28 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.28 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	Exposure is negligible, so resilience is, in effect, high.	1
Presence	No significant presence of rare, unique or endangered species.	1
Total		**2**



9.4.5.4 Impact Significance

Table 9.29 summarises the impact of cooling water discharges to sea on seals and fish, zooplankton and phytoplankton based on the impact significance criteria presented in Chapter 3: Impact Assessment Methodology.

Table 9.29 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
MODU Cooling Water Discharges to Sea	Medium	(Seals & Fish) Low	**Minor Negative**
		(Zooplankton) Low	**Minor Negative**
		(Phytoplankton) Low	**Minor Negative**

The assessment has demonstrated that Minor Negative impacts to seals, fish, zooplankton and phytoplankton are predicted from cooling water intake and discharge. In practice, these impacts are more directly related to the Istiglal; lower discharge temperatures result in a lower impact in the case of the Heydar Aliyev. Therefore, no additional mitigation beyond existing control measures is deemed to be necessary.

9.4.6 Other Discharges

These comprise ballast water, treated black water, grey water and drainage.

9.4.6.1 Mitigation

Existing controls related to other MODU discharges include:

- Ballast Water:
  - Ballast Water - The MODU water intake point will be screened to prevent fish entrainment;
  - Ballasting will be undertaken in accordance with existing ballast water management plans, which include measures designed to avoid introduction of nearshore species offshore and vice versa;
  - The MODU Ballast System will be operated so that ballasting, which uses untreated seawater, will be undertaken daily to maintain stability of the MODU for effective drilling; and
  - There will be no planned discharges to sea of treated oily water with an oil content more than 15ppm.

- Treated Black Water:
  - Under routine conditions, black water will be treated within the MODU sewage treatment system to MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine as low as practicable; and
  - Under non routine conditions when the MODU sewage treatment system is not available black water will be managed in accordance with the existing AGT plans and procedures and reported to the MENR as required.
- Drainage:
  - Deck drainage and wash water will be discharged to sea as long as no visible sheen is observable; and
  - Rig floor runoff, including WBM spills, collected via rig floor drains will be recycled to mud system or if not possible for technical reasons, diluted and discharged to sea (>60cm from sea surface) in accordance with applicable PSA requirements i.e. there shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

9.4.6.2 Event Magnitude

Description and Assessment

Other discharges to sea comprise:

- **Ballast Water** – MODU ballasting activities will consist primarily of:

  - Ballasting the drilling rig for transit to the drilling location – minimum draft configuration for towing, so it may involve near shore discharge of some ballast water if the vessel has been anchored close to shore prior to mobilisation;
  - Taking on ballast water to increase the draft to the drilling configuration once on site;
  - Occasional uptake and discharge of ballast water during drilling operations; and
  - De-ballasting prior to demobilisation once drilling is completed.

Taking into account the existing mitigation uptake and discharge are therefore anticipated to have negligible environmental impact.

- **Treated Black Water –** Based on 120 and 130 POB for the Istiglal and Heydar Aliyev, respectively and a forecasted generation rate of 0.1m^3/person/day, it is expected that approximately 12-13m^3/day of black water will be generated by the Istiglal and Heydar Aliyev rigs respectively during SD2 Project drilling activities. The flow rate is low, so the effluent will be rapidly diluted close to the point of discharge. The discharge of biologically treated black water offshore, including total suspended solids at the proposed treatment level, does not pose any risk of environmental impact.

- **Grey Water –** Grey water will be discharged directly to sea. Grey water (from showers, laundry etc) will contain primarily dilute cleaning agents (soaps and detergents). Daily visual checks will be undertaken during the discharging process in order to confirm that no floating solids are observable.

- **Drainage -** Comprises
    - Deck drainage, washwater and diluted rig floor runoff containing WBM which cannot be returned to the mud system (see Section 9.4.6.1 above) will be routed to sea;
    - In the event of a spill, main deck drainage will be diverted to hazardous drainage tank for spills including LTMOBM, oil/diesel/cement and oily water. Contents of hazardous waste tank will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

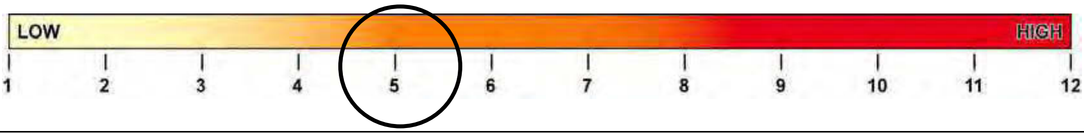
    <u>Heydar Aliyev</u>
    - Waste oil collected from the drainage system will be sent to waste oil tank. The contents of the tank will be incinerated using the rig's incinerator
    - Bilge water will be sent to an oily water separator. Treated bilge water with an oil content less than 15ppm will be discharged to sea; and
    - Drains within the drilling area are connected to the mud system. If it is not possible to send runoff including mud to the mud system it will be directed to a zero discharge centrifuge. Treated water from the centrifuge with an oil content less than 15ppm will be discharged to sea. Separated sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures and separated oil sent to the waste oil tank;

Event Magnitude is summarised in Table 9.30.

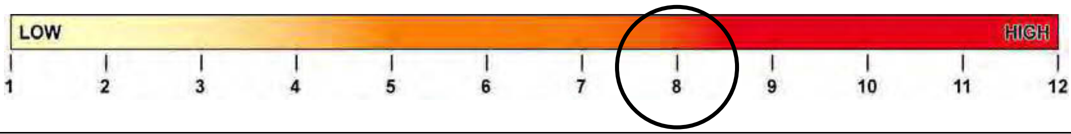
Table 9.30 Event Magnitude

Event Parameter / Discharge	Ballast Water	Treated Black Water	Grey Water	Drainage
Scale	1	1	1	1
Frequency	2	3	3	3
Duration	1	3	3	3
Intensity	1	1	1	1
Event Magnitude	**5**	**8**	**8**	**8**

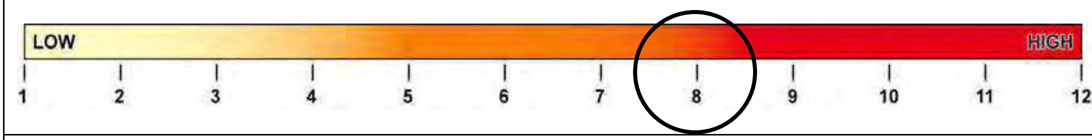
Ballast Water:



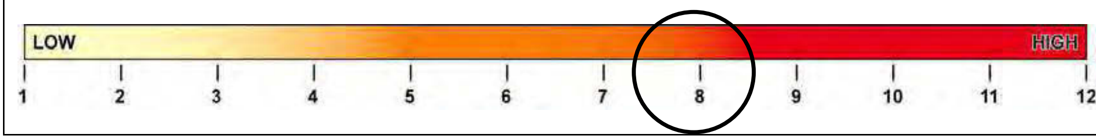
Treated Black Water:



Grey Water:



Drainage:



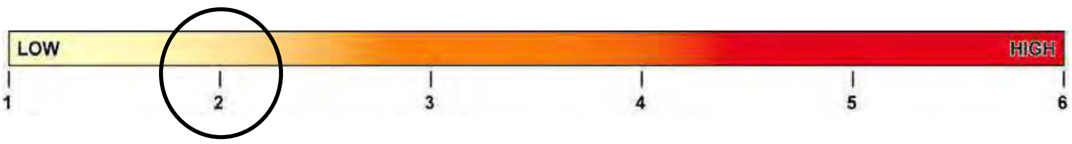
9.4.6.3 Receptor Sensitivity

All of the discharges are low in volume, do not contain toxic or persistent process chemicals and are considered to pose no threat to the environment or the identified biological/ecological receptors.

Table 9.31 present the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.31 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
Presence	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Total		**2**



9.4.6.4 Impact Significance

Table 9.32 summarises the impact of other discharges to sea on seals and fish, zooplankton, phytoplankton and benthic invertebrates based on the impact significance criteria presented in Chapter 3: Impact Assessment Methodology.

Table 9.32 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea **Ballast Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Treated Black Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Grey Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Drainage**	Medium	(All Receptors) Low	**Minor Negative**

Monitoring and reporting requirements associated with discharges of black, grey and drainage water and macerated galley waste (to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards) during MODU drilling, completion and intervention activities include:

Black Water:

- Samples will be taken from the MODU sewage discharge outlet and analysed monthly for total suspended solids, thermotolerant coliforms and BOD;
- Daily visual checks will be undertaken when discharging to confirm no floating solids are observable; and
- Summary of MODU sewage sampling analysis results, recorded floating solids observations and estimated volumes of treated black water discharged daily (based on a generation rate of 0.1m^3/person/day) will be reported to the MENR on an annual basis for each MODU.

Grey water, Galley Waste and Drainage:

- Daily visual checks undertaken when discharging to confirm no floating solids are observable ; and
- Daily estimated volumes of grey water and galley waste from each MODU will be recorded monthly and reported by MODU to the MENR on an annual basis. Estimates will be based on generation rates of 0.018m^3/person/day (galley waste) and 0.22m^3/person/day (grey water).

These requirements are incorporated into the Environmental Management System (EMS) for each MODU, which is aligned to the AGT Region EMS as described within Chapter 14 Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.5 Summary of the SD2 Project Drilling and Completion Activities Residual Environmental Impacts

With regard to the SD2 Project Drilling and Completion Activities, it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

Table 9.33 summarises the residual environmental impacts associated with the SD2 Project Drilling and Completion Activities.

Table 9.33 Summary of SD2 Project Drilling and Completion Activities Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from mobile drilling rig power generation	1	3	3	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
	Emissions from MODU Flaring (well testing, clean up or intervention flaring)	1	3	1	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
	Emissions from support vessel engines	1	3	3	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
Marine Environment	Underwater noise from drilling and vessel movements	1	3	3	1	1 1	Medium	Low	Minor Negative
	Drilling discharges	1	2	3	1	1 1	Medium	Low	Minor Negative
	Cement discharges to seabed	1	3	1	2	1 1	Medium	Low	Minor Negative
	Cement unit washing discharges	1	2	1	2	1 1	Medium	Low	Minor Negative
	BOP testing discharges to sea	1	3	3	1	1 1	Medium	Low	Minor Negative
	MODU cooling water discharges to sea	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig ballast water discharge	1	2	1	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig treated black water discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig grey water discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig drainage discharges	1	3	3	1	1 1	Medium	Low	Minor Negative

10 Construction, Installation and HUC Environmental Impact Assessment, Mitigation and Monitoring

Contents

List of Figures

List of Tables

10.1 Introduction

This Chapter of the Shah Deniz 2 (SD2) Project Environmental and Socio-Economic Impact Assessment (ESIA) presents the assessment of environmental impacts associated with the following SD2 Project phases:

- Onshore Construction and Commissioning of Terminal Facilities;
- Onshore Construction and Commissioning of Offshore and Subsea Facilities;
- Platform Installation, Hook Up and Commissioning (HUC);
- Subsea Export & MEG Pipeline Installation & HUC; and
- Subsea Infrastructure Installation & HUC.

The impact assessment methodology followed and the structure of the SD2 Project impact assessment are described in full within Chapters 3 and 9 of this ESIA, respectively.

10.2 Scoping Assessment

The SD2 Project Construction, Installation and HUC Activities and Events have been determined based on the SD2 Project Base Case, as detailed within Chapter 5: Project Description (see Appendix 10A).

Table 10.1 presents the Activities and associated Events that have been scoped out of the full assessment process due to their limited potential to result in discernable environmental impacts. Judgement is based on prior experience of similar Activities and Events, especially with respect to earlier ACG developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 10.1 "Scoped Out" SD2 Project Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Construction and Commissioning of Terminal Facilities & Installation & HUC of Subsea Export and MEG Pipelines (Onshore)			
CTer-R1	Operation of construction plant and vehicles including diesel generators (onsite) – disturbance/indirect effect to wildlife	5.5.4.1	• Vehicle movements during construction and commissioning activities within Sangachal Terminal vicinity will be restricted to defined access routes and demarcated working areas, unless in the event of an emergency. • Construction traffic associated with the SD2 Project is expected to use the Baku-Salyan Highway during the construction period. • Off-road driving will be prohibited during construction and commissioning activities within Sangachal Terminal vicinity, outside of designated areas unless specifically authorised. • It is expected that local wildlife in the area will avoid noisy areas. • A Wildlife Management Plan will be prepared for the duration of the construction and commissioning activities carried out within Sangachal Terminal vicinity. **Conclusion:** Vehicles will use existing roads and tracks. With the Wildlife Management Plan in place, there will be a limited discernible impact to wildlife.
CTer-R2	Construction vehicle movements (offsite) – disturbance/indirect effect to wildlife	5.5.4.1	

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
CTer-R3	Construction plant/vehicle refuelling	5.5.3.3	• Plant and vehicles associated with the SD2 Project will be either refuelled at the new SD2 dedicated vehicle refuelling facility, or in the location they are operating using mobile fuel bowsers. • A refuelling procedure will be used during construction and commissioning activities in the Sangachal Terminal vicinity, for construction plant and vehicles which details the pre-checks, level indication monitoring, provision of temporary containment and drip trays, communication, training and spill kit requirements. • The dedicated refuelling area at the Terminal will be located within a bund capable of holding 110% capacity. The area will include lined concrete bunds, sized to contain 110% of the stored fuel capacity. Drainage within the refuelling facility will be routed to an oil water separator system • Drainage within the refuelling facility will be routed to an oil water separator system. The refuelling facility oil water separators will be tested on a daily basis to confirm the total oil content is less than 19mg/l daily average and 10 mg/l monthly average. Wastewater from the refuelling facility that does not meet the applicable discharge standards and separated oil will be collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact to the terrestrial environment is expected
CTer-R4	Erection of temporary structures (e.g. buildings) – visual impact	5.5.2.1	• Temporary and permanent structures will be constructed at and adjacent to the SD2 Expansion Area including temporary construction buildings and SD2 utility and process equipment (including the SD2 flare). • All structures will be of a similar scale to the existing ACG and SD facilities at the Sangachal Terminal. • The existing Terminal is not considered to significantly impact existing views from the communities surrounding the Terminal. • The SD2 temporary and permanent structures are likely to be indistinguishable from the existing facilities in these views (with the exception of the SD2 Flare under non routine flaring conditions at night – refer to Chapter 12 Section 12.3.4) **Conclusion:** There will be limited visibility of the temporary construction and permanent SD2 utility and process structures from sensitive receptors and no discernable impact on human receptors is expected.
CTer-R5	Erection of permanent structures (e.g. pipe racks and structural steel works) – visual impact	5.5.2.1	
CTer-R6 & SubOn-R3	Use of temporary lighting (within SD2 Expansion area and along the Onshore SD2 Export Pipeline Corridor)	5.5.3.1	• Under normal conditions, work areas will not be lit outside of working hours during onshore construction and commissioning activities unless for safety/security reasons. • The existing Terminal is heavily lit and the existing lighting around its perimeter would dominate any light associated with the SD2 Project. • A lighting strategy will be implemented during onshore construction and commissioning activities which will include measures to minimise light spillage and glare to the community. Measures will include use of lighting with cowls that can be angled towards the work area and where safe to do so turning off lights when not in use. **Conclusion**: No discernible impact on human and ecological/biological receptors is expected.
CTer-R7	Use of permanent lighting within the SD2 Expansion Area	5.5.3.1	• Permanent lighting will be installed in the Construction Camp and Facilities areas and the SD2 Expansion Area. **Conclusion:** The existing Terminal is heavily lit. Lighting associated with the SD2 Project would be indistinguishable from the current lighting environment
CTer-R8	Above groundworks (e.g. construction of internal road network within the SD2 Expansion Area) - Alteration to surface water flow	5.5.2.1 5.5.2.2	• Above ground structural groundworks associated with the SD2 Project will result in alterations in surface water flows in the vicinity of the Terminal. • Hydrological modelling has been undertaken to determine the flow conditions and flood risk prior and following the SD2 Project works in the Terminal vicinity. • Modelling has shown that both prior to and following the SD2 Project works, Sangachal Town and Sangachal Power Station[1], which both lie significantly above the level of a major flood event, are not at risk of flooding. • Under existing conditions, sections of the railway and highway are currently at risk of flooding during a major flood event. Modelling showed that the SD2 project works do not increase the likelihood or severity of the existing flood risk in these locations. • The Caravanserai, a State protected monument located to the south of the Terminal, was shown to be located in an area which, at it lowest

[1] Major flood event is defined as 1 in 100 year flood

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			point, is very close to the level of a major flood event. The modelling demonstrated that the SD2 Project works are predicted to result in a negligible change to flood levels at this location (<2mm increase). **Conclusion:** Overall, the risk of flooding at key receptors was shown to either marginally reduce or remain largely unchanged following the SD2 Project works.
CTer-R9 & SubOn-R1	Movement and temporary storage of spoil (within SD2 Expansion area and along the Onshore SD2 Export Pipeline Corridor) – Dust generation	5.5.2.2	• Earthworks associated with the SD2 Project will result in the generation of dust. • Dust levels recorded during the baseline surveys are considered to be indicative of a semi-desert environment. • Vehicles will travel during construction and commissioning activities at Sangachal Terminal vicinity at speeds that minimise dust and unpaved roads/tracks and road speeds will be established for different road surfaces. Speed limits will be adhered to at all times in the Sangachal Terminal vicinity during onshore construction and commissioning activities. • Construction activities will be suspended at Sangachal Terminal vicinity if excessive dust arises and measures will be taken to control ground prior to resuming activities. • Loose loads of all construction vehicles entering the construction sites within the Sangachal Terminal vicinity will be covered . • Drivers of onsite construction vehicles operated within the Sangachal Terminal vicinity will be provided with dust management training . • Where unsurfaced, the main access routes will be created using compacted well graded granular fill, appropriately designed to ensure good drainage to minimise the potential for erosion. • All unsurfaced roads located within the Sangachal Terminal vicinity will be regularly maintained to ensure the surface remains stable and compacted. • All hardstanding areas (including paved roads) located within the vicinity of Sangachal Terminal will be regularly inspected to ensure areas are kept clean of dust and mud. • A wheel washing facility will be used at Sangachal Terminal to remove excessive mud from vehicles using unpaved roads, leaving the site using the public highway. • Quantity and duration of spoil exposure will be minimised as far as possible and ground disturbing activities will be sequenced to minimise the area disturbed at one time within the vicinity of Sangachal Terminal. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected
CTer-R8	Above groundworks (e.g. construction of internal road network within the SD2 Expansion Area) - Dust generation	5.5.2.1 5.5.2.2.	
CTer-R10 & SubOn-R2	Subsurface groundworks (e.g. construction of open drains system, underground pipework and foundations, pipeline trenching) – Dust generation	5.5.2.2.	
CTer-R10	Subsurface groundworks at the Terminal (e.g. construction of open drains system, underground pipework and foundations) – cultural heritage	5.5.2.2	• The SD2 Expansion Area has been cleared and terraced during the EIW. • An archaeological watching brief will be implemented at the construction sites located within the vicinity of Sangachal Terminal during any clearance works in areas not previously surveyed during the EIW. **Conclusion:** No discernible impact on terrestrial cultural heritage is expected.
CTer-R10	Subsurface groundworks at the Terminal (e.g. construction of open drains system, underground pipework and foundations) – mobilisation of potential contamination	5.5.2.2	• Stockpiles of subsoil located in the vicinity of Sangachal Terminal, will be appropriately shaped and compacted to avoid erosion and sedimentation of nearby open water courses or drains. • Site drainage and pollution hazards maps will be maintained that show potential sources of pollution (e.g. storage areas), pathways (e.g. drains) and receptors (e.g. the Caspian Sea) located within the Sangachal Terminal vicinity • Designated areas within the Sangachal Terminal vicinity will be established away from watercourses for waste cement/ concrete, which will be contained and collected as a waste once solidified. **Conclusion:** No discernible impact on ecological/biological receptors is expected
CTer-R11	Discharge from oil water separators from construction camp facilities to wadi system	5.5.2.1	• The drainage system within the construction camp and construction facilities area will be designed to: • Route wastewater from the vehicle wash and refuelling facilities for reuse or discharged after treatment using an oil water separator. The oil water separators will be designed to treat wastewater from the vehicle wash facility to applicable oil water standards of 19 mg/l daily average and 10 mg/l monthly average. The separators will be tested on a daily basis to confirm the total oil content daily and average standards are met. Wastewater from the vehicle wash and refuelling facilities that does not meet the applicable discharge standards will be collected by road tanker, handled as liquid waste and removed from site.
CTer-R12	Discharge of water from non-oily water separator systems from construction camp facilities to wadi system	5.5.2.1	

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			• Route canteen waste water to the STP via a dedicated system to separate fats, oil and grease to minimise potential fouling of the STP. The contents of the traps will be collected by road tanker, handled as liquid waste and removed from site. • Surface water flows within the wadi will increase in response to precipitation events. The volume of water discharged from separators into the wadi will not significantly increase the flow conditions currently experienced after a rainfall event. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected
CTer-R13	Discharge of water from the sewage treatment plant into the wadi (when operational after Phase 1)	5.5.2.1	• During construction of the SD2 onshore facilities, sewage will be routed to the new STP when operational or collected by road tanker, handled as liquid waste and removed from site. • Sewage will be treated to comply with applicable project standards: pH (6-9), 5 day BOD of less than 20mg/l, total coliform <400MPN (Most Probable Number) per 100ml, COD of less than 100mg/l, suspended solids of less than 30mg/l and residual chlorine less than 1mg/l (used for irrigation) or less than 0.2mg/l (discharge to the environment). • Treated sewage will be used for irrigation or dust control (preferred option) within the vicinity of Sangachal Terminal. • Residual chlorine content of the sewage discharged from the treatment plant into the wadi will be measured daily. • Samples will be taken from the Sewage Treatment Plant discharge outlet and analysed weekly for pH and daily for BOD, total coliforms, COD and suspended solids against applicable project standards. Assurance monitoring will be completed monthly. • Results from effluent monitoring will be submitted to the MENR monthly. • Sewage sludge will be transported off site for disposal to an appropriately licensed facility • Sumps will be used to provide contingency storage when the STP requires maintenance or is not available. Waste water from the sumps will be collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected.
CTer-R17	Discharge from testing of pipework associated with the construction camp drainage system	5.2.2.1	• Effluent from the pipework testing and chlorination that meets the applicable sewage and oil water performance and monitoring standards presented in Table 5.14 will either be used for irrigation and/or dust control or discharged. Out of spec effluent will be collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected.
CTer-R18	Discharge of onshore plant hydrotest discharge (from all process and utility lines, storage tanks and civil basins/structures)	5.5.2.4	• For each test the system will be filled with freshwater and then emptied. If possible and where practical, the hydrotest water will be temporarily stored and reused. Following the completion of testing the hydrotest water will either be discharged to the site drainage system if it conforms with the applicable standards in Table 5.14 or collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected.
CTer-R19	Open drains discharge during commissioning	5.5.2.4	• The open drains treatment system will be flushed using freshwater to remove any debris within the system prior to start up. Prior to flushing of the complete drainage system, water samples from all drainage sumps will be tested to confirm the oil content. If the oil content of the water in the sumps exceeds 19mg/l daily average[2] the contents of the sump will be collected by road tanker, handled as liquid waste and removed from site. If the total oil content of the water in the sumps is lower than 19mg/l daily average, the sump content will be discharged to the storm water drainage channels. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected
CTer-R20	Produced water discharge during onshore facility commissioning	5.5.2.4	• Off spec produced water during onshore facility commissioning will either be sent to the ACG produced water treatment facilities, tankered off site for 3rd party treatment and disposal or sent to a pond for storage. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected

[2] Note monthly average oil water criteria is not applicable as discharges will be intermittent and of short (~hours) duration.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Construction and Commissioning of Offshore and Subsea Facilities			
CYar-NR1	Construction yard upgrades and expansion works	5.6.2	• Yard extensions, if required, will involve minimal land-take of industrial land adjacent to existing established construction yards. • Yard upgrade works (e.g. systems refurbishment) will be undertaken within existing site buildings/waste/storage areas. • Vessel upgrade work will be completed at an existing port facility. **Conclusion:** Works will be of limited scope and short duration and will be managed by the yard operator in accordance with their HSE requirements and agreements with the Azerbaijani Authorities, resulting in negligible impacts to residential receptors and the terrestrial and marine environment.
CYar-R2	STB01, PLBG, DBA and DSV vessel upgrade works	5.6.2	
CYar-R3	Construction yard utilities (drainage/sewage)	5.6.9.2	• Black and grey water generated at the construction yard(s) will be collected in on site sewer pipes and sumps and then either transferred by road tanker or by sewer pipes to a municipal sewage treatment plant for treatment and disposal. If the construction yard has an operational sewage treatment plant that discharges treated effluent to the environment, the yard operator will be responsible for agreeing the discharge standard with the MENR and maintaining the discharge permit conditions stipulated by the MENR. • Drainage water from areas in the construction yard(s) in which hazardous materials are stored and routinely used will be contained and will be collected by road tanker, handled as liquid waste and removed from site. If the yard operator has an agreement with the MENR for discharge of drainage from areas where hazardous materials are storage or used, they will be responsible for maintaining the discharge permit conditions stipulated by the MENR. **Conclusion:** Discharge of treated sewage and discharge of drainage from areas where hazardous materials are stored or used from the construction yards will be in accordance with MENR requirements.
CTer-R4	Grit blasting/welding and painting of jacket components, piles and pipework	5.6.3	• Grit blasting, welding and painting of jacket components, piles and pipework are required. • The majority of grit blasting and anti corrosion painting of jacket and pile components will be undertaken in a paint shop with a fume extraction and grit recovery system in place. Grit blasting and anti corrosion painting of sections which are too large are to be accommodated within a paint shop, will be undertaken within a temporary enclosure. • Preference to use garnet for grit blasting which is inert, non-hazardous and suitable for disposal under EU legislation in a non-hazardous landfill . **Conclusion:** No discernible impact on ecological/biological receptors is expected
Platform Installation and HUC			
CPlat-R1	Offshore commissioning of the SDB platform complex deluge system	5.6.4	• Discharge of seawater via the SDB-PR open drains caisson at 52m below sea level. **Conclusion:** No chemical/temperature change in seawater and hence no expected impact from discharge.
CPlat-R2	Offshore commissioning of the SDB platform complex foam system	5.6.4	• Discharge of approximately 20 litres of AFFF with 140m^3 of seawater via the open drains caisson at 52m below sea level. • The current foam used by the AGT Region is of very low toxicity (LC_{50} 2.8 g/l for fish, 34.8 g/l for Daphnia) • Readily degradable (28-day degradation 92%) and no bioaccumulation potential. • Small volume will disperse in minutes so little potential for acute toxicity in exposed organisms. • 20 litres of AFFF would require only about 1,500m^3 of seawater to dilute to 96h no-effect level (a volume with an approximate radius of 7m). • The fish most likely to be present for extended periods of time in the SD Contract Area and at the SDB platform complex location are Kilka and Mullet that may be present throughout the year. However, the ASD Contract Area is not exclusively used by these species and the Contract Area is not considered to be of primary importance. **Conclusion:** Limited potential for discernable impact on the marine environment.
CPlat-R3	Jacket buoyancy tank dewatering	5.6.4 5.7.2	• Discharge of treated seawater (including preservation chemicals) will occur during dewatering of the two compartments of the two jacket buoyancy tanks. • Each event will involve a discharge of 187.5m^3 over 3 hours with all compartments emptied over an 8 hour period. • Modelling has indicated that the plume would reach a maximum length of approximately 1.6km, but would be extremely narrow (a few metres at most) (refer to Appendix 10F)

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			• It was estimated that the plume would reach a dilution in excess of 20,000-fold (a greater dilution than that required to reach the no effect concentration of the preservation chemicals) within 4 hours of the end of the discharge. • **Conclusion:** Impact from these discharges is therefore considered to be insignificant**.**
Subsea Export & MEG Pipeline Installation & HUC and Subsea Infrastructure Installation & HUC			
SubOff-R5	Permanent presence of the SD2 Export and MEG Pipelines and the subsea infrastructure	5.8 & 5.9	• Permanent seabed disturbance activities include the installation of the SD2 Export and MEG Import pipelines and Subsea Infrastructure. • In total the SD2 Export and MEG Import pipelines will occupy an area of 9.27km^2, 0.0023% of the Caspian Sea. The Subsea Infrastructure will occupy an area of 9.66km^2, 1.1% of the SD Contract Area. • In practice, it is likely that the majority of the organisms within these areas would be sufficiently mobile to re-establish themselves on either side of the pipelines and subsea infrastructure since this would involve movement of only 30cm to 40cm at most. • The concrete coating of the pipelines and coating of the flowlines is chemically inert by design and will have no effect on either the adjacent sediments or water column. • Temporary seabed disturbance activities include anchoring and chain drag associated with the installation vessels. • The primary impact associated with anchor setting and chain drag will be the disturbance and displacement of the sediment. The organisms living in the sediment are too small to be crushed by anchors and chain drag, although a small amount of mortality might occur at the point where the anchor initially impacts the seabed. • The displacement of sediment will not cause significant levels of mortality in benthic organisms. A small proportion of animals may be buried too deeply to recover to a position near the sediment surface, but the majority of organisms will be able to re-establish themselves once the anchor and chain have been moved to their next position. Up to approximately 1,495m^3 of seabed may be excavated prior to jacket installation. This is anticipated to have a localised and very small impact in the context of Contract Area. Organisms are not anticipated to be significantly impacted and will rapidly recover. **Conclusion:** It is considered that impacts are minimised as far as practicable and no discernible impact to the marine environment due to seabed disturbance.
SubOff-R6	Use of installation and HUC vessels & platform installation (seabed disturbance)	5.8.6 & 5.9.3	
All Construction, Installation & HUC Activities			
ALL-R1	Waste Generation	5.5.4 5.6.9 5.7.7 5.8.7 5.9.5	• Waste generated during SD2 construction, installation & HUC activities will be consistent with the type and quantity that have been routinely generated during previous construction works. • Waste at the construction sites, construction yards and onboard the installation and HUC vessels will be segregated at source, stored and transported in fit for purpose containers . • All waste generated during onshore platform and subsea infrastructure construction and commissioning activities will be managed in accordance with the existing AGT management plans and procedures. • Waste minimisation and management plans will be established for the construction, installation & HUC phase and all waste transfers controlled and documented. **Conclusion:** Waste generated during the SD2 Project will be managed in accordance with the existing BP AGT Region management plans and procedures. No discernable impact to the terrestrial or marine environment expected

The SD2 routine and non-routine Activities and their associated Events that have been assessed with the full impact assessment process are presented in Table 10.2.

Table 10.2 "Assessed" SD2 Project Construction, Installation and HUC Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Onshore Construction and Commissioning of Terminal Facilities				
CTer-R1	Operation of construction plant and vehicles including diesel generators (onsite).	5.5.4.1	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
CTer-R2	Construction vehicle movements (offsite)	5.5.4.1	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
CTer-R14	Piling within the SD2 Expansion Area	5.5.2.2	Onshore noise	Terrestrial Environment (Noise)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
CTer-R15	Commissioning and testing onshore power generation turbines, compressors and firewater pumps	5.5.2.3	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore Noise	Terrestrial Environment (Noise)
CTer-R16	Installation of piles, construction and installation of a new condensate holding tank and bund structure and associated earthworks	5.5.2.1	Potential mobilisation of contamination	Terrestrial Environment (Soil, Groundwater and Surface Water)
Onshore Construction and Commissioning of Offshore and Subsea Facilities				
CYar-R6	Use of yard plant (generators and engines) during jacket, bridge and topside fabrication and topside commissioning	5.6.3	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
CYar-R7	Use of yard cooling water system (including dosing of chlorine) during onshore topside commissioning	5.6.7.1	Cooling water discharges to sea	Marine Environment (Water Column and Seabed)
CYar-R8	Topside Commissioning at the construction yard	5.6.7	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
Platform Installation & HUC				
CIns-R1	Use of vessels for jacket, topside and bridge installation	5.7.6	Emissions to atmosphere (non GHG)	Atmosphere
			Treated sewage water	Marine Environment (Water Column and seabed)
			Grey water	
			Drainage water	
			Underwater noise and vibration	Marine Environment (Water Column and seabed)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
CIns-R2	Foundation piling and grouting for jackets	5.7.2	Seabed disturbance - benthos	Marine Environment (Water Column and seabed)
			Underwater noise and vibration	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Installation & HUC of Subsea Export and MEG Pipelines (Onshore)				
SubOn-R4	Operation of construction plant and vehicles along Onshore SD2 Export Pipeline Corridor and Pipeline Landfall Area	5.8.6	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
			Disturbance/indirect effect to wildlife	Terrestrial Environment (Ecology)
SubOn-R1	Removal and storage of surface soil layer and vegetation within the Onshore SD2 Export Pipeline Corridor	5.8.3.3	Direct/indirect effect to wildlife	Terrestrial Environment (Ecology)
			Loss of habitat	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubOn-R2	Onshore SD2 Export Pipeline Corridor trenching (including the movement, temporary storage and disposal of excess spoil)	5.8.3.3	Potential mobilisation of contamination	Terrestrial Environment (Soil, Groundwater and Surface Water)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubOn-R5	Augur boring associated with onshore pipeline crossings	5.8.3.3.	Onshore noise	Terrestrial Environment (Noise)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
			Disturbance/indirect effect to wildlife	Terrestrial Environment (Ecology)
SubOn-R6	Pipeline drying following offshore pipeline pre commissioning	5.8.4	Emissions to Atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
Installation & HUC of Subsea Export and MEG Pipelines (Nearshore Section)				
SubNr-R1	Installation of finger piers	5.8.3.2	Coastal erosion	Nearshore/Coastal Environment
			Seabed disturbance - benthos	
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)
SubNr-R2	Use of vessels during nearshore trenching and pipelay	5.8.3.1 Table 5.23	Emissions to Atmosphere (non GHG)	Atmosphere
			Underwater noise and vibration	Marine Environment (Water column and seabed)
			Treated sewage water	Marine Environment (Water column and seabed)
			Grey water	
			Drainage water	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubNr-R3	Trenching (from coastline to 12m water depth)	5.8.3.2	Coastal erosion	Nearshore/Coastal Environment
			Seabed disturbance - benthos	
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)
SubNr-R4	Installation of the subsea SD2 export and MEG pipelines	5.8.3.2	Coastal erosion	Nearshore/Coastal Environment
			Seabed disturbance - benthos	
			Underwater noise and vibration	Marine Environment (Water column and seabed)
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Installation & HUC of Subsea Export and MEG Pipelines (Offshore Section) and Installation & HUC of Subsea Infrastructure				
SubOff-R1	Use of vessels during offshore pipelay and subsea infrastructure installation	5.9.3	Emissions to atmosphere (non GHG)	Atmosphere
			Treated sewage water	Marine Environment (Water column and seabed)
			Grey water	
			Drainage water	
			Underwater noise and vibration	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubOff-R2	Installing SD2 export and MEG pipelines, flowlines and infield infrastructure on seabed	5.9.3	Seabed disturbance - benthos	Marine Environment (Water column and seabed)
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)
SubOff-R3	SD2 export pipeline, MEG pipeline and flowline cleaning, hydrotesting and dewatering	5.8.5 Table 5.22 & 5.9.4 Table 5.25	Cleaning and hydrotest discharges to sea	Marine Environment (Water column and seabed)
SubOff-R4	Piling to secure SSIVs	5.9.3	Underwater noise and vibration	Marine Environment (Water column and seabed)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)

10.3 Impacts to the Atmosphere

Non greenhouse gas (GHG) emissions to the atmosphere from Construction, Installation and HUC activities will be associated with construction plant and vehicles, emissions from commissioning of the onshore SD2 facilities at the Terminal and offshore facilities at the construction yards and use of vessels. GHG emissions associated with the SD2 Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts.

10.3.1 Mitigation

Existing controls associated with emissions from Construction, Installation and HUC activities include:

- Construction plant and vehicles will be modern and well maintained in accordance with the written procedures based on manufacturer's guidelines, applicable industry code, or engineering standard to ensure efficient and reliable operation;
- Where practicable, mains electricity will be used instead of mobile generators as a power source;
- Diesel supplied to the construction plant and vehicles from the diesel tank farm will be low in sulphur (typically <0.05%); and
- A Community Engagement and Nuisance Management and Monitoring Plan will be implemented and maintained as a mechanism of communicating with the community and responding to community grievances.

10.3.2 Construction and Commissioning Emissions (Terminal, Onshore Pipelay and Pipeline Drying)

10.3.2.1 Event Magnitude

Description

Construction plant and vehicles will be used in the vicinity of the Sangachal Terminal during the following activities:

- Terminal construction works primarily within the SD2 Expansion Area;
- Construction works to enable installation of the SD2 export and MEG pipelines within the nearshore area and subsequent reinstatement;
- Onshore pipelay and subsequent reinstatement within the SD2 Export Pipeline Corridor; and
- Drying of the SD2 export and MEG pipelines following pre commissioning and dewatering.

The estimated number and type of onsite and offsite construction plant and vehicles that are expected to be used for each of these activities are presented in Appendix 5F.

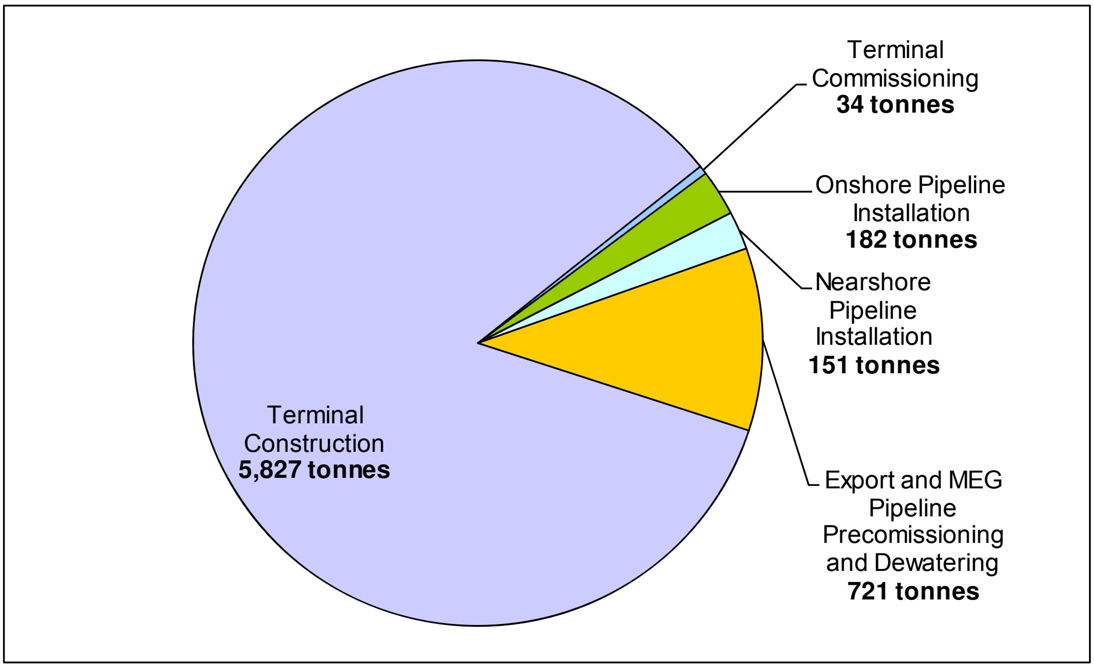
Offsite vehicle movements associated with SD2 Project on the Highway in the vicinity of the Sangachal Terminal expected to increase the existing traffic by a maximum of 1,310 vehicle movements per day.

Emissions during commissioning of the SD2 onshore facilities arise from testing of the SD2 power generator, gas export compressors and diesel users (i.e. firewater pumps and back up air compressor).

Figure 10.1 presents the estimated volume of nitrogen dioxide (NO_2) emissions per source during SD2 Project construction and commissioning activities in the vicinity of the Sangachal Terminal[3].

[3] Basis of the estimate is provided within Appendix 5A

Figure 10.1 Estimated Volume of NO_2 Emissions per Source During SD2 Project Construction and Commissioning Activities (Terminal Vicinity)



Assessment

Construction Emissions

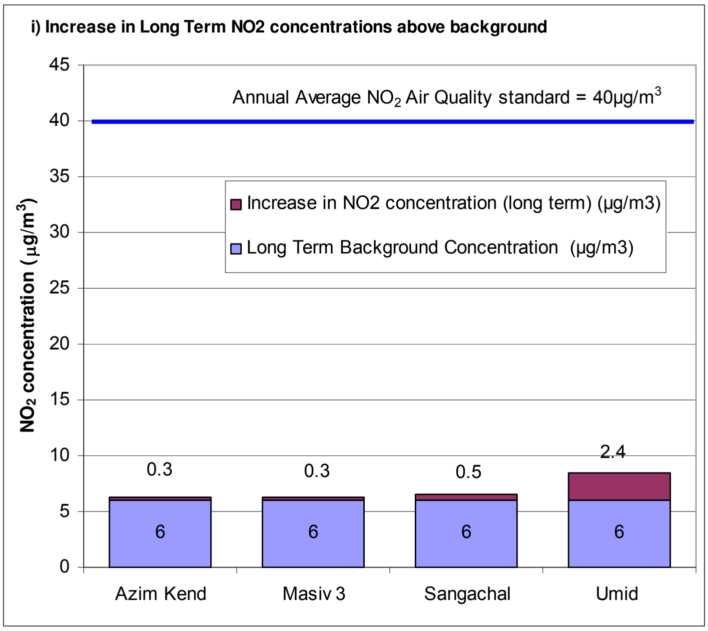
The atmospheric dispersion modelling undertaken for construction plant and vehicles is presented in Appendix 10D. The modelling focuses on NOx (which comprises nitrous oxide (NO) and nitrogen dioxide (NO_2)) as the main atmospheric pollutant of concern, based on larger predicted emission volumes as compared to other pollutants (i.e. SOx and PM_{10}). Modelling of SO_2 and particulates was not deemed necessary as concentrations are expected to be very low based on efficient plant and vehicle operation, regular maintenance and planned use of good quality, low sulphur diesel.

Long term and short term NO_2 concentrations were modelled to assess the contribution of emissions from the onsite construction plant and vehicles in the context of the long term and short term standards for NO_2 (40 and 200 μg/m^3). These standards are relevant to locations where humans are normally resident (i.e. residential locations). The background concentrations assumed for NO_2 were 6μg/m^3 (long term) and 12μg/m^3 (short term) (refer to Appendix 10D).

The modelling assessment was undertaken based on the period when the highest number of plant and vehicles are predicted to be operating at SD2 Expansion area and assuming all plant onsite, along the SD2 Pipeline Route and at the pipeline landfall area (including the generator used during de watering) was operating simultaneously.

Increases in NO_2 concentrations were predicted for receptor locations in the Terminal vicinity. The increase in NO_2 concentrations at these receptors due to onshore construction plant and vehicles is presented in Figure 10.2. Figure 10.3 shows the predicted increase in long term NO_2 concentrations in the Terminal vicinity.

Figure 10.2 Increase in i) Long Term and ii) Short NO_2 Concentrations Due to Construction Plant and Vehicles (Terminal Vicinity)



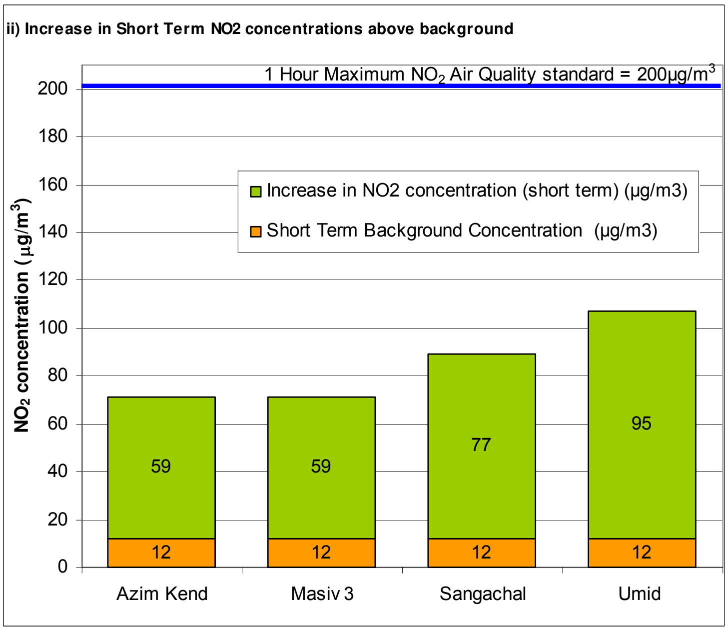
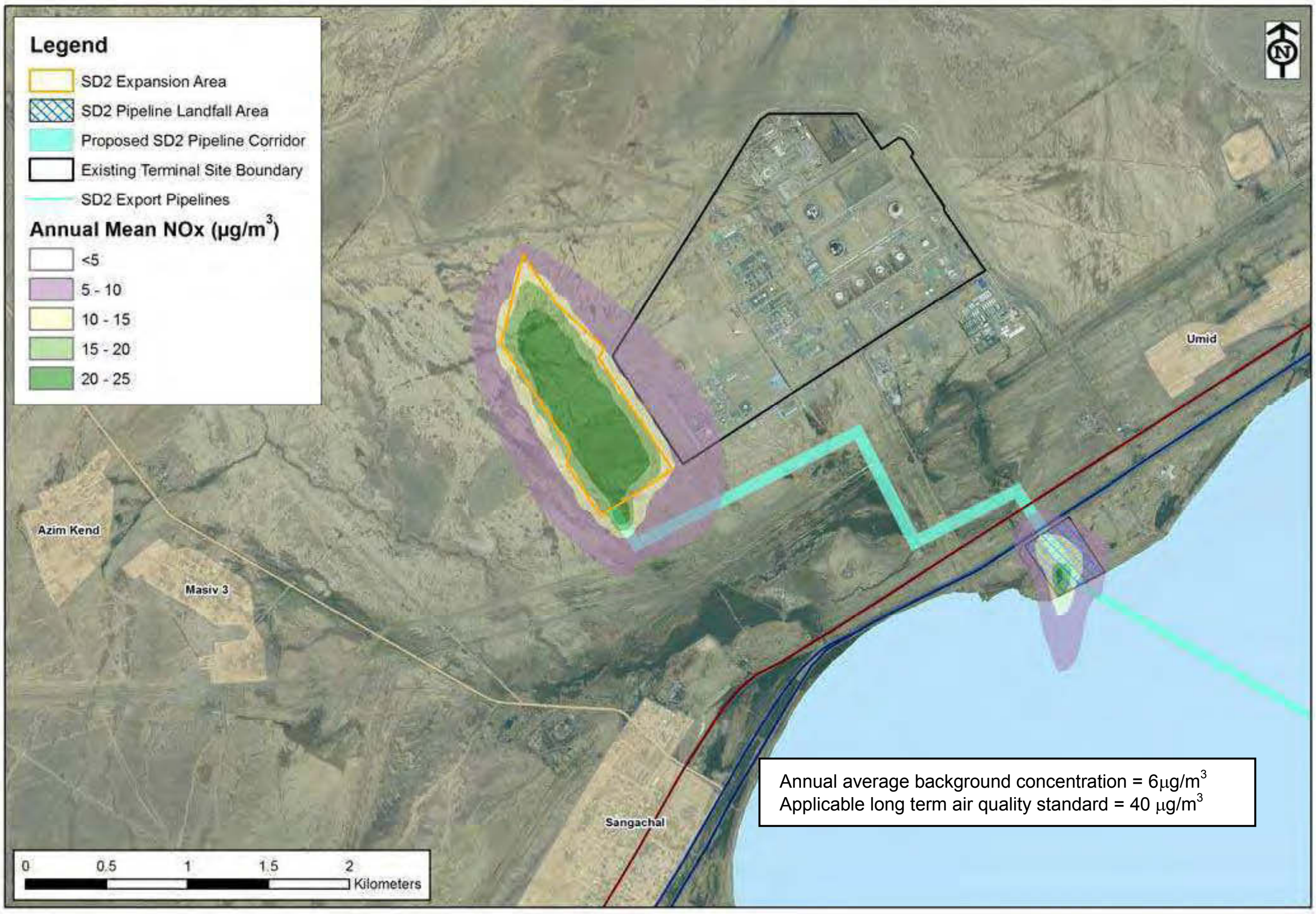


Figure 10.3 Predicted Increase in Long Term NO_2 Concentrations Due to Construction Plant and Vehicles (Terminal Vicinity)



Offsite vehicle emissions were assessed with a screening method. The Design Manual for Roads and Bridges (DMRB) Screening Method, version 1.03c was used, which allows assessment of the mean annual limit values.

The assessment focused on the predicted change in traffic due to the project, rather than absolute concentrations. The greatest increase in traffic flows is expected to occur between April 2014 and May 2016, with an estimated 1,310 vehicle movements per day. The model used the conservative assumption that this level of traffic will continue for an entire calendar year.

The results predicted a change in mean annual NO_2 and PM_{10} concentrations of 1.0µg/m^3 and 0.2µg/m^3 respectively (at a receptor located 20m from Baku-Alyat Salyan Highway (Southbound) and 65m from Baku-Alyat Salyan Highway (Northbound)). At a distance over 150 m from the Highway increases in NO_2 and PM_{10} concentrations were predicted to be less than 0.1µg/m^3.

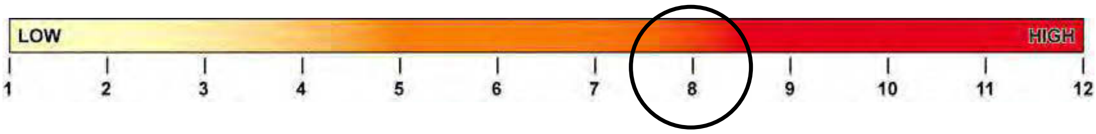
Terminal Commissioning

Commissioning activities will be typically short duration; estimated up to 21 days to test the power generator and up to 24 hours to test the export gas compressors and the diesel users. It is anticipated that loads will vary across the commissioning period. The expected worst case 1 hour increase in NO_2 concentrations under routine operating conditions at Sangachal (immediately downwind of the Terminal) is 9 µg/m^3 (refer to Chapter 11 Section 11.3.3.1. It is considered unlikely that emissions during commissioning result in a significant increase in short term NO_2 emissions.

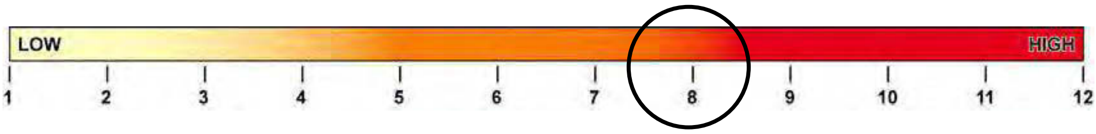
The Event Magnitude associated with emissions from Construction Plant and Vehicles, Terminal Commissioning and Offsite Vehicles is summarised in Table 10.3. In each case a Medium Event Magnitude is predicted.

Table 10.3 Event Magnitude

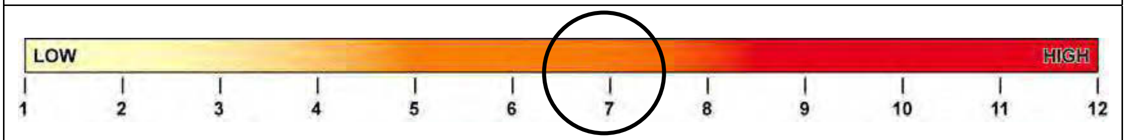
Event Parameter	Construction Plant and Vehicles	Offsite Vehicles	Terminal Commissioning
Extent/Scale	1	1	1
Frequency	3	3	3
Duration	3	3	2
Intensity	1	1	1
Event Magnitude:	**8**	**8**	**7**



Construction Plant and Vehicles



Offsite Vehicles



Terminal Commissioning

10.3.2.2 Receptor Sensitivity

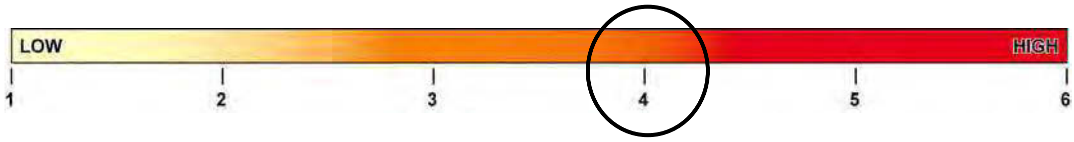
The nearest receptors to the onshore construction activities within the SD2 Expansion Area and along the SD2 Export Pipeline Corridor (refer to Chapter 6 Figure 6.3) are summarised below:

- Sangachal Town approximately 1.2km to the south of the SD2 Expansion Area and the SD2 Export Pipeline Corridor;
- Azim Kend/Masiv 3 approximately 2.2km to the west of the SD2 Expansion Area and the SD2 Export Pipeline Corridor at the pipeline landfall area; and
- Umid approximately 3km to the east of the SD2 Expansion Area and 0.96km to the west of the SD2 Export Pipeline Corridor at the pipeline landfall area.

Table 10.4 presents the justification for receptor sensitivity.

Table 10.4 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptor (Sangachal Town) is located approximately 1.2km from the SD2 Expansion Area. Umid is located approximately 0.96km from the SD2 Export Pipeline Corridor at the pipeline landfall area.	**3**
Resilience	Modelling results have confirmed that emissions from the use of construction plant and vehicles and from Terminal commissioning activities will not exceed air quality standards and local receptors are not considered to be vulnerable. Existing NO_2 concentrations are well below applicable standards.	**1**



10.3.2.3 Impact Significance

Table 10.5 summarises impacts on air quality associated with Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying), offsite vehicles and Terminal commissioning.

Table 10.5 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying)	Medium	Medium	**Moderate Negative**
Offsite Vehicles	Medium	Medium	**Moderate Negative**
Terminal Commissioning	Medium	Medium	**Moderate Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures listed in Section 10.3.1 above and no additional mitigation is required.

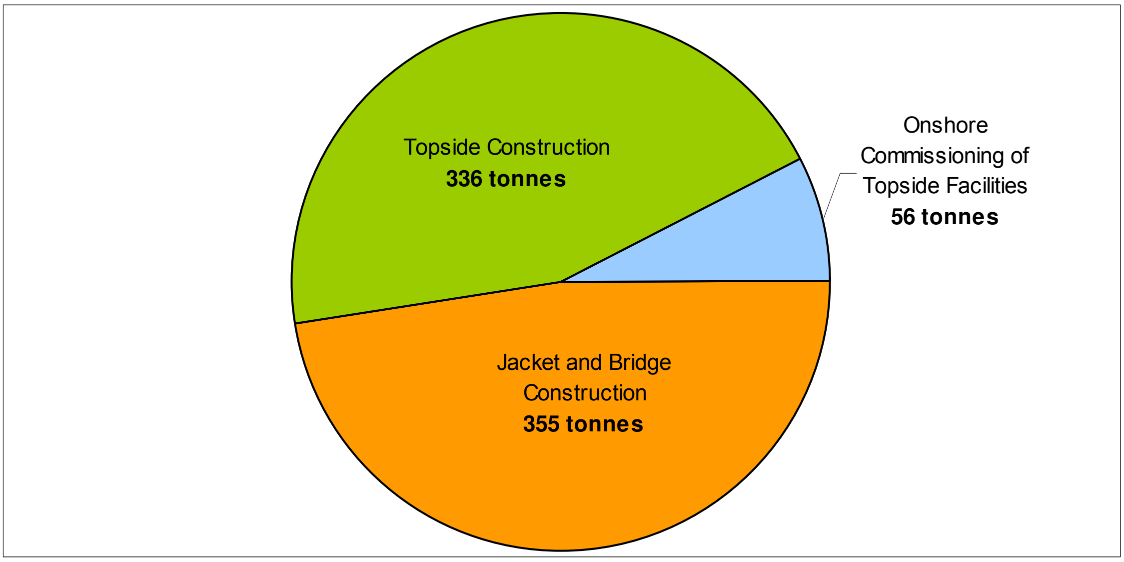
10.3.3 Construction Yard Emissions

10.3.3.1 Event Magnitude

Description

Construction yard emissions will result from use of mobile plant during construction of the SDB jackets, bridge and topsides and commissioning of the SDB power generators onshore. Figure 10.4 presents the estimated volume of nitrogen dioxide (NO_2) emissions per activity[4].

Figure 10.4 Estimated Volume of NO_2 Emissions per Construction Yard Activity



Construction Yard Plant and Vehicles

As stated within Chapter 5: Section 5.6.1, it has been assumed for the purposes of this ESIA that fabrication of the SDB jackets and topsides will be constructed at a combination of the following construction yards:

- Baku Deep Water Jacket Factory (BDJF) yard;
- Construction yards located on the western fringe of the Bibi Heybet oil field; and
- Pipe coating and storage yard.

At each yard, the majority of power required for construction activities such as steel cutting, rolling and shaping will be provided from the Azerbaijan national grid. Onsite plant and equipment used including cranes, generators and vehicles, will consume diesel and gasoline resulting in emissions to atmosphere (refer to Appendix 5A). The anticipated use of mobile plant and expected diesel consumption is calculated based on historic records from yards used during ACG and SD jacket and topside construction.

Onshore Commissioning of Main Platform Generators and Topside Utilities

It is anticipated that onshore commissioning at the topside construction yard will take place over a 10 month period. The most significant emission source is the main platform generators operated as follows (using diesel) during onshore commissioning:

- Each generator run separately and intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%;
- Synchronisation tests of 8 hour duration, running 3 of the 4 generators together at a maximum load of approximately 26%; and

[4] Basis of the estimate is provided within Appendix 5A

- Generators run separately and intermittently for approximately 6 months during commissioning of the compression system and topside utilities.

Assessment

A dispersion modelling assessment was undertaken to assess the potential magnitude of impacts from the construction yard emissions to any nearby receptors (see Appendix 10E). The assessment considered NO_2 emissions, comparing the short term and long term average modelled concentrations at ground level to the long term and short term standards for NO_2 (40 and 200 $\mu g/m^3$). Short and long term background concentrations of NO_2 were assumed to be $12\mu g/m^3$ and 6 $\mu g/m^3$ respectively.

Construction Yard Plant and Vehicles

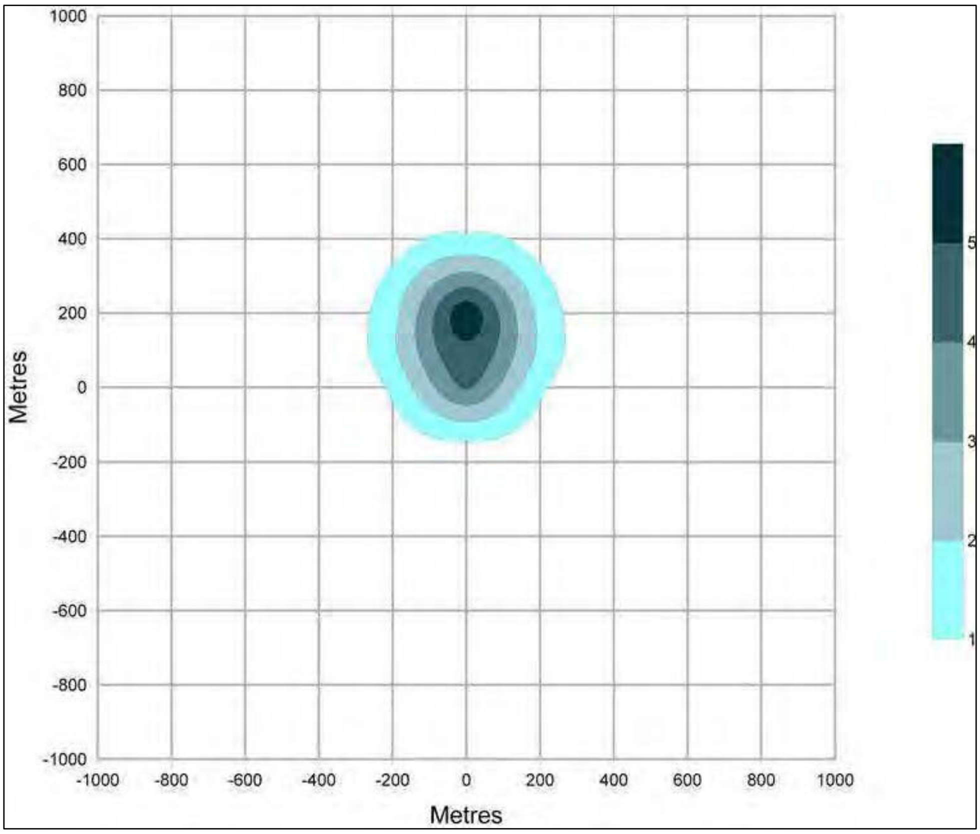
The worst case modelling results demonstrated that construction plant emissions are predicted to result in a maximum short term ground level NO_2 concentration of $6.0\mu g/m^3$ from the centre of the yard, extending up to a distance of 200m away. This reduces to $3.0\mu g/m^3$ at 250m and returns to background concentrations at distances over 400m under high wind speeds (15m/s) (Figure 10.5 below).

For typical wind speeds conditions (5 m/s) the increase in NO_X concentration is predicted to be approximately $6\mu g/m^3$ up to 30 m from the centre of the site, reducing to background concentrations at a distance over 200 m. This value is converted into an annual average (long term) concentration value by assuming that 100% of NO_X is converted to NO_2 and applying assumptions about the frequency of occurrence of the wind speed and the period of time the construction activities will occur. This enables a prediction that the maximum annual average increase in NO_X concentrations will be $1.5\mu g/m^3$, and less than $1\mu g/m^3$ over 200m away from the site boundary, which will result in levels that easily comply with the mean annual ambient air limit of $40\mu g/m^3$.

Under all conditions assessed, the modelling predicted no exceedances of ambient air quality standards in the vicinity of the yards and no discernible increase in short term or long term concentrations of NO_2 more than 400m from the centre of the yard[5].

[5] Historically in Azerbaijan ambient concentrations of NO_2, SO_2, CO and PM_{10} have also been assessed against specific 24 hour and 1 hour standards. These standards were not derived using the same health based criteria as the IFC, WHO and EU guideline values and the standards derived are not widely recognised. Appendices 10D and 10E, however, do show that the historic standards will not be exceeded during onshore construction and commissioning operations.

Figure 10.5 Increase in Short Term NOx Concentrations From Construction Yard Plant (15 m/s Wind Speed)



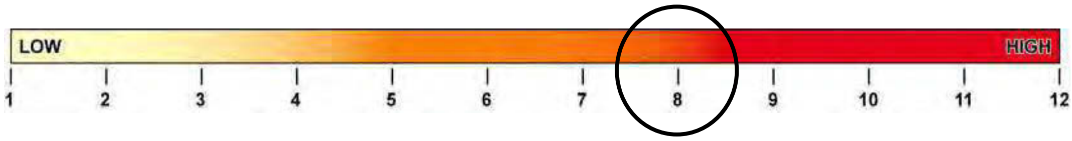
Onshore Commissioning of Main Platform Generators and Topside Utilities

The maximum increase in NO_2 concentrations during onshore commissioning was predicted to be between 30-40µg/m^3, located approximately 500m to 1.5km from the emission source. It is assumed that 50% of short term NO_X is converted into NO_2, thus emissions from the generators at full load are predicted to lead to a maximum increase in 1 hour ground level NO_2 concentration of 15-20 µg/m^3 which represents approximately 10% of the short-term ambient NO_2 limit of 200 µg/m^3**.**

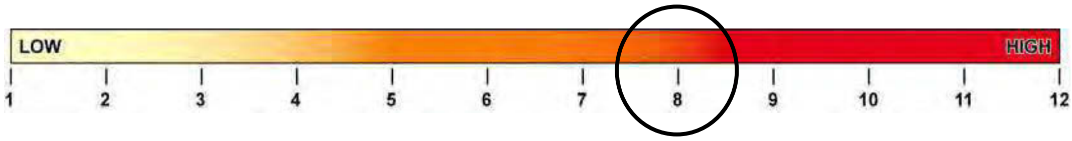
Table 10.6 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 10.6 Event Magnitude

Parameter	Construction Yard Plant and Vehicles	Onshore Commissioning of Main Platform Generators and Topside Utilities
Extent/Scale	1	1
Frequency	3	3
Duration	3	3
Intensity	1	1
Total	**8**	**8**



Construction Yard Plant and Vehicles



Onshore Commissioning of Main Platform Generators and Topside Utilities

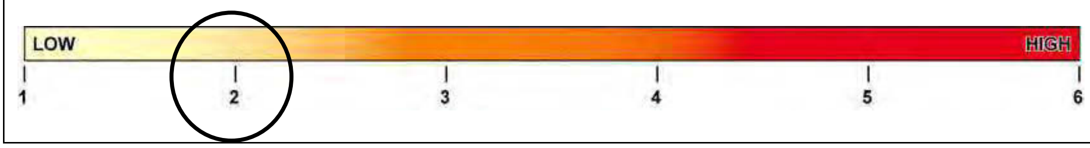
10.3.3.2 Receptor Sensitivity

All candidate construction yards are currently operational, are located within an industrial setting and have been used previously for ACG/SD/COP construction works. Residential properties are not located within close proximity (no residents within 1.5 km) to the construction yard site boundaries.

Table 10.7 presents the justification for assigning a score of 2, which represents Medium Receptor Sensitivity.

Table 10.7 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	All construction yards are located in established industrial areas and there are no residential areas within close proximity of the construction yards site boundaries.	1
Resilience	Modelling results have confirmed that emissions from construction yard sources will not exceed air quality standards and local receptors are not considered to be vulnerable.	1
Total		**2**



10.3.3.3 Impact Significance

Table 10.8 summarises impacts on air quality associated with emissions from Construction Yard Plant and Vehicles and Onshore Commissioning of Platform Generators and Topside Utilities.

Table 10.8 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Yard Plant and Vehicles	Medium	Low	**Minor Negative**
Onshore Commissioning of main Platform Generators and Topside Utilities	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.3.4 Vessel Emissions

10.3.4.1 Event Magnitude

Description

As stated within Chapter 5: Section 5.7.6 and 5.8.3.1, a number of vessels will be used during Construction, Installation and HUC phase to support the installation of the jackets, bridge and topsides, SD2 export and MEG subsea pipelines and the SD2 subsea infrastructure within the Contract Area.

Assessment

NO_X is the main atmospheric pollutant of concern, based on the larger predicted emission volumes as compared to other pollutants (sulphur oxides or SOx, CO and non methane hydrocarbons) and the potential to impact human health and the environment.

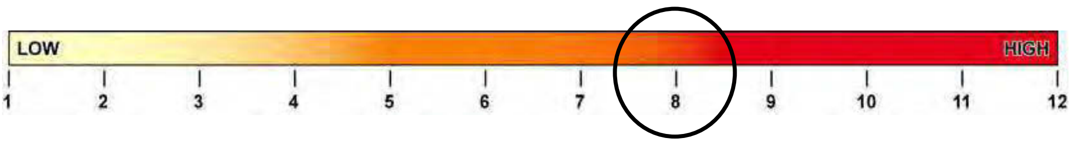
NO_X emissions from vessels used during construction, installation and HUC activities are anticipated to total approximately 6,630 tonnes. These will occur throughout the installation and HUC activities which take place across a large geographic area. They are expected to disperse rapidly and will result in increases in NO_2 concentrations that will be indiscernible from background levels at onshore receptors.

Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel and previous experience, routine operation of the vessels will not result in plumes of visible particulates from vessel engine exhausts.

Table 10.9 presents the justification for assigning a score of 8 to vessel activities during installation and HUC, which represents a Medium Event Magnitude.

Table 10.9 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Increases in concentrations of pollutant species will be indiscernible from background concentrations at onshore receptors	1
Frequency	Emissions will occur continuously.	3
Duration	Emissions will continue throughout the installation and HUC period.	3
Intensity	Modelled long and short term concentrations of key pollutant, NO_2, are predicted to be significantly below relevant ambient air quality standards.	1
Total		**8**



10.3.4.2 Receptor Sensitivity

Table 10.10 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.10 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 50km of the installation activities.	1
Resilience	Changes in air quality onshore associated with vessel emissions will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**

10.3.4.3 Impact Significance

Table 10.11 summarises impacts on air quality associated with support vessels during the installation and HUC phase.

Table 10.11 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Vessel Engines	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.4 Impacts to the Terrestrial Environment Associated with Onshore Noise

This section presents the potential noise impacts to the terrestrial environment from Construction, Installation and HUC activities including use of construction plant and vehicles, piling within the SD2 Expansion Area and commissioning of the onshore SD2 facilities at the Terminal and offshore facilities at the construction yards.

10.4.1 Mitigation

Existing controls associated with noise due to the operation of onsite construction plant and vehicles within the SD2 Expansion Area, onshore SD2 Export Pipeline Corridor, pipeline landfall area and construction yards include:

- Onshore construction plant and vehicles will be modern and well maintained in accordance with written procedures based on the manufacturer's guidelines, applicable industry code, or engineering standards to ensure efficient and reliable operation;
- All construction vehicles and mechanical plant equipment operated in the vicinity of Sangachal Terminal will be fitted with effective exhaust silencers;
- Noisy plant operated in the vicinity of Sangachal Terminal will be located as far as possible from sensitive receptors and where appropriate and practical will be located behind barriers (for example, site huts, acoustic partitions etc.) to provide shielding in order to reduce noise levels at sensitive receptors;
- Continuous noise emitting machinery located in the vicinity of Sangachal Terminal will be housed in a suitable acoustic enclosure;

- Compressors operated in the vicinity of Sangachal Terminal will be fitted with properly lined and sealed acoustic covers that are kept closed whenever in use and pneumatic percussive tools will be fitted with mufflers or silencers;
- Where practicable, mains electricity will be used instead of mobile generators as a power source;
- Onsite personnel of the Sangachal Terminal will be trained in how to minimise noise;
- Where practicable, rotary drills and bursters actuated by hydraulic, chemical, or electrical power will be used for excavating hard or extrusive material in the Sangachal Terminal vicinity;
- When selecting large plant that is used for extended periods within the Sangachal Terminal vicinity, preference will be given to plant that is compliant with EU Noise Directives 2000/14/EC and 2005/88/EC where possible;
- Steel works at the construction yards are planned to be undertaken in fabrication sheds, where practicable and feasible;
- Grit blasting at the construction yards is planned to be undertaken in sheds or within enclosures where practicable;
- All platform generators will be operated for a minimum duration to complete commissioning at the construction yards;
- The main platform generators incorporate appropriate noise reduction measures[6,] and are housed in a generator room/sound reduction enclosure to safeguard the health and safety of personnel on the platform;
- A noise monitoring programme will be established prior to and during terminal construction and commissioning and onshore SD2 export pipeline works and the results provided externally;
- A Community Engagement and Nuisance Management and Monitoring Plan will be implemented and maintained as a mechanism of communicating with the communities surrounding the Sangachal Terminal (i.e. Sangachal, Azim Kend, Masiv 3 and Umid) and responding to community grievances; and
- Where possible communities will be warned in advance of any particularly noisy activities to be undertaken within the vicinity of Sangachal Terminal; when unavoidable, noisy operations will be undertaken during normal daylight working hours.

10.4.2 Construction and Commissioning Emissions (Terminal, Onshore Pipelay and Pipeline Pre-Commissioning)

10.4.2.1 Event Magnitude

Description

As described within Section 10.3.2 above construction plant and vehicles will be used in the vicinity of the Sangachal Terminal during the terminal construction works, onshore and nearshore pipeline installation and SD2 export and MEG pipelines pre commissioning (including dewatering and drying). The estimated number and type of onsite and offsite construction plant and vehicles that are expected to be used for each of these activities are presented in Appendix 5F. In addition up to 7,000 piles will be installed across the SD2 Expansion Area during Phase 2 (Civil Works) of the Terminal Construction programme (approximately 18 installed per day over a 390 day period.

Commissioning of the SD2 onshore facilities will include testing of the SD2 power generator, gas export compressors and diesel users (i.e. firewater pumps and back up air compressor).

[6] Measures include acoustic lagging of combustion air inlet ducting and exhaust ducts and fitting of a suitable splitter silencer to the gas turbine combustion air intake vent.

Assessment
Terminal Construction Plant and Vehicles

Modelling was undertaken to estimate the increase in noise levels at receptors in the Terminal vicinity due to the onsite plant and vehicles (refer to Appendix 10B for the full modelling assessment) at sensitive receptors (i.e. residential locations). The assessment was undertaken in accordance with guidance provided within BS5228:2009[7]. Source noise levels for the proposed onsite plant and vehicles were also derived from BS5228:2009.

The anticipated type and number of plant on site (including piling rigs) was calculated based on the number per phase and the anticipated phasing as shown in Chapter 5 Figure 5.9. To obtain a realistic scenario it was assumed that 50% of plant was located at the boundary of the works (i.e. closest to the receptor being assessed), operating for 6 hours per day (50% of the working day).

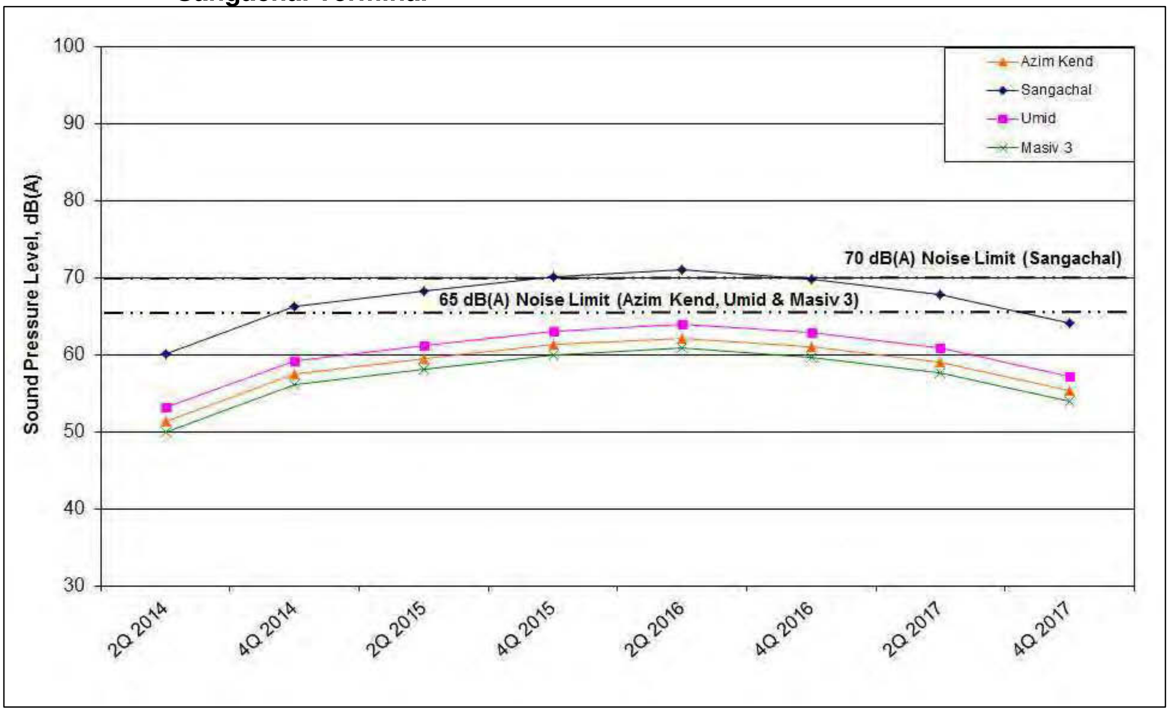
Noise levels were predicted across the construction period and results were compared to noise limits derived for each receptor based on allowable increase in noise levels above the existing ambient noise levels at the receptors (refer to Chapter 6 Section 6.4.6) using the ABC methodology from BS5228:2009.

The results of the modelling showed that:

- Noise levels are expected to be below the relevant 65dBL_{Aeq} limit value at Umid, Azim Kend and Masiv 3 for the duration of the construction programme; and
- Noise levels are expected to be below the relevant 70dB L_{Aeq} limit value at Sangachal for the majority of the construction programme. A slight exceedance of 1dB(A) during peak activity (2Q 2016) was predicted however this is unlikely to be perceptible and is not considered significant

Figure 10.6 shows the noise levels predicted at the four receptors in the Terminal vicinity across the construction period.

Figure 10.6 Predicted Construction Noise Levels at Receptors in the Vicinity of the Sangachal Terminal



7 British Standards Institute (BSi), (2009): 'BS5228 – Noise Vibration Control on Construction and Open Sites', BSi, London

The assessment is considered to represent a reasonable worst case. Construction noise by its nature will vary and, while there may be short durations where the predicted worst case noise levels are reached, for the majority of the construction programme noise levels will likely be lower than forecast.

Onshore & Nearshore Pipelay

Modelling was also undertaken to estimate the increase in noise levels at receptors in the Terminal vicinity due to the onshore and nearshore pipelay activities (refer to Appendix 10B for the full modelling assessment) using the same approach as used for onsite plant. Noise levels were predicted at a number of locations along the pipeline corridor from the pipeline landfall area to the boundary of the Sangachal Terminal. Predicted noise levels varied between 37dB (at Azim Kend) and 50dB (at Sangachal and Umid), which is unlikely to be significantly perceivable at the communities No exceedances of the relevant 65 and 70dBL_{Aeq} limits were predicted.

SD2 Export and MEG Pipeline Pre-Commissioning and Drying

It is anticipated that a number of generators and compressors will be required at the pipeline landfall area and at the Sangachal Terminal during pre-commissioning, dewatering and drying of the SD2 Export and MEG Pipelines. Modelling was completed assuming:

- Use of five 335hp generators and two 540hp air compressors at the pipeline landfall area during pre-in line inspection (ILI) gauging and ILI pigging; and
- Use of two 335hp generators and one 540hp air compressors at the SD2 Expansion during dewatering and air drying.

The results of the assessment are presented in Table 10.12 and show that no exceedance of the relevant 65 and 70dBL_{Aeq} construction noise limits are predicted at any receptor during pipeline pre-commissioning and drying. Noise from pre-commissioning and drying activities is unlikely to be perceivable at receptors.

Table 10.12 Predicted Construction Noise Levels LAeq (dB) During Pre-ILI and ILI Pigging at Pipeline Landfall Area and Pipeline Dewatering and Air Drying at the Sangachal Terminal

	Plant Noise During Pre-ILI and ILI Pigging at Pipeline Landfall Area LAeq (dB)	Plant Noise During Pipeline Dewatering and Air Drying at the Sangachal Terminal LAeq (dB)
Masiv 3	24.1	30.1
Sangachal	28.9	34.6
Umid	36.1	26.6
Azim Kend	22.8	28.8

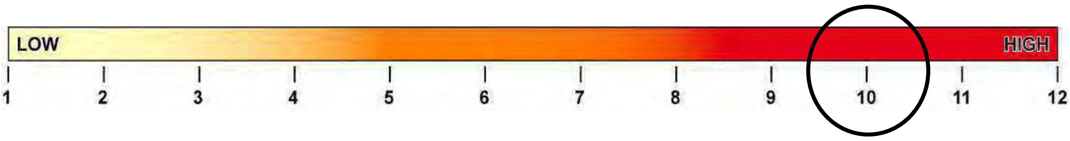
Terminal Commissioning

Terminal commissioning was modelled assuming operation of the SD2 power generator for up to 21 days and of the export gas compressors for up to 24 hours. The modelling showed that the highest noise levels (28.2 dB (A)) were predicted at Azim Kend, Sangachal and Masiv 3. No exceedance of the relevant 65 and 70dBL_{Aeq} construction noise limits were predicted at any receptor during terminal commissioning. Noise from commissioning activities is unlikely to be perceivable at receptors.

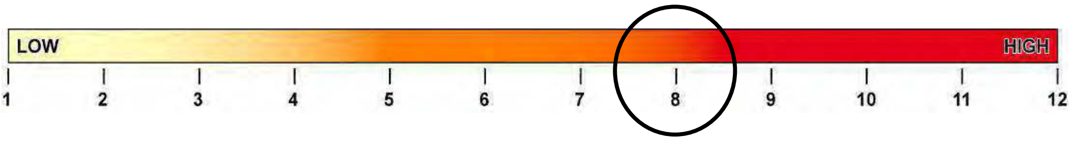
Event Magnitude is summarised in Table 10.13

Table 10.13 Event Magnitude

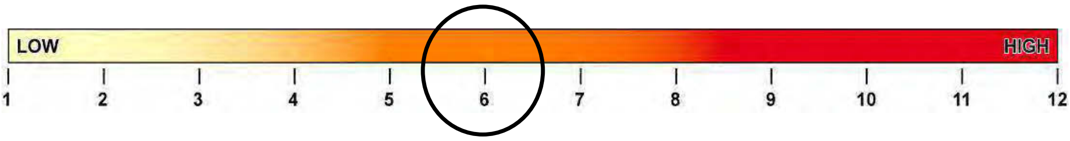
Parameter	Terminal Construction Plant and Vehicles	Onshore & Nearshore Pipelay	SD2 Export and MEG Pipeline Pre-Commissioning and Drying	Terminal Commissioning
Extent/Scale	3	3	1	1
Frequency	3	1	1	1
Duration	3	3	3	2
Intensity	1	1	1	1
Total	**10**	**8**	**6**	**4**



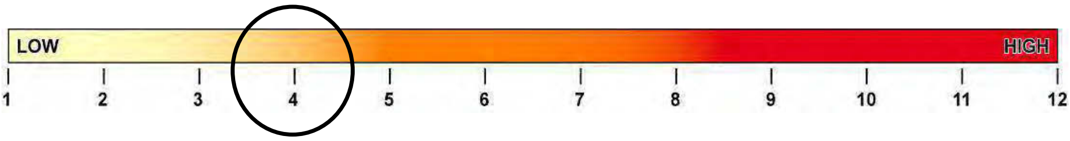
Onsite Construction Plant and Vehicles



Onshore & Nearshore Pipelay



SD2 Export and MEG Pipeline Pre-Commissioning and Drying



Terminal Commissioning

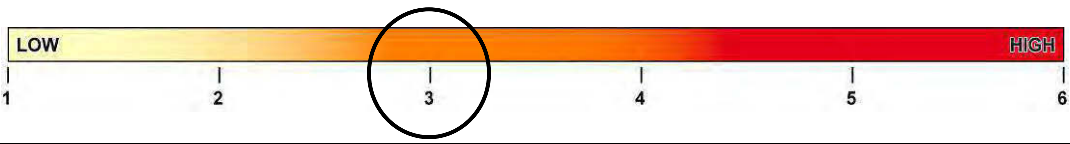
10.4.2.2 Receptor Sensitivity

Human Receptors

Table 10.14 presents the justification for assigning a score of 3 to human receptors, which represents Medium Sensitivity.

Table 10.14 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptors to Terminal construction works are located approximately 1.2km to the south west within Sangachal Town.	2
Resilience	Modelling results have indicated that construction noise, under realistic worst case assumptions, will meet applicable construction noise limits at receptors in the vicinity of Sangachal Terminal except for a slight exceedance at Sangachal during peak activity at the Terminal. This exceedance is unlikely to be perceptible and is not considered significant	1
Total		**3**



Biological/Ecological Receptors

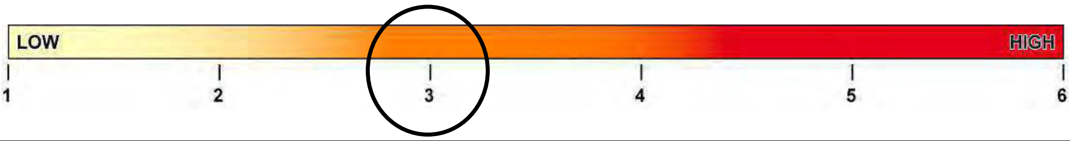
Noise from onsite plant and vehicles has the potential to impact breeding birds. Of the bird species recorded during bird surveys undertaken in the Terminal vicinity between 2008 and 2011 (refer to Chapter 6 Section 6.4.7.4), a total of 25 species (approximately 18% of all species recorded) are considered to be resident (breeding and occurring all year round). Of these, five species[8] are ground nesting, and have been recorded in the semi-desert habitat in the vicinity of the Sangachal Terminal. While the data collected during these surveys does not include the precise locations of nests, the breeding bird species do not tend to nest in the same location each year. It is therefore not appropriate to state the number of breeding birds that use the SD2 Project area as this will vary from year to year. There is no evidence within the surveys completed to date to indicate that the habitat within the SD2 Project area is if unique value to breeding birds.

Breeding birds are most sensitive to disturbance during the breeding season (typically mid March – end August). They are most sensitive to sudden unexpected and loud noise such as hammering. Studies have shown, however, that birds frequently become habituated to anthropogenic noise including construction noise with no recorded effect on behaviour or breeding success[9]. Equally, impacts to breeding success due to noise impacts have also been recorded. The survey results obtained within the Terminal vicinity suggest that the breeding birds are habituated to the industrial noise from the Terminal and Highway traffic noise and may likely also therefore adapt to construction noise.

Table 10.15 presents the justification for assigning a score of 3 to biological/ecological receptors, which represents Medium Receptor Sensitivity.

Table 10.15 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	25 species of residential birds have been recorded during surveys undertaken between 2008 and 2011 in the Terminal vicinity; approximately 18% of these species are breeding birds. Of these, 5 ground nesting breeding nesting bird species were identified. None of these species are rare or threatened.	1
Resilience	While ground nesting birds have been identified within the areas affected by the SD2 Project works there is no evidence to indicate that areas have unique value to these species. It is likely that birds in the area are already tolerant to existing industrial noise and would become habituated to construction noise. It is expected that any disturbance to ground nesting bird breeding would stabilise as they adapt to the construction noise and the ecological functionality of the overall ground nesting bird population will be maintained	2
Total		**3**



10.4.2.3 Impact Significance

Table 10.16 summarises impacts of noise associated with Terminal Construction and Commissioning activities.

[8] These include Chukar *Alectoris chukar*, Red-capped lark *Calandrella cinerea*, Lesser short-toed lark *Calandrella rufescens*, Calandra lark *Melanocorypha calandra* and Crested lark *Galerida cristata*.

[9] Melissa Anne Lackey, (2009), Avian Response to Road Construction Noise with Emphasis on the Endangered Golden-Cheeked Warbler.

Table 10.16 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Terminal Construction Plant and Vehicles	High	Medium (Humans)	**Major Negative**
		Medium (Biological/Ecological)	
Onshore & Nearshore Pipelay	Medium	Medium (Humans)	**Moderate Negative**
		Medium (Biological/Ecological)	
SD2 Export and MEG Pipeline Pre-Commissioning and Drying	Medium	Medium (Humans)	**Moderate Negative**
		Medium (Biological/Ecological)	
Terminal Commissioning	Low	Medium (Humans)	**Minor Negative**
		Medium (Biological/Ecological)	

The following monitoring and reporting requirements related to construction noise will form part of the BP SD2 Construction Phase ESMS:

- A noise monitoring programme will be established prior to and during construction works implemented in the vicinity of Sangachal Terminal, as part of the Nuisance Management Plan; and
- Results from noise monitoring surveys implemented in the vicinity of Sangachal Terminal will be provided to nearby communities through the community engagement process that will be managed by the construction contractor.

10.4.2.4 Additional Mitigation Measures

The assessment above has demonstrated, through noise modelling, that noise from construction plant and vehicles may result in a Major Negative impact to human and biological/ecological receptors. The assessment was based on reasonable worst case assumptions using currently available estimates of numbers and types of construction plant and phasing details. Mitigation already adopted to minimise noise levels is detailed in Section 10.4.1.

To further minimise noise from construction plant and vehicles at the Terminal the following requirements will be included within the Community Engagement and Nuisance Management and Monitoring Plan:

- Prior to construction commencing within the Sangachal Terminal vicinity, a detailed assessment will be undertaken of all plant and vehicles proposed, and the construction programme to specifically identify the activities which result in the highest noise levels and their duration;
- The main construction and installation contractors will complete work plans detailing forecast activities at an agreed frequency. Should very noisy activities be identified the contractor will (following procedures set out in the relevant Community Engagement and Nuisance Management and Monitoring Plan) liaise with the affected communities warning them that a period of high noise will be experienced and the duration of the activity expected; and
- Noise monitoring will be undertaken at community receptors during construction activities implemented in the vicinity of Sangachal Terminal. If noise levels recorded indicate exceedance of the relevant noise limits (65dB Azim Kend, Masiv 3 and Umid and 70 dB Sangachal) the following will be undertaken:
    - The reason for the non-compliance will be established, where possible;
    - Any action that taken immediately following the survey will be recorded;
    - If necessary recommendations will be made for further actions, which may include:
        - Further surveys to identify the reason for the non-compliance;

- Noise control recommendations including, for example:
  - Requirement for equipment maintenance;
  - Selection of alternative equipment; and
  - Screening of equipment.

With these additional mitigation measures in place it is expected the impact associated with terminal construction plant and vehicles will reduce to Moderate Negative.

10.4.3 Construction Yard Noise

10.4.3.1 Event Magnitude

Description

Noise at the selected construction yards during the construction of the SD2 jackets, topsides and bridge will arise from the use of plant and machinery. The majority of activities such as steel rolling and cutting and shaping will be undertaken in workshops. Mobile plant will be used to move materials around the yards. The anticipated use of mobile plant is calculated based on historic records from yards used during ACG and SD jacket and topside construction.

Onshore commissioning of Onshore Commissioning of Main Platform Generators and Topside Utilities will also be undertaken at the topside yard as described within Section 10.3.3.1 above.

Assessment

Construction Yard Plant

A noise modelling assessment was undertaken to determine the potential magnitude of impacts from onshore construction noise to any nearby receptors (see Appendix 10B).

Using reasonable worst case assumptions regarding plant and operating times across the construction period, predictions of potential noise impact from the construction activities at increasing distances from the source were undertaken and compared to the daytime and nightime limit values of 55dB L_{Aeq} and 45dB L_{Aeq} respectively.

The noise screening afforded by the buildings and perimeter fencing around each of the yards was assumed conservatively to provide 5dBA of attenuation. No account was taken for current operations at the construction yards.

The modelling demonstrated that 150m from the noise source, the daytime limit of 55dB will be met and at 450m, the night time limit of 45dB L_{Aeq} will be met. These limits are applicable to residential dwellings, where people are normally present. The modelling predicted no exceedances of the relevant noise limits at a distance of 450m or more from noise sources at the construction yard.

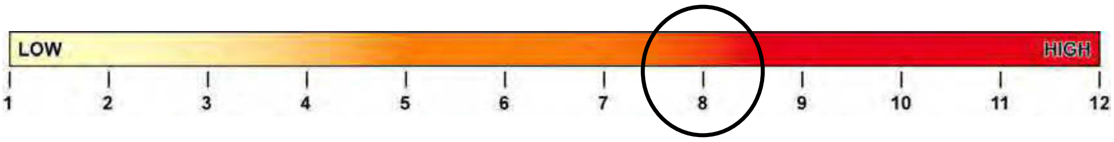
Commissioning of Main Platform Generators and Topside Utilities

Noise modelling was undertaken to determine the likely magnitude of noise impacts from the operation of platform generators at the yards to any nearby receptors (see Appendix 10C). Worst case impacts were considered based on the operation of four generators running concurrently for 8 hours and an allowance of 15dB L_{Aeq} was made for the screening afforded by the generator housing and acoustic controls associated with the platform generators. The modelling demonstrated that at 1750m or more from three generators the most stringent limit (night time limit of 45dB L_{Aeq}) will be met.

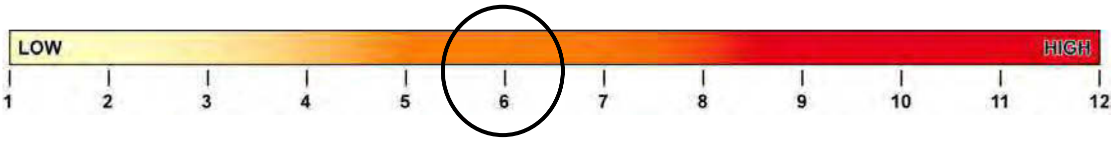
Event Magnitude is summarised in Table 10.17.

Table 10.17 Event Magnitude

Parameter	Construction Yard Plant	Platform Commissioning and Topside Utilities
Extent/Scale	1	**3**
Frequency	3	1
Duration	3	1
Intensity	1	1
Total	**8**	**6**



Construction Yard Plant



Platform Commissioning and Topside Utilities

10.4.3.2 Receptor Sensitivity

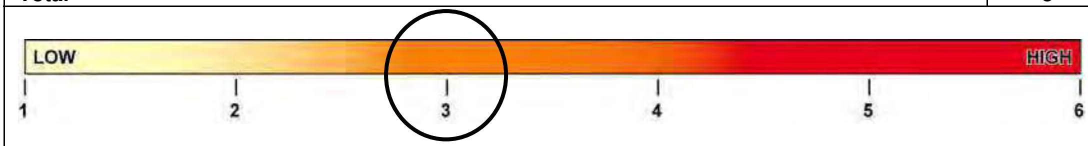
Human Receptors

Both of the candidate construction yards are currently operational and located within an industrial setting. They have been used previously for ACG/SD construction works. The BDJF yard is the most remote. Residential properties are located within 500m – 1km of the Bibi Heybet yard boundaries.

Table 10.18 presents the justification for assigning a score of 3 to human receptors, which represents Medium Receptor Sensitivity.

Table 10.18 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	All construction yards are located in established industrial areas. Residential properties are located within 500m to 1km of the boundaries of the Bibi Heybet yard.	2
Resilience	Local receptors are not considered to be vulnerable to construction yard plant and machinery noise associated with SD2 Project works, given the existing operations at the yard and in the immediate yard vicinity.	1
Total		**3**

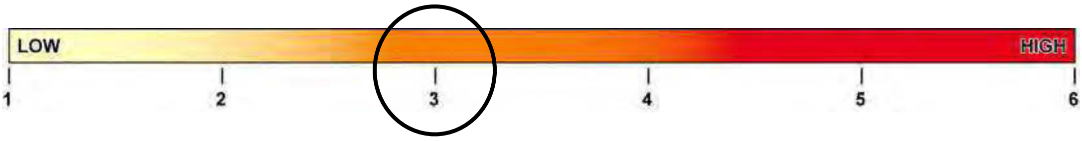


Biological/Ecological Receptors

Table 10.19 presents the justification for assigning a score of 3 to biological/ecological receptors, which represents Medium Receptor Sensitivity.

Table 10.19 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Bird species that may occasionally be present at the yard and adjacent areas are mobile and would not be present for long periods of time, with the exception of the lagoons, which are adjacent to the BDJF yard and support populations of overwintering and residential bird species. Terrestrial ecological receptors are very limited given the industrial nature of the yards and their surroundings.	2`
Resilience	Given the existing industrial activities in and around the yards, species are expected to be unaffected or marginally affected by construction noise associated with the SD2 Project works.	1
Total		**3**



10.4.3.3 Impact Significance

Table 10.20 summarises impacts human receptors from noise due to construction yard plant operations and platform generator commissioning.

Table 10.20 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Yard Plant	Medium	Medium (Human)	**Moderate Negative**
		Medium (Biological/Ecological)	
Platform Commissioning and Topside Utilities	Medium	Medium (Human)	**Moderate Negative**
		Medium (Biological/Ecological)	

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.5 Impacts to the Terrestrial Environment (Ecology)

This section presents the potential impacts to terrestrial ecology from onshore pipeline installation within the onshore SD2 export pipeline corridor.

10.5.1 Mitigation

Existing control measures associated with terrestrial ecology include:

- A construction corridor will be established along the SD2 Pipeline Corridor route and the perimeter of the corridor will be defined. Works outside this perimeter will be strictly controlled by BP in order to minimise the area of ground disturbed;
- Surface soil layer removal and vegetation clearance near to the wetlands, rivers or stream banks will be minimised within the Sangachal Terminal vicinity;
- Prior to removal, vegetation will be inspected to detect the presence of wildlife and activities ceased until appropriate action is taken to ensure any wildlife encountered is not harmed within the Sangachal Terminal vicinity;
- Areas for laydown of soil or loose construction materials will be indentified to minimise impacts to habitats and potential for erosion and sedimentation into watercourses or drains located within the Sangachal Terminal vicinity;
- Checks for wildlife will be undertaken prior to backfilling of the onshore pipeline trench. Any reptiles and mammals in the trench will be removed;
- Records will be maintained of all landscape management works implemented in the Sangachal Terminal vicinity;

- A Restoration and Landscape Management Plan will be prepared for Sangachal Terminal vicinity and will include details of the amount of spoil generated, reused, disposed of and the contamination potential of the spoil. The Plan will also cover details of restoration to restore all areas of disturbed land used on a temporary basis during the SD2 Project works to a condition which is similar to that at preconstruction; and
- An Ecological and Wildlife Management Plan will be developed for Sangachal Terminal vicinity and implemented to manage the relocation of any mammals, reptiles or any IUCN or Azerbaijan Red Data Book listed species encountered within the areas affected by the SD2 Project works.

10.5.2 Onshore Pipeline Installation

10.5.2.1 Event Magnitude

Description

Onshore pipeline installation comprises open cut trenching within the proposed onshore SD2 export pipeline corridor and augur boring at pipeline crossings as discussed in Chapter 5 Section 5.8.3.3. The proposed onshore onshore SD2 export pipeline corridor is approximately 4.4km in length and it is anticipated that a Right of Way (RoW) of approximately 80m in width will be established. During clearance works the vegetation and surface soil will be removed and stored for later reinstatement of the corridor, in order to maintain the environmental characteristics of the area.

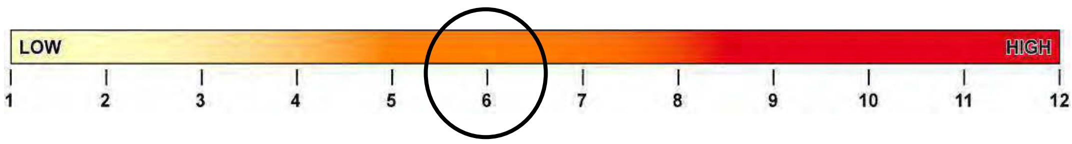
Assessment

The proposed onshore SD2 export pipeline corridor route will pass through predominantly desert/semi-desert habitat and along the eastern fringes of the wetland area south of the Terminal. The pipeline installation works will require the removal of vegetation and surface soil from an area of approximately 35 hectares (ha). The impact will be temporary as it is planned to reinstate the area affected along the route to its pre construction condition. This approach is consistent with previous pipeline installation and reinstatement activities completed for the earlier ACG and SD projects. Surveys completed following previous works have shown reinstatement has been successful and no significant impacts to terrestrial ecology have been recorded.

Event Magnitude is summarised in Table 10.21.

Table 10.21 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	It is anticipated that surface soil and vegetation will be removed from an area of approximately 35ha in total.	1
Frequency	The activity will occur once	1
Duration	Onshore pipeline construction activities are planned to take place over a period of approximately 22 months..	3
Intensity	Soil and vegetation removed during pipeline installation works will be reinstated following the works to their pre construction condition.	1
Total:		**6**



10.5.2.2 Receptor Sensitivity

Local vegetation in the vicinity of the onshore SD2 export pipeline corridor (refer to Section 6.6.4.5.1) is characterised by floral species which are typical for the area surrounding the Terminal and are neither rare nor threatened. The main vegetation assemblages are dominated by low perennial shrubs (including *Salsola nodulosa*, *Salsola dendroides*, *Suaeda* *dendroides*, *Salsola ericoides* and *Artemisa lerchiana*). One Azerbaijan Red Data Book listed species (*Iris acutiloba*) was recorded during surveys in 2004, 2005 and 2008. This species occurs at survey locations to the north east of the Terminal (i.e. not within areas likely to be affected by the pipeline installation works associated with SD2 Project work).

The main wetland habitats are reedbeds, reedmace stands, rush dominated marshes and tamarisk/alhagi scrub (chal-meadow). The area is dynamic in nature and dependant on seasonal water flow through the Shachkaiya Wadi system in addition to smaller contributions from local sources (i.e. existing leaks from water pipelines – refer to Chapter 6 Section 6..4.4.2). Other than this seasonal change, surveys undertaken during 2002, 2010 and 2011 have not shown any significant alterations in the wetlands over time (e.g. in terms of species present and extent of wetlands), other than as a direct result from third party construction activities. The habitat is not considered unique and the area affected by the pipeline installation works is not critical to the function of the habitat as a whole.

The bird surveys undertaken in the Terminal vicinity, as discussed in Section 10.4.2.2 above, have identified breeding birds within the area surrounding the Terminal. However, the habitat within the proposed onshore SD2 export pipeline corridor is not considered critical to breeding birds. They have been recorded throughout the area surrounding the Terminal and use no area exclusively for feeding or nesting.

Faunal surveys have confirmed the presence of the following in the Terminal vicinity:

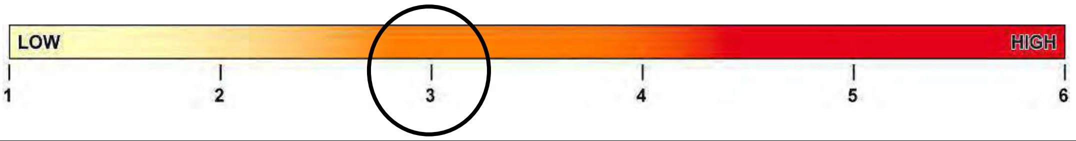
- Euphrates jerboa *(Allactaga elater)* - IUCN Least Concern;
- Grey hamster (*Cricetulus migratorius*) - IUCN Least Concern;
- Marbled polecat (*Vormela peregusna*) – IUCN Vulnerable and Azerbaijan Red Data Book listed;
- Wolf (*Canis lupus*) - no designated conservation status in Azerbaijan;
- Sunwatcher Agama (*Phrynocephalus helioscopus*) - no designated conservation status in Azerbaijan Azerbaijan Red Data Book listed; and
- Spur-thighed tortoise (*Testudo graeca*) - IUCN Red Data List Vulnerable and Azerbaijan Red Data Book listed.

These species have all been found in low numbers (one or two individuals on any occasion) and, with the exception of the spur-thighed tortoise, have not been recorded consistently in surveys undertaken between 2002 and 2011. While spur-thighed tortoise have been consistently recorded in the area, the precise distribution of the tortoise has not been determined. The likely reason for the consistent records of this species is due to the relocation programme that was undertaken prior to and following the previous ACG and SD projects where spur-thighed tortoise were collected prior to the works and then reintroduced once the works were completed. The majority of suitable habitat (i.e. areas which have a mixture of scrub and short vegetation, offering both protection and food supplies) for this species lies outside the area to be affected by the pipeline installation works. The areas to be affected are not considered to be critical or of particular importance for this species. Spur-thighed tortoise are most sensitive during the breeding and egg laying periods which are between April and July.

Table 10.22 presents the justification for assigning a score of 3 for Biological/Ecological Receptor Sensitivity, which represents Medium Receptor Sensitivity.

Table 10.22 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	No rare or protected plant species or breeding bird species have been recorded in the areas to be affected by the pipeline installation works during recent surveys undertaken in 2004-2005 and 2008-2011 (refer to Chapter 6 Table 6.1). Surveys have recorded a number of faunal species with conservation status which include the spur-thighed tortoise, which is classified as vulnerable in the IUCN Red Data List, and also included within the Azerbaijan Red Data Book.	2
Resilience	The areas affected by the pipeline installation works will be temporarily impacted by soil and vegetation removal. Surveys have shown that the areas affected by the works are not critical to ground nesting birds and faunal species, which have been recorded in the Terminal vicinity. The affected areas will be reinstated and would stabilise, and ecological functionality of habitats will be maintained.	1
		3



10.5.2.3 Impact Significance

Table 10.23 summarises impacts on terrestrial ecology associated with the Onshore Pipeline Installation works.

Table 10.23 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Onshore Pipeline Installation	Medium	Medium (Biological/ecological receptors)	**Moderate Negative**

The following monitoring and reporting requirements related to terrestrial ecology will form part of the BP SD2 Construction Phase ESMS:

- An Ecological and Wildlife Management Plan, and restoration and Landscape Management Plan will be prepared, and implemented, which defines the activities and actions to be taken to minimise the impact to local wildlife and habitats during the SD2 Project.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures as listed in Section 10.5.1 above and no further mitigation is required.

10.6 Impacts to the Terrestrial Environment (Soils, Groundwater and Surface Water)

This section presents the potential impacts to the terrestrial environment associated with mobilisation of contamination within soils, groundwater or surface water due to onshore pipeline installation activities and works associated with the SD2 Condensate Tank.

10.6.1 Mitigation

Existing control measures associated with minimising mobilisation of contamination during SD2 construction, installation and HUC activities will include:

- Stockpiles of subsoil located within the Sangachal Terminal vicinity will be appropriately shaped and compacted to avoid erosion and sedimentation of nearby open water courses or drains;

- Site drainage and pollution hazards maps will be maintained that show potential sources of pollution (e.g. storage areas), pathways (e.g. drains) and receptors (e.g. the wetland areas, streams and Caspian Sea) located within the Sangachal Terminal vicinity;
- Designated areas within the Sangachal Terminal vicinity will be established away from watercourses for waste cement/concrete which will be contained and collected as a waste once solidified;
- Analytical testing will be undertaken on excavated soil, surface or ground water encountered that is potential contaminated, based on visual assessment, at a frequency of 1 sample per $500m^3$ to classify the material with regard to re-use and disposal options. Soil and water parameters to be tested and acceptability criteria handling of the soil are defined in Appendix 10G; and
- Dust management and suppression measures will be implemented within the Sangachal Terminal vicinity.

10.6.2 Onshore Pipeline Installation and Condensate Tanks Works

10.6.2.1 Event Magnitude

Description

Onshore pipeline installation comprises open cut trenching and augur boring at pipeline crossings as discussed in Section 10.5.2.1 above. The SD2 Condensate Tank area is located within the existing Sangachal Terminal (refer to Figure 6.1). Works in this area will comprise the installation of piles, foundations, the construction and installation of a new condensate holding tank and bund structure, and associated earthworks.

Assessment

Onshore Pipeline Installation

For the majority of the pipeline route to the Terminal each pipeline will be trenched and installed at a depth of 2.5m below ground level. All soil removed from the trench being excavated will be placed aside and stored so that it will be used later for trench backfilling and reinstatement of the pipeline route, in order to maintain the environmental characteristics of the area.

To control surface water flow, temporary berms and dykes will be constructed, and dewatering of excavations.

The onshore pipelines will need to cross the Baku-Salyan Highway, the railway and various third party pipeline/service lines. Over 60 crossings of existing utilities and pipelines have been identified and combined into groups. It is currently planned to drill the augured sections at a depth of approximately 1.5m below the existing service or pipeline. For each section it will be necessary to excavate launch and reception pits for the auguring and casing equipment at a depth of 3-5m below ground level. All soils excavated from the pits will be placed aside and stored so that it may be used for later reinstatement of the route, in order to maintain the environmental characteristics of the area.

While monitoring to date (refer to Chapter 6 Section 6.4.3) has not indicated any significant or widespread contamination in the SD2 Pipeline Corridor area, it is possible that localised areas of contaminated surface soil and spoil are present which may become mobilised by physical disturbance. Localised contamination of third party origin has been observed within the wetland area south of the Terminal. The onshore SD export pipeline corridor route will pass through the eastern fringes of the wetland area and dewatering of excavations.

SD2 Condensate Tank Area Works

The SD2 Condensate Tank area is located within the existing Sangachal Terminal boundary. Due to historical leakage from produced water holding ponds within and adjacent to the SD2 Condensate Tank area contamination may be locally present. Groundwater is not generally present but waterlogged soils may be encountered locally as a result of this historical leakage.

Soil sampling in 2012 and 2013 within the proposed SD2 condensate tank have indicated that the soil can be classified as category 1. However should category 2 soil, groundwater, ponded surface water or other materials be encountered within the existing Sangachal Terminal property boundary, then they will be classified and managed in accordance with existing BP waste management procedures.

In the event category 2 soil/water (pending event soil/water analysis) is encountered outside of the Sangachal Terminal property boundary the following handling practices will be adopted:

- The soil, surface water, groundwater or other materials will be relocated to an area that is of comparable environmental quality and function;
- The relocation of the soil, surface water, groundwater or other materials to areas that are of comparable environmental quality and function will be undertaken in a manner that will not degrade the environmental further and will promote the natural degradation of contaminants; and
- The following details will be recorded in the event category 2 soil/water is encountered: contaminants detected, handling methods adopted to prevent further environmental degradation, location and quantity of contaminated material detected.

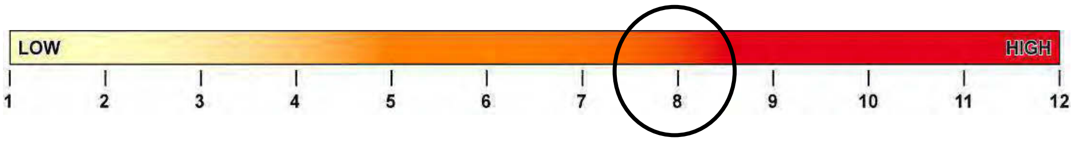
If category type 2 soil/water is encountered within the Sangachal Terminal property boundary then the soil will either be handled in the same manner as material encountered outside of the Sangachal Terminal property boundary or classified as a waste and managed with existing BP AGT Region management plans and procedures.

It is anticipated that areas of contamination within the onshore SD2 export pipeline corridor will be limited. Within the wider wetland area, there are known areas of historic third party contamination and the existence of further localised pockets of such contamination cannot be excluded. However, the above-defined methods and general good construction management practices will be adopted to minimise the potential for mobilisation of contamination.

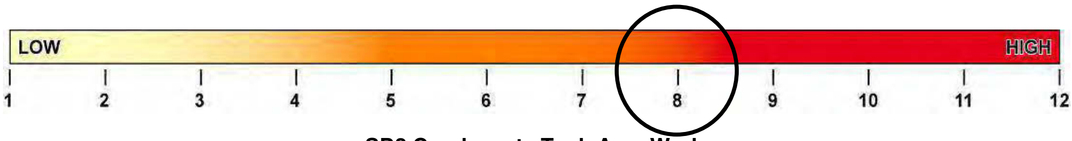
Event Magnitude is summarised in Table 10.24.

Table 10.24 Event Magnitude

Parameter	Onshore Pipeline Installation	SD2 Condensate Tank Area Works
Extent/Scale	1	1
Frequency	3	3
Duration	3	3
Intensity	1	1
Event Magnitude:	**8**	**8**



Onshore Pipeline Installation



SD2 Condensate Tank Area Works

10.6.2.2 Receptor Sensitivity

Relevant receptors include soil and surface water in the vicinity of the Sangachal Terminal and the onshore SD2 export pipeline corridor. Monitoring undertaken to date (Chapter 6 Section 6.4.4) has confirmed that there is no groundwater bearing unit within 20m of the surface.

As reported in Chapter 6, recent soil quality survey results in and adjacent to the onshore SD2 export pipeline corridor (during 2006, 2008 and 2010) indicate no significant contamination. Analysis of soil and water samples have shown no exceedances of relevant standards or limit values (Appendix 10G) (with the exception of elevated levels of arsenic and iron, which are considered to be naturally occurring and consistent with regional data).

Petroleum hydrocarbon concentrations were low, with only one sample within the onshore SD2 export pipeline corridor itself recording a total greater than 100mg/kg. The hydrocarbon within this area was of high molecular weight (suggesting weathering of historic contamination) and highly localised. Therefore, the potential for distribution is considered low.

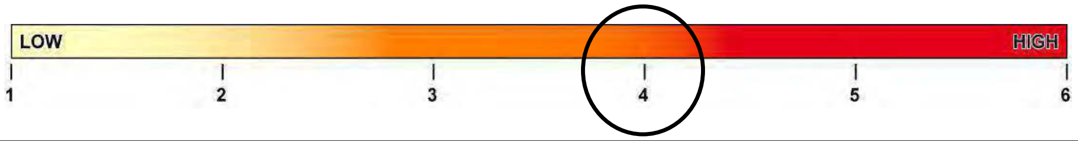
Within the wider wetland areas south of the Terminal, areas of localised hydrocarbon contamination were observed during 2011 and 2012 surveys. All of these appeared to be associated with the release of oil from third-party sources. Other localised spills were observed in the vicinity of the third-party pipelines but no ongoing leaks were visible.

Available analytical data for soil and water in the SD2 Condensate Tank area indicates that the concentrations of potential contaminants of concern are low (soil petroleum hydrocarbon concentrations <40mg/kg). Elevated concentrations of arsenic and iron are recorded but are considered to be naturally occurring. The local presence of elevated concentrations of contamination in soil or groundwater cannot be excluded but its extent and distribution will be strongly limited by the low permeability geological conditions in this area. The risk of mobilisation of any such contamination will be mitigated by the measures presented in Section 10.6.2.1, above.

Table 10.25 presents the justification for assigning a score of 4 to soil and surface water which represents Medium Sensitivity.

Table 10.25 Receptor Sensitivity (Soil and Surface Water)

Parameter	Explanation	Rating
Presence	Pipeline corridor area has moderate value as it is used for local grazing. Surface water bodies not used for public water supply. Used seasonally by herders for watering animals.	2
Resilience	Soil and surface water quality is expected to be largely unaffected by works within the onshore SD2 export pipeline corridor and Condensate Tank Area. Localised contamination was observed within the third party pipeline corridor and wetland area south of the Terminal.	2
		4



10.6.2.3 Impact Significance

Table 10.26 summarises the impact on soil and surface water from the onshore pipeline installation and SD2 Condensate Tank Area works.

Table 10.26 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Onshore Pipeline Installation SD2 Condensate Tank Area works	Medium	Medium	**Moderate Negative**

The following monitoring and reporting requirements related to mobilisation of contamination will form part of the BP SD2 Construction Phase ESMS:

- A Pollution Prevention Management Plan for the terminal construction and onshore pipeline installation will be prepared and implemented;
- Quarterly surface water sampling will be completed within the wetland area for those parameters listed in Appendix 10G; and
- Records (to include, analytical results, photographs, coordinates of the location encountered, action taken and quantities of material) of type 2 soil/water encountered will be maintained and reported to the MENR upon completion of the onshore pipeline construction.

It is considered that impacts are minimised are far as practicable and necessary through the implementation of the existing control measures as listed in Section 10.6.1 above and no additional mitigation is required.

10.7 Impacts to the Terrestrial and Coastal Environment (Cultural Heritage)

This section presents the potential impacts to the cultural heritage due to piling within the SD2 Expansion are and onshore pipeline installation activities.

10.7.1 Mitigation

Existing controls associated with cultural heritage include:

- A watching brief, with representatives from the Institute of Archaeology and Ethnography (IoAE), will be maintained to identify any artefacts of archaeological importance and a chance finds procedure will be in place for construction and commissioning activities implemented within the Sangachal Terminal vicinity;

- Any findings will be reported by the Watching Brief Archaeologists immediately and any corrective measures required will be agreed with an archaeological specialist in liaison with the Ministry of Culture and Tourism and the Institute of Archaeology and Ethnography; and
- In the event archaeological resources are found during excavation work as assessment will be made by the archaeological watching brief on what controls and changes to the excavation work are required and whether work in the area needs to be suspended to allow for more detailed archaeological assessment of the area.

10.7.2 Piling within the SD2 Expansion Area and Onshore Pipeline Installation

10.7.2.1 Event Magnitude

Description

Piling

As discussed within Chapter 5 Section 5.5.2.2, piling will be undertaken across the lower, middle and upper terraces to support the majority of the foundations across the SD2 Expansion Area. A total of approximately 6,750 piles are planned, varying between 450-900mm in diameter and 10-15m in length.

Onshore Pipeline Installation

Onshore pipeline installation comprises open cut trenching and augur boring at pipeline crossings as discussed in Section 10.5.2.1 above.

Assessment

Piling

The nearest cultural site to the SD2 Expansion Area is the medieval Caravanserai however areas where piling is planned to take place are located a minimum of 1,350m from the Caravanserai. As vibrations from piling activities are not expected to travel more than 50m from the source it is considered unlikely that the Caravanserai would be affected by piling activities.

Onshore Pipeline Installation

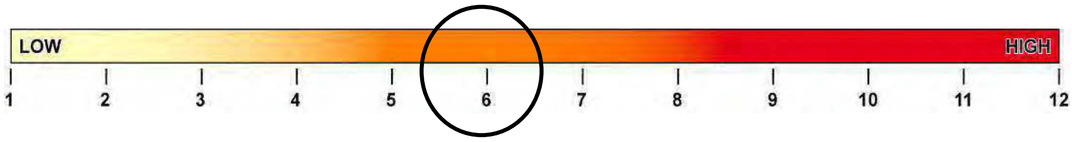
For the majority of the route to the Terminal each pipeline will be trenched and installed at a depth of 2.5m below ground level. The onshore pipeline installation will be conducted within an 80 m RoW along a 4.4km corridor. As a result, approximately 35.2 hectares will be subject to disturbance.

In addition it is planned to use auger boring for pipeline crossings and to drill the augured sections at a depth of approximately 1.5m below the existing service or pipeline. For each section it will be necessary to excavate launch and reception pits for the auguring and casing equipment at a depth of 3-5m below ground level.

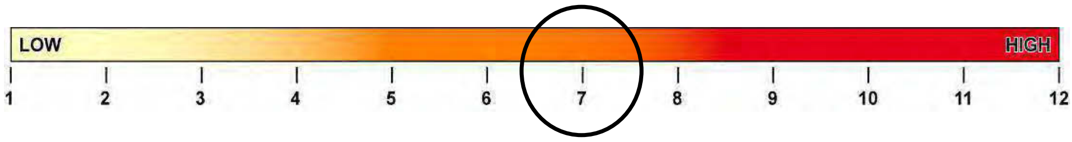
Table 10.27 presents that justification for assigning a score of 6 to piling and 8 to onshore pipeline installation works which represents a Medium Event Magnitude.

Table 10.27 Event Magnitude

Parameter	Piling	Onshore Pipeline Installation
Extent/Scale	1	1
Frequency	3	1
Duration	1	3
Intensity	1	2
Event Magnitude:	**6**	**7**



Piling



Onshore Pipeline Installation

10.7.2.2 Receptor Sensitivity

During the 2011 archaeological baseline survey, no archaeological sites were identified within the lower, middle or upper terrace areas in the SD2 Expansion area. The nearest archaeological sites are Sangachal 10, 12, and 13 (comprising ceramic scatter) located to the northwest of the upper terrace area. However, a number of Isolated Finds, primarily consisting of Medieval Period pot sherds, were identified in the northeast corner of the upper terrace. In addition, a chance find consisting of an isolated Medieval Period potsherd was recovered from the lower terrace area. The recovery of these isolated finds is indicative of human activity in these areas during the Medieval Period. However, the lack of identified archaeological sites and/or features in these areas, during both the baseline survey and watching brief archaeological monitoring during EIW, suggest there is a low potential for encountering any archaeological sites in these areas.

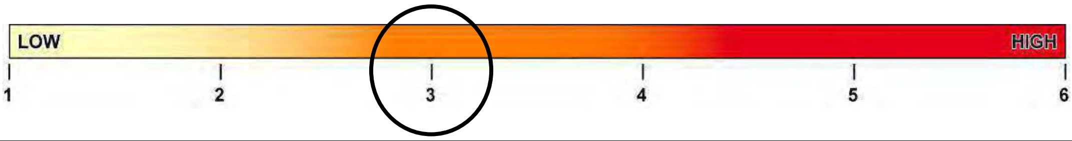
The onshore SD2 Pipeline Corridor was subject to varying levels of investigation during the 2011 archaeological baseline survey. The portion of the proposed route north of the third party pipeline corridor was surveyed and no archaeological sites were identified. A series of isolated finds, consisting predominately of Medieval Period pot sherds, were identified in this area. The portion of the onshore SD2 Pipeline Corridor between the third party pipeline corridor and Baku-Salyan Highway was not intensively surveyed due to the presence of extensive vegetation and standing water.

Based on the available data, the archaeological potential of the onshore SD2 Pipeline Corridor is interpreted as being low to moderate. There is no evidence to suggest the presence of any large, extensive settlements, and as such, the potential for this type of site being present is low. However, the onshore SD2 Pipeline Corridor is located along a historic trade route running from the Sangachal Caravanserai to Karachi Caravanserai (north of the Sangachal Terminal). There is, therefore the potential to encounter small campsites on the route between two caravanserais, within the un-surveyed portions of the SD2 Pipeline Corridor. The Medieval Period isolated finds already identified along the proposed onshore SD2 Pipeline Corridor attests to past human activity in the area.

Table 10.28 present the justification for assigning a score of 3 to cultural heritage which represents Medium Sensitivity.

Table 10.28 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no State protected monuments or archaeological sites within the SD2 Expansion Area and SD2 Export Pipeline Corridor. There is no evidence to suggest the presence of a large, extensive archaeological site in the onshore SD2 Export Pipeline Corridor, although he potential remains for the presence of small archaeological sites.	1
Resilience	If any archaeological sites are present within the upper, middle, or lower terraces of the SD2 Expansion area, pilling activities could result in negative impacts to these sites.	2
		3



10.7.2.3 Impact Significance

Table 10.29 summarises impacts on cultural heritage from piling activities with the SD2 Expansion Area.

Table 10.29 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Piling Activities with the SD2 Expansion Area	Medium	Medium	**Moderate Negative**
Onshore Pipeline Installation			

The following monitoring and reporting requirements related to cultural heritage will form part of the BP SD2 Construction Phase ESMS:

- An Archaeology and Cultural Heritage Management Plan will be prepared detailing how the SD2 Project will be managed in relation to potential cultural heritage impacts; and
- An Archaeology and Cultural Heritage Close Out Report will be issued to the MoCT and IoAE at completion of construction activities.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (which includes the use of a watching brief and a chance finds procedure) and no additional mitigation will be warranted.

10.8 Impacts to the Marine Environment (Water Column and Seabed)

Potential impacts to the marine environment may arise due to cooling water discharge at the construction yards, SD2 Export and MEG Import pipelines and Subsea Infrastructure HUC pre-commissioning discharges, cement discharges, other vessel discharges and underwater noise and vibration from piling and vessels.

10.8.1 Mitigation

Existing controls associated with construction yard cooling water discharge include:

- The system will be designed to meet a temperature specification for the discharge at the edge of the mixing zone, or 100m if a mixing zone is not defined, no greater than 3 degrees more than the ambient water temperature; and
- Neutralising agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l in the construction yard cooling water discharge.

Existing controls associated with SD2 Export and MEG Import pipelines and Subsea Infrastructure HUC pre-commissioning discharges include:

- Hydrotest water used during export pipeline and flowline pre –commissioning will be dosed with chemicals which are not persistent in the marine environment.

Existing controls associated with cement discharges include:

- Cementing chemicals are of low toxicity (UK OCNS “Gold” and “E” categories or equivalent toxicity to those chemicals previously approved for use);
- Cement is designed to set in a marine environment preventing widespread dispersion; and
- The volume of cement used to cement jacket piles into position is calculated prior to the start of the activity. Sufficient cement is used to ensure that the piles are cemented securely while minimising excess cement discharges to the sea.

Existing controls associated with other vessel discharges include the following:

- Depending on the availability of the system, black water will either be:
  - Contained onboard for transfer to shore;
  - Once onshore, black water will be managed in accordance with the existing AGT management plans and procedures; or
  - Black water will be treated to applicable MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine as low as practicable.

- Depending on the availability of the system, galley food waste will either be:
  - Contained and shipped to shore for disposal; or
  - Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge.
- Vessel ballast tanks are designed to ensure that oil and chemicals do not come into contact with ballast water;
- Deck drainage and washwater will be discharged to sea as long as no visible sheen is observable;
- Support vessels will be subject to periodic performance reviews, the scope of which includes environmental performance indicators[10].

Existing control measures associated with underwater noise and vibration from piling and vessels include:

- The frequency of pile driving will be gradually increased to minimise underwater noise impacts to marine species;
- It is planned to begin piling the jacket pin piles and foundation piles using vibration piling as far as practical prior to using impact piling to minimise underwater noise impacts to marine species; and
- Support vessels are subject to periodical performance review which includes environmental performance. Corrective actions will be undertaken to address any performance gaps.

[10] The scope of environmental performance reviews are expected to include, but may not be limited to, the following: energy efficiency and diesel usage, sulphur content of diesel used, ballast water management, waste management, sewage treatment plant operation and management of bilge water.

10.8.2 Construction Yard Cooling Water Discharge

10.8.2.1 Event Magnitude

Description

Construction yard cooling water discharge is discussed in Chapter 5: Project Description Sections 5.6.7.1 and 5.6.9.2.

During onshore commissioning, seawater will be supplied to the topsides via a temporary seawater abstraction system from the quayside. The seawater system will be designed to operate at a flow rate of approximately 600m^3/hr for a period of up to 6 months and will be of a similar design to that approved for previous ACG projects. Seawater will be abstracted from the construction yard quayside and discharged to sea after use. The temperature difference between the seawater intake and discharge will be constant and independent of season as the energy demand on the seawater cooling system when in use will be constant.

Two treatment packages will be used for the temporary cooling water system to inhibit biological growth and corrosion within the seawater system:

- A chlorine/copper anti fouling system, which involves pulse dosing of abstracted seawater at concentrations of 50 ppb chlorine and 5ppb copper; and
- A continuous dosing system, which involves injection of sodium hypochlorite into the abstracted seawater at a concentration of 2mg/l. Prior to discharging the cooling water, a neutralising agent (sodium thiosulphate) will be added. Neutralisation agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l.

Assessment

Dispersion modelling was carried out to assess the distance within which the cooling water plume would exceed a temperature of more than 3ºC above ambient. Modelling was undertaken assuming a temperature difference between the intake and discharge flows of 50ºC (worst case) and 10ºC (typical case). The modelling showed that for worst case 50ºC temperature difference the cooling water plume would reach 3ºC above ambient within 4m from the point of discharge For the typical 10ºC scenario modelling showed the cooling water plume reach 3ºC above ambient within 0.5m of the discharge. Figure 10.7 illustrates the extent of cooling plume for the worst case 50ºC temperature difference scenario.

Figure 10.7 Predicted Cooling Water Plume Temperature Above Ambient at Distance from Discharge (50ºC Temperature Difference Scenario)

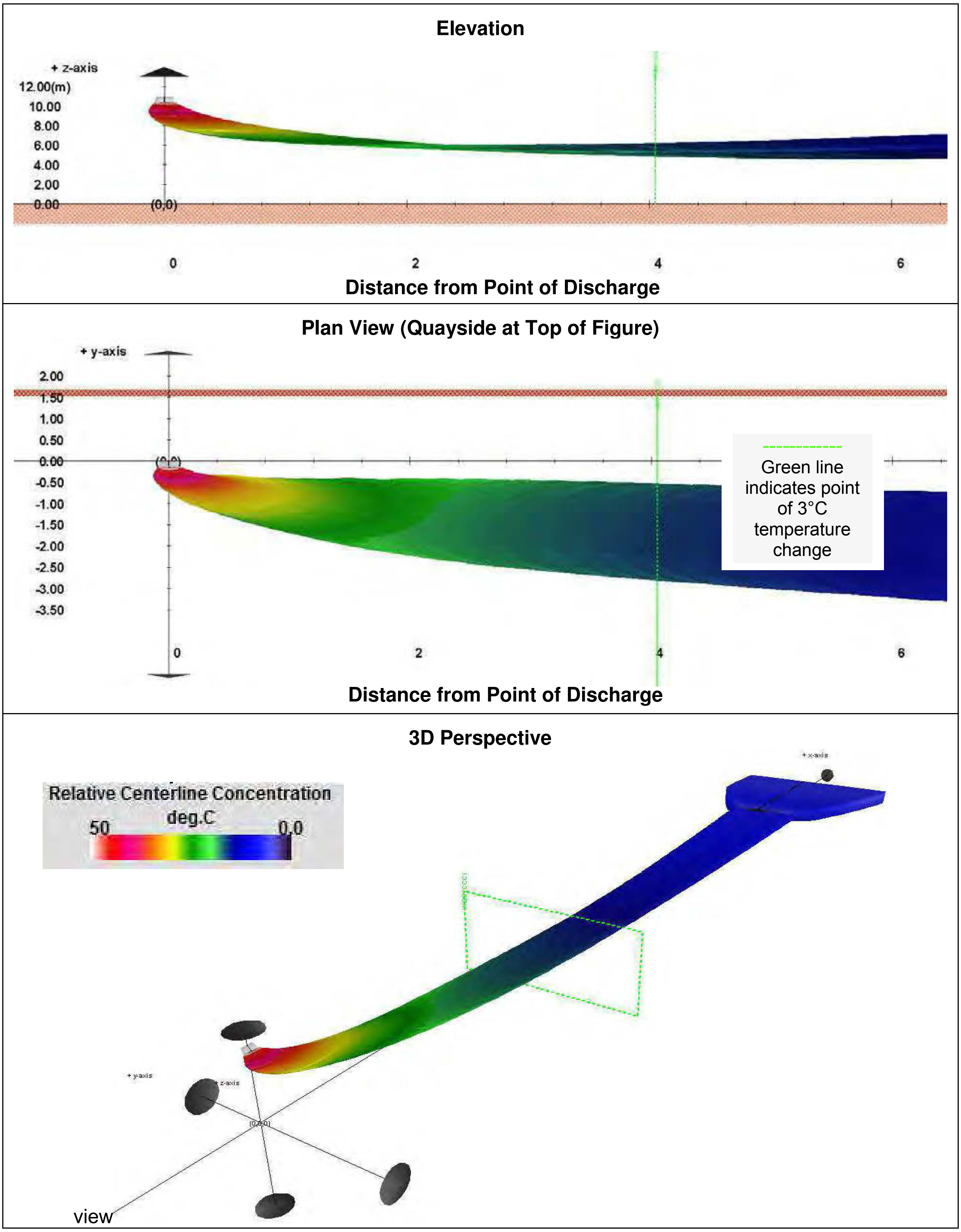
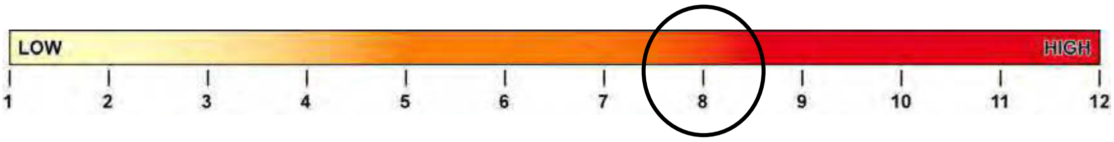


Table 10.30 presents the Event Magnitude for construction yard cooling water discharge. A Medium level Event Magnitude is assigned.

Table 10.30 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Cooling water discharges will be diluted to an acceptable level within 4m of the point of discharge.	1
Frequency	Discharge of cooling water will take place continuously.	3
Duration	The discharge will be continuous for 6 months during topside commissioning.	3
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no harmful persistent materials.	1
		8



10.8.2.2 Receptor Sensitivity

The discharge will take place close to the quayside adjacent to a construction yard in an industrial setting.

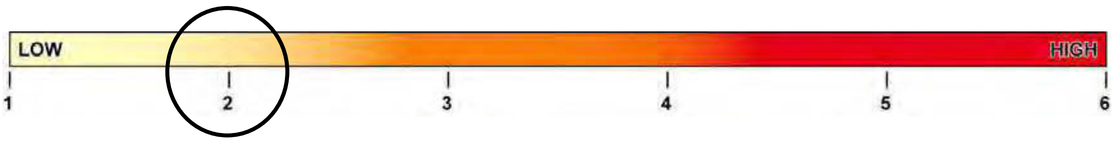
Due to the location of the construction yards within heavily industrialised areas, the presence of seals or threatened species of fish is extremely unlikely. The benthos of the coastal zone is largely dominated by pollution-tolerant invasive species, with few native species present. No plankton studies have been carried out in the vicinity of the construction yards, but it is probable that species diversity is lower than in open waters; and that communities will tend to be dominated by organisms which are tolerant of, or can competitively exploit, water which will often be of poorer quality than open coastal water.

In summary, no sensitive, rare or threatened species are anticipated to be present in the vicinity of the construction yards, and the species most likely to be present and dominant will be those tolerant of the discharges and emissions historically associated with shipping and industrial activity.

Table 10.31 presents the biological/ecological Receptor Sensitivity.

Table 10.31 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the discharge source. No significant exposure of benthos or plankton.	1
Resilience	The species likely to dominate in the area of the construction yards are expected to be predominantly invasive species with a high tolerance to anthropogenic impacts.	1
		2



10.8.2.3 Impact Significance

Table 10.32 summarises impacts to biological/ecological receptors from construction yard cooling water discharge.

Table 10.32 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cooling water discharge from onshore construction yard	Medium	(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to construction yard cooling water discharge will form part of the BP SD2 Construction Phase ESMS:

- Neutralising agent flow and dose pump records will be maintained during construction yard cooling water discharge;
- Weekly sampling and analysis of the residual chlorine content of the construction yard cooling water discharge will be undertaken; and
- Flow and dose pump records and weekly chlorine content sampling results will be managed by the construction contractor during construction yard cooling water discharge.

It is considered that the impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (see Section 10.8.1.) and no additional mitigation is required.

10.8.3 SD2 Export and MEG Import Pipelines and Subsea Infrastructure HUC Discharges

10.8.3.1 Event Magnitude

SD2 Export and MEG Import Pipelines and Infield Flowlines Pre-Commissioning Discharges

Description

Following installation, pre-commissioning activities for the SD2 export and MEG pipelines and the infield flowlines will include flooding, cleaning and gauging (FCG), hydrotesting, leak testing, pre in line inspection (ILI) gauging and ILI pigging and dewatering using treated seawater. The following Base Case chemicals, at the indicated dosage rates, are currently planned to be used:

- 1000ppm Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
- 100ppm Tros Seadye (dye).

In the event that different chemicals are required, the SD2 Project Management of Change Process (see Section 5.16) will be followed.

A summary of the expected volume and location of treated seawater discharges associated with SD2 export and MEG pipeline and the infield flowline pre-commissioning is presented in Chapter 5 Tables 5.22 and 5.25, respectively. All discharges during pre-commissioning will be either a temporary pig trap on the seabed adjacent to the SDB-PR platform or via the SDB-PR platform seawater caisson at a depth of 52m below sea level.

Up to approximately 90 separate discharge events ranging from 1m^3 (discharge from onshore 6” MEG pipeline section during hydrotesting) to 49,858m^3 (discharge from 32” gas export pipelines during ILI pigging) are expected to take place over eight years.

Assessment

The potential environmental impact of the treated seawater (including preservation chemicals) discharges was assessed by:

- Conducting toxicity tests (OSPAR methodology) on seawater dosed with the TROS and Hydrosure products at the levels specified above; and
- Conducting dispersion modelling (DREAM model) on a range of scenarios representing the range and type of discharges.

Ecotoxicity values were expressed as a percentage of preservation chemicals in seawater. Tests were conducted with both phytoplankton (*Skeletonema costatum*) and zooplankton (*Acartia tonsa*), and the lowest LC/EC_{50} (representing greatest sensitivity) from these tests was selected as the basis for assessing environmental impact. The concentration corresponding to a 'no-effect' level was estimated by applying a safety factor of 10 (appropriate for short-duration discharges) to the selected value; for the purposes of modelling, the 'no-effect' concentrations were then expressed as a minimum dilution factor (refer to Table 10.33 lowest value and minimum dilution are highlighted).

Table 10.33 EC/LC_{50} Values and No-effect Dilution Factors for the SD2 Export and MEG Import Pipelines and Infield Flowlines Preservation Product

	Replicate	LC/EC50 (% treated water in seawater)	
		Acartia	Skeletonema
Hydrosure HD5000	1	0.14	0.12
	2	0.12	0.15
	Ave.	**0.13**	**0.135**
No Effect Dilution Factor		**7,692**	**7,407**

A total of 16 scenarios were modelled, each covering dilution factors up to 8,000-fold. In some instances, the treated seawater will be in the SD2 Export and MEG Import pipeline and infield flowlines for up to two years; to assess the extent to which toxicity might decay over time, additional ecotoxicology studies are in progress using stored samples which will be tested at intervals.

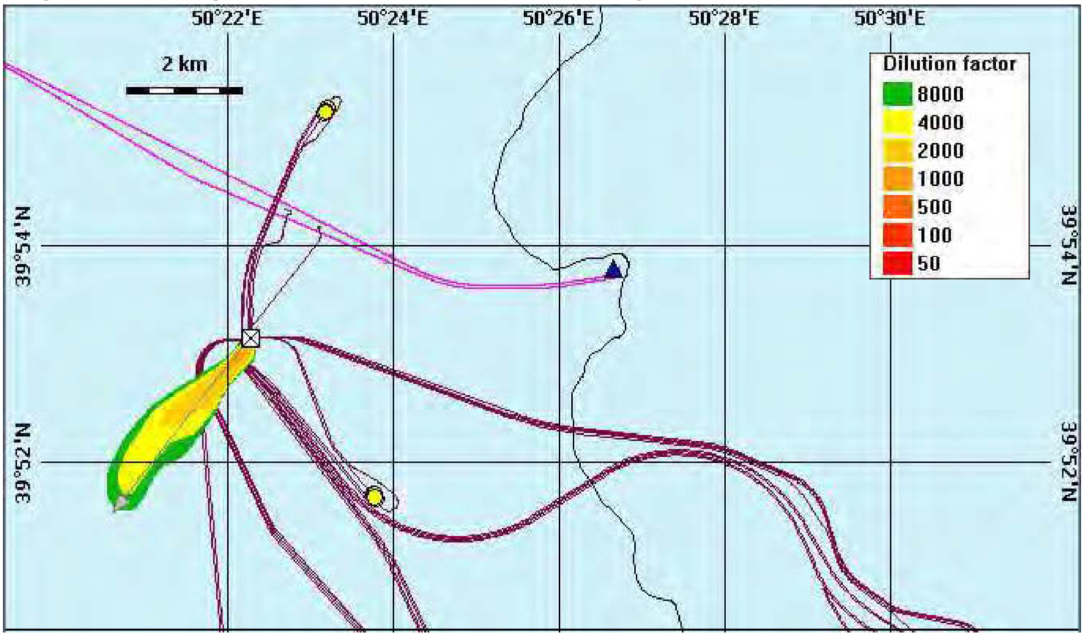
The results of three scenarios, representing small, medium-sized and large discharges, are presented in Figures 10.8 to 10.11. Table 10.34 summarises these scenarios.

Table 10.34 Summary of Small, Medium and Large Discharge Scenarios

Operation	Scenario	Pipeline	Discharge Volume (m^3)	Discharge Duration per Discharge (hr)	Port Diameter (m)	Depth BMSL (m)	Discharge Orientation	Location
Flood, Clean and Gauge	1	Gas	9,002	11	0.23	95 (seabed)	Vertically upward	Temporary Pig Trap
Hydrotest and Leak Test	6	Gas	330	12	1.05	52	Vertically downward	SDB-PR caisson
Dewatering	11	Gas	49,858	60	1.05	52	Vertically down	SDB-PR caisson

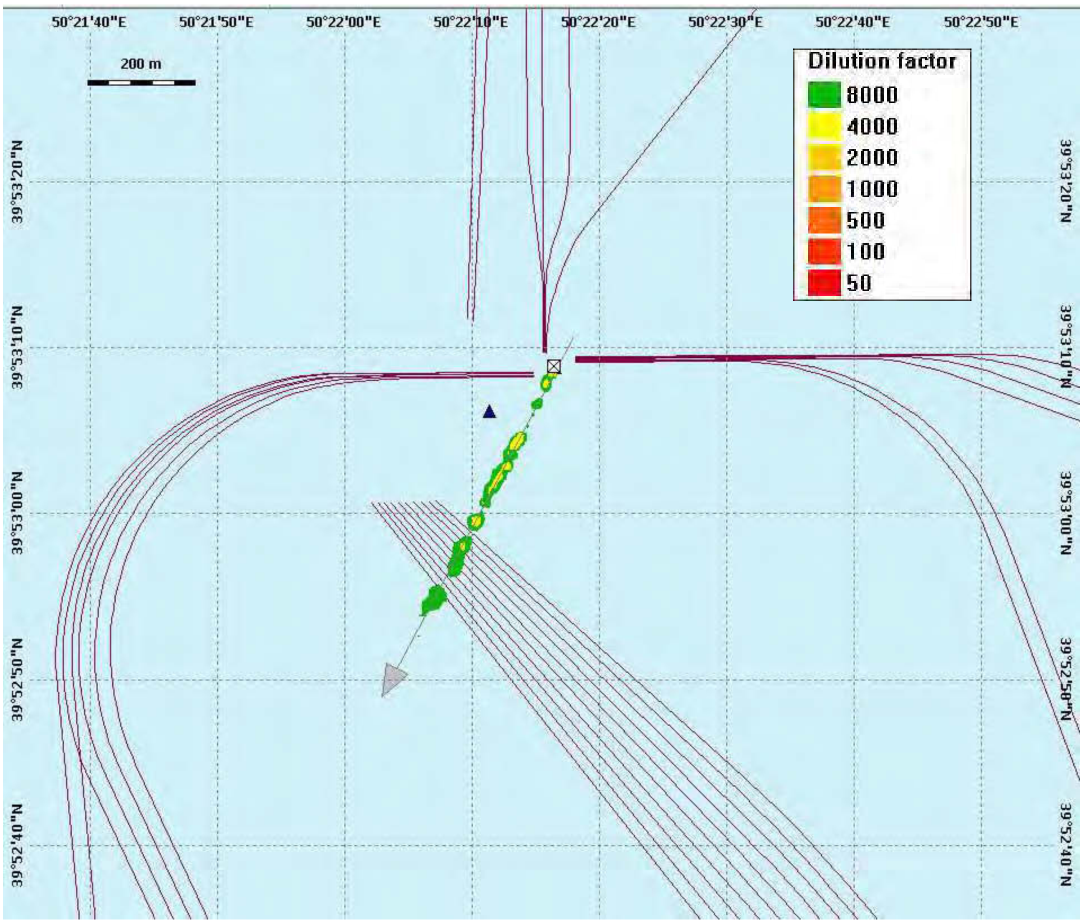
The plume arising from Scenario 1, a discharge at the seabed of 9,000m^3 over a period of 12 hours was estimated to be approximately 1,000m wide and approximately 3.75km long (refer to Figure 10.8 which shows extent of the plume at the end of the discharge event).

Figure 10.8 Snapshot of Plume at End of Discharge Period, Scenario 1



The plume arising from Scenario 6, a discharge of $330m^3$ from the SDB-PR platform caisson over 12 hours, is very shallow and thin at the 8,000-fold dilution contour, and extends approximately 500m from the SDB-PR platform caisson at the end of the discharge (refer to Figure 10.9). Dilution to 8,000-fold is rapid and complete by the end of the discharge period.

Figure 10.9 Snapshot of Plume at End of Discharge Period, Scenario 6



The plume arising from Scenario 11, a discharge of 49,858m^3 from the SDB-PR platform caisson over a period of 60 hours, extends over a distance of approximately 4.5km at the 8,000-fold dilution at the end of the discharge period in summer and approximately 3.1km in winter (refer to Figures 10.10a and 10.10b respectively).

Figure 10.10a Snapshot of Plume at End of Discharge Period, Scenario 11 (summer)

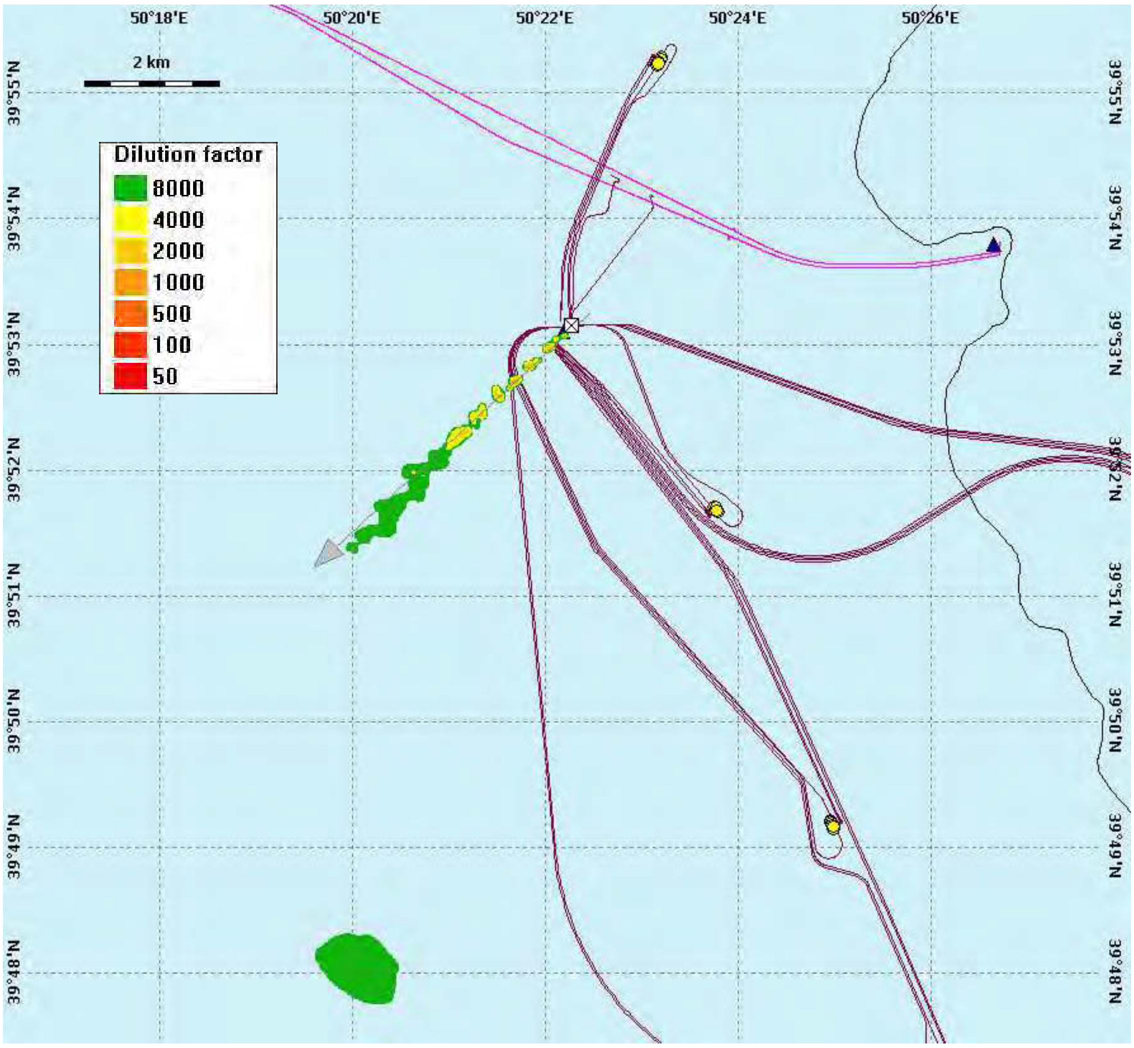
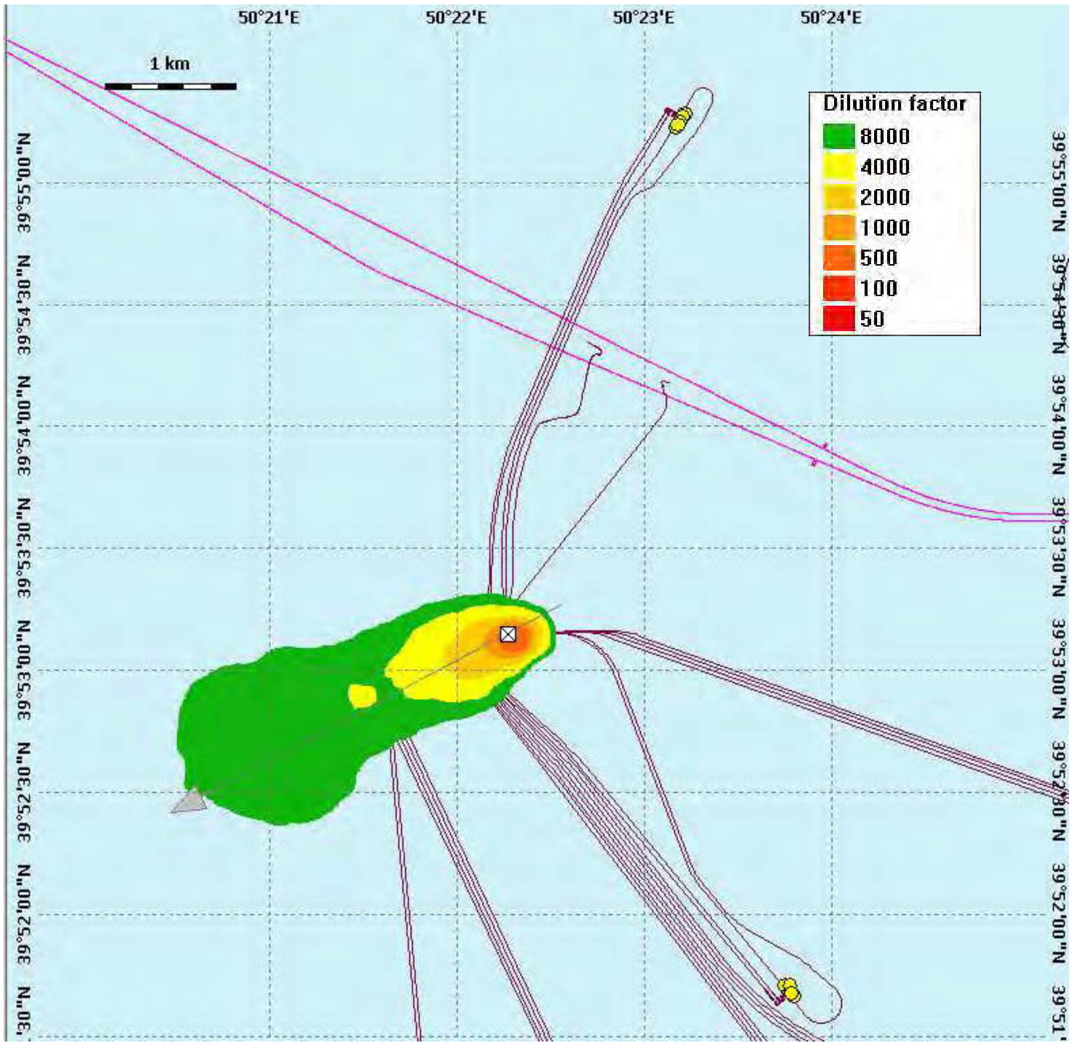


Figure 10.10b Snapshot of Plume at End of Discharge Period, Scenario 11 (winter)

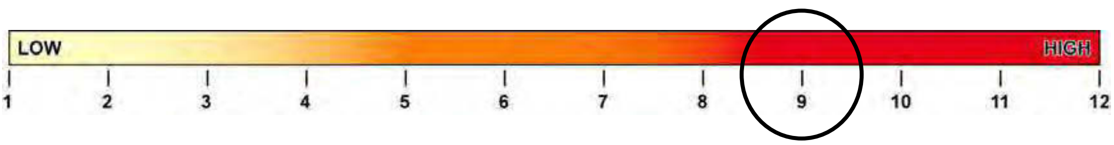


The range of plume sizes and orientation, the short duration of individual events, and the fact that the plumes do not reach the seabed or sea surface, indicate that impact of individual discharges will be transient, and small relative to the scale of the receiving environment. The product is degradable and non-bioaccumulative, and will not give rise to persistent or cumulative impacts.

Table 10.35 presents the justification for assigning score of 9, which represents a High Event Magnitude.

Table 10.35 Event Magnitude (Pre-commissioning Discharges)

Parameter	Explanation	Rating
Extent/Scale	Some discharge plumes will extend up to 4.5km.	3
Frequency	Discharges will occur up to 90 times over eight years.	3
Duration	Discharge durations will be short, and less than 24 hours in most instances.	2
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
		9



Subsea Infrastructure Installation Discharges (MEG Discharges During Subsea Infrastructure Installation)

Description

It is anticipated that the production trees, manifolds, spools, SSIVs and umbilicals are installed pre-filled with MEG. The spools and equipment will be fitted with pressure caps to minimise losses of fluids to sea. However, it is anticipated that small volumes of MEG, of between 10.74 and 13.84m^3, will be discharged to sea at the seabed during installation in the vicinity of each manifold and the associated production trees.

Assessment

MEG is of very low toxicity to aquatic organisms, and CICADs[11] estimates a no-effect concentration of approximately 890mg/l. The discharges have been modelled, and the plume dimensions at the required dilution have been estimated. Figure 10.11 illustrates the steady-state dimensions of the plume under weak current conditions two hours after discharge commences. The no-effect concentration is reached within 20m of the point of release. One hour after the end of the discharge, the concentration of MEG does not exceed 500 mg/l at any point. Under typical current conditions, MEG concentrations were diluted to concentrations of less than 890 mg/l within 2 m of the point of discharge.

Figure 10.11 Dimensions of MEG Discharge Plume Two Hours After Discharge Commences

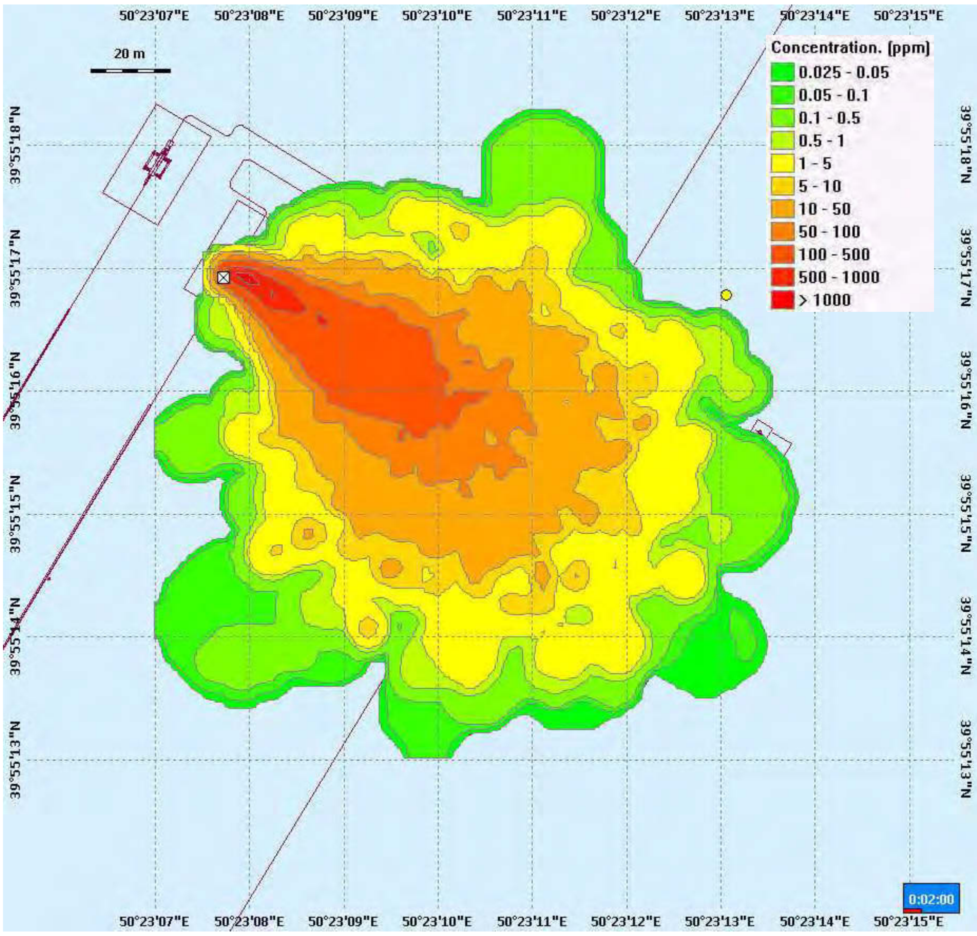
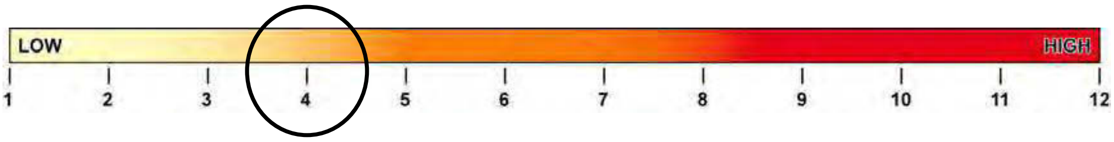


Table 10.36 presents the justification for assigned a score of 4, which represents a Low Event Magnitude

[11] WHO, 2000, ETHYLENE GLYCOL: Environmental aspects, Concise International Chemical Assessment Document 22, Geneva

Table 10.36 Event Magnitude (MEG Discharges During Subsea Production System Installation)

Parameter	Explanation	Rating
Extent/Scale	Discharges will impact only a small area (less than 20m from the release point)	1
Frequency	Discharges will occur once per cluster	1
Duration	Discharges duration is approximately 4 hours	1
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
		4



10.8.3.2 Receptor Sensitivity

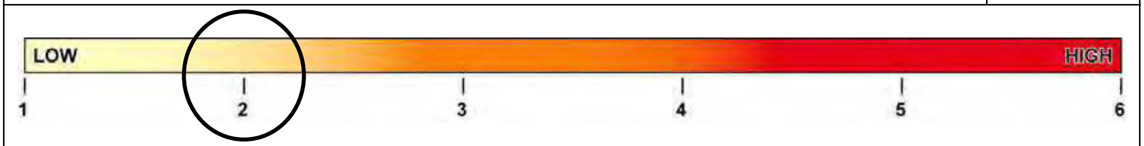
Dispersion modelling has indicated that the treated seawater used during pre-commissioning and MEG discharges will not impact the seabed or the photic (productive) zone. Treated seawater plumes are predominantly long and narrow, and residence time within a plume for fish would be too short to result in either acutely or chronically toxic exposure. Productive phytoplankton populations will not be present in the volumes of water occupied by the plumes. Seals, as air-breathers, are unlikely to be affected by exposure.

Zooplankton are most likely to be exposed and affected, if vertically migrating populations are present at the times at which discharges take place. Water-column surveys in the SD2 Contract Area in recent years have indicated a substantial decline in native and endemic species, to the extent that the zooplankton community is dominated by two invasive species; the copepod *Acartia tonsa* and the ctenophore *Menmiopsis leydii.* Both species are widespread and comparatively abundant, and are therefore not considered vulnerable at a population level to the proposed discharges.

Table 10.37 presents the biological/ecological Receptor Sensitivity.

Table 10.37 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Fish, seals and phytoplankton unlikely to be exposed. Effects on are zooplankton possible.	1
Resilience	Community dominated by widespread and abundant invasive species.	1
		2



10.8.3.3 Impact Significance

Table 10.38 summarises impacts to biological/ecological receptors from SD2 Export and MEG Import pipelines, and Subsea Infrastructure HUC discharges.

Table 10.38 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Pipeline and Flowline Pre-commissioning Discharges	High	(Biological/Ecological) Low	**Moderate Negative**
MEG Discharge During Subsea Infrastructure Installation	Low	(Biological/Ecological) Low	**Negligible**

10.8.3.4 Additional Mitigation, Monitoring and Reporting

The assessment above has demonstrated, with reference to numerical modelling, that pipeline hydrotest discharges will result in a Moderate Negative impact to biological/ecological receptors.

Prior to the commencement of pipeline and flowline hydrotest activities, a hydrotest management plan will be prepared and subsequently maintained. This plan will establish, and regularly update, a schedule of hydrotest events together with a detailed set of commissioning procedures. The MENR will be informed of the hydrotest schedule and will be notified of any changes to the schedule.

Experience gained during the commissioning of the ACG Phase 3 pipelines demonstrated that, in most instances, it is not technically practicable to undertake a programme of field sampling and analysis during hydrotest activities; this constraint applies particularly to events which involve the discharge of degraded hydrotest chemicals after the fluid has been in a pipeline for a period of several months. Accordingly, the following measures will be undertaken for the SD2 Project to provide the most effective and practicable monitoring and assurance:

- The amounts of chemicals used, together with the dosage rates and water flow rates during all pipeline filling, top-up and pressure testing activities will be rigorously recorded;
- The actual volumes of hydrotest water released during each pipeline discharge event will be rigorously recorded; and
- Laboratory samples (seawater dosed with chemicals at the rate recorded during offshore pipeline fill activities) will be prepared and stored onshore under simulated pipeline conditions. These samples will be periodically subject to toxicity testing.

The information collected as a result of these hydrotest monitoring and assurance measures will be collated, interpreted, and issued in the form of a final close-out report to the MENR once all pipeline and flowline commissioning activities have been completed.

It is considered that the impacts are minimised as far as practicable and no additional mitigation is required.

10.8.4 Other Discharges

Other discharges to sea will result from the operation of vessels associated with the installation of the SDB platform complex, SD2 export and MEG pipelines, and subsea infrastructure (refer to Chapter 5 Sections 5.7.7., 5.8.7 and 5.9.5) and will comprise ballast water, treated black water, grey water and drainage.

10.8.4.1 Event Magnitude

Description and Assessment

Other discharges to sea will result from the operation of vessels associated with the installation of the SDB platform complex, SD2 export and MEG pipelines, and subsea infrastructure (refer to Chapter 5 Sections 5.7.7., 5.8.7 and 5.9.5). These will comprise:

- **Ballast Water** – Support vessels will occasionally take up and discharge ballast water during installation support activities.

  Vessel ballast tanks are designed to ensure that ballast water does not come into contact with oil or chemicals. Uptake and discharge are not considered to present a significant environmental hazard;

- **Treated Black Water** –Treated black water will be rapidly diluted close to the point of discharge. Total suspended solids, BOD and coliforms at the proposed treatment level do not pose any risk of environmental impact;

- **Grey Water** - Grey water will be discharged directly to sea. Grey water (from showers, laundry etc) will contain only dilute cleaning agents (soaps, detergents) and the impact of discharge will be minimal. Environmental factors are considered prior to selecting any chemical for use, including cleaning fluids such as detergents; and

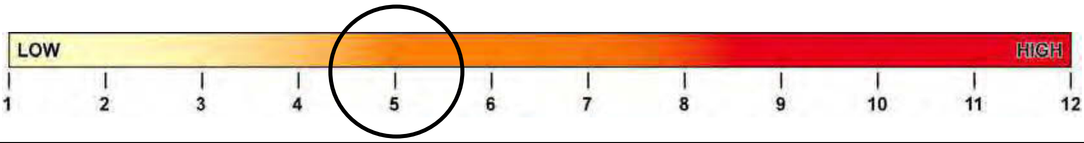
- **Drainage** - Drainage (including deck drainage and washdown water) will be discharged directly to sea, provided no visible sheen is observable. No contaminated water will be discharged and so no environmental impact is anticipated.

Event Magnitude is summarised in Table 10.39.

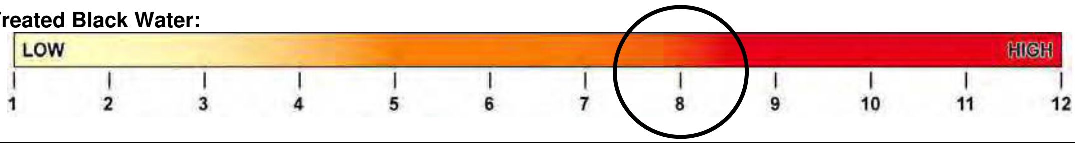
Table 10.39 Event Magnitude

Event Parameter / Discharge	Ballast Water	Black Water	Grey Water	Drainage
Scale	1	1	1	1
Frequency	2	3	3	3
Duration	1	3	3	3
Intensity	1	1	1	1
Event Magnitude	**5**	**8**	**8**	**8**

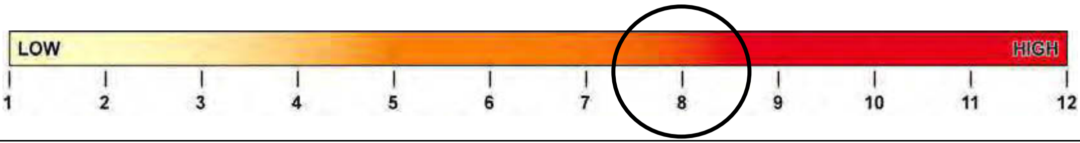
Ballast Water:



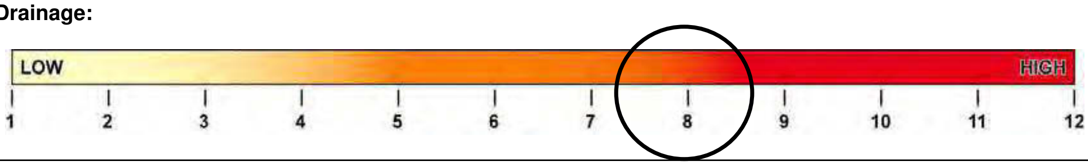
Treated Black Water:



Grey Water:



Drainage:



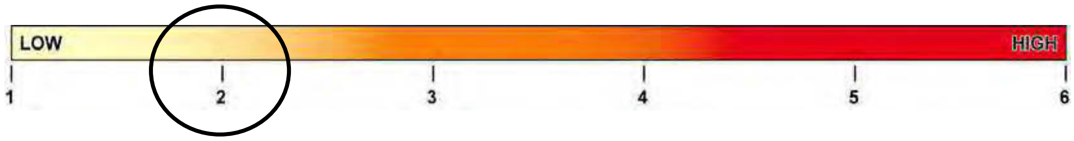
10.8.4.2 Receptor Sensitivity

All of the discharges are low in volume and do not contain toxic or persistent process chemicals (with the exception of chlorination of treated black water). Receptors are not considered to be sensitive to these small discharges.

Table 10.40 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.40 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
Presence	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Total		**2**



10.8.4.3 Impact Significance

Table 10.41 summarises the impact of other discharges to sea on seals, fish, zooplankton, phytoplankton and benthic invertebrates.

Table 10.41 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea **Ballast Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Treated Black Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Grey Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Drainage**	Medium	(All Receptors) Low	**Minor Negative**

The following monitoring and reporting requirements related to vessel ballast water, treated black water, grey water and drainage discharges will form part of the BP SD2 Construction Phase ESMS:

- Black Water:
    - Onboard vessels samples will be taken from the sewage discharge outlet and analysed monthly for total suspended solids, thermotolerant coliforms and BOD. Water samples should meet the following sewage standards: five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine will be as low as practicable;
    - Daily visual checks will be undertaken when discharging from vessels to confirm no floating solids are observable; and
    - Vessel sewage sampling results, recorded daily observations and estimated volumes of treated black water discharged daily (based on POB).
- Grey water and Drainage:
    - Daily visual checks undertaken when discharging grey water and drainage from vessels to confirm no visible sheen; and
    - Daily observations and estimated volumes of grey water and drainage discharged daily from vessels will be recorded .

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.8.1) and not additional mitigation is required.

10.8.5 Underwater Noise and Vibration

10.8.5.1 Event Magnitude

Description

Underwater noise will result from the driving the jacket and SSIV foundation piles and vessel movements during nearshore and offshore pipelay and during installation of the subsea infrastructure as described in Chapter 5 Sections 5.6.4, 5.6.8, 5.7.2 and 5.9.3.

Assessment

Using the same approach as discussed in Chapter 9 Section 9.4.1.1 an analysis of the propagation of underwater noise was undertaken in order to estimate distances at which various acoustic impacts on marine species may occur (refer to Appendix 9C). The assessment identified relative distances at which representative audiological injury and behavioural thresholds for seals and fish (denoted as either hearing-specialist or hearing-generalist depending on their biology e.g. whether or not they have swim bladders and a physiological connection between the swim bladder and the inner ear) were reached for each activity. Thresholds for acoustic impact criteria are available for pinnipeds covering lethality; physical injury including deafness; and behavioural reactions while for fish, they cover lethality and behavioural reactions only.

Thresholds exist for both mild and strong behavioural responses. The mild behaviour response threshold indicates that the seals and fish may be aware of the sounds but does not imply that they will move or be impacted. This assessment therefore, focuses on the thresholds for auditory injury and strong behavioural reactions against which to assess potential impacts to fish and seals.

Figure 10.12 presents a summary of the effect of underwater noise from piling, nearshore and offshore pipelay, and subsea infrastructure installation to audiological injury and strong behavioural thresholds.

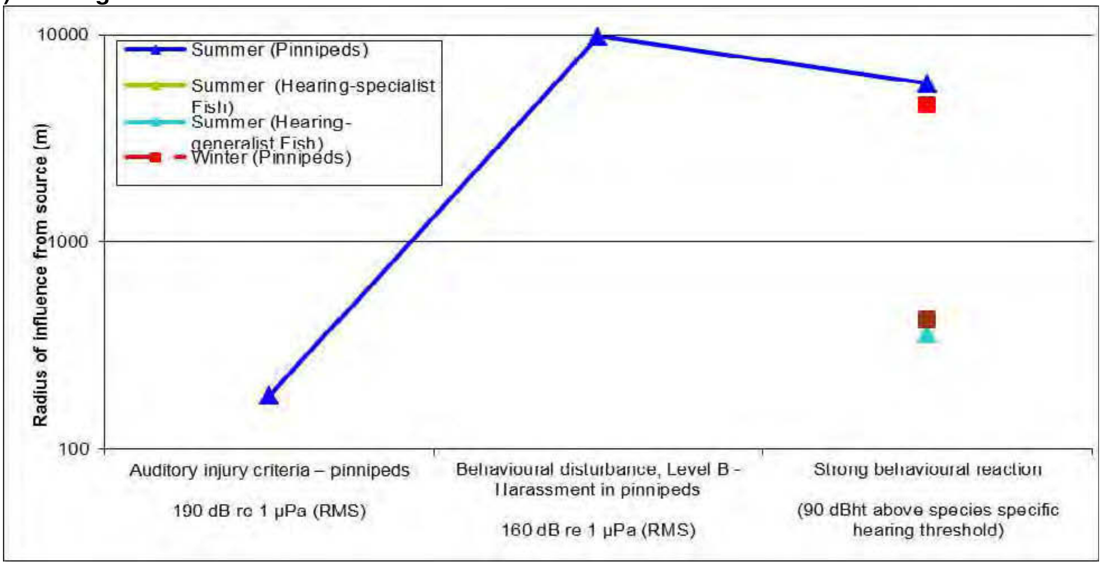
During piling activities the assessment showed that the maximum extent for auditory injury for seals was found to be 180m, while strong behavioural reactions may be evident up to 5.8km from the piling site during winter. The maximum distance at which strong behavioural reactions may be observed is 12.9km for hearing specialist fish, while hearing-generalist fish react at a maximum distance of 420m

Pipelaying activities in the nearshore and offshore environment is predicted to result in strong behavioural reactions in seals up to a distance of 570m from the source, while the corresponding ranges for hearing- generalist fish and hearing-specialist fish are 40m and 670m, respectively.

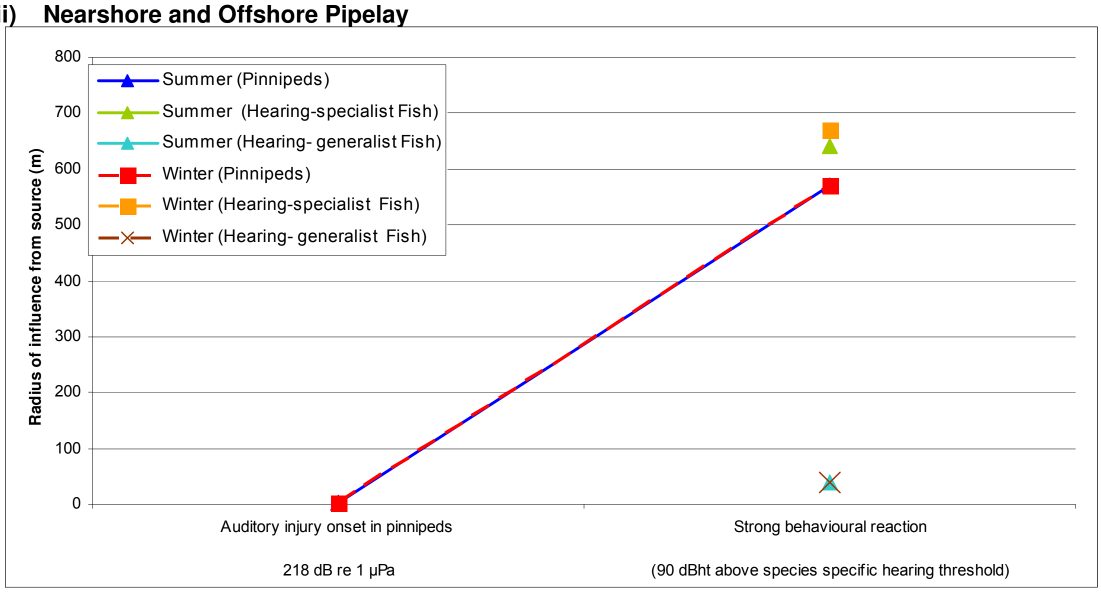
Subsea installation activities involving a crane barge and a survey vessel operating close together are predicted to result in strong behavioural reactions in seals up to 60m, while corresponding ranges for hearing-generalist fish and hearing-specialist fish are 20m and 82m, respectively.

Figure 10.12 Summary of Effect of Underwater i) Piling, ii) Nearshore and Offshore Pipelay and ii) Subsea Infrastructure Installation Noise Relative to Audiological Injury and Strong Behavioural Thresholds

i) Piling



ii) Nearshore and Offshore Pipelay



iii) Subsea Infrastructure Installation

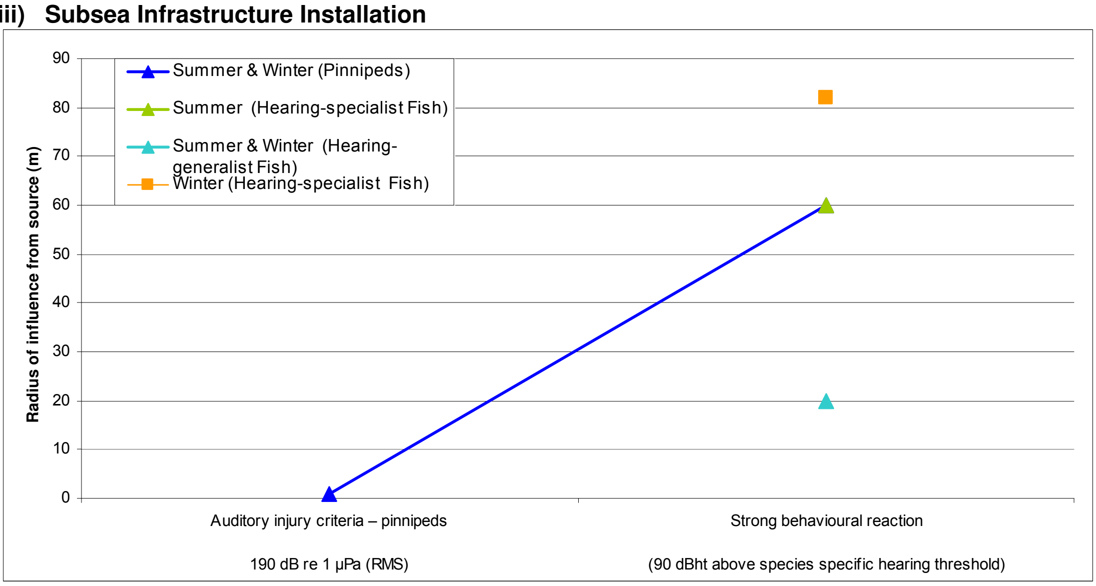
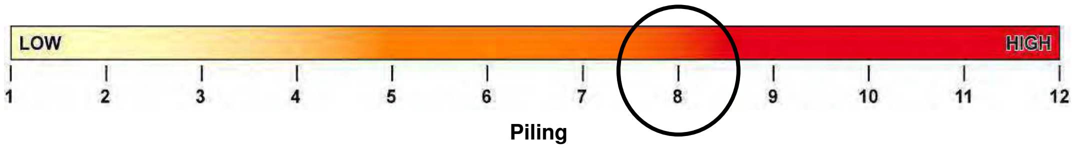


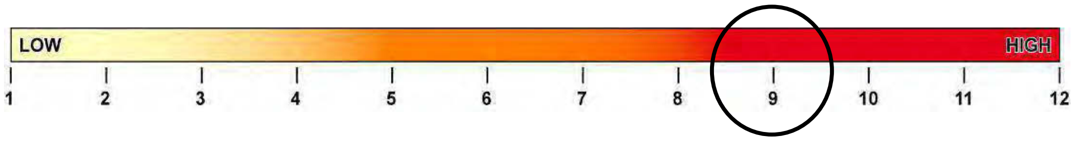
Table 10.42 presents the justification for assigning a score of 7 and 10 to piling and vessel activities respectively, which represents a Medium and High Event Magnitude, respectively.

Table 10.42 Event Magnitude

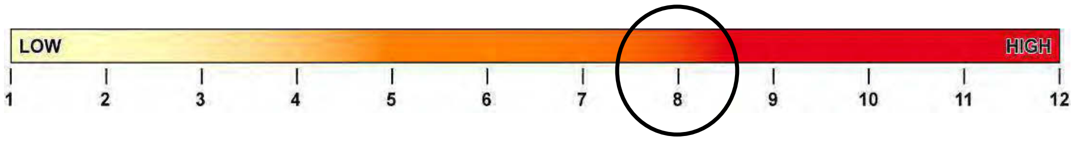
Parameter	Piling	Nearshore and Offshore Pipelay	Subsea Infrastructure Installation
Extent/Scale	3	2	1
Frequency	2	3	3
Duration	1	3	3
Intensity	2	1	1
Event Magnitude:	**8**	**9**	**8**



Piling



Vessels During Nearshore and Offshore Pipelay



Vessels During Subsea Infrastructure Installation

10.8.5.2 Receptor Sensitivity

The only relevant biological receptors to underwater noise are seals and fish[12]. Recent data indicates that Caspian seals, an endangered species. Migrate through the SD Contract Area (refer to Chapter 6 Section 6.7.2.5 and Appendix 6D). The number varies throughout the year with the maximum numbers of up to 4,000 seals migrating through the SD Contract Area during the spring months which significantly reduces to individual seals during the winter months.

Sturgeon, another endangered species, are known to migrate through the SD Contract Area in March/April and September to November but are not common and do not use the area exclusively (refer to Chapter 6 Section 6.7.2.4. and Appendix 6C). Shad also migrate through the SD Contract Area in autumn. Goby species are present throughout the year in the Central and Southern Caspian including the SD Contract Area, however fish such as kilka and mullet are semi migratory primarily present in the SD Contract Area during the winter months. No species is present exclusively within the Contract Area.

Table 10.43 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

[12] Plankton cannot sense the low frequency sound generated because the wavelength is longer than the organism and benthic invertebrates do no have sophisticated sound-sensing apparatus.

Table 10.43 Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Possibility that species may be temporarily affected by underwater piling and vessel noise during pipelay and subsea infrastructure installation but effect would be short term and limited. Ecological functionality will be maintained.	1
Presence	Both fish and seals are likely to be present for limited periods of time in the SD Contract Area. However, the SD Contract Area is not exclusively used by these species	1
Total		**2**

10.8.5.3 Impact Significance

Table 10.44 summarises impacts to seal and fish associated with jacket and SSIV foundation piling and vessel movements

Table 10.44 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Jacket and SSIV foundation piling	Medium	(Biological/Ecological) Low	**Minor Negative**
Nearshore and Offshore Pipelay	High	(Biological/Ecological) Low	**Moderate Negative**
Subsea Infrastructure Installation	Medium	(Biological/Ecological) Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.81) and not additional mitigation is required.

10.9 Impacts to the Nearshore/Coastal Environment

This section assesses the potential for impacts in the nearshore/coastal environment from the construction and presence of two finger piers and nearshore pipeline installation works.

10.9.1 Mitigation

Existing controls related to impacts in the nearshore/coastal environment include:

- A baseline survey of the SD2 Pipeline Corridor in the nearshore area has been completed;
- Vessels and equipment will be subject to periodic performance reviews, the scope of which includes environmental performance indicators[13] ; and
- A process will be established to promote the selection of hydraulic fluids used on the trenching equipment that has the best environmental performance.

[13] The scope of environmental performance reviews are expected to include, but may not be limited to, the following: energy efficiency and diesel usage, sulphur content of diesel used, ballast water management, waste management, sewage treatment plant operation and management of bilge water.

10.9.2 Nearshore Pipeline Installation

10.9.2.1 Event Magnitude

Description

Finger Piers

As discussed in Chapter 5 Section 5.8.3.2, it is anticipated that two temporary finger piers 4-5m wide (10m at the base) will be constructed, extending out approximately 145m to approximately 3m water depth. The berms will be constructed from aggregate and are expected to remain in place for up to two years when they will be removed and the area will be reinstated.

Nearshore Pipeline Installation Works

To install the SD2 export and MEG in the nearshore it is proposed to excavate three trenches from the coastline to 3m water depth either side of the finger piers using excavators. Each trench will be 2.5m deep and 2m wide.

From the 3m to 12m water depth (approximately 7,450m), each trench (approximately 5m wide and 2.5m deep) will be excavated using a cutter suction dredger (CSD) (or a barge based excavator). An alternative option of combining the three trenches into one is also being considered. The single trench would be approximately 34-40m wide and 2.5m deep.

The dredger will removed approximately 1,000,000m^3 of material and deposit it approximately 500m from the trench via a floating pipeline. A spreader pontoon will be connected to the end of this pipeline in order to dispose the dredged material evenly over this area. This form of disposal will lead to ridges being created on the seabed. Should these not be removed from natural backfilling, the material will be removed later by the CSD and used as backfill to cover the pipelines in the trenches, thereby restoring the original seabed as far as practicable.

Assessment

The nearshore baseline coastal processes are described in Chapter 6 Section 6.6.1.

Installation of the pipelines within the nearshore environment will follow the same approach as that adopted for previous ACG Phases 1 and 2, and SD Stage 1 projects, where pipelines were installed within 500m of the SD2 export pipeline route. Previous modelling studies and pre and post surveys undertaken for these previous projects have therefore informed the assessment of the finger berm and nearshore pipeline installation within this section.

Finger Piers

Previous studies have shown that the nearshore location associated with the SD2 export corridor is dynamic. As the pipeline landfall area faces south east, significant profile changes and major littoral transport events are expected to occur due to wind driven waves and currents resulting from discrete storm events generally from a north easterly direction.

The presence of 145m long finger piers and the associated cofferdam crossing the active littoral transport zone perpendicular to the coastline means significant interruption to the natural littoral sediment fluxes will occur, especially under storm conditions. The finger piers will act as a barrier, effectively blocking the north to south net drift within the intertidal and part of the sub tidal zones. This will lead to accretion of sediment on the eastern side of the piers, and erosion along the coastline to the western side of the structures. Local scour effects and locally enhanced suspended sediment concentrations, within the shallow active zone may also occur, due to wave breaking particularly under extreme storm wave conditions.

Depending on the incident wave angle some local sheltering and focussing of waves may be experienced as a result of the finger piers. Due to the predominant northerly winds it is most likely that sheltering will most frequently be experienced in the area west of the finger piers. Localised sheltering may lead to morphological changes and adjustment of the coastline profile in the immediate vicinity of the finger piers.

The construction of the finger piers will also cause a barrier to the typically weak mainly coastal parallel currents, with the structures acting to deflect the flows of offshore currents around the end of the piers. Local acceleration of flows may be experienced, with slacker variable flows expected in the shelter of the structure.

Decommissioning of the finger piers will result in a temporary increase in suspended sediment due to loss of the pier material into the water and re- suspension of bed sediments. This is anticipated to be localised and will occur over a short duration.

Nearshore Pipeline Installation Works

Trenching will lead to the suspension of sediment due to disturbance of the seabed. Generally under this procedure high suspended sediment concentrations are generated from the physical disturbance and/or removal and deposition of sediment. Depending on the machinery used, overflow and splashing during the trenching operations may also lead to high levels of suspended sediment. Therefore benthic habitat could also be indirectly impacted as a result of increased turbidity in the Bay during trenching activities.

Monitoring surveys were undertaken during trenching operations for ACG Phases 1 and 2. Findings of the surveys showed the extension of the plume of turbid water during the trenching operations was estimated to be approximately 0.3km^2 on the two days of plume monitoring. For comparison, the total area of Sangachal Bay measured from the point of the Peninsula to the south, and Primorsk Harbour in the north, is around 35km^2. The area of visibly increased turbidity was stretching typically from 100 to 300m from the trenching activities. Downstream the plume extended beyond this. Although this survey represents only a limited sample, given the similar nature and scale of the trenching planned for the SD2 Project, the impact magnitude is assessed as moderate given the localised extent of the observed plumes.

Tables 10.45 and 10.46 present the justification for assigning a score of 8 for finger pier and a score of 6 for the nearshore trenching, which represents a Medium Event Magnitude.

Table 10.45 Event Magnitude (Finger Piers)

Parameter	Explanation	Rating
Extent/ Scale	Interruption to littoral drift patterns. Down drift erosion and updrift accretion impacting on the beach profile affecting an overall area less than 50 hectares.	1
Frequency	Continuous	3
Duration	For the duration that the finger peirs are in place (~2 years estimated).	3
Intensity	Low intensity with the shoreline morphology and beach profiles adjusting over time.	1
Total		**8**

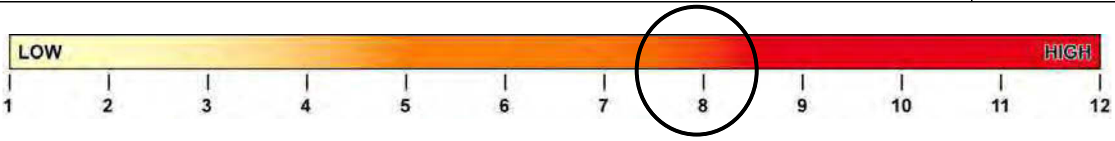
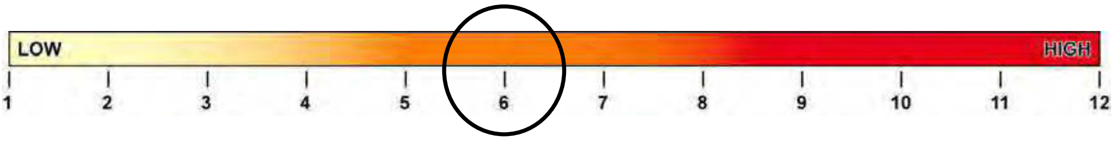


Table 10.46 Event Magnitude (Nearshore Trenching)

Parameter	Explanation	Rating
Extent/ Scale	Nearshore impact. High levels of suspended sediment and direct sea bed disturbance impacting an overall area less than 50 hectares.	1
Frequency	Trenching for each of the four pipelines required.	2
Duration	Up to one month per pipeline expected.	2
Intensity	Previous monitoring of trenching effects demonstrates low intensity impacts.	1
Total		**6**



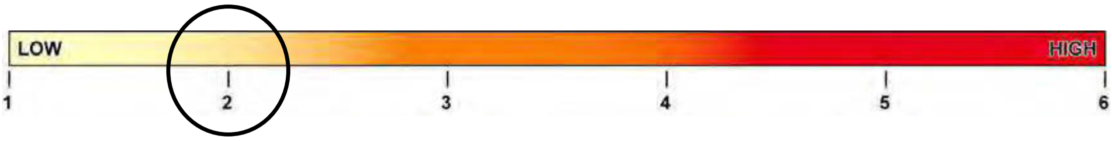
10.9.2.2 Receptor Sensitivity

The receptors present in and adjacent to the SD2 Export Subsea Pipeline corridor are common in local coastal waters. Sangachal Bay is a shallow water environment which is regularly disturbed by wave action, and the biological communities are adapted to periodic turbidity. Seagrass detached by wave action is frequently observed on the shoreline, and the seagrass beds are clearly able to sustain natural stresses which are considerably greater than the effects of finger pier construction or pipeline trenching. The capacity of seagrass to regenerate and colonise is illustrated by the way in which this plant responded to the sea level rise in the late 20th century. Much of the area where seagrass is presently most abundant was dry shoreline in the 1980s, and the main area of seagrass rapidly colonised new habitat as the water level rose. The benthic community present in the Bay is typical of local coastal waters; it comprises a small number of native species, but has also been colonised by a number of alien and invasive species. Regular surveys in the Bay have indicated that neither seagrass nor benthic invertebrates have suffered permanent adverse effects due to pipeline installation.

Table 10.47 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.47 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	The receptors present in the pipeline corridor are common in Sangachal Bay and in adjacent coastal waters. No rare or vulnerable marine species are present.	1
Resilience	Biological communities with the Bay have experienced no lasting impact from previous pipeline installation activities, and are considered resilient.	1
		2



10.9.2.3 Impact Significance

Table 10.48 summarises impacts to the coastal environment associated with the presence of the finger berms and nearshore pipeline trenching.

Table 10.48 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction of finger berms	Medium	Low	**Minor negative**
Nearshore pipeline installation works	Medium	Low	**Minor negative**

The following monitoring and reporting requirements related to finger berm construction and nearshore pipeline installation works will form part of the BP SD2 Construction Phase ESMS:

- Fish population surveys will be undertaken one year prior to trenching activities, during trenching and once trenching has been completed; and
- Pre and post trenching seabed surveys will be undertaken. Post trenching seabed surveys will be undertaken one and three years after completion of trenching activities. The surveys will include drop down video work to confirm seabed distribution.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.9.1) and not additional mitigation is required.

10.10 Impacts to the Coastal and Marine Environment (Cultural Heritage)

This section presents the potential impacts to cultural heritage within the coastal and marine environment due to seabed disturbance during SD2 Project installation activities.

10.10.1 Mitigation

Existing controls associated with coastal and marine cultural heritage include:

- Data collected from previous surveys including 3D seismic and detailed bathymetry surveys and any further seabed surveys completed prior to pipeline and subsea infrastructure installation will be reviewed by a marine cultural heritage specialist to identify potential sites of cultural heritage value which lie within the areas affected by the works;
- In the event that a potential site is identified an assessment of the potential importance of the feature will be undertaken by a marine cultural heritage specialist; and
- Based on the importance of the feature, the pipeline and subsea infrastructure will be repositioned to avoid significantly impacting the feature.

10.10.2 Seabed Disturbance

10.10.2.1 Event Magnitude

Description

Seabed disturbance within the coastal and marine environment will arise from installation of SD2 platform complex and the subsea SD2 export and MEG pipelines and the subsea infrastructure as discussed in Chapter 5 Sections 5.7.2, 5.7.3, 5.8.3.1, 5.8.3.2 and 5.9.3.

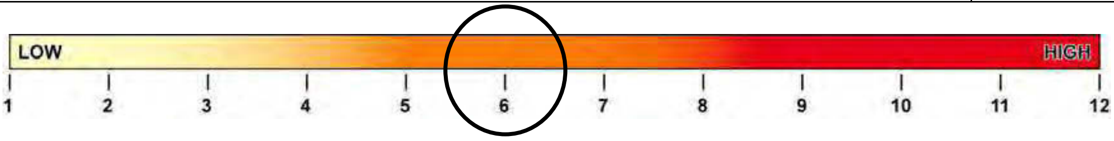
Assessment

The Caspian Sea contains a variety of known and anticipated cultural heritage. This cultural heritage includes shipwrecks that date back at least 2,000 years, artefacts from marine losses and submerged terrestrial archaeological resources. The latter reportedly include entire historic communities that were submerged by tectonic activities. Although reported by professional archaeologists and non professional divers, the exact locations of offshore cultural heritage sites are known in only a few instances. It is not known whether there have been any marine cultural heritage sites identified previously in the areas of potential seabed disturbance. Prior to the commencement of installation works, pre-construction pipeline and anchor surveys will be completed. These will be reviewed by a marine cultural heritage specialist to identify potential sites, which can then be subsequently avoided during installation works.

Table 10.49 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 10.49 Event Magnitude

Parameter	Explanation	Rating
Extent/ Scale	Disturbance will be limited to areas of anchor setting and the area occupied by the SDB Platform Complex, SD2 Export and MEG Import pipelines and Subsea Infrastructure.	1
Frequency	The number of individual events resulting in seabed disturbance will be greater than 50.	3
Duration	Disturbance events will be of short duration.	1
Intensity	Following review of pre-construction and anchor surveys it is expected that installation works will avoid significant physical disturbance to marine cultural heritage sites (if present)	1
Total		**6**



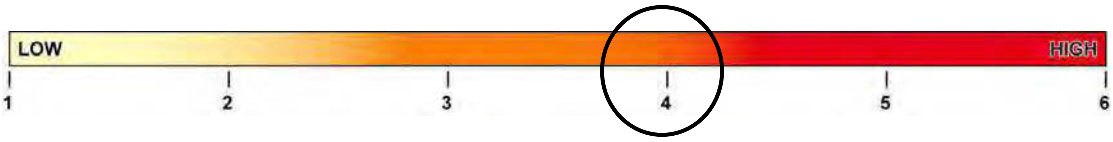
10.10.2.2 Receptor Sensitivity

Marine cultural heritage sites often are assessed to be of national or regional value, when they are present. This is because every shipwreck is unique and most shipwrecks contain unique information. For this assessment, the receptors are considered to be at minimum of regional value, understanding that individual receptors might be of national or international value.

Table 10.48 presents the justification for assigning a score of 4, which represents Medium Receptor Sensitivity for any cultural heritage in the area impacted by seabed disturbance.

Table 10.50 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Lacking baseline data, the receptors are considered to be at minimum of regional value, understanding that individual receptors might be of national or international value.	2
Resilience	Marine cultural heritage can be permanently damaged by impacts to the seabed from anchoring, cable/chain placement, pipelay, and other seabed disturbances, although complete destruction is unlikely.	2
		4



10.10.2.3 Impact Significance

Table 10.51 summarises impacts on cultural heritage from seabed disturbance.

Table 10.51 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Offshore project impacts to cultural heritage	Medium	Medium	**Moderate Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.10.1) and no additional mitigation is required.

10.11 Summary of SD2 Construction, Installation and HUC Residual Environmental Impacts

For all construction, installation and HUC phase environmental impacts assessed it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and additional mitigation measures set out for noisy construction activities at the Terminal. With the implementation of the Nuisance Management Plan noisy construction activities at the Terminal should be no more than moderate negative.

Table 10.52 summaries the residual environmental impacts for the construction, installation and HUC phase of the project.

Table 10.52 Summary of SD2 Project Construction, Installation and HUC Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying)	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Offsite Vehicles	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Terminal Commissioning	1	3	2	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Construction Yard Plant and Vehicles	1	3	3	1	1 1	Medium	Low	Minor Negative
	Emissions from Onshore Commissioning of Main Platform Generators and Topside Utilities	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel Emissions	1	3	3	1	1 1	Medium	Low	Minor Negative
Terrestrial Environment	Terminal Construction Plant and Vehicles (Noise)	3	3	3	1	2 1 1 2	High	Human: Medium Biological / Ecological: Medium	Major Negative - reduced to Moderate Negative following additional mitigation
	Onshore & Nearshore Pipelay (Noise)	3	1	3	1	2 1 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	SD2 Export and MEG Pipeline Pre-Commissioning and Drying	1	1	3	1	2 1 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	Terminal Commissioning (Noise)	1	1	2	1	2 1 1 2	Low	Human: Medium Biological / Ecological: Medium	Minor Negative
	Construction Yard Plant (Noise)	1	3	3	1	2 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Terrestrial Environment	Platform Commissioning and Topside Utilities (Noise)	3	1	1	1	2 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	Onshore SD2 Export Pipeline Installation (Ecology)	1	1	3	1	2 1	Medium	Medium	Moderate Negative
	Onshore Pipeline Installation (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
	SD2 Condensate Tank Area Works (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
	Piling within the SD2 Expansion Area (Cultural Heritage)	1	3	1	1	1 2	Medium	Medium	Moderate Negative
	Onshore Pipeline Installation (Cultural Heritage)	1	1	3	2	1 2	Medium	Medium	Moderate Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Pipeline and Flowline Pre-commissioning Discharges	3	3	2	1	1 1	High	Low	Moderate Negative
	MEG Discharge During Subsea Infrastructure Installation	1	1	1	1	1 1	Low	Low	Negligible
	Ballast Water (Vessels)	1	2	1	1	1 1	Medium	Low	Minor Negative
	Treated Black Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Grey Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Drainage (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Piling – Jackets and SSIVs (underwater noise)	3	2	1	2	1 1	Medium	Low	Minor Negative
	Vessels During Nearshore and Offshore Pipelay (underwater noise)	2	3	3	1	1 1	High	Low	Moderate Negative
	Vessels During Subsea Infrastructure Installation (underwater noise)	1	3	3	1	1 1	Medium	Low	Minor Negative
Nearshore/Coastal Environment	Construction of Finger Piers	1	3	3	1	1 1	Medium	Low	Minor Negative
	Nearshore Pipeline Installation Works	1	2	2	1	1 1	Medium	Low	Minor Negative
	Seabed disturbance (cultural heritage)	1	3	1	1	2 2	Medium	Medium	Moderate Negative

11 Operations Environmental Impact Assessment, Mitigation and Monitoring

Contents

List of Figures

List of Tables

11.1 Introduction

This Chapter of the Shah Deniz 2 (SD2) Project Environmental and Socio-Economic Impact Assessment (ESIA) presents the assessment of environmental impacts associated with the following SD2 Project phases:

- Offshore Operations;
- Onshore Operations; and
- Subsea Operations.

The impact assessment methodology followed and the structure of the SD2 Project impact assessment are described in full within Chapters 3 and 9 of this ESIA respectively.

11.2 Scoping Assessment

The SD2 Project Operations Activities and Events have been determined based on the SD2 Project Base Case, as detailed within Chapter 5: Project Description (see Appendix 11A).

Table 11.1 presents the Activities and associated Events that have been scoped out of the full assessment process due to their limited potential to result in discernable environmental impacts. Judgement is based on prior experience of similar Activities and Events, especially with respect to earlier ACG and SD developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 11.1 "Scoped Out" SD2 Project Offshore, Onshore and Subsea Operations Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Offshore Operations			
OPs-NR4	Fire System Tests	5.10.10.8	• Firewater pump testing will typically occur on a weekly basis for a short duration (approximately 1 hour) with seawater. • Discharge of seawater used for testing will be via the SDB-QU seawater discharge caisson. • There will be no planned discharge of fire fighting foam from the SDB platform complex except during annual system tests. • Foam system chemicals of the same specification and environmental performance as those used in existing SD and ACG platform foam systems will be stored on the platform for emergency use. The small volume of foam will disperse in minutes so there is little potential for acute toxicity in exposed organisms. • The fish most likely to be present for extended periods of time in the SD Contract Area and at the SDB-PR and SDB-QU locations are Kilka and Mullet, which may be present throughout the year. However, the SD Contract Area, including the SD2 Offshore location, is not exclusively used by these species and the Contract Area is not considered to be of primary importance. **Conclusion:** There is limited potential for discernable impact on the marine environment
Ops-R8	Supply Vessel Operations - Emissions to atmosphere	5.10.12	• On average it is assumed there will be support vessel trips every 7-14 days during the Operations phase to supply consumables (e.g. diesel, chemicals) to the SDB platform complex and ship solid and liquid waste to shore for treatment and disposal. • The low volume of emissions released will be dispersed across the entire vessel route and the wider area. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations. • Vessels will be well maintained and use good quality, and low sulphur fuel (typically <0.05% weight). **Conclusion:** Based on efficient operation, regular maintenance and planned use of low sulphur fuel there is deemed to be no discernable impact to human or ecological receptors.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Ops-R9	Support Vessel Operations - Underwater Noise	**5.10.12**	• Support vessels used during the operations phase (every 7-14 days over the PSA period) will be similar to those used using the SD2 drilling activities (used almost continuously throughout the 14 year drilling programme). • Assessment of the underwater noise generated by support vessels during SD2 drilling demonstrated that the source noise levels for vessel operations are below the levels at which lethality and direct physical injury occur. At worst it was anticipated that there may be a strong behavioural reaction in seals within 13m of the noise source and mild behavioural reaction within 72m of the noise source (refer to Appendix 9C for further details). **Conclusion:** Support vessels will be transitory within the offshore environment. Modelling has shown there is a limited potential for impacts to fish and seals.
Ops-R10	Crew Change Operations	5.10.12	• Crew changes will be made on a regular basis using crew change vessels (up to two vessels per week). • The low volume of emissions released will be dispersed across the entire vessel route and the wider area. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations. • Underwater noise impacts will be similar to those for support vessels and are considered not significant. • Helicopters will be used only for non-routine or emergency crew transportation (no more than once a month). Flights will originate from Zabrat heliport. A portion of the flight path will be over residential receptors but at height (>500m). Noise disturbance will be temporary, of short duration and low intensity. • There will be no helicopter or vessel refuelling facilities on the SDB platform complex. **Conclusion:** Emissions and noise from crew change operations are expected to result in no discernable impact to human receptors. Underwater noise impact to fish and seals will be limited.
Ops-R11	Physical Presence of the SDB Platform Complex		• The SDB platform complex will be located approximately 45km from the Azerbaijani coastline. • The SDB platform complex will not be visible from onshore and therefore there will be no visual intrusion to onshore receptors. • The footprint of the SDB platform complex is negligible in the context of the South Caspian. • The fish most likely to be present for extended periods of time in the SD Contract Area and at the SDB-PR and SDB-QU locations are Kilka and Mullet, which may be present throughout the year. However, neither the SDB platform complex location nor the SD Contract Area are exclusively used by these species and the Contract Area is not considered to be of primary importance. • The Contract Area is not located within a bird migration flyover route. Birds found in the area will be transient and not resident. **Conclusion:** The SDB platform complex (including at night when lit/flaring) will not be visible from onshore and no discernable impact on ecological/biological receptors is expected.
Subsea Operations			
Sub-NR2	DEH Operation	5.11.2.2	• The Direct Electrical Heating (DEH) system will be used during low flow or upset conditions to maintain the internal temperature of the flowlines. • Operation will be intermittent; it is expected that the system will be used for approximately 8.5% of the year during the PSA period. • An electrical field will be generated around the flowlines during DEH operation. The field strength drops very rapidly away from the flowlines, halving within 10m of the flowlines. • Research has shown that elasmobranchs (marine species that are the most sensitive to electric fields) may be sensitive to levels as low as 1 nV/m (1 x 10-9 V/m)[1]. However, elasmobranchs are not expected to be present in the SD Contract Area. While other species may be slightly attracted to, or repelled by, the field, no significant impact is expected at the field strengths predicted for the SD2 Project. • Under both routine conditions and when the DEH system is operational, the outer surface of the production flowlines are not expected to be greater than 0.2°C above ambient seawater temperature. **Conclusion:** Impacts from DEH operation will be intermittent and limited to the immediate area surrounding the flowlines. No discernable impact to the marine environment is expected.

[1] Oregon Wave Energy Trust, Effects of electromagnetic fields on marine species: A literature review. September 2010.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Operations			
Ter-NR2	Fire System Tests	5.12.4.12	• It is anticipated that the firewater pumps will be tested on a weekly basis for 1 hour using freshwater from the firewater tank. Water will be routinely returned to the tank following testing. • Foam systems will be used for fire fighting in certain onshore process areas. • A foam system will be used to protect the SD2 condensate storage tank and any other areas where there is significant liquid hydrocarbon risk. SD2 will use foam system chemicals of the same specification and environmental performance as those currently used at the Terminal. No routine testing of the foam system is planned. **Conclusion:** No discernable impact to the marine environment is expected during fire system testing.
Ter-R2	Onshore Drainage: Discharge to Drainage Channel via the Open Drains Treatment Package	5.12.4.9	• Contaminated effluent will be routed to drainage sumps and holding tanks, which will be designed to allow hydrocarbons to be separated out and recovered to the closed drains system. From the open drains holding tank, the effluent will be routed to the open drains treatment package, designed to treat water to the applicable oil in water standards (i.e. less than 10 mg/l as a monthly average and less than 19 mg/l on a daily basis). Treated water will then be discharged to the drainage channel via the discharge basin. Hydrocarbons from the open drains treatment package will be routed to the oil containment chamber within the discharge basin, from where they will be pumped out and subsequently sent offsite for disposal in accordance with the existing AGT waste management plans and procedures. **Conclusion:** No discernable impact to the marine environment is expected.
Ter-NR3	Non Routine Pond Storage of Produced Water (potential soil, ground and surface contamination)	5.12.4.2	• In situations when the ACG produced water treatment facilities and offsite 3rd party treatment contractor are not available SD produced water will be sent to a new pond for storage. • Surface water and flood modelling will be completed to inform the design of the pond and pond integrity is protected • The pond design will include a composite liner and leak detection system. a sloped floor for drainage, composite liner of a type particularly suited to produced water, a gas-venting system to prevent gas build-up and ballooning of the liner, and an automatic leak detection system with a manual back-up. • The new pond design will adopt lessons learned from the existing ponds at the Terminal (refer to Chapter 6 Section 6.4.4). • Potential for contamination of soil, groundwater and surface water in the Terminal vicinity from produced water considered to be minimal; • When the ponds are being used, samples of water sent to the pond will be collected every week analysed for parameters listed in Appendix 11E and results provided to the MENR on a quarterly basis **Conclusion:** No discernible impact to the terrestrial environment is expected.
All Operations			
All-R1	Waste Management	5.10.13.3, 5.12.5.3 5.10.11.1 and 5.10.11.2 and 5.12.4.13	• Waste generated during SD2 Operations phase will be consistent with the types of waste that have been routinely generated by the existing operational ACG and SD onshore and offshore facilities. • Waste generated during Offshore and Onshore Operations will be segregated at source, stored and transported in fit for purpose containers. • There is no planned discharge of pigging waste to the marine environment. • It is expected that pigging waste quantities generated will not require additional handling resources and the waste will be managed in accordance with established practices. • All waste generated during SD2 Offshore Operations and Production Activities will be managed in accordance with the existing AGT management plans and procedures. Waste minimisation and management plans will be established for the Operations phase and all waste transfers controlled and documented. • BP will manage the collection, transportation, treatment, disposal and storage of waste generated during the Operational phase via specialised approved waste management contractors - the destinations of the waste types is provided in Table 5.38 of Chapter 5: Project Description. **Conclusion**: Waste generated during the SD2 Project will be managed in accordance with the existing BP AGT Region management plans and procedures. No discernable impact to the terrestrial or marine environment expected.

Note: Support Vessels refers to both Offshore and Subsea supply/logistical support

The SD2 routine and non-routine Operations Activities and their associated Events that have been assessed with the full impact assessment process are presented in Table 11.2.

Table 11.2 "Assessed" SD2 Project Offshore, Onshore and Subsea Operations Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Offshore Operations				
Ops-R1	Operation of offshore combustion sources under routine conditions	5.10.5, 5.10.7, 5.10.8, 5.10.10.1, and 5.10.13.1	Emissions to atmosphere (non GHG)	Atmosphere
Ops-NR1	Operation of offshore combustion sources under non routine emergency depressurisation conditions	5.10.7 & 5.10.13.1	Emissions to atmosphere (non GHG)	Atmosphere
Ops-NR2	Operation of offshore combustion sources under non routine DEH scenario conditions	5.10.8, 5.11.2.2	Emissions to atmosphere (non GHG)	Atmosphere
Ops-R2	Cooling water intake and discharge	5.10.10.2	Water intake/entrainment	Marine Environment
			Cooling water discharge to sea	
Ops-R3	Treated black water discharge	5.10.10.9	Other discharges to sea	Marine Environment
Ops-R4	Grey water discharges	5.10.10.9	Other discharges to sea	Marine Environment
Ops-R5	Galley waste discharges	5.10.10.10	Other discharges to sea	Marine Environment
Ops-R6	SDB platform complex drainage	5.10.10.5	Other discharges to sea	Marine Environment
Ops-R7	Saline effluent from Freshwater Maker	5.10.10.7	Other discharges to sea	Marine Environment
Subsea Operations				
Sub-R1	Control fluid discharge from Subsea Control System	5.11.3.5 and 5.11.3.6	Control fluid discharge to sea	Marine Environment
Sub-NR1	Discharge during Subsea Interventions	5.11.4	Other discharge to sea	Marine Environment
Onshore Operations				
Ter-R1	Operation of onshore combustion sources under routine conditions	5.12.4.4, 5.12.4.5, 5.12.4.6 and 5.12.4.7	Emissions to atmosphere (non GHG)	Atmosphere
			Noise	Terrestrial Noise Environment
Ter-NR1	Operation of onshore combustion sources under non routine emergency depressurisation conditions	5.12.4.5 and 5.12.4.6	Emissions to atmosphere (non GHG)	Atmosphere
			Noise	Terrestrial Environment
Ter-NR3	Non Routine Pond Storage of Produced Water (Odour)	5.12.4.2	Generation of odour	Terrestrial Environment

Notes: GHG Emissions are addressed in Chapter 13.

11.3 Impacts to the Atmosphere

Non greenhouse gas (GHG) emissions to the atmosphere during Offshore and Onshore operations will be associated with routine and non routine operation of the SD2 facilities and use of support vessels (offshore only). GHG emissions associated with the SD2 Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts during operations.

11.3.1 Mitigation

Mitigation measures associated with emissions from routine and non-routine emissions from Offshore and Onshore Operations include:

- Generators, cranes, flares and pumps will be subject to planned maintenance in accordance with written procedures based on the manufacturer's guidelines, or applicable industry code or engineering standard to ensure efficient and reliable operation;
- Exhaust emissions' testing will be undertaken at least annually in accordance with the PSA requirement to monitor emissions in accordance with generally accepted international Petroleum industry standards and practices;
- The diesel transported to and stored onboard the SDB platform complex and supplied to support vessels will typically contain a sulphur content of <0.05% weight.
- Onshore, flare gas recovery (FGR) will be used on both HP and LP flare systems to minimise hydrocarbon flows to the flare stacks during normal operations;
- Offshore and onshore flares will be designed to 98% combustion efficiency;
- Offshore and onshore flares will be designed to have a "smokeless design" (Ringelmann<1) for all purge and pilot flaring events and as far as practicable for non routine flaring events without comprising safety, combustion efficiency or flare performance in terms of noise;
- There will be no continuous flaring or venting during routine onshore operations (with the exception of purge/pilot flaring and purging of off gas from the production vessels);
- Planned or unplanned onshore flaring or venting of hydrocarbons will be minimised where practical without compromising the safety of personnel or the integrity of plant;
- Fugitive VOC losses will be minimised through limiting valve connections and instrument intrusions as potential leak points wherever possible, taking into consideration construction, maintenance, isolation, process control and other operational requirements;
- If available and suitable for use, fuel gas will be routinely used for power generation during SDB platform complex operations. When not available e.g. during platform shutdown and restart, the preferred option is to use buy back gas from the SD2 32" gas pipeline, or if not available, diesel; and
- Fuel gas will be routinely used for onshore power generation with back up provided by the existing Terminal generation system or from the Azerbaijani grid.

11.3.2 Offshore Operations

11.3.2.1 Event Magnitude

Description

Under routine operating conditions, emissions will arise from use of the main power generators under routine loading, pilot/purge flaring and fugitive emissions from fittings. Intermittent sources including crew change and supply vessels, diesel powered SDB platform complex cranes, emergency generators and fire water pumps (during testing) will also generate emissions.

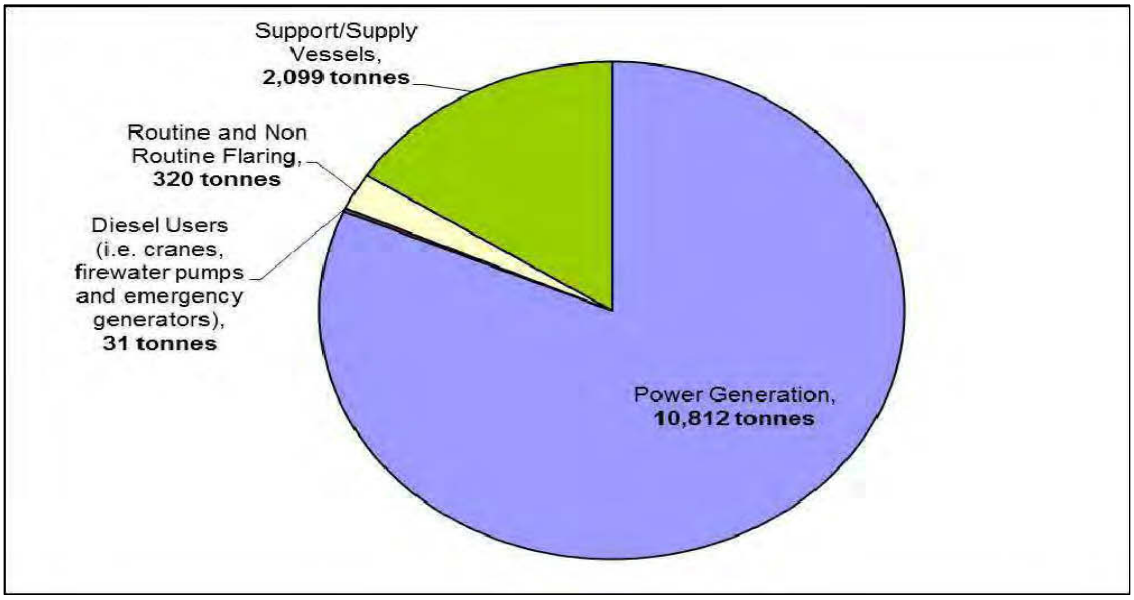
The main power generators on the SDB platform complex also provide power for the DEH, system which is required during low flow or upset conditions to maintain the internal temperature of the subsea flowlines.

During DEH system operation, the loading on the main power generators will increase, depending on the mode of operation (either keep warm or cold start up) and the number of flowlines. The anticipated load profile for the offshore main power generators is provided within Chapter 5 Section 5.10.8. DEH operation is expected for up to 8.5% of the year across the PSA with each event lasting for up to 72 hours.

In addition to pilot and purge flaring, it is intended to route hydrocarbon gases from the processing facilities to the flare under emergency or non routine conditions i.e. due to equipment malfunctions, repairs or maintenance (refer to Chapter 5: Section 5.10.7).

Figure 11.1 below shows the total expected volume of NO_2 emissions from Offshore Operations per source over the PSA period (refer to Appendix 5A for detailed emission estimates and key assumptions).

Figure 11.1 Total Volume of NO_X Emissions from Offshore Routine and Non Routine Operations during the PSA Period Per Source



Assessment

Air dispersion modelling undertaken for the Offshore Operations is presented in Appendix 11C. The modelling focuses on NO_X (which comprises nitrous oxide (NO) and nitrogen dioxide (NO_2)) as the main atmospheric pollutant of concern. Short term (1 hour maximum) and long term (annual average) NO_2 concentrations were modelled to assess the contribution of emissions from SD2 Offshore Operations in the context of relevant standards for NO_2 of 40µg/m^3 (annual average) and 200µg/m^3 (1 hour maximum). These standards are relevant to locations where humans are normally resident (i.e. onshore settlements).

The following scenarios were assessed:

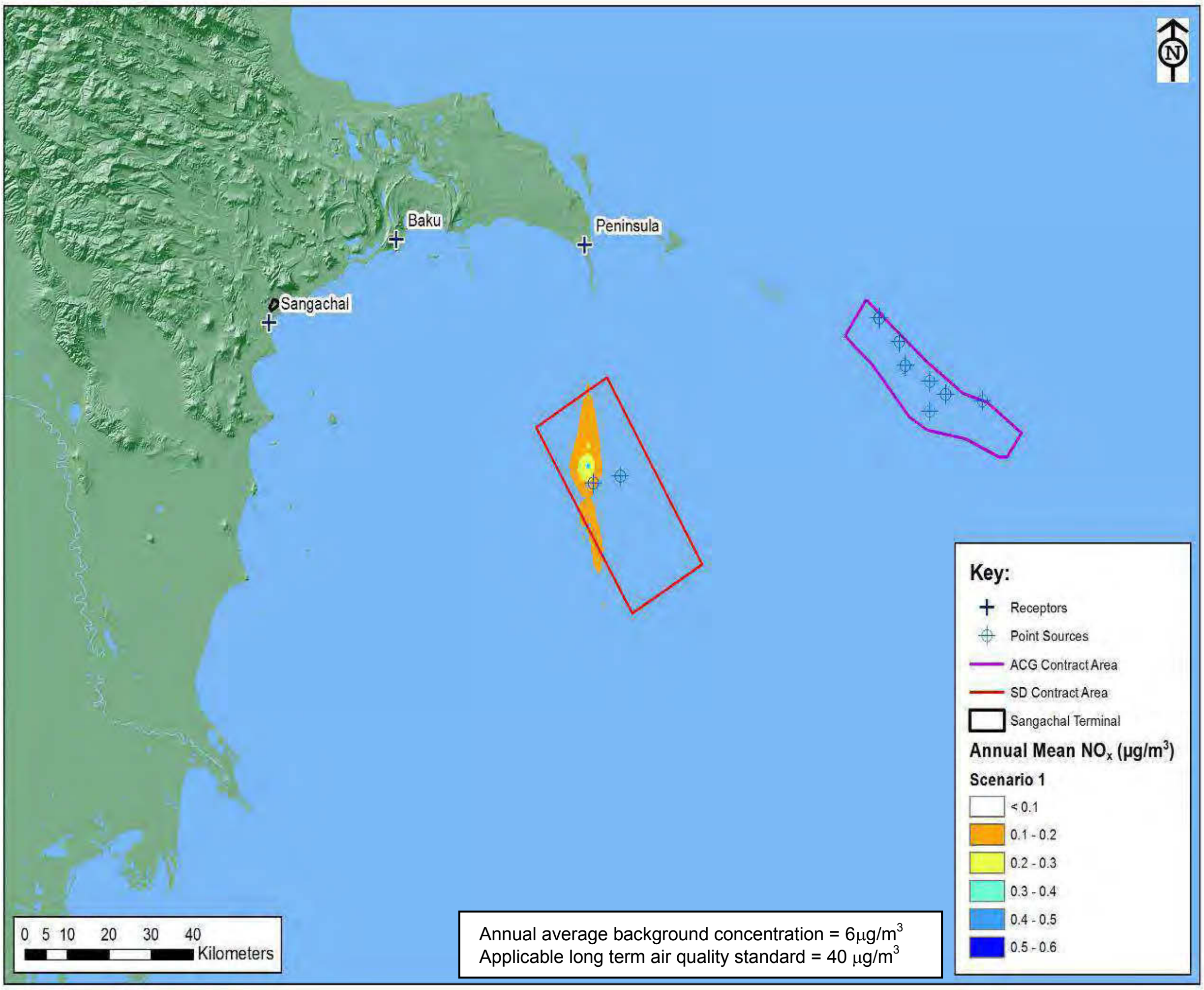
1. Routine operations – sources comprised two of the 11.9MW platform turbines operating at full load on fuel gas;
2. Non routine operations (DEH Operation) – sources comprised all the 11.9MW platform turbines operating at full load on fuel gas; and

3. Non routine operations (Emergency Flaring) - sources comprised two of the 11.9MW platform turbines operating at full load on fuel gas and emergency depressurisation flaring (estimated to occur over an hour).

For each scenario the assessment assumed full loading on the turbines to provide a worst case estimate. The modelling was undertaken based on slightly higher full turbine loads than those anticipated for the SD2 Project Base Case and assuming a total of five rather than four turbines in use for the DEH scenario. The modelling results are therefore considered to be conservative.

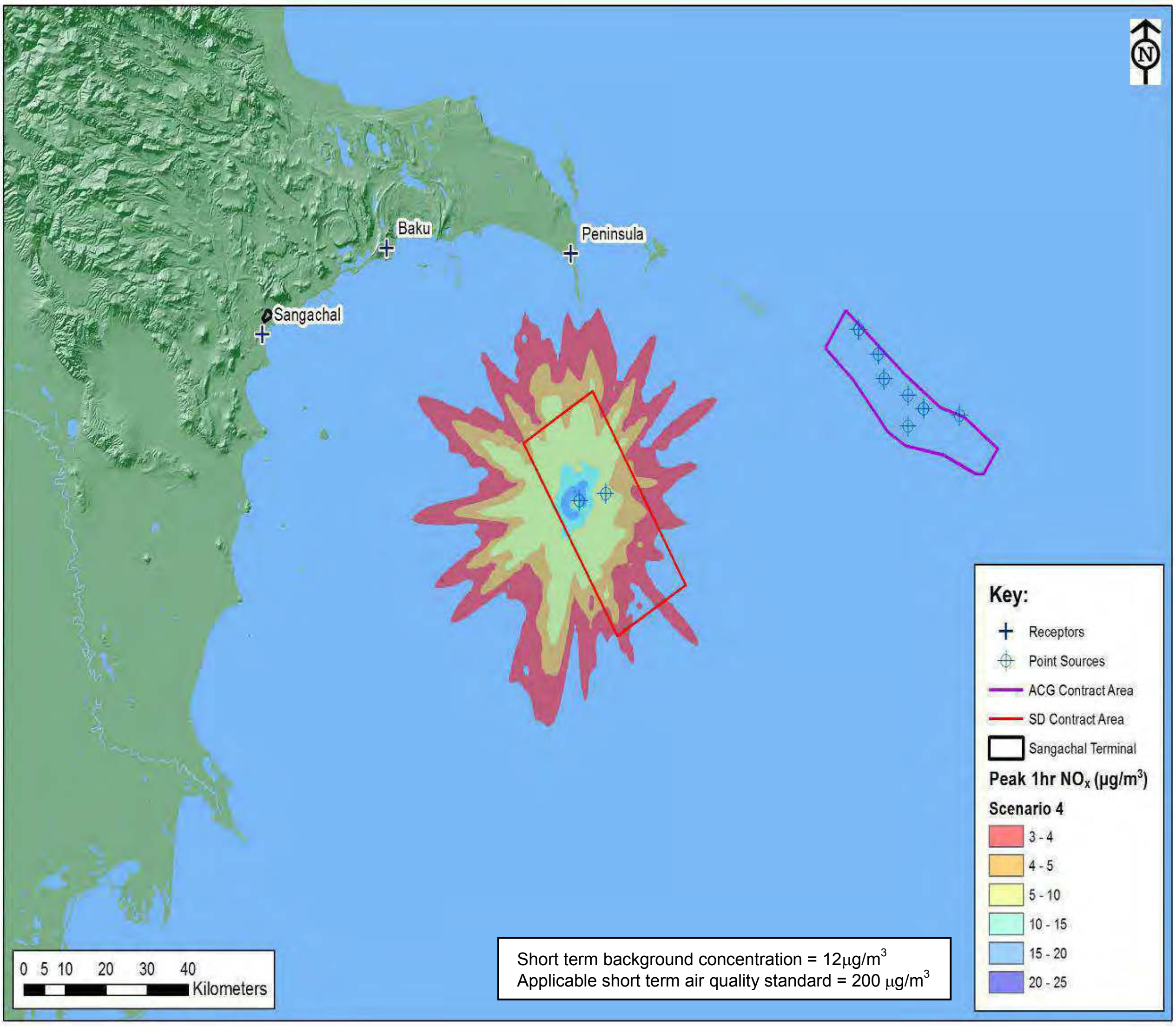
For all scenarios assessed the highest increase in concentrations of NO_2 concentrations were observed where the dispersion plume meets the Absheron Peninsula (at Shahdili Spit) due to prevailing northerly wind direction. Figures 11.2 and 11.3 show the increases in long and short term NO_X concentrations for the routine operation and non routine (Emergency Flaring) scenarios respectively.

Figure 11.2 Increase in Long Term NOx Concentration Onshore During Routine Offshore Operations



Note: As described in Appendix 11C, for the long term it is assumed that all NO_X converts to NO_2 in the atmosphere

Figure 11.3 Increase in Short Term NO_X Concentration Onshore During Non Routine Offshore Operations (Emergency Flaring for up to 1 hour duration)



Note: As described in Appendix 11C, for the short term it is assumed that 50% of NO_X converts to NO_2 in the atmosphere

The results at the Absheron Peninsula/Shahdili Spit receptor for the three scenarios assessed are summarised within Table 11.3. The long term and short term background concentrations of NO_2 were assumed to be 6 and 12 respectively (refer to Appendix 11C for further details).

Table 11.3 Predicted Increase in Long Term and Short Term NO_2 Concentrations at the Absheron Peninsula/Shahdili Spit Receptor for Modelled Offshore Operating Scenarios

Scenario	Long Term Annual Average			Short Term Maximum		
	Increase in NO_2 concentration (long term) (µg/m^3)	% of air quality standard	% increase above background concentration	Increase in NO_2 concentration (short term) (µg/m^3)	% of air quality standard	% increase above background concentration
1. Routine operations	0.1	0.1%	0.8%	1.1	0.5%	9%
2. Non routine operations (DEH Operation)	n/a as event duration is approximately 72 hours			2.1	1.5%	17.5%
3. Non routine operations (Emergency Flaring)	n/a as event duration is approximately 1 hour			1.1	0.5%	9%

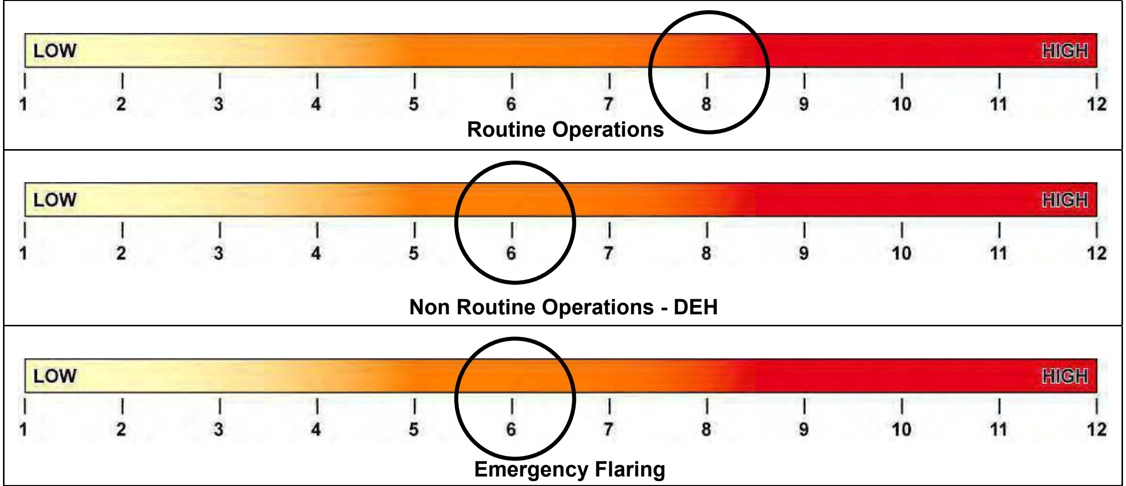
The results show that for all scenarios considered, no exceedances of the onshore short term or long term NO_2 air quality standards were predicted at onshore locations. Increases in NO_2 concentrations above background concentrations were also shown to be insignificant.

Based on efficient operation and regular maintenance, operation of the offshore generators and flaring will not result in plumes of visible particulates.

Table 11.4 presents the justification for assigning a score of 8 to emissions from routine Offshore Operations and 6 to non routine operations including DEH operation and Emergency Flaring, which represents Medium Event Magnitude.

Table 11.4 Event Magnitude

Event Parameter	Routine Operations	Non Routine Operations: DEH	Emergency Flaring
Extent/Scale	1	1	1
Frequency	3	3	3
Duration	3	1	1
Intensity	1	1	1
Event Magnitude:	**8**	**6**	**6**



11.3.2.2 Receptor Sensitivity

Human Receptors

Table 11.5 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.5 Human Receptor Sensitivity

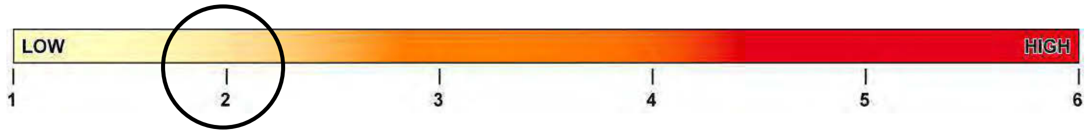
Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 80km of the SDB platform complex.	1
Resilience	Changes in air quality onshore will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**

Biological/Ecological Receptors

Table 11.6 presents the justification for assigning a score of 2 to biological/ecological receptors, which represents Low Receptor Sensitivity.

Table 11.6 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Marine/bird species are mobile and will not be present at one location for long periods of time. Birds found in the area will be transient and not resident.	1
Resilience	Volume of emissions released (including visible particulates) will create a very small increase in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernable to biological / ecological receptors[2].	1
Total		**2**



11.3.2.3 Impact Significance

Table 11.7 summarises impacts on air quality associated with Offshore Operations.

Table 11.7 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Routine Offshore Operations	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
Non Routine Offshore Operations (DEH)	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
Non Routine Offshore Operations (Emergency Flaring)	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**

[2] Note that ambient air quality standards are not relevant to biological/ecological receptors.

The following monitoring and reporting requirements related to emissions to atmosphere form part of the AGT Region Environmental Management System (EMS):

- Emissions testing of SDB platform complex exhausts to confirm that the NO_X, SO_X and CO emissions are at the specified levels (i.e. the levels and tolerances determined by the equipment manufacturer which confirm efficient operation). Monitoring will be undertaken in accordance with the existing AGT Region methodologies and procedures aligned with US EPA and ISO stack emissions measurement and calibration requirements;
- SDB platform complex exhaust emission test results will be submitted to the MENR; and
- Emission volumes for the SD2 facilities based on fuel usage and calculated flare volumes will be submitted to the MENR, SOCAR and the State Statistical Committee at an agreed frequency.

It is considered that impacts are minimised are far as practicable and necessary through the implementation of the existing mitigation measures and no additional controls are required.

11.3.3 Onshore Operations

11.3.3.1 Event Magnitude

Description

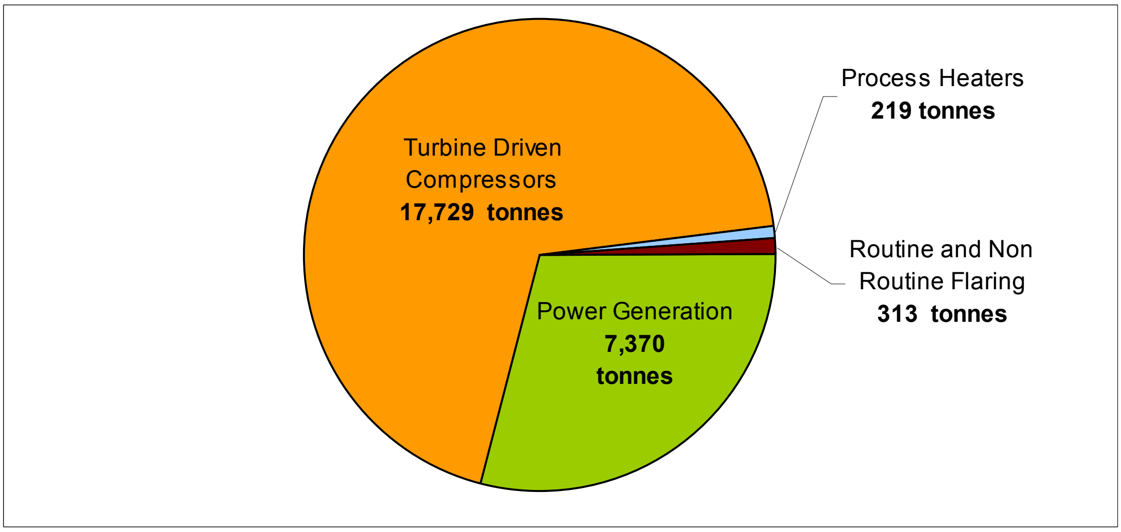
Under routine operating conditions, emissions will arise at the SD2 Sangachal Terminal from the main SD2 power generator, two direct drive export compressors fitted with waste heat recovery units (WHRU) and pilot flaring. During routine operation off gas from the majority of the production vessels and tanks will be sent to the FGR system. Fugitive emissions from fittings and the SD2 condensate tank, which cannot be sent to the FGR system for practical and safety reasons, will be released to the atmosphere.

Under non routine conditions when the WHRU are not available (e.g. during start up and maintenance), the heating requirement for the onshore facilities will be provided by a direct fired oil heater.

In addition to pilot and purge flaring, it is intended to route hydrocarbon gases from the processing facilities to the flare under emergency or non routine conditions i.e. due to equipment malfunctions, repairs or maintenance (refer to Chapter 5: Section 5.12.4.6).

Figure 11.4 below shows the total expected volume of NO_2 emissions from Onshore Operations per source over the PSA period (refer to Appendix 5A for detailed emission estimates and key assumptions).

Figure 11.4 Total Volume of NO_2 Emissions from Onshore Routine and Non Routine Operations during the PSA Period Per Source



Assessment

Air dispersion modelling undertaken for Onshore Operations is presented in Appendix 11B, and focused on NO_X as the main atmospheric pollutant of concern. Short term (1 hour maximum) and long term (annual average) NO_2 concentrations were modelled to assess the contribution of emissions from SD2 Onshore Operations in the context of relevant standards for NO_2 of 40µg/m^3 (annual average) and 200µg/m^3 (1 hour maximum). The long term and short term background concentrations of NO_2 were assumed to be 6 and 12 respectively (refer to Appendix 11C for further details).

The following scenarios were assessed:

1. Routine operations – sources comprised the power generation turbine and the direct drive compressors (with Waste Heat Recovery (WHR) operational);
2. Non routine operations (Fired Heater) – sources comprised the power generation turbine, the direct drive compressors (with WHR not operational) and the direct fired heater; and
3. Non routine operations (Emergency Flaring) - sources comprised the power generation turbine and the direct drive compressors (with WHR operational) and emergency depressurisation flaring (estimated to occur over an hour period).

For each scenario both loading at 100% and 70% were modelled, however the 70% loading is considered to be representative of operating conditions across the PSA period. The modelling was undertaken based on slightly higher turbine and fired heater loads than those anticipated for the SD2 Project Base Case. The modelling results are therefore considered to be conservative.

Increases in NO_2 concentrations for each scenario assessed were predicted for receptor locations in the Terminal vicinity. The increase in NO_2 concentrations at these receptors for onshore routine operations is presented in Figure 11.5. Figure 11.6 shows the predicted increase in long term NO_2 concentrations in the Terminal vicinity.

Figure 11.5 Increase in i) Long Term and ii) Short NO_2 Concentrations Due to Onshore Operations at Onshore Receptors (Routine Conditions)

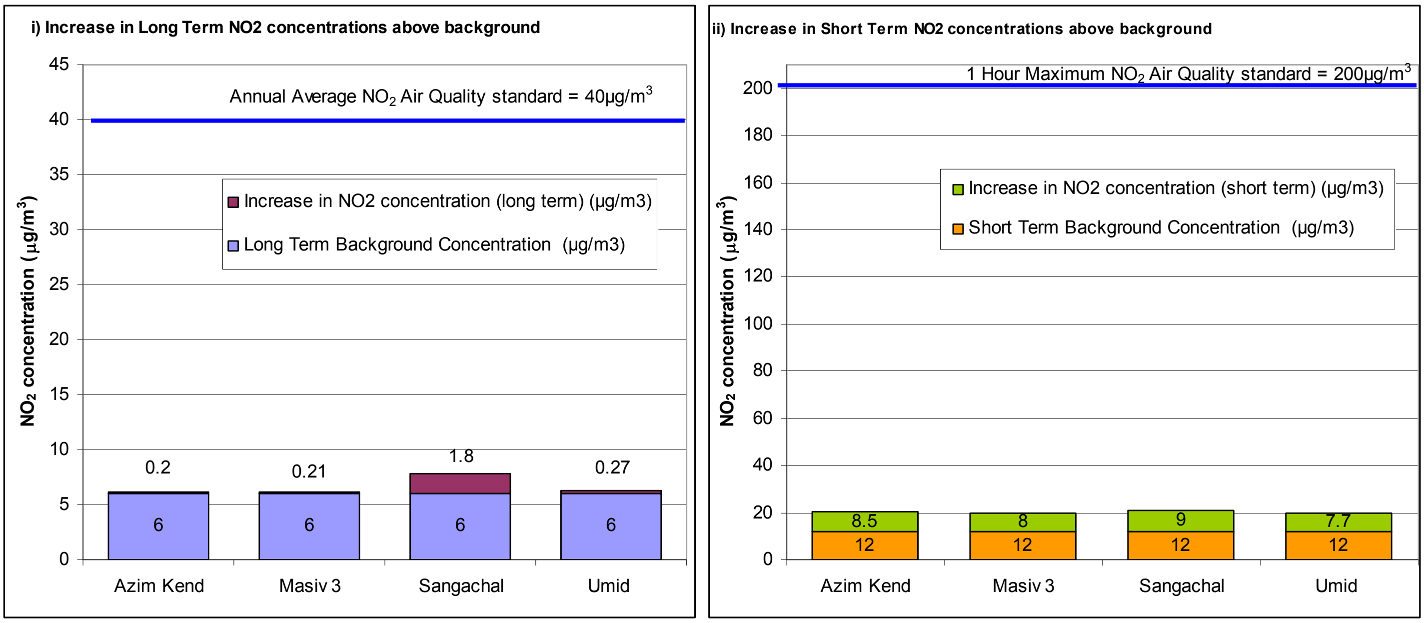


Figure 11.6 Increase in Long Term NO_X Concentrations in the Sangachal Terminal Vicnity During Routine Onshore Operations

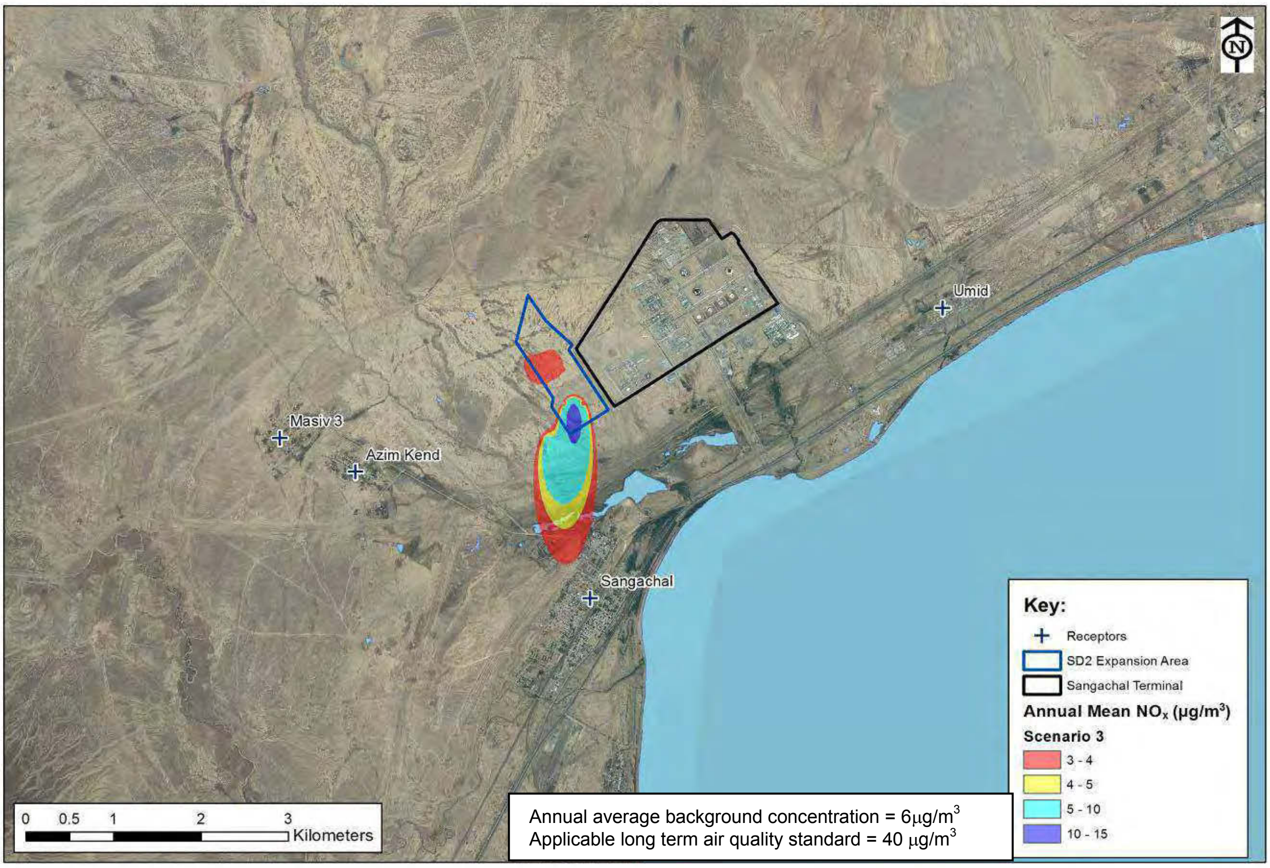


Figure 11.5 and 11.6 show that no exceedances of the onshore short term or long term NO_2 air quality standards were predicted at the onshore locations in the Terminal vicinity under routine operating conditions. The highest increase in NO_2 concentrations was predicted at the Sangachal receptor, which is directly downwind of the Terminal, where NO_2 long term concentrations are expected to increase by 1.8µg/m^3. This represents an increase of 30% above background concentrations however the predicted NO_2 concentration including background concentrations (7.8µg/m^3) remain well below the air quality standard of 40 µg/m^3.

Both non routine operating scenarios (fired heater operation and emergency flaring) are expected to occur intermittently and for short periods. The increase in NO_2 short term concentrations at receptors for onshore non routine operations is presented in Figure 11.7. Figure 11.8 shows the predicted increase in short term NO_2 concentrations in the Terminal vicinity under the emergency flaring scenario.

Figure 11.7 Increase in Short Term NO_2 Concentrations at Onshore Receptors For Non Routine i) Fired Heater and ii) Emergency Flaring Scenarios

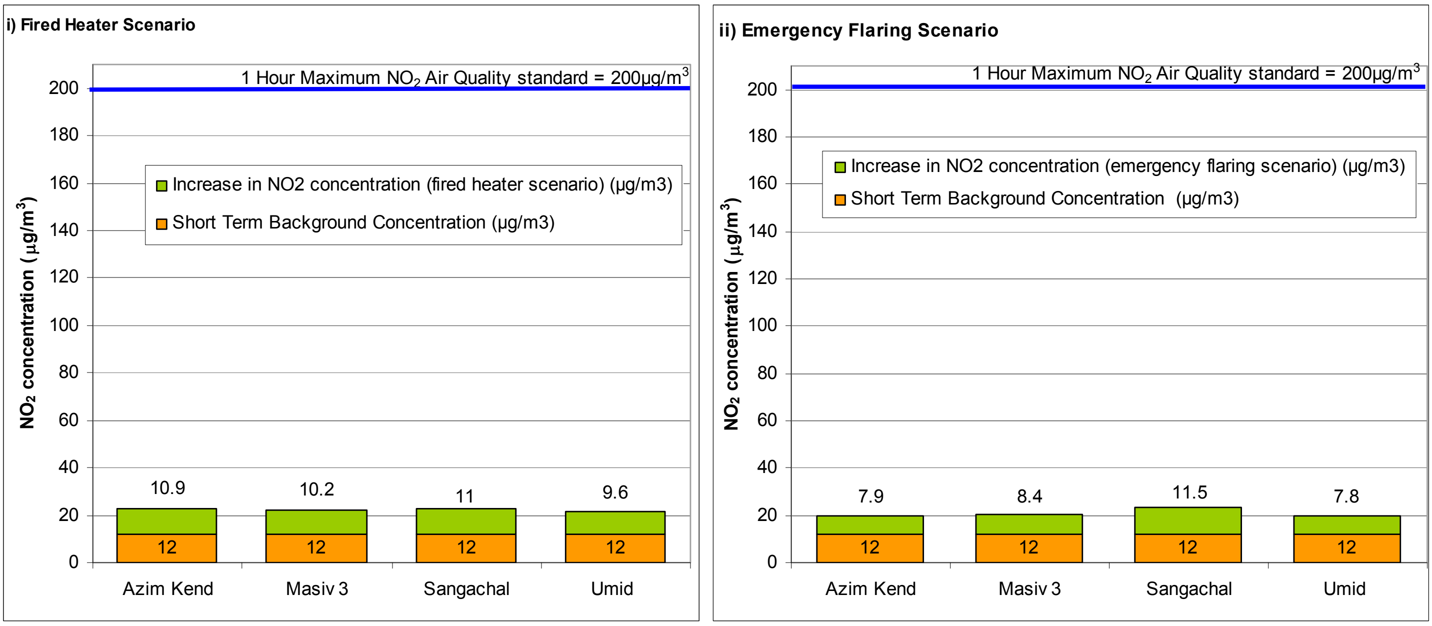
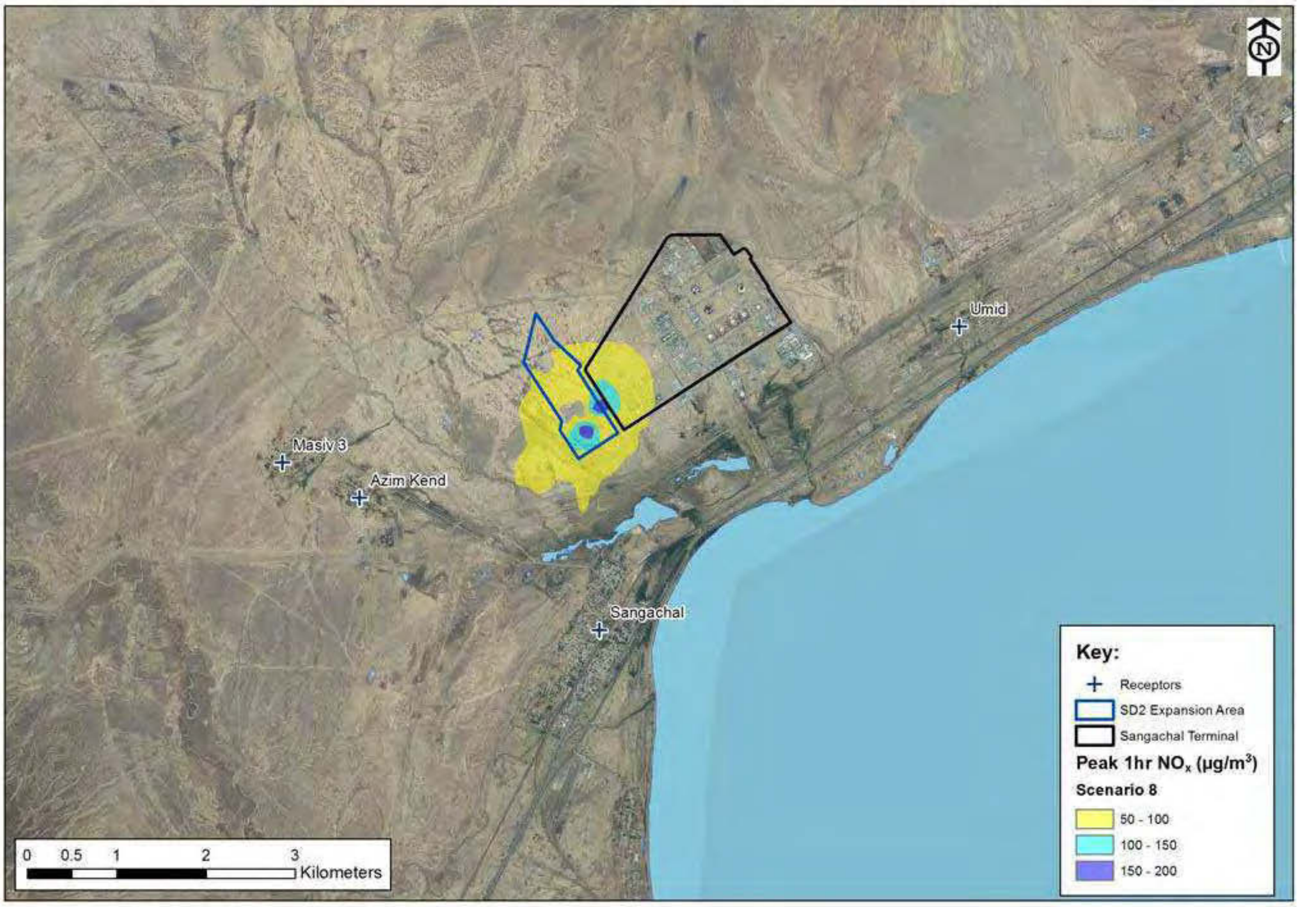


Figure 11.8 Increase in Short Term NOx Concentration in the Sangachal Terminal Vicinity During Non Routine Onshore Operation (Emergency Flaring)



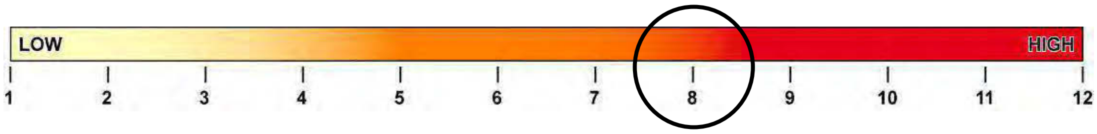
Figures 11.7 and 11.8 show that no exceedances of the onshore short term NO_2 air quality standards were predicted at the onshore locations in the Terminal vicinity under non routine operating conditions. The highest increase in NO_2 concentrations was again predicted at the Sangachal receptor, where NO_2 short term concentrations are expected to increase by 11µg/m^3 for the fired heater scenario. This represents an increase of 92% above background concentrations however the predicted NO_2 concentration including background concentrations (23µg/m^3) remain significantly below the air quality standard of 200µg/m^3.

Modelling focused on short term PM_{10} concentrations was also completed for the non routine emergency flaring scenario. As detailed in Chapter 6 Section 6.4.6.4 monitoring has shown that background concentrations of PM_{10} (estimated as 200 µg/m^3) exceed the relevant 24 hour air quality standard of 50µg/m^3. This is considered to be due to the semi arid environment where natural entrainment of dust in the atmosphere occurs. For the emergency flaring scenario the modelling predicted an increase in short term PM_{10} concentrations at the Sangachal North receptor of 24.1 µg/m^3 representing approximately 48% of the air quality standard. In the context of existing background PM_{10} concentrations this is not considered significant.

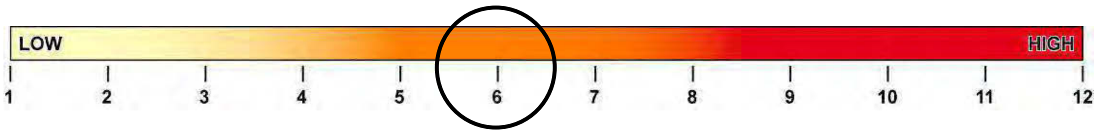
Table 11.8 presents the justification for assigning a score of 8 to emissions from routine Onshore Operations and 6 to non routine operations (both Fired Heater and Emergency Flaring Scenarios), which represents Medium Event Magnitude.

Table 11.8 Event Magnitude

Event Parameter	Routine Onshore Operations	Non Routine Onshore Operations (Fired Heater and Emergency Flaring)
Extent/Scale	1	1
Frequency	3	3
Duration	3	1
Intensity	1	1
Event Magnitude:	**8**	**6**



Routine Operations



Non Routine Operations – Fired Heater / Emergency Flaring

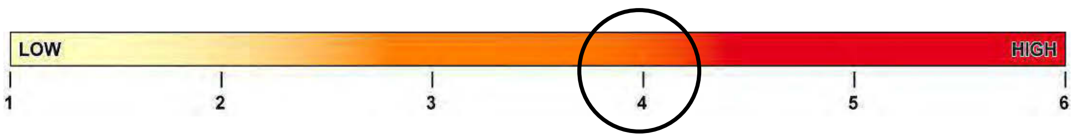
11.3.3.2 Receptor Sensitivity

Human Receptors

Table 11.9 presents the justification for assigning a score of 4, which represents Medium Receptor Sensitivity.

Table 11.9 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Permanently present (i.e. resident) human receptors exist within 1km of the Terminal.	3
Resilience	Existing ambient NO_2 concentrations within residential areas in the Terminal vicinity are approximately 15% of the long term air quality standard and 6% of the short air quality.	1
Total		**4**

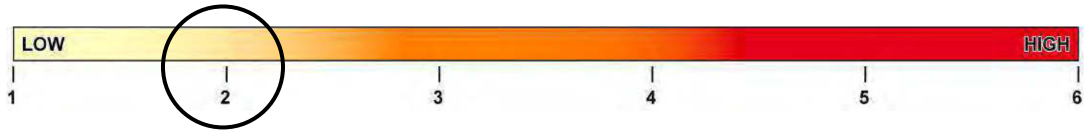


Biological/Ecological Receptors

Table 11.10 presents the justification for assigning a score of 2 to biological/ecological receptors, which represents Low Receptor Sensitivity.

Table 11.10 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Bird/terrestrial species are mobile and will not be present at one location for long periods of time. There is no evidence to indicate that the habitat within the area around the Terminal is of unique value to breeding birds in the vicinity of the Terminal[3].	1
Resilience	Volume of emissions released (including particulates) due to Onshore Operations will create a very small increase in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernable to biological/ecological receptors[4].	1
Total		**2**



11.3.3.3 Impact Significance

Table 11.11 summarises impacts on air quality from onshore combustion plant emissions and flaring.

Table 11.11 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Routine Operations	Medium	(Humans) Medium	**Moderate Negative**
		(Biological/Ecological) Low	**Minor Negative**
Non Routine Operations: (Fired Heater and Emergency Flaring)	Medium	(Humans) Medium	**Moderate Negative**
		(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to onshore emissions to atmosphere form part of the AGT Region EMS:

- Ambient air monitoring will be undertaken at and around the Sangachal Terminal as part of the EMP (quarterly monitoring for NO_X, SO_X and VOC);
- Annual stack emissions monitoring of emission sources will be completed for NO_X, SO_X and CO. Test results will be submitted to the MENR;
- Emission volumes for the SD2 facilities based on fuel usage and calculated flare volumes will be submitted to the MENR, SOCAR and the State Statistical Committee at an agreed frequency; and
- EMP monitoring results will be submitted to the MENR/MTAG.

It is considered that impacts are minimised are far as practicable and necessary through the implementation of the existing mitigation measures and no additional controls are required.

[3] Refer to Chapter 6.
[4] Note that ambient air quality standards are not relevant to biological/ecological receptors.

11.4 Impacts to the Terrestrial Environment – Odour

11.4.1 Onshore Operations Pond Storage of Produced Water

11.4.1.1 Mitigation

Planned mitigation measures associated with potential odour due to the use of produced water storage ponds include:

- Pond design will incorporate features to reduce formation of produced water aerosol during high wind events.

11.4.1.1 Event Magnitude

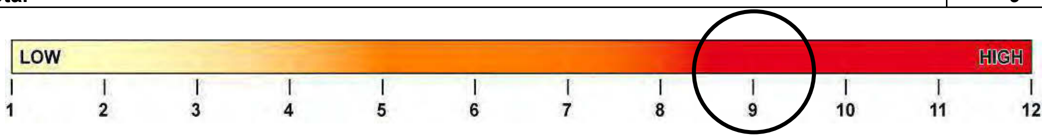
Description and Assessment

In situations when the ACG produced water treatment facilities and offsite 3rd party treatment contractor are not available SD produced water will be sent to a pond for storage. From previous experience during storage there is potential for odours to arise primarily due to the volatile organic compounds (VOCs) present in the produced water.

Table 11.12 presents the justification for assigning a score of 9 to odour generated by non routine pond storage of produced water, which represents a High Event Magnitude for routine operations.

Table 11.12 Event Magnitude

Parameter	Explanation	Rating
Extent / Scale	Based on experience from current operations, depending on meteorological conditions, there is potential for odour from the produced water pond to travel to communities surrounding the Terminal. Existing controls within the SD2 design include features to reduce formation of produced water aerosol during high wind events.	2
Frequency	The pond is not planned to be used on a continuous basis	2
Duration	Produced water maybe present in the pond for period of longer than one month	3
Intensity	Odour thresholds established in accordance with the UK Environment Agency Guidance for odour assessment may be exceeded during periods of pond operation although not on a continuous basis	2
Total		**9**



11.4.1.2 Receptor Sensitivity

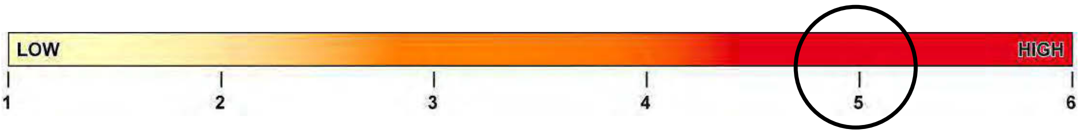
The nearest receptors to the SD2 onshore facilities (refer to Chapter 6, Section 6.4.1) include residents of:

- Sangachal Town, approximately 2.5km southwest of the Terminal;
- Azim Kend, approximately 2.7km west of the Terminal; and
- Umid, approximately 1km southeast of the Terminal.

Table 11.13 presents the justification for assigning a score of 4 to human receptors, which represents High Sensitivity.

Table 11.13 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptors based in Umid are located 1km southwest of the Terminal	3
Resilience	During monitoring odour levels in the communities surrounding the Terminal were generally classed as non offensive or least offensive (refer to Chapter 6 Section 6.4.6.3) however complaints have been received from residents within the communities around the Terminal regarding odours from historic and existing produced water storage in ponds.	2
Total		**5**



11.4.1.3 Impact Significance

Table 11.14 summarises impact of pond storage of produced water on odour levels at the the local communities

Table 11.14 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Odour from non routine pond storage of produced water	High	(Humans) High	**Major Negative**

The following monitoring and reporting requirements related to odour from the non routine storage of produced water in ponds will form part of the AGT Region EMS:

- An odour monitoring programme will be implemented and results provided to the MENR on a quarterly basis.
- When the ponds are being used, samples of water sent to the pond will be collected every week analysed for parameters listed in Appendix 11E associated with odour and results provided to the MENR on a quarterly basis.

11.4.1.4 Additional Mitigation Measures

The assessment above has demonstrated that odour generated from non routine pond storage of produced water may result in a Major Negative impact to receptors. Mitigation already adopted to minimise odour is detailed in Section 11.4.1.

To further minimise odour:

- A treatment package will be used to manage any potential exceedances of air quality thresholds from the produced water stored in the pond and odour control techniques will be evaluated and, if practicable, included in the design.

With this additional mitigation measure in place it is expected the impact associated with odour from non routine pond storage of produced water will reduce to Moderate Negative.

11.5 Impacts to the Terrestrial Noise Environment

This section presents the assessment of potential impacts to the terrestrial noise environment during Onshore Operations associated with routine operation of the SD2 facilities and non routine flaring. Existing mitigation measures relevant on routine and non routine noise from Onshore Operations are presented along with any additional controls that are required to further minimise the predicted impacts if required.

11.5.1 Mitigation

Existing mitigation measures associated with routine and non routine noise associated with the onshore operations include:

- The SD2 onshore facilities design incorporates basic pipework attenuation to achieve a 10 dB(A) reduction in pipework noise e.g. basic pipework cladding scheme of 50 mm mineral wool plus lightweight cladding;
- Cladding will be provided to onshore pipework associated with inlet and outlet compressors, recycle pipework, turbo expander pipework and pipework associated with major process control valves;
- Where cladding is not practical, inline silencers will be included in the onshore pipework where practical;
- Noise source levels for the onshore inlet and export compressors will be specified as no more than 85dB(A) at 1m from the skid;
- There will be no continuous flaring or venting during routine onshore operations (with the exception of purge/pilot flaring and purging of off gas from the production vessels); and
- Planned or unplanned onshore flaring or venting of hydrocarbons will be minimised where practical without compromising the safety of personnel or the integrity of plant.

11.5.2 Onshore Operations

11.5.2.1 Event Magnitude

Description

Under routine operating conditions, noise will result from operation of the SD2 onshore facilities, specifically:

- Large mechanically and electrically driven rotating equipment (i.e. main SD2 power generator, two export compressors, the turbo expander compressors and large pumps); and
- Main process pipe work and compressor pipework.

In addition to pilot/purge flaring during routine operations, non routine flaring will occur across the PSA period due to equipment malfunctions, repairs or maintenance (refer to Chapter 5: Section 5.12.4.6) or emergency depressurisation.

Assessment

Routine Plant Operation

An onshore plant noise modelling assessment was undertaken, taking into account the main noise sources including the main power generator turbine, the gas export compressors, pumps, pipework. The measures listed within Section 11.5.1 above were incorporated into the model. Noise levels were predicted at each receptor surrounding the Terminal (Sangachal Town, Umid and Azim Kend/Masiv 3) and compared against the relevant SD2 noise budgets. These were derived from the night-time noise limit of 45dB(A) (the most stringent noise limit) minus the noise levels currently being experienced at each receptor associated with the existing plant Terminal plant (refer to Appendix 11D for further details of the modelling assessment).

Table 11.15 presents the results obtained from the modelling.

Table 11.15 Summary of SD2 Noise Levels at Receptors During Routine Operations

Receptor	SD2 Noise Budget dB(A)	Predicted Noise Level dB(A)	Predicted Noise Level Relative to SD2 Noise Budget dB(A)
Sangachal	41.3	38.7	-2.6
Azim Kend/ Masiv 3	43.8	35.9	-7.9
Umid	40.1	28.1	-12.0

The modelling predicted noise levels at receptors between 2.6 and 12dB(A) below the SD2 noise budgets and hence the night time noise limit. It is therefore expected that noise limits would be met at all receptors under routine conditions.

Non Routine Flaring

Noise modelling was undertaken to estimate the noise levels at local community receptors due to SD2 non routine flaring in the vicinity of the Terminal and the potential duration of exceedance of the following operational noise limits (to be met for at least 95% of the time):

- Daytime (07:00 to 22:00) LAeq : 45 dB(A); and
- Night-time (22:00 to 07:00 LAeq : 55 dB(A).

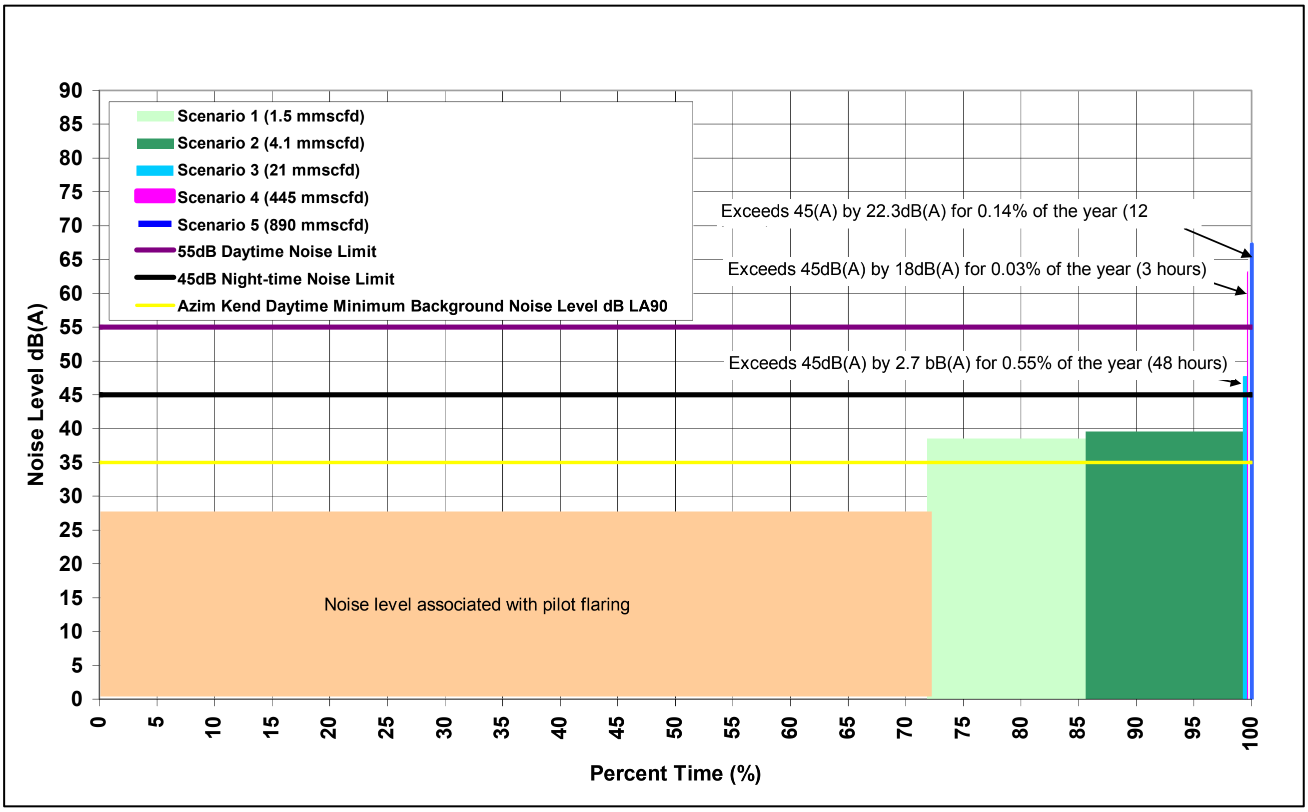
A number of anticipated flaring scenarios were identified for years 1, 2 and 3 onwards, including expected flowrates, frequency and duration of flaring per event. These are presented in Table 11.16.

Table 11.16 Anticipated Flaring Events (Routine and Non Routine Operations)

Event	Year	Flowrate (MMscfd)	Maximum Frequency per Year	Maximum Duration (hours)
Flare Gas Recovery Operation & Pilot Flaring (Routine Operations)	All Years	<1.5	n/a - continuous	
Normal operation with HP flare gas recovery offline	All Years	1.5	10	120
Normal operation with LP flare recovery offline	All Years	4.1	10	120
Loss of Flash Gas compression Operation with 2 x 50% flash gas compression	Years 1 &2	11	4	24
	Year 3 onwards	21	2	24
Small & Medium operational trips e.g. loss of compressor train, export compressor trips	Year 1	290	1	22
Small operational trips e.g. loss of 1 compressor train, 1 gas conditioning train	Year 2	445	1	6
Medium operational trips e.g. loss of 2 compressor trains, 2 export compressor trips	Year 2	750	1	9
Small & Medium operational trips e.g. loss of compressor train, export compressor trips	Year 3 onwards	890	1	12
Emergency Depressurisation	Year 2	1890	1	1

Noise levels were calculated at each receptor surrounding the Terminal (Sangachal, Azim Kend/Masiv 3 and Umid). The highest noise levels were found to occur at Azim Kend/Azim Kend. Figure 11.9 below show the noise levels at Azim Kend for the proportion of the year that the flaring scenario (and hence the noise level) is expected to occur for Year 3 (the worst case in terms of flaring frequency and duration).

Figure 11.9 Predicted Noise Levels Associated with Non Routine Flaring at Azim Kend/Masiv 3 (Year 3)



Based on the expected frequency and duration of the non routine flaring scenarios it was predicted that, as a worst case, the noise 45dB(A) limit would be met for at least 99.3% of the year at Azim Kend/Masiv 3 and Sangachal and at least 99.77% of the year at Umid for all years.

Table 11.17 presents the justification for assigning a score of 8 for routine onshore plant operations, which represents a Medium Event Magnitude for routine operations.

Table 11.17 Event Magnitude - Routine Plant Operations

Parameter	Explanation	Rating
Extent / Scale	Noise generated by Onshore Operations will be audible to residents of local communities that are located a distance greater than 1km from the Terminal. However noise will be low level that does not exceed noise standards.	1
Frequency	Noise emissions will occur continuously.	3
Duration	Emissions will continue for the SD2 Project lifetime.	3
Intensity	SD2 plant noise will not result in the exceedance of noise standards at the nearest residential receptors.	1
Total		**8**

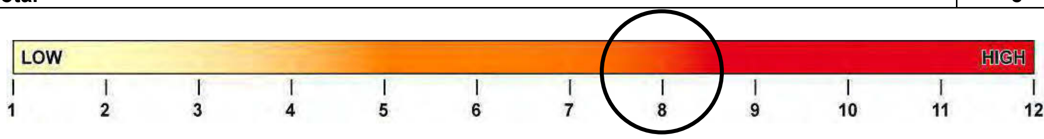
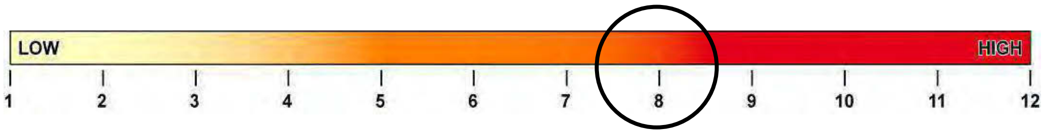


Table 11.18 presents the justification for assigning a score of 8 for non routine onshore flaring, which represents a Medium Event Magnitude.

Table 11.18 Event Magnitude – Non Routine Flaring

Parameter	Explanation	Rating
Extent / Scale	Noise generated by non-routine flaring conditions will be audible to residents of local communities that are located a distance greater than 1km from the SD2 elevated flare package	3
Frequency	Non routine flaring events are predicted to occur up to 27 times a year.	2
Duration	Non-routine flaring events are predicted to occur periodically for up to 120 hours per event	2
Intensity	Applicable noise limits are predicted to be met for 95% of the time per year.	1
Total		**8**



11.5.2.2 Receptor Sensitivity

Human Receptors

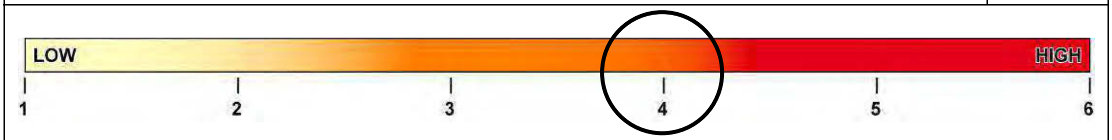
The nearest receptors to the SD2 onshore facilities (refer to Chapter 6, Section 6.4.1) include residents of:

- Sangachal Town, approximately 2.5km southwest of the Terminal;
- Azim Kend, approximately 2.7km west of the Terminal; and
- Umid, approximately 1km southeast of the Terminal.

Table 11.19 presents the justification for assigning a score of 4 to human receptors, which represents Medium Sensitivity.

Table 11.19 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptors based in Umid are located 1km southwest of the Terminal	3
Resilience	Existing noise levels at receptors are dominated by road noise and noise from the Sangachal Power Station. The existing Sangachal Terminal plant is not routinely audible at receptors. Modelling results have confirmed that noise generated by plant will meet noise limits at receptors. Noise associated within non-routine flaring events will meet applicable noise limits at Umid, Azim Kend and Sangachal Town for at least 99.3% of the time (more than minimum 95%)	1
Total		**4**



11.5.2.3 Impact Significance

Table 11.20 summarises the significance of noise generated from routine operations and non-routine flaring events.

Table 11.20 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Routine Operations: Noise	Medium	Medium	**Moderate Negative**
Non Routine Operations (Flaring): Noise	Medium	Medium	**Moderate Negative**

The following monitoring and reporting requirements related to noise emissions form part of the AGT Region EMS:

- Ambient noise monitoring will be undertaken at and around the Sangachal Terminal as part of the EMP;
- EMP monitoring results will be submitted to the MENR/MTAG;
- Noise assessment will continue throughout the detailed design, procurement, mechanical completion and commissioning stages of the SD2 project focused on performance requirements in terms of noise (e.g. required sound power levels for plant items) such that noise limits can be achieved ; and
- An SD2 flaring policy will be developed and implemented. The policy will specify operational procedures aimed at reducing the frequency and duration of flaring associated with SD2 onshore non routine flaring events.

It is considered that impacts are minimised as far as practicable and necessary through the existing mitigation measures for the flare design and no further mitigation is required.

11.6 Impacts to the Marine Environment

Impacts to the marine environment from SD2 Offshore and Subsea Operations are assessed taking into account:

- Discharges to sea associated with SDB platform complex cooling water intake and discharge;
- Other SDB platform complex discharges (including treated black water, grey water, galley waste, drainage and saline effluent);
- Routine control fluid discharges from the subsea production system control system; and
- Non routine discharges associated with subsea production system interventions.

11.6.1 Offshore Operations - Cooling Water Intake and Discharge

11.6.1.1 Mitigation

Existing mitigation measures associated with the SDB platform complex cooling water intake and discharge include:

- The design and operation of the cooling water system has been reviewed and confirmed that the temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees more than the ambient water temperature; and
- The seawater intake caissons design includes a mesh of 200mm diameter to prevent fish entrainment.

11.6.1.2 Event Magnitude

Description

An indirect seawater cooling system will be located on the SDB-QU platform. Seawater will be abstracted from a depth of -75m below sea level at a rate of approximately 2,173m^3/hr (refer to Chapter 5: Section 5.10.10.2).

Abstracted seawater will be electrochlorinated in an antifouling package and dosed with 50ppbv of chlorine and 5ppbv copper; and then filtered to remove any particles that are above 50 microns in diameter. After use, the majority of the seawater (up to 2,124m^3/hr) will be returned to the sea, via the seawater discharge caisson (at a depth of -54.5m below sea level).

Assessment

Seawater Intake

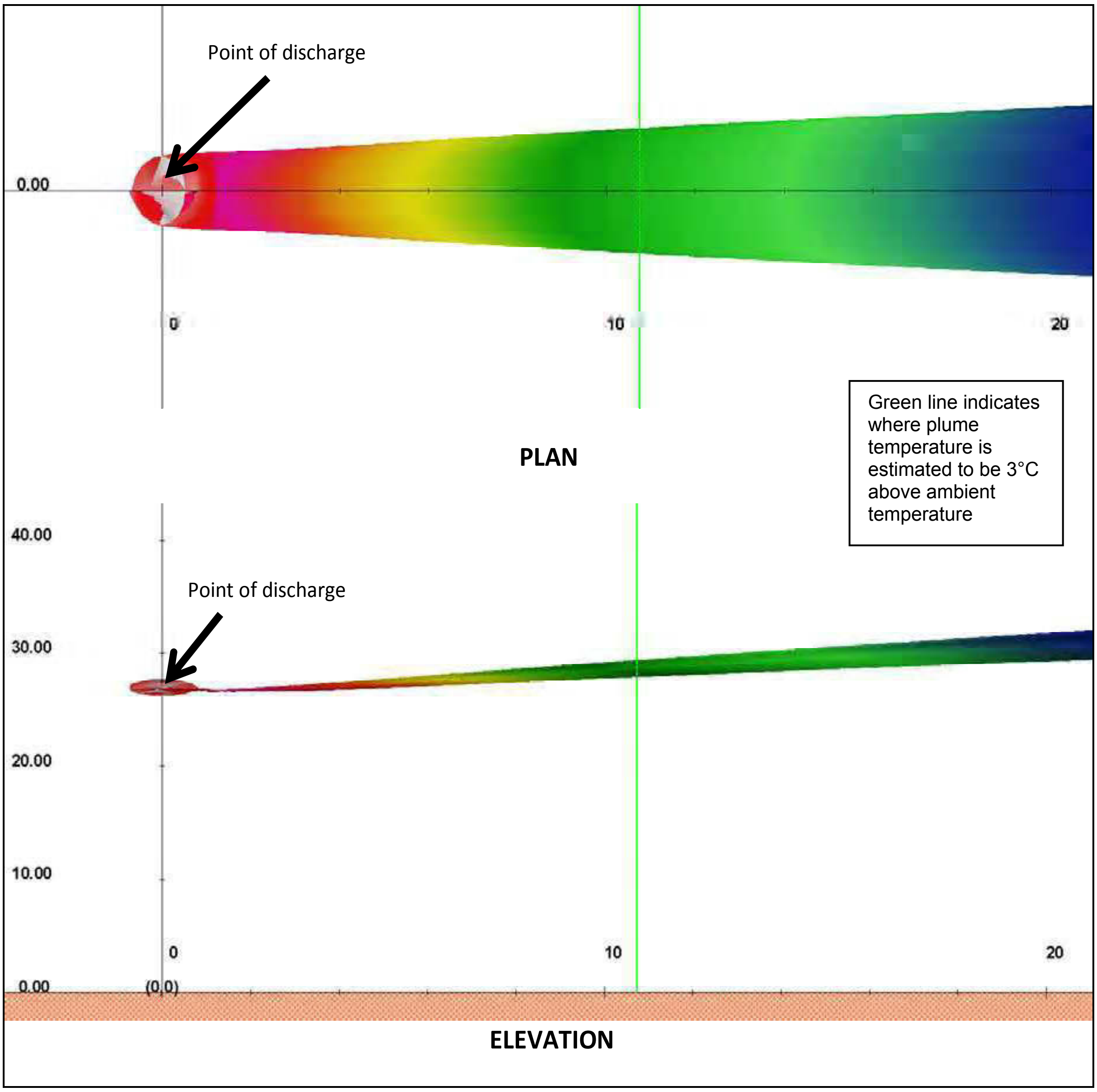
A modelling assessment was completed to assess the potential extent of the velocity field created in the vicinity of the intake location. The assessment was based on an intake rate of 3,360 m^3/hr (approximately 50% greater than the SD2 rate) and showed that water velocity would not exceed 13cm/s within a few centimetres of the intake and that the velocity gradient would extend less than 3m from the intake location, even under near-stagnant current conditions. Consequently, it is concluded that:

- There is a sufficient velocity gradient for fish to detect the intake; and
- The water velocity close to the intake is sufficiently low that even small fish would have no difficulty in avoiding the intake.

Seawater Discharge

The discharge of cooling water was assessed based on a typical discharge temperature of 25ºC. Full details of the modelling assumptions and methodology are provided within Appendix 10F. Figure 11.10 shows the predicted cooling water dispersion plume. The green line shown indicates the point at which the water temperature is estimated to be 3°C above ambient temperature. This occurs within 11m of the point of discharge. At a distance of 100m, the model predicted that the plume would be a maximum of 0.2ºC above ambient temperature. The plume experiences only a limited a degree of rise due to its thermal buoyancy and it is not predicted to reach the surface, or the depth of the thermocline transition. Results for summer and winter conditions were found to be very similar.

Figure 11.10 Plume Trajectory and Distance (m) to 3°C Change for Offshore Cooling Water Discharge at Discharge Temperature of 25°C

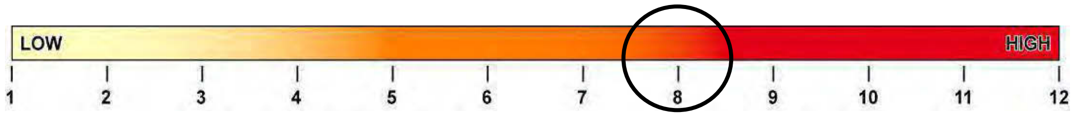


The cooling water system will include a 5ppbv copper/50ppbv chlorine biocide control system, but the concentration of both elements in the discharge will be below the international Environmental Quality Standards (EQS) and national Maximum Permissible Concentration (MPC) levels.

Table 11.21 presents the justification for assigning a score of 8 to offshore cooling water intake and discharge, which represents a Medium Event Magnitude.

Table 11.21 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	**Intake:** The velocity gradient would extend to less than 3m in any direction. **Discharge:** The area within which cooling water discharge effects might occur is limited to within 11m from the point of discharge	1
Frequency	Intake and discharge occur continuously throughout SD2 Offshore Operations.	3
Duration	The cooling water system will operate continuously throughout SD2 Offshore Operations.	3
Intensity	**Intake:** Deemed to be a low intensity activity. **Discharge:** Will met requirement for edge of the cooling water mixing zone (assumed to be 100m from the discharge point) to be no greater than 3°C more than the ambient water temperature. Discharge will contain no harmful persistent materials.	1
Total		**8**



11.6.1.3 Receptor Sensitivity

Benthic invertebrates will not be exposed to either cooling water intake or discharge. The dimensions of the intake current field and the discharge plume are small and the residence time of any water column organism within the discharge plume will be too short to cause harm.

The 3°C temperature gradient limit is reached within 11m of the discharge, and therefore temperatures high enough to cause thermal stress to biological/ecological receptors are only likely to be present within a few tens of centimetres from the discharge location. It is unlikely that any receptors would be resident within such a small zone for long enough to be affected.

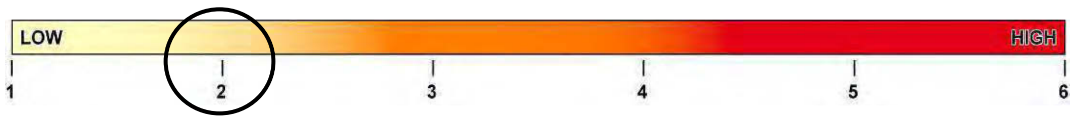
Seals are not considered to be at risk from the intake, and fish present at the intake depth are considered capable of detecting the low intake velocity gradient and avoiding it.

Zooplankton and phytoplankton would not be able to avoid entrainment, but the intake is at a depth of 75m and therefore well below the depth at which the main populations of both groups occur.

Table 11.22 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.22 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Seals, fish and plankton are not expected to be present consistently or in significant numbers within the water volume affected by either intake or discharge. No significant exposure of benthos.	1
Presence	Although exposure is unlikely, seals and fish would not be adversely affected by short term exposure to the discharges. Plankton are unlikely to be exposed to discharge.	1
Total		**2**



11.6.1.4 Impact Significance

Table 11.23 summarises impacts to biological/ecological receptors from water intake and cooling water discharge.

Table 11.23 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Offshore Operations: Cooling water intake and discharge	Medium	Low	**Minor Negative**

The following monitoring and reporting requirement related to cooling water intake and discharge form part of the AGT EMS:

- SD2 platform complex cooling water biocide dosing levels will be checked automatically.

The design of the intake and discharge process, and in particular the depth at which these occur, will minimise the exposure of marine organisms, which are considered to have low sensitivity. The resulting Minor Negative impact is considered to be acceptable and does not require additional mitigation beyond existing controls.

11.6.2 Offshore Operations - Other Discharges

11.6.2.1 Mitigation

Existing mitigation measures associated with other SDB platform complex discharges from include:

- Black water will be treated on the SDB-QU platform to comply with USCG Type II standards i.e. total suspended solids of 150mg/l and fecal coliforms of 200MPN (most probable number) per 100ml)
- Grey water from the laundry will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable. Environmental factors are considered prior to selection of any chemical for use across the ACG and SD facilities, including cleaning fluids such as detergents. Under routine conditions grey water from the living quarters will be treated in the STP;
- The STP will be designed to ensure >90% of the biodegradable surfactants present degrade prior to discharge;
- Sewage sludge will be transported to shore from the SDB platform complex for disposal to an appropriately licensed facility;
- The SDB-QU and SDB-PR open drains caissons will be designed to ensure that there is no visible oil sheen and to discharge at a depth of 52m below sea level;
- Deluge from deck drain boxes will be routed directly overboard for safety reasons; and
- Organic food waste originating from the platform galley will be macerated to less than 25mm in accordance with MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships requirements and discharged to the SDB-QU sewage caisson.

11.6.2.2 Event Magnitude

Description and Assessment

Other SDB platform complex discharges comprise:

- **Treated Black Water** – SDB-QU platform sewage treatment package (STP) treats black water from living quarters and discharges it via the sewage discharge caisson (16.2m below sea level). Based on average 100 POB and an expected generation rate $0.1m^3$/person/day, approximately $10m^3$ of treated effluent will be discharged per day. The flow rate is low, so the effluent will be rapidly diluted close to the point of discharge. Total suspended solids at the proposed treatment level do not pose any risk of significant environmental impact.

- **Grey Water** – Laundry grey water will be discharged to sea without treatment via the SDB-QU sewage caisson. This will contain only dilute cleaning agents (soaps, detergents) and the impact of the discharge will be minimal. Other grey water from the living quarters will be treated in the STP.

- **Galley Waste** - SDB-QU platform galley waste system will be designed to treat food wastes to applicable MARPOL 73/78 Annex V and discharged via the SDB-QU sewage discharge caisson.

- **Drainage** – The SDB-PR and SDB-QU platforms will be provided with separate self-contained open drains systems. The SDB-PR platform will be provided with a hazardous area open drains system, which is routed to the SDB-PR open drains caisson. The SDB-QU platform will be provided with two separate systems; a hazardous area drains system and a non-hazardous area drains system, which will both be routed to the SDB-QU open drains caisson.

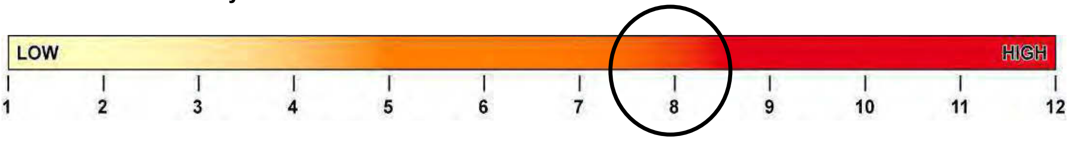
- **Saline Effluent –** The freshwater maker will be located on the SDB-QU platform. Saline effluent from the freshwater maker will be discharged via the SDB-QU seawater discharge caisson.

Event Magnitude is summarised in Table 11.24.

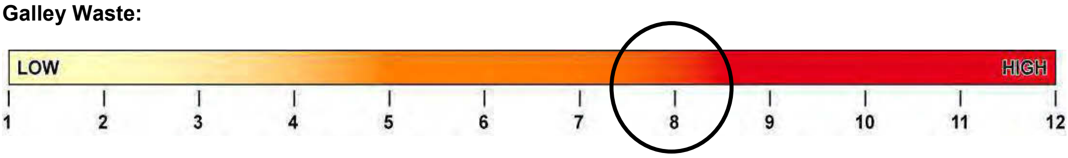
Table 11.24 Event Magnitude

Event Parameter / Discharge	Treated Black Water / Grey Water	Galley Waste	Drainage	Saline Effluent
Scale	1	1	1	1
Frequency	3	3	3	3
Duration	3	3	3	3
Intensity	1	1	1	1
Event Magnitude	**8**	**8**	**8**	**8**

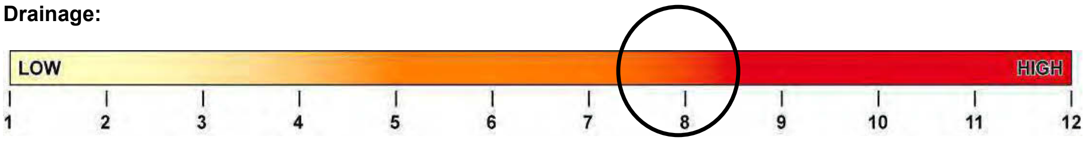
Treated Black and Grey Water:



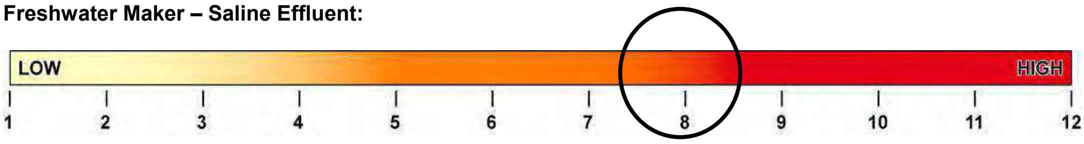
Galley Waste:



Drainage:



Freshwater Maker – Saline Effluent:



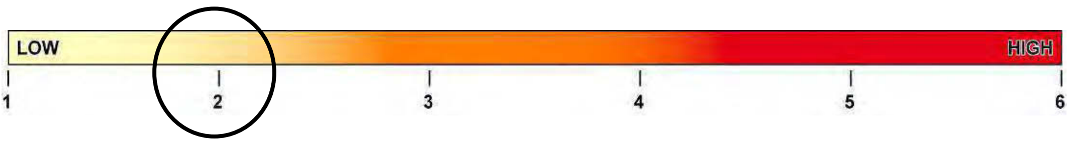
11.6.2.3 Receptor Sensitivity

All of the discharges are low in volume, do not contain toxic or persistent process chemicals and are considered to pose no significant threat to the environment or the identified biological/ecological receptors.

Table 11.25 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.25 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
Presence	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Total		**2**



11.6.2.4 Impact Significance

Table 11.26 summarises impacts to receptors from other offshore discharges to sea.

Table 11.26 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea **Treated Black and Grey Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Galley Waste**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Drainage**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Freshwater Maker – Saline Effluent**	Medium	(All Receptors) Low	**Minor Negative**

The following monitoring and reporting requirements related to other offshore discharges form part of the AGT Region EMS:

- Samples will be taken from the sewage discharge outlet and analysed monthly for total suspended solids and fecal coliforms;
- Daily visual checks will be undertaken when treated sewage is discharging to confirm no floating solids are observable;
- Sewage sampling results will be recorded as daily observations and estimated volumes of daily treated black water discharges will be submitted to the MENR on a monthly basis;
- For discharge of galley waste, grey water and drainage visual checks will be undertaken when discharging to confirm no floating solids are observable and there is no visual sheen; and
- Recorded daily observations will be made. The estimated volumes of domestic wastes (grey water and galley waste) and drainage discharged daily will be submitted to the MENR.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing mitigation measures and no additional controls are required.

11.6.3 Subsea Operations: Control Fluid Discharge during Routine and Non Routine Operations

11.6.3.1 Mitigation

Existing mitigation measures associated with routine and non routine control fluid discharge from Subsea Operations include:

- Use of Castrol Transqua HC10 water based control fluid, which has been selected based on its suitability, environmental performance and low toxicity.

11.6.3.2 Event Magnitude

Description

As described with Chapter 5: Section 5.11.3, hydraulically actuated valves will be used to control and monitor the flow of production fluids within each manifold and production tree using a subsea control system.

Two types of discharges are anticipated to occur:

- Continuous discharge of approximately 0.03cm^3 per minute on average from each directional control valve (DCV) associated with each production tree and manifold; and
- Transient discharges from the actuated valves associated with each production tree and manifold when the valves are actuated.

The five scenarios which result in transient control fluid discharge include:

- Well testing – involves partial shutdown of each well on 3 occasions per year and a full shutdown once a year;
- Flowline pigging – expected to be required on a 3 yearly basis;
- Full field shutdown - expected to occur once every 4 years;
- Partial field shut shutdown - expected to occur once every 4 years; and
- High Integrity Pressure Production System (HIPPS) testing – testing of HIPPS associated with each manifold expected to occur annually.

The expected volumes of control fluid discharged per year are summarised within Chapter 5 Table 5.32.

Both continuous and transient discharges will take place from:

- Four vents on each manifolds; two at the side, 6m above seabed, and two on the top, 8m above seabed; and
- A single vent from the top of the each production tree, 4m above seabed.

Assessment

The dispersion of the control fluid discharge events was modelled to enable the dimensions and persistence of the dispersion plumes to be quantified and visualised. The modelling assumptions, methodology and results are provided in full within Appendix 10F.

Continuous Discharge

The Base Case design assumes 25 DCVs associated with a production tree and 25 DCVs associated with a manifold. The anticipated total flowrate of discharge from a single production tree and manifold was therefore calculated, and dispersion modelling was carried out on these release rates.

From the results of toxicity testing, a no-effect dilution of 40,000-fold was estimated for continuous release of Castrol HC10 (refer to Chapter 4 Section 4.9.3).

The modelling indicated that releases from both trees and manifolds would be diluted rapidly within 10m of the discharge location to more than 40,000-fold. The associated plumes were too small to represent graphically in the model output.

Transient Discharge

For the five anticipated valve operating scenarios, the valves to be actuated at the manifold and production tree per scenario were identified and the associated volume of discharge for a single manifold and production tree was calculated. From the results of toxicity testing, a no-effect dilution of 4000-fold was estimated for these intermittent releases. As a precaution, modelling was carried out for contingency discharge volumes which were larger than the volumes associated with the anticipated valve operating scenarios. Figure 11.11 indicates the maximum plume size 15 minutes after such a release from a production tree; at this point, the plume is less than 20m long, and only a small part of the plume (less than 10m long) remains diluted to less than 4,000-fold. After one hour, the model output indicates that the discharge is completely diluted to >40,000-fold.

Figure 11.11 Dimensions of Tree Discharge Plume 15 Minutes After Discharge (Contingency Discharge Volume)

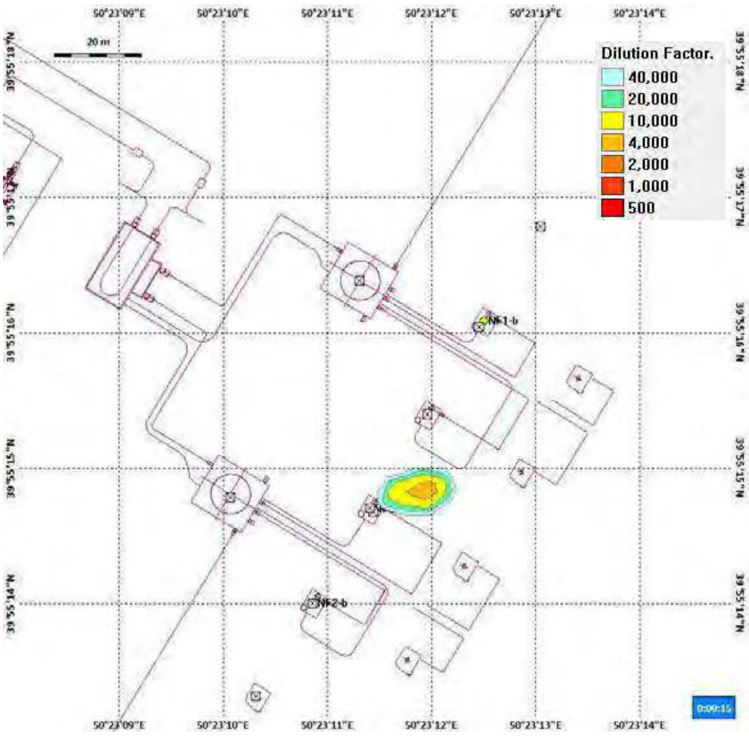
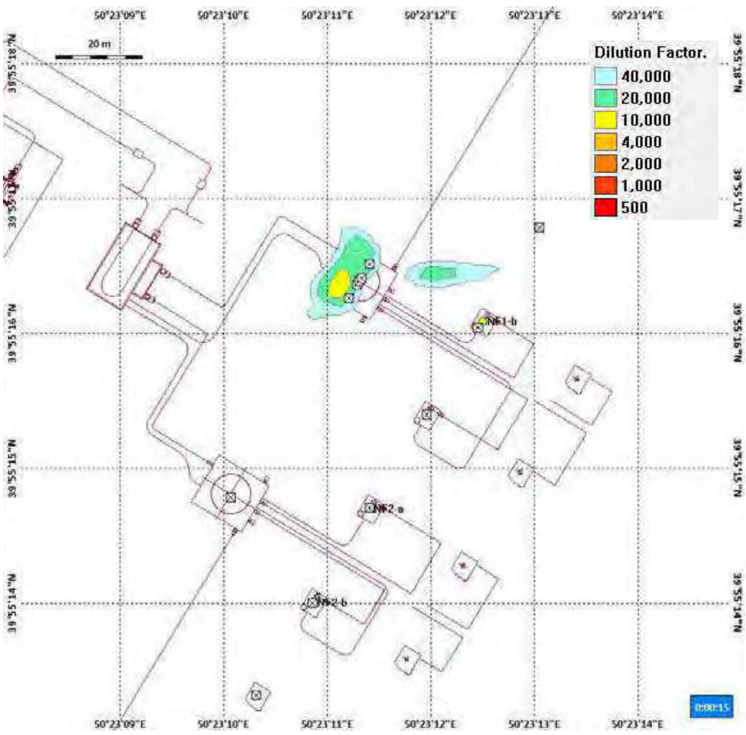


Figure 11.12 indicates the maximum plume size from a manifold discharge 15 minutes after the event. The plume is approximately 20m long, but is already diluted to >10,000-fold. After one hour, the plume is completely diluted to >40,000-fold.

Figure 11.12 Dimensions of Manifold Discharge Plume 15 minutes After Discharge (Contingency Discharge Volume)

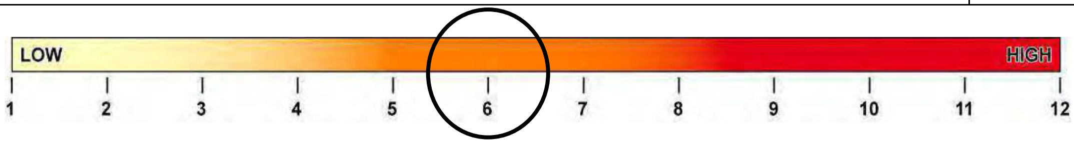


For both trees and manifolds, discharges are diluted to the no-effect concentration within 20m from the point of discharge, and within a very short period of time (less than an hour). OSPAR tests have shown up to 90% degradation of glycol in 28 days. Rapid degradation may however commence after a lag period of 7 days[5]. Glycol, nevertheless, is highly biodegradable and will rapidly disperse to no effect concentrations in the marine environment following discharge and then completely degrade.

Table 11.27 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 11.27 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Control fluid discharges are expected to affect a small area around the source up to a distance of approximately 20m from the discharge location.	1
Frequency	Routine and non routines discharges will take place continuously and on a regular basis (more than 50 times) throughout the PSA period.	3
Duration	Individual events will have a duration of between a few minutes and a few hours.	1
Intensity	Discharges will reach no effect concentration (established from Caspian specific toxicity testing) within short distance of discharge location. Discharge will contain no harmful persistent materials.	1
Total		**6**

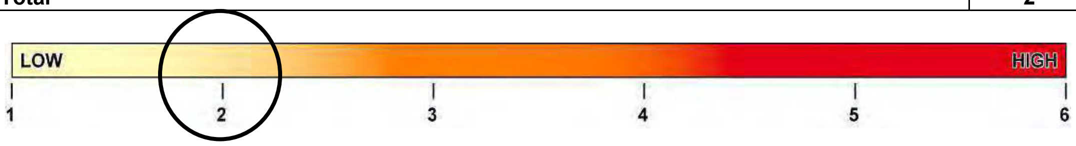


11.6.3.3 Receptor Sensitivity

Table 11.28 presents the justification for assigning a score of 2, which represents a Low Receptor Sensitivity.

Table 11.28 Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Although exposure is unlikely, seals and fish would not be adversely affected by short-term exposure to the discharges.	1
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the seabed discharge sources. No significant exposure of benthos or plankton.	1
Total		**2**



11.6.3.4 Impact Significance

Table 11.29 summarises impacts to biological/ecological receptors from discharges associated with control fluid discharges.

[5] Concise International Chemical Assessment Document 22, Ethylene Glycol: Environmental Aspects, Geneva 2000

Table 11.29 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Subsea Operations: Routine and non routine control fluid discharge:	Medium	(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to control fluid discharge form part of the AGT Region EMS:

- Caspian specific ecotoxicity testing will be completed on samples of control fluid collected every 6 months and compared to the initial HC10 ecotoxicity testing to confirm the findings of the ecotoxicity risk assessment for control fluid discharges remain valid;
- Results of control fluid ecotoxicity testing will be reported to the MENR; and
- The quantity of control fluid discharged will be recorded and reported to the MENR annually.

The resulting Minor Negative impact from control fluid discharge is considered to be acceptable, since the volumes will be small and have a low toxicity.

11.6.4 Subsea Operations: Non Routine Discharges During Subsea System Interventions

11.6.4.1 Mitigation

Existing mitigation measures associated with discharge of fluids from interventions during Subsea Operations include:

- Prior to subsea interventions (not including control modules and production tree chokes) which may result in discharges to sea a risk assessment will be completed and the MENR informed as required.

11.6.4.2 Event Magnitude

Description and Assessment

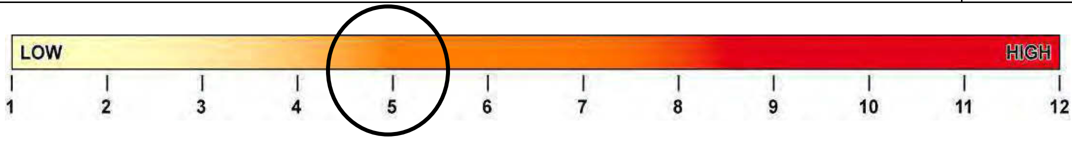
As described with Chapter 5 Section 5.11.4 during operations it will be necessary to replace components of the subsea production system. The most frequent replacements (known as interventions) are expected to be the control modules associated with the production trees and manifolds. During replacement activities, the relevant valves will be actuated to isolate the module being replaced, resulting in discharges of control fluids. These are expected to small and included within the control fluid volumes within Table 5.32. Discharges of approximately 1.3m^3 are also anticipated to result from replacement of each production tree choke (26 in total). This is expected to occur once for each production tree over the PSA period.

MEG discharges to the marine environment are discussed within Chapter 10 Section 10.8.3 where a discharge of up to 13.84m^3 of MEG during subsea production system installation is assessed. The modelling undertaken for this greater volume of MEG discharge indicated that the no-effect concentration would be met within 20m of the discharge location. For a discharge of 1.3m^3 it is therefore anticipated that the no-effect concentration would be met within a few metres from the point of discharge.

Table 11.30 presents the justification for assigning a score of 5, which represents a Medium Event Magnitude.

Table 11.30 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	No effect concentration would be met within a few metres of the discharge location (lass than 20m)	1
Frequency	Discharges will occur once per tree, 26 times in total	2
Duration	Individual discharges associated with subsea system interventions will last no more than 6 hours	1
Intensity	Discharges consist of a low toxicity, non-persistent substance	1
Total		**5**

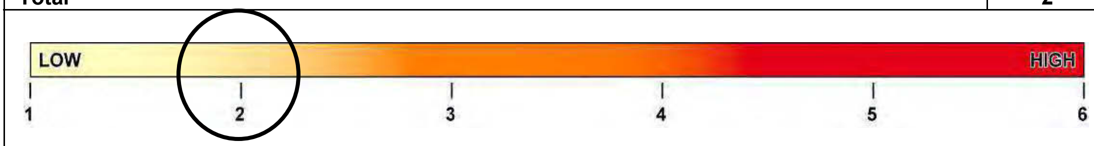


11.6.4.3 Receptor Sensitivity

Table 11.31 presents the justification for assigning a score of 2, which represents a Low Receptor Sensitivity.

Table 11.31 Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Although exposure is unlikely, seals and fish would not be adversely affected by short-term exposure to the discharges.	1
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the seabed discharge sources. No significant exposure of benthos or plankton.	1
Total		**2**



11.6.4.4 Impact Significance

Table 11.32 summarises impacts to biological/ecological receptors associated with non routine discharge of fluids during subsea production system interventions.

Table 11.32 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Subsea Operations: Non Routine Discharge of Fluids during Subsea Production System Interventions	Medium	(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to non routine discharge of fluids during subsea production system interventions form part of the AGT Region EMS:

- The composition and estimated quantity of fluids used and discharged during each intervention activity will be recorded and reported to the MENR periodically.

The resulting Minor Negative impact from discharges during interventions is considered to be acceptable, since the volumes will be small and have a low toxicity.

11.7 Summary of the SD2 Project Operations Residual Environmental Impacts

For the environmental impacts which the SD2 Project has been assessed, it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required. Table 11.33 summarises the residual environmental impacts for the operations phase of the project.

Table 11.33 Summary of SD2 Project Operations Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Non-GHG Emissions from Routine Offshore Operations	1	3	3	1	1 1	Medium	Low	Minor Negative
Atmosphere	Non-GHG Emissions from Non Routine Offshore Operations (DEH)	1	3	1	1	1 1	Medium	Low	Minor Negative
Atmosphere	Non-GHG Emissions from Non Routine Offshore Operations (Emergency Flaring)	1	3	1	1	1 1	Medium	Low	Minor Negative
Atmosphere	Non-GHG Emissions from Routine Onshore Operations	1	3	3	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
Atmosphere	Non-GHG Emissions from Non Routine Onshore Operations (Emergency Flaring)	1	3	1	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
Terrestrial Environment	Noise associated with Routine Onshore Plant Operations	1	3	3	1	3 1	Medium	Medium	Moderate Negative
Terrestrial Environment	Noise associated with Non Routine Onshore Flaring	3	2	2	1	3 1	Medium	Medium	Moderate Negative
Terrestrial Environment	Odour from non routine pond storage of produced water	2	2	3	2	3 2	High	High	Major Negative - reduced to Moderate Negative following additional mitigation
Marine Environment	Offshore Operations: Cooling Water intake and discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: **Treated Black and Grey Water**	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: **Galley Waste**	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: **Drainage**	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Offshore Operation: Other Discharges to Sea: **Freshwater Maker – Saline Effluent**	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Subsea Operations: Routine and Non Routine Control Fluid Discharge	1	3	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative
Marine Environment	Subsea Operations: Non Routine Discharge of Fluids during Subsea Production System Interventions	1	2	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative

12. Socio-Economic Impact Assessment, Mitigation and Monitoring

Contents

12.1 Introduction

This Chapter describes the socio-economic impacts, and mitigation and monitoring measures, associated with the Shah Deniz Stage 2 (SD2) Project. The direct and indirect socio-economic impacts that are expected to occur are described and assessed in accordance with the impact methodology presented in Chapter 3 and have been quantified, where possible.

The assessment of socio-economic impacts for the SD2 Project takes into consideration experience gained from the Azeri Chirag Guneshli (ACG) Phases 1-3, SD Stage 1 (SD1), Chirag Oil Project (COP) and SD2 Early Infrastructure Works (EIW) Projects. The type of socio-economic impacts assessed in the Environmental and Socio-Economic Impact Assessment (ESIA) prepared for the SD2 EIW included, amongst others, the creation of local employment, training and skills development of the workforce, the procurement of goods and services to local businesses and a temporary disruption of public access to a small area along the shoreline.

The socio-economic impacts associated with the SD2 Project are similar to those previously assessed for the SD2 EIW, although the SD2 Project involves significantly higher onshore workforce numbers at the Sangachal Terminal (ST), includes use of construction yard contractors and vessel operations that take place in the nearshore and offshore environment. The scale of impacts assessed in this chapter includes changes that are predicted to occur at a local, regional and national level.

12.2 Assessment of Scoped-Out Activities and Events

The scoping process has used judgement based on prior experience of similar Activities and Events and has excluded a number of SD2 Project Activities and associated Events. This is due to their limited potential to result in discernible socio-economic impacts, or if they have been already assessed in other Chapters of the ESIA. Justification for the scoping out of specific Activities and Events is presented below for the following:

- Disruption to road and rail users;
- Access restrictions along the shoreline;
- Community disturbance from artificial lighting used at the ST;
- Community disturbance from construction yards; and
- Community health and safety from onshore pipeline installation works.

12.2.1 Disruption to Road and Rail Users

The Baku-Salyan Highway will be the primary route used for the transport of construction materials and workers who are resident outside the local communities (defined as Sangachal Town, Umid, Azim Kend and Masiv 3). Construction vehicle movements will occur along the Baku-Salyan Highway and access roads into the ST; local roads will not be used. Road users may experience temporary disruption through increased traffic congestion, delays associated with the transport of oversized and heavy loads, and from damage to the physical condition of the Baku-Salyan Highway.

Driver management and vehicle standards will be developed and monitored, to minimise the risk to community safety. There is no planned disruption to users of the Baku-Salyan Highway or railway from the installation of the onshore pipelines, as these will be drilled using auguring and casing equipment at a depth of approximately 1.5m below the surface. Consequently, the onshore pipeline works will not require any temporary road or rail closures.

Increased road traffic during the construction phase has the potential to disrupt communities and businesses along the routes used through increased noise and traffic flows. To minimise the number of vehicle movements associated with the SD2 Project during onshore construction works at the ST, buses will be used to transport the workforce using the Baku-Salyan Highway Taking into consideration the use of busses to transport the workforce, onshore construction vehicles associated with the ST construction and commissioning activities are expected to be 500 vehicles per day. This represents a total traffic flow increase of approximately 5%.

If parts of the Baku-Salyan Highway become damaged as a direct result of transport movements associated with the SD2 Project, then the change in road conditions will be reported to the appropriate government authority. However, the Baku-Salyan Highway is currently maintained in a good condition and is designed to withstand physical impacts associated with the frequent passage of heavy vehicles. Consequently, physical damage to the Baku-Salyan Highway is not expected to occur.

In order to ensure that any disruption to road users is minimised from increases in traffic and the transport of oversized and heavy loads, a Transportation and Traffic Management Plan will be developed and implemented. The Plan will require a risk assessment to be undertaken prior to the transportation of oversized and heavy loads which will include an inspection of the transport route for obstructions and hazards, the requirement for traffic diversions and the use of lifting, loading and rigging equipment. The Azerbaijan Ministry of Transport and the State Police will be notified in writing before the scheduled movement, and the exact time and date of the movement will be agreed. Once approved, oversized and heavy loads will be accompanied by front and back escort vehicles equipped with appropriate warning signage and/or lights as required. All received grievances associated with vehicle movements will be logged and appropriate corrective action determined in accordance with the Transportation and Traffic Management Plan.

12.2.2 Access Restrictions Along the Shoreline

Pipeline installation works within Sangachal Bay includes the construction of two temporary finger piers to provide access for construction plant to the nearshore for trenching. The works also include the use of excavators and an onshore pulley rigging arrangement that will pull the pipelines onshore from the pipe-lay vessel situated in the nearshore environment, as well as an access road from the Baku-Salyan Highway to the beach area

The pipeline installation works will temporarily restrict public land access to a relatively small area within Sangachal Bay. Access will be restricted to local people who use the shoreline area for recreational purposes and to fishermen who use the shoreline to launch small vessels into the sea. Currently the beach area is being developed in the form of houses and apartments. An agreement will be reached with the developer and BP in relation to land access restrictions.

The impact to members of the public and fishermen is expected to be negligible, as alternative sites for recreational walking and the launching of small vessels are available along other parts of the shoreline which will not be impacted by the pipeline installation works.

12.2.3 Community Disturbance from Artificial Lighting Used at the Terminal

During onshore construction works at the ST, along the onshore pipeline corridor, at the Pipeline Landfill Area and during operation of SD2 facilities, artificial lighting will be used. Under normal conditions, all areas will not be lit outside of working hours unless for safety/security reasons. The existing topography in the Pipeline Landfall Area will restrict the potential for light spill to occur to the shoreline and Sangachal Bay. A lighting strategy will be implemented at all locations, which will include measures to minimise light spillage and glare to the residents of local communities.

12.2.4 Community Disturbance from Construction Yards

It is not known the extent to upgrade works will be required at the construction yard(s) used to fabricate the SDB jackets and topsides. In either case, it is considered that as all candidate yards are existing industrial sites with very limited residential premises in near proximity to their site boundaries, the potential for significant disturbances to occur from any upgrade or expansion works is limited. In the event that site expansion is required, it is highly unlikely that this will include the need to acquire residential land. It will be the responsibility of the construction contractor to complete any necessary land acquisition processes.

An assessment of potential noise and air quality impacts from SD2 Project activities at the construction yards, which includes the associated existing controls and mitigation, is provided in Chapter 10. The assessment concludes that the potential for disturbance to occur from construction yard activities to residential receptors is negligible. All waste generated during onshore platform and subsea infrastructure construction and commissioning activities will be managed in accordance with the existing AGT management plans and procedures.

12.2.5 Community Health and Safety from Onshore Pipeline Installation Works

The proposed SD2 Pipeline Corridor between the Pipeline Landfall Area and the ST is approximately 4.4km. Along the majority of the route, the pipeline will be installed into trenches excavated to a depth of 2.5m. After installation, the trench will be backfilled and topsoil replaced so that the pipeline right of way can be reinstated to its original condition.

The following controls will be used to maintain community health and safety during onshore pipeline installation works:

- Public access to all areas where construction works are ongoing will be restricted through the use of the security fencing;
- Warning signs will be attached to the security fence to inform members of the public about the hazard associated with the works and the presence of deep excavations; and
- The period of time when the pipeline trench and any other excavated areas are left open will be minimised through the use of careful planning.

Considering the type of existing controls that are listed above, impacts to community health and safety are expected to be negligible.

12.3 Impact Assessment

12.3.1 Enforcement of Marine Exclusion Zones

The following marine exclusion zones will be enforced during the SD2 Project:

- 500m either side of the SD2 Subsea Export Pipeline Corridor during berm construction and nearshore trenching, pipe-laying works associated with the export and MEG pipelines, and backfilling and deconstruction of the berms. These activities are expected to be commence from Q3 2014 and be completed by end of Q3 2016 (duration of 27 months);
- A radial distance of 50m surrounding the drilling rigs whilst drilling is in progress at each well site location. Well drilling is expected to continue from Q1 2014 until the end of 2016; and
- A radial distance of 500m during the transport, installation and operation of the two offshore platforms which will start from Q3 2015 when the SDB-PR jacket is transported offshore. The marine exclusion zone will then continue to be enforced during the operational period of the SD2 Project.

The enforcement of marine exclusion zones may impact:

- **Commercial shipping operations** – economic displacement may be experienced by an increase in travel time and the quantity of fuel consumed by vessels who are forced to deviate from their original route due to the enforcement of the marine exclusion zones;
- **Commercial scale fishing operations** – economic displacement may be experienced for the reasons given above and from a reduction in access to sea resources used for fishing operations;
- **Small-scale fishing operations** - economic displacement may be experienced for the reasons given above, in addition to from the relocation of static fishing gear which is located inside future exclusion zones, such as netting; and
- **Scientific research activities** – ongoing scientific research is undertaken within the Azerbaijani Sector of the Caspian Sea.

Magnitude

The magnitude of the expected impacts is evaluated as follows:

- **Commercial shipping operations** – there are three shipping routes that pass through the SD Contract Area which are regularly used by oil and gas supply vessels undertaking scheduled visits to existing offshore platforms. Two of these shipping routes are located inside the marine exclusion zone associated with the proposed SD2 Subsea Export Pipeline Corridor;
- **Commercial fishing operations** – commercial fishing operations occur within Sangachal Bay, the SD Contract Area and along the export pipeline corridor route where marine exclusion zones will be enforced;
- **Small-scale fishing operations** – based on the number and type of vessels which have granted permission by the Department on Protection and Reproduction of Aquatic Bioresources (DPRAB) to undertake fishing operations in 2012 in the Azerbaijan sector of the Caspian Sea, the estimated number of people involved in small-scale fishing operations is 53 persons; and
- **Scientific research activities** – regular samples of sturgeon are collected from seven experimental trawling locations, which include ‘1D’ and ‘1E’ located inside the SD Contract Area.

Receptor Sensitivity

Receptor Sensitivity is evaluated as follows:

- **Commercial shipping operations** – considered to be ‘low’ as the majority of commercial shipping operations that occur are directly related to the oil and gas industry. Consequently, mariners working in the area of the Southern Caspian Sea are used to avoiding marine exclusion zones;
- **Commercial fishing operations** – considered to be ‘low’ as the location of the marine exclusion zones will not change the level of access to favoured fishing stations, such as the Makarov bank and Andreev bank, and will restrict access to a small area of sea within the Azerbaijan sector of the South Caspian Sea;
- **Small-scale fishing operations** – considered to be ‘high’ as there is the potential that fishing gear may be present within the nearshore environment where marine exclusion zones will be enforced. In addition, small-scale fishermen were compensated for economic displacement arising from the ACG and SD projects. Consequently, there is likely to be an expectation amongst fisherman that BP will provide compensation during the SD2 Project; and
- **Scientific research activities** – considered to be ‘low’ as the location of experimental trawling locations ‘1D’ and ‘1E’ located in the SD Contract Area will have been relocated (effective from 01 January 2015) to outside the SD Contract Area in written agreement with the Ministry of Ecology and Natural Resources (MENR).

Mitigation & Monitoring

A Notice to Mariners will be issued to warn mariners of the presence of nearshore and offshore activities and the position/duration of marine exclusion zones. The location of the SDB Platform Complex will be clearly marked on marine navigation charts provided to the appropriate government authority.

A fishing livelihood baseline survey will be undertaken to gather additional information on small-scale fishing activities within Sangachal Bay and the nearshore environment prior to installation works. The survey will identify the location, status and ownership of any fishing gear that may be directly or indirectly impacted from construction works. The results of the survey will be used to determine if a Small-Scale Fishing Management Plan should be prepared that will describe the process used to identify and agree compensation with fisherman who experience economic displacement as a direct result of the SD2 Project.

12.3.2 Employment

Main construction and installation contractors (including their sub-contractors) used by BP during the SD2 Project are required to develop and implement their own Employee Relations Management Plan (ERMP) which will include, as a minimum, the following:

- Project labour arrangements including the need to recruit new labour and potential sources of new workers;
- How the contractor will comply with the national requirements of Azerbaijan labour law;
- Details of a grievance mechanism that is available for use by the workforce;
- Training and development activities in the form of a Training Plan;
- Demobilisation and demanning (see Section 12.3.3);
- A nationalisation programme;
- Cultural awareness and language familiarisation; and
- Statistical reporting and monitoring.

Site specific Labour Management Forums (LMF) will be established by BP and regular meetings will occur between the BP project site management team and the main construction and installation contractors to discuss workforce welfare and related matters. The role of the LMFs are to undertake:

- A regular review of labour management performance and identify any trends;
- A review of work plans within the site for the next three to six months, discussing labour requirements and potential risks for labour management;
- Review the actions taken to mitigate the identified risks;
- Monitor the implementation of community development programme activities; and
- Discuss the results of statistical monitoring and the content of reports which have been submitted to BP.

Main construction and installation contractors and their sub-contractors will actively design and implement training and skill development programmes for their national staff. Main construction and installation contractors will prepare and submit a Training Management Plan to BP on an annual basis which will include details of the training initiatives being undertaken in the next 12 months, and a summary of training activities completed in the past 12 months. Main construction and installation contractors will conduct regular audits of its sub-contractors EMRP and Training Management Plan, providing the results of these audits to BP.

Existing controls associated with the main construction and installation contractor at the ST which relate to employment are the following (these controls do not apply at construction yards):

- Information will be provided to the local communities by main construction and installation contractors on the nature and levels of employment required;

- At all times the individual recruited will be the person who is most suited to the particular post, based on the applicant's abilities, qualification, experience and merit as measured against the job description and person specification;
- Measures will be implemented by main construction and installation contractors to maximise employment as far as practical from the local communities, to achieve, or improve if practical, the local content percentages achieved for the previous ACG Phases 1-3, SD1 and SD2 EIW Projects;
- Where local employment falls below the local content percentage targets, the reasons for this non-compliance will be investigated by BP and practical measures will be developed to meet the local content percentages targets;
- A grievance procedure for managing all community complaints related to the recruitment process will be established. All employment-related grievances, including those associated with recruitment processes, will be recorded and reported, along with details of measures taken to resolve concerns raised; and
- A formal system of competency assurance will be implemented and records maintained of competency testing and training activities completed, with training certificates provided to workers who are eligible to receive them.

Magnitude

It is anticipated that main construction and installation contractors responsible for onshore construction works at the ST will employ between 81 and 3,600 people over the duration of the works. Peak employment will reach 3,571 with a total duration of 3 months during the 2Q 2015. Additional employment may be required at construction yards, particularly if upgrade and expansion works are required. It is estimated that employment associated with the marine subsea works will peak at approximately 2,000 during 2015 and 2016. During the operational phase, approximately 100 permanent jobs will be created by the SD2 Project.

Receptor Sensitivity

Within job seekers based in the local communities, there are high expectations associated with the provision of training and skills development activities. This is partly a result of the previous training provided by BP during the ACG Phases 1-3 and SD1 projects. Receptor sensitivity is considered to be 'high'.

Mitigation & Monitoring

The benefits of employment to successful job seekers are expected to include, at a household and individual level, an increase in socio-economic and health status, improvement to their quality of life and living conditions, and the benefits from greater household expenditure on education and healthcare resources. Workers from households located in Azim Kend and Masiv 3 may experience the greatest extent of positive change compared to households in Sangachal Town and Umid, due to their high unemployment status and current low level of expenditure on education and healthcare resources. Employment will benefit a greater number of individuals than the total workforce number, as positive changes at a household level will benefit partners (including women), relatives and young people.

It is expected that almost all (temporary or permanent) employed workers will benefit from the provision of training and skill development activities during the SD2 Project. Such activities will commence before the start of construction activities as workers will be required to undergo competency-based training to undertake their role to the standard required. Similar to the previous ACG Phases 1-3 and SD1 projects, the training and skill development activities will include the enhancement of technical skills in parallel with health and safety, information technology and communication/administrative skills. Training and skill development activities will continue throughout the project, and will provide workers with abilities that can be used to obtain future employment positions after their involvement in the SD2 Project is complete.

The following workforce monitoring information will be submitted by the main construction and installation contractors to BP on a monthly basis:

- The number of job applications that have been received, accepted for interview and offered/accepted a position broken down by the following: job category, gender, age, the geographical origin of the applicant (the community name) and whether the applicant has any special needs due to a disability or other reason;
- The total percentage of local and non-local employment, broken down for each job category;
- The number of grievances that have been received, the actions taken to resolve the grievance and whether the grievance was resolved within 30 days;
- The number of hours that has been lost due to sickness or other reasons of absence (the reason of absence should be recorded); and
- The number of hours of training and skill development activities that have been received, broken down into each job category and a percentage of the workforce.

The SSES identified a strong and consistent expectation that BP should provide local residents with jobs preferentially, to address the lack of jobs locally available. Considering the relatively high number of employment positions that will be available to individuals based in the local communities, the preferential employment will be sufficient to meet these local expectations.

12.3.3 Demanning

As the onshore construction works at the ST pass the point of peak employment, the construction contractor's workforce will need to be reduced. The existing controls associated with a reduction in employment numbers (referred to as de-manning) are:

- Development and implementation of the EMRP which specifically includes a requirement to plan for demanning activities;
- Regular communication will occur between BP and the main construction and installation contractors associated with the demanning activities during LMF meetings; and
- Adequate staff communications between the main construction and installation contractors and their workforce which will inform the workforce of project progress and expected completion dates, so they can start to seek alternative employment positions in advance of their position being made redundant.

Magnitude

The process of demanning will occur after peak employment is reached in 2Q 2015, during a period of six months when the SD2 Project is expected to be completed by the end of 2015. Individuals, who are able to obtain alternative employment, or return to their previous role prior to their involvement in the SD2 Project, may experience a temporary change in household income during the transition between employment roles. Workers unable to obtain an alternative source of employment may experience impacts across a longer timescale.

Receptor Sensitivity

Receptor sensitivity is considered to be 'high' in relation to demanning as the individuals made redundant will be forced to find alternative sources of employment after their involvement in the SD2 Project is complete.

Mitigation & Monitoring

Individuals who are made redundant from the SD2 Project may experience increased psychological stress associated with the uncertainty of securing future household income, a reduction in general well-being, quality of life, and reduced household access to private healthcare and educational resources. Changes in the employment status of heads of households may also disrupt family life, personnel relationships and could potentially affect the welfare of children.

There is a variety of regional industrial developments that are either planned or under construction across the Garadagh region, which is creating numerous professional and non-professional employment opportunities. However, within the local communities, there are unlikely to be sufficient vacancies available that can immediately absorb the large numbers of workers, many of whom will have similar non-professional skills sets to offer the employment market. This situation is reflected by the relatively high numbers of unemployed in the local communities recorded during September 2011 by the SSES, some of whom have been unemployed for a significant period of time.

The workers based in the local community will have been ‘targeted’ preferentially for employment by the contractor responsible for the onshore construction works at the ST. These individuals may not have the motivation and skill set required to proactively seek-out new employment opportunities across the region, after their employment on the SD2 Project is complete.

However, the training and skills development activities undertaken during implementation of the Training Plan will include providing practical support to individuals to find alternative sources of employment, which aims to minimise the time workers spend between employment positions. Workers who are based across the region, outside of the local communities, are expected to be able to find alternative employment easily, as they may have greater mobility (and are less reliant on public transport) and will be familiar with seeking employment from across a wider geographical area.

It is expected that a large proportion of the construction workforce will be able to seek out alternative job opportunities after their involvement in the SD2 Project is complete. The provision of training and skills development to the workforce, certificates to provide competence for certain types of professional positions and adequate warning in advance of their position being made redundant, will reduce the impact of demanning to the extent possible. No additional mitigation is required.

12.3.4 Community Disturbance from the Visual Impact of the Elevated Flare

The SD2 Project currently includes a single HP/LP Main Flare with a stack height of 107m. During the operational phase of the SD2 Project, the elevated flare will operate across a range of routine and non-routine flaring scenarios. In order to predict the visibility of the SD2 Flare, a viewshed analysis was completed and the results are presented in Appendix 12B.

Magnitude

The results of the viewshed analysis indicate that at Sangachal Town, views towards the SD2 HP/LP Main Flare will be partly obscured by a ridge located behind the town. The percentage of residents who are expected to be able to see the SD2 HP/LP Main Flare is predicted to be 75% when operating under non-routine conditions associated with a recompressor trip. This is expected to result in an increase in flame height to 3m, compared with a routine flaring pilot/purge flame height of 1m. During an emergency shutdown (ESD) event, the height of the flame height is predicted to increase to 138m above the SD2 HP/LP Main Flare stack and the area of visibility at Sangachal Town increases to 98%.

From Umid, Azim Kend and Masiv 3 the viewshed analysis indicated that the SD2 HP/LP Main Flare will be visible to almost all residents during non-routine conditions associated with a recompressor trip and an ESD. During routine pilot/purge conditions, the SD2 HP/LP Main Flare is still expected to be visible to the majority of residents, due to the absence of any topographic features at these locations.

Receptor Sensitivity

Local resident perceptions towards BP's industrial operations within the communities were recorded during the Stakeholder and Socio-Economic Survey (SSES) and SD2 Infrastructure ESIA[1] consultation and disclosure process. The SSES recorded that operation of existing flares at the ST is perceived by local residents to have caused physical damage to their health, through the inhalation of strong odours. The meeting minutes from the SD2 Infrastructure ESIA consultation and disclosure process indicate that after a general welcome and introduction was given by a BP representative, the first question asked by local residents at meetings held at Sangachal Town, Azim Kend and Umid, related to existing flaring activities at the ST and concern about human health impacts, also from strong odours. This suggests that there are negative perceptions associated with existing flaring activities by some local community residents.

The results of the latest air quality monitoring data, which started in 1997 prior to the start of Early Oil Project (EOP) activities commencing at the ST, indicates that there has not been any significant change in air quality. Consequently, there is no evidence to support the perception that operation of flares has caused impacts to human health.

However, strong odours are occasionally generated by the presence of produced water within existing storage ponds located inside the ST. As the produced water ponds are low-lying and not visible to the local residents, they are not aware that this is the source of the odour. Consequently, the occasional presence of strong odours within local communities is seen by many residents to be a direct result of the elevated flares which are, in contrast, clearly visible during day and night time periods.

Operation of the SD2 Project HP/LP elevated flare, even under pilot/purge conditions, will be visible to the majority of local residents, especially during non-routine flaring events when the height of the flame will be greater than 1m. Consequently, receptor sensitivity is considered to be 'high'.

Mitigation & Monitoring

The negative perceptions associated with inhaling local air may result in changes to resident's mental health and general well-being. This change could occur as a consequence of increased psychological stress, anxiety, depression and related symptoms. Consequently, it is likely that visibility of the SD2 Project elevated flare, particularly during non-routine flaring conditions when the flame is high, will result in even stronger negative perceptions.

To reduce the impact associated with changes in community well-being, community engagement activities will be undertaken prior to the operation of the SD2 Project elevated flare, with the aim of providing information about non-routine flaring events to local residents.

12.4 Indirect Socio-Economic Impacts

12.4.1 Anti-Social Behaviour

The increase in local economic capital flows within the nearby communities arising from the increased employment and increased use of businesses may result in a variety of negative impacts. These impacts may include, but not be limited to, a rise in anti-social behaviour, family breakdown, alcohol and substance abuse, prostitution, domestic violence and desertion. These types of impacts will place greater demands on local social welfare resources, such as the State Police, educational and healthcare resources, and social services.

It is expected that these impacts will be mitigated, to some extent, through the implementation of BP's community investments programmes. In addition, employee awareness campaigns comprise an important part of the Employee Relations Management Plan, to encourage

[1] The SD2 Infrastructure ESIA assessed the activities associated with the SD2 EIW Project.

workers to use the income gained from employment in a responsible manner that benefits themselves and their household members, both now and in the future.

12.4.2 Increased Economic Flows

The significant increase in local employment levels within the nearby communities that will occur during the construction phase may result in a rapid, temporary increase in local economic capital flows. While affected individuals and business owners will typically consider this to be a positive change, there is a potential for local inflation to occur through an increase in the demand for the same types of good and services. Business owners may also seek to maximise the local rise in household income by increasing prices to take full advantage of increased capital that becomes locally available.

A variety of contractors based in Azerbaijan will be used during the SD2 Project which will result in an increase to their business revenue. Any increase in business revenue has the potential to benefit business owners through increased profits, the workforce through extended employment contracts, individuals who gain new employment with contractors, and government revenues through the collection of additional tax revenues.

The use of local, regional and national businesses to provide supply chain goods and services to BP's major contractors will be maximised where possible to do so. The use of in-country businesses for the construction of the SDB jackets and topsides will meet the strong expectation amongst local, regional and national business owners that a significant proportion of the total procurement will be allocated to in-country suppliers. In addition, the procurement of additional goods and services through the supply chain used by the construction yards will further contribute towards socio-economic development at a local, regional and national level.

The SD2 Project requirement for professional staff to be preferentially sourced from the local communities may divert individuals from existing professional roles, to the SD2 Project with the aim of securing higher paid employment. For example, if large numbers of professional public workers (such as health care staff and teachers for example) depart their current employment then such changes may have negative consequences to the local community, particularly if the quality of education and social services that is provided to vulnerable groups is reduced.

The negative impacts associated with increased economic flows cannot be mitigated to any reasonable extent, as BP does not have control over the way in which third-parties will use their additional income, or have any control on which individuals will apply for a professional job in the local workforce. However, all job advertisements associated with the SD2 Project will emphasise the temporary nature of the employment offered, to try and reduce existing professionals from leaving their current positions. In addition, the salaries of professional roles will be similar to those offered nationally and benchmarked using recent data available. The use of benchmarked salaries will avoid large discrepancies occurring between public sector roles and the temporary employment offered by BP's major contractors.

12.4.3 Social Conflict

There is the potential for conflict to occur from (perceived or actual) competition between individuals seeking jobs. Such conflicts could occur between members of the same settlement, between individuals from the local communities, or between 'local' and 'non-locals'. Such conflicts may be exacerbated by pre-existing tensions between groups of people and in particular, between non-locals and vulnerable groups (such as IDPs). In-migration may also place significant pressure on exiting social infrastructure, such as waste management and sewage networks.

Local targets (for professionals and non-professionals) will be used to maximise employment as far as practical for the existing residents of Sangachal Town, Umid, Azim Kend and Masiv 3, which will be verified by the prospective employee's identification card and supporting information, in accordance with the EMRP. This will act to minimise the potential for in-migration by job seekers located outside of these communities.

13 Cumulative and Transboundary Impacts and Accidental Events

Contents

List of Figures

List of Tables

13.1 Introduction

This Chapter of the Shah Deniz Stage 2 (SD2) Project Environmental and Socio-economic Impact Assessment (ESIA) discusses:

- Cumulative and Transboundary Impacts; and
- Accidental Events that could potentially occur during SD2 Project works and the control, mitigation and response measures designed to minimise event likelihood and impact.

13.2 Cumulative and Transboundary Impacts

As discussed within Chapter 3, cumulative impacts arise from:

- Interactions between separate project-related residual impacts; and
- Interactions between project-related residual impacts in combination with impacts from other projects and their associated activities.

As outlined in Chapter 1 of this ESIA, the SD2 Project comprises the next stage of development of the SD Contract Area. The existing EOP, ACG Phase 1, 2 and 3 and SD1 Project facilities at the Sangachal Terminal have been operational since 1997. The effects of these projects on the environmental and socio-economic environments are therefore incorporated into the existing baseline as presented in Chapters 6 and 7 (except where noted in the assessments below). The potential for cumulative impacts with other projects have been determined, based on a review of available information relating to projects in the vicinity of the Sangachal Terminal, which are of a scale that has the potential to result in cumulative impacts.

13.2.1 Cumulative Impact Between Separate Project Impacts

A detailed assessment of environmental and socio-economic project impacts, based on expected activities and events, is presented in Chapters 9, 10 and 11 of the ESIA. The assessment takes into account each activity and the existing controls and additional mitigation identified to minimise and manage impacts.

13.2.2 Cumulative Impact With Other Projects

Based on a review of available information it is understood that the following projects, which have the potential to interact with the impacts of the SD2 Project based on their location and scale, are planned or under construction in the vicinity of the Sangachal Terminal (refer to Figure 13.1):

- **Qizildas Cement Plant** – new cement plant to be located approximately 4km north of the Sangachal Terminal. The project incorporates dry kiln technology and will be designed to produce up to 2,000,000 tonnes of cement per annum from raw materials supplied from local quarries in the Garadagh and Absheron regions, at a distance of 2 to 40km from the plant. A new road to enable construction and operational vehicles to access the plant from the Baku-Salyan Highway is planned and the project also includes a railway spur from the railway line between the Sangachal Terminal and Umid. The numbers of jobs generated by the construction and operational phases of the plant is not known. Construction works are expected to be completed by 2014. Impacts associated with the operational phase of Qizildas Cement Plant have been assessed within an ESIA completed in 2009[1];
- **SD1 Flare Project** – replacement of an existing ground flare and surrounding enclosure located within the existing Sangachal Terminal boundary. Construction works are due to be completed by 2015. The new elevated flare package comprises the following: a HP/LP (High Pressure/Low Pressure) Main Flare A with a stack height of

[1] Qizildas Cement Factory ESIA, 2009.

50m; a HP/LP Main Flare B (50m stack height); and a HP Emergency Flare (100m stack height);

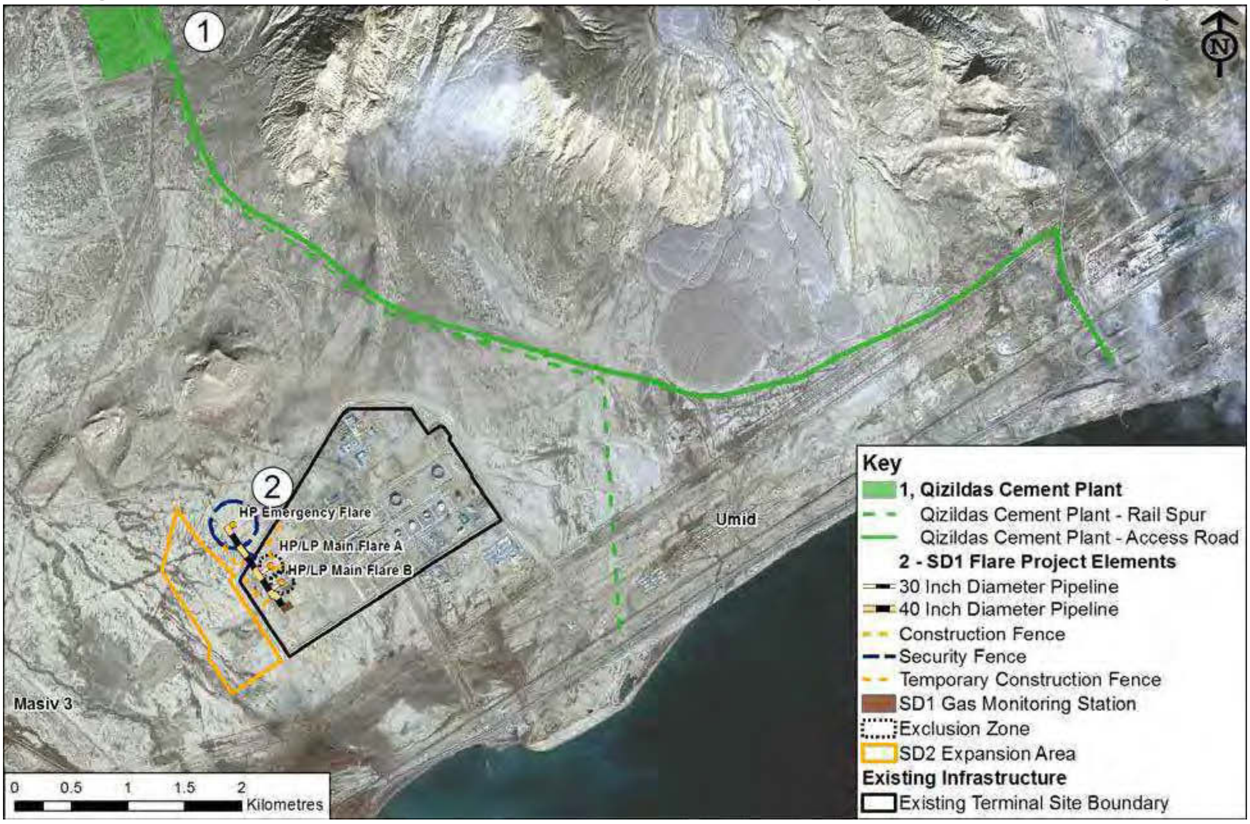
- **Garadagh District Umbaki (Jeyildagh) Jailhouse** – a new jailhouse prison that has a maximum capacity of 1,500 people. Construction works commenced in 2007 and are expected to be complete by December 2013;
- **New Baku Port** – the new port is located close to Alyat settlement, 25km to the south of the Sangachal Terminal and is being undertaken by the Ministry of Transport. The port covers an area of 400 hectares and includes the construction of two bridges for ferry boat movements; three freight bridges for container vessels; road networks for the movement of roll-on and roll-off cargo; and a dry cargo storage area. Construction works started in November 2012 and are expected to be complete by 2015;
- **State Oil Company of Azerbaijan Republic (SOCAR) Petrochemical Complex** – to be located approximately 3-4km to the north of the Sangachal Terminal and is expected to comprise a gas processing plant, oil refinery and petrochemical plant. The actual location of this development is not currently known and may overlap, or lie adjacent to, the land already identified for the Qizildas Cement Plant. Construction works are expected to commence during 2013-2014 with the facility being operational by 2020. According to press reports[2] the facility will employ a maximum of 15,000 over the construction and operation phase;
- **Baku Shipyard Company** – a modern shipyard facility located 23km from the Sangachal Terminal adjacent to an existing deep water plant. This project is being implemented by SOCAR in partnership with Keppel Offshore and Marine (a Singaporean company). Construction works started in 2011 and the facility is due to be completed by 2013; and
- **Navy and Military Camp for Navy Officers** – located close to Sahil settlement, this development aims to provide residential housing for officer’s families and is being undertaken by the Ministry of Defence. Construction works are underway and some housing units have already been built. The development is expected to be complete by 2014.

Traffic flow along the Baku- Salyan Highway has increased in recent years[3] and is expected to continue to increase in the future due to development of these projects. To provide capacity for increased traffic flows, a requirement has been recognised to widen the Baku-Salyan Highway to four lanes in each direction. Additional information, such as the schedule and physical extent of the infrastructure upgrade works, are not available.

[2] http://www.usacc.org/news-publications/investment-news/construction-on-energy-refining-and-petrochemicals-complex-to-begin-in-2013-socar-president-says.html.

[3] Per comms, Head of the Technical Division, Azerbaijan Highway Authority, 2010.

Figure 13.1 Location of Planned or Under Construction Projects in the Terminal Vicinity



13.3 Approach to the Cumulative Assessment

Key assumptions made for the cumulative assessment with other projects are:

- The Qizildas Cement Plant is expected to be operational from 2015 and it has been assumed that the construction phase will overlap with the SD2 Project construction activities in the vicinity of the Sangachal Terminal; and
- The SOCAR Petrochemical Complex is expected to be operational from 2020 and it has been assumed that the construction phase will overlap with the construction phase of the SD2 Project.

For non greenhouse (GHG) emissions (refer to Section 13.7) the assessment of cumulative impacts between the SD2 Project and other planned or under construction projects includes the operational onshore and offshore SD and ACG facilities such that the combined impact of all Terminal operations can be assessed.

The approach taken to assessing cumulative impact between SD2 Project impacts focuses on assessing the potential temporal and geographic overlap between environmental impacts based on the current project schedule (refer to Chapter 5 Figure 5.3) and the results of modelling assessments demonstrating the expected geographic extent of the impacts (refer to Chapters 9, 10 and 11).

13.4 Terrestrial Environment: Cumulative Impacts

13.4.1 Cumulative Impact Between Separate Project Impacts

Construction activities associated with the SD2 Project will occur in the vicinity of the Sangachal Terminal (within the SD2 Expansion Area, the pipeline landfall area and along the onshore SD2 export pipeline route) and at the construction yards. While yet to be selected, the anticipated construction yards where the SDB platform complex topsides, jackets and bridge will be constructed are located more than 10km from the Sangachal Terminal. There is therefore no potential for overlap between separate project impacts in these locations in terms of environmental impacts (e.g. noise).

The assessments of noise and emissions associated with the onshore construction activities within the vicinity of the Sangachal Terminal are presented in Chapter 10. These assessments take into account the cumulative impact to receptors of all construction activities during construction works at the Terminal, onshore and nearshore pipeline installation works, pipeline pre-commissioning activities and Terminal commissioning. The assessments concluded that, following the application of existing and additional mitigation (which includes the development and implementation of a Community Engagement and Nuisance Management and Monitoring Plan) impacts are considered to be no more than Moderate Negative.

13.4.2 Cumulative Impact With Other Projects

13.4.2.1 Changes to Hydrology

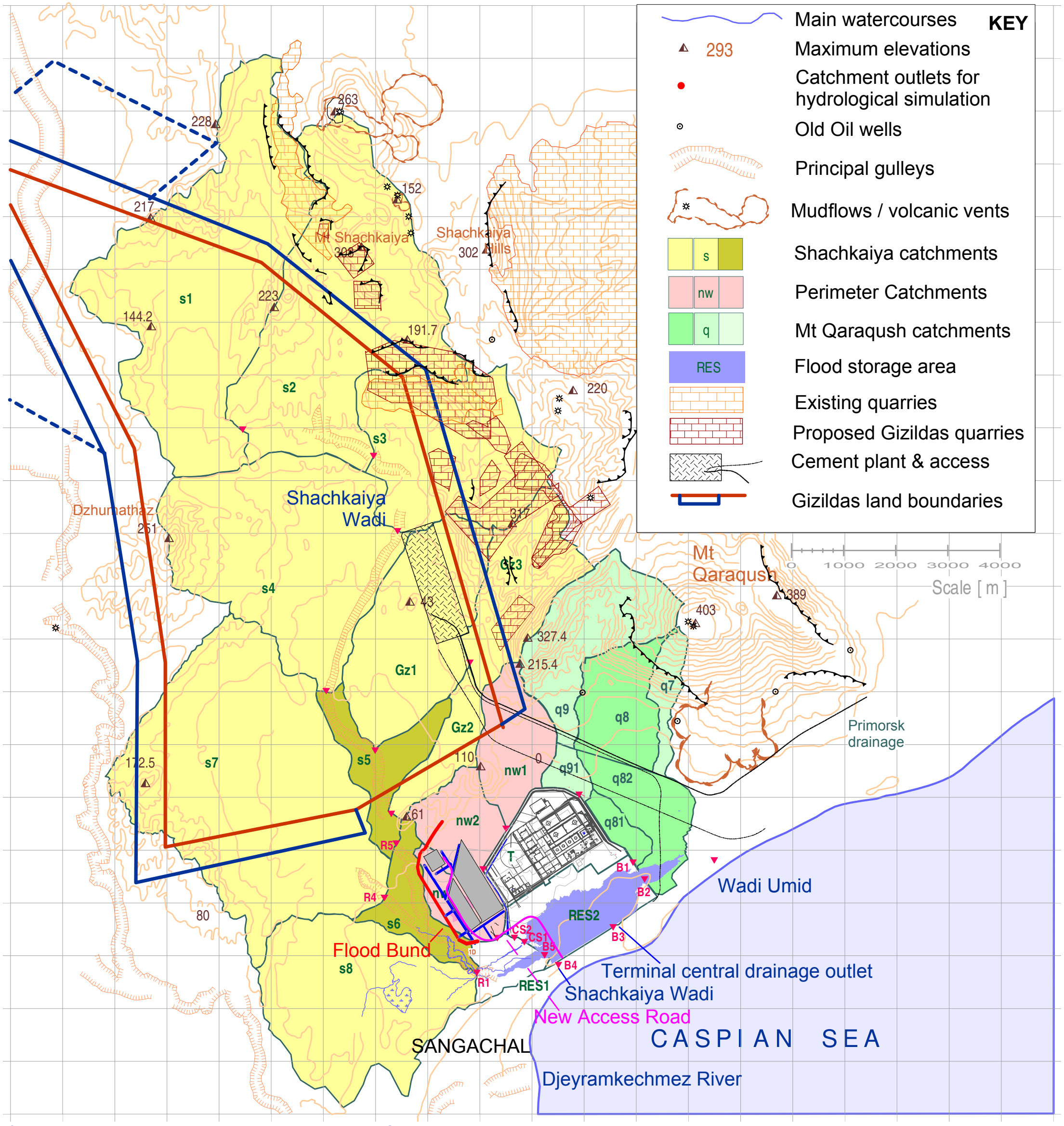
Any alteration to local hydrological conditions may change the existing flood risk to sensitive receptors located in the vicinity of the Sangachal Terminal.

The Qizildas Cement Plant and SOCAR Petrochemical Complex developments are expected to use land which is currently unoccupied, is located to the north and north east of the Sangachal Terminal and lies within the upper Shachkaiya Wadi catchment area (refer to Figure 13.2). The existing level of flood risk to downstream receptors may be modified through:

- An increase in the volume of water discharged directly into the Shachkaiya Wadi and its tributaries from the discharge of industrial wastewater associated with operation of the Qizildas Cement Plant and SOCAR Petrochemical Complex developments: and
- The rapid diversion of rainwater falling within areas covered with impermeable cover associated with the construction of roads, buildings and industrial areas that feature bunding and hardstanding materials. Rain and runoff water falling within impermeable areas will be rapidly diverted into drainage systems and discharged into the Shachkaiya Wadi and its tributaries, rather than falling onto natural soil and slowly infiltrating vertically.

The hydrological changes described above will act to reduce the amount of time taken for surface water levels within the Shachkaiya Wadi and its tributaries to increase. This may result in higher surface water volumes within the Shachkaiya Wadi and its tributaries which, during heavy precipitation events, may increase the overall level of flood risk to downstream receptors.

Figure 13.2 Main Drainage Catchment Areas in the Vicinity of the Sangachal Terminal and Qizildas Cement Plant



© Water Resource Associates Ltd. Based on Soviet mapping at 1:50,000 scale, with WRA data added

The hydrological model constructed for the SD2 Early Infrastructure Works (EIW) was used, with assumptions that the Qizildas Cement Plant and SOCAR Petrochemical Complex would alter surface water infiltration rates within the Gizilidas land boundary shown in Figure 13.2, to assess changes in flood level at:

- Sangachal Town; and
- The Caravanserai.

Table 13.1 Flood Levels at Key Receptors from the Qizildas Cement Plant and SOCAR Petrochemical Complex

Receptor	1 in 100-year flood levels in mAOD			
	Undeveloped Upper Catchment Area	Development of the Qizildas Cement Plant Only	Development of the SOCAR Petrochemical Complex Only	SOCAR Petrochemical Complex and Qizildas Cement Plant
Sangachal Town	-12.93	-12.47	-12.49	-12.47
Caravanserai	-20.95	-20.21	-20.36	-20.21

The results of the flood modelling in Table 13.1 indicate that the Qizildas Cement Plant will increase water volumes within the Shachkaiya Wadi during a 1 in 100 year flood event, from $61m^3/s$ to $80m^3/s$, leading to an increase in the flood level of Sangachal Town by 0.46m and 0.71m at the Caravanserai. The change in flood levels from the SOCAR Petrochemical Complex Plant is expected to increase by 0.44m at Sangachal Town and 0.59m at the Caravanserai. When the development of the Qizildas Cement Plant and SOCAR Petrochemical Complex is combined, flood levels increase by 0.46m at Sangachal Town and 0.74m at the Caravanserai.

In isolation, the SD2 Project is not expected to have a significant impact to flood levels at any sensitive receptors. The hydrological modelling has indicated that the future development of the Qizildas Cement Plant and SOCAR Petrochemical Complex has the potential to slightly increase flood risk to some downstream receptors.

13.4.2.2 Noise

The SOCAR Petrochemical Complex is likely to include a number of significant operational noise sources. While the internal layout of the complex is not known it is understood it will be sited within 2-3km of Azim Kend to the north of the existing Sangachal Terminal. A screening assessment was completed, taking into account the noise budgets at each of the receptors surrounding the Sangachal Terminal. These were derived from the nightime noise limit of 45dB(A) minus the existing Sangachal Terminal plant noise from the SD and ACG facilities and the predicted noise from the SD2 plant (refer to Appendix 11D for further details). Based on the assumed location of the site it was calculated that, in order for the nightime limit to be met, the noise from the operational SOCAR facility will need to be less than LAeq 35dB.

Specific details of the plant and operation of the facility are not known and as such a detailed analysis of the operational noise is not possible. To assess the likely cumulative impact a sound power level at the SOCAR Petrochemical Complex site boundary of LWA 120dB was assumed based on data for a similar petrochemical complex in the UK. The screening assessment indicated that, based on this assumption, the 45dB(A) nighttime noise limit would be met at Sangachal and Umid but exceeded at Azim Kend and Masiv 3 by up to 1dB(A). However detailed modelling would need to be completed for the facility once the location and layout has been finalised.

An assessment was also undertaken considering potential cumulative impacts associated with SD1 and SD2 non routine flaring, based on the flaring scenarios and associated noise levels anticipated for the new SD1 elevated flare and for the SD2 elevated flare.

The assessment for each flare system took the same approach as described within Chapter 11 Section 11.5.2.1 whereby the estimated noise levels at each receptor for each flaring scenario and the % duration of the year that the scenario was expected to occur was calculated. The results therefore indicated for what proportion of a year the most stringent noise limit (45dB(A) would be exceeded and this was compared against the requirement for noise limits to be met for 95% of the year. While the assessment for the SD2 Project flare as presented in Chapter 11 showed that compliance with the noise limit was expected for at least 99.3% of the year, with the addition of the SD1 flare, it was predicted that the noise limit would be exceeded for 12.1% of the year. This exceedance was found to be due to the frequency and duration of the SD1 compressor trip. The SD1 Flare Project have committed to implement a flaring policy to reduce the frequency and duration of this scenario.

13.5 Marine Environment: Cumulative Impacts

13.5.1 Cumulative Impact Between Separate Project Impacts

Environmental interactions will arise from the following activities and operations:

- Pipeline and flowline installation (physical disturbance);
- Pipeline commissioning (treated seawater discharges including preservation chemicals);
- Drilling (drill cuttings and drilling fluid discharges);
- Subsea cluster infrastructure installation (physical disturbance);
- Platform installation (physical disturbance);
- Platform operations;
- Routine subsea operations (control fluid discharge); and
- Non-routine subsea interventions (MEG, condensate, water and control fluid discharges).

Physical disturbance associated with pipelaying and subsea and platform installation is restricted largely to the footprint of the infrastructure. Disturbance arising from anchor handling during pipelaying will be transient. Physical disturbance is not considered to have a cumulative impact, or a cumulative interaction with other impacts.

Discharges of treated seawater discharges (including preservation chemicals) associated with the commissioning of pipelines and flowlines will involve more than 90 transient events of varying size, over a period of several years. The impact of most of these events is minimal (refer to Chapter 10 Section 10.8.3). The larger events are distributed in time and space, and the impacts will not overlap. It is considered that there will be no cumulative interaction between these discharges, and no cumulative interaction with other impacts.

The deposition of drill cuttings deposition has been modelled for both shallow-water and deep-water subsea clusters and for discharges from a single well and discharges from six wells at two separate drill centres (refer to Chapter 9 Section 9.4.2). Within each cluster, the progress of the drilling programme will lead to a cumulative interaction between the deposits arising from successive wells; however in both shallow and deep locations, the cuttings deposits (assuming deposition to 1mm thickness) will be confined to within a radius of 100-400m of the cluster centre, with maximum depth of accumulation being 1.2m within a radius of 200m range (depending on water depth at the drilling location). The subsea clusters are widely separated, and there will be no cumulative interaction between clusters. Once all wells at a cluster are completed, there will be no further drilling and accumulations of cuttings and cement that could interfere with the installation of the subsea production facilities will be dispersed by mechanical means or water jet.

During routine subsea operations, the only environmental interaction will arise from the discharge of subsea control fluids. This will take two forms; continuous discharge at a very low rate (0.03cm^3 per minute per valve) from directional control valves on the manifolds and trees, and intermittent discharge of larger volumes (litres per event) when actuator valves are operated. These releases have been modelled, and it has been demonstrated that no impact will occur more than 20m from the point of release, and that the potential duration of impact is less than one hour (refer to Chapter 11 Section 11.6.3). It is considered that there will be no cumulative impact from these discharges, and that there is no potential for cumulative interaction with other impacts.

During routine platform operations, the principal discharges will be cooling water, black water, grey water, and open drains water. Cooling water discharge has been modelled to assess the potential for thermal impact[4]. The modelling indicated that the discharge would meet the required 3ºC temperature gradient between the discharge plume and ambient sea

[4] CORMIX 8.0GT (i.e. the latest version) was used for thermal discharge modelling

temperature within 11m from the point of discharge. Other routine discharges are small in volume, and have no persistent or cumulative effect.

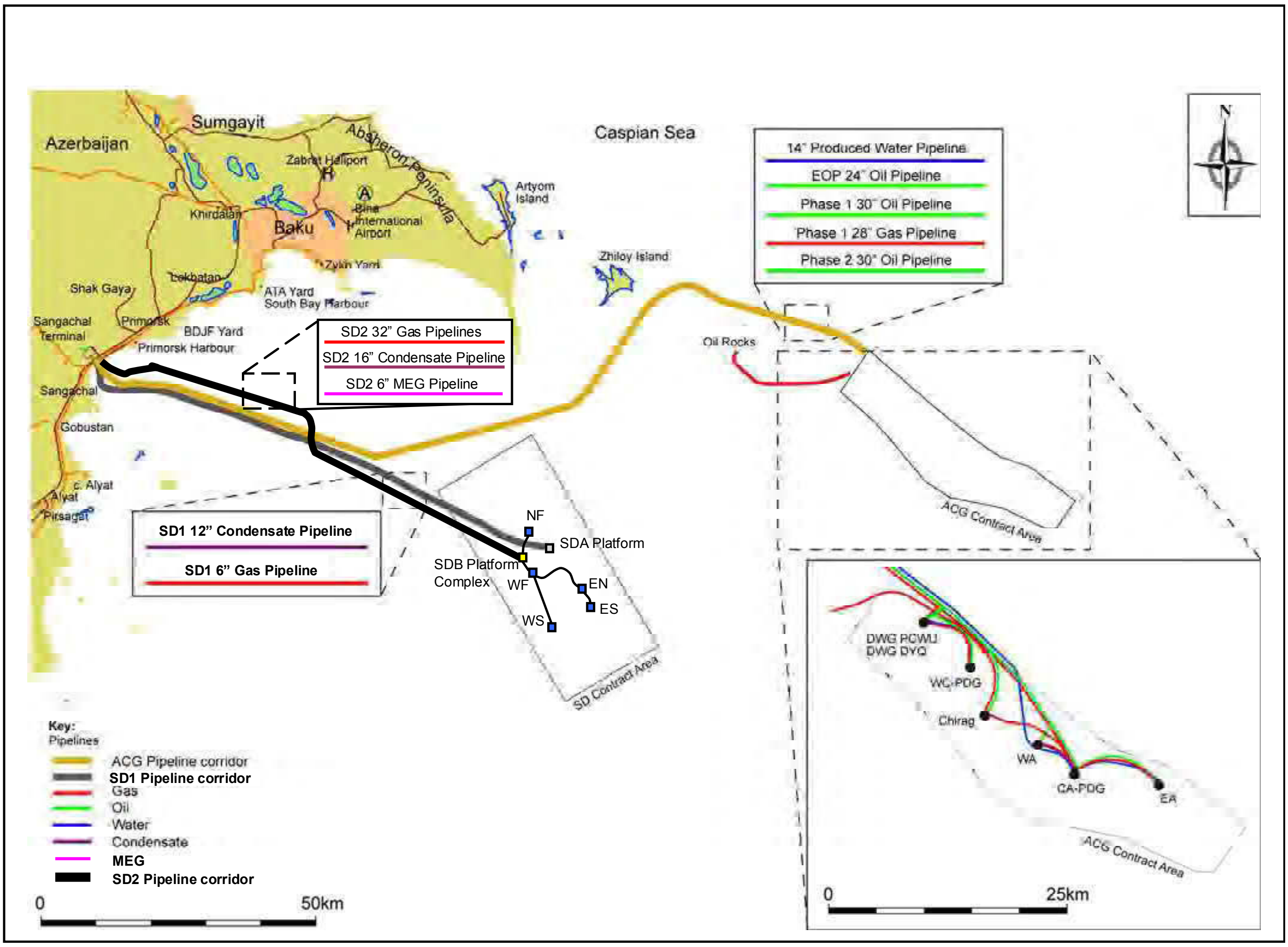
The MEG discharges associated with foreseeable subsea interventions are small in volume ($1.3m^3$), and will occur infrequently i.e. once per production tree across the PSA period. The impact has been assessed as no more than minor negative (refer to Chapter 11 Section 11.6.4).

Overall, with the exception of highly localised cumulative consequences arising from successive drilling activities within clusters, no events or activities will have cumulative impacts either in themselves or in combination with other project impacts.

13.5.2 Cumulative Impact With Other Projects

The location of the SD2 offshore and subsea facilities in the context of the existing SD and ACG offshore facilities is shown in Figure 13.3. As discussed in Section 13.5.1 above it is anticipated that treated seawater discharges from pipeline and flowline pre-commissioning, drilling discharges and control fluid discharges will impact a small area (no more than 400m in radius) within the locality of the discharge location. There is therefore no potential for cumulative impacts between SD2 Project discharges and discharges from the operational platforms within the ACG Contract Area (over 60km to the north east) and SD-Alpha platform (approximately 7km from the SDB platform complex and approximately 3-4 km from the nearest SD2 wells).

Figure 13.3 Location of Existing SD and ACG Offshore Facilities and Proposed SD2 Offshore and Subsea Facilities



13.5.3 Mitigation and Monitoring

Control measures to mitigate impacts to the marine environment from routine and non routine discharges associated with the SD2 Project and associated reporting requirements are detailed within Chapters 9, 10 and 11 of this ESIA. These include design and operating principles (e.g. no planned discharge of non-WBM), facility maintenance regimes, appropriate chemical selection and monitoring to confirm effective operation and/or confirm compliance with standards.

Monitoring and reporting procedures and documentation requirements for each SD2 Project phase are included within BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy (Refer to Chapter 14). Once operational, SD2 will become a component of the AGT Region and will develop a set of project specific monitoring, management and reporting procedures based on, and consistent with, the procedures already in use on existing SD and ACG platforms.

13.6 Socio-Economic Environment: Cumulative Impacts

13.6.1 Cumulative Impact Between Separate Project Impacts

A detailed assessment of individual socio-economic project impacts, based on expected activities and events, is presented in Chapter 12 of the ESIA. The assessment takes into account each activity and the existing controls in place to manage the impact. No requirement for additional mitigation was identified and all impacts were considered to be minimised as far as practicable.

The expected activities and events that may result in a cumulative socio-economic impact from different components of the SD2 Project are:

- An rise in employment opportunities during the construction phase;
- An rise in economic flows from the use of major construction and installation contractors and their associated supply chain network of companies; and
- An increase in road traffic on the Baku-Salyan Highway.

13.6.1.1 Economic Flows

The SD2 Project is expected to increase economic flows at a regional (Garadagh District) and national level through increased employment and the procurement of goods and services. This is expected to occur from the use of different construction and installation contractors at the same time during the construction phase. The increase in economic flows is expected to contribute at a regional level, to socio-economic development and lead to improvements in the current status of health, education and other social infrastructure.

13.6.1.2 Employment

Employment levels during the SD2 Project construction phase are estimated as:

- 4,800 positions associated with the onshore construction works at the Sangachal Terminal which is expected to peak during 2016;
- 1,500 positions at the onshore construction yard used to fabricate the jacket which is expected to peak during 2015;
- 2,260 positions at the topsides onshore construction yard which is expected to peak during 2015; and
- 2,000 positions associated with marine subsea works, which are expected to peak during 2015 and 2016.

Whilst almost all of the jobs associated with the SD2 Project will be temporary, workers will be provided with an opportunity to develop their skills and experience during their employment. This will be achieved through implementation of the Employee Relations Management Plan and formal training activities.

Given the existing control measures in place and the positive impacts associated with employment, it is considered that the appropriate measures are in place to appropriately maximise the cumulative impacts associated with employment.

13.6.1.3 Increased Traffic on the Baku-Salyan Highway - Congestion

The Baku-Salyan Highway is the main traffic route in the local area and is expected to be used by traffic associated with the main construction and installation contractors working at and in the vicinity of the Sangachal Terminal. There is the potential for increased traffic on the Baku-Salyan Highway to cause disruption to other road users from increased congestion.

Off-site vehicle movements during Terminal Construction and Commissioning Activities are expected to peak during Phase 3 and Phase 4 to 1,310 a day, which reflects an increase of 13.1% of the total on the Baku-Salyan Highway traffic flow.

There are a number of improvements to the Baku-Salyan highway that are underway that will reduce congestion. All of the main construction and installation contractors will implement a Traffic and Transportation Management Plan, one of the aims of which will be to minimise impacts to road users and ensure that adherence to BP’s strict procedures associated with vehicles and safe driving are enforced. The Traffic and Transportation Management Plan will be subject to regular review and update and will take into account any changes in traffic flows or routing issues during the project duration.

Considering the planned future improvements to the Baku-Salyan Highway and use of the Traffic and Transportation Management Plan, the SD2 Project’s contribution to potential traffic impacts are minimised as far as possible.

13.6.2 Cumulative Impact With Other Projects

13.6.2.1 Visual Impacts

There is a potential for cumulative visual impacts at receptors in the Sangachal Terminal vicinity from the operation of the SD1 and SD2 flares.

A viewshed analysis was undertaken (refer to Appendix 12B) to determine the potential for cumulative visual impacts to occur between the SD2 Project and SD1 Flare Project. The viewshed analysis was based on a number of anticipated non-routine flaring scenarios to reflect conditions when the height of the flames above the elevated flare stacks, will be at their highest and are therefore, expected to be visible to residents from the local communities.

The analysis, which is based on the topography of the area and does not take into account features such as buildings and structures, demonstrated that SD2 flare was calculated to be visible to approximately 75% of the area surrounding the Terminal as a minimum. The additional of the SD1 flare increased the visibility to a maximum of 80% at Sangachal. This indicates that the additional visibility of an elevated feature at Sangachal Town is relatively low at 5%, resulting in a relatively minor cumulative impact.

The results of the viewshed analysis indicate that the extent of visibility for the residents of Umid, Azim Kend and Masiv 3 from an elevated feature associated with either the SD2 Project or SD1 Flare Project is similar, and that elevated features from both projects can be seen by local residents. This indicates that almost all residents of Umid, Azim Kend and Masiv 3 are predicted to see features associated with both the SD2 Project and SD1 Flare Project. Consequently, the cumulative impact associated with the SD1 Flare Project to these receptors is negligible.

The assessment of cumulative visual impacts from elevated features associated with the SD2 Project and SD1 Project are expected to be limited and no additional mitigation is required.

13.6.2.2 Increased Traffic on the Baku-Salyan Highway - Congestion

The Baku-Salyan Highway is expected to be used by traffic associated with the other projects described in Section 13.2.2. There is the potential for increased traffic on the Baku-Salyan Highway from the other projects to cause disruption to other road users from increased congestion, particularly during the construction phase of the SD2 Project where off-site vehicle movements will be greatest.

From all of the other projects described in Section 13.2.2, the potential to result in the highest contribution to traffic flows is expected to be the New Baku Port during operation from the road transport of cargo which lies 25km to the south of the Sangachal Terminal from 2015, and traffic associated with construction works at the SOCAR Petrochemical Complex (the actual timeframe for this project is not known).

The Qizildas Cement Plant project is also expected to result in additional traffic flows on the Highway however construction works are currently expected to be complete in 2014[5]. There is therefore a limited a period when construction would overlap with the SD2 Project works. Off-site construction vehicle movements associated with the construction phase of the SD1 Flare Project is expected peak at 26 off-site vehicles per day during 2014/2015.

Considering the scale of these other projects, it is expected that throughout the SD2 Project, there will be gradual increase in the volumes of traffic using the Baku-Salyan Highway. However, the overall cumulative contribution to traffic flows, particularly during the operation phase, is expected to be small, particularly if expansion of the Baku-Salyan Highway is implemented during the SD2 Project construction phase.

13.6.2.3 Employment

The increase in employment opportunities associated with the SD2 Project and the other projects described in Section 13.2.2, will benefit the individuals and households employed at a local, regional and national level. It is expected that the workforce required for the construction phase of the other projects will be similar to those needed at the Sangachal Terminal and onshore construction yards used by the SD2 Project. Where construction works overlap in time between the other projects, there may be increased competition between developers to secure the services of highly skilled and experienced construction workers, leading to increase in wage inflation. The rate of in-migration from job seekers based elsewhere in Azerbaijan into the regional area could also increase from the overlap when large numbers of construction workers are required.

13.6.2.4 Economic Flows

The contribution of the SD2 Project to the other projects described in Section 13.2.2 will lead to increased economic flows at a local, regional and national level. The increase in economic flows cannot be quantified as the expected economic benefits from the other projects are not stated. However, given the economic scale of the other projects, particularly the SOCAR Petrochemical Complex which represents a major oil and gas development, it is likely that economic flows created will be far greater than those attributed to the SD2 Project. This may increase the overall level of industrialisation and socio-economic development within the Garadagh District, attract additional ‘follow-on’ projects, and result in improved transport and communications infrastructure which will continue to enhance the region.

[5] Qizildas Cement Factory ESIA, 2009.

13.6.2.5 Community Development Initiatives

There is little information associated with community initiatives that will be designed and implemented by the other projects described in Section 13.2.2. BP's own community investment programme is described in Chapter 7, Section 7.12. BP is currently involved in educational programmes which provides support to people from a young age and continues to a university research level. BP also supports the development of local suppliers through training and financing programmes, building skills and sharing BP's internal standards and practices as appropriate. Such activities enable a greater number of local businesses to participate in their supply chain.

Cumulative impacts from the implementation of BP's community investment programmes with similar initiatives from the other projects are expected to be complimentary and have a positive impact upon local communities.

13.6.2.6 Conclusion

The assessment of socio-economic cumulative impacts demonstrates that negative cumulative impacts associated with the SD2 Project and other projects in the vicinity of the Sangachal Terminal, are expected to be limited. Positive cumulative impacts are expected to occur from employment, increased economic flows and the implementation of community development initiatives. These positive impacts will occur in parallel with increasing industrialisation across the Garadagh region which may lead to improvements in transport, communications, utility connections and social infrastructure.

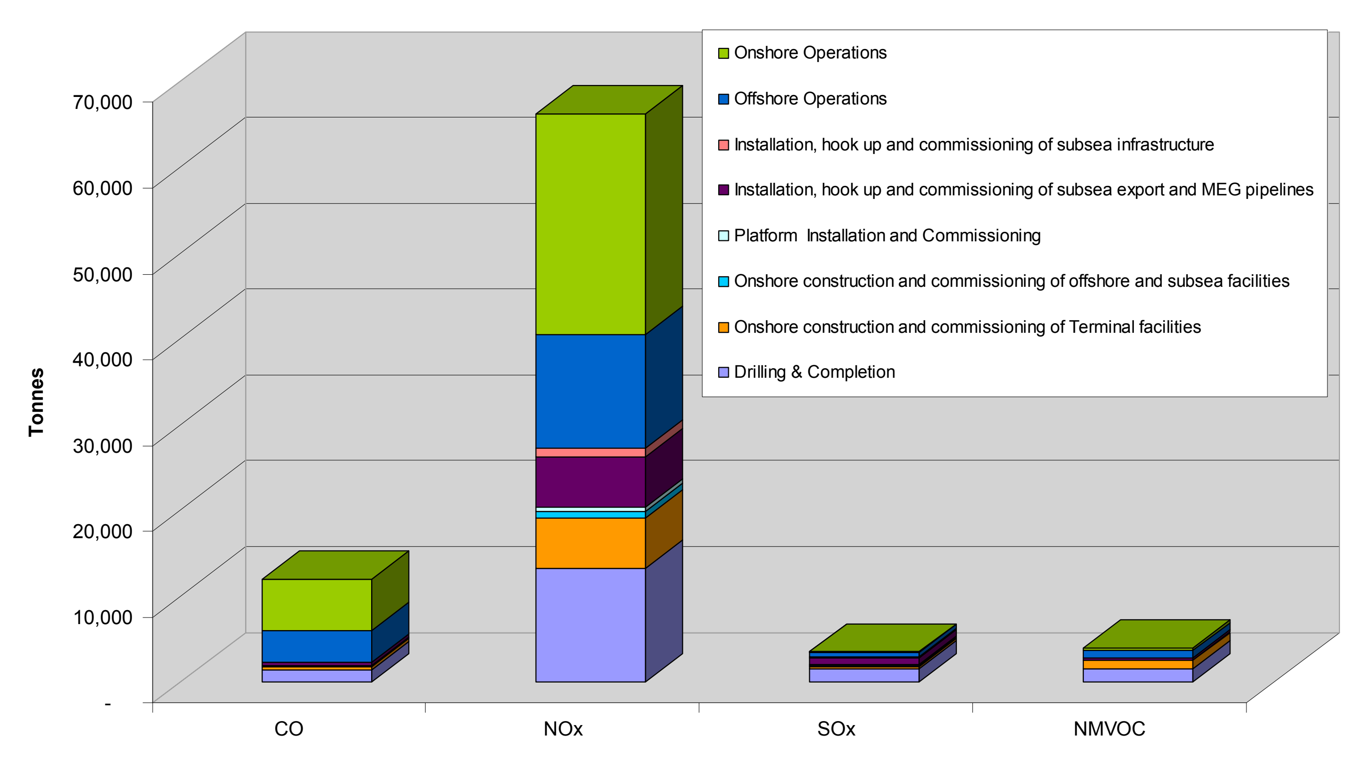
13.7 Non-Greenhouse Gas Atmospheric Emissions: Cumulative Impacts

Atmospheric emissions will be generated from the each SD2 Project phase due to:

- Operation of construction and operational plant;
- Operation of mobile drilling rigs and vessels;
- Flaring (during drilling and operations); and
- Fugitive emissions.

Figure 13.4 presents the volumes of the non-greenhouse gas (non-GHG) emissions nitrous oxides, sulphur oxides, carbon monoxide and non methane hydrocarbons, for each phase of the SD2 Project.

Figure 13.4 SD2 Non-GHG Emissions Per Project Phase



13.7.1 Cumulative Impact Between Separate Project Impacts

Air dispersion modelling (focused on NO_2) has been completed for emissions to atmosphere during SD2 drilling, SD2 construction activities at the construction yards and in the vicinity of the Sangachal Terminal and during onshore and offshore operations. Based on a review of the project schedule and the results of the modelling as presented in Chapters 9, 10 and 11 it is not expected there will be a cumulative impact associated with SD2 Project emissions to atmosphere. While the project will require a number of vessels operating within the SD2 Contract Area and along the SD2 Pipeline Route during drilling, pipeline and subsea infrastructure installation it is anticipated that vessel emissions will rapidly disperse and no impact to onshore receptors is predicted.

13.7.2 Cumulative Impact With Other Projects

13.7.2.1 Onshore Non-Greenhouse Gas Atmospheric Emissions

Modelling has been undertaken to assess the cumulative impact of the following on air quality at receptors in the vicinity of the Sangachal Terminal (refer to Appendix 11B):

- SD2 Project onshore facilities (routine operation);
- Existing SD and ACG facilities (routine operation);
- Proposed SD1 elevated flare (pilot flaring);
- Proposed Gizildash cement plant; and
- Proposed power plant associated with the SOCAR Petrochemical Complex (assumed to be the main source of emissions within the complex).

As no detailed plans or data is currently available for the SOCAR Petrochemical Complex, it was assumed, based on similar petrochemical plants of this size, that a 250MW power station would be required. Model input data was based on relevant emission factors for petroleum refining using natural gas as fuel and reasonable worst case assumptions regarding stack height and diameter.

Table 13.2 presents the long term annual average NO_2 concentrations predicted by the modelling for Azim Kend, Masiv 3, Sangachal and Umid in the context of the annual average air quality standard of 40 μg/m^3 and the background concentration of 6 μg/m^3.

Table 13.2 Predicted Annual Average NO_2 Concentrations at Receptors in the Sangachal Terminal Vicinity (Cumulative Scenario)

Receptor Name	NO_2 Annual Average (μg/m^3)		
	Modelled Contribution (μg/m^3)	Percentage of Limit Value (%)	Predicted Concentration (μg/m^3)
Azim Kend	3.8	9.4%	9.8
Masiv 3	6.0	15.0%	12.0
Sangachal	14.5	36.1%	20.5
Umid	4.2	10.5%	10.2

The results indicate that for the cumulative scenario modelled the annual average air quality standard will be met at all receptors. Comparing the results to those obtained for the SD2 Project alone (routine operations) the additional projects are anticipated to contribute between 3.9μg/m^3 and 12.6μg/m^3 to NO_2 concentration at receptors. Cumulative impacts to air quality are not considered significant and no additional mitigation measures are required.

13.7.2.2 Offshore Non Greenhouse Gas Atmospheric Emissions

Modelling has been undertaken to establish the cumulative effect from non-GHG emissions due to the operation of the EOP, ACG Phases 1, 2 and 3, COP, SD1 and the SD2 offshore facilities on NO_2 concentrations onshore (refer to Appendix 11C).

NO_2 emissions from both the existing platforms and proposed SD2 platform complex were modelled to determine the future contribution of emissions to the air quality onshore. Concentrations taking into account existing background levels[6] were compared against relevant long term (annual average) and short term (1 hour peak) air quality standards for the protection of human health[7].

The modelling demonstrated that during routine operations, NO_2 emissions disperse rapidly and the increase in long term and short term NO_2 concentrations due to all ACG, SD1 and COP offshore operations are likely to be indiscernible from background levels. Table 13.3 presents the NO_2 long term concentrations predicted for the routine modelling scenario relative to background concentrations and the relevant long term air quality standard of 40 μg/m^3.

Table 13.3 Predicted NO_2 Concentrations at the Absheron Peninsula and Sangachal During Routine Operation of all ACG and SD Offshore Facilities

Receptor Name	NO_2 Annual Average (μg/m^3)		
	Modelled Contribution (μg/m^3)	Percentage of Limit Value (%)	Predicted Concentration (μg/m^3)
Absheron Penisula (Shadili Spit)	0.15	0.4%	6.15
Sangachal	0.02	0.05%	6.02

[6] Refer to Chapter 6: Environmental Description for background levels

[7] Applicable 1 hour average (short term) and annual average (long term) standards for NO_2 are 200μg/m^3 and 40μg/m^3 respectively

13.8 Non-Greenhouse Gas Atmospheric Emissions: Transboundary Impacts

The potential for transboundary impacts associated with non-GHG emissions are dependant on the environmental / health effects associated with the pollutant, residence time (i.e. atmospheric lifetime) and the expected dispersion characteristics of the pollutant in the atmosphere in addition to the location of potential receptors.

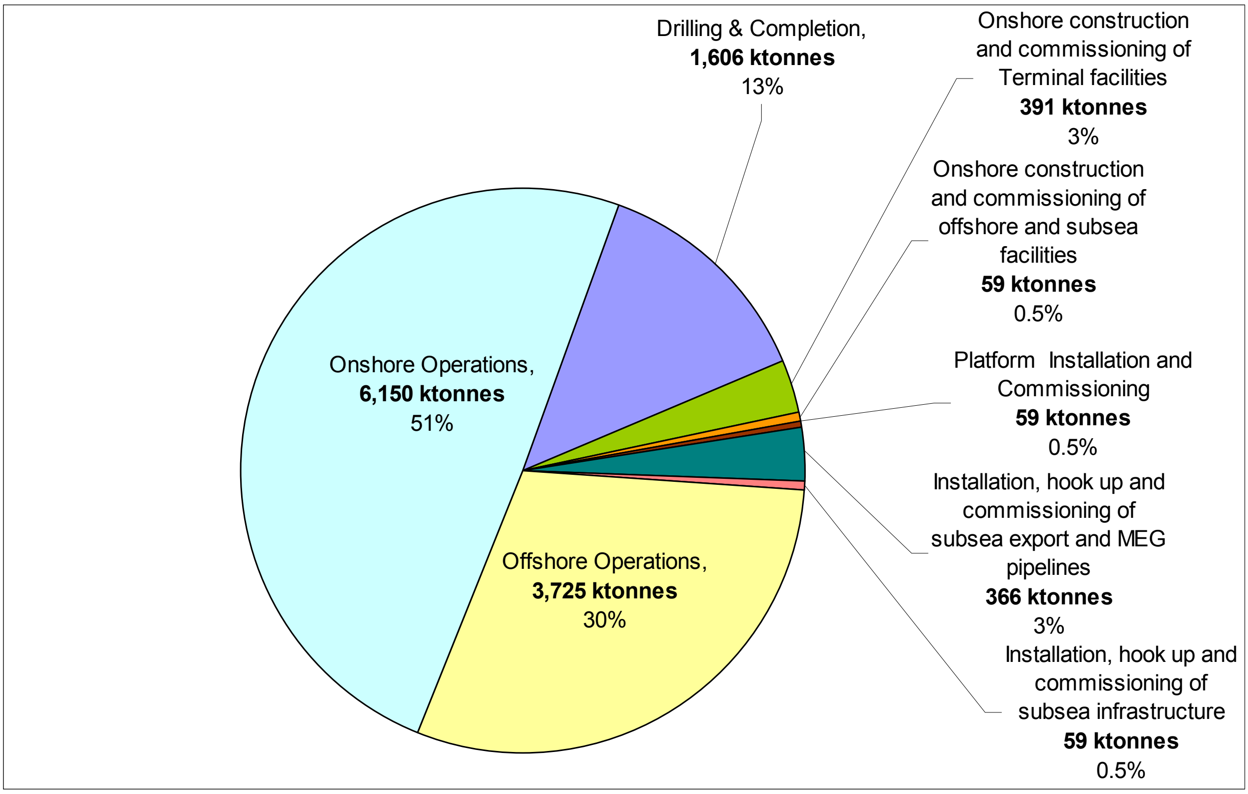
The most significant pollutant in terms of health impacts is NO_2. It has been demonstrated that emissions associated with SD2 Project activities alone and emissions from worst-case cumulative ACG and SD onshore activities are not expected to result any discernable changes in onshore NO_2 concentrations at the nearest onshore receptors in Azerbaijan. Based on the limited geographic scope of pollutant species, which will disperse rapidly in the atmosphere, no transboundary impacts associated with air quality and human health are predicted.

For both onshore and offshore activities, the volumes of emissions released (including visible particulates) due to the SD2 Project are expected to result in very small increases in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernable to biological / ecological receptors. SO_2 emissions will be minimised through the planned use of low sulphur diesel and the low H_2S content in the fuel gas used on the platform under routine conditions and at the SD2 Terminal facilities onshore, and are expected to disperse rapidly due to appropriate equipment design. Contribution of SD2 project SO_2 emissions to acid rain generation is therefore expected to be insignificant.

13.9 Greenhouse Gas Atmospheric Emissions: Cumulative and Transboundary Impacts

Expected greenhouse gas (GHG) emissions from SD2 activities (including carbon dioxide and methane) are presented in Chapter 5 of this ESIA for all phases of the project. Figure 13.5 shows the predicted contribution per phase.

Figure 13.5 SD2 Greenhouse Gas Emissions Generated for Each SD2 Project Phase



The majority (79.8%) of GHG is predicted to result from onshore and offshore activities during the SD2 Project operations phase. Activities associated with drilling and completion of SD2 wells is predicted to contribute 13.0% of the total volume of GHG emissions produced by the SD2 Project.

Figure 13.6 presents the volume of SD2 average annual GHG emissions during the operations phase, compared with the annual GHG emission volumes that have been recorded during operation of the ACG Phases 1, 2 and 3 and SD1 projects during 2012.

Figure 13.6 ACG & SD1 GHG Emissions (2012) and Average Annual Forecast SD2 GHG Emissions

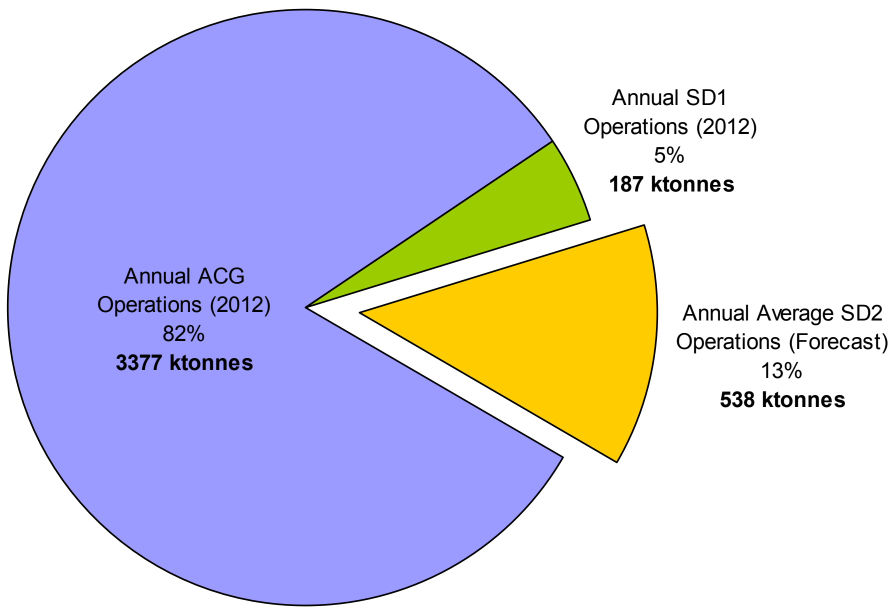


Figure 13.6 demonstrates that the SD2 will contribute approximately 13% of the annual operational GHG emissions from BP's upstream activities in Azerbaijan.

The most recent forecast of GHG emissions in Azerbaijan[8] indicates that by 2020, total GHG emissions may be approximately 109,895 kt with the majority resulting from fuel combusted in the energy industry. As a proportion the SD2 Project forecast GHG emissions for 2020 are expected to contribute approximately 0.36% to the national total.

The UNFCCC was approved by Decree by the Milli Mejlis (Parliament) of the Azerbaijan Republic in 1995. Following the signing of the UNFCCC, a Convention State Commission on Problems of Climate Change was established in 1997 by Decree of the then President of Azerbaijan Republic, H.A. Aliyev to implement commitments under the Convention. The chairman of the State Committee on Hydrometeorology was appointed deputy chairman of the Commission. The chairman of the State Committee on Hydrometeorology was replaced with the Minister of Ecology and Natural Resource in the Commission by Decree of the President in 2003. The Climate Change and Ozone Centre was established in 2005 within the Ministry of Ecology and Natural Resources. The aim of the Centre is to ensure the implementation of the Convention, coordinate various activities within the climate change sector and to act as an implementing arm of the State Commission.

The Republic of Azerbaijan has already identified development priorities as part of national development strategies, poverty reduction strategies and sector policies. These strategies are reflected in long-term State Programmes such as "State Programme on Renewable and Alternative Sources of Energy (2008–2015)", "State Programme for the Development of Fuel

[8] First National Communication of Azerbaijan on Climate Change, May 23, 2000

Energy Complex (2005–2015)", "State Programme on Reliable Provision of Population of Azerbaijan Republic with Food Products (2008-2015)" and so on[9].

13.9.1 Conclusion

The principal sources of GHG emissions from the SD2 Project are associated with power generation, process heating at the Sangachal Terminal and non-routine flaring of gas which is required to maintain the safety of the facilities, operational workforce and surrounding communities. BP is committed to assessing and, where practical, reducing the GHG emissions. As each project has come forward, the following principles have been followed:

- Evaluate options to reduce flaring - develop and implement an operational flare policy;
- Maximise energy efficiency;
- Challenge and justify well testing requirements;
- Minimise combustion and fugitive emissions; and
- Avoid venting.

Design measures across the ACG and Shah Deniz developments that contribute to GHG savings include:

- Onshore flare gas recovery;
- Onshore inert purge gas;
- Centralised power offshore for the Azeri Field;
- No continuous flaring for production;
- Gas re-injection (as opposed to flaring) at the Azeri Field;
- External floating roof tanks at the Terminal;
- Use of aero-derivative turbines; and
- Electric motor driven export compression on Phase 3 and COP.

In addition to these measures, the ACG Projects participates in a gas management strategy whereby the majority of associated gas produced by the ACG developments is routinely re-injected into the subsurface reservoir, and the remaining gas used for offshore platform power generation in the main gas turbines and exported to Sangachal Terminal.

As described within Chapter 4: Options Assessed, energy efficiency and GHG reduction was a key aspect taken into account during the development of the SD2 Project design, contributing to the selection of the following:

- Offshore compression vs onshore compression;
- Offshore flare vs vent;
- Direct Drive Gas Turbines onshore vs electric drives;
- Waste Heat Recovery on onshore compression gas turbines; and
- Onshore Flare Gas Recovery.

These resulted in a saving of approximately 103,700 ktonnes of CO_2 emissions across the SD PSA period.

As for non-GHG emissions, GHG monitoring and reporting procedures and documentation requirements for each ACG and SD project are included within BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy (see Chapter 14). Once operational, SD2 will implement a set of specific GHG monitoring, management and reporting procedures based on and consistent with the procedures already in use on existing ACG platforms.

[9] Ministry of Ecology and Natural Resources, Technology Needs Assessment Report - Adaptation (July 2012)

13.10 Accidental Events

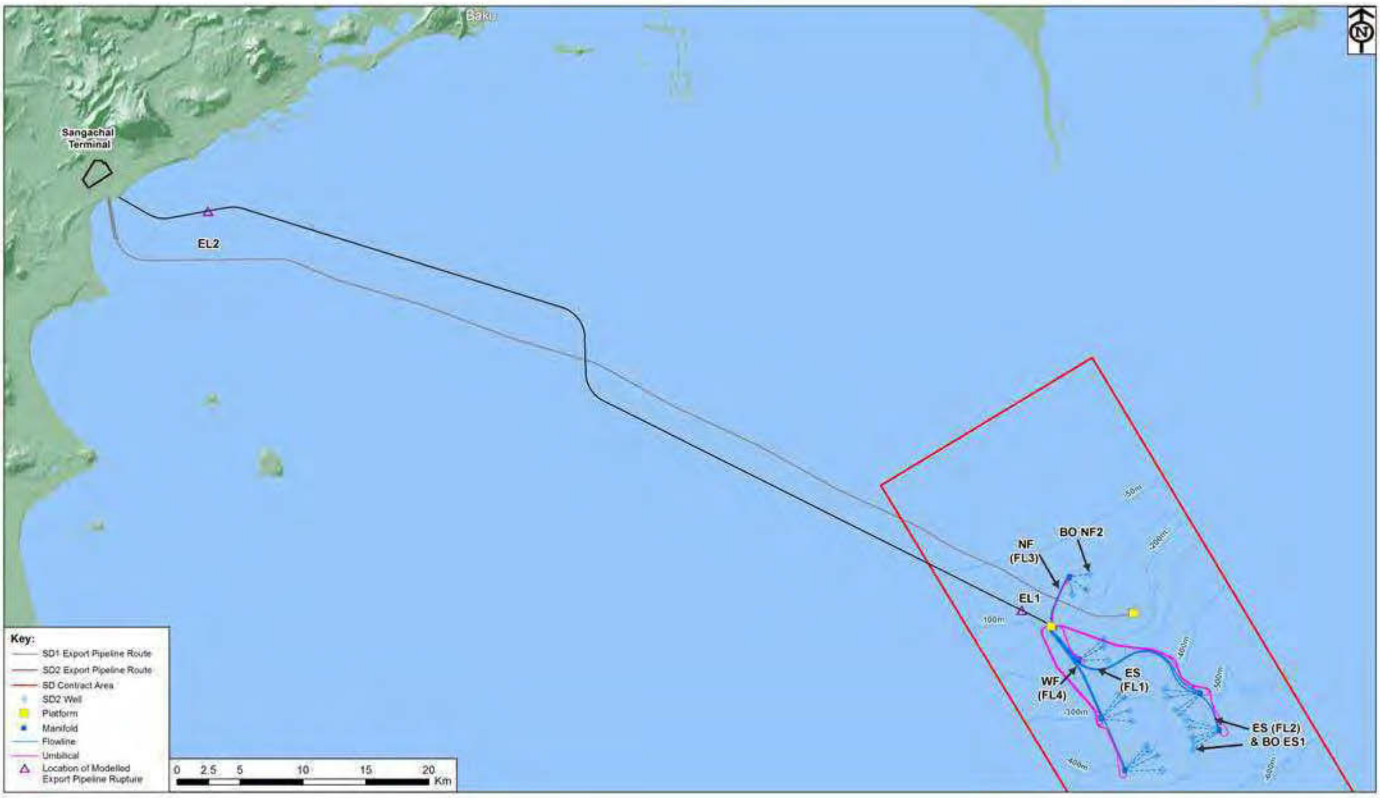
Accidental Events are considered separately from routine and non-routine activities as they only arise as a result of a technical failure, human error or as a result of natural phenomena such as a seismic event.

This section addresses the probable consequences of offshore releases of condensate and diesel fuel, taking into account aspects such as persistence of the spilled material and the prevailing environmental conditions.

13.10.1 Overview

A range of accidental events that could result in the release of condensate have been considered and modelled. The locations of the events considered, which include blowouts, flowline ruptures, condensate export pipeline ruptures and platform diesel inventory loss, are shown in Figure 13.7. Appendix 13A contains a summary of the spill modelling assessment report.

Figure 13.7 Locations of Accidental Events Resulting in Release of Condensate Considered Within Spill Modelling Assessment



13.10.2 Blowout Condensate Release Scenarios

Condensate will be present in the SD2 wells in association with the other reservoir fluids (gas and produced water). A blowout, as a consequence of loss of well control, would result in large quantities of all fluids (gas, produced water and condensate) being released simultaneously, with the condensate being entrained in the flow of released gas. A proportion of the liquid condensate would be mechanically dispersed into the water column as small droplets by the intense turbulence created by the high-pressure, high-velocity gas stream entering the water. The small condensate droplets would have little inherent buoyancy due to their small size, but would initially be propelled upwards through the water column with the rapidly rising plume of gas. Larger condensate droplets would have sufficient buoyancy to float to the sea surface.

Two blowout scenarios, BO ES 1 and BO NF 2 (refer to Figure 13.7) have been modelled. The common inputs used in both scenarios are presented in Table 13.4.

Table 13.4 Blowout Scenarios – Common Modelling Input Data

Scenario	Liquid flow rate (excluding gas)		Gas to Oil Ratio m^3/m^3	Orifice release diameter (ID) m	Time to shut in well
	Condensate m^3/hr	Water m^3/hr			
BO ES 1 and BO NF 2	165.4	56.3	1900	0.219	224 days

The input flow rate of 165.4m^3/hr (3969.6m^3/day) is equivalent to 25,000 bbls/day. With the blowout continuing for 224 days before a relief well would divert the flow, the total amount of condensate released into the water would be 889,190 m^3 or 4.928 million barrels.

The inputs specific to each of the two scenarios modelled, namely well location, water depth at these locations and discharge temperatures, are shown in Table 13.5.

Table 13.5 Blowout Scenarios –Key Input Data Specific to Each Modelling Scenario

Scenario	Release location	Water depth at release (m)	Discharge temperature (°C)
BO ES 1	ES C well location	530	72.2
BO NF 2	NF 1 / SD-X 6 well locations	70	74

The ES1 well is approximately 45km from the nearest shore and in deep water while the NF2 well is closer to shore (approximately 31km) and in relatively shallow water.

13.10.3 Flowline Rupture Condensate Scenarios

The SD2 Project Base Case includes 10 infield flowlines carrying gas, condensate and produced water from the wells and subsea manifolds to the fixed SDB-PR processing platform. Rupture of any of these flowlines would result in a high-pressure release of gas, condensate and produced water into the water column. The gas released into the sea would rapidly expand as it rose up towards the sea surface as a plume of gas bubbles. Depending on release depth, a proportion of the gas would dissolve into the water and some gas would rapidly rise as bubbles to the sea surface and then disperse into the air. A large proportion of the total amount of liquid condensate contained within the ruptured flowline would be ejected into the water along with the gas and would enter the water as droplets of various sizes. The smaller droplets would be mechanically dispersed into the water column. The flowline would continue to depressurise after the flow had been shut off and eventually would start to fill with seawater, to the extent that the geometry of the flowline would allow.

Three flowline rupture scenarios, ES FL1, ES FL2 and WF FL4, have been modelled (refer to Figure 13.7 for rupture locations). The common inputs used in all three scenarios are shown in Table 13.6. Two liquid flow rates have been used; the same for scenarios ES FL1 and 2, but lower for WF FL4 in accordance with the Base Case design.

Table 13.6 Flowline Rupture Scenarios – Common Modeling Input Data

Scenario	Liquid flow rate (excluding gas)		Gas to Oil Ratio (m^3/m^3)	Orifice release diameter (ID) m	Time to shut off flowline
	Condensate (m^3/hr)	Water (m^3/hr)			
ES FL 1	122.1	29.2	1900	0.314	5 minutes
ES FL 2					
WF FL 4	84.4	20.9			

The input specific to each of the three scenarios modelled, namely flowline length & volume, release locations, water depth at release location and discharge temperatures, are shown in Table 13.7.

Table 13.7 Flowline Rupture Scenarios– Key Input Data Specific to Each Modelling Scenario

Scenario	Flowline length (km)	Flowline volume (m^3)	Release location	Water depth at release (m)	Discharge temperature (°C)
ES FL1	18.3	1,425	Close to escarpment	185	26
ES FL2	18.3	1,425	ES C well upstream	530	62
WF FL4	3.3	258	WF wells upstream	164	50

13.10.4 Condensate Export Pipeline Rupture Scenarios

The gas is separated from the condensate and produced water on the SDB-PR processing platform. The condensate is sent to the Sangachal Terminal via a new dedicated 16” diameter subsea pipeline, 89 km in length.

Rupture of the condensate export would result in an initial release of condensate before the flow was stopped, followed by a slower condensate release during depressurisation due to the pressure drop and expansion of the vapour and residual gas in the pipeline. The pressure in the pipeline would rapidly drop to that of the water pressure at the depth of rupture locations. A further, much slower, release of condensate would occur as the ruptured pipeline partly filled with seawater, to the extent that the geometry of the pipeline would allow.

Two condensate export pipeline rupture scenarios, EL 1 and EL 2, have been modelled (refer to Figure 13.7 for rupture locations). The common inputs are shown in Table 13.8.

Table 13.8 Condensate Export Pipeline Rupture Scenarios – Common Modelling Input Data

Scenario	Condensate (mbd) maximum	Gas to Oil Ratio (m^3/m^3)	Orifice release diameter (ID) (m)	Time to export pumps being stopped (minutes)
EL1 and EL 2	122	13.4	0.314	4

The inputs specific to each of the two scenarios modelled, namely release location, water depth at release location and discharge temperatures, are shown in Table 13.9.

Table 13.9 Condensate Export Pipeline Rupture Scenarios – Key Input Data Specific to Each Modelling Scenario

Scenario	Release location	Water depth at release (m)	Discharge temperature (°C)
EL 1	Upstream of NRV	85	39.4
EL 2	Nearshore	12	Winter 6 Summer 25

13.10.5 Platform Diesel Inventory Loss

A single platform inventory loss of 123 m^3 of diesel fuel from the SDB-PR platform has been modelled. The inputs are shown in Table 13.10.

Table 13.10 Diesel Inventory Loss Scenario – Input Data

Scenario	Release location	Liquid flow rate (m^3/hr)	Duration (hours)	Water depth at release (m)	Discharge temperature (°C)
SD2 PR	SDB-PR platform	123	1	Surface	Winter 10 Summer 25

13.10.6 Modelling Results

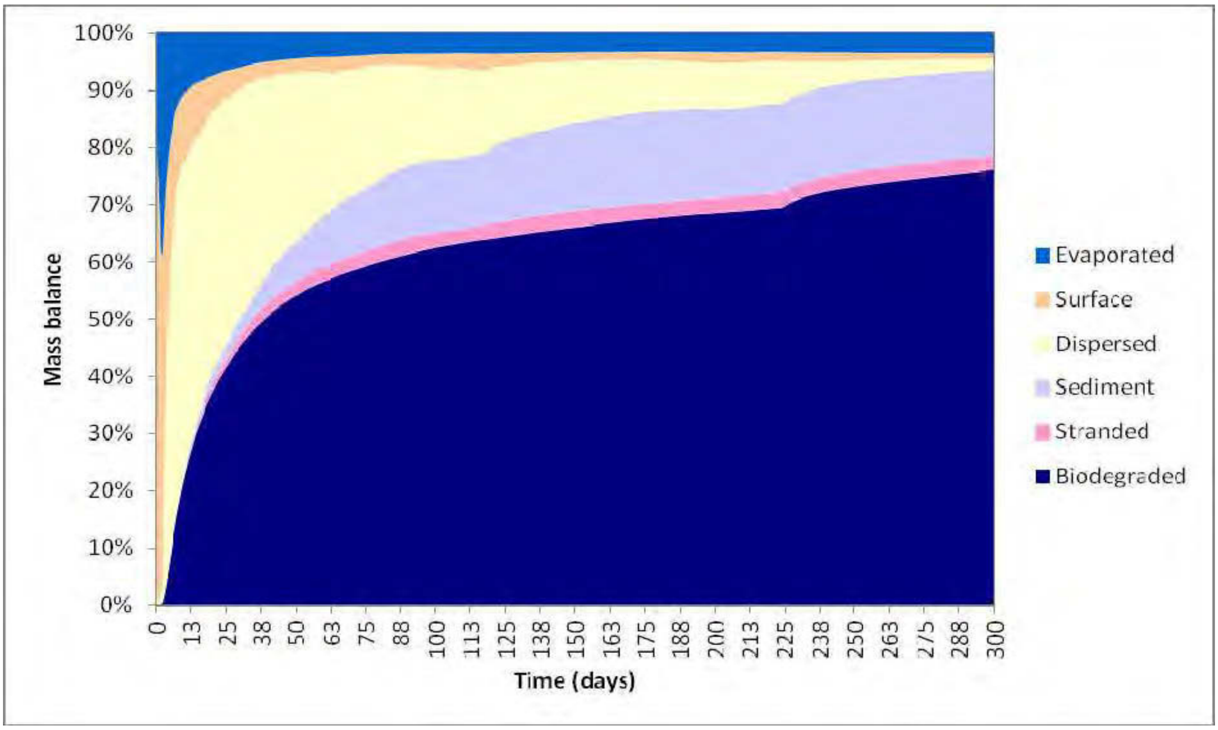
13.10.6.1 Results from Blowout Release Scenarios

The modelling[10] that has been undertaken indicates that the released condensate would undergo the following processes.

- **Dispersed into the sea and subsequently biodegraded**
  A proportion of the condensate released subsea would be mechanically and permanently dispersed as small droplets into the water column by the intense turbulence associated with the simultaneous release of gas, condensate and produced water. A proportion of the condensate that reached the sea surface would be naturally dispersed by the prevailing wave action. A large proportion of the dispersed condensate would eventually be biodegraded while in the water column.
- **Dissolved into the sea**
  Some of the small proportion of partially water-soluble chemical compounds in the condensate would be dissolved into the water column. Although this would only account for a very small proportion of the volume of the released condensate it has implications for the potential for negative effects to be caused to marine organisms.
- **Sedimentation**
  Some of the dispersed condensate would become associated with sediment in the water column and would be eventually deposited over a wide area of the seabed.
- **Lost to the air by evaporation**
  Volatile components in the condensate residue would evaporate from the condensate residue that reached the sea surface.

The relative proportions of the condensate that would undergo these processes depend on prevailing conditions and are illustrated in Figure 13.8 for the BO ES1 in summer blowout scenario.

Figure 13.8 Fate of Condensate Released from BO ES 1 (Summer Blowout Scenario)



10 Both stochastic (multiple scenario) and deterministic (single scenario) modelling was undertaken. Stochastic modelling was used to allow the selection of appropriate weather periods to run all the scenarios as deterministic under worst case summer and winter conditions. Results for the deterministic cases are presented in the ESIA Chapter 13 to provide a summary of the worst case scenarios. Appendix 13A includes the both the stochastic and deterministic modelling results.

A small proportion of the total volume of condensate that had been released would remain on the sea surface in the form of a waxy residue. This waxy residue would drift under the influence of the prevailing currents and winds and some condensate residue would eventually come ashore.

The sources of ecological concern, as discussed in Section 13.10.7.2 below, are:

i. The transfer of partially water-soluble and potentially toxic chemical compounds, such as the BTEX (Benzene, Toluene, Ethylbenzenes and Xylenes) compounds, from the condensate and into the water column during the release and subsequently as the condensate is naturally dispersed. The concentration of these chemical compounds in the water column and the duration for which these concentrations persist is therefore of interest.

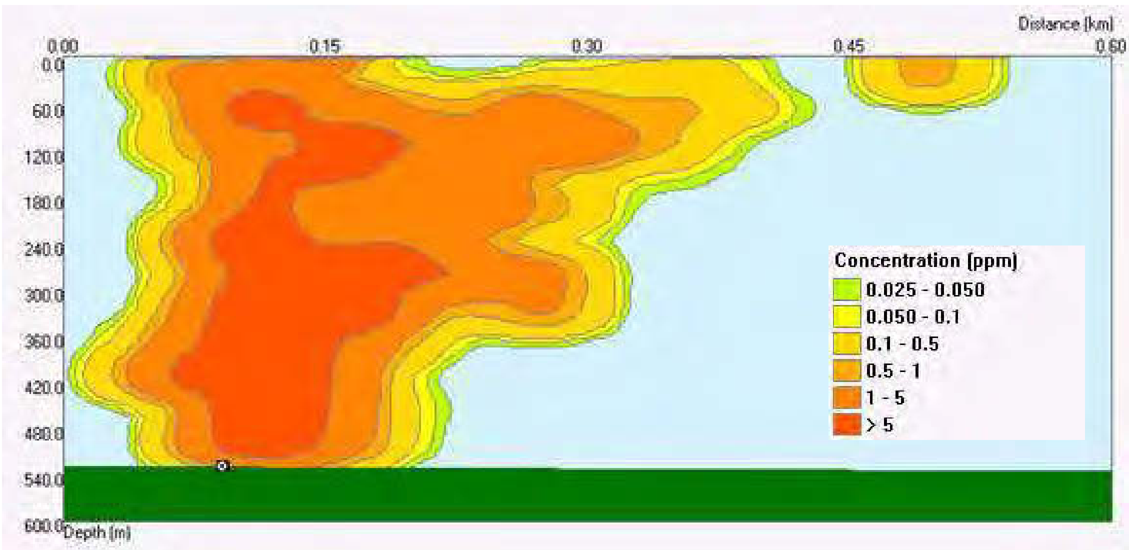
ii. Condensate residue persisting at sea for long enough to eventually drift ashore. Unlike most crude oils, the condensate does not form high-viscosity water-in-oil emulsions that contaminate seabirds' plumage and smother small coastal animals. Compared to crude oils, the condensate residue will contain only very low levels of potentially toxic chemical compounds. The BTEX type compounds will be depleted because they will have already been transferred into the water column.

The modelled consequences of these aspects of the behaviour of the condensate released from the blowout scenarios are summarised in Table 13.11.

Concentrations of Hydrocarbons and Potentially Toxic Compounds In The Water Column

Figure 13.9 shows a cross-section of the plume of condensate (dissolved fraction) produced at a blowout under winter conditions.

Figure 13.9 Fate of Condensate Released from BO ES1 Blowout Scenario – Vertical Cross Section through Plume



Very small condensate droplets produced during the blowout release will have very low buoyancy due to their small size and will only float slowly towards the sea surface. However, the condensate droplets will be propelled upwards through the water by the buoyant gas plume.

As the gas dissolves into the water, the buoyancy of the gas plume will decrease. The condensate droplets will float upwards towards the sea surface at a velocity proportional to their buoyancy; the smaller condensate droplets will be permanently dispersed in the water column and the larger droplets will rise to the sea surface.

Partially water-soluble chemical compounds in the condensate will dissolve out of the condensate and into the water. Concentrations of hydrocarbons in the water column, including both condensate droplets and dissolved chemical compounds, will rise rapidly to high concentrations of many ppm (parts per million) close to the blowout. The maximum concentration of hydrocarbons in the vicinity of the blowouts is shown in Table 13.11 for both the relatively shallow water BO NF2 scenario and the deeper water BO ES1 scenario.

Table 13.11 Summary of Modelled Blowout Outputs

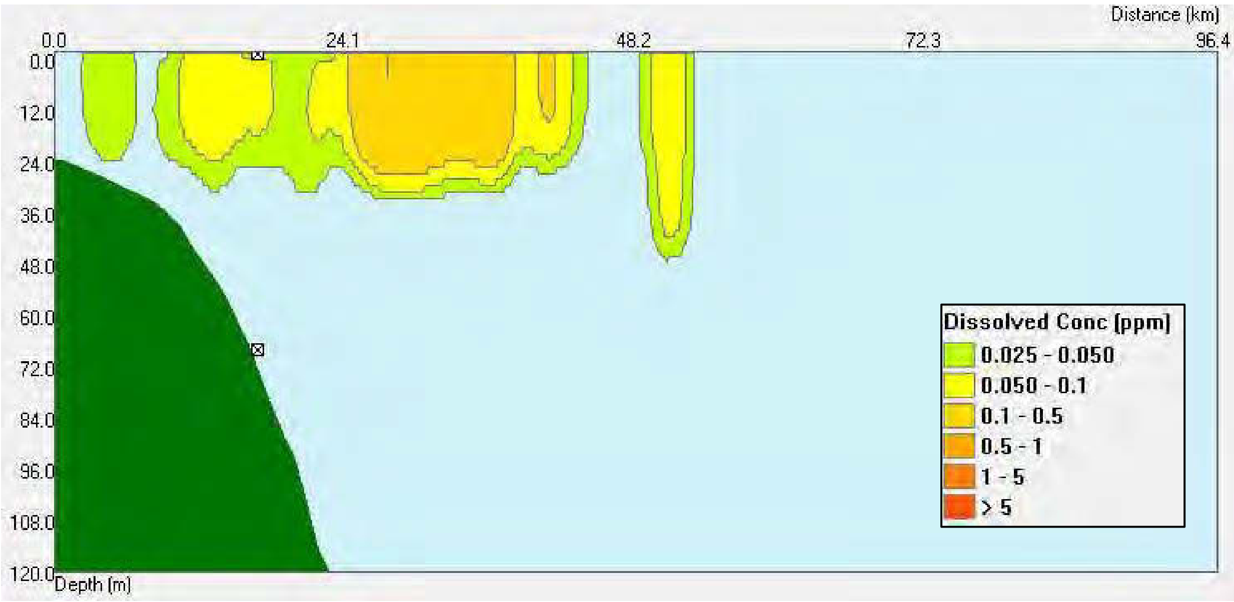
Scenario	Release location	Maximum total water column concentrations[1] (ppm)		Duration of exposure to elevated hydrocarbon concentrations	Minimum time to beaching (days)		Maximum mass onshore (tonnes)	
		Summer	Winter		Summer	Winter	Summer	Winter
BO ES 1	ES C well location	4.9	2.5	Approximately 240 days	13	13	18,960	20,570
BO NF 2	NF1/ SD-X 6 well location	8.5	10.0	Approximately 240 days	9.5	8.5	2,426	3,103

Note 1: Water column concentrations include both hydrocarbon droplets/solids and dissolved hydrocarbons

The blowout in the shallower water produces higher peak hydrocarbon concentrations in water, around 10 ppm, that the blowout in deeper water where the peak concentrations are less than half this concentration.

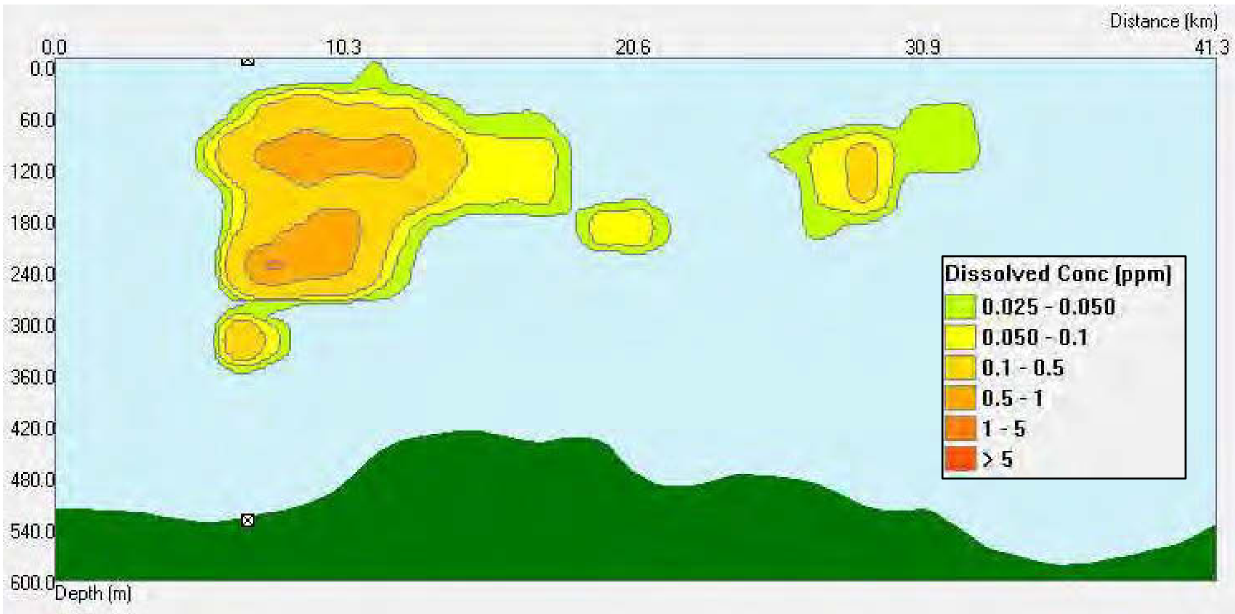
In the case of the relatively shallow water BO NF2 blowout scenario, the elevated dissolved hydrocarbon concentrations will be in the upper water layers and spread out by the rising and spreading plume of gas (Figure 13.10).

Figure 13.10 Dissolved Hydrocarbon Concentrations in the Water for Day 15 of the BO NF2 Blowout Scenario



For the deeper water BO ES 1 scenario, the elevated dissolved hydrocarbon concentrations will be in deeper water, but above the release source as the condensate droplets are carried upwards by the buoyant gas plume (Figure 13.11)

Figure 13.11 Dissolved Hydrocarbon Concentrations in the Water for Day 15 of the BO ES1 Blowout Scenario



These hydrocarbon-in-water concentrations will be maintained in the volume of water in the vicinity of the blowout for the entire blowout duration. Hydrocarbon concentrations in the water column will subside relatively quickly when the blowout ceases, taking from 6 to 12 days to fall to below 25 ppb (parts per billion).

Amounts of Condensate Coming Ashore, Time To Come Ashore and Probable Locations

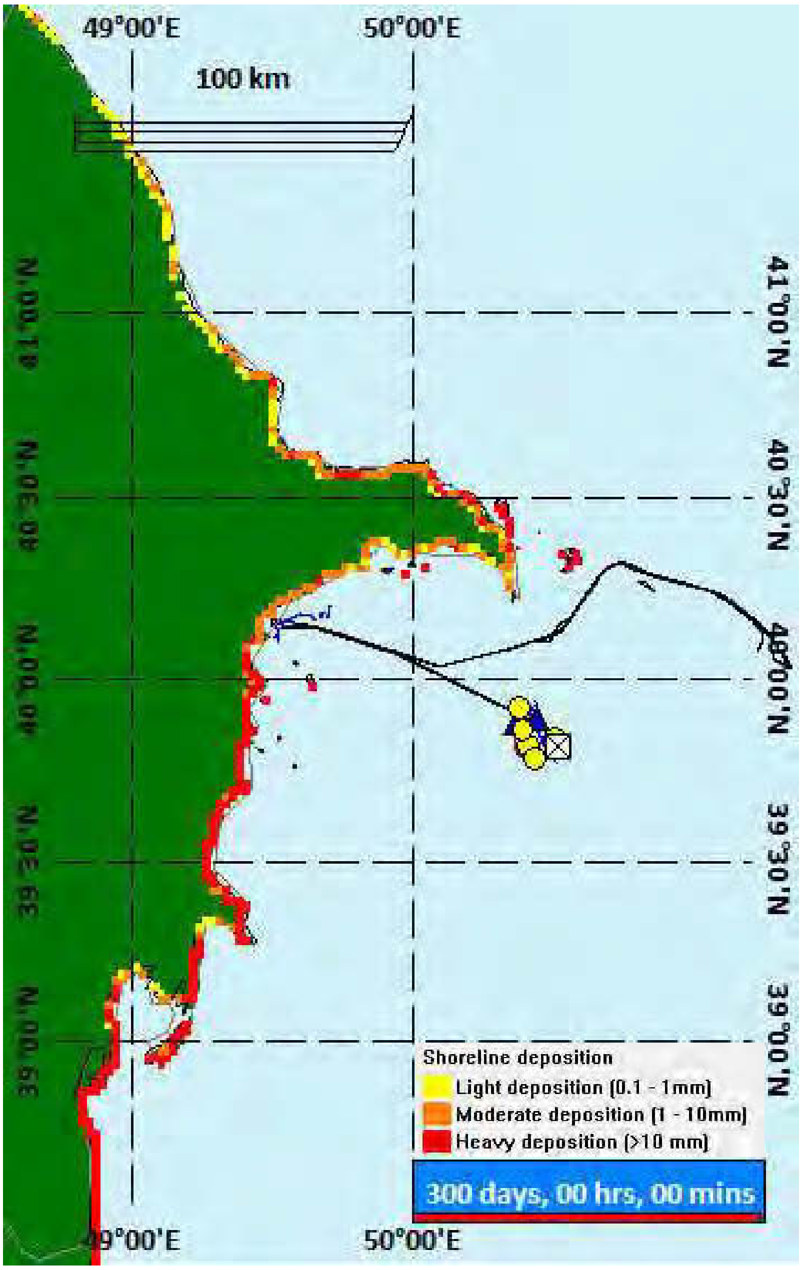
The amount of condensate residue that would come ashore at any particular location after a blowout will depend on the location of the blowout (distances from shores), the persistence of the condensate residue on the sea surface and the prevailing currents and winds.

The modelling results presented in Table 13.11 indicate that the condensate residue would start to come ashore after approximately 9 days from the shallow water BO NF2 blowout and after 13 days from the more distant deeper water BO ES1 blowout.

More condensate residue would come ashore from the deeper water BO ES1 blowout scenario, around 20,000 tonnes, than would come ashore from the relatively shallow water BO NF 2 blowout scenario, around 3,000 tonnes, even though the shallow water blowout is closer to shore. The difference in condensate beaching relates to the fate of the dispersed wax particles. In deeper water these disperse over a wide area and many reach currents that bring them onshore. For the shallower release scenario they tend to encounter different currents that keep the wax particles at sea for longer, thus resulting in reduced beaching. Although these may seem to be relatively large quantities of condensate that are predicted to be washed onshore, they represent only a small fraction of the total amount of condensate released (3.6% in the case of the BO ES 1 scenario and 0.5 % in the case of the BO NF 2 scenario).

The location of shoreline deposition will depend on the prevailing winds, prevailing currents and the water depth at the release. Figure 13.12 shows the predicted shoreline deposition under worst case winter conditions.

Figure 13.12 Shoreline Deposition Resulting from the BO ES1 Blowout Scenario in Winter



13.10.6.2 Results from Flowline Rupture Release Scenarios

The release of condensate from a ruptured flowline occurs in two stages:

1. Condense release during depressurisation;
   a) Depressurisation release: a fast phase taking place over 1 or 2 minutes, and
   b) Displacement release: a slower phase taking 4 to 9 minutes, until pipeline pressure drops to ambient hydrostatic pressure;
2. Condensate release due to subsequent seawater ingress displacing some of the remaining condensate over a period of hours until water-accessible lengths of the pipeline are filled.

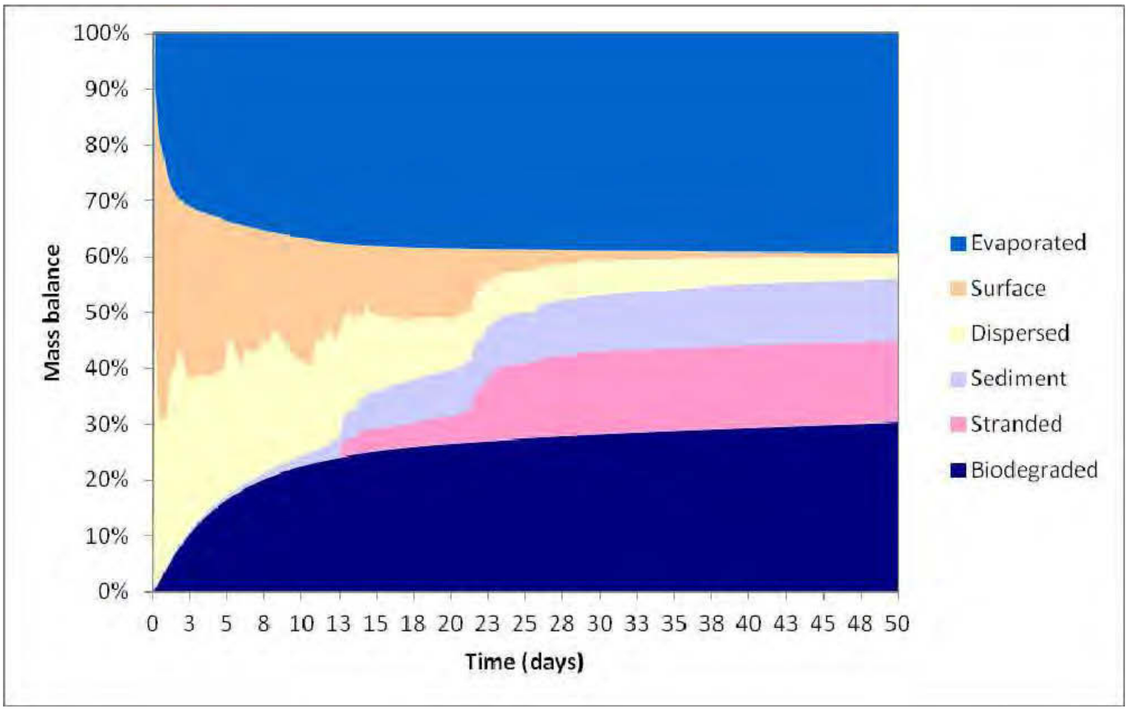
These processes were modelled using the pipeline spill quantification software POSVCM (Pipeline Oil Spill Volume Estimation Model), developed by SINTEF for the US Minerals Management Service. The amount of condensate released from a ruptured flowline depends on the scenario and is shown in Table 13.12.

Table 13.12 Amounts of Condensate Released from Ruptured Flowlines

Scenario	Release location	Water depth at release (m)	Depressurisation release (m^3)	Displacement release (m^3)	Total release (m^3)
ES FL1	Close to escarpment	185	209.5	901.8	1111.3
ES FL2	Deep water near well location	530	153.3	0.0	153.3
WF FL4	WF wells upstream	164	65.4	0.0	65.4

Condensate released from a ruptured flowline would undergo the same processes of dispersion, biodegradation, sedimentation and evaporation as described in Section 13.10.6.1 for condensate released from a blowout. Figure 13.13 illustrates the fate of the relative proportions of the condensate for the ES FL1 in winter scenario.

Figure 13.13 Fate of Condensate Released from ES FL1 in Winter (Flowline Rupture Scenario)



Concentrations of Hydrocarbons And Potentially Toxic Compounds in the Water Column

The maximum concentrations of total hydrocarbons in the vicinity of the flowline ruptures are shown in Table 13.13 for all three flowline rupture scenarios. The concentrations range from 2.9 to 4.9 ppm in summer and are lower in winter.

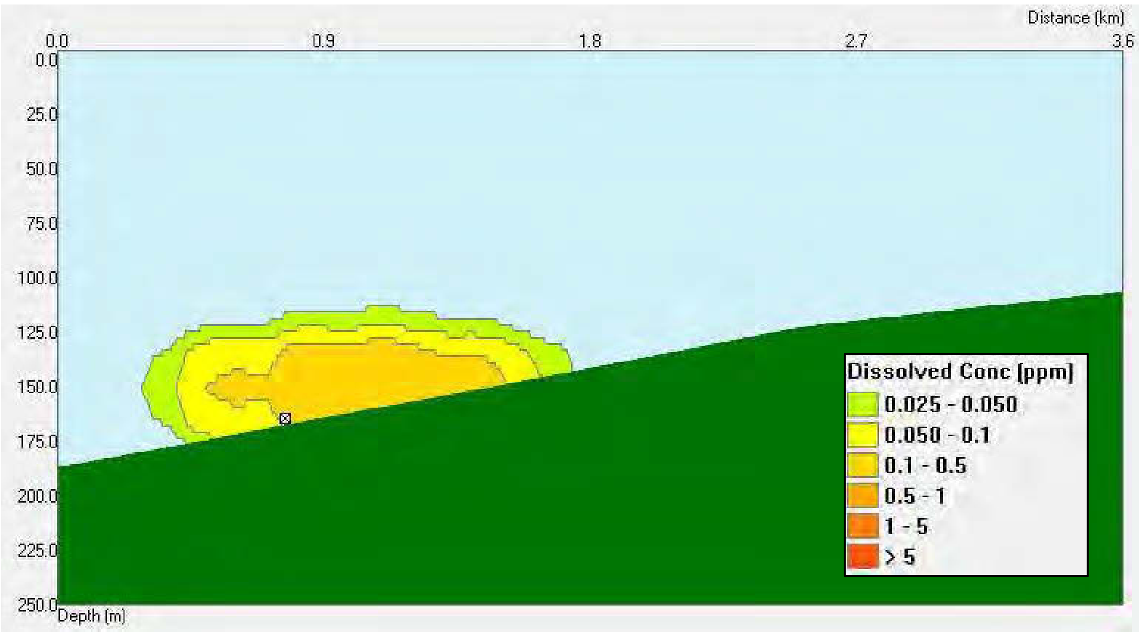
Table 13.13 Summary of Modelled Flowline Rupture Outputs

Scenario	Release location	Maximum total water column concentrations[1] (ppm)		Duration of exposure to elevated hydrocarbon concentration	Minimum time to beaching (days)		Maximum mass onshore (tonnes)	
		Summer	Winter		Summer	Winter	Summer	Winter
ES FL 1	Close to escarpment	4.9	2.5	1 or 2 days	20	11.5	44	152
ES FL 2	ES C well flowline upstream	2.1	2.6	1 or 2 days	n/a	n/a	Negligible	Negligible
WF FL 4	WF wells flowline upstream	2.9	0.3	1 or 2 days	n/a	n/a	Negligible	Negligible

Note 1: Water column concentrations include both hydrocarbon droplets/solids and dissolved hydrocarbons

The distribution of dissolved hydrocarbon concentrations for day 1 of the WF FL4 flowline rupture scenario at 164m water depth is shown in Figure 13.14. The elevated dissolved hydrocarbon concentrations are close to the rupture location. The concentrations of total hydrocarbons in the water and the concentrations of dissolved hydrocarbons in the water will rapidly decrease when the initial phase of the release has ended and will be below 25 ppb in 2 to 4 days.

Figure 13.14 Dissolved Hydrocarbon Concentrations in the Water for Day 1 of the WF FL4 Flowline Rupture Scenario



Amounts of Condensate Coming Ashore, Time to Come Ashore and Probable Locations

The modelling results presented in Table 13.13 show that only a relatively small amount of condensate residue from the ES FL1 scenario will persist at sea for long enough to drift ashore. In the cases of the ES FL2 and WF FL4 scenarios the amount coming ashore will be negligible.

13.10.6.3 Results from Condensate Export Line Rupture Scenarios

The release of condensate from a ruptured condensate export pipeline occurs in two stages in a similar way to that described for a ruptured flowline in Section 13.10.6.2. The processes were modelled using the pipeline spill quantification software POSVCM and the results are shown in Table 13.14.

Table 13.14 Amounts of Condensate Released from Ruptured Condensate Export Pipeline

Scenario	Release location	Water depth at release (m)	Depressurisation release (m^3)	Displacement release (m^3)	Total release (m^3)
EL 1	Upstream of NRV	85	541.9	239.0	780.9
EL 2	Near-shore	12	744.9	1078.8	1823.7

More condensate is released from the ruptured export pipeline at the 12m water depth because of the greater hydrostatic pressure at 85m water depth that counters the outflow. The geometry of the pipeline, being uphill from the platform to the shore, also allows for a greater volume of condensate to be displaced by the ingress of seawater.

A summary of the modelling outputs is presented in Table 13.15.

Table 13.15 Summary of Modelled Condensate Export Pipeline Rupture Outputs

Scenario	Release location	Maximum total water column concentrations[1] (ppm)		Duration of exposure to elevated hydrocarbon concentration	Minimum time to beaching (days)		Maximum mass onshore (tonnes)	
		Summer	Winter		Summer	Winter	Summer	Winter
EL 1	Upstream of NRV	7.6	8.6	6 or 7 days	8.5	11.5	117	73
EL 2	Near-shore	68	93	6 or 7 days	1.1	1.9	356	367

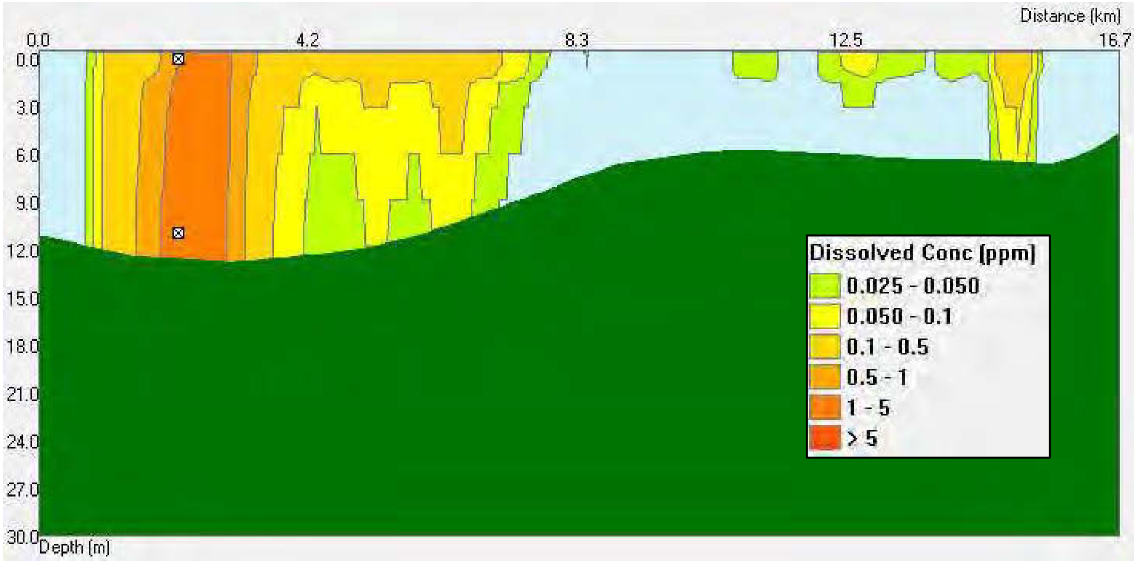
Note 1: Water column concentrations include both hydrocarbon droplets/solids and dissolved hydrocarbons

Concentrations of Hydrocarbons and Potentially Toxic Compounds in the Water Column

The shallow water, near-shore condensate release (EL2 scenario) causes very high maximum total hydrocarbon concentrations of 68 to 93 ppm in the water near the release.

These high concentrations of total hydrocarbons are accompanied by high concentrations of dissolved hydrocarbons as is illustrated in Figure 13.15. These high concentrations of dissolved hydrocarbons would persist for several days after the release, eventually being reduced to 25 ppb after 6 or 7 days.

Figure 13.15 Dissolved Hydrocarbon Concentrations in the Water for Day 1 of the EL2 Condensate Export Pipeline Rupture Scenario

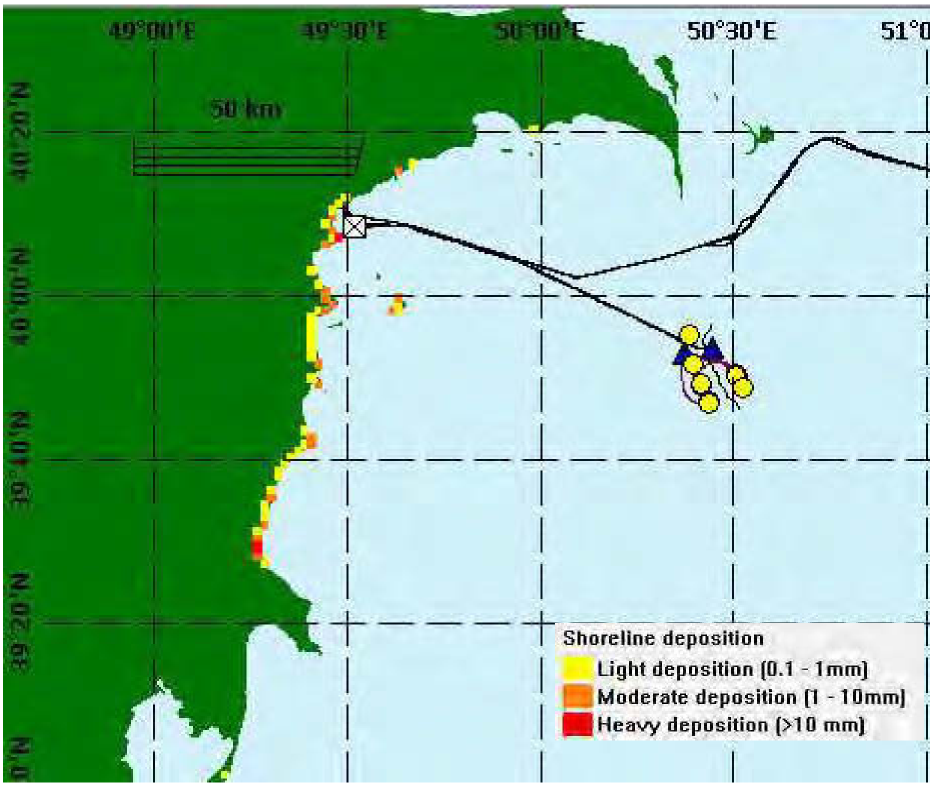


Amounts of Condensate Coming Ashore, Time to Come Ashore and Probable Locations

The model results predict that approximately 360 tonnes of condensate residue will come ashore from the near-shore EL2 scenario, while less will come ashore from the EL1 scenario that is further offshore.

The shoreline deposition from the near-shore EL2 scenario would be heaviest close to the release location, although some deposition would also occur to the north and to the south (Figure 13.16).

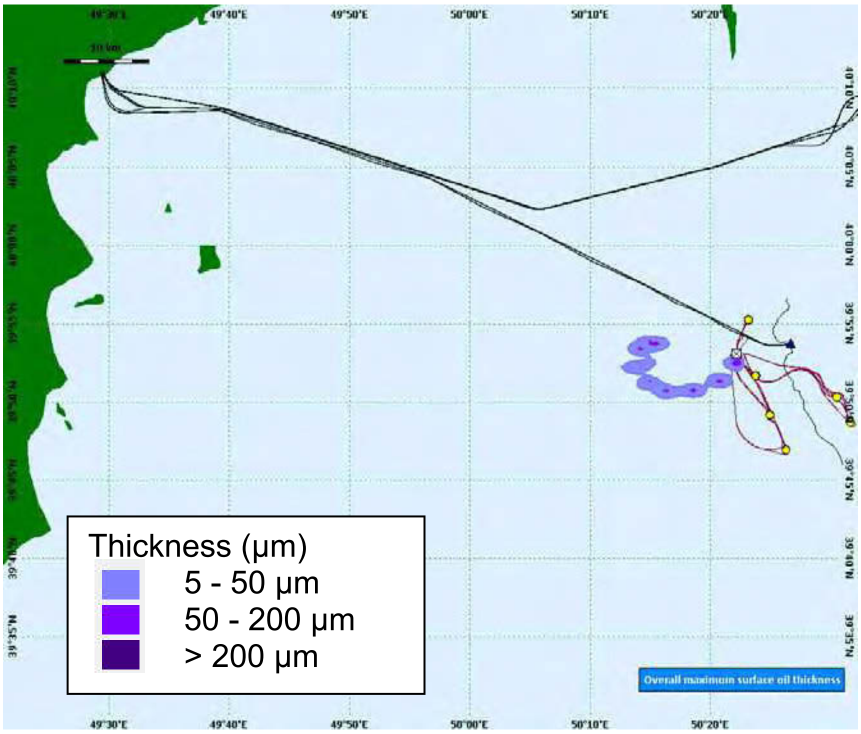
Figure 13.16 Shoreline Deposition Resulting from the EL2 Condensate Export Pipeline Rupture Scenario In Winter



13.10.6.4 Results from Platform Diesel Inventory Loss Scenario

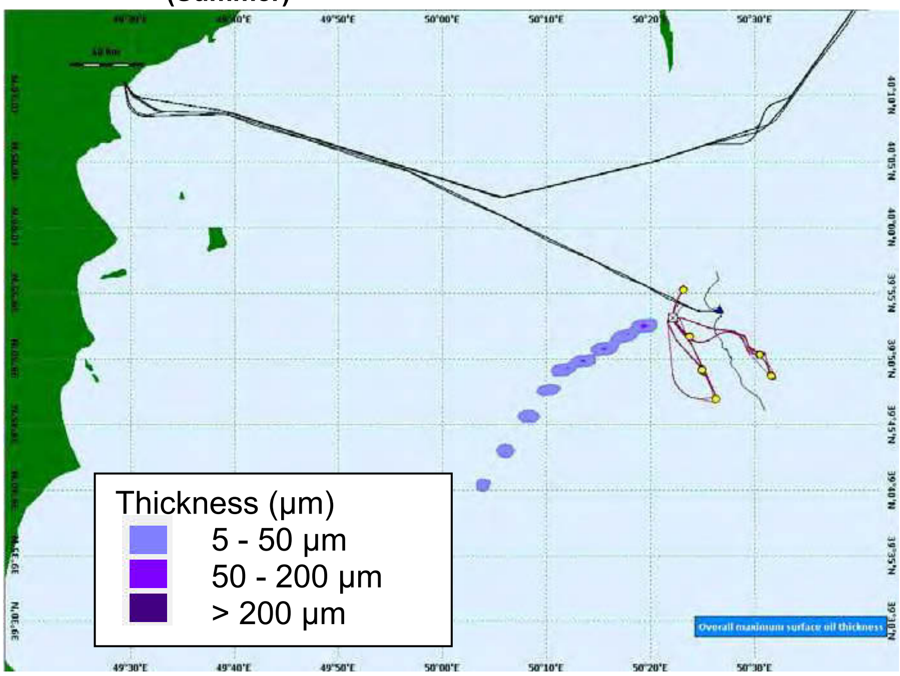
The 123m^3 of diesel fuel released from the SDB-PR platform would rapidly spread out to form a thin sheen on the sea surface. Modelling indicated that the area of sea surface covered by a film of diesel of 5μm or thicker from this spill would be approximately 42km^2 in summer and 13km^2 in winter. Figures 13.16a and 13.16b present the modeling results for winter and summer, suggesting that the film on the sea surface would be visible up to 13km and 42km from the SDB complex respectively.

Figure 13.16a Maximum Time-averaged Thickness of Diesel on the Sea Surface (Winter)



Note: This does not represent the size of the slick, but is the maximum thickness that occurs at any point during the simulation i.e. not a snapshot

Figure 13.16b Maximum Time-averaged Thickness of Diesel on the Sea Surface (Summer)



Figures 13.16c and 13.16d shows the modelled thickness and water column concentrations of the diesel spill 24 and 48 hours after release during winter respectively.

Figure 13.16c Thickness of Diesel Spill i) 24 hours and ii) 48 hours Post-Release (Winter)

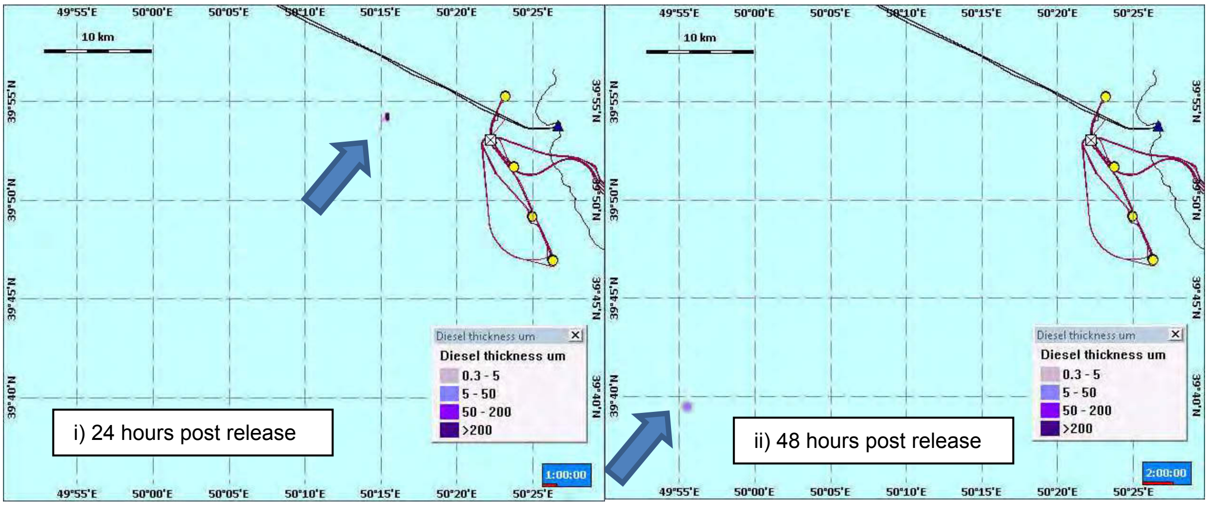
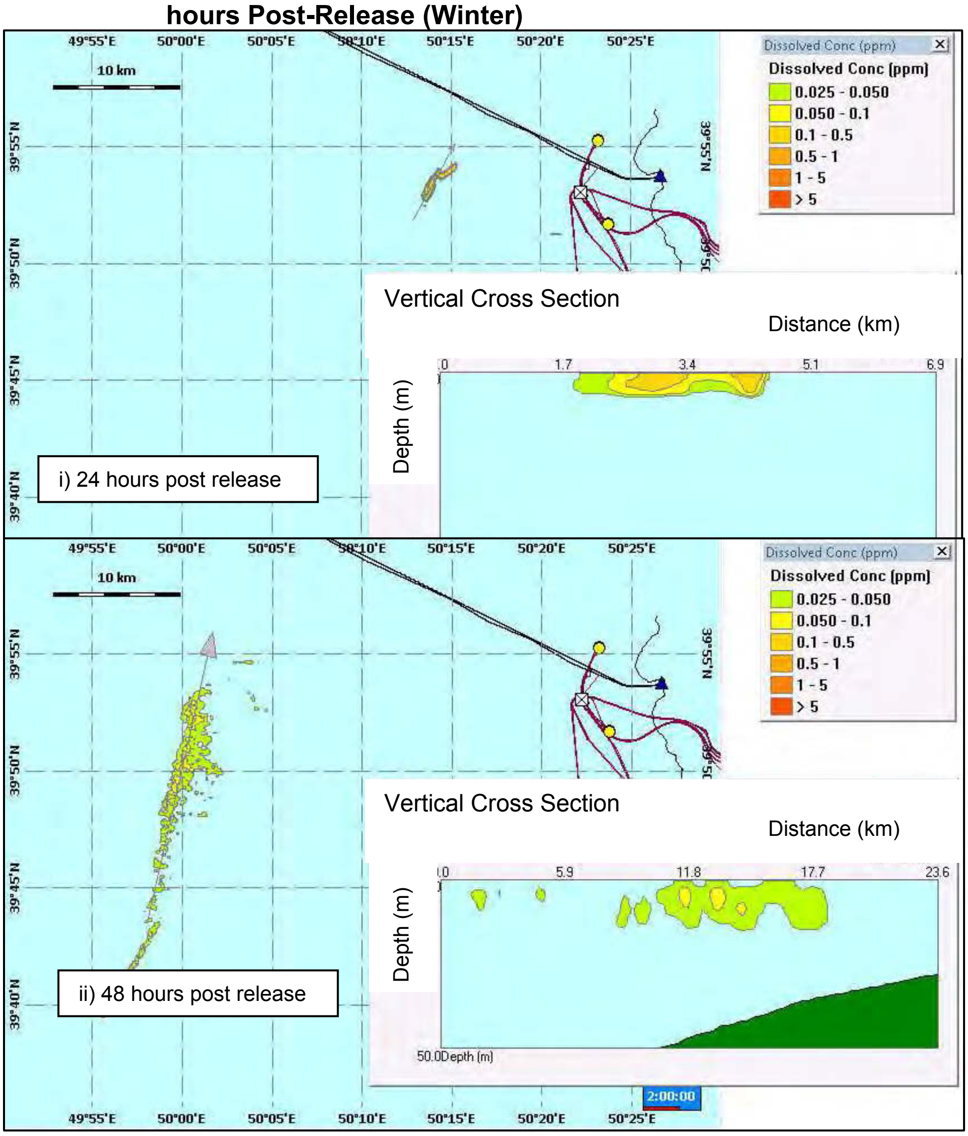
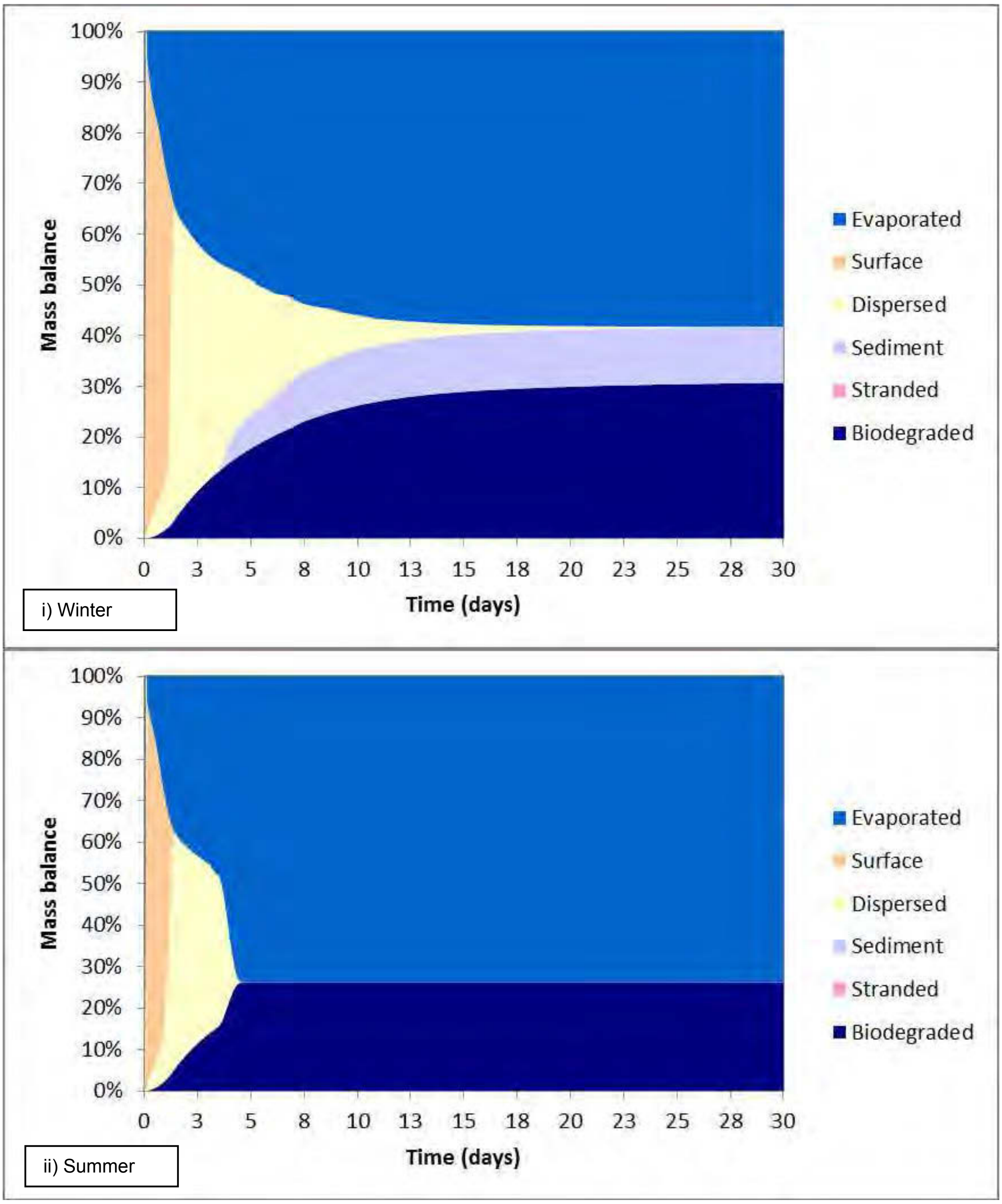


Figure 13.16d Concentration of Diesel Within the Water Column i) 24 hours and ii) 48 hours Post-Release (Winter)



Over time following the release diesel would be lost from the sea surface by evaporation into the air and by natural dispersion into the water column. Figure 13.16e presents the fate of the relative proportions of the diesel for the winter and summer conditions.

Figure 13.16e Fate of Diesel Released for i) Winter and ii) Summer Conditions



As Figure 13.16e shows, the majority of the volume of the released diesel is rapidly lost to the air by evaporation or naturally dispersed into the water column and then biodegraded. The modelling completed showed that all of the diesel released would be removed from the sea surface by these processes within approximately 2 days in winter and 11/2 days in summer.

The concentrations of naturally dispersed diesel in the water column were shown to reach a maximum of around 1 ppm, which will decline to less than 25 ppb dissolved in the water column within 48 hours under both summer and winter conditions.

13.10.7 Impact of Condensate and Diesel Releases

13.10.7.1 Physical State of SD2 Condensate and Residues Remaining After Weathering

The condensates to be produced from the various reservoirs at Shah Deniz 2 have relatively high wax contents and Pour Points, ranging from +3°C to +12°C. Precipitated wax can be seen in the samples of various condensates at room temperature (Figure 13.17).

Figure 13.17 Appearance of Various Condensates to be Produced at SD2

SINTEF conducted a laboratory weathering study on a condensate sample from well SDX-05Y. The condensate sample has a Pour Point of +9°C. Distillation residues were prepared to simulate different degrees of evaporative loss from the condensate. The 150°C+, 200°C+ and 250°C+ distillation residues, representing 19%, 34% and 50% volume loss from the condensate had Pour Points of +21°C, +30°C and +33°C, respectively.

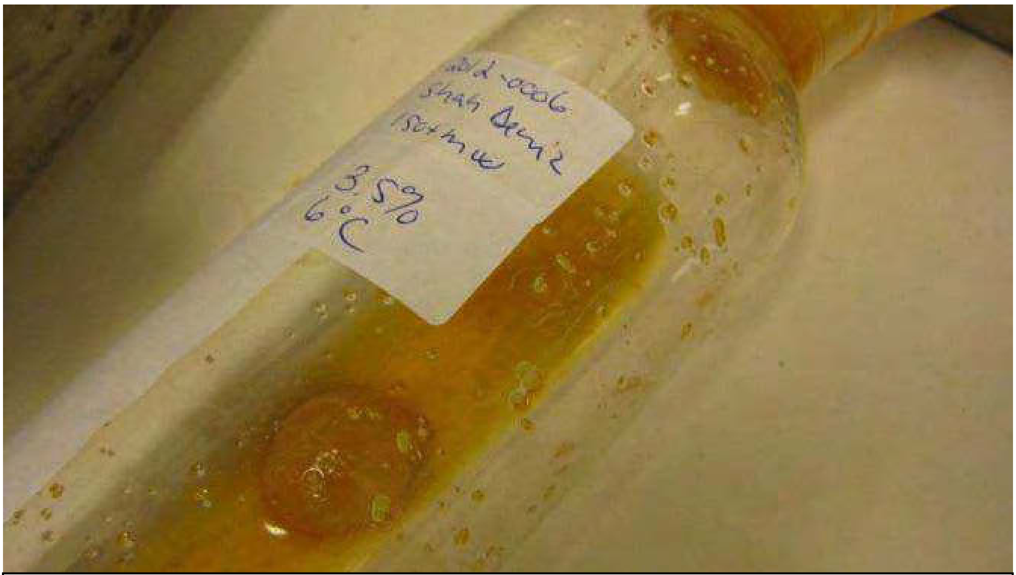
The 200°C+ distillation residue, representing the evaporative loss after 0.5 to 1 day on the sea surface, was totally solid at room temperature of approximately 24°C (the inverted bottle in Figure 13.18).

Figure 13.18 Physical State of the Distillation Residues at a Room Temperature Of 24°C

Photograph from SINTEF Report Shah Deniz Condensate – Weathering properties, WAF and Toxicity

When the 250°C+ distillation residue was mixed with seawater at 6°C for 24 hours to investigate the possibility of water-in-oil emulsion formation the condensate separated into two phases; a wax-depleted, liquid oily phase and a wax-enriched, solid waxy phase. The wax agglomerated into a single large lump in the flask (Figure 13.19).

Figure 13.19 Lump of Wax Produced on Mixing the 250°C+ Distillation Residue With Seawater at 6°C



Photograph from SINTEF Report Shah Deniz Condensate – Weathering properties, WAF and Toxicity

Spills and releases of high Pour Points condensate have previously occurred. A relatively recent example was the Montara incident in the Timor Sea, off northern Australia in August 2009. The released condensate had a Pour Point of +27°C and the sea surface temperature was also 27°C, although the air temperature at times was over 40°C. The condensate released during the Montara incident weathered at sea and the Pour Point increased. The spilled condensate was present on the sea surface in the form of wax in thick layers when contained by booms (Figure 13.20), but as scattered particles when uncontained (Figure 13.21).

Figure 13.20 Weathered Condensate at Montara Incident Contained in a Boom

Photograph from MONTARA WELL RELEASE, TIMOR SEA . Monitoring Study O2 Monitoring of Oil Character, Fate and Effects Report 01. AMSA (Australian Maritime Safety Authority) 24th September 2009

Figure 13.21 Weathered Condensate at Montara Incident on Sea Surface

Photograph from MONTARA WELL RELEASE, TIMOR SEA . Monitoring Study O2 Monitoring of Oil Character, Fate and Effects Report 01. AMSA (Australian Maritime Safety Authority) 24th September 2009

The precise behaviour of the SD2 condensate released into the sea will depend on the release conditions. Condensate released simultaneously into the sea at depth with large amounts of gas and some produced water from the blowout and flowline release scenarios will initially be in the form of very small droplets of liquid condensate. Large globules of condensate will be released from the less intense turbulence associated with an export pipeline rupture. The droplets or globules will rise up through the water column, losing water-soluble components into the water as they rise. On arriving at the sea surface, the more volatile components will be rapidly lost by evaporation. This is most likely to lead to a waxy residue being left on the sea surface in some release circumstances.

13.10.7.2 Ecological Impacts from Accidental Releases of Condensate.

There are two potential sources of environmental impacts resulting from accidental releases of condensate.

Ecological Impacts in the Water Column

The accidental release of condensate into the water column could cause negative effects to marine organisms in the locality of the release because of an increased level of potentially toxic compounds being released from the condensate into the water column.

There are several classes of chemical compounds that are present in crude oils that have the potential to exert toxic effects on marine organisms (Table 13.16). Condensates contain some, but not all, of these compounds. The extent to which these different classes of compound partition in to the water column or evaporate into the air will be the primary factors in determining their potential impact.

Table 13.16 Chemical Compounds in Crude Oils and Condensates That Have the Potential to Exert Toxic Effects on Marine Organisms

Chemical Compounds	Includes	Potential Effects	Exposure Route	Fate
Low molecular weight alkanes	Pentane, Hexane, Heptane	Narcosis (often reversible)	Slightly soluble in water	Evaporate from slick into air
BTEX	Benzene, Toluene, Ethylbenzenes and Xylenes	Acute toxicity	Moderately soluble in water	Evaporate from slick into air, or biodegraded in the water column
SVOC (Semi-Volatile Organic Compounds)	Substituted (alkylated) naphthalenes	Acute toxicity	Transfer from dispersed condensate droplets into water column	Biodegraded
PAHs (Polycyclic Aromatic Hydrocarbons)	3, 4 or 5 (or more) fused aromatic rings and include anthracene, chrysene, benzo-a-pyrene (and many others).	Chronic toxicity	Ingestion of condensate and subsequent metabolisation	Persistent

The severity of negative effects that could be caused to marine organisms by these chemical compounds will be a function of their exposure to them. Exposure is a function of the concentration of these chemical compounds in water and the duration for which the organisms are exposed.

Blowout Scenarios

The maximum concentrations of total hydrocarbons (both dissolved and in the form of condensate droplets) in water generated in the blowout scenarios (Section 13.10.6.1) are predicted by the modelling to be from 3 to 10 ppm (Table 13.11). The concentrations of dissolved hydrocarbons are lower (Figures 13.10 and 13.11), but are high enough to cause negative effects to exposed marine organisms, particularly as they will be maintained at these levels for the entire blowout duration and take several days longer to subside to low levels. The duration of exposure is very likely to cause severe negative effects to affected marine organisms.

Flowline Rupture Release Scenarios

The maximum concentrations of total hydrocarbons in water generated in the flowline rupture scenarios (Section 13.10.6.2) are predicted to be between 0.3 and 4.9 ppm (Table 13.13), but the exposure duration will be for only 1 to 2 days. The volumes of water with elevated dissolved hydrocarbons (as in the example illustrated in Figure 13.14) will be small and localised to the vicinity of the flowline rupture. The relatively short exposure in confined water volumes is likely to cause only very localised and temporary effects to affected populations of marine organisms.

Condensate Export Pipeline Rupture Scenarios

The condensate release from the ruptured pipeline in near-shore, shallow water (Scenario EL2 in Section 13.10.6.3) will generate extremely high maximum concentrations of total hydrocarbons in water of 68 or 93 ppm (Table 13.15). The dissolved hydrocarbon concentrations will also be very high, over 5 ppm (Figure 13.15) in the water volume near the pipeline rupture location. These high concentrations will be maintained for 6 or 7 days and could have a severe impact on the affected marine organisms.

Ecological Impacts on The Sea Surface And Shore

The waxy residue of condensate that would remain at sea for a relatively long time would have been depleted in the most potentially toxic chemical compounds that could cause negative effects by chronic exposure. Almost all of the BTEX and SVOCs would have been previously lost by dissolution and evaporation. The condensate does not contain significant levels of Polycyclic Aromatic Hydrocarbons (PAHs) that can cause negative effects by chronic exposure. Unlike most crude oils, the condensate does not form stable water-in-oil emulsions that could smother small coastal animals and contaminate the plumage of seabirds.

The waxy residue that comes ashore after condensate releases will be in the form of wax particles, or granules, widely scattered along the shoreline, although there may be localised concentrations. These wax particles may melt in the sun during the day and soak into sandy shoreline substrates.

The ecological effects of waxy condensate residue coming ashore are therefore likely to be minimal, certainly much less severe than would be the case for emulsified crude oil coming ashore.

13.10.7.3 Ecological Impacts from Accidental Releases of Diesel

Potential Ecological Effect of Diesel on the Sea Surface

The water depth under the spilled diesel on the sea surface will always be greater than approximately 70 metres. The upper layers of this water will be well-oxygenated. The duration of time that there will be a layer of diesel on the sea surface will be a maximum of 2 days. During this time, the diesel will not be present as a coherent, stationary layer capable of preventing oxygen transfer into the water. Instead, it will be present as an oil slick that drifts across the sea surface and is continually being exposed to wave action that disrupts, and eventually disperse it. There will be little, if any, oxygen depletion in the upper water column and no significant effects on marine organisms.

Potential Ecological Effect of Diesel in the Water Column

The diesel-in-water concentration will rise up to a maximum of 1 ppm (parts per million) in localised areas under the drifting oil slick and then rapidly decline to less than 25 ppb (parts per billion) within 48 hours. Experience and laboratory studies have shown that exposure to these diesel concentrations for this duration are too low and too brief to cause any significant effects on any marine organisms.

13.10.8 Spill Prevention and Response Planning

13.10.8.1 Oil Spill Contingency Planning - Azerbaijan Offshore

An Oil Spill Response Plan has been developed, which provides guidance and actions to be taken during a hydrocarbon spill incident associated with all Shah Deniz offshore operations, which include mobile offshore drilling units, platforms, subsea pipelines and marine vessels. It is valid for spills that may occur during the commissioning, operation, and decommissioning of the systems.

The Oil Spill Response Plan is designed to:

- Establish procedures to control a release or the threat of a release, that may arise during offshore operations and associated facilities;
- Establish procedures to facilitate transition of response operations from a Tier 1 incident to a Tier 2/3 release or threat of release;
- Minimise the movement of the hydrocarbon spill from the source by timely containment;
- Minimise the environmental impact of the oil spill by timely response;
- Maximise the effectiveness of the recovery response through the selection of both the appropriate equipment and techniques to be employed; and
- Maximise the effectiveness of the response through trained and competent operational teams.

BP’s response strategy is based on: an in-depth risk assessment of drilling and platforms operations and subsea pipelines; analysis of potential spill movement; environmental sensitivities and; the optimum type and location of response resources. BP supplements its dedicated resources with specialist spill response contractors.

BP has contracted an independent oil spill response contractor in Azerbaijan to provide a response to a Tier 2 oil spill incident originating from BP's offshore operations and these resources may be accessed for larger spills in Azerbaijan. Oil Spill Response (Ltd) (OSRL) is a Tier 3 responder who has bases in both the UK and Singapore and will provide Tier 3 services to BP in the event of a major release and/or highly sensitive Tier 2 incident. In addition to the supply of equipment, they can also provide response technicians and supervisors.

BP will also coordinate with local emergency services and government agencies in Azerbaijan, both prior to, and during oil spill incidents, and additional resources are available from the Ministry of Emergency Situations. The OSRP describes how BP will utilise these resources to protect the environment in which it resides.

13.10.8.2 BP Capping Resources - Azerbaijan Offshore

In addition to oil spill response capability, BP also has a well capping stack, dispersant, debris removal and ROV tooling system designed to be transported by air to any location around the world where BP operates. In addition, BP is a subscriber to the Subsea Well Response Project (SWRP) through which it will have access (from 2013 and subject to availability) to four capping stacks and two subsea dispersant systems. OSRL will own, store and maintain the four capping stacks and the two dispersant systems at bases in Stavanger, near Rio de Janeiro, near Cape Town and in Singapore. The systems are available for deployment to any global location (excluding the US). Both the BP and the SWRP capping stack systems are capable of being transported to Azerbaijan but are subject to deployment limitations in the Caspian as described below.

The Caspian region is limited in the number of response vessels and vessels with suitable ROV and subsea crane capabilities to deploy a capping stack system. There is also a concern that the high flow-rate wells in the Caspian in combination with shallow water will limit vertical access to a failed BOP. This is due to high VOCs (Volatile Organic Compound) at surface and challenging vessel surface operating conditions.

At present, there are significant challenges to an operator's ability to deploy a capping stack on Caspian wells. Work is ongoing through SWRP and BP, however, to understand capping stack landing limitations on a failed BOP, assess deployment requirements and develop vertical offset installation methods to respond to an incident in the Caspian.

13.10.9 Reporting

All non-approved releases (liquids, gases or solids) including releases exceeding approved limits or specified conditions during all phases of the SD2 Project will be internally reported and investigated. Existing external notification requirements agreed with the MENR will be adopted during the operation phase of the SD2 Project are:

- For liquid releases to the environment exceeding a volume of 50L, notification will be made to the MENR within 24 hours after the incident verbally and within 72 hours in the written form; and
- If the release to the environment is less than 50L, then information about the release will be included into the BP AGT Region Report on Unplanned Releases and sent to the MENR on a monthly basis.

Spills that occur at the main construction and installation contractors sites and from vessels they operate will be reported to the MENR by the contractors.

A Protocol "On Agreeing the Main Principles of Cooperation for Regulation of Unplanned Material Releases" signed between BP and MENR in December 2012 defines an approved release as "a release that is permitted by applicable PSA, MENR permitted and/or approved documents including ESIA, EIA, Technical Note, Technical Letter, individual discharge request letters to MENR or any other written agreement with the MENR". Unapproved releases are those that do not fall into this definition.

14 Environmental and Social Management

Contents

List of Figures

List of Tables

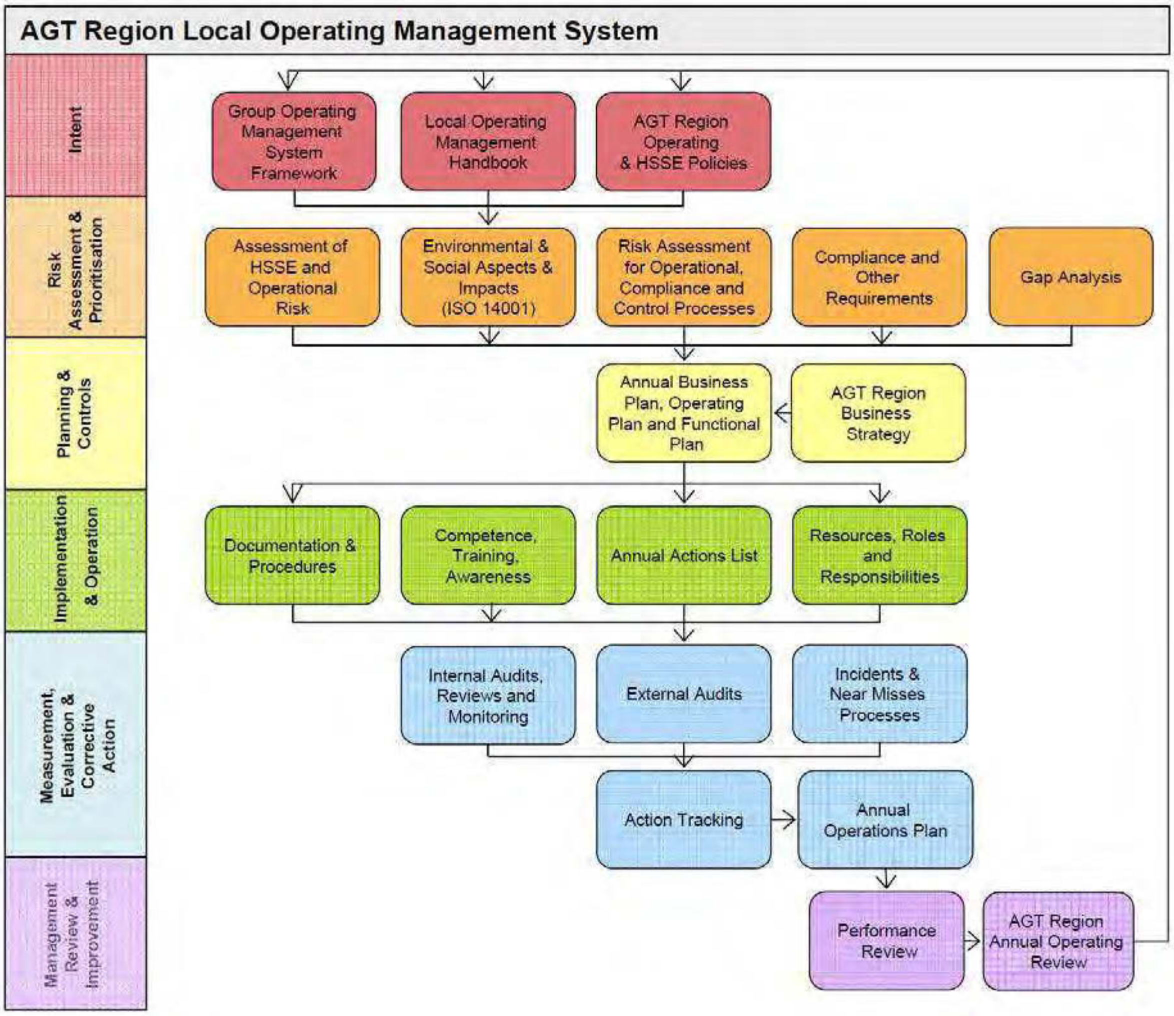
14.1 Introduction

Under the Shah Deniz (SD) Production Sharing Agreement (PSA), BP as Operator is responsible for the environmental and social management of the SD activities, to ensure that project commitments are implemented, and conforms to applicable environmental and social legal, regulatory and corporate requirements. This Chapter provides an overview of the system that will be used to manage the environmental and social issues associated with the SD2 Project.

The Azerbaijan Georgia Turkey (AGT) Region manages BP's operations in Azerbaijan and have an established Local Operating Management System (LOMS). This system forms the structured framework to the HSSE performance of the organisation for which there are six key stages as set out in Figure 14.1:

- Intent;
- Risk Assessment & Prioritisation;
- Planning & Controls;
- Implementation & Operation;
- Measurement, Evaluation and Corrective Action; and
- Management Review & Improvement.

Figure 14.1 AGT Region Local Operating Management System Framework



The environmental portion of the AGT Region Local Operating Management System for operations is certified to ISO 14001, the leading international standard on environmental management.

In line with the six stages within the LOMS, BP apply the following principles of environmental and social protection:

- **Plan** – prior assessment of potential environmental and social impact;
- **Do –** implementing design and mitigation measures that seek to avoid, reduce or minimise potential impact;
- **Check –** monitoring performance and the efficacy of the mitigation measures that are implemented; and
- **Act –** auditing and tracking the implementation of corrective actions.

This section of the ESIA highlights how these principles shall be applied to the SD2 Project.

14.2 Construction Phase Roles and Responsibilities

14.2.1 BP

BP is responsible for the detailed design, procurement, construction and operation of the SD2 Project. BP has appointed design contractors to undertake the detailed design of the project and a drilling contractor to operate the MODU's that will drill the wells. In due course, BP will issue technical bid documents for the various elements of the construction work scope. Where relevant, the bid documents will include a copy of BP's minimum environmental and social requirements (referred as HSSE Contract Clauses) into the bid documents.

BP will manage the construction phase of the Project, monitoring and auditing the technical, environmental and social performance of its contractors throughout the construction phase. The contractors will be responsible for the management of their staff (to the extent that reflects staffing at the site).

A SD2 Construction Phase Environmental and Social Management System (ESMS) will be developed and implemented by BP and will include the following:

- The commitments register that BP has produced listing all the commitments within this ESIA that are to be implemented during the construction phase;
- A legal register of legislation applicable to the SD2 Project;
- An Environmental and Social Management and Monitoring Plan (ESMMP) which will be reviewed and updated as needed as part of a process of continuous improvement;
- A schedule of monitoring, inspection and audit of environmental performance that includes checking that the main construction and installation contractors are meeting the expectations set out in the ESMMP; and
- Implementation of an action tracking system to monitor the findings of inspections and audits that do not conform to the ESMMP and the implementation of corrective actions.
-

14.2.2 Main Construction and installation Contractors

The main construction and installation contractors for the jacket, topside, subsea facilities and terminal construction will be expected to conform fully to the relevant aspects of the BP SD2 Construction Phase ESMS for which they are responsible.

The main construction and installation contractors will be required to develop and implement their own Construction Phase ESMS for the SD2 Project that will become an integral part of the BP SD2 Construction Phase ESMS.

14.3 Construction Phase ESMSs

14.3.1 Introduction

The BP SD2 Construction Phase ESMS will form the framework for managing social and environmental issues throughout construction, prior to the operation of the SD2 facilities and will be consistent with, but not necessarily certified to, ISO 14001.

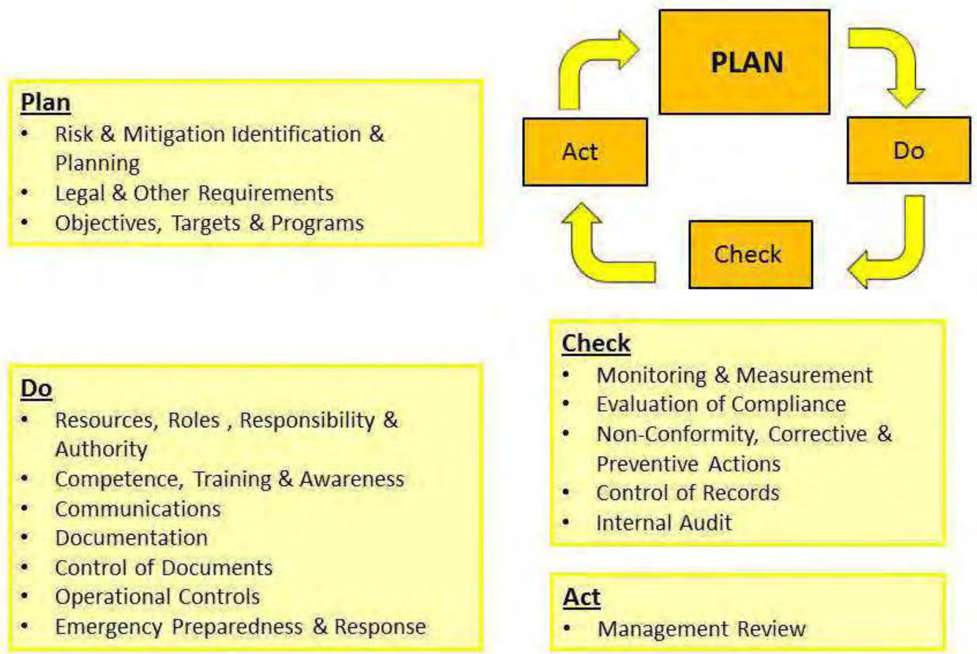
The BP SD2 Construction Phase ESMS will be used to deliver the SD2 ESIA commitments and coordinate and review the environmental and social performance of the Project at the construction stage. Special consideration will be given to the following:

- Practical training and raising the environmental and social awareness of personnel;
- Supervision and monitoring of environmental and social issues in the field; and
- Continuous improvement of environmental and social performance throughout the Project.

14.3.2 BP's ESMS Framework

Figure 14.2 presents an overview of the elements of the BP Construction Phase ESMS 'plan–do–check–act' cycle. This document will establish a common understanding between the key staff involved in delivering effective environmental and social management of the Project.

Figure 14.2 BP's Construction Phase ESMS Elements



14.3.3 Plan

The 'plan' stage of the cycle seeks to identify hazards and risks to the Project, e.g. through the SD2 ESIA process, resulting in a commitments register for the Project and development of mitigation measures in construction phase execution plans. Planning also involves the identification of legal and other requirements, such as the development of goals and target setting using Key Performance Indicators (KPIs).

The SD2 ESIA commitments register lists the commitments that have been generated through the Project's comprehensive ESIA process. The ESIA commitments register assigns each commitment that will be implemented in the 'do' stage of the management cycle within the BP SD2 Construction Phase ESMS. Operation phase commitments will be reflected in the BP Operations ESMS.

14.3.4 Do

The 'Do' stage of the cycle reflects the implementation of the BP SD2 Construction Phase ESMS and its key components:

- Strategy and framework documents;
- ESMMP;
- Management plans; and
- Contractor procedures.

The ESIA Management of Change Process (see Chapter 5, Section 5.16) will be followed if there is a need to change the Base Case design of the SD2 Project.

14.3.4.1 ESMMP

The BP Construction Phase ESMS will include the ESMMP that describes:

- Conformance requirements;
- Roles and responsibilities of BP and the main construction and installation contractors;
- The actions needed to avoid and/or mitigate environmental and social impacts and to put the commitments in the ESIA into effect; and
- The assurance process that will be adopted to monitoring and report environmental and social performance will include inspection, audit and monitoring programs such as sewage treatment plant performance monitoring.

To support the ESMMP, environmental and social management plans will be developed by BP to present the SD2 Project environmental and social requirements by subject matter. Table 14.1 lists those management plans that have been identified as being applicable to the SD2 Project. The SD2 Project environmental and social management plans will be finalised during mobilisation of the main construction and installation contractors, and regularly reviewed as construction work proceeds.

Table 14.1 Environmental and Social Management Plans

Title of Plan	Issues Covered
Restoration and Landscape Management Plan	• Landscape management training • Topsoil and subsoil management (during onshore pipeline installation works and subsequent reinstatement) • Site restoration • Spoil management • Monitoring and reporting
Waste Management and Minimisation Plan	• Waste management training • Waste hierarchy (i.e. reduction at source, reuse, recycling, energy recovery, responsible disposal) and green procurement • Identification and classification of waste • Waste register • Waste handling (i.e. collection, segregation and containers, storage, treatment, transport and documentation, disposal) • Monitoring and reporting
Ecological and Wildlife Management Plan	• Ecology and wildlife training • Pre-construction ecological surveys and wildlife inspections • Habitat and species protection during construction (i.e. translocation, traffic restrictions, code of conduct) • Monitoring and reporting
Pollution Prevention Management Plan	• Pollution prevention training • Energy efficiency (vehicle and equipment selection, maintenance) • Emissions and dust management (i.e. vehicle, equipment and generator emissions, dust management)

Title of Plan	Issues Covered
	• Wastewater management (i.e. drainage, trench dewatering, hydrotest water disposal and use of chemicals in hydrotest water, vehicle and equipment washing) • Sewage treatment and disposal • Chemical selection and management, and hazardous materials management • Noise and vibration management • Treatment of contaminated soil • Monitoring and reporting
Community Engagement and nuisance management and monitoring	• Community liaison training • Grievance mechanism • Nuisances management and monitoring (i.e. construction noise, artificial light from work areas, odours, pests and vermin) • Community interaction (i.e. prior notification of noisy activities, road congestion associated with the transport of oversize and heavy loads) • Monitoring and reporting
Archaeology and Cultural Heritage Management	• Cultural heritage training • The protection of known archaeological resources (i.e. their location, legal status, protective buffers) • Watching brief procedure for all ground breaking activities • Archaeological chance finds procedure • Monitoring and reporting
Spill Prevention, Response, Notification and Close Out Actions	• Spill prevention • Spill response training • Spill response management • Monitoring and reporting
Traffic and Transportation Management Plan	• Driver management training • Onsite vehicle movements • Offsite vehicle movements and the prohibition on off-road driving • Risk assessment for the transport of oversized and heavy loads • Monitoring and reporting
Employee Relations Management Plan	• Training and skill development activities • Grievance mechanism • Demanning • Monitoring and reporting

14.3.4.2 Training

At the ‘do’ stage of the BP SD2 Construction Phase ESMS, training is fundamental to the successful delivery. The SD2 Project construction activity will be of relatively short duration, so establishing key environmental and social requirements at the outset is important to the provision of effective training. The main training elements required are:

- Management briefings;
- Induction training for BP, the main construction and installation contractors and their sub-contractor staff; and
- Toolbox talks and awareness programmes during construction.

14.3.4.3 Management Briefings

An environmental and social training session will provide the BP Project Management Team with an overview of the BP SD2 Construction Phase ESMS and a common understanding of roles, responsibilities and applicable standards.

Following award of contract, a second environmental and social training session will seek to ensure that the BP Project Management Team and the main construction and installation construction contractors’ senior personnel adopt a coordinated approach to implementing BP requirements, and to affirm BP’s commitment to good environmental performance and to establishing good community relations.

14.3.4.4 Induction Training

All Project construction staff will receive an environmental and social induction that will explain the key requirements to everyone on site.

14.3.4.5 Toolbox Talks

In addition to toolbox talks delivered by the main construction and installation contractors as part of skills training, sessions to raise awareness will be held for the following environmental and social issues:

- Waste management and handling;
- Refuelling; and
- Hazardous materials management/handling.

14.3.5 Check

14.3.5.1 Monitoring, Inspections, Reporting and Audits

The BP SD2 Construction Phase ESMS will identify key indicators that will be used to measure environmental and social performance.

BP's and the main construction and installation contractors procedures and plans will be used to collect and regularly report monitoring data to BP, including the following:

- Data (e.g. waste volumes, types and disposal, complaints received and resolved);
- Activities carried out (e.g. surveys, meetings with communities, site inspections and findings);
- Status of non-conformances identified during inspections;
- Environmental, social and cultural heritage issues arising in the course of the works (e.g. contaminated land discovered, archaeological finds and ecological issues); and
- Site observations and reports, from inspections and incidents such as spill events.

BP and the main construction and installation contractors will conduct audits to track progress and performance in implementing the Construction Phase ESMSs and the effectiveness of the mitigation measures implemented in avoiding environmental and social impacts. The schedule of these audits will be determined after the contract has been awarded, but the aim will be to audit all elements of the Construction Phase ESMSs. The frequency of auditing for individual commitments will be reviewed regularly and adjusted as necessary to take account of audit findings. BP will also carry out spot check audits of any issues that are of environmental and social concern.

14.3.6 Act

14.3.6.1 Corrective Action

The inspection and audit processes described in Section 14.3.5 will be documented with non-conformance reports (NCRs) and corrective action requests (CARs). Both BP and the main construction and installation contractors will develop and maintain action-tracking systems to monitor the effectiveness of actions taken in response to NCRs and CARs.

BP will track the implementation of corrective actions and will update the Project Manager and the Environmental and Social Manager daily on non-conformances that require follow-up actions. The contractors will be responsible for the management of their staff (to the extent that reflects staffing at the site).

14.4 Operations Phase ESMS

BP will operate the SD2 facilities using an Operations Phase ESMS that is certified to ISO 14001 Environmental Management System (EMS) and will be based on the 'plan-do-check-act' cycle. The BP Operations Phase ESMS will be developed prior to commencement of SD2 operations and transition plans will be developed to assist with the movement from the construction to the BP Operations Phase ESMS.

Similar to the BP Construction Phase ESMS, the primary functions of the BP Operations Phase ESMS will be to operate SD2 Project facilities in accordance with the ESIA commitments and applicable legal and regulatory standards and BP policy.

Through a management system that mirrors the ISO 14001 EMS, the SD2 Operations Phase EMS will:

- Regularly assess the environmental and social aspects and impacts of its activities;
- Develop objectives and targets to address any significant aspects;
- Appropriately resource and train staff; and
- Monitor and audit the success of its actions in addressing the significant impacts.

This system will be implemented with the aim of ensuring continual improvement in performance. Key components of the BP Operations Phase ESMS, consistent with ISO 14001 requirements, are shown in Table 14.2.

Table 14.2 ISO 14001 EMS Components

ISO 14001 EMS Components	
1. EMS General Requirements	10. EMS Documentation
2. Environmental Policy	11. Document Control
3. Environmental Aspects	12. Operational Control
4. Legal and other requirements	13. Emergency Preparedness and Response
5. Objectives and Targets	14. Monitoring and Measurement
6. Environmental Management Programmes	15. Non-Conformance and Corrective Action
7. Structure and Responsibility	16. Records
8. Training and Awareness	17. Environmental Management System Audit
9. Communication	18. Management Review

The operations commitments included within this ESIA will be implemented through the operations phase environmental of environmental management system. The following existing plans will be updated to incorporate SD2 Project or new plans developed as required:

- Emissions management;
- Waste management; and
- Ecological management and monitoring.

In addition, the existing AGT Region Emergency Response Plan (ERP) will be reviewed and amended to reflect the location of new pipe sections and new SD2 Project facilities.

14.5 MODU Management System

14.5.1 Approach

The MODUs used to drill the SD2 Pre-drilling Project wells will be operated by a rig operator(s) who have their own independent EMS already in place. Alignment of the plans, procedures and reporting requirements of the rig and AGT Region EMS has been achieved through the development of an EMS Interface Document. The document defines clearly how all activities will be managed to ensure a safe and environmentally acceptable working environment; roles and responsibilities are described in Figure 14.3.

The aim of the EMS Interface Document is to ensure that both the AGT Region and the rig operator's EMS do not result in any of the following, which is reflected in the AGT Region Local Operating Management System Policy:

- No accidents;
- No harm to people; and
- No harm to the environment.

Figure 14.3 Roles and Responsibilities Associated with Rig Environmental Management

BP EMS

- Compliance with requirements and commitments as set out in:
  - Shah Deniz Production Sharing Agreement (SD PSA),
  - Shah Deniz Environmental Protection Standards (once agreed) (SD EPS)
  - Relevant ESIAs
  - Environmental Technical Notes (ETNs) and Addendums to ETNs
- Waste Management Procedure
- Reports regularly to the authorities
- Maintains documents according to Environmental Objectives and Targets
- Update and maintenance of the EMS interface document
- Update and maintenance of the Environmental Operating Procedure document

Rig Operator EMS

- Implement the EMS to all rig staff
- Operations to be carried out according to set operational procedures
- Undertake management and monitoring to meet environmental requirements
- Reporting according to the Environmental Operating Procedure and completion of Environmental monitoring and report forms
- Support the AGT Region Senior Environmental Advisor

The EMS Interface Document is a live document and is reviewed annually at a minimum. Both the BP EMS and the Rig Operator EMS monitor the same targets and objectives which are separately audited as part of their internal review process. Communications lines are in place to ensure the effective sharing of the findings and action lists.

14.5.2 Monitoring and Reporting

Monitoring and reporting is undertaken in accordance with AGT Region policy and procedures and is set out within the rig Environmental Operating Procedure which details the method and frequency of reporting for the following categories:

- Deck drainage and wash water, garbage disposal unit effluent and grey water treatment effluent, oily water, fuel usage records;
- Volume of drilling fluids and cuttings discharged and Water Based Muds (WBM) fluid properties;
- Wastes sent to shore;
- Drilling/ workover/cementing/testing chemicals;
- Mud sampling and labelling;
- Rig chemicals reporting;
- Seabed Remotely Operated Underwater Vehicle (ROV) monitoring;
- Environmental accidents, incidents, oil, base fluid and chemical spill reporting; and
- End of well environmental report.

14.5.3 Audit and Review

Auditing and checking is a key element of the rig EMS. Both the AGT Region and the rig operator have systems in place to audit their respective EMS. Individuals from each company are tasked with the responsibility of sharing the audit findings. Where necessary, additional audits and reviews may be undertaken to address identified areas of concern. Joint audits are undertaken to ensure that procedures are being followed appropriately. Both the AGT Region and the rig operator have systems in place to control communication, tracking and follow up of audit and review recommendations.

14.6 Environmental Monitoring Programme

BP's AGT Region has implemented an Environmental Monitoring Programme (EMP) designed to provide a consistent, long-term set of data, with the objective of ensuring an accurate picture of potential impacts on the surrounding environment, so that they can be managed and mitigated as effectively as possible.

The EMP follows a 10 year schedule and detailed monitoring plans are prepared for the next 3 years, with outline planning for the following 7 years. This approach allows a progressive and systematic modification of the programme to take into account the results and conclusions of the programme to date.

Offshore marine monitoring can be separated into the following categories:

- Baseline surveys – to provide a general understanding of the physical, chemical and ecological parameters at a particular location before development commences. Any unusual or sensitive ecological features, which might affect the design of a development, can also be identified;
- Post-drill surveys – completed following drilling operations in order to assess the impact of drilling discharges on the surrounding environment;
- Routine environmental monitoring surveys – to provide an assessment of the impact of AGT Region operations, aiding responsible environmental management; and
- Regional surveys – completed to permit the identification and type of environmental changes and trends that occurs over time. Sampling is undertaken at locations remote from AGT Region activities, providing information on changes in the terrestrial and marine environment that have resulted from natural processes, or other third party activities. This helps to distinguish potential impacts resulting from AGT Region activities from natural background environmental changes and other anthropogenic sources.

Offshore marine monitoring has been conducted as part of the SD Contract Area development, with the primary focus being the benthic environment as sediments and their associated biological communities are widely considered to be the source of the most reliable indicators of ecological status and impact. Periodic water quality sampling is also undertaken.

In terms of onshore terrestrial operations, effort has focused on environmental monitoring in the vicinity of the ST in the form of terrestrial ecosystem monitoring, bird surveys, ambient air quality monitoring, and groundwater and surface water quality monitoring. In addition, nearshore fish monitoring and biomonitoring has been conducted within Sangachal Bay and future surveys will be conducted in accordance with the 10 year schedule.

The environmental monitoring programme will be expanded for the SD2 Project, to integrate operational monitoring of key discharges carried out by the AGT Region. This will allow a more complete understanding of the potential impacts of AGT Region operations. The aim of regular monitoring is to establish an understanding of trends over time, taking into account results of concurrent regional surveys and initial baseline data. Combined with operational discharge monitoring, this approach provides a robust basis for assessing the impact of SD2 Project operations, and for comparing the observed impact with that predicted in the ESIA.
Specifically with reference to the SD2 Project's offshore operations, the EMP will:

- Undertake post-drilling seabed survey at each cluster on completion of the cluster drilling programme;
- Undertake a post-installation seabed survey at the SDB platform location; and
- Develop an offshore operational monitoring programme in consultation with the Environmental Sub-Committee.

The surveys will follow the standardised EMP design to maximise the usefulness of comparisons over time and between locations. Baseline surveys have already been completed at the platform and cluster locations. Surveys associated with the pipeline nearshore trenching will also be completed. Fish population surveys will be undertaken one year prior to trenching activities, during trenching and once trenching has been completed. Pre and post trenching seabed surveys will be undertaken. Post trenching seabed surveys will be undertaken one and three years after completion of trenching activities. The surveys will include drop down video work to confirm seabed distribution.

14.7 Waste Management

Waste generated during the SD2 Project will be managed in accordance with the existing BP AGT Region management plans and procedures. All wastes generated as part of the SD2 Project will be identified and managed in accordance with the following requirements:

- Site specific Waste Management Plans will be prepared by BP and the main construction and installation contractors for the jacket, topside, subsea facilities and terminal construction;
- Workforce awareness and training;
- AGT Region Approved Waste Contractors List;
- AGT Region Waste Streams Register; and
- AGT Region Waste Management Strategy and Manual.

In accordance with internationally recognised best practice, the waste hierarchy, coupled with the AGT Region Best Practicable Environmental Option (BPEO) assessment of available waste disposal / treatment technologies that has been completed and will be adopted as the basis for guiding waste management decisions. This approach is intended to ensure that wastes are managed in the most sustainable way and in compliance with all applicable AGT Region standards and national legislation whilst ensuring they are recovered, recycled or disposed of efficiently without endangering human health and minimising environmental and social impacts.

14.7.1 Waste Management Processes and Procedures

Waste Management and Minimisation Plans will be developed and maintained to cover the duration of the SD2 Project's activities to match the anticipated waste streams, likely quantities and any special handling requirements.

A schedule of internal audits will be developed to objectively monitor the performance of the waste management systems during the SD2 Project's activities and to ensure that all corrective actions and improvements are identified and implemented.

To support the Waste Management and Minimisation Plan, the main construction and installation contractors will receive waste management training covering:

- Identification of waste types and potential associated hazards;
- Waste segregation; and
- Waste transfer documentation (if involved in waste movement).

All new waste disposal routes are routinely assessed prior to use and must be compliant with applicable local laws and regulations. Waste will only be routed to those waste disposal facilities that have been approved for use by the AGT Region.

14.7.2 Waste Segregation and Transfer

Waste streams will be segregated at source to permit reuse/recycling and to avoid contact between incompatible materials. The segregation requirements will be clearly indicated by the use of containers with clear signage denoting the waste types that are suitable for the containers provided.

All waste transfers will be accompanied by individual Waste Transfer Notes (WTNs), confirming the waste type, quantity, waste generator, consignee, consignor (if different from the generator) and, in the case of hazardous wastes, both Waste Passports and, where required, Material Safety Data Sheet (MSDS) documentation. A final visual inspection of all waste consignments will be made prior to transfer note sign-off and uplift. Coloured copies of the waste transfer documentation together with other relevant information e.g. MSDS, Waste Passports, will be retained by the waste generator. All parties involved in transporting wastes will retain a copy of the waste transfer note.

Depending upon the nature of the waste and the approved method of recycling/disposal, wastes may be routed via the Central Waste Accumulation Area (CWAA), waste transfer station or similar facility, or alternatively may be routed directly to their final approved destination.

15 Residual Impacts and Conclusion

Contents

List of Tables

15.1 Introduction

This Chapter of the Environmental and Socio-economic Impact Assessment (ESIA) summarises the residual impacts and conclusions of the Shah Deniz Stage 2 (SD2) Project ESIA.

15.2 Design, Construction, Installation, HUC and Operation

The Shah Deniz Bravo (SDB) platform complex, SD2 onshore facilities, SD2 export and MEG pipelines and the infield subsea infrastructure are based on established and proven designs and will be constructed and installed by experienced contractors using established facilities and a well-trained workforce.

15.3 Environmental Impacts

Environmental impacts have been assessed separately for the following:

- Drilling and Completion Activities (ESIA Chapter 9);
- Onshore Construction and Commissioning Activities, Platform, Export & MEG Pipeline and Subsea System Installation, Hook Up and Commissioning (HUC) (ESIA Chapter 10); and
- Offshore, Onshore and Subsea Operations (ESIA Chapter 11).

Cumulative impacts, transboundary impacts and accidental events have also been assessed.

15.3.1 Drilling and Completion Activities

Table 15.1 summarises the outcome of impact assessment for the Drilling and Completion Activities associated with the SD2 project.

Table 15.1 Summary of Residual Environmental Impacts for SD2 Drilling and Completion Activities

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from mobile drilling rig power generation	1	3	3	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
	Emissions from MODU Flaring (well testing, clean up or intervention flaring)	1	3	1	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
	Emissions from support vessel engines	1	3	3	1	1 1 1 1	Medium	Human: Low Biological/ Ecological: Low	Minor Negative
Marine Environment	Underwater noise from drilling and vessel movements	1	3	3	1	1 1	Medium	Low	Minor Negative
	Drilling discharges	1	2	3	1	1 1	Medium	Low	Minor Negative
	Cement discharges to seabed	1	3	1	2	1 1	Medium	Low	Minor Negative
	Cement unit washing discharges	1	2	1	2	1 1	Medium	Low	Minor Negative
	BOP testing discharges to sea	1	3	3	1	1 1	Medium	Low	Minor Negative

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Marine Environment	MODU cooling water discharges to sea	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig ballast water discharge	1	2	1	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig treated black water discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig grey water discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel and drilling rig drainage discharges	1	3	3	1	1 1	Medium	Low	Minor Negative

Emissions associated with mobile drilling rig (MODU) power generation, well test, clean up and intervention flaring and the activity of support vessels will all occur offshore and disperse into the atmosphere. Modelling was undertaken to determine the concentration of key pollutants associated with these activities at receptor locations (i.e. onshore) and hence event magnitude. Based on existing good air quality relative to recognised standards for the protection of health, receptor sensitivity was considered to be low and the impact of atmospheric emissions was considered to be minor.

During Drilling and Completion Activities, the largest discharges to the marine environment by volume are drilling discharges, specifically the discharge of water based mud (WBM) associated drill cuttings and WBM, discharge of control fluid during blow out preventer (BOP) testing and the discharge of cooling water from the MODU. Modelling has been completed to aid the assessment of the extent and scale of mud and cuttings deposition on the seabed during SD2 Project drilling. This was compared to trends observed during post- drilling surveys. These surveys have shown that WBM and cuttings discharges have a very limited ecological impact to marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact was assessed as minor.

Modelling of the BOP control fluid discharged during BOP testing was undertaken to enable the dimensions and persistence of the dispersion plumes to be assessed. It was concluded that the dispersion plume would have a limited area of potential impact and that BOP testing would have a very short duration; the maximum plume size was predicted to be 51m wide and 98m long, and overall persistence would be less than 2 hours. The BOP fluid is inherently biodegradable and is non-bioaccumulative, thus the impact was assessed as minor.

Small quantities of cement will be discharged to the seabed during the cementing of all hole sections and during plugging of the geotechnical holes. These will remain close to the wellhead in the same area as drill cuttings are deposited. Cement discharges will also occur from wash out activities where cement remaining in the cement unit and associated hoses will be slurrified with water and discharged from each MODU. Modelling of the washed out cement indicated that less than 0.1% of the cement solids would settle within 1.5km of the rig, and no significant deposition will occur at any location. Water column plumes will be limited in size (approximately 150m by 10m), and cement particle concentrations will fall below 5 mg/l within 4 hours of the start of each discharge. Benthic communities will not be impacted, and turbidity effects in the water column will be minor and transient. The impact was assessed as minor.

MODU cooling water discharges are estimated to have a zone of influence (i.e., where the temperature of the discharge is greater than the ambient water temperature) of only a few metres and are also considered to have a minor impact upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish).

The remaining discharges to sea (ballast water, black water, grey water and deck drainage) are all small in volume (relative to drilling discharges, BOP control fluid and cooling water discharges) and do not contain components of high environmental concern. These discharges, which are monitored in accordance with existing procedures to ensure applicable project standards are met, will be rapidly diluted and are all assessed as having a minor impact upon biological receptors in the water column.

Underwater noise and vibration associated with the Drilling and Completion Activities was also assessed. Propagation of underwater noise was modelled to estimate distances at which various acoustic impacts on marine species may occur. For drilling, the source level was found to be below the levels at which lethal injury, permanent deafness, temporary deafness or auditory injury to marine species may occur. It was concluded that mild avoidance to drilling noise may be observed for hearing generalist fish and hearing specialist fish up to approximately 27m from the noise source. Pinnipeds are not expected to exhibit behavioural reactions at the noise levels predicted.

For vessel noise the modelling concluded that noise levels will be below the level at which both lethality and direct physical injury might occur to fish and pinnipeds. Hearing-generalist fish, hearing-specialist fish and pinnipeds may undergo strong avoidance reactions at up to 13m from the noise source Mild avoidance reactions are also expected at distances up to 72m. The assessment concluded that marine species in the area may be temporarily affected by noise, however, ecological functionality will be maintained and the impact was therefore assessed as minor.

For all Drilling and Completion Activities environmental impacts assessed it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

15.3.2 Construction, Installation and HUC Activities

Table 15.2 summarises the outcome of impact assessment for the Construction, Installation and HUC Activities associated with the SD2 Project.

Table 15.2 Summary of Residual Environmental Impacts for SD2 Construction, Installation and HUC Activities

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying)	1	3	3	1	3 1	Medium	Medium	Moderate Negative
Atmosphere	Emissions from Offsite Vehicles	1	3	3	1	3 1	Medium	Medium	Moderate Negative
Atmosphere	Emissions from Terminal Commissioning	1	3	2	1	3 1	Medium	Medium	Moderate Negative
Atmosphere	Emissions from Construction Yard Plant and Vehicles	1	3	3	1	1 1	Medium	Low	Minor Negative
Atmosphere	Emissions from Onshore Commissioning of Main Platform Generators and Topside Utilities	1	3	3	1	1 1	Medium	Low	Minor Negative
Atmosphere	Vessel Emissions	1	3	3	1	1 1	Medium	Low	Minor Negative
Terrestrial Environment	Terminal Construction Plant and Vehicles (Noise)	3	3	3	2	2 2 1 2	High	Human: Medium Biological / Ecological: Medium	Major Negative - reduced to Moderate Negative following additional mitigation

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
	Onshore & Nearshore Pipelay (Noise)	3	1	3	1	2 2 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
Terrestrial Environment	SD2 Export and MEG Pipeline Pre-Commissioning and Drying	1	1	3	1	2 2 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
Terrestrial Environment	Terminal Commissioning (Noise)	1	1	2	1	2 2 1 2	Low	Human: Medium Biological / Ecological: Medium	Minor Negative
Terrestrial Environment	Construction Yard Plant (Noise)	1	3	3	1	3 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
Terrestrial Environment	Platform Commissioning and Topside Utilities (Noise)	3	1	1	1	3 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
Terrestrial Environment	Onshore SD2 Export Pipeline Installation (Ecology)	1	1	3	1	2 1	Medium	Medium	Moderate Negative
Terrestrial Environment	Onshore Pipeline Installation (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
Terrestrial Environment	SD2 Condensate Tank Area Works (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
Terrestrial Environment	Piling within the SD2 Expansion Area (Cultural Heritage)	1	3	1	1	1 2	Medium	Medium	Moderate Negative
Terrestrial Environment	Onshore Pipeline Installation (Cultural Heritage)	1	1	3	2	1 2	Medium	Medium	Moderate Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Pipeline and Flowline Pre-commissioning Discharges	3	3	2	1	1 1	High	Low	Moderate Negative
Marine Environment	MEG Discharge During Subsea Infrastructure Installation	1	1	1	1	1 1	Low	Low	Negligible
Marine Environment	Ballast Water (Vessels)	1	2	1	1	1 1	Medium	Low	Minor Negative
Marine Environment	Treated Black Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Grey Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Drainage (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
Marine Environment	Piling – Jackets and SSIVs (underwater noise)	3	2	1	2	1 1	Medium	Low	Minor Negative
Marine Environment	Vessels During Nearshore and Offshore Pipelay (underwater noise)	2	3	3	1	1 1	High	Low	Moderate Negative
Marine Environment	Vessels During Subsea Infrastructure Installation (underwater noise)	1	3	3	1	1 1	Medium	Low	Minor Negative

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Nearshore/ Coastal	Construction of Finger Piers	1	3	3	1	1 1	Medium	Low	Minor Negative
	Nearshore Pipeline Installation Works	1	2	2	1	1 1	Medium	Low	Minor Negative
	Seabed disturbance (cultural heritage)	1	3	1	1	2 2	Medium	Medium	Moderate Negative

In the vicinity of the Sangachal Terminal, emissions to atmosphere will arise from construction plant and vehicles associated with nearshore pipeline installation, SD2 onshore facility construction and commissioning and SD2 onshore pipeline installation and pre-commissioning activities. In addition emissions will arise from offsite vehicles using the Baku-Salyan Highway. The combined impact to air quality (specifically the contribution to NO_2 concentrations) from these sources at sensitive receptors (i.e. Sangachal Town, Umid, Azim Kend and Masiv 3) is considered to be of no more than a moderate negative impact.

Noise associated with the onshore construction activities in the Terminal vicinity was also assessed. Modelling demonstrated that, based on realistic worst case assumptions for all activities assessed, the predicted construction noise levels at Azim Kend, Masiv 3 and Umid would be below relevant noise limits for the duration of the construction programme. At Sangachal it was predicted noise limits would be met for the majority of the construction programme with a slight exceedance of 1dB(A) predicted during peak construction activity. It was considered unlikely that this 1dB(A) increase would be perceptible. Due to the anticipated duration of the works (approximately four years in total) and the distance construction noise is expected to travel as well as the sensitivity of the community receptors to noise (assessed as Medium), construction noise associated with the onsite plant and vehicles was assessed as having Major negative impact. Therefore, in addition to existing control measures regarding appropriate selection, use and maintenance of plant and equipment, to further minimise noise from construction plant and vehicles at the Terminal the following requirements will be included within the Community Engagement and Nuisance Management and Monitoring Plan:

- Prior to construction commencing within the Sangachal Terminal vicinity, a detailed assessment will be undertaken of all plant and vehicles proposed, and the construction programme to specifically identify the activities which result in the highest noise levels and their duration;
- The main construction and installation contractors will complete work plans detailing forecast activities at an agreed frequency. Should very noisy activities be identified the contractor (following procedures set out in the relevant Community Engagement and Nuisance Management and Monitoring Plan) will liaise with the affected communities warning them that a period of high noise will be experienced and the duration of the activity expected; and
- Noise monitoring will be undertaken at community receptors during construction activities implemented in the vicinity of Sangachal Terminal. If noise levels recorded indicate exceedance of the relevant noise limits (65dB Azim Kend, Masiv 3 and Umid and 70dB at Sangachal) the following will be undertaken:
    - The reason for the non-compliance will be established, where possible;
    - Any action that taken immediately following the survey will be recorded; and
    - If necessary recommendations will be made for further actions, which may include:
        - Further surveys to identify the reason for the non-compliance;
        - Noise control recommendations including, for example:
            - Requirement for equipment maintenance;
            - Selection of alternative equipment; and
            - Screening of equipment.

With these additional mitigation measures in place it is expected the impact associated with Terminal construction plant and vehicles will reduce to Moderate Negative.

Emissions and noise associated with onshore construction activities at the construction yards were also assessed. Modelling demonstrated impacts to onshore receptors were considered to be minor and moderate respectively and additional mitigation was required.

During commissioning of the platform topsides at the construction yard(s), temporary cooling water systems will abstract and discharge water at the quayside. The thermal impact of the discharge was modelled, and indicated that the discharged water (at a worst-case temperature of 50ºC) would not exceed ambient temperature by more than 3ºC at a distance of more than 4m from the point of discharge. Thermal impact is therefore considered minimal, with no need for further mitigation. The cooling water will be treated to inhibit marine fouling and neutralised prior to discharge. The discharge will contain no harmful persistent materials.

The impact of onshore pipeline installation activities to soil, groundwater and surface water, cultural heritage and ecology were assessed taking into account the baseline surveys which have been completed in the area affected by the works. In each case, the impact was assessed to be moderate negative. The impact to soil, groundwater and surface water associated with the SD2 condensate tank activities were also assessed to be moderate negative.

The construction of finger piers, and the trenching of pipelines in shallow nearshore water, will follow practices and procedures established during the SD1 project and the ACG Phase 1 and Phase 2 projects. Monitoring of benthic, seagrass and fish communities in the vicinity of the existing pipeline corridors has shown that pier construction and removal, and pipeline trenching, has had no persistent impact on the local marine ecology. The following monitoring will be undertaken for the SD2 Project:

- Fish population surveys will be undertaken one year prior to trenching activities, during trenching and once trenching has been completed; and
- Pre and post trenching seabed surveys will be undertaken. Post trenching seabed surveys will be undertaken one and three years after completion of trenching activities. The surveys will include drop down video work to confirm seabed distribution.

In addition the impact of these activities and activities offshore which may result in seabed disturbance on cultural heritage were assessed. Taking into account existing control measures, which included the requirement for 3D seismic and bathymetry surveys to be reviewed by a marine cultural heritage specialist, a no more than moderate impact was identified.

Underwater noise sources include jacket and SSIV foundation piling activities and movement of vessels used during platform, pipeline and subsea infrastructure installation. Piling activities will generate the greatest sound volume but the sound will occur intermittently and over a short period. Vessel noise will be more persistent but will be at a much lower level than piling noise. Underwater noise modelling, undertaken to determine the extent of the noise impacts, coupled with an assessment of the associated injury and strong avoidance behaviour reactions recorded in fish and seal populations, demonstrated that the activities would result in a moderate to minor impact.

Aqueous discharges from installation vessels (ballast water, grey water, black water and drainage) will also be similar in magnitude and impact to those for the Drilling and Completion programme and were assessed as having a minor impact upon biological receptors.

Following installation of the pipelines and flowlines, they will be filled with seawater containing preservation chemicals (to prevent corrosion and biological growth). Over the lifetime of the project, there will be a number of treated seawater discharges for each line, following initial filling, hydrotesting, leak testing and integrity testing. On completion of these activities, each line will be dewatered, dried and filled with inert nitrogen. Aquatic toxicity tests have been carried out on the preservation chemicals, and no-effect concentrations have been estimated for the treated seawater. Dispersion modelling has been conducted for a representative range of discharges, in order to estimate the point at which the discharges will be diluted to the no-effect concentration. Many of the smaller (hydrotest and leak test) discharges diluted almost immediately to a no-effect concentration. The largest discharges (associated with gas export line dewatering) generated narrow plumes 3.1 - 4.5km long. In no instance did a plume reach the seabed or the sea surface. The volumes of water occupied by the discharge plumes are small relative to the receiving environment, and the discharge durations are short. The preservation chemicals are non-persistent, and it is considered that there will be no cumulative effects from successive events. Measures to monitor and control hydrotest discharges (i.e. seawater containing preservation chemicals) will comprise:

- Preparation and maintenance of a hydrotest management plan, which will include a regularly updated schedule of hydrotest events together with a detailed set of commissioning procedures;
- The amounts of chemicals used, together with the dosage rates and water flow rates during all pipeline filling, top-up and pressure testing activities will be rigorously recorded;
- The actual volumes of hydrotest water released during each pipeline discharge event will be rigorously recorded; and
- Laboratory samples (seawater dosed with chemicals at the rate recorded during offshore pipeline fill activities) will be prepared and stored onshore under simulated pipeline conditions. These samples will be periodically subject to toxicity testing.

Based on previous experience, these measures are considered to provide effective and practicable monitoring and assurance during hydrotesting and are designed to ensure that the impact to the marine environment is of no more than minor significance.

Overall, the majority of residual impacts were assessed as moderate or minor. The only major impact was noise associated with Terminal construction plant and vehicles which was subsequently revised to moderate following identification of additional mitigation measures. While impacts arising from onshore construction activities will not result in exceedences of applicable air quality or noise standards for the protection of human health, community liaison and engagement, similar to that undertaken for the previous SD and ACG projects, will be a key element throughout the construction phase to ensure these impacts are minimised.

15.3.3 Offshore, Onshore and Subsea Operations

Table 15.3 summarises the outcome of impact assessment for the Offshore, Onshore and Subsea Operations phase of the SD2 Project.

Table 15.3 Summary of Residual Environmental Impacts for the SD2 Offshore, Onshore and Subsea Operations Activities

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Non-GHG Emissions from Routine Offshore Operations	1	3	3	1	1 1	Medium	Low	Minor Negative
	Non-GHG Emissions from Non Routine Offshore Operations (DEH)	1	3	1	1	1 1	Medium	Low	Minor Negative
	Non-GHG Emissions from Non Routine Offshore Operations (Emergency Flaring)	1	3	1	1	1 1	Medium	Low	Minor Negative
	Non-GHG Emissions from Routine Onshore Operations	1	3	3	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
	Non-GHG Emissions from Non Routine Onshore Operations (Emergency Flaring)	1	3	1	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
Terrestrial Environment	Noise associated with Routine Onshore Plant Operations	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Noise associated with Non Routine Onshore Flaring	3	2	2	1	3 1	Medium	Medium	Moderate Negative
	Odour from non routine pond storage of produced water	2	2	3	2	3 2	High	High	Major Negative - reduced to Moderate Negative following additional mitigation
Marine Environment	Offshore Operations: Cooling Water intake and discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Treated Black and Grey Water**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Galley Waste**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Drainage**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Freshwater Maker – Saline Effluent**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Subsea Operations: Routine and Non Routine Control Fluid Discharge:	1	3	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative
	Subsea Operations: Non Routine Discharge of Fluids during Subsea Production System Interventions	1	2	1	1	1 1 1	Medium	Biological / Ecological: Low	Minor Negative

Each operational interaction was assessed based on event magnitude and receptor sensitivity to determine the impact significance.

Events for Offshore Operations include emissions to atmosphere from the SDB platform complex, cooling water discharge and aqueous discharges (i.e. black water, grey water, galley waste, drainage, saline effluent).

The impact of emissions to atmosphere from routine and non routine offshore operations was assessed using dispersion modelling. Sources included the offshore platform generators during routine operations and during Direct Electrical Heating (DEH) (when the power demand increases) and the offshore platform flare during emergency depressurisation. For all scenarios assessed a minor impact to onshore receptors was predicted.

Cooling water intake and discharge associated with the SDB platform complex were assessed. Previous modelling work was used to determine that effects on water velocities in the vicinity of the intake will be such that fish are able to detect and avoid the intake. The cooling water discharge was modelled to determine the extent and travel of the thermal plume. The distance from the discharge to where the water temperature is estimated to be 3°C above ambient temperature is determined to be within 11m of the discharge point. Thus it is concluded that the discharge will have a zone of influence (i.e., where the temperature of the discharge is greater than the ambient water temperature) of a small area. It is considered that this zone of influence will have a minor impact upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish).

The remaining discharges to sea from Offshore Operations (black water, grey water, galley waste, drainage and saline effluent) are all small in volume (relative to cooling water discharges) and do not contain components of high environmental concern. These discharges, which are monitored in accordance with existing procedures to ensure applicable project standards are met, will be rapidly diluted and are all assessed as having a minor impact upon biological receptors in the water column.

Onshore Operations events assessed include routine and non routine operations at the Terminal resulting in air emissions and noise. To assess the impact of emissions to atmosphere dispersion modelling was undertaken for routine and non routine operations. Sources included the onshore power generator, direct drive export compressors and the SD2 elevated flare (under emergency depressurisation conditions). The modelling predicted no significant change to air quality (in terms of NO_2 concentrations) at nearby receptors and no exceedances of internationally recognised ambient air quality standards for the protection of health at onshore receptors.

Modelling was also undertaken to assess the impact of onshore plant at the Terminal to noise levels at receptors and predicted no exceedances of the most stringent night time noise limit at any receptor. The impact of non routine flaring to noise levels at receptors was also assessed and results compared to limit values which must be met for 95% of the time. The modelling showed that the while there would be exceedances of the night time noise limits the limit would be met for 99.3% at Azim Kend/Masiv 3 and Sangachal 99.77% of the year at Sangachal respectively. Noise impacts associated with both routine and non routine onshore operations were assessed to be moderate negative.

Impacts associated with odour due to the anticipated non routine use of ponds for produced water storage were assessed to be of moderate adverse impact, taking into account existing controls and additional mitigation, which includes use of a treatment package to manage any potential exceedances of air quality thresholds from the produced water stored in the pond and evaluation of odour control techniques to be included in the design, if practicable.

For Subsea Operations there will be discharge of control fluid during routine conditions from continuous control valve discharge and intermittent valve operations. The control fluid discharge was the subject of dispersion modelling for routine operations. The results of these studies have been used to estimate the degree of dilution required to reach a “no effect” level and the size of the dispersion plume within which such dilution would occur. The modelling showed that for the continuous release scenario the plume persistence and maximum total plume volume is negligible.

For intermittent valve operation discharge during routine operations, the worst case showed that a maximum plume length (at the no-effect concentration boundary) of less than 20m was reached 15 minutes after a discharge, and that the plume was diluted to less than one-tenth of the no-effect concentration within one hour.

Based on the sensitivity of the receptors in the water column and the limited magnitude of the subsea discharge events, the discharges from both routine and non routine operation were assessed as having a minor impact upon biological receptors.

Over the PSA period it will be necessary to replace a number of the subsea production system elements. Discharges of approximately $1.3m^3$ are anticipated to result from replacement of each production tree choke (26 in total). This is expected to occur once for each production tree over the PSA period. Based on the modelling completed for larger MEG discharges during subsea production system installation it was concluded that the no-effect concentration would be met within a few metres from the point of discharge (less than 20m). MEG is of very low toxicity and low persistence and thus discharges during subsea interventions were deemed to have a minor negative environmental impact.

Overall, the majority of residual impacts from Offshore, Onshore and Subsea Operations are assessed as minor or moderate.

The expected moderate negative impacts associated with emissions and noise during Onshore Operations at the Sangachal Terminal will also be mitigated through existing community liaison and engagement supported by the EMP ambient monitoring undertaken in and around the Terminal. All activities will be managed in accordance with previously established practice and AGT Region procedures and impacts are considered to be controlled and mitigated to an acceptable level.

15.4 Socio-Economic Impacts

The majority of SD2 Project related Activities (with the exception of the offshore platform and subsea system installation and hook up) occur onshore and use existing operational onshore infrastructure capacities (e.g. Sangachal Terminal, the Baku Deep Water Jacket Factory (BDJF)). With reference to the experience gained on from ACG Phases 1-3 and SD1 projects, the following key socio-economic issues were assessed:

- Disruption or restriction of fishing and commercial shipping operations' access to coastal, nearshore and offshore resources through the enforcement of marine exclusion zones;
- Employment creation and subsequent de-manning of the construction workforce, after peak employment has been reached;
- Training and skills development opportunities provided to the workforce;
- Procurement of goods and services by the main construction and installation contractors through the use of internal supply chains; and
- Community disturbance through the visual impact of the elevated flare.

The assessment concluded that the national workforce to be employed during the SD2 Project construction phase is likely to peak at approximately 8,560. Additional and new employment during the operations phase will be less in terms of new positions. Employment impacts are likely to be distributed within the local area with the majority of employees expected to be recruited from the local Garadagh area.

Although the jobs created during the construction phase will not be required once the SD2 Project construction phases are complete, training and skills development opportunities, similar to those undertaken during the previous ACG Phases 1-3 and SD1 projects, will be provided to the construction workforce by the implementation of an Employee Relations Management Plan. Training programmes to be implemented cover topics including Health, Safely and Environment (HSE), and work task specific language and computer skills, driving and certified courses including painting, lifting, scaffolding and welding. It is expected that the employment generated by the SD2 Project will result in positive impacts to individuals and their households.

As the construction phase will generate temporary employment opportunities only, planning for the conclusion of construction workforce contracts will be carefully planned from the start of the SD2 Project. Measures to mitigate this will include adequate staff communications between the main construction and installation contractors and their workforce which will inform the workforce of project progress and expected completion dates, so they can start to seek alternative employment positions in advance of their position being made redundant.

The overall socio-economic impacts of the SD2 Project, particularly from employment creation throughout the construction, installation and hook-up and commissioning phases were assessed as positive.

Potential negative impacts to community well being associated with visual impacts from non routine operational flaring were assessed. To reduce the impact associated with changes in community well-being, community engagement activities will be undertaken prior to the operation of the SD2 Project elevated flare, with the aim of providing information about non-routine flaring events to local residents.

15.5 Cumulative, Transboundary and Accidental Events

Discharges to the marine environment are not predicted to have any transboundary consequences. The majority of the discharges are small, and are comparable to discharges associated with previous projects and existing operations. The largest discharges will either be confined to a small area of seabed (drilling discharges) or will be short in duration and have transient impact (discharge of treated seawater pipeline hydrotesting). All of the discharges associated with construction, hook-up and commissioning, and operation, have been assessed, and it is concluded that there will be no cumulative or additive interactions between the impacts.

The most significant air quality pollutant in terms of health impacts is NO_2. It has been demonstrated that emissions associated with SD2 Project activities alone and emissions from worst-case cumulative ACG and SD onshore activities are not expected to result any discernable changes in onshore NO_2 concentrations.

For both Onshore and Offshore activities, the volumes of atmospheric emissions released (including visible particulates) are expected to result in very small increases in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernable to biological/ecological receptors.

Based on the limited geographic scope of pollutant species, which will disperse rapidly in the atmosphere, no transboundary impacts associated with air quality and human health are predicted from the SD2 Project.

The majority (79.8%) of GHG is predicted to result from onshore and offshore activities during the SD2 Project operations phase. Activities associated with well drilling and completion is predicted to contribute 13.0% of the total volume of GHG emissions produced by the SD2 Project. The annual contribution of SD2 Project in the year 2020 to the predicted national Azerbaijan forecast[1] was estimated to be approximately 0.36%.

Energy efficiency and GHG reduction was a key aspect taken into account during the development of the SD2 project design, contributing to the selection of the following:

- Offshore compression vs onshore compression;
- Offshore flare vs vent;
- Direct Drive Gas Turbines onshore vs electric drives;
- Waste Heat Recovery on onshore compression gas turbines; and

[1] First National Communication of Azerbaijan on Climate Change, May 23 2000.

- Onshore Flare Gas Recovery.

These resulted in a saving of approximately 103,700 ktonnes of CO_2 emissions across the SD PSA duration.

To support the assessment of accidental events, modelling of spill behaviour in water column and sea surface was undertaken as well as laboratory weathering analysis of SD2 condensate. The key accidental event scenarios assessed included:

- Well blow-out;
- Flowline rupture;
- Export pipeline rupture; and
- The loss of diesel inventory on the platform.

In the worst case, a blow-out could continue for an estimated 224 days, which is the time which would be required to mobilise a drilling rig and to drill a relief well. During this time, approximately 20,000 barrels of condensate would be released per day. Turbulent mixing driven by gas pressure will give rise to total (dispersed and dissolved) hydrocarbon concentrations in the water column of between 2.5 and 10 ppm, and these will persist for the duration of the blowout. Depending on the water depth at which the blowout occurs, between 0.5% and 3.6% of the condensate is predicted to reach the shoreline; this will be in the form of waxy flakes (the residue after condensate weathering). The magnitude and duration of a blowout event is such that it is likely to have a severe impact on the water column over tens of kilometres from the point of release. The hydrocarbons in the water column will be predominantly BTEX and substituted naphthalenes, and concentrations are predicted to decline rapidly to part-per-billion levels once the release stops.

Flowline and export pipeline ruptures are likely to be of much small magnitude than a blow-out. In the case of a flowline rupture, the control valves can be closed within 5 minutes, limiting the volume released to a range of approximately 65-1000 m^3. Maximum hydrocarbon concentrations in the water column will be of the same order of magnitude as for a blow-out, but will persist for only 1-2 days within less than 1km from the release point. Ecological impact is therefore likely to be limited. Very little condensate is predicted to reach the shoreline, even from a release from the more northerly subsea clusters.

In the event of a rupture of the condensate export pipeline, the amount of condensate released will depend on water depth; a release at 85m depth will result in a total release of about 780 m^3, while a release at a depth of 12m (with less hydrostatic head at the point of rupture) would result in a release of abut 1800 m^3. A nearshore export line rupture would give rise to much higher water column hydrocarbon concentrations than with an offshore rupture, a blow-out or a flowline rupture, and the more protracted loss of inventory (once the pipeline pressure drops to ambient) will mean that these higher concentrations will persist for 6 or 7 days over a distance of up to 10km. The entire water depth within this area could be impacted, and the ecological effects would be substantial. Up to 367 tonnes of wax residue would be likely to come ashore from a shallow-water release.

A loss to sea of 123m^3 of diesel was assessed. This would rapidly spread out to form a thin surface sheen, which would disperse within 24 hours. Total water column hydrocarbon concentrations were predicted to decline to less than 25 ppb within 48 hours. No significant ecological damage would be anticipated from a spill of this magnitude.

An Oil Spill Response Plan has been developed, which provides guidance and actions to be taken during an oil spill incident associated with all Shah Deniz offshore operations, which include mobile offshore drilling units, platforms, subsea pipelines and marine vessels.

15.6 Environmental and Social Management

Each phase of the SD2 Project will be subject to formal environmental and social (E&S) management planning.

The BP Construction Phase Environmental and Social Management System (ESMS) will include the Environmental and Social Management and Monitoring Plan (ESMMP) that describes:

- Conformance requirements;
- Roles and responsibilities of BP and the main construction and installation contractors;
- The actions needed to avoid and/or mitigate environmental and social impacts and to put the commitments in the ESIA into effect; and
- The assurance process that will be adopted to monitoring and report environmental and social performance will include inspection, audit and monitoring programs such as sewage treatment plant performance monitoring.

To support the ESMMP, environmental and social management plans will be developed by BP to present the SD2 Project environmental and social requirements by subject matter. The SD2 Project environmental and social management plans will be finalised during mobilisation of the main construction and installation contractors, and regularly reviewed as construction work proceeds.

The MODUs used to drill the SD2 Project wells will be operated by a rig operator(s) who have their own independent EMS already in place. Alignment of the plans, procedures and reporting requirements of the rig and AGT Region EMS has been achieved through the development of an EMS Interface Document.

BP will operate the SD2 facilities using an Operations Phase ESMS that is certified to ISO 14001 Environmental Management System (EMS) and will be based on the ‘plan-do-check-act’ cycle. The BP Operations Phase ESMS will be developed prior to commencement of SD2 operations and transition plans will be developed to assist with the movement from the construction to the BP Operations Phase ESMS.

The environmental and social management process during all phases of the SD2 Project will benefit from accumulated experience and ‘lessons learned’ from executing the previous ACG and SD1 projects. Major benefits of previous project experience include the development of:

- Effective and reliable procedures for on-site segregation and management of waste;
- A non-hazardous landfill site designed and constructed to EU standards; and
- An effective process for identifying and utilising opportunities for waste recovery and recycling.

15.7 Conclusions

Activities associated with the SD2 Project have been assessed for all project phases. Residual environmental and socio economic impacts identified have either been negligible, minor or moderate with positive impacts arising from employment, training and skills development and through procurement of goods and services.

The monitoring and mitigation plans and procedures associated with each impact have been presented and discussed, and it is concluded that these are sufficient to ensure the sound management of impacts throughout the project duration. This conclusion is underpinned by the project philosophy of using only tried and tested technology, and by the substantial experience acquired by BP, its partners, and its contractors in successfully executing previous projects in the ACG and Shah Deniz Contract Areas.

APPENDIX 2A

Shah Deniz Production Sharing Agreement Extract

Appendix 2A

Shah Deniz Production Sharing Agreement Extract

ARTICLE 26 - Environmental Protection and Safety

26.1 Environmental Standards

Contractor shall develop jointly with SOCAR and the State Committee of the Azerbaijan Republic on Ecology and Control over the Use of Natural Resources ("SCE") safety and environmental protection standards and practices appropriate for the regulation of Petroleum Operations. The safety and environmental protection standards shall take account of the specific environmental characteristics of the Caspian Sea and draw, as appropriate, on (i) international Petroleum industry standards and experience with their implementation in exploration and production operations in other parts of the world and (ii) existing Azerbaijan safety and environmental legislation. In compilation of such standards and practices account shall be taken of such matters as environmental quality objectives, technical feasibility and economic and commercial viability. Subject to the first sentence of Article 26.4 the standards, which shall apply to Petroleum Operations from Effective Date shall be the standards and practices set out in part II of Appendix 9 until substituted by new safety and environmental protection standards devised and agreed between Contractor, SOCAR and SCE on a date between the Parties and SCE and from such date such agreed standards and practices shall have the force of law as if set out in full in the Agreement. In the event that the safety and environmental protections standards and practices are imposed otherwise than with the agreement of Contractor it is agreed that the provisions of Article 23.2 shall apply. The Parties and SCE shall agree a separate protocol for the detailed implementation of the joint development and definition of the new standards and practices for safety and environmental protection. The cost to Contractor of such development and definition shall be Cost Recoverable.

26.2 Conduct of Operations

Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with the Environmental Standards to minimise any potential disturbance to the general environment, including without limitation the surface, subsurface, sea, air, lakes, rivers, animal life, plant life, crops, other natural resources and property. Contractor shall implement an integrated management system covering all health, safety and environmental aspects of the activities carried out in relation to the Petroleum Operations as outlined in Part 1 of Appendix 9.

26.3 Emergencies

In the event of emergency and accidents, including but not limited to explosions, blow-outs, leaks and other incidents which damage or might damage the environment, Contractor shall promptly notify SCE (Goskomokhrana) and SOCAR of such circumstances and of its first steps to remedy this situation and the results of said efforts. Contractor shall use all reasonable endeavours to take immediate steps to bring the emergency situation under control and protect against loss of life and loss of or damage to property and prevent harm to natural resources and to the general environment. Contractor shall also report to SOCAR and appropriate Government Authorities on the measures taken.

26.4 Compliance

Contractor shall comply with present and future Azerbaijani laws or regulations of general applicability with respect to public health, safety and protection and restoration of the environment, to the extent that such laws and regulations are no more stringent than the Environmental Standards. In the event any regional or multi-governmental authority having jurisdiction enacts or promulgates environmental standards relating to the Contract Area, the Parties will discuss the possible impact thereof on the project. The provisions of Article 23.2

shall apply to any compliance or attempted compliance by Contractor with any such standards which adversely affect the rights or interests of Contractor hereunder.

26.5 Environmental Protection Strategy

An environmental protection strategy shall be developed which shall include:
(a) The establishment of an environmental management system as an integral part of Petroleum Operations and the formation of an environmental sub-committee as described in the Environmental Standards.
(b) An environmental work programme carried out in sequences appropriate to the normal phases of Petroleum Operations as described in the Environmental Standards (seismic survey, exploration drilling, field development and production).

26.6 Environmental Damage

(a) Contractor shall be liable for those direct losses or damages incurred by a Third Party (other than Government Authority) arising out of any environmental pollution determined by the appropriate court of the Azerbaijan Republic to have been caused by the fault of Contractor. In the event of any environmental pollution or environmental damage caused by the fault of Contractor, Contractor shall reasonably endeavour, in accordance with generally acceptable international Petroleum industry practices, to mitigate the effect of any such pollution or damage on the environment.
(b) Contractor shall not be responsible and shall bear no cost, expense or liability for claims, damages or losses arising out of or related to any environmental pollution or other environmental damage, condition or problems which it did not cause, including but not limited to those in existence prior to the Effective Date of this Agreement and SOCAR shall indemnify and hold harmless Contractor, its Sub-contractors and their consultants, agents, employees, officers and directors from any and all costs, expenses and liabilities relating thereto.
(c) Any damages, liability, losses, costs and expenses incurred by Contractor arising out of or related to any claim, demand, action or proceeding brought against Contractor, as well as the costs of any remediation and clean-up work undertaken by Contractor, on account of any environmental pollution or environmental damage (except for such pollution or damage resulting from the Contractor's Wilful Misconduct) caused by Contractor shall be included in Petroleum Costs.

ARTICLE 26 – APPENDIX 9 – Environmental Standards and Practices

I. Integrated Management System

A. Environmental Sub-Committee

1. The formation and organisation of an environmental sub-committee of the Steering Committee shall be set forth in a proposal of Contractor which will be submitted to SOCAR for approval. Once approved SOCAR, the environmental sub-committee shall be formed in accordance with the approved recommendation and shall be composed of environmental representatives of Contractor Parties and SOCAR, the State Committee of the Azerbaijan Republic on Ecology and Control over the Use of Natural Resources, Azerbaijan Academy of Sciences and other relevant research institutes.
2. Responsibilities of the environmental sub-committee shall be to:
   - Design monitoring programme for monitoring of selected environmental parameters
   - Coordinate monitoring programme
   - Review results and propose recommendations
   - Publish annual report

B. Environmental Work Programme

The environmental work programme to be pursued during Petroleum Operation pursuant to Article 26.2 shall be phased as follows:

1. For seismic surveys
   - Environmental impact assessment
   - Health, safety and environmental management plan for seismic operations, including emergency procedures, oil spill contingency plan, waste management plan and an audit programme
2. For exploration drilling
   - Drilling environment impact assessment
   - Baseline environmental study
   - Health, safety and environment management plan for exploration drilling, including emergency procedures, oil spill contingency plan, waste management plan (including drill cuttings disposal) and an audit programme
3. For development and production
   - The environmental work programme for the Development and Production Period shall be submitted together wit the Development Programme to SOCAR for approval

II Environmental Standards

The following are general and specific guidelines relating to discharges associated with oil and natural gas exploration and production activities.

A. General Guidelines

1. There shall be no discharge of waste oil, produced water and sand, drilling fluids, drill cuttings or other wastes from exploration and production sites except in accordance with the following guidelines.
2. There shall be no unauthorised discharges directly to the surface of the sea. All discharges authorised by these guidelines shall be controlled by discharging into a caisson whose open end is submerged, at all times, a minimum of two (2) feet below the surface of the sea.

B. Discharge Guidelines and Monitoring

1. Produced Water

(a) Contractor will endeavour to utilise produced water for reservoir pressure maintenance if, through standard compatibility testing with Caspian Sea water, no damage to the reservoir resulting in a reduction in overall hydrocarbon recovery would occur by mixing the two water streams. In the event that the two water streams are compatible, Contractor may only discharge a volume of produced water after treatment to the Caspian Sea that exceeds the total volume required for reservoir pressure maintenance or in the event of an emergency, accident or mechanical failure. In the event that the two water streams are not compatible, Contractor may discharge produced water to the Caspian Sea after treatment in accordance with generally accepted international Petroleum industry standards and practices.

2. Drill Cuttings and Drilling Fluids

(a) There shall be no discharge of oil based drilling fluids, other than low toxicity and biodegradable drilling fluids.

(b) There shall be no discharge of drill cuttings generated in association with the use oi oil based drilling fluids, invert emulsion drilling fluids, or drilling fluids that contain radiation, if any, waste engine oil, cooling oil, gear oil, or other oil based lubricants, other than cuttings generated in association with the use of low toxicity and biodegradable drilling fluids.

(c) There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than four (4) times the ambient concentration of the receiving water.
(d) Prior to the start of the drilling programme, a drilling mud system will be designed and laboratory tested under the US EPA, 96-hour acute toxicity test using mycid shrimp or other indicator organisms of the Caspian Sea agreed between Contractor and SOCAR. Those muds biodegradable and of low toxicity will be authorised for discharge during the drilling programme.
(e) During drilling operations, mud samples will be collected periodically to determine toxicity using procedures established for the Caspian Sea.
(f) The composition of the mud system may be altered as necessary to meet changes in the drilling operations. The modified mud system may be discharged if it has been shown to meet the above limits on oil, salinity and toxicity.

3. Other Wastes
(a) Sanitary waste may be discharged from a U.S Coast Guard certified or equivalent Marine Sanitation Device (MSD) with total residual chlorine content greater than 0.5 mg/l but less than 2.0 mg/l as long as no floating solids are observable. The Hach method CN-66-DPD test shall be used to measure the residual chlorine.
(b) Domestic wastes and grey water may be discharged as long as no floating solids are observable.
(c) Desalinisation unit wastes shall be discharged.
(d) Deck drainage and wash water may be discharged as long as no visible sheen is observable. Oily and clean drainage or wash water shall be segregated: clean water shall be discharged to the sea and oily water shall be treated as provided in B.1 above.
(e) Trash shall not be discharged offshore. Trash shall be transported to an appropriate land-based disposal facility

4. Monitoring
(a) Produced Water
    1. The volume of produced water discharged and concentration of oil and grease contained in the discharge will be monitored daily.
    2. The daily maximum and monthly average oil and grease concentration will be reported to the appropriate environmental authority monthly.
(b) Drill Cuttings and Drilling Fluids
    1. An inventory of drilling fluids additives and their volumes or mass added to the drilling fluid system will be maintained for each well.
    2. Drilling fluid properties, including volume percent oil concentration of chlorides, will be monitored daily for each well.
    3. The estimated volume of drill cuttings and drilling fluids discharged shall be recorded daily and reported monthly to the appropriate environmental authority.
(c) Other Wastes
    1. The estimated volume of other wastes discharged shall be recorded daily and reported monthly to include:
        (i) Sanitary waste
        (ii) Domestic waste
        (iii) Deck drainage and wash water

C. Air Emission Guidelines and Monitoring

Contractor is authorised to discharge air emissions. Such discharges will be limited and monitored in accordance with generally accepted international Petroleum industry standards and practices.

D. Safety Guidelines

Contractor shall take into account subject to the provisions of Article 26.1 relevant Azerbaijani regulations and the following international safety and industrial hygiene standards in conducting its Petroleum Operations under the Agreement:

1. Oil Industry International Exploration and Production Forum (E&P Forum) Reports – HSE Management
2. International Association of Drilling Contractors (IADC) – Drilling Safety Manual
3. Association of Geophysical Contractors International (IAGC) – Operations Safety Manual
4. Threshold Limited Values for Chemical Substances in the Work Environment – American Conference of Governmental Industrial Hygienists.

APPENDIX 5A

Emissions Estimate Assumptions

Appendix 5A
Onshore and Offshore Atmospheric Emissions Estimates

CONTENTS

1 Introduction

This Appendix provides supplementary information to the emissions calculations presented in Chapter 5: Project Description and includes pollutant emission factors and the basis of emissions estimates for each SD2 Project phase.

Emissions were calculated using internationally accepted emission factors from the following sources:

- European Environment Agency EMEP/CORINAIR Emission Inventory Guidebook – 2007;
- United States Environmental Protection Agency AP42;
- E&P Forum Report No. 2.59/197 (Methods for Estimating Atmospheric Emissions from E&P Operations, Report No. 2.59/197; The Oil Industry International E&P Forum, September 1994); and
- EEMS Atmospheric Emission Calculations Issue 1.8 (UK Offshore Operators Association Ltd, 2008).

2 Emissions Factors

2.1 Stationary Combustion Sources, Flaring, Vessels and Helicopters

Table 1 presents emissions factors used to calculate emissions from:

- Stationary combustion emission sources including gas and/ or diesel engines, generators, turbines and heaters;
- Flares (including MODU flares); and
- Vessels and helicopters.

Table 1 Stationary Combustion Source, Flare, Vessel and Helicopter Emission Factors

Type of Source	Fuel	Unit	CO_2	CO	NO_X	SO_X	CH_4	VOC
Engine[1]	Diesel	tonnes emissions/ tonnes of fuel used	3.2	0.0157	0.0594	0.004	0.00018	0.002
Turbine[1]				0.00092	0.0135		0.0000328	0.000295
Heater[1]				0.00071	0.0028		0.00000705	0.0000282
Engine[1]	Gas		2.86	0.0076	0.0576	0.0000128	0.0198	0.0032
Turbine[1]				0.0030	0.0061		0.00092	0.000036
Heater[1]				0.0006	0.0024		0.000089	0.0000099
Vessel[2]	Diesel		3.2	0.0052	0.0125	8.00E-03	0.000087	0.0008
Helicopter[2]				0.008	0.059		0.00027	0.0024
Platform Flare[1]	Gas	tonnes emissions/ tonnes of gas flared	2.8	0.0067	0.0012	0.0000128	0.010	0.010
MODU Flare[1]			2.8	0.0067	0.0012	0.0000128	0.045	0.005

Sources:
[1] EEMS- Atmospheric Emissions Calculations, UK Department of Energy & Climate Change, 2008, Issue 1.810a
[2] E&P Forum - Report No. 2.59/197

2.2 Construction Plant

Table 2 presents emission factors used to calculate emissions forecasts from construction plant including trucks, cranes, loaders etc. These factors are dependant on the engine size of the construction plant.

Table 2 Construction Plant Emission Factors

Engine size	Species Emission Factors (g/kWhr)				
	[1]CO_2	[2]NO_x	[2]CH_4	[2]CO	[2]NMVOC
0-20	948	14.4	0.05	8.38	3.82
20-37	948	14.4	0.05	6.43	2.91
37-75	948	14.4	0.05	5.06	2.28
75-130	948	14.4	0.05	3.76	1.67
130-300	948	14.4	0.05	3	1.3
300-560	948	14.4	0.05	3	1.3
560-1000	948	14.4	0.05	3	1.3
>1000	948	14.4	0.05	3	1.3

[1] Carbon Dioxide Calculation from US EPA420-R-05-019 Exhaust Emission Factors for Nonroad Engine Modelling NR-010e
[2] EMEP/CORINAIR Emission Inventory Guidebook - 2007. Group 8: Other mobile sources and machinery. SNAP Sector 0808 Industry.

As there are no standard emission factors for Carbon Dioxide (CO_2) from non-road vehicle emissions, Table 3 below provides an emission factor calculation method based on brake specific fuel consumption (BSFC) of a diesel engine according to the US EPA AP42. The relevant parameters required to calculate the CO_2 emission factor are presented in Table 3 below.

Table 3 Brake Specific Fuel Consumption Emission Factors

CO_2 emissions factors from BSFC[1]		
1,232	g/hp-hr	gCO_2/hp/hr
948	g/kWhr	gCO_2/kWhr
Brake Specific Fuel Consumption (BSFC) of Diesel Engine		
50.0	KW	Engine size
0.4	Efficiency	Efficiency of engine
125.0	kJ/s	Engine Fuel Input
44,800.0	KJ/kg	Calorific value of Diesel
0.003	kg/s	Mass Fuel Input
26.0	hp	Power Fuel Input
0.1	g/hp/s	BSFC

[1]Using the equation CO2 = (BSFC * 453.6 - HC) * 0.87 * (44/12), where;
- CO_2 is in g/hp-hr
- Brake Specific fuel Consumption (BSFC) is the diesel fuel consumption in lb/hp-hr
- 453.6 is the conversion factor from pounds to grams
- HC is the in-use adjusted hydrocarbon emissions in g/hp-hr
- 0.87 is the carbon mass fraction of gasoline and diesel fuel
- 44/12 is the ratio of CO_2 mass to carbon mass

3 Methodology

3.1 Drilling and Completion Activities

To calculate emissions forecast from drilling and completion activities, the estimated fuel usage for each emission source and the anticipated duration of use was multiplied by the relevant emission factor provided in Table 1. Calculations were undertaken for drilling, completion and intervention activities based on the estimated number of vessels and duration of use as provided in Appendix 5F.

Emission forecasts associated with flaring were based on the estimated flowrates, duration and frequency of well test, clean up and invention flaring as described within Chapter 5 Section 5.4 of the ESIA. The volume of flaring anticipated was then multiplied by the relevant emissions factor to provide the expected emissions over the PSA.

Table 4 Estimated Drilling, Completion and Intervention Emissions

	Drilling[1]			Completion[3]		Intervention[4]		
	MODU Power Generation	Support Vessels and helicopters	Well Testing & Clean Up Flaring[2]	MODU Power Generation	Support Vessels and helicopters	MODU Power Generation	Support Vessels and helicopters	Intervention Flaring[5]
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)
CO_2	135,680.0	330,366.2	278,008.2	52,416.0	120,640.0	41,472.0	95,451.4	341,835.3
CO	665.7	825.8	665.2	257.2	220.0	201.0	238.6	818.0
NO_x	2,518.6	6,088.8	119.1	973.0	1,543.9	85.5	1,759.9	146.5
SO_x	169.6	825.9	1.3	65.5	212.0	51.8	238.6	1.6
CH_4	7.6	27.9	4,468.0	2.9	7.0	0.3	8.1	5,493.8
NMVOC	0.0	247.7	496.4	32.8	66.0	8.6	71.6	610.4
GHG	135,840.3	330,951.4	371,836.0	52,477.9	120,787.4	41,477.4	95,620.6	457,204.7

Basis of estimate:
1. 16 wells to be drilled. Each well takes approximately 265 days to drill. Number and type of vessels provided in Appendix 5F
2. Each well to undergo clean up and 1 well test at each of the two remaining flank locations will undergo well testing. Duration and flowrate as provided within Chapter 5 Section 5.4 of this ESIA
3. 26 wells to be completed. Each well takes approximately 70 days to complete. Number and type of vessels provided in Appendix 5F
4. Up to 160 intervention events across PSA, approximately 8.9 per year, requiring 9 days of MODU and vessel support per events. Number and type of vessels provided in Appendix 5F
5. 50% of intervention events result in flaring. Duration and flowrate as provided within Chapter 5 Section 5.4 of this ESIA

3.2 Onshore Construction and Commissioning of Terminal Facilities

Terminal Construction

The estimated number of typical key construction plant and vehicles expected to be used onsite during the construction of the Terminal facilities per phase is presented in Table 2 of Appendix 5F.

Using the schedule (which shows the expected duration and overlapping of phases) presented in Figure 5.9 Chapter 5 of the ESIA, emissions for each phase were calculated by multiplying total plant operating hours and the relevant emission factors provided in Tables 2 and 3 of this Appendix, taking into account engine size.

The emissions per plant type is provided in Table 5 below.

Table 5 Estimated Onshore Construction of Terminal Facilities Emissions by Plant Type

Plant	CO_2	NO_x	CH_4	CO	NMVOC	SO_2
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)
Bulldozer	2,553.5	38.8	0.1	8.1	3.5	1.6
Wheeled loader	38,798.4	589.3	2.0	263.2	119.1	24.2
Tracked excavator	2,285.7	34.7	0.1	12.2	5.5	1.4
Dump truck	21,510.9	326.7	1.1	145.9	66.0	13.4
Motor grader	685.1	10.4	0.0	4.6	2.1	0.4
Asphalt paver	2,342.5	35.6	0.1	7.4	3.2	1.5
Road lorry	9,136.5	138.8	0.5	62.0	28.0	5.7
Diesel generator	81,397.9	1,236.4	4.3	322.8	143.4	50.9
Mechanical water bowser	4,429.8	67.3	0.2	30.0	13.6	2.8
Mobile telescopic crane	10,924.4	165.9	0.6	74.1	33.5	6.8
Mobile telescopic crane	7,986.8	121.3	0.4	54.2	24.5	5.0
Mobile telescopic crane	2,904.7	44.1	0.2	19.7	8.9	1.8
Mobile telescopic crane	1,703.4	25.9	0.1	11.6	5.2	1.1
Mobile telescopic crane	417.6	6.3	0.0	2.8	1.3	0.3
Mobile telescopic crane	417.6	6.3	0.0	2.8	1.3	0.3
Tower Crane	2,279.5	34.6	0.1	9.0	4.0	1.4
Large lorry concrete mixer	263.0	4.0	0.0	2.3	1.1	0.2
Fork lift truck	321.0	4.9	0.0	2.8	1.3	0.2
Water pump	2,015.9	30.6	0.1	13.7	6.2	1.3
Concrete pump	2,745.2	41.7	0.1	10.9	4.8	1.7
Large rotary bored piling rig (110 t)	10,460.4	158.9	0.6	33.1	14.3	6.5
Air Compressor	1,399.3	21.3	0.1	12.4	5.6	0.9
TIG & MIG Welding Machine	15,110.2	229.5	0.8	80.7	36.3	9.4
TIG Welding Machine	30,623.9	465.2	1.6	163.5	73.7	19.1
MIG Welding Machine	31,187.0	473.7	1.6	166.5	75.0	19.5
Welding Machine (electric)	46,926.0	712.8	2.5	250.5	112.9	29.3
Welding Machine (Diesel)	31,374.7	476.6	1.7	167.5	75.5	19.6
Truck	3,083.0	46.8	0.2	20.9	9.5	1.9
Mini loader (Bobcat)	1,038.0	15.8	0.1	9.2	4.2	0.6
Man lift (cherry picker)	10,504.9	159.6	0.6	71.3	32.2	6.6
Drain Pump	1,591.7	24.2	0.1	10.8	4.9	1.0
Repair Truck	1,661.2	25.2	0.1	11.3	5.1	1.0
Lube Oil Truck	1,661.2	25.2	0.1	11.3	5.1	1.0
Vacuum Truck	553.7	8.4	0.0	3.8	1.7	0.3
Fuel bowser	1,328.9	20.2	0.1	9.0	4.1	0.8
TOTAL	**383,624**	**5,827**	**20**	**2,082**	**937**	**240**

Terminal Commissioning

Terminal commissioning activities that will result in emissions are expected to comprise:

- Testing of the turbine for SD2 power generation – run over a 21 day period over a range of power loads from idle to full load. Gas will be supplied from the existing SD1 facilities during these tests with power generated to be exported to the Azeri grid.
- Testing of export gas compression turbines – each gas compression turbine is expected to be run for up to 24 hours. Gas will be supplied from the existing SD1 facilities
- Diesel user testing – it is planned to test the following diesel users for a maximum of 24 hours:
    - Air compressor package; and
    - Firewater pumps.

In order to calculate emissions during terminal commissioning the anticipated maximum emission flowrates for each source calculated from the operations phase assessment (see Section 3.6 below) were multiplied by the duration of the activity. The emissions per type of source are provided in Table 6.

Table 6 Estimated Onshore Terminal Facilities Commissioning Emissions

Emission	Estimated Emissions During Terminal Commissioning (Turbines)	Estimated Emissions During Terminal Commissioning (Diesel Users)	Estimated Emissions During Terminal Commissioning (All)
	(tonnes)	(tonnes)	(tonnes)
SOx	0	0	0.03
CO_2	6,751.7	0.17	6,751.88
CO	7.4	0.001	7.40
NO_x	33.8	0.003	33.85
CH_4	2.3	0	2.27
NMVOC	0.1	0.0	0.09
GHG	6,799.5	0.17	6,799.62

Onshore Construction and Commissioning of Offshore and Subsea Facilities

Emission estimates during onshore jacket, bridge and topside construction were calculated based on historic fuel records from the Bibi Heybet and BDJF yards where previous ACG and SD jackets and topsides were constructed. Estimated fuel usage per month for onsite generators and engines was multiplied by the relevant emission factors provided in the Table 1.

Emissions during commissioning activities were estimated assuming the main platform generators and the diesel platform users (emergency generators, firewater pumps and cranes) will be run for frequencies and durations as described in Section 5.6.7.3 of Chapter 5. Emissions were calculated by multiplying the anticipated diesel consumption rates by these frequencies and duration and the relevant emission factors (provided in Table 1).

Emissions forecast for Onshore Construction and Commissioning of Offshore and Subsea Facilities are provided in Table 7.

Table 7 Estimated Onshore Construction and Commissioning of Offshore and Subsea Facilities Emissions

Emissions	Jacket and Bridge Construction	Topside Construction	Onshore Commissioning	TOTAL
	(tonnes)	(tonnes)	(tonnes)	(tonnes)
CO_2	24,480	22,848	11,565	**58,893**
CO	88.2	83.9	5.5	**177.6**
NO_x	355.2	336.4	55.7	**747.3**
SO_2	30.6	28.6	14.5	**73.6**
CH_4	1.1	1.0	0.1	**2.2**
NMVOC	11.6	11.0	1.3	**24.0**
GHG	24,502	22,869	11,568	**58,939**

Basis of Estimate:
- Topside and jacket estimates derived from contractor fuel consumption records during construction of DWG platforms at ATA and BDJF yards.
- Monthly diesel at topside yard estimated as 130 tonnes, monthly gasoline consumption 40 tonnes
- Monthly diesel consumption at jacket yard estimated as 206 tonnes, monthly gasoline consumption 40 tonnes
- Records indicate 65% generator usage and 35% engine usage
- Onshore commissioning estimate based on assumptions as provided by the project regarding diesel usage, frequency and duration of testing of main generators and platform diesel users
- Emission factors: EEMS Atmospheric Emission Calculations Issue 1.8 UKOOA 2008

3.3 Platform Installation, Hook Up and Commissioning

To calculate the emissions estimates for the vessels associated with platform installation, hook up and commissioning processes, the estimated fuel consumption rates of each vessel were multiplied by the expected number and duration of use for each vessel (as detailed in Appendix 5F) and applicable emission factors (provided in Table 1 of this Appendix).

Emissions associated with platform commissioning activities are expected to arise from (refer to Section 5.7.5 of Chapter 5) :

- One 1MW temporary diesel generator used for up to 6 months
- Main platform generators will be run on intermittently diesel for 6-8 months during the commissioning period. As a worst case it was assumed that the generators would be run for up to 6 months on diesel.

Emissions were calculated by multiplying the anticipated duration of use, fuel consumption rates and the relevant emissions factors (refer to Table 1 of this Appendix).

Table 8 below provides emissions forecast calculated for Platform Installation, Hook Up and Commissioning phase of SD2 Project.

Table 8 Estimated Platform Installation, Hook Up and Commissioning Emissions

	PR Jacket installation	QU Jacket installation	PR Topside Installation	QU Topside Installation	Bridge Installation	Fotel Support	Commissioning	TOTAL
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)
CO_2	5,500.80	5,481.60	2,208.00	1,872.00	1,248.00	2,112.00	40,320.00	**58,742.40**
CO	13.75	13.70	5.52	4.68	3.12	5.28	11.59	**57.65**
NO_x	101.42	101.07	40.71	34.52	23.01	38.94	170.10	**509.76**
SO_x	13.75	13.70	5.52	4.68	3.12	5.28	50.40	**96.46**
CH_4	0.46	0.46	0.19	0.16	0.11	0.18	0.41	**1.97**
NMVOC	4.13	4.11	1.66	1.40	0.94	1.58	3.72	**17.53**
GHG	5,510.55	5,491.31	2,211.91	1,875.32	1,250.21	2,115.74	40,328.68	**58,783.72**

3.4 Installation, Hook Up and Commissioning of Subsea Export and MEG Pipelines

Installation, hook up and commissioning of MEG import and export pipelines consists of:

- **Offshore and Nearshore Pipeline Installation** – emissions during this phase will arise from vessel usage (see Table 9). Emissions were calculated based on estimated fuel consumption rates of each operated vessel multiplied by the expected number and duration of usage of each vessel (provided in Table 5 of Appendix 5F) and relevant emission factors (provided in Table 1 of this Appendix).

Table 9 Estimated Offshore and Nearshore Pipeline Installation Emissions (Vessels)

	Pipeline Installation (tonnes)	Pipeline Commissioning (tonnes)	Total (tonnes)
CO_2	282,144.0	14,016.0	296,160.0
CO	705.4	35.0	740.4
NO_x	5,202.0	258.4	5,460.5
SO_x	705.4	35.0	740.4
CH_4	23.8	1.2	25.0
NMVOC	211.6	10.5	222.1
GHG	286,587.8	14,040.8	296,684.8

- **Onshore and Nearshore Pipeline Installation** – emissions during this phase will arise from construction plant and vehicle usage (see Table 10). Emissions were calculated based on the number of plant and equipment predicted to be used (refer to Section 4 of Appendix 5F) and the relevant emissions factors (provided in Table 2 of this Appendix) taking into account engine size.

Table 10 Estimated Onshore and Nearshore Pipeline Installation Emissions (Construction Plant)

Onshore						
	CO_2	**NOx**	**CH_4**	**CO**	**NMVOC**	**SO_2**
	tonnes					
Tracked Excavators	2,432.6	37.0	0.13	16.50	7.5	1.5
Dump Trucks	750.8	11.4	0.04	5.09	2.3	0.5
Forklift Trucks	75.1	1.1	0.00	0.66	0.3	0.0
Mobile telescopic crane	750.8	11.4	0.04	5.09	2.3	0.5
Mechanical Water Bowser	600.7	9.1	0.03	4.07	1.8	0.4
Fuel Bowser	600.7	9.1	0.03	4.07	1.4	0.4
Mini loader (Bobcat)	150.2	2.3	0.01	1.33	0.6	0.1
Roller Compactors	1,501.6	22.8	0.08	10.19	4.6	0.9
Bulldozers	2,687.9	40.8	0.14	8.51	3.7	1.7
Side Booms	2,432.6	37.0	0.13	16.50	7.5	1.5
Nearshore						
	CO_2	**NO_X**	**CH_4**	**CO**	**NMVOC**	**SO_2**
	tonnes					
Mobile telescopic crane	819.1	12.4	0.04	5.56	2.514	0.5
Bulldozer	3,909.7	59.4	0.21	12.37	5.361	2.4
Tipper Trucks	1,365.1	20.7	0.07	9.26	4.190	0.9
Back Hoe	546.0	8.3	0.03	3.70	1.676	0.3
Generators	3,276.3	49.8	0.17	10.37	4.493	2.0

- **Pipeline Pre-commissioning and Dewatering** – pipeline pre-commissioning undertaken from onshore will involve usage of one air compressor supported by a diesel powered generator. Emission estimates have been calculated by multiplying estimated diesel consumption rate for the plant by the predicted duration of the activity (refer to Section 4 of Appendix 5F). Table 11 presents the estimated emissions.

Table 11 Estimated Pipeline Pre-Commissioning Emissions (Onshore)

Emission	**CO_2**	**NOx**	**CH_4**	**CO**	**NMVOC**	**SO_2**
	tonnes					
Air Compressor	1,334.8	20.3	0.1	4.2	1.8	0.8
Generators	46,154.7	701.1	2.4	146.1	63.3	28.8

3.5 Installation, Hook Up and Commissioning of Subsea Infrastructure

Emissions during installation, hook up and commissioning of subsea infrastructure will arise from vessel usage (see Table 12). Emissions were calculated based on estimated fuel consumption rates of each operated vessel multiplied by the expected number and duration of usage of each vessel (provided in Table 6 of Appendix 5F) and relevant emission factors (provided in Table 1 of this Appendix).

Table 12 Estimated Subsea Infrastructure Installation Emissions

	Subsea Installation (tonnes)	Subsea Commissioning (tonnes)	Total (tonnes)
CO_2	38,880.0	20,160.0	59,040.0
CO	97.2	50.4	147.6
NO_x	716.9	371.7	1,088.6
SO_x	97.2	50.4	147.6
CH_4	3.3	1.7	5.0
NMVOC	29.2	15.1	44.3
GHG	38,948.9	20,195.7	59,144.6

3.6 Offshore Operations

Estimated emissions to air were calculated based on a combination of emission forecasting using bespoke software and spreadsheet-based manual calculations.

The emissions forecasting software (developed by PI Ltd.) was used to calculate CO_2 and NO_X emissions from the SDB platform complex from combustion processes over the duration of the PSA. CO, CH_4, SO_2 and VOC emissions were calculated manually using the EEMS emission factors.

The source of the main data inputs were:

- Process data was obtained from the project heat and material balance
- Fuel Gas composition was taken from the project heat & material balance
- Equipment Details were obtained from the:
  - Electrical Load Summary
  - Equipment Lists
  - Equipment Load Profile
  - Electrical Load Profile
  - Electrical Load Lists
- Production Data was obtained from the latest production profile.
- Flaring scenarios (duration, frequency and flowrates) as estimated by the project.

In addition the volumes of diesel usage over the PSA both by diesel users and the main diesel generators were made based on data provided by the project engineers. The model assumed 10 days of shut down for planned maintenance activities every two years during which the main generators would be powered by diesel for 2 days and buy back gas for 8 days. An average 0.23 tonnes per day of diesel was been included in the estimate to account for cranes usage and usage of the emergency generators and diesel fire pumps during weekly testing.

The model took into account the load profile associated with the anticipated use of DEH as presented within Chapter 5 Table 5.28 and the anticipated subsea infrastructure installation schedule and 1^{st} – 5^{th} gases as shown in Figure 5.3.

The model was run at 15°C, in order to simulate average ambient meteorological conditions as the performance of the main emission sources are affected by the ambient air temperature.

Modelling was undertaken on an annual basis from 2018 until 2036, i.e. until the end of the PSA. Table 13 below provides emissions forecast for the SDB platform complex combustion source during Operations

Table 13 Estimated SDB Platform Complex Emissions (Combustion Sources) During Operations

OFFSHORE	CO_2				NOx				SOx				CO				CH_4				VOC			
YEAR	Power Generation	Extraneous Diesel	Flare	**All Sources**	Power Generation	Extraneous Diesel	Flare	**All Sources**	Power Generation	Extraneous Diesel	Flare	**All Sources**	Power Generation	Extraneous Diesel	Flare	**All Sources**	Power Generation	Extraneous Diesel	Flare	**All Sources**	Power Generation	Extraneous Diesel	Flare	**All Sources**
2018	67,927	40	11,340	**79,307**	247	1	5	**253**	5	0.03	0.05	**5**	69	0.20	28	**97**	21	0.00	18	**38**	1	0.03	3	**4**
2019	102,743	114	17,689	**120,547**	393	2	8	**403**	8	0.07	0.08	**9**	102	0.56	43	**146**	30	0.01	28	**58**	2	0.07	4	**7**
2020	155,977	57	33,920	**189,955**	608	1	15	**624**	12	0.04	0.16	**12**	156	0.28	83	**239**	46	0.00	53	**99**	3	0.04	9	**12**
2021	157,050	114	50,776	**207,940**	616	2	22	**641**	13	0.07	0.24	**13**	157	0.56	124	**282**	46	0.01	79	**125**	4	0.07	13	**16**
2022	156,641	114	48,279	**205,035**	612	2	21	**636**	12	0.07	0.23	**12**	157	0.56	118	**276**	47	0.01	75	**122**	4	0.07	12	**16**
2023	164,342	114	50,360	**214,816**	667	2	22	**691**	13	0.07	0.24	**14**	164	0.56	123	**288**	49	0.01	78	**127**	4	0.07	13	**16**
2024	156,496	57	47,862	**204,416**	611	1	21	**633**	12	0.04	0.22	**12**	157	0.28	117	**274**	47	0.00	74	**121**	4	0.04	12	**16**
2025	164,192	114	49,736	**214,042**	666	2	22	**690**	13	0.07	0.23	**14**	164	0.56	121	**286**	49	0.01	77	**126**	4	0.07	13	**16**
2026	156,306	57	47,238	**203,601**	610	1	21	**632**	12	0.04	0.22	**12**	157	0.28	115	**273**	47	0.00	73	**120**	4	0.04	12	**15**
2027	156,400	114	48,904	**205,418**	612	2	21	**636**	13	0.07	0.23	**13**	156	0.56	119	**276**	46	0.01	76	**122**	4	0.07	12	**16**
2028	152,781	57	46,406	**199,245**	586	1	20	**608**	12	0.04	0.22	**12**	153	0.28	113	**267**	46	0.00	72	**118**	3	0.04	12	**15**
2029	152,787	114	47,654	**200,556**	587	2	21	**610**	13	0.07	0.22	**13**	152	0.56	116	**269**	45	0.01	74	**119**	4	0.07	12	**16**
2030	152,377	57	45,366	**197,800**	583	1	20	**604**	12	0.04	0.21	**12**	153	0.28	111	**265**	45	0.00	70	**116**	3	0.04	11	**15**
2031	152,364	114	46,614	**199,092**	584	2	20	**607**	12	0.07	0.22	**13**	152	0.56	114	**267**	45	0.01	72	**118**	4	0.07	12	**15**
2032	151,178	57	38,914	**190,150**	575	1	17	**593**	12	0.04	0.18	**12**	152	0.28	95	**247**	45	0.00	60	**106**	3	0.04	10	**13**
2033	149,695	114	32,672	**182,481**	567	2	14	**584**	12	0.07	0.15	**12**	149	0.56	80	**230**	44	0.01	51	**95**	3	0.07	8	**12**
2034	149,110	57	25,389	**174,556**	562	1	11	**574**	12	0.04	0.12	**12**	149	0.28	62	**211**	44	0.00	39	**84**	3	0.04	6	**10**
2035	148,982	114	22,059	**171,155**	562	2	10	**574**	12	0.07	0.10	**12**	148	0.56	54	**203**	44	0.01	34	**78**	3	0.07	6	**9**
2036	148,756	57	19,561	**168,375**	559	1	9	**569**	12	0.04	0.09	**12**	149	0.28	48	**197**	44	0.00	30	**75**	3	0.04	5	**8**
PSA Total	2,796,103	1,643	730,740	**3,528,487**	10,812	31	320	**11,163**	222	1.03	3.42	**226**	2,794	8.11	1,788	**4,591**	831	0.09	1,136	**1,966**	63	1.03	183	**248**

Emissions during operations will also arise from:

- Fugitive emissions e.g. from fittings (refer to Annex 1 of this Appendix); and
- Supply and support vessels and non routine use of helicopters. Emissions associated with vessels and helicopters during offshore operations were estimated based on estimated fuel consumption rates multiplied by the expected number and duration of use for each vessel/helicopter (as detailed in Appendix 5F) and applicable emission factors (provided in Table 1 of this Appendix).

Table 14 presented the total estimated emissions during offshore operations.

Table 14 Total Estimated Offshore Operations Emissions

	CO_2	CO	NO_x	SO_2	CH_4	VOC	GHG
	ktonnes	tonnes	tonnes	tonnes	tonnes	tonnes	ktonnes
Combustion Sources (including Flaring)	3,528.5	4,590.6	11,162.9	226.2	1,966.4	247.7	3,569.8
Fugitive Sources	0	0	0	0	1,944.0	453.9	48.6
Helicopters/Supply Vessels	114.0	284.8	2,099.2	285.0	9.6	85.4	114.2
TOTAL	**3,642.5**	**4,875.4**	**13,262.1**	**511.2**	**3,920.9**	**786.9**	**3,724.8**
Note: SO_2 assumed to be equivalent to SO_x							

3.7 Onshore Operations

As for the offshore operations estimated emissions to air were calculated based on a combination of emission forecasting using bespoke software and spreadsheet-based manual calculations.

The emissions forecasting software (developed by PI Ltd.) was used to calculate CO_2 and NO_x emissions from the onshore combustion sources over the duration of the PSA. CO, CH_4, SO_4 and VOC emissions were calculated manually using the EEMS emission factors.

The source of the main data inputs were:

- Process data was obtained from the project heat and material balance
- Fuel Gas composition was taken from the project heat & material balance
- Equipment Details were obtained from the:
  - Electrical Load Summary
  - Equipment Lists
  - Equipment Load Profile
  - Electrical Load Profile
  - Electrical Load Lists
- Production Data was obtained from the latest production profile.
- Flaring scenarios (duration, frequency and flowrates) as estimated by the project.

As for offshore the model assume a 91% availability (i.e. 9% for downtime). However, it is assumed that the electrical power required by the SD2 facilities during production downtime will be provided by the existing Sangachal Terminal utilities. It was therefore assumed that the facilities would be operated for 332 days per year on gas and 0 days on diesel. Flaring scenarios (including frequency, duration and flowrate) were provided by the project team.

The model was run at 15°C, in order to simulate average ambient meteorological conditions as the performance of the main emission sources are affected by the ambient air temperature.

Modelling was undertaken on an annual basis from 2018 until 2036, i.e. until the end of the PSA. Table 15 below provides emissions forecast for the onshore combustion sources during Operations

Table 15 Estimated SD2 Onshore Facility Emissions (Combustion Sources) During Operations

ONSHORE	CO_2					NOx				
YEAR	Power Generation	Turbine Driven Compressors	Process Heaters	Flare	**All Sources**	Power Generation	Turbine Driven Compressors	Process Heaters	Flare	**All Sources**
2018	80,726	96,976	10,570	38,062	**226,334**	358	285	9.3	16.7	**669.0**
2019	82,309	124,196	17,163	38,812	**262,480**	374	570	15.1	17.1	**976.2**
2020	87,037	205,562	23,756	36,374	**352,729**	424	1073	20.8	16	**1533.8**
2021	87,593	208,307	19,219	36,374	**351,493**	430	1108	16.9	16	**1570.9**
2022	87,341	208,307	14,683	36,374	**346,705**	428	1108	12.9	16	**1564.9**
2023	87,249	208,307	10,145	36,374	**342,075**	427	1108	8.9	16	**1559.9**
2024	86,978	208,307	7,953	41,812	**345,050**	424	1108	7	18.4	**1557.4**
2025	86,608	208,307	12,111	36,374	**343,400**	419	1108	10.6	16	**1553.6**
2026	86,133	208,307	18,613	36,374	**349,427**	414	1108	16.3	16	**1554.3**
2027	85,617	208,307	25,116	36,374	**355,414**	409	1108	22	16	**1555.0**
2028	85,025	208,307	19,623	36,374	**349,329**	402	1108	17.2	16	**1543.2**
2029	84,214	208,307	14,133	41,812	**348,466**	394	1108	12.4	18.4	**1532.8**
2030	83,158	208,307	8,642	36,374	**336,481**	383	1108	7.6	16	**1514.6**
2031	82,839	208,307	7,953	36,374	**335,473**	380	1108	7	16	**1511.0**
2032	81,656	206,653	7,953	36,374	**332,636**	368	1086	7	16	**1477.0**
2033	78,504	192,495	7,953	36,374	**315,326**	337	916	7	16	**1276.0**
2034	78,225	153,949	7,953	41,812	**281,939**	334	539	7	18.4	**898.4**
2035	78,069	122,367	7,953	36,374	**244,763**	333	547	7	16	**903.0**
2036	78,032	120,598	7,953	36,374	**242,957**	332	525	7	16	**880.0**
PSA Total	1,587,313	3,514,173	249,445	711,546	**6,062,477**	7,370	17,729	219	313	**25,631**

ONSHORE	SOx					CO				
YEAR	Power Generation	Turbine Driven Compressors	Process Heaters	Flare	**All Sources**	Power Generation	Turbine Driven Compressors	Process Heaters	Flare	**All Sources**
2018	0.4	0.5	0.0	0.2	**1.1**	88.5	106	2.3	93.5	**290.3**
2019	0.4	0.6	0.1	0.2	**1.3**	90.3	136	3.8	95.3	**325.4**
2020	0.4	1	0.1	0.2	**1.7**	95.5	225	5.2	89.3	**415.0**
2021	0.4	1	0.1	0.2	**1.7**	96.1	228	4.2	89.3	**417.6**
2022	0.4	1	0.1	0.2	**1.7**	95.8	228	3.2	89.3	**416.3**
2023	0.4	1	0.0	0.2	**1.6**	95.7	228	2.2	89.3	**415.2**
2024	0.4	1	0.0	0.2	**1.6**	95.4	228	1.7	103	**428.1**
2025	0.4	1	0.1	0.2	**1.7**	95	228	2.7	89.3	**415.0**
2026	0.4	1	0.1	0.2	**1.7**	94.5	228	4.1	89.3	**415.9**
2027	0.4	1	0.1	0.2	**1.7**	93.9	228	5.5	89.3	**416.7**
2028	0.4	1	0.1	0.2	**1.7**	93.3	228	4.3	89.3	**414.9**
2029	0.4	1	0.1	0.2	**1.7**	92.4	228	3.1	103	**426.5**
2030	0.4	1	0.0	0.2	**1.6**	91.2	228	1.9	89.3	**410.4**
2031	0.4	1	0.0	0.2	**1.6**	90.9	228	1.7	89.3	**409.9**
2032	0.4	1	0.0	0.2	**1.6**	89.6	227	1.7	89.3	**407.6**
2033	0.4	0.9	0.0	0.2	**1.5**	86.1	211	1.7	89.3	**388.1**
2034	0.4	0.7	0.0	0.2	**1.3**	85.8	169	1.7	103	**359.5**
2035	0.4	0.6	0.0	0.2	**1.2**	85.6	134	1.7	89.3	**310.6**
2036	0.4	0.6	0.0	0.2	**1.2**	85.6	132	1.7	89.3	**308.6**
PSA Total	7.6	16.9	0.9	3.8	**29.2**	1,741	3,848	54	1,748	**7391.6**

ONSHORE	CH_4					VOC				
YEAR	Power Generation	Turbine Driven Compressors	Process Heaters	Flare	**All Sources**	Power Generation	Turbine Driven Compressors	Process Heaters	Flare	**All Sources**
2018	27.2	32.6	0.3	60.8	**120.9**	1.1	1.3	0	8.1	**10.5**
2019	27.7	41.8	0.6	62	**132.1**	1.1	1.6	0.1	8.2	**11.0**
2020	29.3	69.1	0.8	58.1	**157.3**	1.2	2.7	0.1	7.7	**11.7**
2021	29.5	70.1	0.6	58.1	**158.3**	1.2	2.7	0.1	7.7	**11.7**
2022	29.4	70.1	0.5	58.1	**158.1**	1.2	2.7	0.1	7.7	**11.7**
2023	29.3	70.1	0.3	58.1	**157.8**	1.2	2.7	0	7.7	**11.6**
2024	29.3	70.1	0.3	66.8	**166.5**	1.1	2.7	0	8	**11.8**
2025	29.1	70.1	0.4	58.1	**157.7**	1.1	2.7	0	7.7	**11.5**
2026	29	70.1	0.6	58.1	**157.8**	1.1	2.7	0.1	7.7	**11.6**
2027	28.8	70.1	0.8	58.1	**157.8**	1.1	2.7	0.1	7.7	**11.6**
2028	28.6	70.1	0.6	58.1	**157.4**	1.1	2.7	0.1	7.7	**11.6**
2029	28.3	70.1	0.5	66.8	**165.7**	1.1	2.7	0.1	8.9	**12.8**
2030	28	70.1	0.3	58.1	**156.5**	1.1	2.7	0	7.7	**11.5**
2031	27.9	70.1	0.3	58.1	**156.4**	1.1	2.7	0	7.7	**11.5**
2032	27.5	69.5	0.3	58.1	**155.4**	1.1	2.7	0	7.7	**11.5**
2033	26.4	64.7	0.3	58.1	**149.5**	1	2.5	0	7.7	**11.2**
2034	26.3	51.8	0.3	66.8	**145.2**	1	2	0	8.9	**11.9**
2035	26.3	41.2	0.3	58.1	**125.9**	1	1.6	0	7.7	**10.3**
2036	26.2	40.6	0.3	58.1	**125.2**	1	1.6	0	7.7	**10.3**
PSA Total	534	1,182	8	1,137	**2,862**	21	46	1	150	**217**

Emissions during onshore operations will also arise from:

- Fugitive emissions e.g. from fittings (refer to Annex 1 of this Appendix); and
- Fugitive emissions from the new SD2 condensate tank. These were calculated based on estimated mode of operation of the tank including anticipated turnovers and filling levels and using the tank characteristics as provided by the SD2 project engineers. The emissions of total VOCs were calculated using the US EPA TANKS model and volumes of NMVOC and CH4 calculated using Appendix II of EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002.

Table 16 presented the total estimated emissions during onshore operations.

Table 16 Total Estimated Onshore Operations Emissions

	CO_2	CO	NO_x	SO_2	CH_4	VOC	GHG
	ktonnes	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**ktonnes**
Combustion Sources (including Flaring)	6,062.5	7,391.6	25,631.0	29.2	2,861.5	217.3	6,122.6
Fugitive Sources (fittings)	0	0	0	0	1,318	80	32.9
Fugitive Sources (tanks)	0	0	0	0	11.0	0.7	231.0
TOTAL	**6,062.5**	**7,391.6**	**25,631.0**	**29.2**	**4,190.1**	**297.9**	**6150.5**

Annex 1 Fugitive Emissions from Fittings

Offshore:

Table A1 Fugitive Emissions Estimate - Offshore

Component	Emission Rate(kg/ component/year)[1]	Number of Components[2]	Fugitive Emissions (te/year)
Connections	0.946	12,760	12
Valves	4.52	7,280	33
Other[3]	60.9	2,100	128
		Total Fugitive Emissions (tonnes/year)	**173**

Notes:
1. EEMS-Atmospheric Emissions Calculations, UK Department of Energy & Climate Change, 2008, Issue 1.810a
2. EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002 - number of components for gas platform facility Type B - production rate 330 mmscfd - multiplied by 5.4 based on SD2 production rate of 1777 mmscfd
3. Includes pumps and open-ended fittings.

Table A2 Offshore Fugitive GHG Emissions

Emission Gas	Total Volume (tonnes/year)[1]	GHG (tonnes/year)	Total Volume (over PSA)[1]	GHG (over PSA)
CH_4	102	2,150	1,945	48,623
VOC	24	-	454	
	Total Fugitive Emissions (GHG) tonnes	2,559		48,623

Notes:
1. Volumes of CH_4 and VOC emissions calculated from total fugitive emissions multiplied by CH4 and VOC factors respectively (derived from Appendix II of EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002)

Onshore:

Table A3 Fugitive Emissions Estimate - Onshore

Component	Emission Rate(kg/ component/year)[1]	Number of Components[2]	Fugitive Emissions (te/year)
Connections	2.4	5,546	13
Valves	33.9	1,521	52
Pumps	101	41	4
Other	42.7	268	11
		Total Fugitive Emissions (tonnes/year)	**80.46**

Notes:
1. EEMS-Atmospheric Emissions Calculations, UK Department of Energy & Climate Change, 2008, Issue 1.810a
2. EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002

Emission Gas	Total Volume (te/year)[1]	GHG (tonnes/year)	Total Volume (over PSA)[1]	GHG (over PSA)
CH_4	69	1,734	1,318	32,939
VOC	4	-	80	-
	Total Fugitive Emissions (GHG) tonnes	1,734		32,939

Notes:
1. Volumes of CH4 and VOC emissions calculated from total fugitive emissions multiplied by CH4 and VOC factors respectively (derived from Appendix II of EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002)

Annex 2 PI Forecasting Software

Performance Improvements (PI) Ltd are international market leaders in CO_2 reduction and energy assessments, having developed energy reduction protocols, carried out site assessments and implemented remedial work plans for oil, gas and power production sites all over the world. Over 150 assessments have been completed for companies including BP, Shell, BG, Shell, Talisman, Total, ConocoPhillips, Chevron, ExxonMobil and globally in countries including the UK, Ireland, Holland, Norway, Azerbaijan, UAE, Kazakhstan, USA, Pakistan, Trinidad, Gabon and Australia.

PI has developed a software application specifically intended to allow energy and emissions forecasts to be carried out over the Life of Field (LoF). The forecast software does not rely on the use of energy factors (i.e. power per unit production). It uses bespoke machinery curves to take into account the changes in machine efficiency relating to the load point actually occurring at a particular throughput.

The performance characteristics of most modern gas turbines are modelled in the PI Forecaster software using Original Equipment Manufacturers' (OEM) performance curves for these engines.

The 'Forecaster' software allows for both operating assets and project teams to forecast the atmospheric emissions, fuel gas consumption and associated fuel and CO_2 costs which can be expected for different machinery configurations.

The concept of the 'Forecaster' software is based on the fact that the fundamental thermodynamics, aerodynamics and hydrodynamics of gas turbines, centrifugal gas compressors and centrifugal liquid pumps that form the major power users on most oil and gas facilities do not change. What does change from installation to installation is the production throughput and hence the scale of the equipment required to process it. Because the fundamental physics involved does not change, it is possible to scale the equipment performance characteristics to suit a particular installation and its production throughput. Knowing the production throughput in terms of volumes of oil and gas produced, volumes of water pumped for re-injection and cooling, quantities of heat required in the process and the balance of utility electrical power, it is possible to build a software model of the plant that will predict its overall power consumption. It then follows that, given the type and numbers of prime movers on the installation the fuel requirement can be determined. Again, given definition of the fuel types to be used, the emissions arising from the prime-movers can be determined. Emissions from process heaters and flares can be similarly obtained.

The production rate of oil and gas inevitably varies over the life of a field, building up from low levels in the early years as wells are drilled and output capacity increases up to the nameplate rating of the associated process plant. There are then a number of years of steady, or plateau, production until the reservoir depletes to a point where the wells can no longer provide sufficient flow to satisfy process plant nameplate rating and the plant throughput follows an ever reducing decline curve until the reservoir is exhausted and the field is abandoned. The "Forecaster" software can be programmed to calculate the power consumption and emissions production throughout the build-up / plateau / decline sequence of a field's exploitation and can hence predict the total emissions to be expected over the whole life of field.

The Forecaster software has been "blind" tested against several existing oil and gas installations and has been shown to predict the combustion emissions to an uncertainty of better than +/- 5%. Additional detail on how the model has been developed and the validation work completed can be found within SPE 111527. Developing Rigorous GHG Forecasts for E&P Operations.GHG Forecasting Tool. J.Edwards, A. Watson and M.Guinee.

APPENDIX 5B

Shah Deniz 2 Project
Composition and Function of Key SD2 Chemicals with Potential for Discharge

The tables in this Appendix provide a list of the product name, chemical composition, function, and usage of key products which will, or could potentially, be discharged to sea during all phases of the Shah Deniz (SD) 2 Project. The tables also indicate the environmental rating of each product.

Chemicals with the most favourable available environmental rating have been selected for the project, with the aim of minimising the environmental impact of any unavoidable discharges. The composition and chemistry of each planned or potential discharge has been fully taken into account in the impact assessment process.

Table 1: Drilling Chemicals

Product	Composition	Function	Total Worst Case Discharge Volume per Hole (Tonnes)	Rating	Activity	Application
Barite	Barium sulphate	Weighting Agent	648	E	Drilling	Pilot Hole Drilling (Seawater / PHB Sweeps/ WBM)
Bentonite	Bentonite	Viscosifier	30	E	Drilling	Pilot Hole Drilling (Seawater / PHB Sweeps/ WBM)
Soda Ash	Soda Ash	Alkalinity Control	3	E	Drilling	Pilot Hole Drilling (Seawater / PHB Sweeps/ WBM)
Polypac UL	Poly Anionic Cellulose	Water Soluble Polymer Designed to Control Fluid Loss	6	E	Drilling	Pilot Hole Drilling (WBM)
Duovis	Xanthan Gum	Viscosifier	4	E	Drilling	Pilot Hole Drilling (WBM)
Nut Plug	Nut Shells	LCM /Pipe Scouring	3	E	Drilling	Pilot Hole Drilling (WBM)
Barite	Barite	Weighting Agent	1200	E	Drilling	Geotechnical Hole (Seawater / PHB Sweeps/ WBM)
Bentonite	Bentonite	Viscosifier	90	E	Drilling	Geotechnical Hole (Seawater / PHB Sweeps/ WBM)
Soda Ash	Soda Ash	Alkalinity Control	7	E	Drilling	Geotechnical Hole (Seawater / PHB Sweeps/ WBM)
Polypac UL	Poly Anionic Cellulose	Water Soluble Polymer Designed to Control Fluid Loss	12	E	Drilling	Geotechnical Hole (WBM)
Duovis	Xanthan Gum	Viscosifier	6	E	Drilling	Geotechnical Hole (WBM)
Nut Plug	Nut Shells	LCM /Pipe Scouring	3	E	Drilling	Geotechnical Hole (WBM)
Barite	Barite	Weighting Agent	116	E	Drilling	42” Section (Seawater / PHB Sweeps/ WBM)
Bentonite	Bentonite	Viscosifier	35	E	Drilling	42” Section (Seawater / PHB Sweeps/ WBM)
Soda Ash	Soda Ash	Alkalinity Control	1	E	Drilling	42” Section (Seawater / PHB Sweeps/ WBM)
Polypac UL	Poly Anionic Cellulose	Water Soluble Polymer Designed to Control Fluid Loss	2.1	E	Drilling	42” Section (WBM)
Duovis	Xanthan Gum	Viscosifier	0.35	E	Drilling	42” Section (WBM)
Nut Plug	Nut Shells	LCM /Pipe Scouring	0.7	E	Drilling	42” Section (WBM)

Product	Composition	Function	Total Worst Case Discharge Volume per Hole (Tonnes)	Rating	Activity	Application
Magnesium oxide	Magnesium oxide	pH control	3	E	Drilling	42” Section (WBM)
Barite	Barite	Weighting Agent	289	E	Drilling	32” Section (Seawater / PHB Sweeps/ WBM)
Bentonite	Bentonite	Viscosifier	54	E	Drilling	32” Section (Seawater / PHB Sweeps/ WBM)
Soda Ash	Soda Ash	Alkalinity Control	0.7	E	Drilling	32” Section (Seawater / PHB Sweeps/ WBM)
Polypac UL	Poly Anionic Cellulose	Water Soluble Polymer Designed to Control Fluid Loss	3.5	E	Drilling	32” Section (WBM)
Duovis	Xanthan Gum	Viscosifier	0.85	E	Drilling	32” Section (WBM)
Nut Plug	Nut Shells	LCM /Pipe Scouring	1.4	E	Drilling	32” Section (WBM)
Magnesium oxide	Magnesium oxide	pH control	3	E	Drilling	32” Section (WBM)
Barite	Barite	Weighting Agent	1826	E	Drilling	28” Section (Seawater / PHB Sweeps/ WBM)
Soda Ash	Soda Ash	Alkalinity Control	2	E	Drilling	28” Section (Seawater / PHB Sweeps/ WBM)
Polypac UL	Poly Anionic Cellulose	Water Soluble Polymer Designed to Control Fluid Loss	19	E	Drilling	28” Section (WBM)
Duovis	Xanthan Gum	Viscosifier	5	E	Drilling	28” Section (WBM)
Potassium Chloride	Salts (KCl)	Borehole Stabiliser/Shale Inhibitor	325	E	Drilling	28” Section (WBM)
Ultrahib	Poly Ether Amine/Poly Ether Amine Acetate Blend	Shale Inhibitor	96	GOLD	Drilling	28” Section (WBM)
Ultracap	Aliphatic Terpolymer	Anti-Accretion Additive	7	GOLD	Drilling	28” Section (WBM)
Ultrafree	Ester/Alkenes C15-C18 Blend	Shale Encapsulator	92	GOLD	Drilling	28” Section (WBM)
Super Sweep	Polyproplene Fibres	Hole Cleaning Agent	2	GOLD	Drilling	28” Section (WBM)
STARCARB	Oil well chemical containing quarts	Sealing/Bridging Agent	15	E	Drilling	Drilling Contingency Chemical (WBM)

Product	Composition	Function	Total Worst Case Discharge Volume per Hole (Tonnes)	Rating	Activity	Application
STEELSEAL	Calcined petroleum coke	Sealing/Bridging Agent	15	E	Drilling	Drilling Contingency Chemical (WBM)
EZ SPOT	Pipe freeing agent	Spotting Fluid	2.3	Not Currently Listed Into UK OCNS Ranked Lists of Notified Products	Drilling	Drilling Contingency Chemical (WBM)
STARCIDE	N,N-methylene-bis(5-methyloxazolidine)	Biocide	1.3	GOLD	Drilling	Drilling Contingency Chemical (WBM)
OXYGON	OXYGON: granulate / powder	Oxygen Scavenger	0.3	GOLD	Drilling	Drilling Contingency Chemical (WBM)
SOURSCAV	Synthetic chemical compound	H_2S Scavenger	1.9	GOLD	Drilling	Drilling Contingency Chemical (WBM)
Bentonite	Bentonite	Viscosifier	5	E	Drilling	Drilling Contingency Chemical (WBM)
Sodium Bicarbonate	Sodium Bicarbonate	Alkalinity Control	1	E	Drilling	Drilling Contingency Chemical (WBM)
Magnesium Oxide	Magnesium Oxide	pH Control	6	E	Drilling	Drilling Contingency Chemical (WBM)

Table 2: Cementing Chemicals

Product	Composition	Function	Total Worst Case Discharge Volume per Hole (Tonnes)	Rating	Activity	Application
Cement Class G D907	Cement	Cement	151	E	MODU Cementing	Section Casing Cementing
Antifoaming Agent D206	Dimethyl Siloxanes, Silicones And Sorbitan Stearate	Antifoam Agent	0.77	Gold	MODU Cementing	Section Casing Cementing
Silicate Additive D075	Silicic Acid, Sodium Salt	Cement Additive	0.91	E	MODU Cementing	Section Casing Cementing
Hematite Weighting Agent D076	Hematite	Weighting Agent	1	E	MODU Cementing	Section Casing Cementing
Liquid Accelerator D077	Calcium Chloride	Accelerator	0.3	E	MODU Cementing	Section Casing Cementing
SALTBOND II Additive D080A	Solution Of Aromatic Polymer	Dispersant	0.25	Not Currently Listed Into UK OCNS Ranked Lists of Notified Products	MODU Cementing	Section Casing Cementing
Liquid Retarder D081	Lignosulfonate	Low Temperature Retarder	0.4	E	MODU Cementing	Section Casing Cementing
D095 Cement Additive	Glass Fiber	Cement Additive	0.28	E	MODU Cementing	Section Casing Cementing
Litefil D124 extender	Aluminium silicate	Solid Extender, cement additive.	19	E	MODU Cementing	Section Casing Cementing
Low Temperature Liquid Dispersant D145A	Sulfonated Melamine-Formaldehyde	Dispersant	0.97	Gold	MODU Cementing	Section Casing Cementing

Product	Composition	Function	Total Worst Case Discharge Volume per Hole (Tonnes)	Rating	Activity	Application
Retarder D177	Organic Salts	Mid Temperature Retarder	1.365	Not Currently Listed Into UK OCNS Ranked Lists of Notified Products	MODU Cementing	Section Casing Cementing
Low Temperature Dispersant D185	Polycarboxylic Polymer	Low Temperature Dispersant	0.35	Gold	MODU Cementing	Section Casing Cementing
Low Temperature Cement Set Enhancer D186	Accelerator	Cement or Cement Additive	0.1	Gold	MODU Cementing	Section Casing Cementing
Ultralite D188	Glass	Extender	4	E	MODU Cementing	Section Casing Cementing
Fluid Loss Control Additive D193	Polymer Aqueous	Fluid Loss Agent	2.7	Gold	MODU Cementing	Section Casing Cementing
Losseal W D199	Losseal W D199	Lost Circulation Material	0.9	Gold	MODU Cementing	Section Casing Cementing
GASBLOK LT D500	Polymeric Microgels	Cement or Cement Additive	6.18	Gold	MODU Cementing	Section Casing Cementing
D600 GASBLOK Gas Migration Control Additive	Latex Particles, Surfactant	Cement or Cement Additive	5.4	Gold	MODU Cementing	Section Casing Cementing
Mid-Temp Retarder-L D	Lignosulfonate Retarder	Cement or Cement Additive	0.3	E	MODU Cementing	Section Casing Cementing
MUD PUSH II Spacer D182	Sulfonated Organic Polymer, Glucoside Polymer	Cement or Cement Additive	0.77	Gold	MODU Cementing	Section Casing Cementing
D168	Fluid Loss Control Additive	Fluid Loss Control Additive	3.4	Gold	MODU Cementing	Section Casing Cementing
D209 Extender	Extender	Cement or Cement Additive	4	E	MODU Cementing	Section Casing Cementing
Cement Class G D907	Cement	Cement	16	E	MODU Cementing	Cement Unit Washing

Table 3: Blow Out Preventer Fluid Chemicals

Chemical	Total Worst Case Discharge Volume (Litres), per Well for Two Pods Testing	Activity	Application
Propylene Glycol	513	Drilling	BOP Testing
Ethylene glycol	30.78	Drilling	BOP Testing
Monoethanolamine	10.26	Drilling	BOP Testing
Triazine	5.13	Drilling	BOP Testing
Triethanolamine	10.26	Drilling	BOP Testing

Table 4: Commissioning and Operations Chemicals

Product	Composition	Function	Total Worst Case Discharge Volume (m^3)	Rating	Activity	Application	Concentration in Discharge/Dosing Regime
Hydrosure HD50000	Combined Biocide, Corrosion Inhibitor and Oxygen Scavenger	Treat seawater used for hydrotesting	0.75	Gold	Jacket Installation	Jacket Ballasting	1000ppm
Tros Seadye	Tros Seadye	Dye	0.075	Gold	Jacket Installation	Jacket Ballasting	100ppm
Hydrosure HD50000	Combined Biocide, Corrosion Inhibitor and Oxygen Scavenger	Treat seawater used for hydrotesting	455	Gold	Subsea Export Pipelines	Pipeline Pre Commissioning	1000ppm
Tros Seadye	Tros Seadye	Dye	45	Gold	Subsea Export Pipelines	Pipeline Pre Commissioning	100ppm
Hydrosure HD50000	Combined Biocide, Corrosion Inhibitor and Oxygen Scavenger	Treat seawater used for hydrotesting	33	Gold	Infield Subsea Flowlines	Flowlines Pre Commissioning	1000ppm
Tros Seadye	Tros Seadye	Dye	3.3	Gold	Infield Subsea Flowlines	Flowlines Pre Commissioning	100ppm
Mono Ethylene Glycol (MEG)	MEG	MEG used to pre-fill subsea components	63	E	Subsea Infrastructure	Subsea Infrastructure Installation	n/a
MEG	MEG	MEG used to pre-fill subsea components	33.8	E	Subsea Infrastructure Intervention	Production Tree Replacement	n/a
Castrol Transqua HC10	Water Based Control Fluid	Subsea control system fluid	286.3	D	Valve Operations and Discharge	Subsea Operations	n/a

Note: Volume of Castrol Transqua HC10 per discharged varies between approximately 4.5 litres per thousand barrel of condensate produced (plateau) to 0.2 litres per thousand barrel of condensate produced (end of PSA)

APPENDIX 5C

Determination of Chemical Hazard Categories

1. CHARM

The Offshore Chemical Notification Scheme (OCNS) conducts hazard assessments on chemical products that are used offshore. The CHARM model calculates the ratio of Predicted Effect Concentration against No Effect Concentration (PEC: NEC), and is expressed as a Hazard Quotient (HQ), which is then used to rank the product. The HQ is converted to a colour banding (see Table 1 below), which is then published in the Definitive Ranked Lists of Approved Products, Excel format (ZIP, 355.62 KB, updated 3 August 2010). The PEC is estimated for a standard platform with a standard mixing zone and a standardised estimate of tidal advection. PEC also takes into account standard chemical usage rates and includes an estimate of the fraction released (based on oil-water partitioning data). NEC is derived from the results of standardised acute toxicity tests, using an application factor of 10-1000 (the selection of the application factor is built in to the model and reflects the type and quantity of toxicity data available). Data used in the CHARM assessment include toxicity, biodegradation and bioaccumulation, and the model is divided into 4 main algorithms: Production, Completion / Workover, Drilling and Cementing.

Although the current OCNS is based on hazard assessment, it remains primarily a ranking system; the actual HQ values are dependent on assumptions about the size of the mixing zone and on the rate of dispersion, and these assumptions will not be valid for the Caspian. However, the rankings remain valid for any consistent set of assumptions, and will therefore provide a reliable indication of relative environmental effects for all water bodies.

Table 1 The OCNS HQ and Colour Bands

Minimum HQ value	Maximum HQ value	Colour banding	
>0	<1	**Gold**	
≥1	<30	**Silver**	
≥30	<100	**White**	Lowest Hazard
≥100	<300	**Blue**	Highest Hazard
≥300	<1000	**Orange**	
≥1000		**Purple**	

2. Non-CHARM (Old OCNS Ranking)

Products not applicable to CHARM model (i.e. inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A – E, with A being the greatest potential environmental hazard and E being the least (see Table 2 below).

This system awards the offshore chemical a letter grouping between A and E. (N.B. care should be taken not to confuse these values with the results of the Netherlands pre-screening scheme). Each individual substance in an offshore chemical should be ranked by applying the OCNS Ranking Scheme. The overall ranking is determined by that substance having the worst case OCNS ranking scheme assignment. The method of assignment of the OCNS letter grouping is described below.

2.1 Initial Grouping

The initial group is determined using Table 2. All submitted toxicity data for the product are compared with the table and the value giving the worst case 'Initial Grouping' (i.e. the test giving the most toxic response) is used as the Initial Group for the substance.

Table 2 Initial OCNS Grouping

Initial Grouping	A	B	C	D	E
Result for Aquatic toxicity data (ppm)	<1	>1-10	>10-100	>100-1,000	>1,000
Result for sediment toxicity data (ppm)	<10	>10-100	>100-1,000	>1,000-10,000	>10,000

- **Aquatic toxicity** refers to the Skeletonema costatum EC_{50}, Acartia tonsa LC_{50}, and Scophthalmus maximus (juvenile turbot) LC_{50} toxicity tests; and
- **Sediment toxicity** refers to the Corophium volutator LC_{50} test.

2.2 Adjustment for Environmental Performance to Determine Final Group

The final grouping is determined using Table 3 as a guide. Select the column that applies to the candidate product and adjust the initial Group accordingly. If the classification should theoretically move beyond Group A or E, the product will nevertheless be assigned to that particular Group.

Table 3 Adjustment Criteria for OCNS Grouping

Increase by 2 Groups e.g. From C to E	Increase by 1 Group e.g. from C to D	Do not adjust initial grouping	Decrease by 1 group e.g. From C to B	Decrease by 2 groups e.g. From C to A
Substance is readily biodegradable and is non-bioaccumulative	Substance is inherently biodegradable and is non-bioaccumulative	Substance is not biodegradable and is non-bioaccumulative or	Substance is inherently biodegradable and bioaccumulates	Substance does not biodegrade and bioaccumulates
		Substance is readily biodegradable and bioaccumulates		

Definitions of terms used in the classification table:

- **Readily biodegradable** - Results of >60% biodegradation in 28 days to an OSPAR HOCNF accepted ready biodegradation protocol;
- **Inherently biodegradable** - Results of >20% and <60% to an OSPAR HOCNF accepted ready biodegradation protocol or result of >20% by OSPAR accepted Inherent biodegradation study;
- **Not biodegradable** - Results from OSPAR HOCNF accepted ready biodegradation protocol or inherent biodegradation protocol are <20%;

- **Non-bioaccumulative/non-bioaccumulating** - Log Pow <3, or results from a bioaccumulation test (preferably using Mytilus edulis) demonstrates a satisfactory rate of uptake and depuration, or the molecular mass is > 700;
- **Bioaccumulative/Bioaccumulates** - Log Pow >3, or results from a bioaccumulation test (preferably using Mytilus edulis) demonstrates an unsatisfactory rate of uptake and depuration, and the molecular mass is < 700;
- **Aquatic toxicity test result** - LC/EC_{50} data for Skeletonema costatum, Acartia tonsa or Scophthalmus maximus (Juvenile turbot) (units = ppm or mg/litre); and
- **Sediment toxicity test result** - LC_{50} data for Corophium volutator (units = ppm or mg/kg).

APPENDIX 5D

Seismic Design of SD2 Platforms and Onshore Facilities

1. SDB Platforms Seismic Loads and Seismic Design Criteria

1.1 Design Criteria

The seismic design will be carried out in accordance with the recommendations of ISO 19901-2. Draft ETP GP 66-02 will also be consulted for guidance.

The ISO guidelines for seismic design are based on a two level design check following the concept of balanced strength and ductility. An Extreme Level Earthquake (ELE) is used to demonstrate sufficient component strength without damage and an Abnormal Level Earthquake (ALE) is used to demonstrate sufficient system capacity with possible component damage. The ALE spectral accelerations are determined from the site-specific hazard curve for the ISO target annual probability of failure. The ELE spectral acceleration is estimated from the ALE based on the platform system ductility. For a balanced design the ELE analysis provides assurance that the design will meet the ALE performance requirements.

In addition to the two levels specified in ISO, a third return period of seismic activity will be considered as an additional risk reduction assessment with aim of meeting the intent of draft GP 66-02.

1.2 Design Seismic Conditions

The design seismic conditions cover the following seismic events:

- Firstly, the offshore platforms are designed against an earthquake that has a relatively low likelihood of occurrence during the life of the platform, referred to as the ELE. Structures are expected to sustain little or no damage and economic viability should be ensured. This is interpreted to mean that the facilities can be placed in a safe state, structural capacity will be unaffected, hydrocarbon containment shall be ensured and production systems can be re-started after the earthquake. The return period of ELE is 240 years.

- Secondly, the offshore platforms are checked against a rare earthquake that has a very low likelihood of occurrence during the platform life. This event is referred to as ALE. The platforms can sustain local damage; however, it should not collapse or have high Health, Safety or Environmental consequences. Command and control functions are to be maintained to ensure the facilities can be placed in a defined safe-state, platform collapse through direct or secondary fire effects will be avoided, Temporary Refuge (TR) will remain available and orderly evacuation accomplished. The return period of ALE is 3,400 years.

- Finally, performance of the platforms in terms of global and local response to a 10,000 year return period earthquake is assessed in accordance with draft GP 66-02. Structure should not suffer complete loss of integrity for sufficient time to enable emergency evacuation. Global collapse of the platform is not permitted, although local damage, such as member buckling is allowed. Hinging of piles must be limited and structures supporting safety critical deck systems, such as the living quarters, must remain intact. Damage at critical load transfer points, such as skirt pile to jacket framing and top of jacket to deck leg connections should be limited.

1.3 Seismic Analysis

Seismic criteria were developed based on a site-specific probabilistic seismic hazard analysis (PSHA) performed by EQE International and a non-linear site response analysis performed by a specialist consultant (D'Appolonia). These site-specific ELE, ALE and extrapolated 10,000-yr seismic loads (spectral accelerations and time history data from seven suitable earthquakes) have been quality checked by the BP UEC subject matter expert and independently verified by a competent third party (Energo).

The effects of soil liquefaction on ground motions have been included in the time histories provided. The accelerations traces supplied by D'Appolonia have been baseline corrected for liquefied behaviour by KBR prior to use in structural analyses. The analysis will be carried out in accordance with the seismic loading as defined in ISO 19902.

Table 1 and Figure 1 below present the ELE, ALE and 10,000-year horizontal acceleration spectra at mudline. Following ISO recommendations, the vertical spectral accelerations may be taken as 50% of the horizontal value.

Table 1. 5% Damped Horizontal ELE, ALE & 10,000yr Design Spectra at Mudline

		Horizontal Spectral Acceleration (g)		
Frequency (Hz)	**Period (Sec)**	**ELE**	**ALE**	**10,000yr**
PGA	PGA	0.116	0.155	0.159
20	0.050	0.161	0.219	0.215
13.33	0.08	0.208	0.250	0.278
10	0.10	0.236	0.298	0.310
6.67	0.15	0.308	0.364	0.390
5	0.2	0.329	0.360	0.387
3.33	0.3	0.348	0.369	0.388
2	0.5	0.314	0.439	0.479
1.33	0.75	0.247	0.510	0.514
1	1.0	0.231	0.436	0.508
0.67	1.5	0.145	0.356	0.429
0.5	2.0	0.131	0.298	0.398
0.33	3.0	0.094	0.250	0.321
0.25	4.0	0.048	0.170	0.284
0.10	10.0	0.004	0.023	0.057

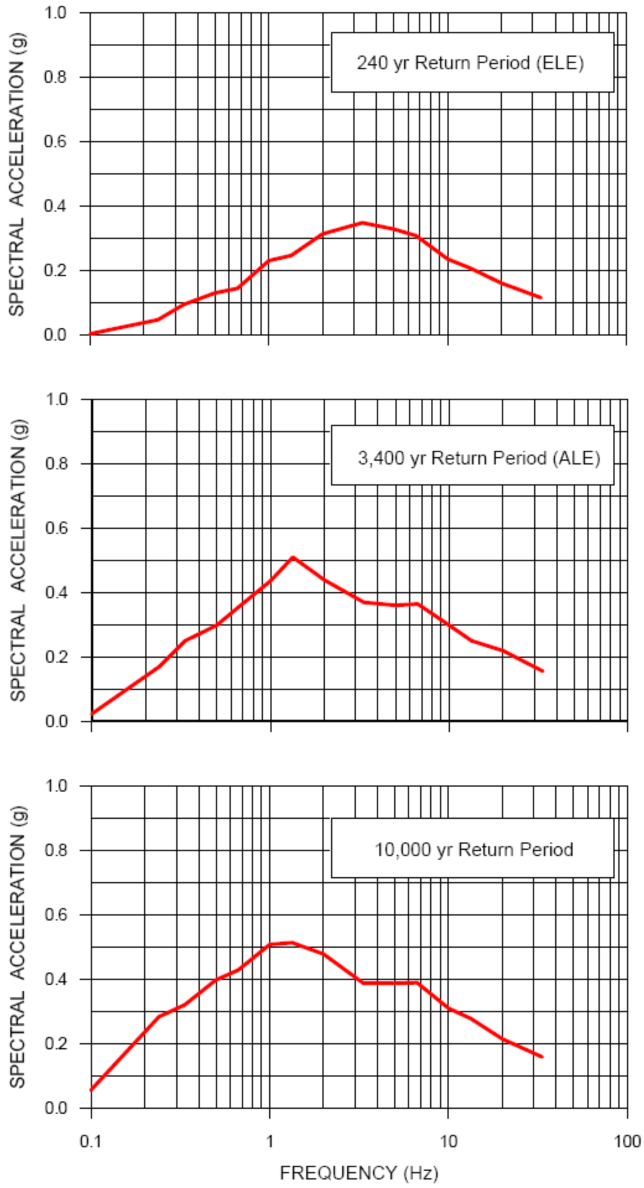


Figure 1. SDB Platform Location - Mudline Response Spectra

2. Onshore Facilities Seismic Loads and Seismic Design Criteria

2.1 Design Criteria

The seismic design and seismic design criteria shall be in accordance with ASCE 7-10.

2.2 Design Seismic Conditions

The Onshore safety Philosophy identifies the following seismic design requirements:

- All facilities to be fully functional after a 475-year return period event (Design Earthquake: DE),
- Essential Facilities shall provide containment of significant hydrocarbon inventories, ensure safe plant shutdown and facilitate emergency response after a 2,475-year event (Maximum Considered Earthquake: MCE), and,
- Critical Facilities shall achieve containment of the incoming pipeline inventories and large hydrocarbon storage tanks, avoid immediate collapse of manned buildings during a 10,000-year event and after it for a time commensurate with emergency response actions (Extreme Earthquake: EE).

2.3 Seismic Analysis

Sangachal Terminal specific seismic DE, MCE and EE design criteria have been developed by a specialist consultant (Arup) in accordance with ASCE 7-10 and best international practice. Figures 2 and 3 below show horizontal acceleration response spectra corresponding to the 475-year (DE), 2475-year (MCE), and 10000-year (EE) return period events at the Sangachal Terminal site.

Due to the collapsible nature of the existing soils at Sangachal Terminal when saturated, response spectra were developed based upon dry and wet soil conditions for the DE and MCE events, and upon dry soil conditions for the EE event.

Figure 2 – Surface Response Spectra for DE and MCE (Dry Soils)

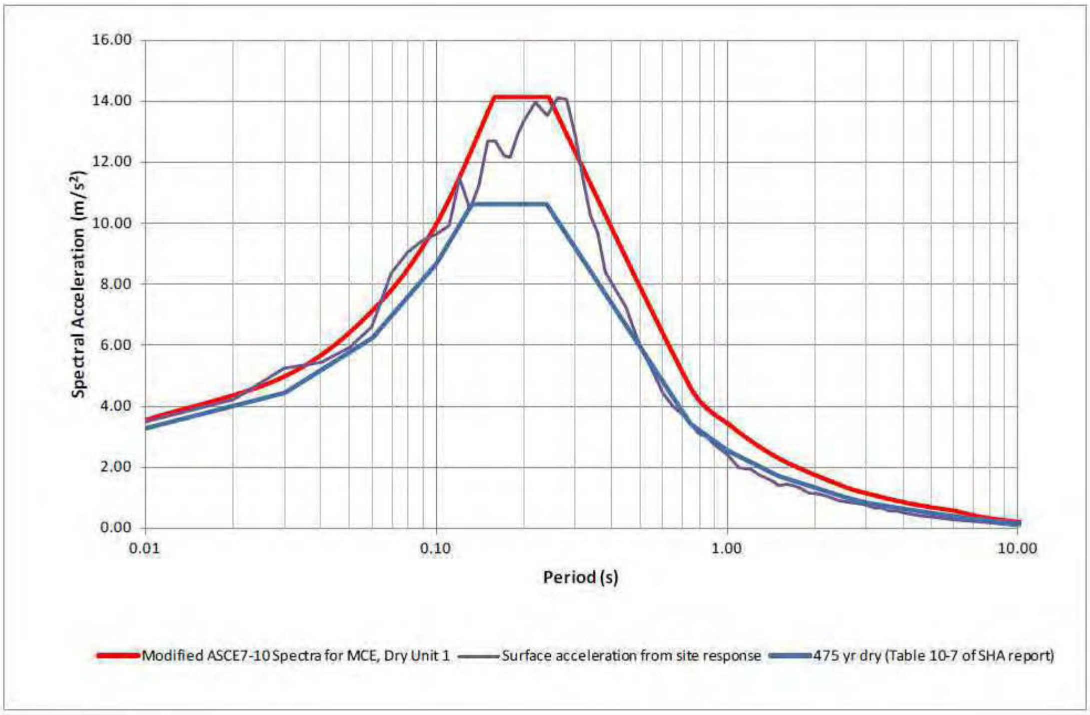
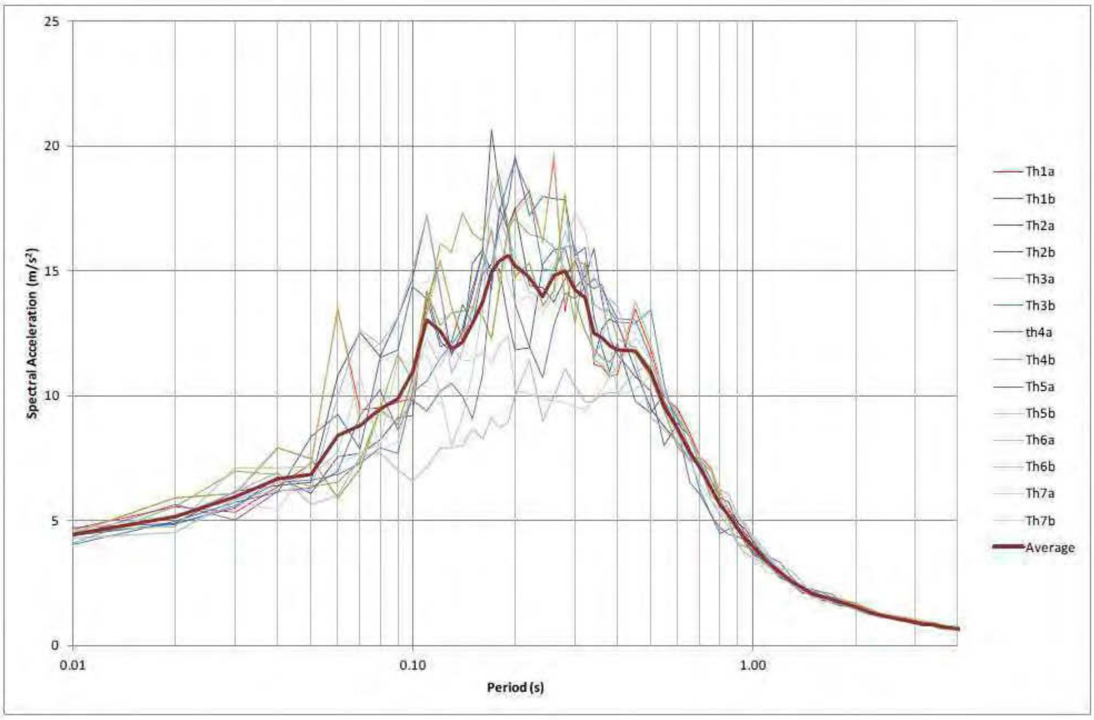


Figure 3 – Surface Response Spectra for EE (Dry Soils)



APPENDIX 5E

Estimate of Sludge Generated from the SD2 Platform Complex

Estimate of Sludge Generated from the SD2 Platform Complex

The relationship is as follows:

Daily volumetric sludge production =

$$POB \times Sludge \cdot production \cdot for \cdot black \cdot water \big/ MLSS$$

Maximum persons on board (POB) = 240 (during commissioning)

Mixed liquor suspended solids concentration (MLSS) = 15,000 g/m^3

Sludge production for black water = 20 to 40 g/head.d

The calculated volumetric sludge productions are given below for range of sludge productions:

	Units	Highest (offshore)	Average (domestic)	Least (vendors)	Calculation steps
Mixed liquor suspended solids	g/m^3	15,000	15,000	15,000	Typical value for membrane bioreactor (MBR) plants
Sludge dry solids production	g/head.day	40	30	20	Black water per person load of 40 g BOD removed/head.d x dry solids production for MBR plants (extended aeration) of 0.3 to 1.0 kg dry solids / kg BOD removed (source).
Max estimated daily sludge volume	m^3/d	0.64	0.48	0.32	POB x g/head.day / MLSS
Number of days per month	days	30	30	30	
Monthly sludge volume (max)	m^3/month	19.2	14.4	9.6	Daily sludge volume x days/month

Source: Construction Industry Research and Information Association Report (CIRIA) Report (2000) The selection of package wastewater treatment plants. CIRIA report FR/IP/33.

APPENDIX 5F

Estimated Vessels, Construction Plant and Vehicles Used for Shah Deniz 2 Project Activities

1. Introduction

Appendix 5F summarises estimated numbers and period of use of vessels, equipment and plants that will support each phase of SD2 Project.

2. Drilling and Completion Activities

Table 1 below summarises the anticipated MODU and support vessel usage during drilling and completion activities per well.

Table 1 Use of MODU and Vessels per Well (Drilling and Completion)

Vessel/Rig	Number	Duration/ Frequency of Use	Function	Maximum Person on Board	Average Fuel Consumption (tonnes/day)
MODU	1	Continuous	Drill pilot holes, geotechnical holes and wells	120 for the Istiglal 130 for the Heydar Aliyev	9
MODU mobilisation support vessels	3	4 days	Tow out and position MODU	15	15
		4 days	Demobilise MODU		
Pre-drill programme support vessels[1]	9	Per week	Supply drilling mud, diesel and other consumables to the MODU Ship solid and liquid wastes (including lower hole cuttings) to shore for treatment/disposal	15	8
Pre-drill programme stand by vessel	1	Continuous	Back up support for MODU/support vessels	5	4
Crew change vessels[1,2]	3	Per week	Personnel transfer	15	15

1. Vessel trips may be shared with other Azerbaijan Georgia Turkey (AGT) Region Offshore installations.
2. Helicopters may be used for some crew changes.

3. Onshore Terminal Construction

Table 2 summarises the anticipated usage of key plant and equipment during SD2 Terminal Construction Activities per construction phase as per Figure 5.9 of the ESIA.

Table 2 Key Construction Equipment for the SD2 Terminal Construction Activities

	Estimated Number of Plant/Equipment per Phase					
Construction Equipment	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**
Bulldozer e.g. CAT D7 179kW (28 t)	1	1	1	1	0	0
Wheeled Loader e.g. CAT 980H 260kW	11	10	10	8	4	0
Tracked excavator e.g. CAT 329D 140kW (27 t)	7	6	6	4	2	0
Dump truck e.g. Volvo A30F (23 t 18m^3)	68	60	50	48	24	0
Motor Grader e.g. CAT 160M (25 t)	2	2	2	1	1	0
Asphalt paver (+ tipper lorry)	1	1	1	1	1	0
Road lorry e.g. Mercedes Actros 4x2 Tractor unit (39 t)	4	13	25	25	18	5
Diesel generator (150 kVA)	3	30	36	36	24	2
Mechanical water bowser / Road sweeper	8	8	8	8	8	8
Mobile telescopic crane (25t)	8	20	30	31	17	3
Mobile telescopic crane (40t)	5	15	22	23	12	2
Mobile telescopic crane (80t)	2	5	7	8	6	1
Mobile telescopic crane (120t)	1	2	6	5	3	0
Mobile telescopic crane (300t)	0	1	1	1	1	0
Mobile telescopic crane (600t)	0	1	1	1	1	0
Tower Crane	0	0	1	1	1	0
Air Compressor (8/20 m3/min)	1	11	12	12	8	1
X-Ray Equipment	1	4	8	10	6	0
TIG & MIG Welding Machine	2	10	20	24	16	1
TIG Welding Machine	4	19	44	49	30	2
MIG Welding Machine	4	19	44	49	33	2
Welding Machine (electric)	7	29	67	73	49	3
Welding Machine (Diesel)	4	19	45	49	33	2
Truck (20t)	1	6	8	8	5	2
Mini loader (Bobcat)	8	7	7	6	2	0
Man lift (cherry picker)	13	20	21	14	11	2
Drain Pump	6	6	7	4	0	0
Repair Truck	3	3	3	3	3	3
Lube Oil Truck	3	3	3	3	3	3
Vacuum Truck	1	1	1	1	1	1
Fuel bowser (10.000 litters)	3	3	3	3	3	3
Earthworks compactor / roller (18 t)						
Large rotary bored piling rig (110 t)	4	10	0	0	0	0
Large lorry concrete mixer (216kW)	14	12	10	10	5	0
Fork lift trucks e.g. CAT TH514 Telehandler	1	3	4	4	3	1
Water pump 20kW	0	5	7	7	5	0
Concrete pumps	2	3	2	2	1	0

Numbers of Offsite Vehicles and Routing

Table 3 summarises the estimated number of offsite vehicle movements expected to take place associated with the SD2 Project on the public road network. All the vehicles detailed within Table 3 are expected to travel along the main highway.

Table 3 Estimated Number of Offsite Construction Vehicles Associated with SD2 Terminal Construction and Commissioning Activities

Vehicle		Estimated Number of Daily Movements Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Low loader	In	10	5	5	5	2	2
	Out	10	5	5	5	2	2
Road lorry 25 T	In	50	100	200	200	75	10
	Out	50	100	200	200	75	10
Minibus (18-20 Seater)	In	25	75	100	100	100	50
	Out	25	75	100	100	100	50
7.5 Tonne Flat Bed	In	10	25	50	50	25	10
	Out	10	25	50	50	25	10
4x4 Pickup Truck	In	20	35	50	50	35	20
	Out	20	35	50	50	35	20
Private Car	In	75	150	250	250	150	50
	Out	75	150	250	250	150	50

4. Platform Installation, Hook Up and Commissioning

Table 4 summarises the estimated usage of vessels during installation, hook up and commissioning phase of the SDB platforms.

Table 4 Installation, Hook Up and Commissioning Vessels

Vessel	PR Jacket Installation No.	PR Jacket Installation Duration (Days)	QU Jacket Installation No.	QU Jacket Installation Duration (Days)	PR Topside Installation No.	PR Topside Installation Duration (Days)	QU Topside Installation No.	QU Topside Installation Duration (Days)	Bridge Installation No.	Bridge Installation Duration (Days)	Flotel Support No.	Flotel Support Duration (Days)
DBA	1	49	1	49	1	20	1	15	1	10	1	20
Anchor handling tug	2	49	2	49	2	15	2	15	2	10	2	20
STB-01 & tow tug	1	17	1	16	1	20	1	15	1	10	-	-

5. Subsea Export and MEG Pipelines Installation, Hook Up and Commissioning

Offshore and Nearshore Vessels:

Table 5 below summarises the estimated usage of number of vessels during offshore and nearshore subsea pipelay activities.

Table 5 Offshore and Nearshore Pipelay Support Vessels

Vessel	Function	No.	Duration (Days)	POB
Pipelay barge	Pipelay	1	730	280
Anchor handling vessels	Positioning of pipelay barge and standby duty	3		15
Pipe supply vessels	Supplies pipe to the pipe-lay barge from onshore	4		10
Pipelay barge support vessels	Tow pipeline barge and support functions	2		14
Survey vessel	Inspects laid pipeline	1		26
DSV	Diver support to survey vessel	1		26

Nearshore Plant - expected plant and equipment anticipated to be used for the nearshore works (i.e. construction of the finger berms, trenching up to 3m water depth, beach pull activities and reinstatement works) comprises:

- 5 tipper trucks;
- 2 bulldozers;
- 2 back hoes;
- 3 mobile cranes; and
- 2 diesel powered generators.

Nearshore works are anticipated to last approximately 16 months.

Onshore Pipeline Construction Plant - it is anticipated the following plant will be used throughout the onshore pipeline construction works:

- 6 side booms;
- 6 excavators;
- 2 dump trucks;
- 1 forklift;
- 2 cranes;
- 2 water bowsers;
- 2 fuel bowsers;
- 1 low loader;
- 4 roller compactors; and
- 1 bulldozer.

Onshore pipeline works are anticipated to last approximately 22 months.

Pipeline Pre-Commissioning and Dewatering Plant

Up to three 7.5kW air compressor and up to two 250 kVA generators will be used during the pipeline pre commissioning and dewatering. To complete all pre-commissioning stages associated with all four pipelines it is anticipated that the air compressors will be used for 90 days and the two generators for 160 days.

6. Subsea Infrastructure Installation, Hook Up and Commissioning

Table 6 provides a summary of vessel usage during installation of the subsea infrastructure.

Table 6 Subsea Infrastructure Installation, Hook Up and Commissioning Vessels

Vessel	Function	No.	Duration	POB
DBA	Crane barge used to install subsea infrastructure	1	Approximately 7 months per flank	240
Pipelay barge	Pipelay	1	Between 26 and 82 days per flank	280
DSV	Diver support to survey vessel	1	Approximately 9 months per flank	26

APPENDIX 6A

Air Quality Monitoring Results

Introduction

Appendix 6A summarises the monitoring data that was used to determine the air quality baseline conditions for the SD2 Project.

Air quality monitoring has been carried out for nitrogen dioxide (NO_2), sulphur dioxide (SO_2), benzene and total volatile organic compounds (VOCs) in and around Sangachal Terminal since 2003 using diffusion tubes. The air quality monitoring programme has used a total of 23 monitoring station locations throughout this time period.

From 2003 to 2007, air quality monitoring occurred at 13 locations (ST01-ST13). Post 2007, monitoring at stations ST01 to ST05 was discontinued and an additional 10 monitoring stations (AAQ14 – AAQ23) were established. Monitoring locations are presented in Figure 1.

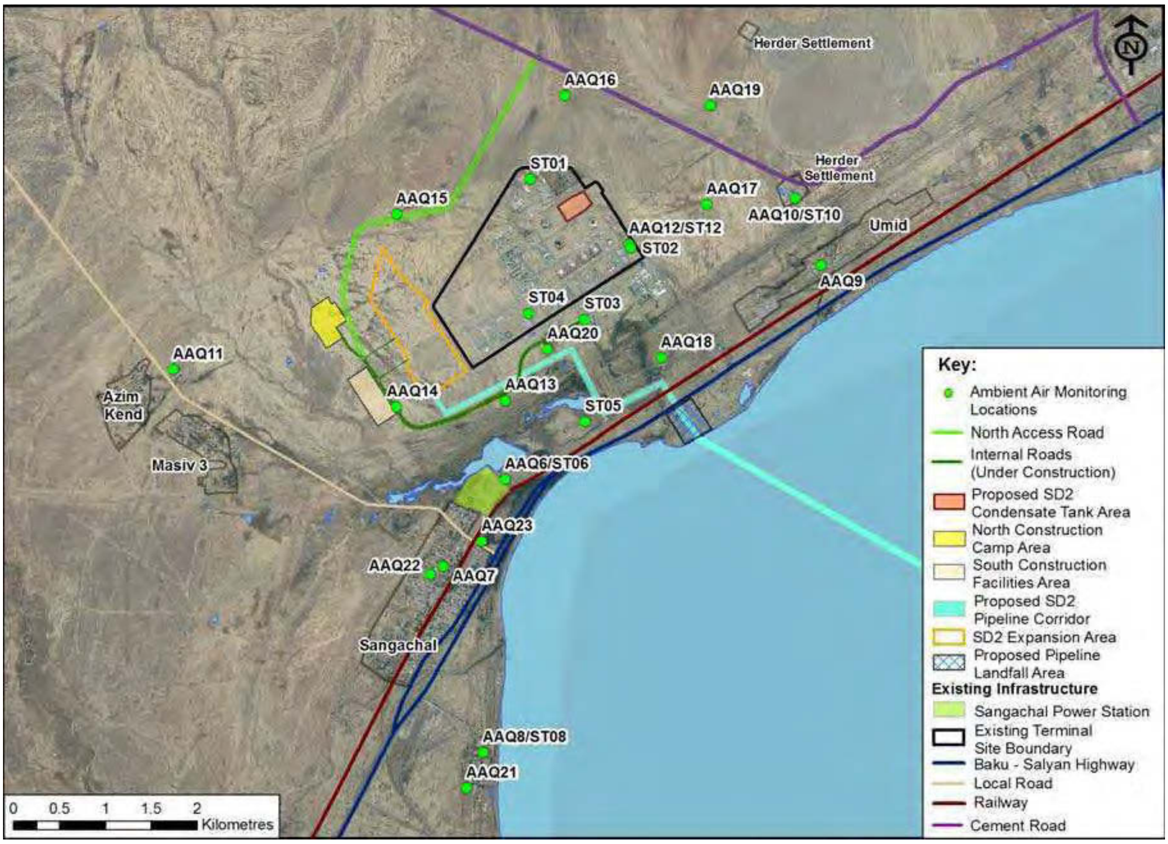
Data from 2007 included anomalously high data values for all pollutants. The reason for this is not known. In addition monitoring techniques have also changed throughout this period. As a result, data from 2008 to 2011 was used to establish the baseline air quality

Within the ESIA the monitoring stations have been divided into three groups:

- Background: locations upwind of the Terminal and away from local communities and major sources (e.g. the Power Station and Highway);
- Terminal: locations around the Terminal and the SD2 Expansion Area, predominantly downwind of the Terminal; and
- Receptors: locations within the local communities i.e. Sangachal, Azim Kend/Masiv 3 and Umid.

In addition an automatic monitoring station was established at location AAQ23. Monitoring results from the automatic station are also presented.

Figure 6A.1 Ambient Air Quality Monitoring Locations (2003 – 2011)



Nitrogen Dioxide (NO_2)

Table 6A-1 summarises the monitoring data collected for NO_2 between 2003 and 2011. The air quality monitoring stations have been divided into their respective groups.

Table 6A-1 NO_2 Monitoring Data ($\mu g/m^3$), 2003-2011

Group		Monitoring Station	Year								
			2003	2004	2005	2006	2007	2008	2009	2010	2011
Background		ST08/AAQ8	N/A	4.2	9.6	13.0	12.5	12.0	10.1	9.5	10.8
		ST10/AAQ10	9.3	4.7	7.9	12.0	7.9	15.1	9.0	10.2	8.8
		AAQ15	-	-	-	-	-	3.7	4.0	4.8	5.6
		AAQ16	-	-	-	-	3.4	3.2	3.8	3.9	6.1
		AAQ17	-	-	-	-	-	12.3	4.8	2.4	5.4
		AAQ19	-	-	-	-	-	6.2	4.9	4.6	5.6
		AAQ21	-	-	-	-	-	10.5	11.2	10.2	10.1
		Average	**9.3**	**4.5**	**8.8**	**12.5**	**9.0**	**6.8**	**6.5**	**7.5**	**9.3**
Receptors	Azim Kend	ST11/AAQ11	3.2	4.7	4.9	4.0	4.6	3.3	3.6	3.9	5.5
	Sangachal	ST07/AAQ7	N/A	4.7	10.2	13.0	86.0	6.2	11.7	12.3	11.4
		AAQ22						14.0	10.3	11.4	10.9
	Umid	ST09/AAQ9	N/A	6.0	7.4	11.0	10.8	9.6	7.8	8.7	10.4
		Average	**3.2**	**5.1**	**7.5**	**9.3**	**8.6**	**8.9**	**9.6**	**9.8**	**3.2**
Terminal		ST01	25.0	4.5	10.4	8.7	-	-	-	-	-
		ST02	23.0	4.7	9.4	14.0	-	-	-	-	-
		ST03	30.0	13.0	22.3	30.0	-	-	-	-	-
		ST04	29.0	4.3	18.0	18.0	-	-	-	-	-
		ST05	8.6	6.6	14.9	13.0	-	-	-	-	-
		ST06/AAQ6	8.0	5.8	9.8	14.0	-	11.4	14.0	13.5	14.0
		ST12/AAQ12	36.0	10.2	19.8	17.0	9.1	13.7	7.7	9.5	8.8
		AAQ13	-	-	-	-	17.5	9.3	19.1	12.0	
		AAQ14	-	-	-	-	9.4	4.2	3.9	6.3	6.9
		AAQ18	-	-	-	-	5.0	9.6	5.4	7.8	8.7
		AAQ20	-	-	-	-	-	11.3	5.5	9.2	8.1
		Average	**22.8**	**7.0**	**14.9**	**16.4**	**9.7**	**8.0**	**9.4**	**7.4**	**22.8**

Sulphur Dioxide (SO_2)

Table 6A-2 summarises the monitoring data collected for SO_2 between 2003 and 2011.

Table 6A-2 SO_2 Monitoring Data ($\mu g/m^3$), 2003-2011

Group		Monitoring Station	Year								
			2003	2004	2005	2006	2007	2008	2009	2010	2011
Background		ST08/AAQ8	N/A	19.2	25.9	3.7	11.2	1.7	3.3	5.2	10.0
		ST10/AAQ10	1.7	130	15.9	1.9	1.8	7.3	3.5	3.7	10.8
		AAQ15	-	-	-	-	-	N/A	1.4	0.8	5.4
		AAQ16	-	-	-	-	-	7.3	3.5	0.8	13.9
		AAQ17	-	-	-	-	-	N/A	0.8	2.1	1.0
		AAQ19	-	-	-	-	-	N/A	2.5	4.7	3.2
		AAQ21	-	-	-	-	-	N/A	70.8	5.3	1.7
		Average	**1.7**	**74.6**	**20.9**	**2.8**	**6.8**	**12.6**	**2.9**	**4.9**	**9.2**
Receptors	Azim Kend	ST11/AAQ11	1.7	12.5	37.7	2.7	13.4	12.5	1.8	21.6	6.5
	Sangachal	ST07/AAQ7	N/A	296.0	3.5	4.2	2.0	1.5	7.6	3.6	5.3
		AAQ22						n/a	2.8	0.8	5.7
	Umid	ST09/AAQ9	N/A	279.8	14.9	9.1	11.7	42.8	9.0	4.3	9.7
		Average	**1.7**	**196.1**	**18.7**	**5.3**	**9.0**	**12.4**	**4.7**	**8.0**	**6.2**
Terminal		ST01	1.6	8.45	18.1	10.2	-	-	-	-	-
		ST02	1.6	9.5	18.5	6.5	-	-	-	-	-
		ST03	1.6	21.1	11.3	29.6	-	-	-	-	-
		ST04	1.6	16	12.9	7.0	-	-	-	-	-
		ST05	1.7	26.6	49.5	2.8	-	-	-	-	-
		ST06/AAQ6	1.7	215	4.4	24.0	N/A	1.1	10.0	11.2	26.1
		ST12/AAQ12	1.6	17.5	5.2	20.0	3.0	1.0	8.5	4.7	N/A
		AAQ13	-	-	-	-	3.8	50.2	3.3	N/A	N/A
		AAQ14	-	-	-	-	1.8	0.9	2.3	5.3	N/A
		AAQ18	-	-	-	-	-	102.6	17.8	0.9	3.5
		AAQ20	-	-	-	-	-	N/A	2.0	2.1	11.5
		Average	**1.6**	**44.9**	**17.1**	**14.3**	**27.8**	**12.2**	**4.5**	**7.2**	**11.2**

Benzene

Table 6A-3 summarises the monitoring data collected for Benzene between 2003 and 2011.

Table 6A-3 Benzene Monitoring Data (µg/m^3), 2003-2011

Group		Monitoring Station	Year								
			2003	2004	2005	2006	2007	2008	2009	2010	2011
Background		ST08/AAQ8	N/A	1.0	1.5	1.3	1.2	0.9	2.1	3.4	1.4
		ST10/AAQ10	1.6	0.8	1.2	2.2	2.2	1.3	4.1	2.8	1.7
		AAQ15	-	-	-	-	N/A	0.7	3.1	2.3	2.2
		AAQ16	-	-	-	-	1.4	0.7	3.5	3.5	1.6
		AAQ17	-	-	-	-	-	N/A	2.6	1.8	2.0
		AAQ19	-	-	-	-	-	0.6	2.9	2.3	2.6
		AAQ21	-	-	-	-	-	1.6	2.5	2.3	1.4
		Average	**1.6**	**0.9**	**1.4**	**1.8**	**1.6**	**1.0**	**3.0**	**2.6**	**1.8**
Receptors	Azim Kend	ST11/AAQ11	1.4	0.7	1.2	1.2	1.4	1.6	2.2	2.4	0.9
	Sangachal	ST07/AAQ7	N/A	2.0	2.3	1.9	17.9	3	20.8	68.3	2.2
		AAQ22						1.4	4.4	4.7	2.0
	Umid	ST09/AAQ9	N/A	1.3	2.7	2	1.6	1.4	3.7	3.1	1.8
		Average	**1.4**	**1.4**	**2.1**	**1.7**	**7.0**	**1.9**	**8.7**	**23.0**	**1.8**
Terminal		ST01	1.4	0.7	1.3	1.2	-	-	-	-	-
		ST02	1.5	0.6	1.2	1.8	-	-	-	-	-
		ST03	1.8	1.4	1.4	1.7	-	-	-	-	-
		ST04	1.8	1.1	1.6	1.2	-	-	-	-	-
		ST05	2.1	3.3	1.2	1.5	-	-	-	-	-
		ST06/AAQ6	1.9	1.0	1.5	1.6	N/A	4.2	9.1	6.4	12.2
		ST12/AAQ12	1.7	1.0	1.4	1.3	1.5	1.1	3.7	3.8	4.0
		AAQ13	-	-	-	-	N/A	0.8	3.6	N/A	N/A
		AAQ14	-	-	-	-	4.7	0.6	3.3	2.7	N/A
		AAQ18	-	-	-	-	-	0.8	4.0	2.6	1.7
		AAQ20	-	-	-	-	-	1	8.0	4.0	2.1
		Average	**1.7**	**1.3**	**1.4**	**1.5**	**3.1**	**1.4**	**5.3**	**3.9**	**5.0**

Volatile Organic Compounds (VOCs)

Table 6A-4 summarises the monitoring data collected for VOCs between 2003 and 2011.

Table 6A-4 VOC Monitoring Data (µg/m^3), 2003-2011

Group		Monitoring Station	Year								
			2003	2004	2005	2006	2007	2008	2009	2010	2011
Background		ST08/AAQ8	N/A	47.0	32.0	81.0	53.5	23.0	69.0	69.6	67.3
		ST10/AAQ10	14.0	36.0	31.0	85.0	86.0	28.7	102.0	83.7	50.9
		AAQ15	-	-	-	-	N/A	29.0	56.0	36.9	119.5
		AAQ16	-	-	-	-	254.0	19.5	62.0	44.7	269.3
		AAQ17	-	-	-	-	N/A	N/A	46.0	41.3	74.9
		AAQ19	-	-	-	-	-	15.0	39.0	45.3	381.0
		AAQ21	-	-	-	-	-	99.0	95.0	85.6	66.3
		Average	**14.0**	**41.5**	**31.5**	**83.0**	**131.2**	**35.7**	**67.0**	**58.2**	**147.0**
Receptors	Azim Kend	ST11/AAQ11	5.3	49.3	24.0	86.0	62.5	29.3	45.0	67.9	37.5
	Sangachal	ST07/AAQ7	N/A	62.7	36.0	70.0	155.0	46.7	687.0	1858.3	78.6
		AAQ22						48.7	120.0	118.1	81.6
	Umid	ST09/AAQ9	N/A	51.3	41.0	63.0	179.5	21.7	93.0	71.6	59.3
		Average	**5.3**	**54.4**	**33.7**	**73.0**	**132.3**	**38.8**	**269.7**	**620.8**	**67.4**
Terminal		ST01	120.0	50.7	50.0	53.0	-	-	-	-	-
		ST02	18.0	46.0	33.0	69.0	-	-	-	-	-
		ST03	26.0	53.0	67.0	75.0	-	-	-	-	-
		ST04	34.0	55.3	55.0	77.0	-	-	-	-	-
		ST05	18.0	57.0	36.0	50.0	-	-	-	-	-
		ST06/AAQ6	11.0	65.5	27.0	60.0	N/A	115.3	297.0	208.6	444.4
		ST12/AAQ12	26.0	63.3	28.0	53.0	63.5	27	205.0	240.5	261.5
		AAQ13	-	-	-	-	83.5	27.7	132.0	73.0	N/A
		AAQ14	-	-	-	-	67.0	45.0	64.0	56.9	N/A
		AAQ18	-	-	-	-	132.0	24.7	128	64.9	74.4
		AAQ20	-	-	-	-	-	34.7	672.0	272.7	102.5
		Average	**36.1**	**55.8**	**42.3**	**62.4**	**86.5**	**45.7**	**249.7**	**152.8**	**220.7**

Automatic Monitoring Station

A real-time monitoring station located at AAQ23 measuring NO, NO2, NOx, SO2 and Particulates (PM10). The monitoring equipment is located inside a pump station and is close to the highway and the Sangachal Power Station. This area may be influenced by vehicle traffic and other industrial emissions. Frequent interruptions to the electrical supply have lead to equipment system failures over time. The station has been effectively non-operational since 2010. Table 6A-5 summarises the monitoring data collected from the monitoring station for PM_{10} in 2009 and 2010.

Table 6A-5 PM_{10} Concentrations 2009 and 2010 ($\mu g/m^3$)

Month	PM_{10} Concentrations ($\mu g/m^3$)	
	2009	2010
February	102	-
March	52	-
April	26	-
May	115	51
June	-	56
July	-	33
August	-	125
September	-	146
October	-	118
November	-	160
December	-	180
Average	74	109

APPENDIX 6B

Bird Survey Report

Appendix 6B
Bird Survey

CONTENTS

1. Introduction

The Absheron-Pirallahi coastline of the Caspian Sea represents a migration route for waterfowl and coastal birds nesting in European parts of Russia, western Siberia, north-western Kazakhstan and migrating to southern coasts of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, southwest Asia and Africa for wintering. During the migration, a large number of birds stop in this area for rest and feeding. Then, they stay in this area for wintering and nesting in numbers of international significance, while the rest fly on (4, 5, 8, 9, 10).

In addition to its diverse bird fauna, this area also represents importance to the development of the oil industry. A large number of birds, including those listed in the Red Book of Azerbaijan and the Red List of Threatened Species of the International Union for the Conservation of Nature (IUCN) (1, 14), can perish as a result of negative impacts of oil production and transportation in this and adjacent areas.

The objective of the survey is to analyse the literature on the number and species of the birds inhabiting the area, which has been published since 2002, and to identify the birds temporarily and permanently inhabiting the Absheron-Pirallahi coastline and the importance of this area for these species.

1.1 Research carried out and its analysis

The migration (initial, active and in the last days), wintering and reproduction periods of waterfowl and coastal birds differ from each other. However, the birds of Pirallahi-Shahdili area of the Caspian Sea have been studied only in winter (11-12.01.2002; 22-23.01.2004; 15-16.01.2005; 15-26-01.2006), in the first days of spring migration (18.02.2003), during incubation and hatching phases (28.05-4.06.2006) of the reproduction period (3, 11).

1.2 Biotopes, migration, species and numbers of birds during wintering and reproduction

Pirallahi coastline: The habitat of birds mainly stretches from a large shallow coastal area of the sea (4-5 km into the sea) to a narrow (5-20m) humid sandy area. Coastal water in the north and south of the island (southern Absheron bay) is contaminated with oil. Only occasional movement of motor vehicles of oil companies can be observed here. This disturbs the birds and forces them to move to other areas. The south-eastern and western coastline of the island (northern Absheron bay) is not contaminated. On windy days (depending on wind direction), birds shelter either on the western or eastern side of the bay, or near the dam connecting the island with the Absheron Peninsula. Water depth here is 5m in the centre, but it sharply decreases towards the coast. Coastal pattern is quite diverse. While the western coastline mainly consists of ravines, the south-eastern part of the island is covered with moist sands. The constant movement of people can be observed in the sandy areas. There are underwater and above-water rocks in the central part of the bay. The complex terrain limits the movement of motorboats. The diversity of substrates creates favourable conditions for the development of phyto-benthos and zoo-benthos, which serves as food for the birds. Thirteen species of phyto-benthos and 10 species of zoo-benthos have been recorded in this area. The biomass of *Abra ovata* and *Mytilaster lineatus* bottom fauna is dominant (7). This leads to the accumulation of internationally significant numbers of birds in clean water areas of the island during wintering and migration.

In the beginning of spring migration (18.02.2005), 19 bird species – a total of 7559 birds - dwell in coastal waters of Pirallahi Island, 7397 of them are waterfowl, while 162 are coastal birds. Among the waterfowl only the number of *Podiceps cristatus* and *Aythya ferina* exceeds the 1% limit (12, 13) established for the provision of the RAMSAR status (i.e. of international importance). These species are endangered, i.e. *Cygnus olor* is included in the Red Book of Azerbaijan, while *Pelecanus crispus* is included both in the Azerbaijan Red Book and the IUCN Red List of Threatened Species.

Shahdili coastline: The habitat of waterfowl and coastal birds consists in a large shallow coastal area of the sea (4-5 km into the sea), the lagoons in the dry land of the Shahdili cape, thin reed and tamarisk bushes, narrow (2-10 m) moist sands, Tulen, Gu, Greater Tava, Small Tava and other islands. 783 hectares of the territory is part of the Absheron National Park. There is no oil contamination on the territory of the park. On windy days, birds shelter in Shahdili lagoons, different parts of the island stretching deep into the sea (10 km, width 600 m) and other islands. The sea is rich in key food source of the waterfowl such as seaweed, phyto-benthos and zoo-benthos. The constant movement of motor vehicles belonging to people catching fish outside protected areas, poachers and oil companies can be observed. This disturbs the birds and forces them to move towards quieter areas of sea which are not as abundant in terms of food. 26 species of birds (a total of approximately 28436 birds) dwell here in the beginning of the spring migration (19.02.2005). 28239 of these birds are waterfowl and 197 are coastal birds. The number of waterfowl such as *Podiceps cristatus, Cygnus olor, C.cygnus, C.bewickii, Netta rufina, Aythya ferina* and *A.fuligula* exceeds 1% limit established for the provision of the RAMSAR status in wetland areas and the total number of waterfowl exceeds the 20,000 threshold (12, 13). Some endangered birds dwell here, thus *Phoenicopterus roseus, Cygnus olor, C.bewickii* are listed in the Red Book of Azerbaijan, *Aythya nyroca* in the IUCN Red List of Threatened Species and *Pelecanus crispus* is included both in the Red Book of Azerbaijan and the IUCN Red List of Threatened Species.

1.3 Species and numbers of birds during reproduction period

Pirallahi coastline: Birds nest on old rigs and some small islands. Only 14 species of waterfowl (*Phalacrocorax carbo*) and 4 species of coastal birds (*Larus cachinnans, Sterna sandivicensus, S.albifrons, S.hirundo*) were registered in this area. A total of 102 birds were registered.

Shahdili coastline: Birds nest on old rigs, reeds, on Sah, Tulen, Gu and other islands. Only four species of waterfowl *Phalarocorax carbo* (a total of 30), *Tachybabtus ruficollis* (a total of 6), *Tadorna ferruginea* (a total of 2), *Fulica atra* (a total of 15) and 12 species of coastal birds were registered. The most numerically abundant were *Larus cachinnans* (a total of 1760), *Sterna hirundo* (a total of 300) and *S.sandivicensis* (a total of 260). In total, there were 2552 coastal birds (5).

The reproduction period of birds in the Pirallahi and Shahdili coastline starts at the end of April / beginning of May and continues until mid-July. At the end of July and beginning of August they leave nesting places and disperse across in the territory.

1.4 Species and number of wintering birds

Pirallahi coastline: The absolute majority of wintering birds are waterfowl. The average number of waterfowl in 2002-2006 was 24873, while the number of coastal birds was 181.

In different years different species of birds reached internationally important numbers. For example, the number of *Podiceps cristatus* exceeded 1% limit established for the provision of the RAMSAR status in wetlands in 2002, *Aythya ferina* passed this threshold in 2004, 2005, 2006, while *Aythya fuligula* and *Falica atra* in 2006. The total number of waterfowl exceeded the 20,000 threshold required for the RAMSAR status to wetlands.

Two species of rare and endangered birds were registered. They were *Cygnus olor* listed in the Red Book of Azerbaijan and *Numenius arquata* listed in the IUCN Red List of Threatened Species.

Table 1 Species and Numbers of Birds in the Area (Total Number)

Name of species and ecological group	11-12.02. 2002		12-19.02. 2003		22-23.01. 2004		15-16.01. 2005		28.05-04.06. 2005		15-26.01. 2006		1% threshold
	Pirallahi	Shahdili	Pirallahi	Shahdili	Pirallahi	Shahdili	Pirallahi	Shahdili	Pirallahi	Shahdili	Pirallahi	Shahdili	
Waterfowl Total	22442	21733	7397	28239	22138	22005	29027	29063	14	53	25259	12020	
Podiceps ruficollis - little grebe		24	7		11		8	2		6		18	10000
P.nigricollis - black-necked grebe	51	15		14	148	27	119	44			219	44	250
P.auritus – eared grebe					1			1			2	11	150
P.grisegena – red-necked grebe		2			6								150
P.cristatus – great crested grebe	376	9	120	120	61	43	66	27			90	82	100
Pelicanus crispus – Dalmatian pelican			3	2		4							110
Phalacrocorax carbo – Great Cormorant	27	6	19	30	16	4	20	1	14	30	55	250	1000
Ph.pygmaeus – little cormorant	2	15	3	12								44	1000
Cygnus olor – mute swan	95	36	350	3700	1			2				300	2500
C.cygnus- whooper swan	19	2	150	400	18			16			4	16	200
C.bewickii –Bewick's swan				33									5
Tadorna ferruginea – Ruddy Shelduck	1									2			500
Tadorna tadorna – Common Shelduck											1	48	800
Anas acuta – northern pintail												800	7000
A.penelope – Eurasian Wigeon			470	1200		338		25				370	2500
A.crecca – Common Teal	25	20	600			77							15000
Anas platyrhynchos – Mallard	108	1016		2200	365	1479	67	2017				350	8000
A.clupeata – Common shoveller			300	1300		9		42					4000
A.sterepera – Gadwall				1		6							1300
Netta rufina – Red-crested Pochard		1	820	6000	2	13	17	3067			493	1100	2500
Aythya nyroca – Ferruginous Duck				22									1000
A.ferina – Common Pochard	99	3192	375	4500	8910	5360	4632	6660			8088	7000	3500
A.marila – Greater Scaup			180	400								15	1500
A.fuligula – Tufted Duck	1845	4142	2100	8500	1606	10000	883	9645			4965	312	2000
Bucephala clangula – Common Goldeneye	3	1			1	3		5			5	44	250
Merqus albellus – Smew	2	1				4					16	18	300
M.serrator – Red-breasted Merganser	56	1			25	3	33				163		200
Fulica atra – Eurasian Coot	19835	13230	1900	3600	11064	4612	23177	2010		15	11284	1200	20000
Coastal birds Total	412	369	162	197	24	23	180	144	102	2552	108	256	
Botaurus stellaris – Eurasian Bittern		1											

Eqretta garzetta– Little Egret	16	18	4	6	8	3					4		580
E.alba - Great Egret		6			2	6					4		1000
Ardea cinerea - Grey Heron	4	6			2	3				4			
A.purpurea – Purple Heron													
Phoenicopterus roseus - Greater Flamingo				6							4		2900
Recurvirostrab avosetta - Pied Avocet				6	13								
Charadrius dubius – Little Ringed Plover													
Ch.hiaticula – Ringed Plover	25				5		15			4			
Ch.alexandrinus – Snowy Plover		1								10			
Ch.beshenaultii – greater sand plover	2												
Pluvialis squatarola – Grey Plover					4	1							
Calidris temminckii - Temminck's Stint	190	60											
C.alpina – Dunlin		1	11	48			75					106	
Gallinago gallinago – American snipe				4		10		3					
Numenius arquata - Eurasian Curlew	1												
Tringa nebularia - Common Greenshank		4										12	
Larus minutus – Little Gull							21	3			4		
L.ridibundus – Black-headed Gull	1						1	3					
L.genei – Slender-billed Gull	6				1					90			
L.canus – Common Gull	1				1		12				11	18	
L.cachinnans – Caspian Gull									20	1760			
L.argentatus – Herring Gull	66	290	141	94	1		56	134			85	104	
Sterna sandvicensis- Sandwich Tern								1	32	260			
S.albifrons – Little Tern									8	80			
Sterna hirundo – Common Tern									42	300			
Ch.leucopterus – White-winged Black Tern										20			
Chlidonias hybrida – Whiskered Tern										10			
Gallinula chloropus – Common Moorhen				12									
Rallus aquaticus – Water Rail				14						10		12	
Porphyrio porphyrio – Purple Swamphen										4			
Total number	22856	22000	7559	28436	22162	22028	29207	23714	116	2605	25267	12276	
Total species	25	26	19	26	24	20	17	20	5	16	21	26	

Shahdili coastline: As is the case in Pirallahi, the majority of birds in this coastline are waterfowl. The total number of waterfowl in 2002-2006 was 20004, while coastal birds numbered 198. The various species of waterfowl reached a number of international importance in different years (2, 11). For example, the number of *Podiceps cristatus* exceeded 1% limit established for the provision of the RAMSAR status in wetland areas in 2002, *Aythya ferina* passed this threshold in 2004, 2005, 2006, while *Aythya fuligula* and *Falica atra* in 2006. The total number of waterfowl exceeded the 20,000 threshold required for assignment of RAMSAR status to wetland areas

Three species of rare and endangered birds were registered. They were *Cygnus olor* and *Porphyrio porphyrio* listed in the Red Book of Azerbaijan and *Pelecanus crispus* listed both in the Red Book of Azerbaijan and the IUCN Red List of Threatened Species.

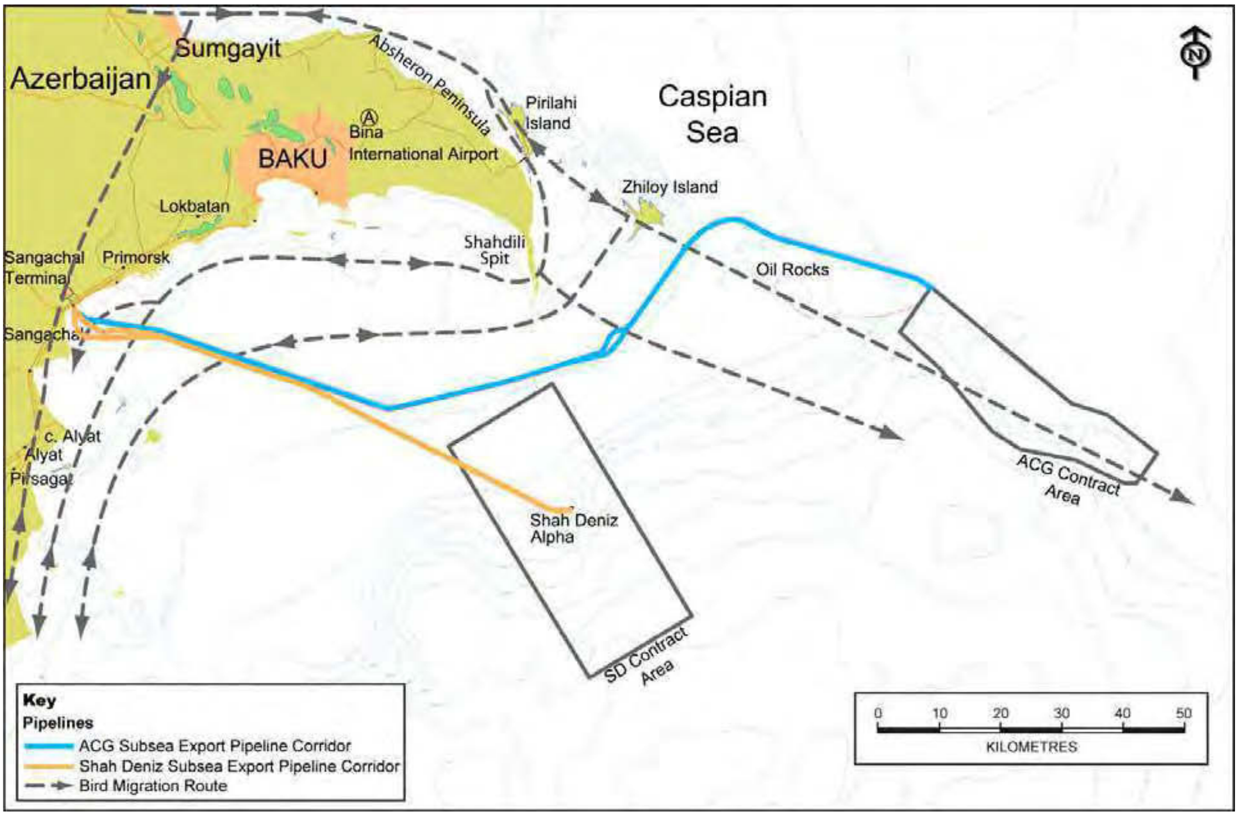
1.5 Migration Period and Direction

The autumn migration of the waterfowl and coastal birds in Absheron mainly starts in the second half of August and continues until mid-December. In case of severe winter conditions in Russia, this migration continues until 10 January. The most active period of migration is November. The spring migration starts in the second half of February and finishes in April with March being the most active period (9, 10). During the autumn migration, 51.43% of birds fly along the Caspian coast to the south, 36.64% fly to the southwest, while 11.93% of the birds fly from the Pirallahi-Shahdili coastline to the southeast (Figure 1). In spring, 39.76% of the birds fly to the north, 26.32% to the northwest and 25.50% to the northeast (6).

The following conclusions from the analysis of the data can be drawn:

1. Pirallahi and Shahdili coastlines have an international importance as a waterfowl habitat. The total number of waterfowl migrating or wintering in this territory exceeds the 20,000 threshold set for the provision of the RAMSAR status of wetlands and the number of individual species (*Podiceps cristatus, Cygnus olor*, *Netta rufina, Aythya ferina* və *A.fulica*) is above 1% limit for the said status;
2. 59 species of birds of waterfowl and coastal ecological groups inhabit the Pirallahi and Shahdili coastlines; and
3. In order to provide an objective assessment of the negative impact on birds around the Shah Deniz Contract Area, birds must be monitored throughout the year (in winter in January, during the active migration period in March, egg-laying and hatching phases of the reproduction period in May-June, the growing and dispersing period of younglings at the beginning of August, and during November migration period).

Figure 1 Migration Movements of Birds



1.6 Reference Literature

1. Red Book of Azerbaijan SSR. Baku. “İşıq” publishing house, 1989 – ***in Azeri***
2. Babayev I. R., Salifova Sh. H. Large accumulation areas of the waterfowl in Absheron-Gobustan area of the Caspian Sea and the sensitivity of these areas to oil spills. Materials from the 1st Congress of Azerbaijan Society of Zoologists. Baku, “Elm”, 2003 **– *in Azeri***
3. Babayev I. R., Gandilov N. Q. Absheron-Gobustan, Ecological peculiarities and protection of rare, endangered birds in Southeast Shirvan and adjacent Caspian Sea coastal water (final report). ANAS Institute of Zoology. Baku, 2003 **– *in Azeri***
4. Babayev I. R., Asgarov F., Ahmadov F. T. Biodiversity, Waterfowl in Azerbaijan Sector of the Caspian Sea. Baku, “Nurlar” publishing house graphic art centre, 2007 **– *in Azeri***
5. Babayev I. R. Distribution and quantitative indicators of waterfowl and coastal birds during the reproduction period on Azerbaijan coasts of the Caspian Sea//Theses of scientific practical congress “Academician Hasan Aliyev and Azerbaijan” dedicated to the 100th anniversary of prominent scientists and public figure Hasan Aliyev. Baku. “Çaşıoğlu” publishing house, 2007 **– *in Azeri***.
6. Karabanova N. I. Migrations of birds in the northeast part of Azerbaijan. Abstract of a thesis for a degree of Cand. S. {Biology}. Kishinyov, 1991 **– *In Russian***.
7. Kasimov A.G. Ecology of the Caspian Lake, “Азербайджан” publishing house, Baku, 1994 **– *In Russian***.
8. Gambarov K. M. et al. Materials on Absheron Peninsula birds. “Tutorial notes ASU named after S.M.Kirov, series biology” No 1.1958 **– *In Russian***.
9. Mustafayev G. T., Sadigova N. A. Azerbaijan birds (defining monograph) Baku, “Çaşoğlu” publishing house, 2005 **– *In Azeri***.
10. Tuayev D. G. Catalogue of Azerbaijan birds. Baku, “Elm”, 2000 **– *In Azeri***.
11. Aspinal S., Babayev I. et al. Monitoring study of the waterfowl in winter from Absheron Peninsula to Kura river estuary (final report 2002-2006). URS, BP, Baku, 2006 **– *In Russian***.

12. Scott, D. A. & Rose, P. M. 1996. Atlas of Anatidae populations in Africa and Western Eurasia/ Wetlands International, Wageningen, The Netherlands – ***In English***.
13. Delany, S & Scott, D.A. 2002. Waterfowl Population Estimates. Third edition Wetlands international Global Series N 12, Wageningen, The Netherlands – ***In English***.
14. Threatened birds of the world (Official IUCN Red list), Birdlife international – ***In English***.

APPENDIX 6C

Fish and Fishing Review Report

Appendix 6C
Fish Report

Table of Contents

List of Tables

List of Figures

1 Background Information

1.1 Sources of Information

Information presented in this review, prepared by Professor Mehman M Akhundov (Doctor of Biological Science), has been taken from the following sources:

- Governmental bodies of the Azerbaijan Republic responsible for the control and regulation of commercial fishing in the Azerbaijan sector of Caspian Sea;
- Fishing fleet of legal entities and individuals carrying out commercial fishing in the Azerbaijan sector of Caspian Sea; and
- Azerbaijan Scientific-Research Institute of fishing industry (AzerNIIRKh) of the Ministry of Ecology and Natural Resources (MENR) of the Azerbaijan Republic.

1.2 Regulatory Bodies and Licensing

The following are regulatory governmental bodies of the Azerbaijan Republic that control commercial fishing activity in the Azerbaijan sector of Caspian Sea:

- State Marine Administration (SMA);
- Ministry of Emergency Situations (MChS);
- Department on Protection and Reproduction of Aquatic Bioresources (DPRAB) of the Ministry of Ecology and Natural Resources (MENR);
- Marine Transport Police (MTP) under the Ministry of Internal Affairs (MIA); and
- State Frontier Police (SFP).

Functions of regulatory governmental bodies are outlined in Table 1.0.

Table 1.0 – Functions of Regulatory Government Bodies

Regulatory Government Body	Function
SMA	Issues documents regarding identity/ownership of vessel, crew composition, country where the vessel is registered.
MChS	Checks technical condition of vessel, issues technical passport for the vessel: • For small vessels control is carried out by specific inspectorate of MChS; and • For large vessels permits are issued by the Shipping Register of Russian Federation that has representation office in Baku.
DPRAB-MENR	For vessels with relevant documentation issued by SMA and MChS, DPRAB-MENR: • Issues official permit and determines quota for fishing (licence) for specific vessel; and • Undertakes inspection to confirm compliance with volume and species composition of bioresources (fish) caught by the vessel with the official permit issued by DPRAB-MENR.
MTP	For vessels with relevant documentation issued by SMA, MChS and DPRAB-MENR, MTP: • Checks vessel activities correspond with its functionality and technical status; • Confirms whether the vessel is intended for fishing or other purposes, e.g. for transportation of dry cargo; • Checks whether the vessel is a passenger vessel or tank vessel (liquid cargo), or some other; and • Confirms whether it holds an official permit (licence) from DPRAB-MENR for fishing - without such documents MTP would not allow the vessel to sail.

Regulatory Government Body	Function
SFP	For vessels with relevant documentation issued by SMA, MChS and DPRAB-MENR, SFP: • Checks with what purpose the vessel sails off; and • Whether it holds an official permit (licence) from DPRAB-MENR - fishing of bioresources (fish) within the 10-mile fishing zone it controls - without these documents SFP would not allow the vessel to sail.

1.2.1 Fishing Licence Requirements

To obtain a licence for fishing of bioresources (i.e. a fishing licence) legal entities or individuals need to apply to the DPRAB of the MENR with the following documents:

- A copy of the relevant by-law;
- Registration certificate;
- Certificate issued by tax inspection;
- Documents specifying vessel's owner (legal entity or individual); and
- Technical documentation regarding vessel condition (register).

An application for a fishing licence should specify:

- Vessel name;
- Requested volume (quota) and fish species composition (kilka, grey mullet, herring, ordinary/small fish[1)]; and
- Area (including coordinates) of planned activities.

1.2.2 Sturgeon Fishing Licensing

Licences for catching sturgeon (*Acipenseridae*) are only issued for scientific-research activities (where a quota applies), as well as for the artificial reproduction for sturgeon farms. Two documents are required; namely a special permit and fishing licence. The scientific-research vessel (SRV) "Alif Gadzhiyev" is used for catching sturgeon, with numbers limited by the scientific quota. Every year two Caspian expeditions are carried out to assess sturgeon populations using this vessel (during summer and winter). These two scientific expeditions are organized by the AzerNIIRKh to assess:

- Population numbers (i.e. abundance);
- Field reserves and distribution of sturgeons in the Azerbaijan waters of Caspian Sea, changes in distribution; and
- Ratio of various sturgeon populations in Azerbaijani waters of the Caspian Sea.

In addition to the special permit and licence for sturgeon fishing associated with scientific-research purposes, permission is also granted by AzerNIIRKh for fishing at two nearshore stations during the year at Nabran (Yalama-6, Middle Caspian) and Narimanabad (Southern Caspian). In addition, special permits and fishing licences are also issued every year, in March-April, to legal entities or individuals, for the purpose of artificial reproduction of sturgeons so that fish farms have an adequate quantity of sturgeon breeding stock.

[1] The main focus of commercial fishing is kilka

1.2.3 Commercial Fishing Licence Requirements and Reporting

To control commercial fishing, DPRAB-MENR issue:

- A special permit, and
- A fishing licence.

The name of the vessel and name of person responsible for fishing are indicated in these documents, which are issued after the legal entity or individual (i.e. the applicant) has paid a fee to a DPRAB dedicated account intended to provide compensation for the use of biological resources. At the end of each year this money is transferred from the DPRAB dedicated account to the Environment Protection Fund under MENR. Permit and fishing licence are issued to the applicant for a period from the day of his application by DPRAB-MENR to the end of the current calendar year. These documents authorise the applicant to carry out fishing in accordance with the licence conditions. DPRAB also issues official notification to the Agency for the Protection of Aqueous Bioresources (a Department of DPRAB), and copy of this notification is provided to the successful applicant.

At the end of each month the legal entity/individual is required to submit a report detailing the results of their fishing activities to DPRAB. According to the Law of the Azerbaijan Republic on fishing (1998), representatives of DPRAB (Agency for Protection of Aqueous Bioresources Department) have the right to be present during fishing and to check relevant documents.

1.3 Commercial (Field) Activity in the Azeri-Chirag-Guneshli and Shah Deniz Contract Areas and Adjoining Areas of the Caspian Sea

Currently the following legal entities and individuals carry out commercial fishing in the Southern Caspian including the Azeri-Chirag-Guneshli (ACG) and Shah Deniz (SD) Contract Areas which are located within the western section of the Southern Caspian:

- Closed joint-stock company (ZAP) “Khazarbalig” (“Khazarbalig” MMM);
- Closed joint-stock company (ZAO) “Khazar-Shay Company” (“Khazar-Shay Company” MMC);
- Closed joint-stock company “Baku marine fishing harbor” (“Baku Deniz Balig Limani” MMC);
- Commercial company “Globus-5” (“Globus-5” IKF);
- Closed joint-stock company “Gartal” (“Gartal firmasi” MMC);
- Closed joint-stock company “Caspian Fish Co Azerbaijan”;
- Open joint-stock company (OAO) Z.Tagiyev Fish curing plant;
- Individual - A. Mamedov;
- Individual - A. Guliyev; and
- Individual - R. Gasanov.

Currently, in accordance with the permits issued by regulatory bodies discussed in Section 1.2 above, 25 vessels registered in Azerbaijan carry out commercial fishing in the Southern Caspian including the ACG and SD Contract Areas. These vessels, which all operate under annual permits, issued from the beginning of the calendar year, and their technical specifications are listed in Table 2.0.

Table 2.0 – Specifications for National Fishing Vessels Having Permit for Commercial Fishing in the Southern Caspian (Including the ACG and SD Contract Areas), 2009 Data[1]

Legal Entity/Individual	Vessel Type and Name[2]	Vessel Displacement (Tonnes)	Powerplant output (kWt)	Deadweight (Tonnes)	Fishing Equipment Used
Legal Entities					
ZAO "Khazar-Shay Company	LTV "Shay-1"	86.01	165	57	Cone-shaped net
	LTV "Shay-2"	86.01	165	54	Cone-shaped net
	LTV "Shay-3"	86.01	165	54.08	Cone-shaped net
	LTV "Shay-5"	86.01	165	54	Cone-shaped net
ZAO "Baku marine fishing harbor"	LTV "Mardakan"	86.01	165	57	Cone-shaped net
	LTV "Tebriz"	86.21	165	56.86	Cone-shaped net
	SB "Akhmedli"	85.04	110	38	Cone-shaped net
	MFT "Lenkoran baligchisi"	723	852	414	Fish pump
	MFT "Namig Hafizoglu"	722	852	414	Fish pump
Commercial company "Globus-5"	LTFV-50 "Antaris"	190	232	70	Cone-shaped net
ZAO "Gartal"	LTV -29	81	132	54	Cone-shaped net
ZAP "Khazarbalig"	SB "Dolphin"	85.04	110	38	Cone-shaped net
	SB "Shusha"	86.01	166	54	Cone-shaped net
	SB "Fortuna"	85.04	110	38	Cone-shaped net
	LTV "Shans"	86	165	31	Cone-shaped net
	LTV "Dalga"	85.02	166	54	Cone-shaped net
	LTV "Bayaz"	86.01	166	54	Cone-shaped net
ZAO "Caspian Fish Co Azerbaijan"	LTFV-50 "Shahriyar"	189	232	73	Cone-shaped net
OAO Z.Tagiyev Fish curing plant	SB "Nardaran"	85.04	110	38	Cone-shaped net
Individuals					
A. Mamedov	SB "Khazar"	78	110	26	Cone-shaped net
	LTV "Kompas"	86.3	165	54	Cone-shaped net
	LTV "102"	86	165	31	Cone-shaped net
A. Guliyev	LTV «Mirmohammed -96"	86.01	166	54	Cone-shaped net
R. Gasanov	LTV "Sir"	86.03	165	54	Cone-shaped net
	SB "Gobustan"	85.04	165	38	Cone-shaped net

Notes:
1 – DPRAB, Closed joint-stock company (ZAP) "Khazarbalig", "Lenkoran fish plant"
2 – Vessel types:
LTV – Lifting Transportation Vessel;
LTFV – Lifing Transportation Freezer Vessel;
SB – Seine Boat; and
MFT – Medium Freezer Trawler
Refer to Section 2.3.1 below for further data regarding vessel types

Cone-shaped nets on the vessels detailed in Table 2.0 are used at a maximum depth of 20 to 90m from the sea surface, and fish pumps are used at a maximum depth of 100-120m.

In Table 3.0, 19 additional fishing vessels are listed as belonging to various legal entities and individuals. Currently these vessels do not have a permit for commercial fishing for various reasons including technical or commercial issues, however, if they obtain such permits from the regulatory bodies they could potentially operate in the Southern Caspian, including the ACG and SD Contract Areas.

Table 3.0 – Fishing Vessels of Legal Entities and Individuals That Currently Do Not Have Permits for Commercial Fishing, 2009 Data[1]

Legal Entities and Individuals	Vessel Type and Name[2]	Vessel Displacement (Tonnes)	Powerplant output (kWt)	Deadweight (Tonnes)	Used Fishing Equipment
Legal Entities					
ZAP "Khazarbalig"	OSA "T.Ismailov"	86.01	166	54	Cone-shaped net
	OSA "Khudaferin"	85.04	110	38	Cone-shaped net
	OSA "Azeri"	81	132	54	Cone-shaped net
	OSA "Lenkoran"	85.02	166	54	Cone-shaped net
	OSA "Nizami"	85.04	165	38	Cone-shaped net
	LTV "Osmanly"	86	165	31	Cone-shaped net
	OSA "Sara"	78	110	26	Cone-shaped net
	OSA "Sevryuga"	85.04	110	38	Cone-shaped net
	LTV "Turan"	86.01	166	54	Cone-shaped net
	LTRV "Sultan"	189	232	73	Cone-shaped net
ZAO "Lenkoran fish plant"	OSA "Yastreb"	85.04	165	38	Cone-shaped net
	OSA "Komsomolets"	85.02	166	54	Cone-shaped net
	LTV "Pobeda"	86.21	165	56.86	Cone-shaped net
	OSA "Salyanly"				Cone-shaped net
	LTRV "Narimanabad"	190	232	70	Cone-shaped net
	OSA "Albatros"	85.04	110	38	Cone-shaped net
	LTV "Nasimi"	86.01	165	57	Cone-shaped net
Individuals					
Individual unknown[3]	LTV "Sumgait"	86	165	31	Cone-shaped net
Individual unknown[3]	LTV "Yurd"	86.21	165	56.86	Cone-shaped net

Notes:
1 DPRAB, ZAO "Khazar-Shay Company, ZAO "Baku marine fishing harbor", Commercial company "Globus-5", ZAO "Gartal", ZAP "Khazarbalig", OAO Z.Tagiyev Fish curing plant, physical persons A. Mamedov, A. Guliyev, R. Gasanov
2 Vessel types:
OSA – Operating with Shipborne Airlift;
LTV – Lifting Transportation Vessel; and
LTRV – Lifting Transportation Refrigerator Vessel.
Refer to Section 2.3.1 below for further data regarding vessel types.
3 Vessels were previously owned by Neftchala fish factory. Current owners not disclosed.

Therefore, in 2009 there were 44 fishing vessels of the Azerbaijan Republic equipped to carry out commercial fishing sailing under the national flag, but in 2009 only 25 vessels obtained the relevant permits to fish.

Fishing vessels that have obtained a fishing licence are required to maintain a logbook where coordinates of the region they have fished are registered. Information about volumes and species composition of fish caught is also documented in the log. Vessel owners/operators have the right to sell caught fish.

In 2009 those legal entities and individuals who obtained licences for fishing in the Azerbaijan Republic and were only permitted to catch kilka caught 811.2 tonnes of kilka. The volumes caught by each legal entity/individual are set out in Table 4.0[2].

Table 4.0 – Fish Caught by Each Legal Entity and Individual in 2009

Legal Entities and Individuals	Volume of Fish Caught (kilka, tonnes)
Legal Entitiy	
ZAO “Khazar-Shay Company	23.7
ZAO “Baku marine fishing harbor”	548.0
Commercial company “Globus-5”	20.7
ZAO “Gartal”	41.4
ZAP “Khazarbalig”	86.905
ZAO “Caspian Fish Co Azerbaijan”	26.9
OAO Z.Tagiyev Fish curing plant	0
Individual	
A. Mamedov	36.63
A. Guliyev	16.21
R. Gasanov	10.728

Of those legal entities and individuals listed in Table 4.0, the following vessels deliver caught fish (kilka) to Govsany fish plant (Baku), from where fish products are sold to the sales network of the Russian Federation:

- ZAO “Khazar-Shay Company;
- ZAO “Baku marine fishing harbor”;
- Commercial company “Globus-5”; and
- ZAO “Caspian Fish Co Azerbaijan”.

The majority of fish caught in 2009 by these companies (619.3 tonnes) was packed and sold by Govsany fish plant.

ZAP “Khazarbalig” processes fish at their own enterprise, selling and exporting it themselves. The remaining companies and individuals also process and sell the caught fish themselves, mainly exporting it to the Russian Federation.

1.4 Estimate of the Scale and Nature of Unregulated Fishing

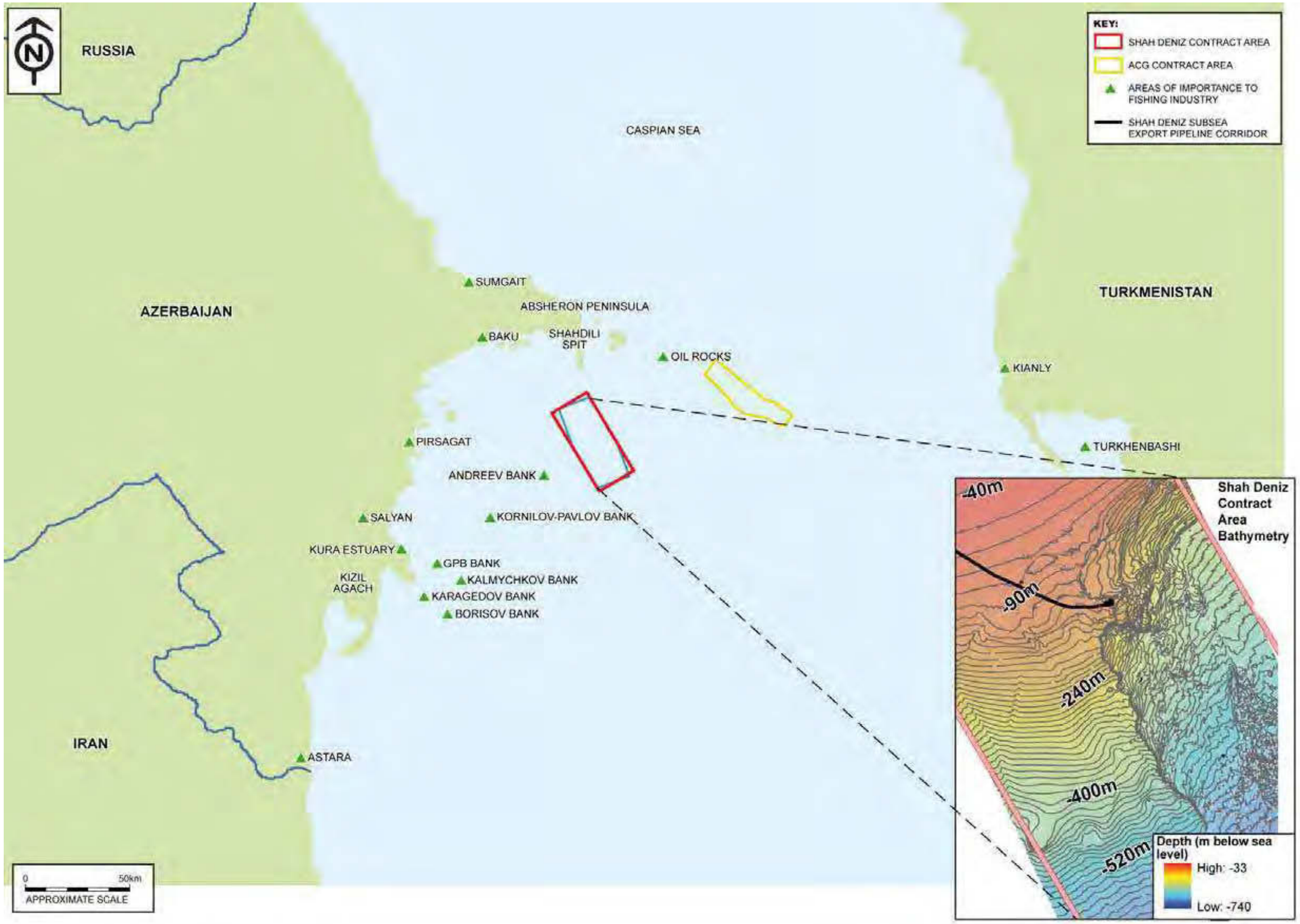
DPRAB-MENR is responsible for the protection of biological resources, including fish resources. The Department for Protection of Aqueous Bioresources carries out its inspection activities in the Azerbaijan sector of Caspian Sea, within the 10-mile zone, in three near shore aqueous zones.

- Sumgait-Khachmaz;
- Absheron-Baku; and
- Salyan-Astara.

The ACG and SD Contract Areas fall under the sphere of activity of the Absheron-Baku division of the Agency for protection of aqueous bioresources. Figure 1 shows the location of the ACG and SD Contract Areas and key features/locations within the Azerbaijani sector of the Caspian Sea.

[2] As discussed in Section 2.1 below, kilka account for 75% of fish caught in the Caspian Sea and its associated river estuaries.

Figure 1 Map of Azerbaijani Sector of Caspian Sea



As a result of inspections carried out in 2009 regarding protection of fish resources in the Azerbaijan Republic, 103 violations of fish protection legislation were identified, 114 people were prosecuted, 94 were charged with criminal offences, 49 fishing boats were confiscated, in addition to 3,125m of nets, 1,995 “kalada” hooks, 9 outboard motors, 3,224kg of small (ordinary) fish – and 2649kg of sturgeon were also confiscated. The sum of imposed fines was 10,364 AZN. The total sum of fines imposed as a result of court action during this period was 123,554 AZN which was equivalent to 154,442 USD.

In the Absheron-Baku division of the Agency for the Protection of Aqueous Bioresources 31 violations of fish protection legislation were identified and 14 people were brought to justice. Two of these cases were sent to Republican District Courts. Six cases were of criminal nature and were sent to law enforcement agencies, four cases were examined by DPRAB in accordance with administrative procedures.

In 2009 four fishing boats were confiscated, along with 119m of nets, 1995 “kalada” hooks, 2 outboard motors and 2,769kg of various fishes. The sum of claims during this period was 8,309 AZN.

2 Methods of Fishing and Equipment Used

2.1 Commercial Fish Species

Areas up to a depth of approximately 100m below sea level in the ACG and SD Contract Areas and in the immediate vicinity of the Contract Areas have been the traditional fishing region in the Southern Caspian since the 1950s. The depth profile of the SD Contract Area extends from approximately 40m to 640m below sea level and for the ACG Contract Area the depth profile extends from approximately 100m to 400m below sea level. Up to 20 fish species can be found in ACG and SD Contract Areas depending on the season. Table 5.0 lists the species recorded.

One of these species is the Goby, which predominantly found in nearshore waters at a depth of no more than 50-75m below sea level, however there are some deepwater gobies that can be found at water depths of 200m to 300m below sea level. Other species, including sturgeon, grey mullet, herring, anchovy kilka and big eyed kilka, migrate across the Southern Caspian region during spring (March-April) and autumn (October-November). During the winter months these species are found wintering near the western shores and southern slopes of the Absheron sill (herring, anchovy and big-eyed kilka). The migration routes and spawning areas of fish species found within the SD Contract Area are shown in Figures 2 and 3.

Figure 2 Shad, Sturgeon and Mullet Migrations Routes

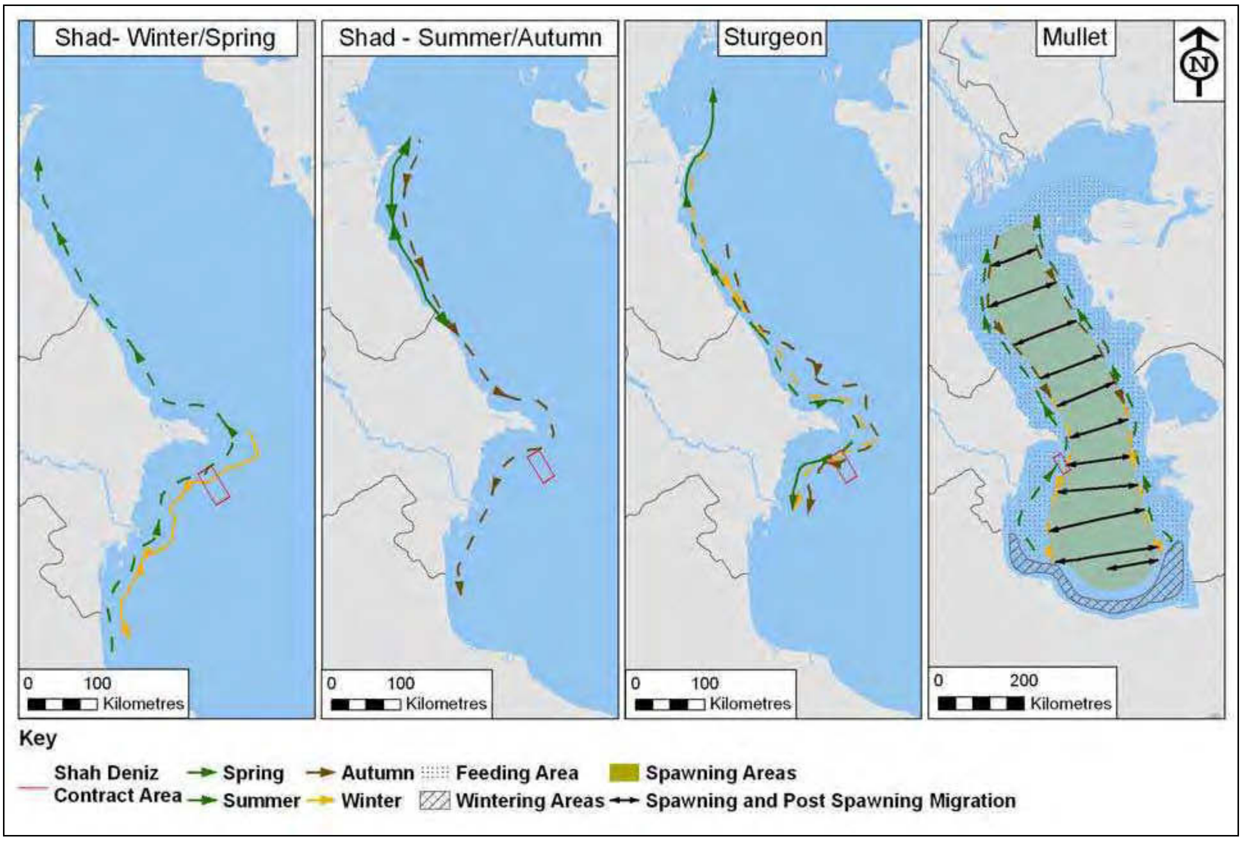


Figure 3 Kilka and Beluga Migration Routes

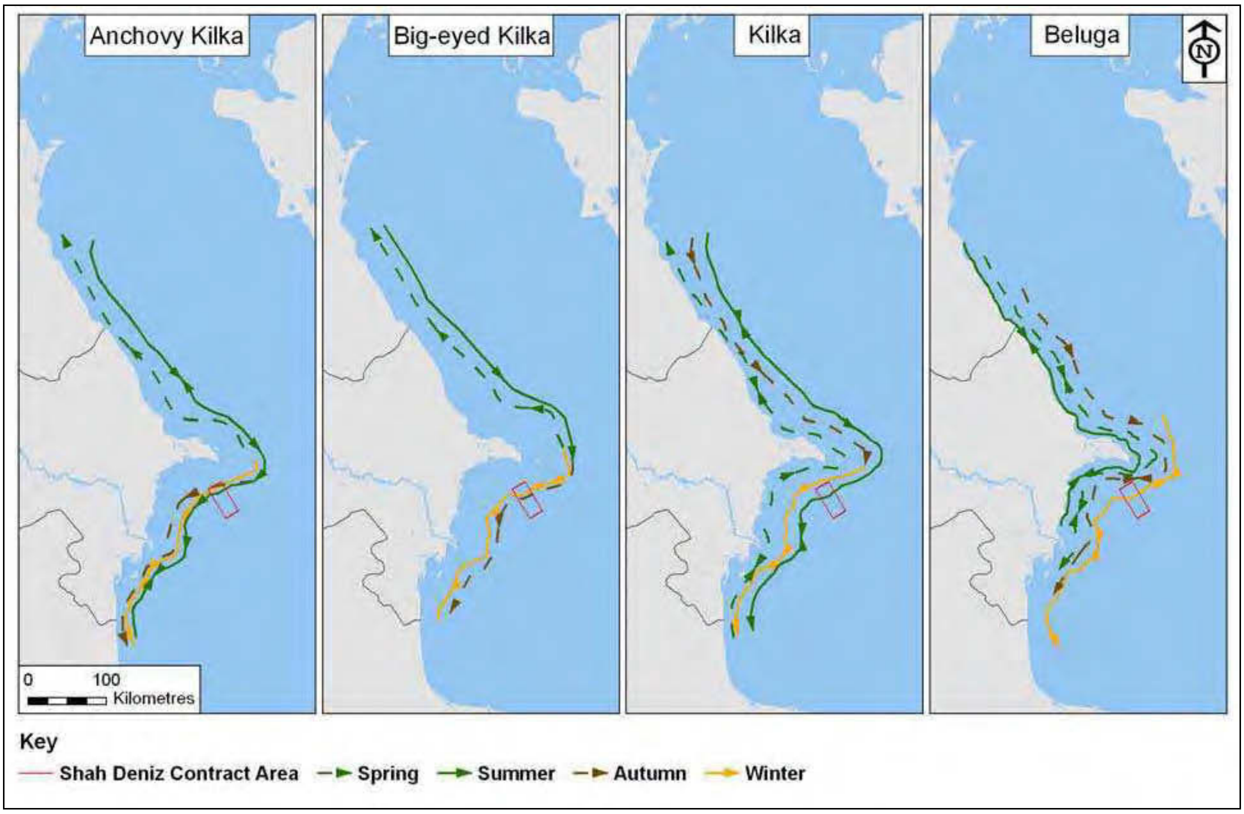


Table 5.0 – Fish Species Composition in the ACG and SD Contract Areas and Adjacent Areas of the Caspian Sea[1]

Species Name	Depth of Occurrence
Acipenseridae family – sturgeons	
Beluga	up to 70m; in autumn and winter up to 100-200m
Sturgeon, Russian sturgeon	up to 70m; in autumn and winter up to 80-100m
Kura (Persian) sturgeon	up to 70m; in autumn and winter up to 80-100m
Kura spiny (bastard) sturgeon	up to 70m; in autumn and winter up to 80-100m
Kura (Southern Caspian) starred sturgeon (sevryuga)	up to 50m; in autumn and winter up to 75-100m
Clupeidae family – herring ***Clupeonella genus (Kessler) – tyulka, or kilka***	
Anchovy kilka	In the aqueous areas 100-300m deep, everywhere, mainly in the area of slope-water gyral offshore. In these aqueous areas from the surface to the depths: in summer – up to 40m, in autumn – up to 60-80m, in winter – up to 100-300m.
Big-eyed kilka	Most deepwater form. slope-water gyral 350-450m deep, everywhere, mainly in the area of slope-water gyral offshore. In these aqueous areas from the surface to the depths: in summer – up to 80 m, in autumn – up to 80-100m, in winter – up to 130-450m.
Caspian ordinary kilka	up to 30-40m
Clupeidae family – herring **Alosa Cuvier genus – herring**	
Caspian shad	Area of occurrence – the whole sea. From the surface to 30-40m, deeper in winter.
Big-eyed herring	Area of occurrence – Southern Caspian. From the surface to 30-40m, deeper in winter.
Volga (black-backed) shad	Wintering in the Southern Caspian to depth 100m and higher
Black-backed shad	Area of occurrence – the whole sea. Wintering in the Southern Caspian to depth 100m and higher
Cyprinidae family – chubs (carps)	
Kutum (Black sea roach)	up to 20-50m
Mugilidae family – Grey mullet	
Golden mullet	Area of occurrence – the whole sea. Up to 400-500m
Leaping grey mullet	Area of occurrence – the whole sea. Up to 200-300m
Gobiidae family – gobies	
Goby (Khvalynski)	up to 30-50m, less frequent up to 80-100 m
Round goby	up to 30-50m, less frequent up to 80-100m
Caspian goby (shirman)	up to 30-50m, less frequent up to 80-100m
Monkey goby	up to 30-50m, less frequent up to 80-100m
Caspian bighead goby	up to 30-50m
Knipowitsch goby longicaudata	up to 30-50m, less frequent up to 80-100m
Grimm bighead goby	up to 30-50m
Knipowitschia Iljini goby	Pelagic deepwater species, up to 300-400m
Deepwater goby – Neogobius bathybius (Kessler))	up to 300-500m
Goby Mesogobius nonultimus (Iljin)	up to 300-400m
Goby Benthophilus ctenolepidus Kessleri	up to 300-400m
Goby Anatrirostrum profundorum (Berg)	up to 300-400m

Notes:

1 Akhundov M.M. Biodiversity of the Azerbaijan sector of Caspian sea. Ichthyofauna. Country report of the Azerbaijan Republic. UNDP/Caspian Environmental Programme. -2000. -27 p.
Derzhavin A.N. Inventory of fresh-water fishes of Azerbaijan. Baku, 1949, 46 p.
Derzhavin A.N. Fishes of superclass. Fauna of Azerbaijan. Baku, 1951, pp. 207-248
Derzhavin A.N. Fauna of Azerbaijan. Kura fisheries. Baku, 1956, pp. 28-57
Derzhavin A.N. Kura fisheries. Publishing House of the Azerbaijan Academy of Sciences, Baku, 1956. 535 p.
Kazancheev Ye.N. Fishes of the Caspian Sea (ranger). - Moscow: Light and Food Industry, 1981. -168 p.
Caspian Sea. Ichthyofauna and field resources. Moscow, 1989.
Ragimov D.B. Biology of gobies breeding near the western shores of Middle and Southern Caspian: Statement 2. Transactions (Izvestiya) of the Azerbaijan Academy of Sciences, Series of biological sciences. 1968. - № 2. pp. 5I-57.

Catch records show that kilka is the predominately caught species of fish, accounting for about 75% of total fish catch in the Caspian and in estuaries of the rivers flowing into the Caspian. At present kilka is most abundant fish present (in terms of biomass) in the Caspian and associated river estuaries with sturgeon as the second most predominate. Fishing in Azerbaijan is carried out mainly in the Caspian Sea, Kura River and inland water reservoirs. Commercial fishing in the Kura River and Caspian Sea includes over 20 fish species. Fishing for sturgeon, solely for the purpose of fish breeding, is carried out mainly in the Kura River, and in the mouth of the Kura estuary. Foraging schools of sturgeon dwell on the western shelf of the Middle Caspian (refer to Figure 1), in the territorial waters of the Azerbaijan Republic. This is where commercial sturgeon stocks originate. Breeding sturgeon located here are at the II and II-III stages of maturity[3]. To the south of the Kura estuary, breeding sturgeon are at the III and III-IV stages of maturity.

Currently, when legal entities and individuals apply for a fishing licence, only kilka is specified in the documents as the objective for fishing, but licences can be obtained for other fish specie including grey mullet and herring. Kilka, which is a key object for commercial fishing, comprises three species:

- Ordinary;
- Anchovy; and
- Big-eyed.

Besides its commercial value, kilka is the main food source for sturgeon, herring and other predatory fish, as well as for the Caspian seal. This explains why the ACG and SD Contract Areas and adjoining areas include all of the above mentioned fish species and seals, which migrate through these areas.

2.2 Locations of Commercial Activity of Fish Vessels

As mentioned in Sections 1.1, 1.2 and 2.1 of this report, kilka is main object of commercial fishing for vessels in the Caspian Sea, including Azerbaijani waters. Figure 1 above shows the main areas where kilka are fished. The main accumulations of kilka were registered in the Southern Caspian from Oil Rocks to Kornilov-Pavlov bank. In this area ordinary kilka are found between 20 to 40m below sea level, anchovy kilka between 100 to 300m below sea level and big eyed kilka between 130 to 450m below sea level. However, the densest accumulations have been found in the nearshore zone up to 50m below sea level. Commercial fishing for kilka is carried out in the vicinity of the following:

- Oil Rocks;
- Kornilov-Pavlov bank;
- Andreev, Karagedov and Kalmychkov banks;
- GPB bank;
- Borisov bank; and
- The mouth of the Kura estuary.

Andreev bank, located opposite Byandovan cape and approximately 15-20km from the SD Contract Area and 80-90km from the ACG Contract Area, is the closest to commercial fishing area with respect to the ACG and SD Contract Areas. Depending on the season, a maximum

[3] Sturgeon undergo five stages of maturity, namely:
I – Immature;
II – Developing or resting (m) / maturing virgin or resting (f);
III – Developed (m) / developing (f);
IV – Embryos fully formed and developed for reproduction; and
V – Mature.
Stages I-IV of maturity takes place at sea. The last stage (V) is observed in mature individuals during spawning in the rivers. Various species of sturgeon living in the Caspian Sea reach these stages of maturity at different ages and body mass. Sturgeon mature and are ready for spawning (stage V) at the following ages:

Starred sturgeon (sevruga)	8- 10 years;
Russian sturgeon	10 – 12 years;
Persian sturgeon	12 -14 years;
Barbel sturgeon	14 – 16 years; and
Beluga (great sturgeon)	16 – 18 years.

of 15 fishing vessels commercially fish in the Southern Caspian at any one time on the route from Oil Rocks to Kornilov-Pavlov. Fishing is carried out during the whole year with the exception of May and June when kilka are spawning and migrate to the Northern and Middle Caspian. During this period kilka do not shoal and therefore fishing is not productive. During the winter, commercial fishing is carried out at a depth of 60-80m below sea level, and in the summer at a depth of 30-40m below sea level. At these depths the main fish caught are ordinary kilka species.

Anchovy and big-eyed kilka stay in the ACG and SD Contract Areas, mainly during winter. During autumn-winter months a relationship can be seen between the distribution of herring and kilka, (food source for herring) and the distribution of zooplankton (food source for kilka). Herring spend winter in the Southern Caspian, from Chilov Island to Astara, mainly near the western shores and southern slopes of the Absheron sill[4]. Herring and kilka in the ACG and SD Contract Areas are generally found mainly in winter, at depths up to 50-100m, but can sometimes be found at depths of 130-300m below sea level. However, vessels equipped with cone shaped nets predominately fish from 60-80m below sea level, while vessels equipped with fish pumps catch fish at 100-120m below sea level.

Invader plankton-feeding comb jelly *Mnemiopsis leidyi*, has diminished food reserves in the Caspian Sea, consuming large quantities of zooplankton, so that the situation is almost catastrophic for organisms which feed on zooplankton and throughout the food chain. With the appearance of *Mnemiopsis leidyi* in the Caspian Sea kilka reserves have reduced. Volumes of caught fish overall in the Caspian basin have reduced from 271 thousand tonnes in 1999 to 54 thousand tonnes in 2003[5], i.e. a 5-fold decline. Recently kilka began feeding on zooplankton *Acartia*. Predominance of *Acartia (clausi+tonsa)* within the structure of modern zooplankton instead of *Eurythemora, Limnocalanus and Calanipeda*, leads to a change of biochemical composition of food consumed by Caspian kilka (mainly the anchovy kilka).

During recent years, the distribution and abundance of kilka has changed; while they can be found throughout the Azerbaijan sector of the Caspian Sea their concentrations have reduced due to the *Mnemiopsis* invasion. Prior to the last 4 to 5 years the average volume caught by the cone-shaped nets of the Azeri commercial fleet was 5.8kg and 11.3kg per hoist in the Middle Caspian and Southern Caspian, respectively. From 2002 to 2004 the majority of fish caught was the anchovy kilka representing 63.4-83.5%, the share of ordinary kilka was 14.6-28.6% and that of big-eyed kilka 0.2-2.8%. However, during the last 4 to 5 years (Table 6.0), compared to the previous years, the percentage share of ordinary kilka caught increased significantly (4-5 times) (up to 69.9% in 2009), whilst big-eyed kilka practically disappeared from the catch (0.7% in 2009). Major accumulations of kilka were observed in the Southern Caspian from Oil Rocks to the bank of Kornilov-Pavlov, whereas most dense accumulations were observed in the nearshore zone (at depths up to 50m).

Table 6.0 – Change of the Ratio of Various Kilka Species (%) Caught in the Azerbaijan Sector of Caspian Sea in 2005-2009[1]

Year	Species of Kilka (% Caught)		
	Anchovy	Ordinary	Big-eyed
2005	75.2	22.0	2.8
2006	63.4	36.25	0.35
2007	20.9	78.1	1.0
2008	34.1	65.3	0.6
2009	29.4	69.9	0.7

Notes:
1 DPRAB

4 Kazancheev, 1981
5 Sedov et al., 2004

Thus, commercial fishing from vessels in the Azerbaijan sector of Southern Caspian during the last 4-5 years has changed as follows:

1. There has been a reduction in the abundance of anchovy kilka (which is now found at relatively shallow depths – up to 50m during the summer months, whereas previously it was caught at a depth 80-120m), and a corresponding reduction of caught fish volumes; and
2. Fishing vessels have become more active at relatively shallow sea depths (30-50m), which results in increased catch volumes of ordinary kilka (which usually stays at relatively shallow depths and is also called “nearshore kilka”).

Recently, in connection with the invasion of comb jelly *Mnemiopsis leidyi* and changes in the trophic structure of Caspian Sea, adult fish dominate within the catch and the proportion of young fish is very small. Commercial fishing for kilka is currently carried out predominantly in the areas of Oil Rocks, banks of Kornilov-Pavlov, Andreev, Karagedov, Kalmychkov, GPB, Borisov, sea area near Kura river mouth. Results from recent analysis at Borisov, Karagedov banks and Oil Rocks show that fishing at depths of not more than 70-80m shows that the anchovy kilka caught most recently have been mainly of adult size groups. Young kilka were very rare or even absent. This trend has become especially evident since 2001. Shortages of young kilka within the fish catch indicate that from 2001 to present, reproduction of kilka has been low. The appearance of the invader, comb jelly *Mnemiopsis leidyi* in the Caspian Sea during 1997-1998, which eats kilka roe, was one of the reasons attributed to the reduction of the proportion of young kilka in the catch. While the main cause in the reduction of kilka has been the result of comb jelly *Mnemiopsis leidyi*, excessive fishing (over fishing) also negatively affects kilka reproduction.

2.3 Fishing Technique and Equipment Used in the Azerbaijan Sector of Caspian Sea

As shown in Section 1.2 and Table 2.0 above, almost all fishing vessels of the Azerbaijan fleet use cone-shaped nets (LTV, SB, OSA and LTRV type vessels) and only two vessels use fish pumps (MFT “Lenkoran baligchisi” and MFT “Namig Hafizoglu”). An overview of the fishing equipment used on the vessels in the Southern Caspian Sea is provided below. Appendix A provides further details.

The Azerbaijani fishing fleet is of high importance in the national fish industry. Fish caught from vessels is processed on board and transported to the shore. The vessels are designed for commercial fishing and there are many types of commercial fishing vessels including trawlers and seine boats.

2.3.1 Fishing Vessel Types

Fish Trawlers

Fish trawlers are designed for offshore fishing, mainly with the use of trawls, however occasionally drift nets or similar are used. No trawler vessels permitted to fish commercially for kilka in Azerbaijani waters employ the use of trawl fishing techniques. The use of trawl fishing methods is employed by scientific research vessels only. Several types of fish trawlers exist: large fish trawlers (BRT), medium fish trawlers (CRT) and small fish trawlers (MRT).

Seine Boats

Seine boats are also used in the Caspian Sea. Seine boats are designed for purse-seine (seine-net) fishing, however when necessary, they can be used for other types of fishing.

The following methods of commercial fishing are currently used:

- Fish entanglement within the net – linemeshing fishing gear;
- Fish filtering from water – fish trawling gear (trawler nets);
- Trays and pickups;
- Fishing with the use of traps –fixed fishing gear;
- Fishing with the use of hooks – fishing hooks/tackle; and
- Special fishing methods – electric fishing, fish pumps, fishing wheels, etc.

Appendix A provides figures showing both trawler and seine fishing vessels.

2.3.2 Historical Fishing Methods

In earlier years herring drift nets were used in the Southern Caspian (the hanging net length was 30m, hanging net heights were 6.55 and 4.15m, respectively). The main target for drift fishing was herring. Drift fishing for herring was used in the Caspian Sea in the 1940s and 1950s. Depending on the arrangement, stationary nets can be bottom and pelagic nets. In terms of design, there could be ordinary single-walled nets, nets with vertical walls, frame nets, double-walled nets, triple-walled nets and combined gill (rough) nets. However, due to a large inadvertent catch (known as a by-catch) of young sturgeons and following the recommendations of scientists, drift fishing in the Caspian was banned in 1962.

2.3.3 Current Fishing Methods

Currently most fishing vessels in the Azerbaijan sector of the Southern Caspian use cone-shaped nets for kilka fishing with the use of electric light. Electric fishing is widely used and was developed by Professor P.G. Borisov. Later, developing this method further, I.V. Nikonorov and others used fish pumps, attracting fish with electric light. The high efficiency of new fishing methods has resulted in significant improvements in the volume of fish caught and the proportion of kilka caught within a haul with the use of electric light reaches up to 80%. Fishing for kilka in the Caspian Sea with the use of subsea electric light is most important as kilka are attracted to the light and gather near the catching devise. Later, centrifugal fish pumps and then airlifts were used for fishing. All three types of fishing are used on the Caspian i.e.:

- Cone-shaped purse nets;
- Centrifugal fish pumps; and
- Airlift.

Light attracts all three species of kilka; however anchovy kilka makes up the major share of commercial catches when fishing in water depths of 80-120m below sea level. Anchovy kilka lives in the open water of the Middle and Southern Caspian, avoiding low salinity water, while ordinary kilka are found in shallower nearshore waters (30-50m). In summer commercial populations of kilka are found all along the western and eastern coast of Caspian Sea, up to the Northern Caspian. The largest commercial populations of ordinary kilka can be found from the Mangyshlak peninsular to Kenderli Bay in the east and in the area of Makhachkala in the west. Regions especially rich with ordinary kilka in the southern part of the sea are Kianly-Turkmenbashi on the eastern coast, southwards from Salyan – Pirsagat on the western coast (Azerbaijan territorial waters). In these areas kilka is found in large quantities in winter as well.

Fishing for kilka is carried out the year round (with the exception of May and June) from seine boats PC-300, specially re-equipped for kilka fishing in the Caspian Sea. Earlier commercial fishing was carried out mainly from refrigerator vessels such as “Druzhba” and “Zelenodolsk”. Vessels of “Druzhba” type are 57.2m long, 9m wide, displacement 850 ton and deadweight 180 ton. They operate with the use of two diesel-generators, 300 horsepower (h.p.) each, their cruising capacity is 20 days. These vessels were gradually replaced by vessels of “Zelenodolsk” type, which are 55.35m long, 9.5m wide, displacement 985 ton and deadweight 305 ton. They are operated with the use of two diesel-generators, 400 h.p. each. The vessel is intended for fishing and fish freezing. Later this business was supported with the introduction of new vessels of “Caspian” type. To attract kilka to fishing gear 500-1000 watt electric lamps are used, providing ordinary white (colourless) light. These lamps have well insulated special sockets, preventing water entry to their bases. Lamps are fixed to the fishing gear with their bulbs being oriented upwards. When fishing from PC-300 type vessels, cone pickups are used, and vessels of "Druzhba" and "Zelenodolsk" type are equipped with fish pumps and airlift.

Cone Shaped Nets

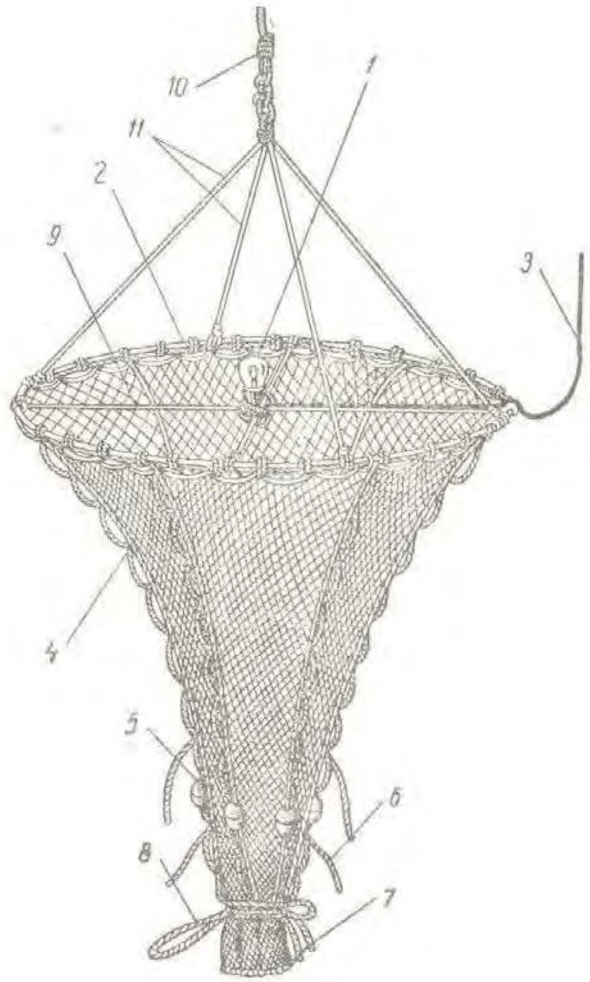
All cone-shaped nets comprise six net trapeziums. The cone-shaped net for Caspian kilka consists of webbing of two kinds: in the upper part webbing is made of 20/12 thread with 30millimetre (mm) net-mesh, the bottom part is made of 34/9 thread, with 8mm net-mesh. The ferrule (i.e. hoop) diameter is usually 2.5m. The general appearance of cone-shaped nets is shown in Figure 4. Fishing is carried out with two nets, alternately from two sides of the vessel. The nets remain at the fishing depth horizon for 0.5-10 minutes depending on the concentration of fish populations. The rate the net is pulled out of water is typically 0.3-0.4 metes per second (m/s). As stated within Section 1.3 above cone shaped nets are used at a maximum depth of 20 to 90m below the sea surface.

Fish Pumps and Airlift

In 1948 N.S. Fershtut suggested using fish pumps for Caspian kilka fishing. This method was improved by I.V. Nikonorov. For this technique one or two fish pumps of HP-150 type are installed on the vessel. A vacuum (suction) hose is used which corresponds in length to the desired depth at the fishing location. Two strong lamps are attached at the end of the suction hose, on its side. After the underwater electric lights are switched on, the kilka approach the hose and are sucked into it and delivered to the deck of the vessel. Fishing is undertaken without the participation of fishermen and is quite efficient if the concentration of fish populations are high enough. Fish pump units RBU-100, RBU-150 and RBU-200 are used for kilka fishing (the code numbers indicate the suction hose diameter in mm).

The pump or pumps are installed on the vessel deck and the suction hose is thrown overboard and lowered into water in a place where kilka are concentrated. Rubber hoses are usually used, which are smooth inside and corrugated outside. They can be lowered to any depth up to 150m. The end of the suction hose is turned upwards and is equipped with a catching device, consisting of a suction nozzle with a guarding ferrule (hoop). Slings are connected the ferrule and to a hoist rope and winch. Electric lamps (usually white light) are fixed to the sides of suction nozzle. Lamp capacity is 1.0–1.5 kilowatts (kWt). When the lamps are switched on, kilka will approach the catching device and are sucked in by the pump and delivered to the deck. This process is continuous and does not require pulling and lowering of fishing gear. Fishing efficiency is 50-60% higher than when cone-shaped nets are used. At the same time the cost of production is reduced and working conditions improved. Commercial fishing for kilka using fish pumps began in 1955. In the 1970s production of kilka in the Caspian Sea reached 423 thousand tonnes, and 80% were caught with the use of fish pumps. However, a major disadvantage of kilka fishing with the use of fish pumps and light is that large quantities of fish damaged by rotating parts of equipment. To address this, special pumps were introduced known as airlifts. Airlifts includes a corrugated hose, which is lowered from the vessel to a depth where kilka are concentrated. The technique used and organization of fishing with the use of airlifts is the same as with the centrifugal fish pumps. The advantage of this method is that the kilka is not damaged as lift pumps are used at relatively shallow depths (20-40m) and a lower level of pressure is required. Therefore the majority can be used for preservation. Fish pumps can be used up to a maximum depth of 100-120m.

Figure 4 Cone-Shaped Net – Key Features



1 – Electric lamp; 2 – Ferrule (hoop); 3 – Electric cable; 4 – Wale;
5 – Weight; 6 – Lead; 7 – Metal rings; 8 – Tightening rope;
9 – Cross-piece; 10 – Hoist rope; 11 – Slings.

2.3.4 Scientific Research Using Trawl Fishing

Trawl fishing in the Caspian Sea is used for scientific-research purposes only (twice in a year – in winter and summer) to assess abundance and distribution of sturgeon and other fish. Depending on the purpose of the study, variable-depth and variable size trawls are used. A 9m trawl surveys at depths of up to 10m while the 24.7m Mikhov's trawl is used for depths in excess of 10m below sea level. Both the 9m trawl and 24.7m Mikhov's trawl are used in the Northern and Middle Caspian. As the Southern Caspian sampling stations are located at larger depths the 24.7m trawl is used.

Scientific Investigations are carried out using following vessels:

- "Issledovatel Kaspiya"; and
- "Alif Gadzhiyev".

Investigations are carried out from the vessel "Issledovatel Kaspiya" belonging to Russian Federation. Trawl surveys using the 24.7m bottom trawl of the vessel "Issledovatel Kaspiya" are carried out outside the 12-mile zone of the Turkmenistan and Kazakhstan sectors of the Caspian Sea, and also in the Northern Caspian, in the territorial waters of the Russian Federation. In 2007 and 2008, using a permit issued by the Ministry of foreign Affairs of the Azerbaijan Republic, the "Issledovatel Kaspiya" was used in the Azerbaijani sector of the Caspian Sea.

Since 2002, Azerbaijan annually undertakes two offshore expeditions (summer and winter) in the Middle and Southern Caspian with the purpose of assessing the following with regard to sturgeon:

- Abundance;
- Commercial reserves and distribution of sturgeon;
- Specie composition and the abundance of the biomass of plankton and macrozoobethos; and
- Identification of changes in distribution and proportion of population of various species of sturgeons.

Trawl surveys are carried out on 11 sections each comprising 5 sampling stations. In total there are 55 sampling stations in the nearshore sea zones, at 10, 25, 50, 75 and 100m depths below sea level. Investigations are carried out on the scientific-research vessel "Alif Gadzhiyev" (Figure 5). The DPRAB approved network of sampling stations, follow the sections perpendicular to the shoreline. The technical parameters of the vessel "Alif Gadzhiyev" and equipment installed on board are presented in Table 7.0.

Table 7.0 – Technical Parameters of Scientific-Research Vessel "Alif Gadzhiyev" and Equipment (instruments) On Board

Name of Equipment (Instrument)	Grade, Specification of Equipment (Instrument)	Country, Year of Production
Scientific-research vessel "Alif Gadzhiyev"	Type: ocean-sea-river Model: 655 (research); IMO № 8422462; displacement: 693 ton; deadweight: 207 ton; length: 45.6m; width: 10.0m; maximum draft: 3.6m; vessel anchoring depth: 175m; POB (persons on board): 23 persons; powerplant output: 985 kWt, 1340 h.p.; vessel speed: 12.0 $\pm$ 0.2 knots; cruising radius: 10 000 miles; cruising capacity: 35 days;	Finland, Turku, 1987
Device for determination of direction and velocity of sea currents up to a depth 1000m	2D-ACM	USA, 2006
Bottom grab (sampler) for taking samples of bottom sediments	Van-Veen, sampling area 0.2 m^2	UK, 2007
Bathometer - sea water sampling device	Niskin, volume 10 litre	France, 2004; UK, 2004
Field trawl for ichthyologic studies	24.7m (Mikhov's design)	Russia, 2007
Fry (beam) trawl for ichthyologic studies	9m	Russia, 2007

For a 24.7m trawl at depth over 10m the direct distance between the front edges of the wings (edges of the net) is 17m and 5m on vertical opening (refer to Figure A2). Catching efficiency at depths over 10m for all sturgeon species is taken as 0.1 (i.e. 10% efficiency). Fishing with trawls is not carried out in areas with a rocky sea bottom and where there are other underwater obstructions as this would be dangerous and may result in the inadvertent loss of the trawler.

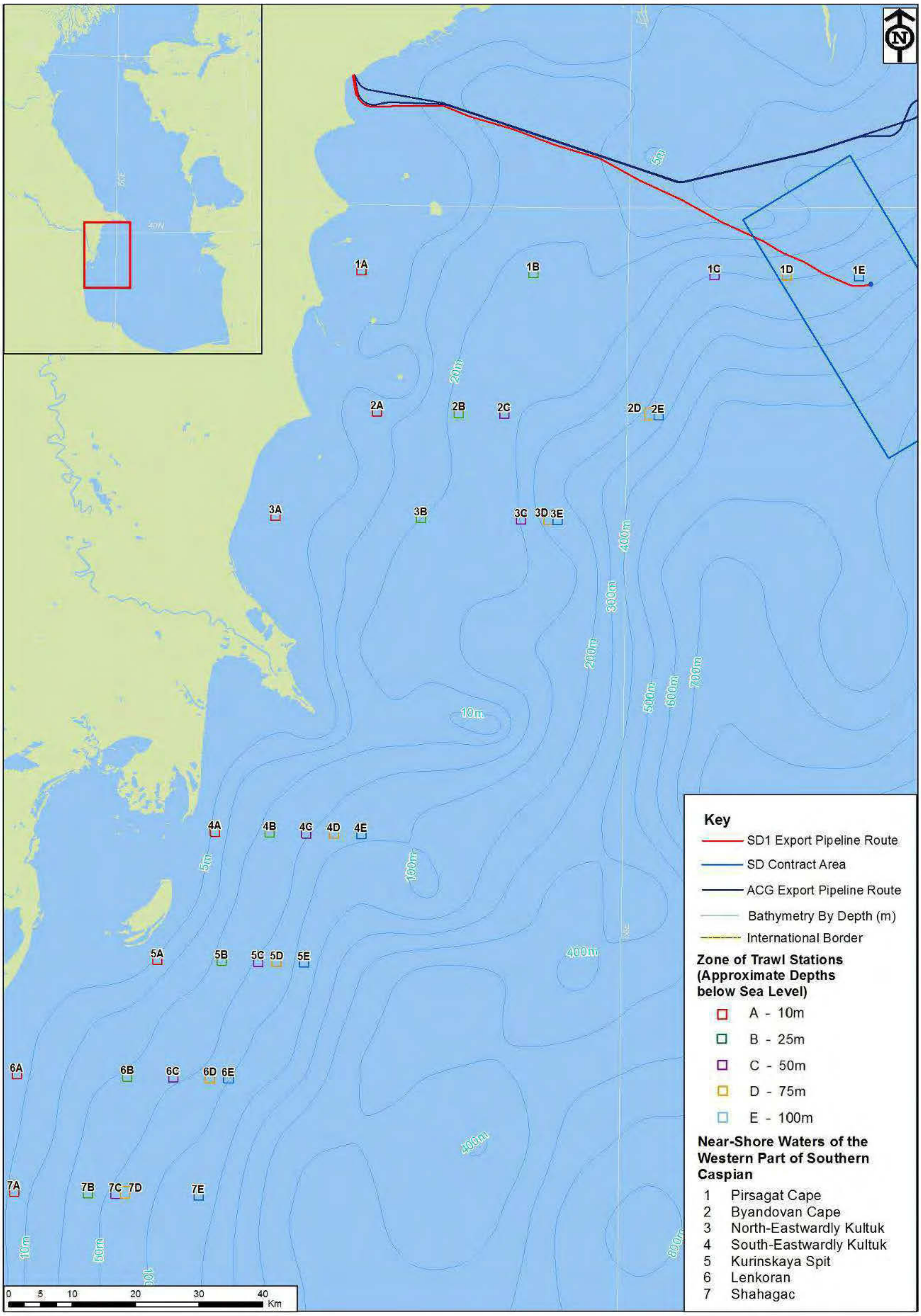
Coordinates of sections and trawl sampling stations in the Southern Caspian are presented in Table 8.0 below and illustrated in Figure 6

Table 8.0 – Coordinates of Sections and Trawl Sampling Stations in the Southern Caspian

ID	Section	Coordinates	Depth (m) Below Sea Level
1A	Pirsagat Cape	$39^{0} 54^{\prime}$ – $49^{0} 30^{\prime}$	-10
1B		$39^{0} 54^{\prime}$ – $49^{0} 49^{\prime}$	-25
1C		$39^{0} 54^{\prime}$ – $50^{0} 09^{\prime}$	-50
1D		$39^{0} 54^{\prime}$ – $50^{0} 17^{\prime}$	-75
1E		$39^{0} 54^{\prime}$ – $50^{0} 25^{\prime}$	-100
2A	Byandovan Cape	39^{0} 42/ – 49^{0} 32/	-10
2B		39^{0} 42/ – 49^{0} 41/	-25
2C		39^{0} 42/ – 49^{0} 46/	-50
2D		39^{0} 42/ – 50^{0} 02/	-75
2E		39^{0} 42/ – 50^{0} 03/	-100
3A	North-eastwardly Kultuk	$39^{0} 33^{\prime}$ – $49^{0} 21^{\prime}$	-10
3B		$39^{0} 33^{\prime}$ – $49^{0} 37^{\prime}$	-25
3C		$39^{0} 33^{\prime}$ – $49^{0} 48^{\prime}$	-50
3D		$39^{0} 33^{\prime}$ – $49^{0} 51^{\prime}$	-75
3E		$39^{0} 33^{\prime}$ – $49^{0} 52^{\prime}$	-100
4A	South-eastwardly Kultuk	$39^{0} 06^{\prime}$ – $49^{0} 15^{\prime}$	-10
4B		$39^{0} 06^{\prime}$ – $49^{0} 21^{\prime}$	-25
4C		$39^{0} 06^{\prime}$ – $49^{0} 25^{\prime}$	-50
4D		$39^{0} 06^{\prime}$ – $49^{0} 28^{\prime}$	-75
4E		$39^{0} 06^{\prime}$ – $49^{0} 31^{\prime}$	-100
5A	Kurinskaya spit	$38^{0} 55^{\prime}$ – $49^{0} 09^{\prime}$	-10
5B		$38^{0} 55^{\prime}$ – $49^{0} 16^{\prime}$	-25
5C		$38^{0} 55^{\prime}$ – $49^{0} 20^{\prime}$	-50
5D		$38^{0} 55^{\prime}$ – $49^{0} 22^{\prime}$	-75
5E		$38^{0} 55^{\prime}$ – $49^{0} 25^{\prime}$	-100
6A	Lenkoran	$38^{0} 45^{\prime}$ – $48^{0} 54^{\prime}$	-10
6B		$38^{0} 45^{\prime}$ – $49^{0} 06^{\prime}$	-25
6C		$38^{0} 45^{\prime}$ – $49^{0} 11^{\prime}$	-50
6D		$38^{0} 45^{\prime}$ – $49^{0} 15^{\prime}$	-75
6E		$38^{0} 45^{\prime}$ – $49^{0} 17^{\prime}$	-100
7A	Shahagach	$38^{0} 35^{\prime}$ – $48^{0} 54^{\prime}$	-10
7B		$38^{0} 35^{\prime}$ – $49^{0} 02^{\prime}$	-25
7C		$38^{0} 35^{\prime}$ – $49^{0} 05^{\prime}$	-50
7D		$38^{0} 35^{\prime}$ – $49^{0} 06^{\prime}$	-75
7E		$38^{0} 35^{\prime}$ – $49^{0} 14^{\prime}$	-100

Figure 5 Scientific Research Vessel "Alif Gadzhiyev"

Figure 6 Location of Sampling Stations



Each survey station, located at 10, 25, 50, 75 and 100m depth, is positioned in accordance with earlier established coordinates. Work on each station begins with recording depth (i.e. bathymetry readings), after that standard hydrochemical parameters are determined:

- Water temperature (surface and near-bottom);
- Salinity;
- pH;
- Dissolved oxygen content; and
- Transparency.

Zooplankton samples are then taken with the use of a Juday plankton net, and samples of the comb jelly *Mnemiopsis* are obtained using special net. Samples are taken from the bottom to the surface, one at each station. The nets are pulled in at a speed of 0.3m/s. Samples of bottom sediments are taken with the use of Van-Veen bottom samplers to obtain macrozoobenthos samples. After washing, samples are preserved in 4% formaldehyde (formalin) solution coloured with special dye “Rose-Bengale”. After the completion of zooplankton sampling, *Mnemiopsis* and macrozoobenthos trawling of ichthyofauna begins. In the Middle Caspian, trawling is carried out across 4 sections, including 20 stations, and in the Southern Caspian – across 7 sections, including 35 trawling stations. The standard 24.7 bottom trawl of Mikhov design is used. The speed of bottom trawling is 2.5 knots, giving a trawling exposure at each station of 30 minutes.

In addition to the zooplankton samples taken using a Juday plankton net, water samples are taken using Niskin a bathometer, at a distance 3-5m from the bottom of the sea, avoiding contact with the sea floor. By contrast, the Van-Veen bottom sampler reaches the bottom and takes benthic samples from the sea floor. In accordance with the method of investigation, three replicate samples of macrozoobenthos are taken at each station.

None of the seven sections along which bottom trawling is carried out for research purposes in the Southern Caspian coincides with the pipeline routes from the ACG or SD Contract areas to Sangachal Bay. The section from Pirsagat Cape going eastwards (up to 100m depth) is the closest to the SD Contract Area and pipeline routes to the Sangachal Terminal. However, as shown in Figures 7 and 8, trawl stations ‘1E’ and ‘1D’ are located in close proximity to the SD1 export pipeline. Trawl station ‘1E’ is located approximately 2-3km north of the pipeline and trawl station ‘1D’ is located approximately 5-6km south.

Figure 7 The Trawl Stations in Relation to the SD Contract Area Subsea Infrastructure

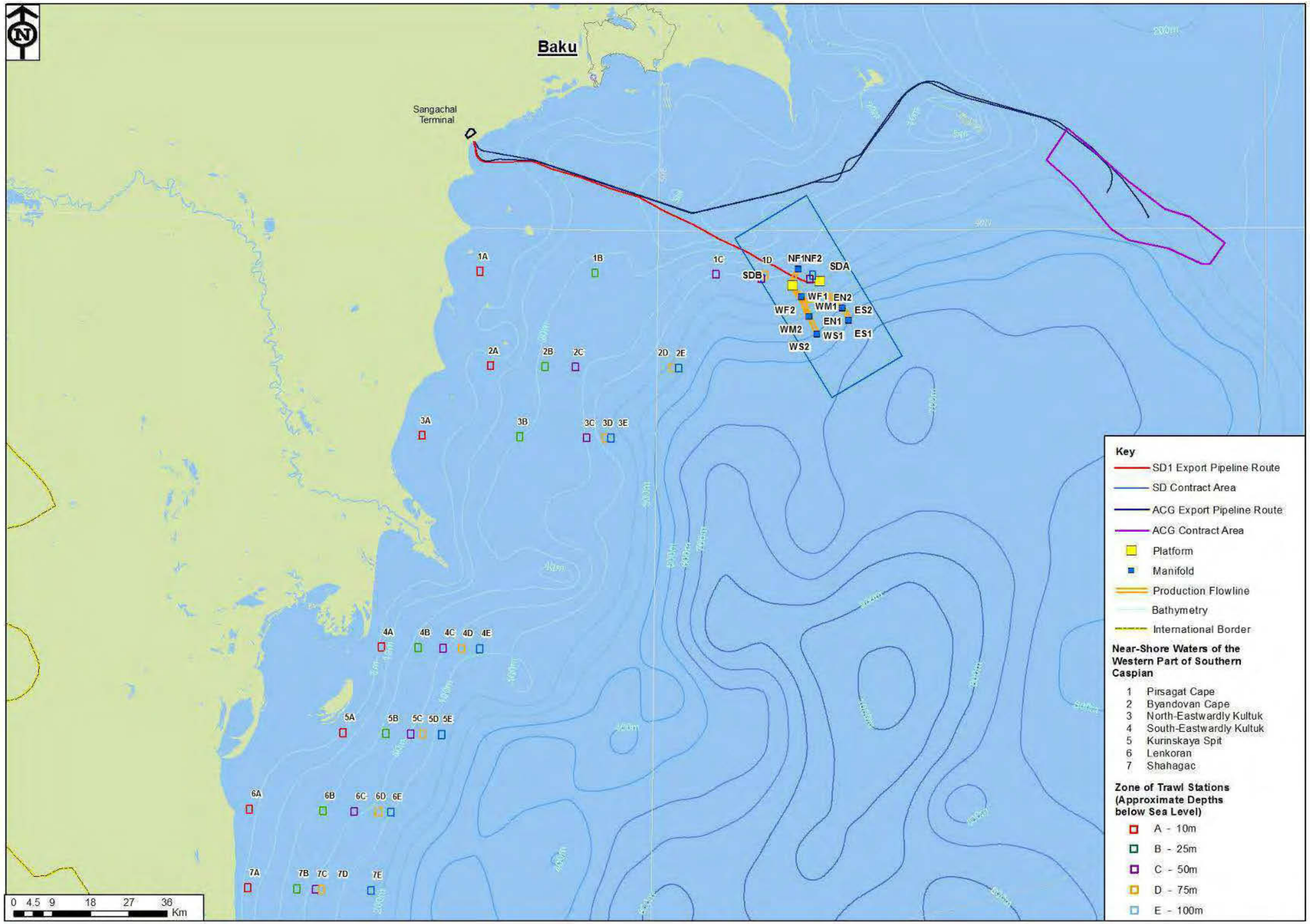
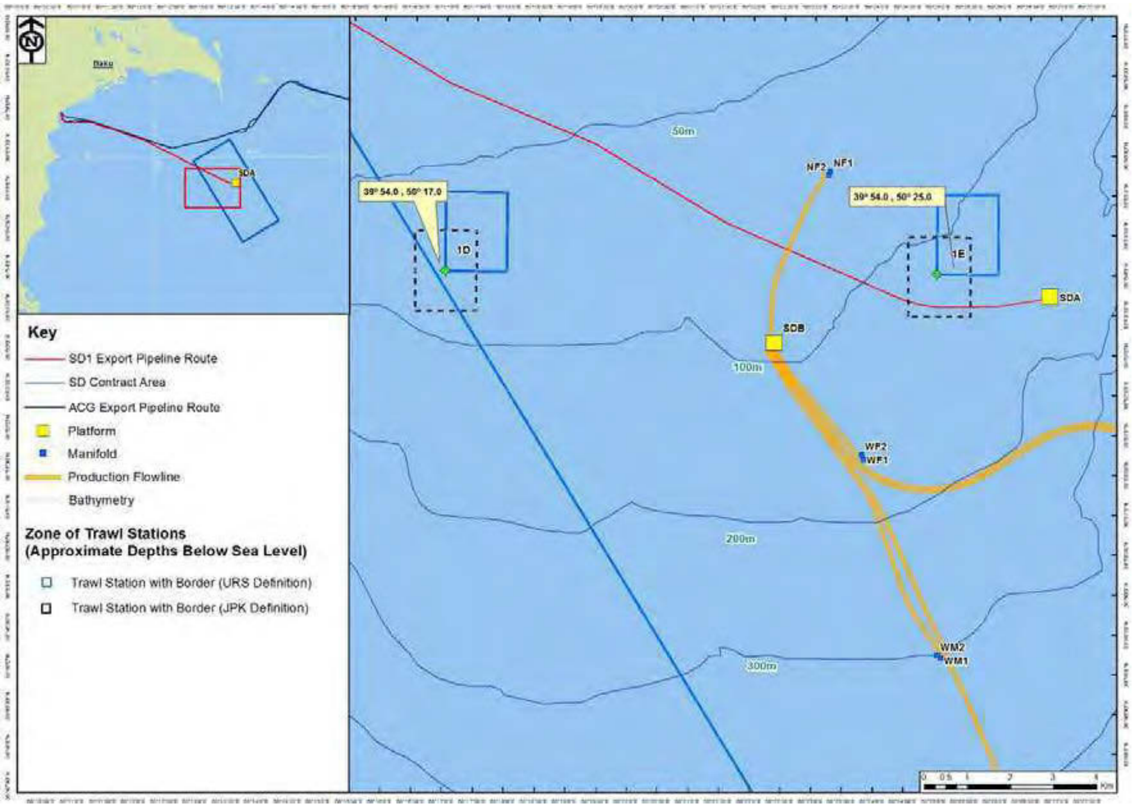
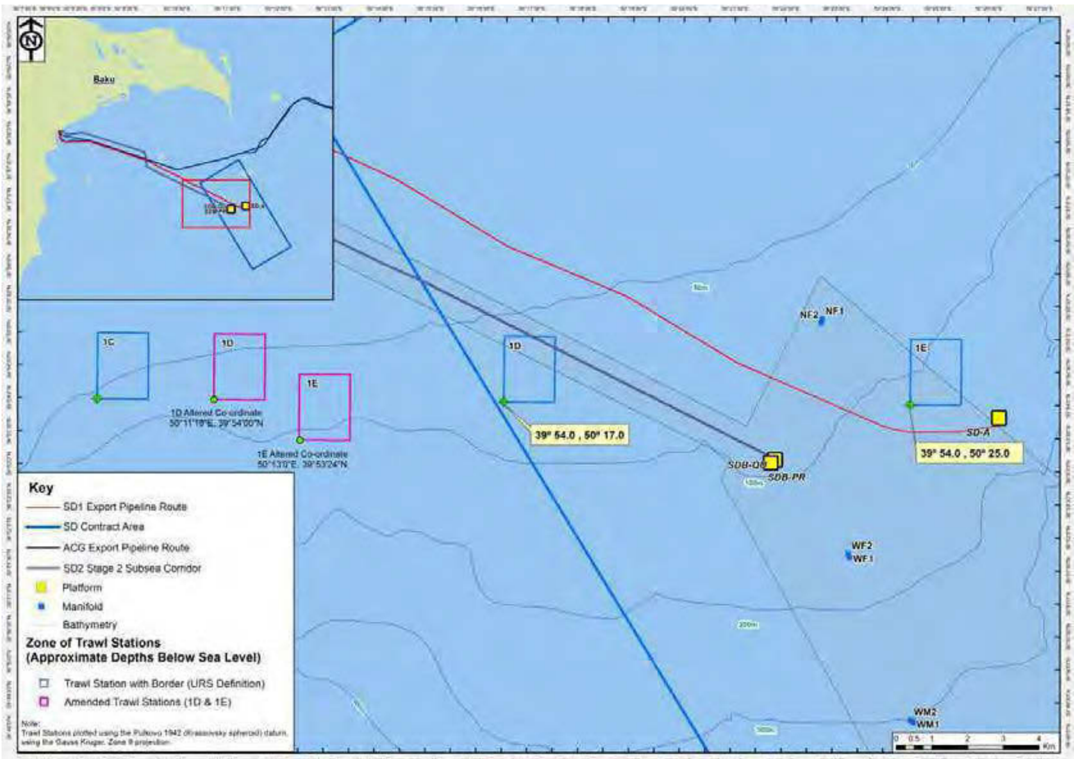


Figure 8 Close Up of Trawl Stations '1E' and '1D' and the SD1 Pipeline



Through subsequent correspondence between, BP, the Azerbaijan Fisheries Research Institute and MENR, it as been agreed that trawling operations at 1D and 1E will be suspended from 1 January 2015 for an indefinite period. From this current year (2012), it has also been agreed to move these two test trawling locations further west outside of the SD Contract Area. Figure 9 indicates the new locations for 1D and 1E.

Figure 9 Amended Trawl Stations at 1D and 1E



3 Social and Economic Advantages

3.1 Total Economic Value of Fishing Activities

3.1.1 Operating Costs and Gains from Fishing Vessels

Maintenance and operation costs for one of the 25 currently active fishing vessels with the required permits for fishing (listed above in Table 1.0, Section 1.2) is, on average, about 36 000 AZN (manat) in a year, i.e. 45 000 USD (without seamen wages). Whereas maintenance and operation costs for one of the 19 vessels that failed to obtain permits for fishing and are assumed to be idle at the time of writing (Table 2.0, Section 1.2) is, on average, about 12 000 AZN, i.e. 15 000 USD (without seamen wages). Thus, in 2009 total costs of maintenance and activity of all 44 vessels were 48000 AZN, namely about 60 000 USD (without seamen wages). Both legal entities and individuals would not provide information about their revenues from fishing activity. However, it is clear that revenues from fishing will be the difference between the sum of the profit obtained from the sale of caught fish and the vessel maintenance costs and wages paid to seamen and fishermen.

3.1.2 Value and Species of Fish Delivered to the Shore

Fishing vessels mentioned above (Section 1.2) fish predominately only for kilka. A total 811.2 tonnes of kilka was caught and sold to the retail trade market in 2009.

3.1.3 Level and Importance of Employment on Fishing Fleet

For each of the 25 mentioned fishing vessels that are involved in commercial fishing (Table 1.0, Section 1.2) an average of 6 people are employed, therefore 150 people are employed in total on those 25 vessels overall. The average annual wages of one person is 1,000 AZN, including the twonth downtime in May and June. Therefore fishing generates 150,000 AZN in a year, i.e. 187,500 USD for 150 people in total. On each of the 19 fishing vessels that failed to obtain a permit for fishing and are assumed to be idle at the time of writing (Table 2.0, Section 1.2) 6 people are also employed on average, i.e. 114 people on 19 vessels. Each person has an average annual wage of 900 AZN; giving a total for 114 people of 102,600 AZN, i.e. 128,250 USD. Thus, the annual wages of the 264 people on the 44 national fishing vessels identified during 1 year is about 252,600 AZN, i.e. 315,750 USD.

3.1.4 Level and Importance of the Onshore Markets and Sales Process

In 2009 legal entities and individuals that obtained a permit for fishing in the Azerbaijan Republic were fishing predominately only for kilka. In 2009 legal entities and individuals caught 811.2 tonnes of kilka (see Table 3.0, Section 1.2). The ZAO “Khazar-Shay Company”, ZAO “Baku marine fishing harbor”, commercial firm “Globus-5” and ZAO “Caspian Fish Co Azerbaijan” (Table 3.0) deliver caught fish (kilka) to Govsany fish plant (Baku), and, from there, fish products are sold to the sales network of the Russian Federation. The major proportion of fish caught in 2009 (619.3 tonnes) by these companies was packed and sold by Govsany fish plant. ZAP “Khazarbalig” processes fish at their own enterprise, then sells and exports caught fish. The remaining companies and individuals also process and sell caught fish themselves, mainly exporting it to the Russian Federation.

3.1.5 Level and Importance of Employment Onshore

415 people are involved in the process of preparing vessels for marine operations, and in fish processing and marketing, each with an average annual wage of 1200 AZN. Therefore, in total 415 people wages totals 498,000 AZN, i.e. 622,500 USD.

3.2 Economic Value of Fishing Activities within the Vicinity of the SD Contract Area

It is quite difficult to determine total economic value of fishing activity within the borders of the SD Contract Area, as fishing vessels of legal entities and individuals change their locations depending on the dynamics of kilka populations in the Southern Caspian, which are currently distributed around various offshore banks and other areas as described in Section 2.2 above. However, considering that in winter fishing is carried out at depths of 60-80m below sea level, and in summer – at 30-40m depths below sea level, i.e. at a substantial distance from the ACG and SD Contract Areas and the adjoining parts of the sea including pipeline routes, it can concluded that the impact from the oil-gas operations and hydrocarbon transportation on the social-economic indices associated with fishing in the Azerbaijan sector of the Caspian Sea will be negligible.

4 References

N.N.Andreev. Handbook on fishing gear, nets and field accessories // Moscow. Pishchepromizdat. – 1962, 504 pp.

N.N.Andreev. Some issues of the theory of fishing with the use of gill nets // Proceedings of VNIRO (Russian Scientific-Research Institute of fishery and oceanography). Vol. XXX. – Pishchepromizdat – 1955.

N.N.Andreev. Theory of fishing using stake gill nets // Fishery. – 1985. - № 11. – C. 58-60.

I.Ya. Akhlynov. Design of trawl and technique of trawl fishing // Moscow. Pishchepromizdat – 1954.

Yu.B. Baranov. Methods of commercial fishing. – Moscow. – Pishchepromizdat – 1960, 695 pp.

V.A. Borodatov, Yu.Yu. Marti. Drift fishing of herring // Murmansk. – 1947.

Ye.L. Varein. On design of river shore seines (throw nets) // Proceedings of Caspian Scientific-Research Institute of fishery. – 1963, vol. 19, pp. 17-32.

Voinikanis – V.N.Mirski. Principles of commercial fishing // Moscow. Food industry. – 1969. – 302 стр.

Voinikanis – V.N.Mirski. Methods of commercial fishing // Moscow. Food industry. 1969. Part 2. – 456 pp.

A.I. Zonov. Operation of fishing gear with respect to fish behavior // News of GosNIORKh. 1971. Vol. 73. – pp. 75-88.

V.A. Ionas. Efficiency of trawl nets // Moscow. Food industry. 1967. 50 pp.

V.F. Kanin. Fishing with the use of stake nets // Moscow. Pishchepromizdat – 1950.

V.K. Korotkov, A.S. Kuzmina. Trawl, behaviour of the fishing objects and underwater surveys // Moscow. Food industry. 1972. – 296 pp.

Yu.I. Kostyunin. Fishing trawls // Moscow. Food industry. 1968. - 174 pp.

S.K. Malkyavichus. Fishing at sea without nets and its perspectives // Fishery. 1977. No 8 – pp. 64-67.

V.N. Melnikov, V.V. Reshetnyak, V.N. Savin. Commercial fishing for Caspian kilka // Moscow. Food industry. 1977. – 98 стр.

F.M. Mikhov. Trawl and technique of fishing with trawls // Moscow. Pishchepromizdat – 1947.

I.V. Nikonorov. Fishing with the use of electric light (Theory and practice) // Moscow. Fishery. – 1963. – 166 pp.

I.V. Nikonorov. Methods of continuous fishing // Moscow. Food industry. 1968. – 103 pp.

V.R. Protasov. Behavior of fishes // Moscow. Food industry. 1978. – 295 pp.

Fishing gear used in the Caspian basin // Moscow. Pishchepromizdat – 1951.

Fishing industry. Editor A.G. Vitchenko // Moscow. Light and food industry. 1981. – 238 pp.

Yu.S. Sergeev. Foundations of the theory of fishing using stake nets and trawls // Moscow. Food industry. 1979. – 142 pp.

V.G. Sternin, Yu.K. Bumester, I.V. Nikonorov. Fundamentals of fishing with the use of electric light // Moscow. Food industry. 1972. – 360 pp.

A.I. Treshchev. Intensity of fishing // Moscow. Light and food industry. 1983. – 235 pp.

A.L. Fridman. Design and theory of commercial trawls // Murmansk. – 1957.

A.L. Fridman. Theory and design of commercial fishing gear // Moscow. Food industry. 1982. – 327 pp.

V.M. Khalilov. Optimum length of the wing of stake net // Fishery. 1972. No 1. pp. 42-44.

V.M. Khalilov. Analysis of efficiency of commercial fishing pumps // Fishery. 1979. No 2. – pp. 50-52.

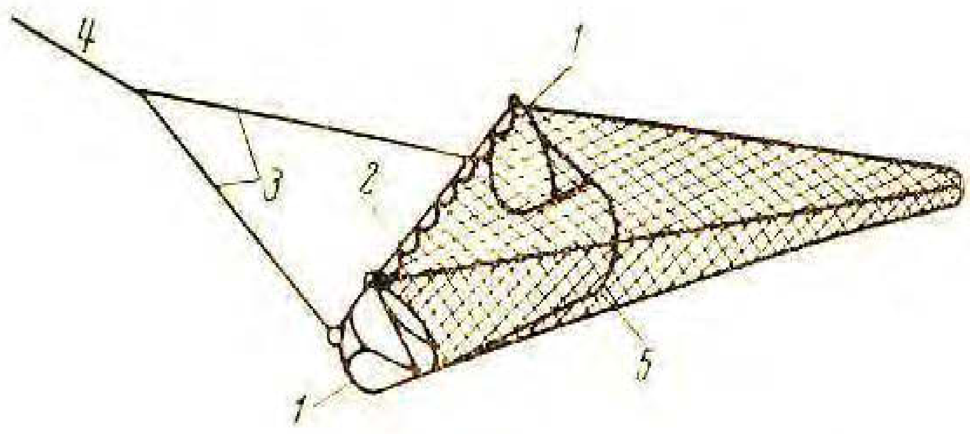
V.M. Khalilov. Technique of commercial fishing. Baku. Zeka. 2006 – 864 pp.

Appendix A
Trawl Fishing

The principle of trawl fishing is that one or two vessels tow special fishing gear along the bottom of the water body or within the water column, and this fishing gear collects fish as it progresses. If fishing is carried out from two vessels it is called pair trawling. When fishing from one vessel the fishing gear is called a trawl, and the fishing is known as trawl fishing. Trawls include bottom trawls and variable-depth (floating) trawls. The principle of operation of pair trawl fishing gear involves a net bag of a special design which is towed through the water body by two identical twin vessels, catching fish as they progress. This type of fishing was used in the 1930s in the Northern Caspian and Azov Sea using seine (purse) nets, was quite successful, and became a major business on the Caspian. However, as a result of the decrease in stocks both in the Caspian and Azov seas, trawl fishing was banned in these regions.

Another type of trawl, spacer trawls, are trawls that are opened horizontally with the use of otter boards attached to the front side of the trawl, at an angle to its direction of movement. These boards expand wings and open the trawl. In terms of horizontal opening trawls, these are sub divided into beam trawls and otter trawls. A beam trawl is shown in Figure A1.

Figure A1 Beam Trawl



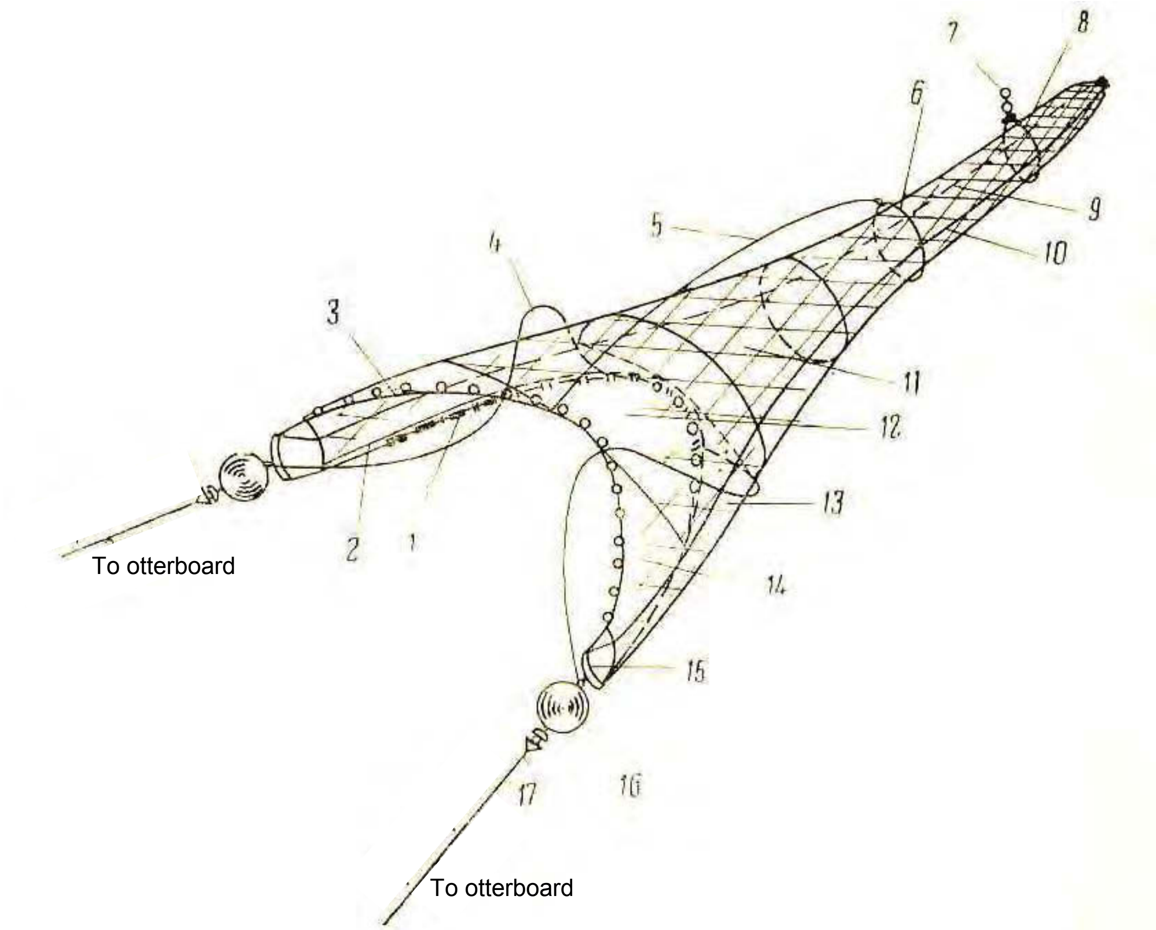
1 – Cradle; 2 – Beam; 3 – Bridle; 4 – Wire (drag rope); 5 – Guard rope.

The base of a beam trawl is a solid wooden block with the beam up to 20m long with diameter about 30cm. The average length of the beam is 15-16m. Due to disadvantages associated with beam trawl operation related to the bulkiness of its frame it was necessary to search for more efficient solutions. As a result the so called brace trawl, or otter trawl, appeared.

In practice bottom trawls and variable-depth (floating) trawls are used. Bottom trawls are intended for catching fish that spend the major part of their life cycle at the bottom of the sea or directly near it. Bottom sweep is a variety of bottom trawl and is used mainly for fishing of seed-herring that stays at some distance from the bottom. Variable-depth (floating) or pelagic trawls have been used for fish, which stay within the water column (herring, pilchard/sardine, kilka, etc.). The design of the variable-depth trawl incorporates the absence of square (pocket park) and ground ropes.

Numerous designs of trawls exist that vary in size, cut, accessories etc. The trawl designed by F.M. Mikhov in the beginning of the 1950s has been used most frequently from the vessels of beam (side) trawling and stern trawling. The length of a Mikhov trawl is 24.7m. In 1959 this trawl was upgraded and is currently used on most vessels of beam (side) trawling and stern trawling. All parts of the trawl are made of kapron webbing with 3mm mesh. Cones of the upper and lower wings are made of two-part strand webbing.

Figure A2 General View of Mikhov's Bottom Trawl



1 – Ground rope; 2 – Lower guard rope; 3 – Upper guard rope; 4 – Quarter-rope; 5 – Jamming rope line; 6 – Jamming rope; 7 – Kukhtyl (ball float); 8 – Special "delezhny" sling; 9 – Cod end; 10 – Belly line; 11 – Pocket (purse); 12 – Square; 13 – Lower wing; 14 – Upper wing; 15 – Moth; 16 – Dan leno; 17 – Cable.

Some models of fish trawlers and seine boats are shown in Figures A3 - A7.

Figure A3 Medium-size fish trawler CRT-400

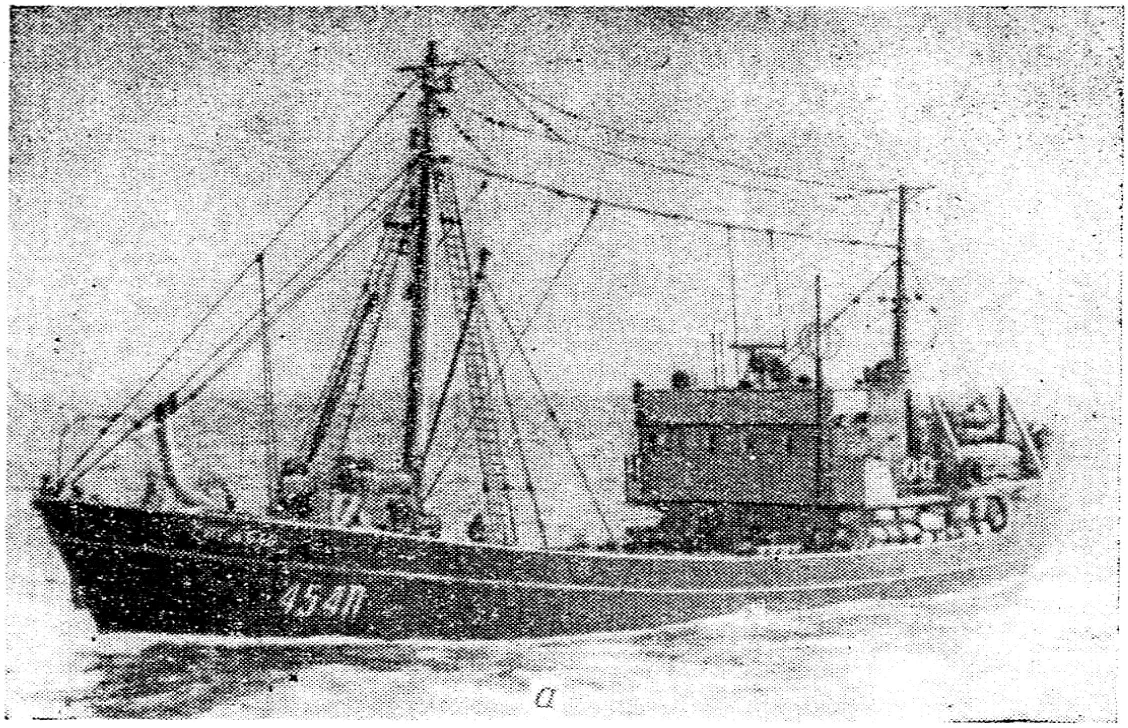


Figure A4 Medium-size fish trawler CRTR

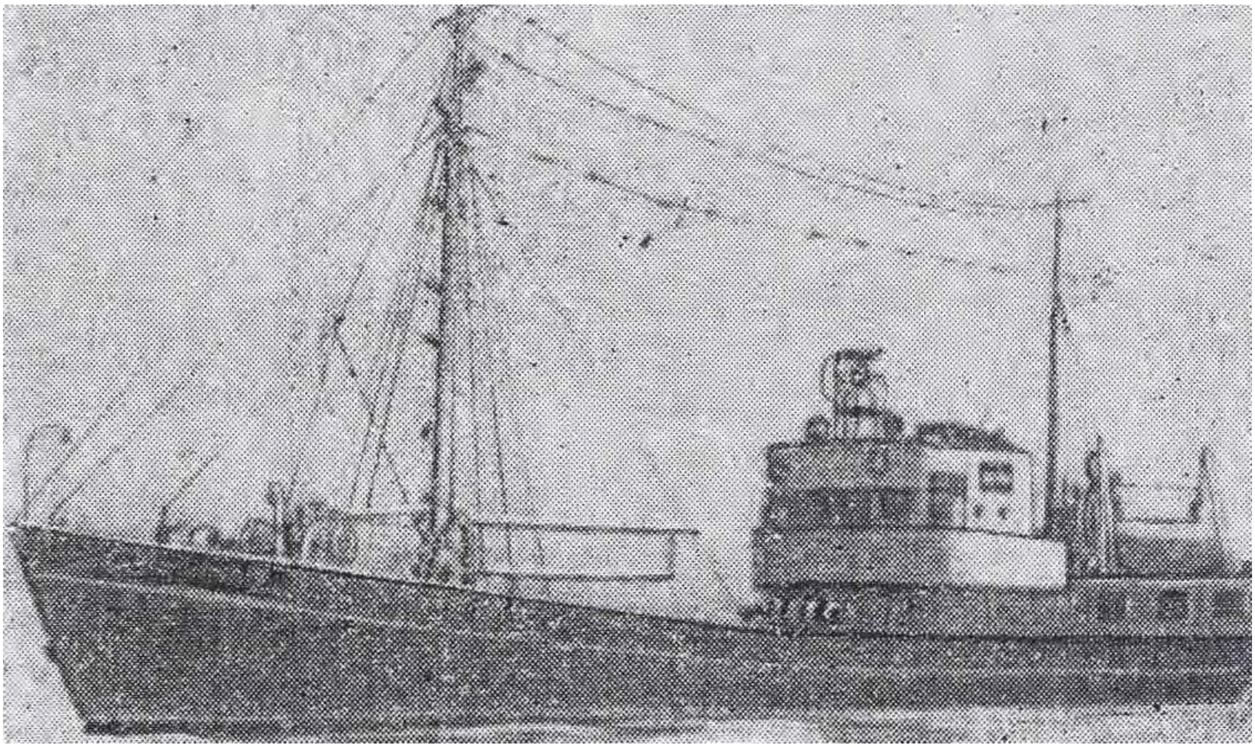


Figure A5 Seine boat CO-300

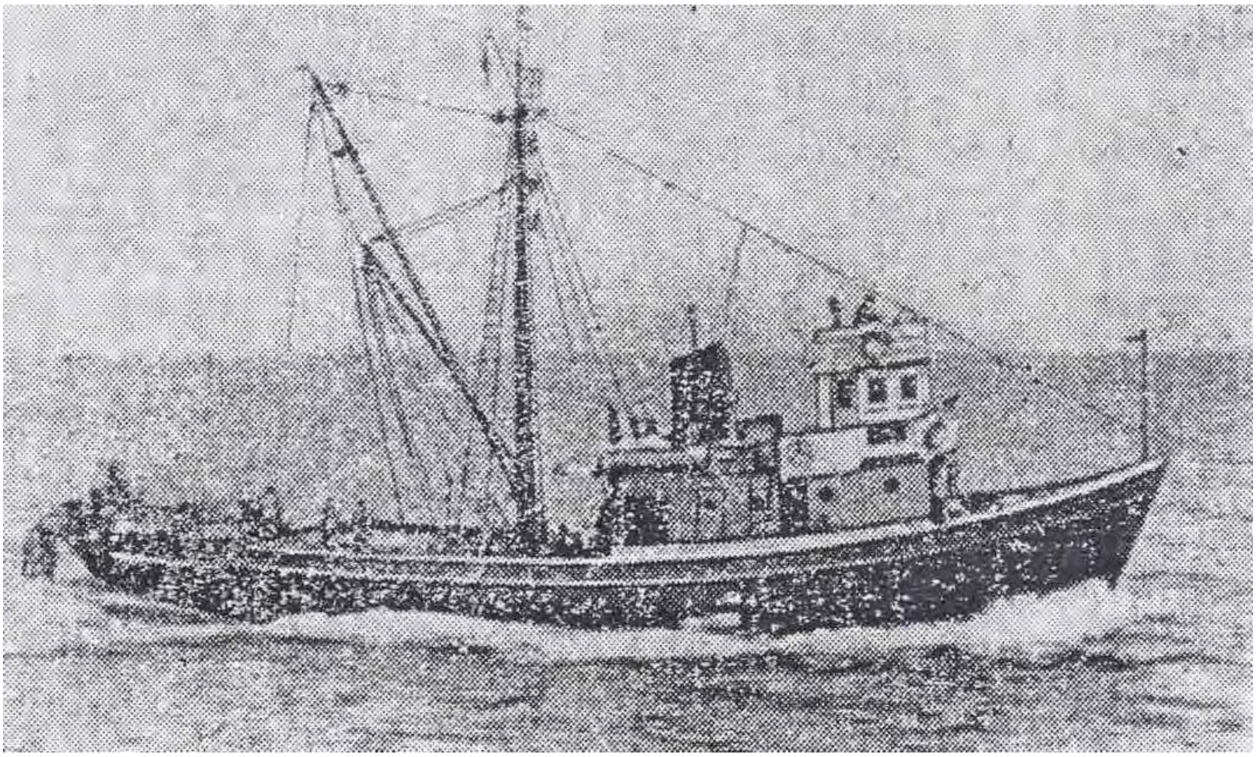


Figure A6 Seine boat PC-300

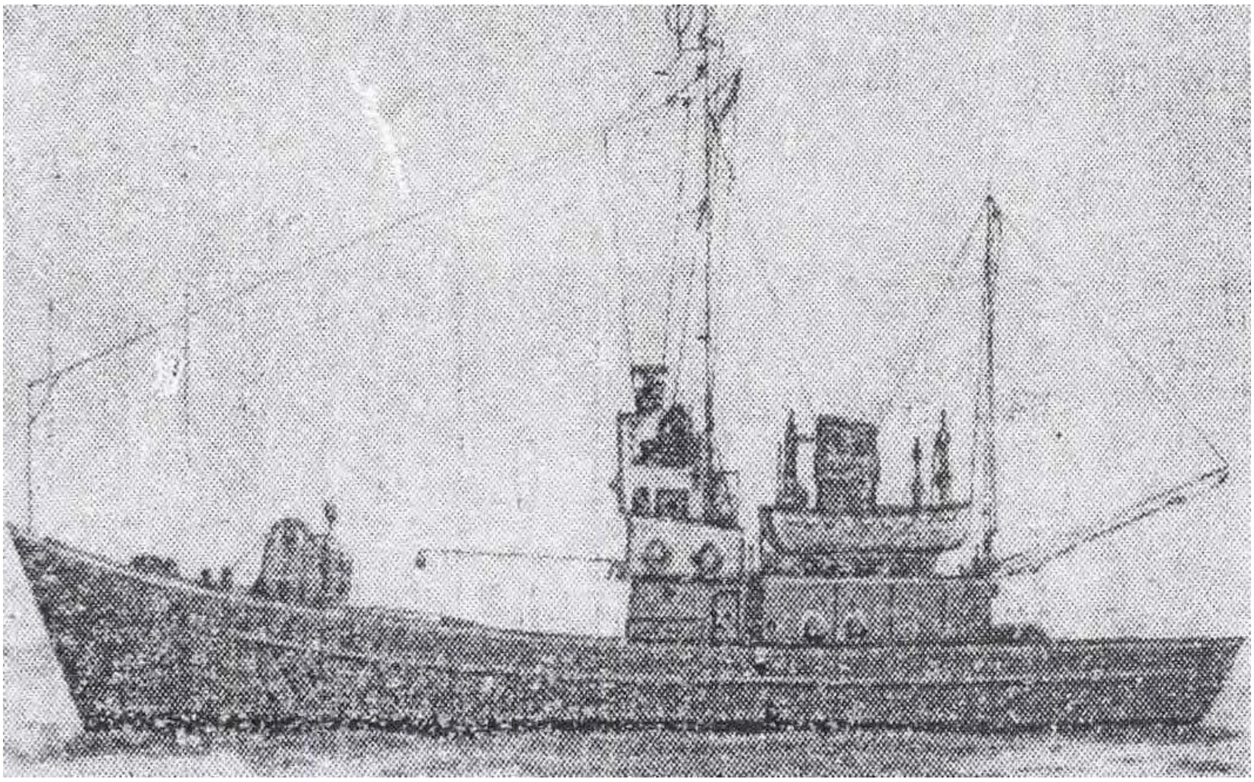
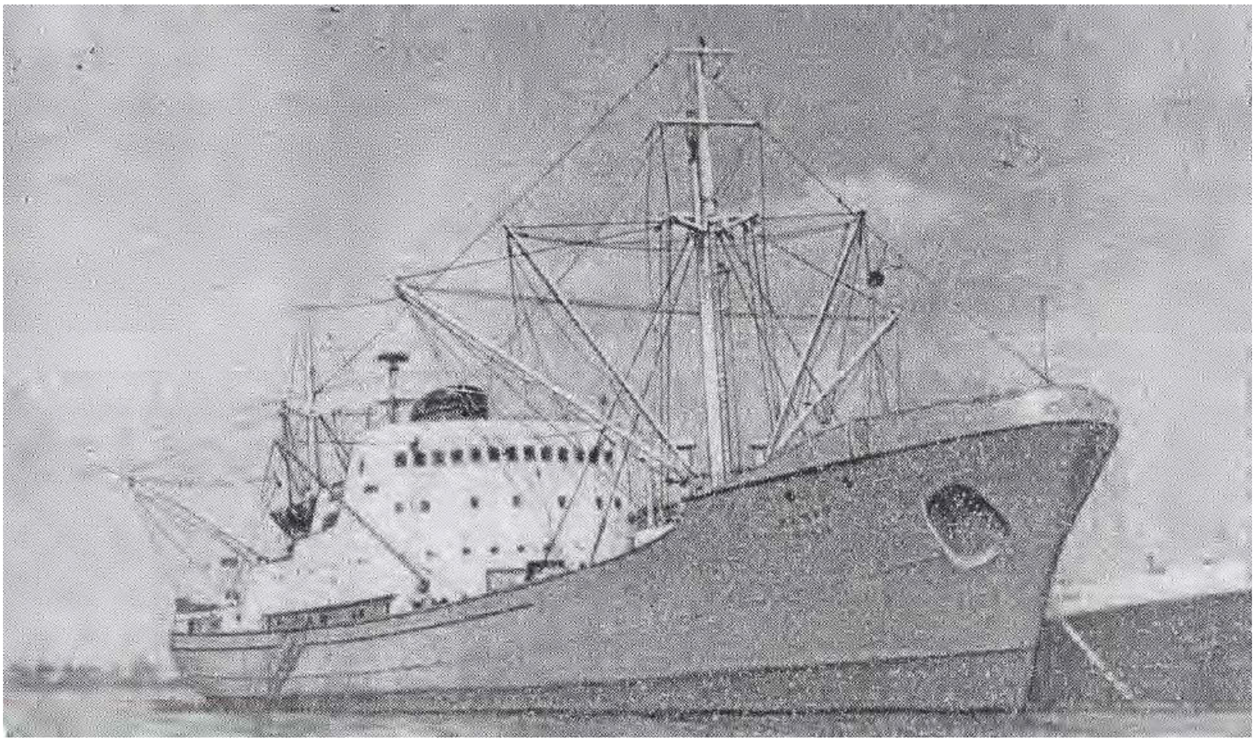


Figure A7 Freezer vessel



APPENDIX 6D

Caspian Seal Report

Appendix 6D
Caspian Seal Report

Table of Contents

List of Tables

List of Figures

1 Review of Seal Studies in the Azerbaijan Area of the Caspian Sea

1.1 Introduction

This review has been prepared by Dr. Tariel Eybatov, leader of the Darwin Caspian Seal project Azerbaijan research group, with additional input from Dr. Simon Goodman of the University of Leeds and includes an overview of the following:

- The existing programmes and projects associated with Caspian seal monitoring across the Caspian Sea;
- Current status, trends and survey findings as reported at the International Caspian Seal Seminar 2009;
- Results of surveys undertaken in the Azerbaijan sector of the Caspian Sea between 1971 and 2009;
- Observed seal activity within the Shah Deniz Contract Area; and
- Conclusions.

1.2 Background and Overview of Existing Caspian Seal Programmes and Projects

The Caspian seal (*Phoca Caspica*) is endemic to the Caspian Sea and has been listed on the IUCN red list as ‘Endangered’ since October 2008 (see http://www.iucnredlist.org/apps/redlist/details/41669/0 for full citation). The Caspian seal population has decreased by more than 90% since the start of the 20th Century and continues to decline, considered to be due to commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations using nets. Historically, the population of Caspian seals was estimated to have exceeded one million. In 2005 it was estimated that the total population was approximately 111,000 (Ref. 1). Subsequent surveys (Ref. 2 and 3) of Caspian seal pup numbers carried out on the winter ice-field in Kazakhstan territory (the primary breeding ground for Caspian seals) have reported further reductions in population as a result of reductions in pup production[1].

The Caspian seals distribution throughout the Caspian Sea is dictated by migration patterns. Migration routes are illustrated in Figure 1.

They typically spend the summer months in the Central and Southern Caspian, migrating northeast in the autumn (October – December). Females typically give birth in the early winter (mid-January to late February) on ice at haul out sites in the Northern Caspian and pups enter the water around late March. Migration to the south begins around April to May. It should be noted that the Caspian seal is a transboundary species which migrates throughout the whole of the Caspian over an annual cycle. As such there is no exclusive Azerbaijan population although the species does make use of Azeri waters at different times of the year.

Modern post-Soviet studies of Caspian seals began after 1997 in response to the high mortality of the species observed that year. This event led to the World Bank sponsored ECOTOX Project[2] (2000-2002) (Ref. 4) being established to investigate the causes of seal mortality in the Caspian. The ECOTOX Project established that a further high mortality event in 2000-2001 was the result of the Canine Distemper Virus (CDV) (Ref. 5) although deaths caused by other causes including fishing nets and the commercial hunting of newborn pups were also noted to be contributing to declining seal populations.

The Caspian Seal Conservation Network (CSCN) was established in 1997 as part of the World Bank’s developing Bioresources Network and developed further throughout the ECOTOX Project to facilitate communication between seal biologists in the Caspian region and to facilitate inter-country cooperation in research projects relating to Caspian seals. The CSCN was adopted as a working network at the Darwin Project’s (see below) initial meeting in 2006.

The Caspian Environmental Programme (CEP) was set up in 1998 with the backing of the five Caspian littoral states (Iran, Azerbaijan, Russia, Kazakhstan and Turkmenistan) to establish procedures for the conservation, management and sustainable development of the Caspian environment. A number of subsequent surveys and projects have been set up specifically in relation to the Caspian seal including:

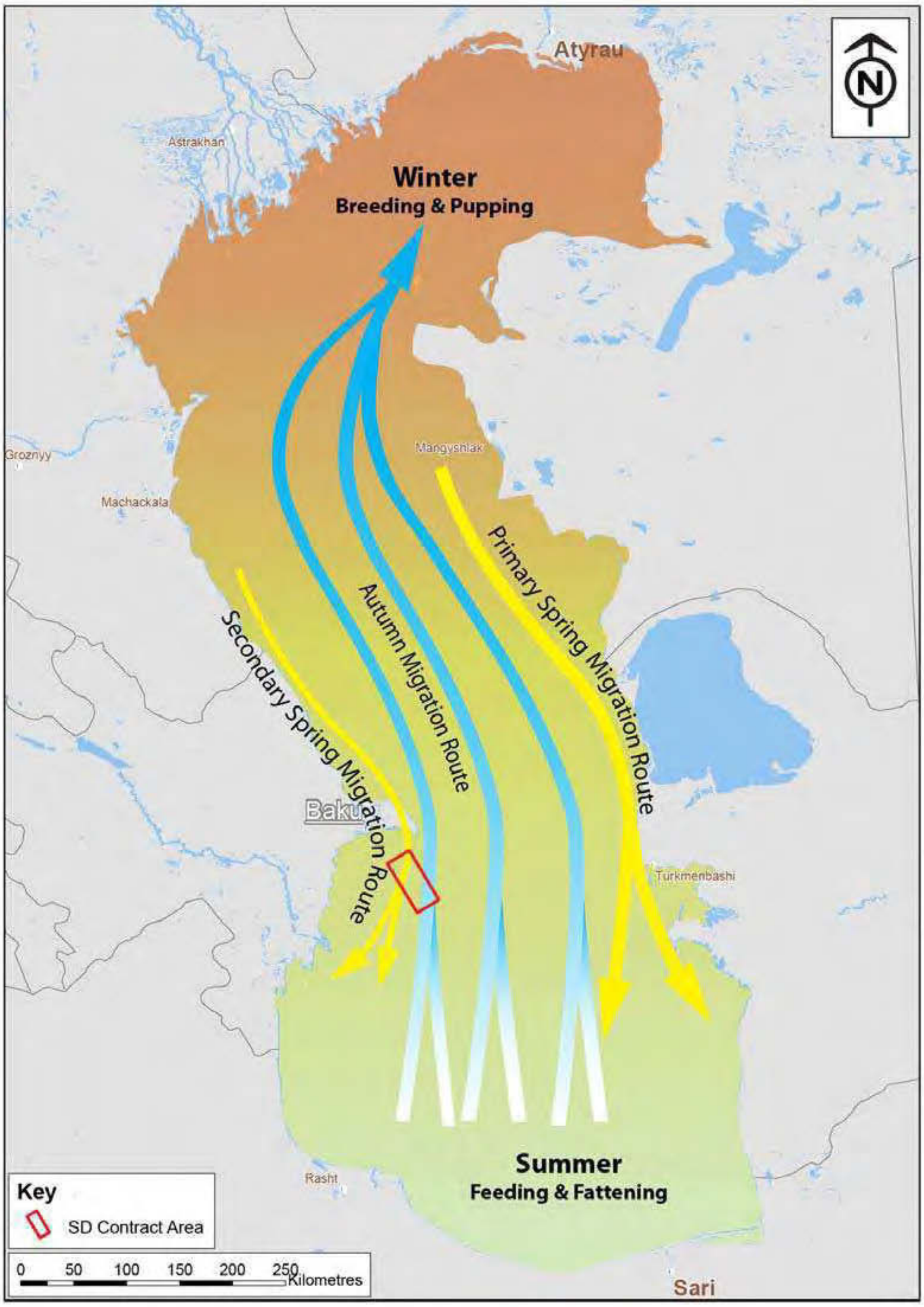
- The (Darwin) Caspian Seal Project - the project aims to establish population monitoring, assess threats,

[1] The reports from the latest surveys do not provide estimates for the total population of Caspian seals.
2 Ecotoxicology Study: Investigation into Toxic Contaminant Accumulation and Related Pathology in the Caspian Sturgeon, Seal and Bony Fish.

develop conservation action plans and educate local communities. In addition to specialists located in the Caspian states, support is also provided from specialists in seal science from the international community, currently from the UK, Sweden, Estonia and Russia. Since 2006 the Caspian Seal Project has received financial support from the UK Government Darwin Initiative and the Kazakh Fisheries Research and Production Centre; and

- The Caspian International Seal Survey (CISS) - the CISS comprises a number of research teams from Iran, Azerbaijan, Russia, Kazakhstan and Turkmenistan who undertake population surveys and carry out related research. The CISS teams work along side and in conjunction with the Darwin Caspian Seal Project. Survey results and findings are held by the CSCN, also working jointly with the Darwin Caspian Seal Project (Ref. 6).

Figure 1: Caspian Seal Migration Routes



Through the CEP, the Caspian Seal Project team has worked in conjunction with the CISS group to produce a Caspian Seal Conservation Action Plan (CSCAP) (Ref. 7). The CSCAP, which details the activities required to halt the decline of the population and begin its recovery, was ratified by the five littoral States in 2007, and is designed to implement Article 14 of the 2003 Tehran Convention with respect to Caspian seals.

A development as a result of the CSCAP is a new CaspEco programme which started in 2010 for Caspian governments to develop a network of Seal Special Protected Areas (SSPAs) for the Caspian seal throughout the Caspian. The objectives of this programme are to safeguard sufficient habitat of all types which are vital for all stages of the seals life cycle – breeding, moulting, feeding, resting, nursery etc, corridors of access to such locations, and to make allowances for the shift of such locations in response to future environmental changes. In addition habitat areas important for seals, but which currently are not used by them, should be maintained or restored to facilitate recovery of the population. The identification of potential SSPAs is currently the subject of a consultation exercise (Ref. 8).

1.3 Overview of International Caspian Seal Seminar 2009

An international Caspian seal seminar entitled "*The Threat to Existence of Caspian Seals. Obtained Data, Required Studies and Mitigation Measures*" was held between 17th and 19th September 2009 in Atyrau, Kazakhstan. The seminar was organised by:

- The CISS;
- Agip KCO jointly with the Darwin Caspian Seal Project research groups; and
- Representatives of the Caspian states involved in Caspian seal monitoring.

Results of the seal monitoring studies in the Azerbaijan sector of the Caspian Sea were presented at the seminar by Dr Tariel Eybatov as leader of the Darwin Caspian Seal project Azerbaijan research group.

The studies, which form part of the wider, Darwin Caspian Seal Project, began on 1st July 2006 and will be finalised on 1st July 2010. Final project results are expected to be published at the end of 2010.

Key points highlighted at the seminar are outlined below:

- Systematic fixed wing aerial surveys of the breeding population of Caspian seals on the winter ice-field from 2005-2009 showed that pup production declined from 21,000 pups in 2005 to around 7000 in 2008. The represents a ~60% collapse in the reproductive output of the population over this period. The causes are presently unknown, but potentially food availability might be one of the main drivers. Research is ongoing to test this hypothesis (Ref. 9);
- It was established via aerial surveys and satellite data that in recent years there has been a steady reduction of ice areas where seals are breeding which has reportedly led to reduction of seals number (Ref. 10 and 11);
- It was agreed by the seminar working group that bycatch from fishing (both legal and illegal) was currently the single most important threat to the Caspian seal population since the bycatch may exceed at least 10% of current population size per year. Commercial hunting, habitat loss, ecosystem changes and industrial disturbance were also identified as important factors;
- Anecdotal evidence of illegal seal fishing taking place in practically all Caspian littoral states was discussed. For the first time it was reported at the seminar by the Russian research group led by A. Kondakov, that in the Russian sector of the Caspian Sea (off the coast of the Dagestan republic) in addition to licensed commercial fishing, illegal fishing and commercial processing of seals also takes place (Ref. 12). In 2009, the Russian research group also initiated monitoring of dead seal bodies found on the Russian coast of the Caspian Sea as part of their seal survey programme, enabling comparison of similar data collected within Azerbaijan and Iran; and
- A group of Iranian researchers presented the results of their project associated with measures promoted in Iran to minimise seal mortality due to fishing nets. The project was focused on educating and raising awareness of fisherman and the local population on the issue. The experience in European countries where nets are designed to be safe for seals was also discussed at the seminar.

2 Caspian Seals in the Azerbaijan Sector of the Caspian Sea

Caspian seal monitoring has been undertaken in the Azerbaijan sector of the Caspian Sea since 1971. The most recent surveys for which the data collected that has been analysed was in 2009.

2.1 Azerbaijan Caspian Seal Monitoring 2009

In 2009 monitoring studies were undertaken along the coast of the Absheron Peninsular and on the islands of the Absheron and Baku archipelago. The monitoring demonstrated that since 2005 there are no longer any permanent seal rookeries in these locations. Temporary seasonal rookeries (haul-outs) were observed only during the spring migration from a north to south direction in April-May and during the autumn migration, which occurs in a south to the north direction in October-December. These temporary rookeries were found on the Southern spit and Urunos on Chilov island, and on the small islands between Pirallakhi and Chilov islands (Malaya Plita, Bolshaya Plita, Podplitochny and Dardanella). These were observed by the Azerbaijan seal research group for the last time in 2002. No permanent or temporary seal rookeries at Shakhova spit have been observed since this time.

Throughout 2009 observations were been made by fishermen, helicopter pilots and oil field workers (on vessels and platforms) in the Azerbaijan sector of the Caspian Sea and reported to the Azerbaijan seal survey group. Details of these observations are provided in Appendix A of this document. In summary:

- The 1st sighting of a shoal of migrating seals was in early April, much earlier than in all previous years;
- Regular sighting throughout late spring, summer and autumn on Chilov Island (between the Southern spit and Urunos), in open sea (including a large group moving across the Shah Deniz Contract Area in mid May) and on the Shakhova spit; and
- Observations indicated that the autumn seal migration was much later than in previous years, towards late November/December.

2.2 Monitoring of Mortality in the Azerbaijan Waters of Caspian Sea

In 2009 a reduction in the number of dead seals was recorded on the northern shore of the Abershon Peninsular; the lowest number since long term monitoring began in 1971. The total number of dead seals in 2009 was the lowest annual number recorded across the 2000 to 2009 period. Table 1 presents the number recorded on the northern shore of the Absheron Peninsular since 2000.

Table 1: Number of Dead Seals Recorded on the Northern Shore of the Absheron Peninsular 2000 - 2009 (100km Zone)

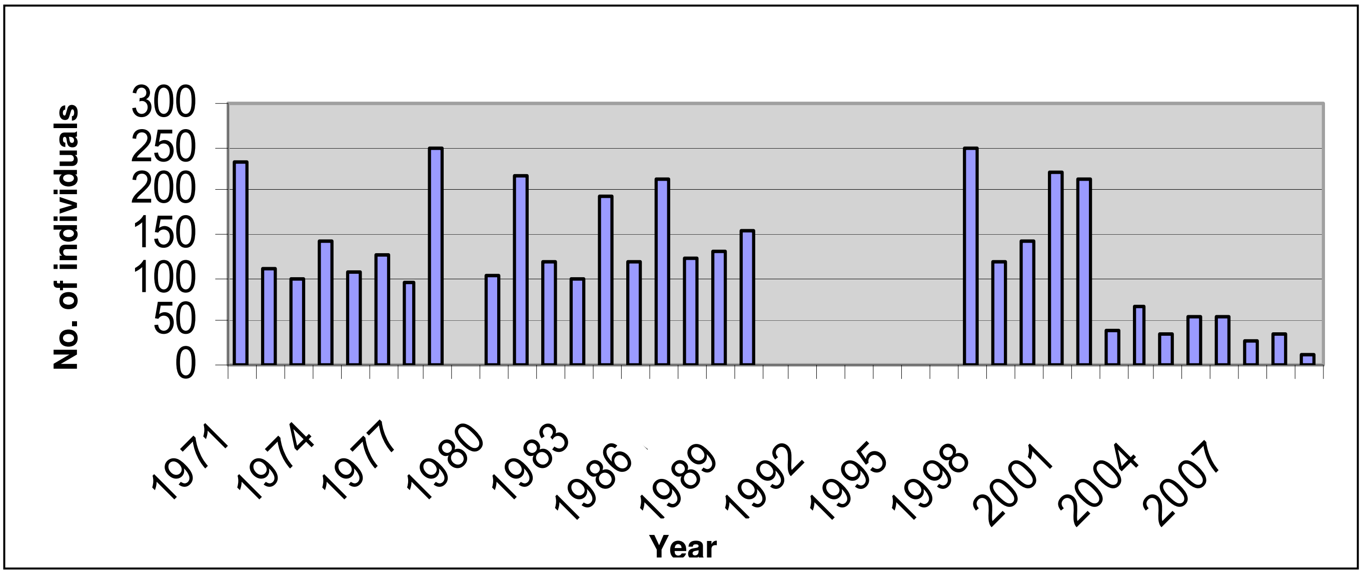
Year	Number of individuals	% Males	% Females	Embryos within Females (as % of individuals)
2000	2210	57.5	42.5	2.7
2001	2140	63.5	36.5	0.5
2002	410	41.5	58.5	2.4
2003	670	31.3	68.7	6
2004	350	42.8	57.2	2.8
2005	540	51.5	48.5	3.7
2006	560	32	68	8.9
2007	270	40.7	59.3	11.1
2008	360	38.9	61.1	16.6
2009	130	38.5	61.5	7.7

As shown in Table 1, both the total number of dead seals (recorded throughout the year) and the number of dead pregnant females (recorded during spring) were reduced during the 2008- 2009 period. In previous years, it was indicated in the first report (2009) (Ref. 13) that a reduction from 2008 to 2009 in the number of seal corpses correlated with a reduction in the population of the Caspian seals across the Caspian Sea. In early 2010, during the period of whelping in the Northern Caspian (i.e. when new pups are born), participants of the Darwin Caspian Seal Project undertook an aerial photography exercise to survey the seals and pups. Results of the survey are not yet available.

Figures 1 and 2 present the number of dead seals recorded on the northern shore of Absheron Peninsular since 1971 and at the monitoring zone Buzovna - Severnaya GRES (see Figure 1) since 2000, respectively. While there is some fluctuation, Figure 2 shows that, during the last 8 years, the number of dead seals recorded has gradually reduced. As discussed within Sections 1.3 and 2.1 above this has been accompanied by a reduction in seal populations and births. The causes of the population decrease are complex but thought to include the following (Ref. 6):

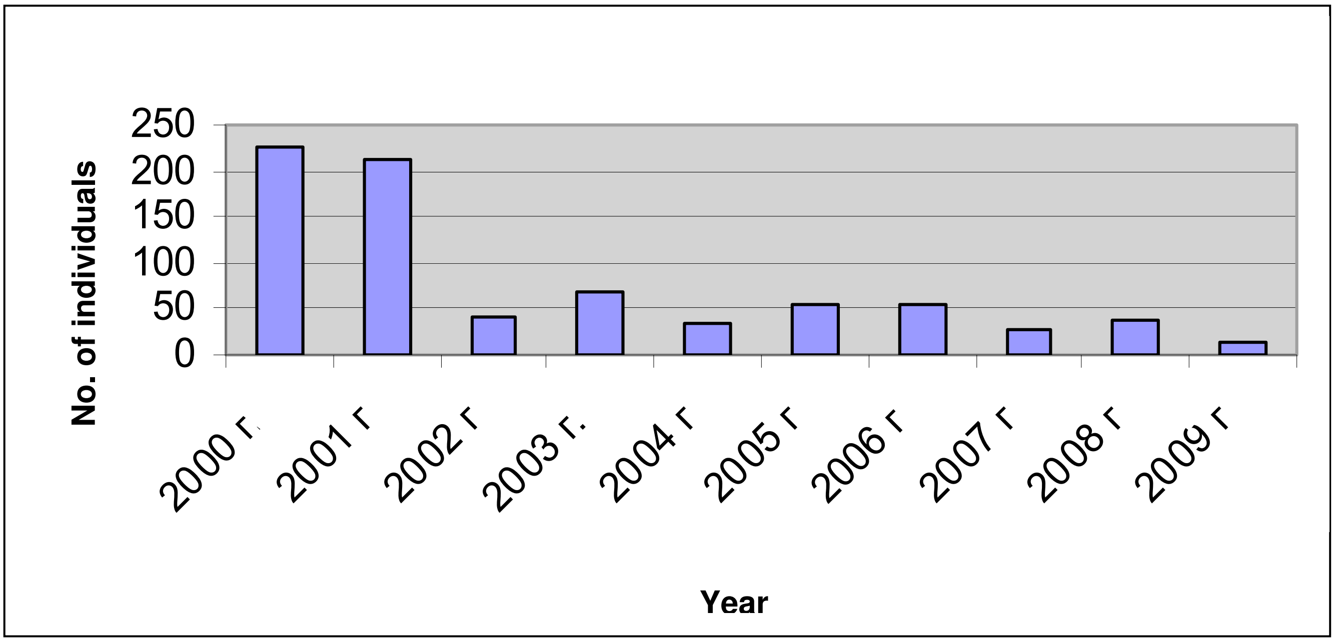
- CDV;
- The impact of invasive species such as the comb jellyfish which feeds on the same main food sources (Zooplankton) as the fishes that the Caspian seals feed on;
- Natural predation of pups;
- Pollution (mainly organochlorides e.g.DDT);`
- Fishing, particularly fishing using nets;
- Disturbance from vessel activities;
- Commercial seal hunting (both historic and present day hunting)[3]; and
- Global warming.

Figure 2: Number of Dead Seals Recorded on the Northern Shore of the Abershon Peninsular Since 1971



[3] Licenses to hunt seals are administered by the Commission on Aquatic Bioresources of the Caspian Sea.

Figure 3: Number of Dead Seals Recorded in the Buzovna - Severnaya GRES Monitoring Zone since 2000



2.3 Estimated Caspian Seal Population in the Azerbaijan Waters of Caspian Sea

Analysis of data available in 2009 (predominantly observations including those recorded in Appendix A) suggests that the population of seals visiting the Azerbaijani sector of the Caspian Sea includes approximately 10-15,000 individuals. The maximum concentration of seals is observed during spring around the islands of the Absheron archipelago, based on observations reported by fishermen and helicopter pilots. Their number in this region is estimated to be a minimum of 5,000 individuals (Ref. 14). Since 2000, seals have not been observed near the islands of the Baku archipelago.

Small groups of seals, one to three individuals on the two to three kilometre (km) line, have been observed along the shoreline, from Yalama seashore to the Lenkoran coast, during the spring-summer-autumn season (Ref. 14). Most often these seals have been observed becoming caught in the nets at a distance of 10-20km from the coast.

Evidence from Krylov (Ref. 15) has indicated that there remained approximately 10-15,000 seals in the Southern Caspian - at the rookeries and in the open sea towards the end of the 20th century. However, within Turkmenistan waters seal numbers have dropped by more than ten fold during the 21st century (Ref. 15).

2.4 Caspian Seal Population in the Shah Deniz Contract Area

The number of seals found in the Shah Deniz Contract Area varies throughout the year. Table 2 provides a breakdown by season (Ref. 14).

Table 2: Estimate of the Caspian Seal Population within the Shah Deniz Contract Area per Season

Season	Estimated Number of Caspian Seals	Comment
Spring	3,000-4,000	During spring, seals are known to migrate through the Contract Area towards Iranian waters.
Summer	500-550	-
Autumn	1,000- 2,000	The number of individuals found in the Contract Area will increase during the autumn migration in a northward direction. This migration usually begins at the end of October and ends at the end of November; however in 2009 migration continued till 20th December. During the period of autumn migration the seals are less concentrated than in spring, and do not form large shoals.
Winter	Only individuals	Recently during winter months in Azerbaijan, only individual seals could be found and hence, it can be concluded that in winter there will be very few or no seals in the Contract Area.

With regard to the seals' main food source, it should be noted that before 1990, with particular reference to the Soviet era, studies of the numbers of fish, the character of their migration, and fishing were centralised and all littoral Caspian states, with the exception of Iran, had access to this information. Unfortunately, this information now remains confidential in each country or region and it is difficult to relate the migration of Caspian seals with the migration of their food sources and fish populations.

Consequently, the diet of Caspian seals is poorly understood, particularly in relation to patterns of spatial and temporal data. There are no up to date comprehensive studies of seal diet at present although there are presently studies underway. However, a literature review carried out in 1995 (Ref. 16) suggests a large percentage of the total seal population migrates to the middle and southern Caspian between May and June to feed in areas rich in pelagic fish species. During late summer and early autumn, many seals move offshore to feed in deeper waters, which include the Shah Deniz Contract Area. It is thought they feed here until September when the majority of them migrate to the north. While commercially important species such as herring and kilka are probably eaten by seals, there is little quantitative information about this. It is considered likely that there has been a shift in seal diets compared to previous decades because of the fall in fish numbers from over fishing which is reflected by the collapse of the commercial fishing industry.

It should be noted that information regarding the Shah Deniz Contract Area is mainly provided by helicopter pilots, as helicopters transport personnel to individual platforms. Information on seal sightings are also received from fishing boats and support vessels, oil workers, in particular those working on Oil Rocks, as well as from military personnel safeguarding this territory. With the exception of limited surveys undertaken under the Darwin Initiative, no specific surveys within the Contract Area are undertaken. Usually the information about the appearance of seals in the Shah Deniz Contract Area coincides with their appearance in the area of Chilov Island, where large groups of seals are registered during the spring migration prior to moving south.

Prior to 1997, during spring, seals swam very close to the shoreline and occasionally got out of the water to rest on shore. However, in recent years this appears to have changed as fishermen have observed small groups of seals in the open water. One of the potential reasons for this is because of a suspected increase in illegal fishing using nets close to the shoreline (based on anecdotal evidence). During interviews undertaken with local people (including beach patrol staff, local fisherman and local residents) following the discovery of a dead seal on the shoreline there have been very few reports from these sources of seeing live seals in the sea.

At the end of the 20th century there was approximately one seal per square kilometre (km^2) of the Caspian Sea and numbers are now estimated to have reduced by approximately four fold. Based on this estimate, the total number of seals within the Caspian Sea would be approximately one individual per $4km^2$. As the number of seals in the Caspian Sea has reduced, this implies, assuming seal migration routes are unchanged, that there has also been a reduction in seals present in the Shah Deniz Contract Area.

Table 3 below sets out the most sensitive time of the year for the Caspian seals in the Southern Caspian with particular reference to the Shah Deniz Contract Area.

Table 3: Caspian Seal Sensitivity per Season within Shah Deniz Contract Area

J	F	M	A	M	J	J	A	S	O	N	D
	Most sensitive period/expected presence										
	Moderately sensitive period/some presence										
	Least sensitive period/not present										

Key oil and gas development activities in the Caspian Sea to which seals are sensitive include:

- Vessel movements and platform operations – seals may be attracted to fish which are attracted to lights associated with vessels and platform operations but appear to be sensitive to noise and vessel movements;
- Seismic surveys and other similar activities in the Caspian or on the seabed – seals may be sensitive to the methods employed for various surveys and activities that involve disturbance to the marine environment; and
- Installation activities involving disturbance of the seabed sediment – seals orientate with their eyes and could be disoriented by plumes of sediment in their path.

2.5 Summary of the Status of Caspian Seals in Azerbaijan

It can be seen from the mortality graphs (Figures 1 and 2) that there had been four fold reduction in seal numbers since 1990, but from 2003 to 2008 the population appeared to stabilise. However, in 2009 a further reduction in the number of seals was recorded. This was established from the number of dead seal bodies found on the northern shore of the Absheron Peninsular and also corresponds to an observed reduction in the number of seals migrating along the Azerbaijan shoreline (Ref. 14).

Although seal numbers in Azerbaijan appear to be falling, one of the objectives of the CaspEco protected area programme is to maintain and restore habitats to facilitate recovery of the seal population. Therefore degradation of habitat in areas of decreasing seal numbers should be avoided.

2.6 References

Ref. 1 Caspian International Seal Survey (2005). Population size and density distribution of the Caspian seal (Phoca caspica) on the winter ice field in Kazakh waters 2005.

Ref. 2 Caspian International Seal Survey (2008). Caspian seal survey 2007 Final Report.

Ref. 3 Harkonen, T, Jussi, M., Baimukanov, M., Bignert, A, Dmitrieva, L., Kasimbekov, Y., Verevkin, M., Wilson, S. and Goodman, S. J. (2008). Pup Production and Breeding Distribution of the Caspian Seal (*Phoca caspica*) in Relation to Human Impacts. Ambio Vol. 37, No. 5, 356-361.

Ref. 4. World Bank, (2002). Ecotoxicological Study: Investigation into Toxic Contaminant Accumulation and Related Pathology in the Caspian Sturgeon, Seal and Bony Fish (ECOTOX Study) – Final Workshop Report.

Ref. 5 Kennedy, S., Kuiken, T., Jepson, P.D., Deaville, R., Forsyth, M., Barrett, T., van de Bildt, M.W.G., Osterhaus, A.M.D.E., Barret, S., Eybatov, T., Callan, D., Kydyrmanov, A., Mitrofanov, I. And Wilson, S. (2000). Mass die-off of Caspian seals caused by canine distemper virus. Emerging Infectious Diseases 6, 637–639.

Ref. 6 Caspian Seal Project website - http://www.caspianseal.org/

Ref. 7 Caspian Environment Programme, (2007). Caspian Seal Conservation Action Plan.

Ref. 8 Caspian Environment Programme (2010). Caspeco Project Component I – Creation of Special Protected Areas for the Caspian Seal.

Ref. 9 Baimukanov, M; Verevkin, M; Wilson, S; Goodman, S; and Dmitrieva L (2006), Report of International Group on Caspain seals studies with the results of accounting of Caspian seals population in 2006, Part 1: Number of seal puppies and distribution of Caspian Seals on the winter ice in the Northern Caspian in 2005 and 2006.
Part 2: Study of behavioral response of nursing seals and puppies to the icebreaker ship passing nearby.

Ref. 10 Dmitrieva L; Jüssi, M; Jüssi, I; Baimukanov, M; Härkönen, T; Bignert, A; Verevkin, M; Wilson, S; and Goodman, S (2007), Climate change impacts on ice breeding seals, and future scenarios for the Caspian Sea.

Ref. 11 Kouraev, A., Papa, F., Mognard, N. M., Buharizin, P. I., Cazenave, A., Cretaux, J., Dozortseva, J. and Remy, F. (2004). Sea ice cover in the Caspian and Aral Seas from historical and satellite data. Journal of Marine Systems 47 89– 100.

Ref. 12 Dmitrieva, L., Kondakov, A., Oleynikov, E., Wilson, S. and Goodman, S. (manuscript in preparation). By-catch in illegal fisheries is a major source of mortality for Caspian seals.

Ref. 13 Unpublished data – due for publication 2010

Ref. 14 Unpublished data collected as part of the Darwin Initiative – due for publication 2010.

Ref. 15 Krylov I. V. (1990), Resources and rational use of Caspian Seals in current ecological conditions, pp78-98. In: Some aspects of biology and ecology of Caspian Seal, VNIRO, Moscow, 1990. 100p

Ref. 16 AIOC (1995). Environmental Baseline Study Literature Review, 1995, Woodward Clyde International

Appendix A
Caspian Seal Observations

In 2009 helicopter pilots detected early migration of Caspian seals to the Azerbaijan water of the Caspian Sea. The first large shoal of seals: 300 – 500 individuals were found on 1st April in the area of Southern spit and islands between Pirallakhi and Chilov islands (Malaya Plita, Bolshaya Plita, Podplitochny and Dardanella). According to fishermen, at that time in this area a mass migration of sprat was observed, and migration of seals was related to the presence of these shoals of fish.

At the end of April – beginning of May the seals moved to the water area between Chilov Island and Shakhova spit. At that time helicopter pilots observed an accumulation of seals around Shakhova spit. Small groups of seals were also observed by oilmen on the Oil Rocks. According to the observations of fisherman, large groups of seals were observed in mid-May moving southwards, across the Shah Deniz Contract Area towards the Iranian waters. Iranian colleagues who came to the International Caspian Seal Seminar in Atyrau in 2009 informed that the first seals appeared in Iranian waters in the beginning of June.

Never, during the more than 35-year monitoring studies had the spring migration began as early as it did in 2009. Seals usually appeared in the Azerbaijan waters towards the end of April, beginning of May, occasionally towards the end of May, while large numbers of dead bodies of seals on the Northern coast were usually observed in May and June.

One more interesting feature of 2009, whilst earlier autumn migration of seals to the Northern Caspian for breeding ended in November, in 2009 this tendency changed. On 20th of December large groups of seals (over 300 individuals) were observed for the first time in the area between Pirallakhi and Chilov Island. Namely, this year northward migration of seals was also delayed.

On 17th April fishermen observed thousands of seals (up to 5,000) on Chilov Island, between the Southern (Yuzhnaya) spit and Urunos. Fishermen stated that shoals of herring were accompanied by seals. Almost all fish in the nets had been eaten or partially eaten by the seals. Large shoals of herring first appeared in the area of Chilov Island, closer to the Southern spit, and islands between Pirallakhi and Chilov. This was at the beginning of April, afterwards almost all seals moved to Urunos. Towards the end of April, fish disappeared from Chilov Island and shoals of seals moved southwards to Shakhova spit. In the beginning of May, military helicopter pilots observed, over two to three days, these shoals in the open sea and at Shakhova spit. By mid May the seals had practically disappeared in this area, with large groups moving southwards, across the Shah Deniz Contract Area, migrating and distributing in Iranian waters.

The Shah Deniz Contract Area is a zone of active migrations of anchovy kilka and historically an area of seal growing (fattening) although there are no up to date published studies to confirm the diets or numbers of seals in the area.. Main shoals of seals appear at night when kilka ascends from the depth to the surface. During daytime seals are found in this area as small groups. This was observed during a previous survey carried out by an international group of researchers (including S.Goodman, S.Wilson, T.Eybatov, L.Dmitriyeva, S.Eybatov, P.Yerokhin) on 29th May, 2007. Using a motor boat from Shikhovo beach the researchers crossed the northern part of Shah Deniz Contract Area and at 10am several groups of seals were observed: three to four individuals were observed in each group, at a distance 500-600m from each other (photos were taken, and GPS coordinates registered (Ref. 14). At night large groups of seals were concentrated around the vessels, which were fishing for kilka with light.

During the summer of 2009, one or two seals were observed periodically on the Southern spit of Chilov Island by fishermen and helicopter pilots. One more interesting fact for 2009 is that the shrimp population (another food source for the Caspian seal) in waters around the Absheron Peninsular reduced sharply. This commodity became scarce and prices rose sharply. However, there was still no dead bodies of seals found on the northern coast of Absheron during the summer. This is unusual for that time of the year given that the seals have or are in the process of migrating south at this time. In spring researchers managed to find and take photos of just two very old deposited corpses of seals within the 10km zone (Buzovna-Severnaya GRES/ Northern hydroelectric power plant).

To mid-May seals from the area of Shakhova spit began moving southwards across Shah Deniz Contract Area to Iranian waters of the Caspian Sea. In previous years during the spring most seals from Chilov Island moved towards Oil Rocks and further to the east towards Turkmenistan. However, this was not the case in 2009.

According to reports from oil workers in the area there were practically no seals observed on Oil Rocks in spring and only small groups of seals: 1-2 individuals were registered 2-3 times.

Until the end of May only individual seals were registered on Chilov Island. One seal was observed on the Southern spit on the 20th of May. On 29th of May fishermen saw two seals on Urunos. On the 14th of June fisherman saw a single seal on the Southern spit.

On the 6th of June two seals were observed on the Southern spit. One seal was observed lying on the shore and another swam nearby. In the second half of summer, seals were absent around the islands of Absheron and Baku archipelagos and in the adjoining aqueous area.

On the 17th September at 3pm helicopter pilots called from Chilov Island and informed that fishermen saw 20-30 seals on the small islands between the Southern spit and Urunos. Black sea roach (kutum) appeared in the nets and seals were seen.

On 20th December at 8:30am, a helicopter pilot called from Chilov Island and stated that he had a fisherman with him who, while sailing from Chilov to Pirallakhi Island for fuelling on 19th December, saw about 300 seals at the intermediate islands. Prior to that, this fisherman observed one or two seals in this region.

APPENDIX 8A

Scoping Consultation Presentations and Meeting Minutes

BP- MENR WG Meeting

Date/Venue: 15.00, 5th August 2008 / Expertise Department, MENR

Participants:
BP
Bill Boulton, Environment Team Lead, MPPU **(BB)**
Ayaz Hasanov, ESIA Coordinator, MPPU **(AH)**
Saadet Gaffarova, Senior Environmental Advisor, CET **(SG)**
Ilgar Mammadov, Project in Country Fabrication Director, MPPU **(IM)**

MENR
Tatyana Javanshir, Expert of Expertise Department **(TJ)**
Mirsalam Gambarov, Head of CCEMA **(MG)**

Subjects of discussion:

- Presentation of BP New Projects for the ESIA Development, presentation pack used contained:
  - COP and SDII Project information received from Mel Green & Greg Withers
  - Proposed ESIA schedule for COP, SD II Early Civils and SD II ESIA's
  - Key focus areas of the ESIA's
  - Summary of lessons learnt from previous ESIA
  - Recommendation that technical presentations are provided to the MENR and other key stakeholders as the design work progresses

- Subsea manifold discharges:
  - MENR representative TJ expressed concerns about open loop system on manifolds and discharges of hydraulic control fluid from multiple manifolds. She suggested reviewing alternative options and avoiding the use of open loop systems that result in a discharge of hydraulic fluid
  - **Action:** Early engagement with the MENR on the issue of open vs. closed loop essential. BB to liaise with Leatherhead/Staines team to confirm consultation program with MENR, technical presentation to the MENR required in 3/4Q 2008.

- Produced water forecasts:
  - MENR representative TJ request confirmation on the produced water forecasts for the SDII project and clarification on the presented forecast for COP & ACG
  - **Action:** Non-Technical description on how the ACG produced water forecast was prepared required. AH to liaise with Martin Snodgrass and prepare document covering ACG produced water forecast and issue to MENR by 8/9/08
  - **Action:** Technical presentation with MENR required once better definition on SD II produced water composition, forecasts and handling options. BB to liaise with UK SD II team and plan meeting with MENR late 4Q 2008

- Early civils ESIA and relocation of 3rd party utilities and services:
  - MENR representative MG requested BP to pay particular attention to the requirements of local legislation when planning the removal of third party services, ensuring all relevant authorities are consulted and the MENR would need to be involved in the approval process of the relocation of the services.
  - **Action:** BB to work with Nushaba Guliyeva and Nick Thomas to assess implication MENR involvement in the approval process of the 3rd party services and potential schedule impacts and confirm MENR engagement plan by 1/9/08.
  - **Action:** Nushaba Guliyeva to liaise with Permitting and Regulatory affairs team to confirm list of agencies, which will need to be involved and/ or notified of the 3rd party services relocation, and provide engagement plan by 1/9/09.

- Sangachal Terminal expansion work:
    - MENR representative TJ required clarity on the modifications and changes to Sangachal Terminal that have been made to the terminal that are not covered by the ACG Phase I-III ESIA's and SD Stage I and subsequent ESIA's. TJ recommended that the ESIA covering the SDII project also covers the modifications.

      BP representatives stressed that the SD II Project ESIA's will focus purely on SDII expansion work and that BP would address the modification work issue to the present operating terminal separately.

    - **Action:** Sangachal Operations Team: Abdulla Abdullayev (Sangachal Terminal HSSE Manager) and Amjad Shaikh (Sangachal Terminal Environmental Team Lead) to address MENR request for clarification and meet with the MENR by 15/9/08 – date to be confirmed with Abdulla/Amjad.

- Convention on Environmental Impact Assessment in a Trans-boundary Context:
    - MENR representative TJ request BP to formally notify that the SDII Project and COP will potentially result in trans-boundary impacts. Azerbaijan has ratified the international convention on the subject and MENR will advice whether BP are required to notify riparian countries about COP and SD II ESIA's.
    - **Action:** AH to confirm with AzSPU compliance team, BP's obligations under the convention, confirm BP actions and issue formal response to the MENR by 10/9/08.

Shah Deniz 2 Infrastructure ESIA
Initial Consultation Meeting with IoAE

Thursday 12/05/11, BP Hyatt Tower 2

Attendees:
Rashad Bayramov (RB [C&EA])
Ali Aliyev (AA [C&EA])
Ibrahim Ismayilov (II [C&EA])
Najaf Museyibli (NM [IoAE])
Chris Polglase (CP [URS])
Dave Maynard (DM [Landsker])

1. Introduction (RB)

- Briefly thanked Najaf for attending.
- Explained that we were going to discuss two new projects, one that is imminent and fairly concrete, the other that is just in the early planning stages.

2. SD 2 Discussions (CP, NM)

- CP introduced the project and referred Najaf to the letter that they received earlier this week from BP C&EA.
- CP explained that we are seeking IoAE's input as we plan the project and that we would like their comments in writing.
- CP also explained that BP's plan is to incorporate IoAE's information in our plans for archaeological baseline studies for SD2 and that CP might be back in a few weeks to discuss this further with IoAE.
- NM provided the following initial feedback:
    - He could only think right now of the information that we have already (i.e., the known sites, the caravanserai, and the Muslim cemetery that is well outside of the project area).
    - He said that it is hard to assess archaeological potential without going into the field, but that he expects that some form of archaeological baseline survey would be required and that IoAE would need to be involved.
    - He assumed that any work conducted for SD2 would follow the same principles as were used for BTC/SCP. CP interpreted this to mean he was assuming that we'll follow the 5 phase approach.
    - He wanted to know about the sequence and timing of the work and whether this was part of an ESIA. CP explained that it was in support of an ESIA, and that we might need IoAE support both before the ESIA is completed, and afterwards if there are any needs for additional phases of work. CP also let him know that construction may be a year off.
    - Najaf said that he will need better project details at some time in the future to better plan activities.
    - Najaf stated that we should not need to interact with the Ministry of Culture and Tourism, because the issues for SD 2 related to archaeology. CP explained that because of the presence of the caravanserai, BP needs to consult with MoCT as well.

ACTIONS:		
IoAE (NM)	IoAE will provide written comments to C&EA in response to the letter that initiated discussions related to SD 2. The letter will address concerns regarding known archaeological sites and monuments and expectations for archaeological baseline surveys, if any.	Ongoing
URS (CP)	Upon receipt of written comments from IoAE, URS will draft an SoW for an archaeological baseline survey. When the general plan for this survey is approved by BP, it will be presented to IoAE for consideration and discussions regarding how to execute.	URS is waiting for receipt of IoAE letter w/comments
BP	Provide IoAE with more detailed project plans.	When available

3. SCPx Discussions (DM, NM)

- DM introduced the SCPx project and noted that the project was just in the planning stages.
- NM had few questions, because of the early stage of the discussion.
- No immediate actions required.

4. Meeting Close-out

- NM asked about the status of the Smithsonian book.
- CP explained that it was finished and that his understanding is that it was stuck in customs at Baku airport.
- NM also asked about a previously discussed book launch in Baku. None of the C&EA people had information about the book launch.

Shah Deniz 2 Infrastructure ESIA
Consultation Meeting with MoC and IoAE

Thursday 2/06/11, Caspian Energy Centre

Attendees:
Ali Aliyev (AA [C&EA])
Jeyhun Karamov (JK [BTC Operations])
Steve Laming (SL [Shah Deniz 2])
Guivami Rahimli (GR [C&EA])
Goshchar Goshcharli (GG [IoAE])
Temur ???? (T? [IoAE])
Malahat Farajova (MF [MoC/Gobustan])
Arif Aliyev (Arif [MoC])
Two additional MoC staff (not introduced)
Chris Polglase (CP [URS])

1 Introduction (AA)

- Provided safety note.
- Thanked representatives of MoC and IoAE for attending.
- Provided a brief explanation that BP was preparing an ESIA for the SD2 project and that we were meeting to discuss our needs.

2 SD 2 Description (SL)

- Explained that as part of this presentation he was going to focus solely on the on-shore components of the project.
- Referred to the two projects for SD2 (infrastructure vs. construction) and described the separate project by the Roads Authority for the flyover/interchange.
- Identified broad schedule as the work for the infrastructure project beginning in January 2012 and the work on the flyover/interchange beginning at the end of 2012.
- SL described some of the environmental constraints (i.e., soil and hydrology) that affected the design of the project and that a geotechnical study was underway.
- Asked for questions or comments.

3 Questions/Comments

- GG stated that an archaeological survey would be needed and that it was expected practice to extend that survey beyond the project impact area.
- Arif and MF noted that MoC wanted to know how far the pipeline landfall will be from the Sand Cave and they will want protection around the cave. They indicated that the cave is a protected monument.
- CP indicated that one reason for this meeting and the letter sent in April was for MoC to provide information like this, that BP was not aware that the Sand Cave was a protected monument and that if they had additional similar information, BP would like a response in writing from MoC.
- MF asked how far the project was from the Gobustan reserve and asked for detailed plans of the project.
- One of the unnamed MoC staff asked what controls would BP put in place to protect cultural heritage from catastrophic events, such as the oil spill in the Gulf. SL responded that BP was working on detailed risk analyses so that they could put in place appropriate means for mitigating large-scale events.
- After seeking clarification on the size of the project, Arif explained that any project over one hectare required a permit from MoC. He emphasized that the completion of a report by the IoAE does not mean a project has been permitted. MoC still needs to approve the project. SL asked for clarification on the roles and responsibilities of MoC and IoAE and Arif clarified that MoC was the legal permitting authority and that IoAE provides technical guidance to MoC in permitting projects. Arif explained that MoC has no archaeologists on staff (except at the Gobustan Reserve), so they use IoAE to review and/or conduct studies, but that any reports should be provided to MoC so that they can approve a project. GG concurred with these points.

- Arif also mentioned that the law indicates that MoC may provide an observer during archaeological excavations.
- When offered a brief tour, GG explained that IoAE might need two days to tour the site and would need to come out with appropriate PPE. It was not clear what GG was referring to when suggesting that IoAE might need two days for a tour.
- GG mentioned again the need for a survey and CP explained that he would be in touch with IoAE to begin to scope the survey.
- Arif thanked BP for their efforts and acknowledged BP's commitments to cultural heritage, which he said exceeded most other organizations.

4 Meeting Close-out (AA)

- AA thanked everyone for attending.

5 Bus Tour

- SL guided a brief bus tour out to the expansion area.

ACTIONS:		
URS (CP)	The SD2 team needs to coordinate the scoping of an archaeological survey with the IoAE	Ongoing
URS (CP)	Attempt to limit the archaeological survey to just the SD2 area of direct impacts	Ongoing
BP	Get clarification regarding GG's suggestion that IoAE would need two days to complete a tour of the site.	Ongoing
BP	Seek definitive statement from MoC that they have no concerns regarding maritime cultural heritage that may be affected by the project	Ongoing
URS (CP)	Add the Sand Cave to areas listed in project plans for protection.	Ongoing
URS (CP)	Get coordinates on the Sand Cave	Completed 3/6/11
URS (CP)	Confirm that the Sand Cave is a protected monument	Ongoing
URS (CP)	Check on the law defining responsibilities of MoC and determine if they legally can ask to monitor archaeological studies	Ongoing
MoC (Arif)	MoC will provide written response to letter from C&EA related to SD2.	Ongoing
BP	BP will provide detailed plans of SD2 to MoC	Ongoing

Shah Deniz 2 Infrastructure ESIA
Meeting with MoCT

Tuesday 4/10/11, Hyatt Tower III

Attendees:
Ali Aliyev (AA [C&EA])
Jeyhun Karamov (JK [BTC Operations])
Aysel Yurifsade, (AY [BTC Operations])
Bill Boulton (BB [S'D2 Environmental and Social Manager])
Malahat Farajova (MF [MoCT])
Fazil Mamedov (FM [MoCT])
Haji Hajiyev (HH [MoCT])
Unnamed MoCT Staffers (two)
Chris Polglase (CP [URS])
Carrie Albee (CA [URS])

1 Introduction (AA)

- Thanked representatives of MoCT for attending.
- Brief introductions of meeting participants.

2 SD 2 Infrastructure Project Background (BB)

- Referred to the two projects for SD2 (infrastructure vs. construction) and described the separate project by the Roads Authority for the flyover/interchange.
- Identified broad schedule as the work for the infrastructure project beginning in January 2012 and lasting for 18 months. Construction works will follow.
- Explained that the Cultural Heritage Baseline Surveys (CHBS) were being completed as part of the ESIA for the Infrastructure Project and that the reports from the CHBS would be incorporated into a revision to the ESIA.
- Let MoCT know that there would be a CHBS close-out meeting in November, after the report was submitted.
- Indicated that Watching Brief would be conducted during earthworks activities.

3 Discussion Regarding Architectural Baseline Survey (CP)

- Explained URS' plans for the architectural baseline survey at the caravanserai and the Sand Cave.
- Noted that URS' focus was on the current condition of the monuments, since we do not believe, at this time, that the project will have direct impacts.
- Reviewed schedule for delivery of study.
- Posed a series of question (see below) regarding the monuments.

4 Questions/Comments

- In response to a question of the age of the monuments, FM stated that the caravanserai dated from the 15th or 16th century and the Sand Cave was a natural feature that was very old. He also stated that they had no reason to doubt these dates.
- FM and MF agreed to provide available data related to monuments if Garadagh District and regarding the caravanserai. FM explained that if URS wanted detailed historical research that we could contract to a new department in the MoCT that has been set up for this purpose.
- The MoCT staff reviewed their knowledge of other caravanserai in the area and how the caravanserai were part of a broader transportation system that included wells and bridges as part of the generalized trade routes.
- MoCT staff asked if there would be a watching brief during construction and BB and CP confirmed that there would be such. FM then explained that MoCT can choose to participate during such monitoring and that his team may want to participate alongside the IoAE.

- BB and CP offered to provide a draft protocol for watching brief and interface between BP, their contractors, IoAE and MoCT during the close-out meeting in November and to discuss this protocol at that time.
- FM offered to have a member of his staff, Tarana, be the regular interface with BP and AY will serve as the BP interface.

5 Meeting Close-out (AA)

- AA thanked everyone for attending.

ACTIONS:		
URS (CP)	Complete CHBS fieldwork	Ongoing
BP	Provide CHBS reports to MocT.	Ongoing
BP	Schedule CHBS close-out meeting to include MoCT representatives.	Ongoing
BP	Provide draft protocol for watching brief and interface with MoCT for close-out meeting.	Ongoing

APPENDIX 8B

Public Consultation and Disclosure Presentations and Meeting Minutes

Shah Deniz 2 ESIA Disclosure Meeting

12th August 2013, Hyatt Guba Room, Baku

Attendees:

No.	Name		Company/Position
1	Saadat Gaffarova	SG	BP
2	Mehriban Gahramanova	MG	BP
3	Amrita de Soyza	AS	BP
4	Zaur Hasanov	ZH	BP
5	Nijat Hasanov	NH	BP
6	Faig Askerov	FA	BP - Regulatory Compliance and Environmental Director
7	Farah Mahmudova	FM	AMEA Geology Institute
8	Azer Valiyev	AV	AMEA Geology Institute
9	Tofig Rasidov	TR	AMEA Geology Institute
10	Ilyas Babayev	IB	AMEA Zoology Institute
11	Qaza Musfafayev	QM	Baku Caucuses University
12	Rafiq Qasimov	RQ	AMEA Physics Institute
13	Eldar Novruzov	EN	AMEA Botany Institute
14	Nariman Ismayilov	NI	AMEA Microbiology Institute
15	Rahim Amrahov	RA	SOCAR Ecology Department
16	Rustam Rustamzadeh	RR	SOCAR Ecology Department
17	Araz Panahov	AP	SOCAR Ecology Department
18	Oqtay Guliyev	OG	SOCAR Ecology Department
19	Roman Isayev	RI	SOCAR Ecology Department
20	Azer Najafov	AN	SOCAR
21	Fuad Aliyev	FA	AMEA Journalists
22	Haji Ismayilov	HI	Neftgazlayihe (Oil-Gas-Projects)
23	Rasim Dashdiyev	RD	Neftgazlayihe (Oil-Gas-Projects)
24	Tofiq Qazgozov	TQ	AMEA
25	Ramiz Mammadov	RM	AMEA Geography Institute
26	Ilqaz Hasanov	IH	MES
27	Hamlet Mayilov	HM	MES
28	Sohzab Rahimov	SR	XKEMI
29	Bill Boulton	BB	BP - SD2 Environmental and Social Manager
30	Elshad Damirchiyev	ED	BP- Drilling Engineer
31	Phil Murgatroyd	PM	BP- SD2 Process Engineer
32	Frank Farquharson	FF	WRA - Hydrology specialist
33	Sean Hayes	SH	Genesis - Discharge and spill modelling specialist
34	Alun Lewis	AL	Spill specialist
35	Garry Gray	GG	URS - Air quality specialist
36	Anna Rouse	AR	URS - SD2 ESIA Project Manager
37	Hikmat Abdullayev	HA	URS - SD2 ESIA Consultant

1. Introduction and Presentation

Faig Askerov welcomed all participants to the meeting, provided a general overview and outlined the meeting agenda.

Bill Boulton provided a detailed overview of the project and how the Environmental and Socio-Economic Impact Assessment (ESIA) has been completed.

Elshad Damirchiyev presented a number of slides, which described how the drilling conditions within the SD2 Contract Area have informed the selection of a subsea development approach to the SD2 Project.

Phil Murgatroyd provided an overview of the proposed SD2 offshore and onshore facilities as well as providing a summary of anticipated onshore and offshore flaring scenarios.

Following the introductory presentation a number of workshop sessions were then held. The key questions raised during these workshops are described below. It was planned to also hold a workshop to further describe the drilling conditions within the SD2 Contract Area (title "No drill zone") however this workshop was not held due to lack of interest.

2. Surface Water Modelling and Flood Assessment – Frank Farquharson

Following the presentation the following questions were raised:

Question: Had the study considered the risks of groundwater flooding?

Response: FF explained that this had not been studied as it was not considered to be a threat to either the SD2 site or to other local infrastructure. The soils were generally of relatively low permeability and the greatest flood risk comes from surface water.

Question: What impacts might there be from construction of the proposed SOCAR Petrochemical Plant in the upper catchment area?

Response: FF explained that potential impacts had been assessed, although considerable uncertainty remained as it is not yet precisely clear what the nature of the development might be. Similarly the possible impacts of the new Gizildas Cement Plant and associated quarrying activities had been modelled and the results are presented in the ESIA document

3. Discharge Modelling – Sean Hayes

Following the presentation the following questions were raised:

Question: Is it possible to carry out a 3D discharge modelling assessment which is focused on the Azerbaijan sector of the Caspian Sea?

Response: SH explained that the modelling assessments for this project used metocean data specific to the discharge locations and the surrounding area where the discharge subsequently disperses. Currents are provided for 32 depths in the water column and currents and wind data are spaced at 4 km in each direction varying every 3 hours. The modelling output is provided in showing both the distance the plume travels horizontally and the vertical dispersion within the water column between the surface and the seabed.

Question: What is the size of the area covered by SD2 discharge modelling exercises?

Response: SH explained that the modelling focused on the discharge locations and they subsequently disperse to reach concentrations or temperatures where no effect to the marine environment occurs. For example, for the hydrotest discharges, this was an area of 36 km by 24 km while for the cement this was an area of 2 km by 2 km. Beyond these areas, no measurable impact to the environment was predicted.

Question: How does the area affected by cuttings deposition compare with previous assessments?

Response: SH explained that the extent of cuttings deposition for the SD2 Project has considered up to a cuttings thickness of 1 mm. Scientific studies by SINTEF have indicated that beyond this thickness there would be no measurable impact to the benthic environment. It has been common in the past to consider the extent of cuttings deposition to a thickness less than 1mm therefore the areas predicted are not directly comparable.

[*Post meeting note:* modelling was completed for a single well for the SD1 project in 2002. The cuttings deposition areas (up to a thickness of 1mm) were estimated to be between 9,662 and 11,896m^2 depending on current condition and season. The cuttings deposition areas (up to a thickness of 1mm) for the SD2 Project were estimated to be between $10,000m^2$ to $15,000m^2$ depending on current condition, season and well location. Therefore the results are comparable]

Question: Would BP use local current measurements to calibrate its model?

Response: Existing metocean data is modelled by Imperial College over the period of 2006-2009 including 3D current data for the whole Caspian Sea and 2D wind data. It would be possible to review local current data if available to confirm the modelling results.

Question: Is it possible to include further details regarding the biodegradation of the glycol when control fluid is discharged in the SD2 ESIA documentation e.g. how long MEG will remain in the water before biodegrading?

Response: OSPAR tests have shown up to 90% degradation of glycol in 28 days. Rapid degradation may however commence after a lag period of 7 days (Ref. Concise International Chemical Assessment Document 22, Ethylene Glycol: Environmental Aspects, Geneva 2000). Glycol, nevertheless, is highly biodegradable and will rapidly disperse to no effect concentrations in the marine environment folllwing discharge and then completely degrade.

Question: Can you provide a "normalised" volume of control fluid discharges i.e. how much control fluid will be discharged per barrel condensate/cubic metre of gas?

Response: This information will be included within the updated ESIA

4. Condensate Characterisation - Alun Lewis

Following the presentation the following questions were raised:

Question: What proportion of the condensate is wax?

Response: AL explained that following a spill approximately 50% of the condensate evaporates, 10% remains in the liquid phase and 40% is wax.

[Post meeting note: Depending on the prevailing temperature, approximately 50% weight of the condensate spill would rapidly be lost by evaporation to the air. The remaining 50% weight of residue would have a Pour Point of +33°C. It would be present on the sea surface as a waxy solid at temperatures below this temperature.

The waxy solid with a Pour Point of +33°C would not consist of pure wax. This will consist of wax crystals that inter-lock together and liquid that is trapped in the structure. If this waxy solid is subject to some form of mechanical disturbance, a proportion of the liquid phase can be released.

Practical experiments at SINTEF, where SD2 distillation residues were mixed with water of different salinities at different temperatures, produced a wax 'slurry' consisting of approximately 80% as a waxy solid and 20% of a liquid phase. This is representative of the fate of SD2 condensate that would reach the sea surface.]

Question: The wax content of crude is approximately 6%, therefore 40% wax within the condensate seems high. Can you explain why this is?

Response: AL confirmed that using the same assay methodology used to determine the wax content of crude, the wax content of condensate is approximately 10%.

[Post meeting note: The wax present in SD2 condensate consists of paraffin hydrocarbons (C_{18} - C_{36}) known as paraffin wax. The wax content of the SD2 condensate of 6% weight was determined by a method such as UOP46-85. This method determines the pure wax content of the 'fresh' condensate.

After the evaporative loss of 50% of the condensate, the pure wax content of the residue would rise to approximately 12% weight, because the wax would not evaporate and would be concentrated in the residue.

The pure wax content of the of the residue on the sea surface would be 12% weight, but as described above, the residue present on the sea surface would be present as a waxy solid, consisting of wax crystals and trapped liquid.]

Question: Did the spill modeling consider different seasons?

Response: Yes – summer and winter were considered. AL referred workshop attendees to the subsequent spill modelling workshop for further information.

Question: Will the wax transfer into the water column?

Response: AL confirmed that a very small amount of wax will transfer to water column, but it has a very low density and the vast majority of it will float on the sea surface.

Question: Has the toxicity of a condensate spill to the marine environment been assessed?

Response: AL confirmed that the BTEX components that transfer to the water column will be toxic to marine life. Due to the aerosol effect created when a blowout or pipeline/flowline rupture occur, the liquid component readily dissolves into the water column. The extent of the impact to marine life is however very localized. The wax component will travel to shore however it will be of very low toxicity and will comprise scattered particles not a thick sticky slick (as oil does).

Question: Will a spill therefore have a very significant effect on the water column due to the dissolved BTEX components?

Response: AL explained that the effects will be localised and have been assessed within the spill modelling. Workshops attendees were referred to the subsequent presentation on spill modelling for additional information.

5. Spill Assessment - Sean Hayes

Following the presentation the following questions were raised:

Question: A figure showing the geological characteristics of the reservoir should be included as an Appendix into the ESIA for the reader's information. This will help to understand the methodology adopted for the SD2 drilling processes.

Response: A cross section of the reservoir is currently included in Chapter of the SD2 ESIA. An additional figure will be included to show how wells are planned to drilled around the areas of the reservoir where the difference between the pore pressure and fracture gradient is too small to allow safe drilling.

Question: Are you planning to use any equipment which includes radioactive sources for modelling and monitoring associated with the SD2 Project?

Response: Yes. Tank levels will be monitored using metering which including nucleonic sources.
Question: What will the extent of the impact be to Baku Bay following a spill of condensate?

Response: SH explained the majority of spilled condensate will not reach any shoreline as it will evaporate, decay and disperse at sea. The material arriving at the shoreline will be dispersed wax particles of a very small size. The circulation currents within the Caspian would take the dispersed wax particles further south than Baku Bay. These will be of very low toxicity and would break down naturally in the environment.

Question: Following a major spill incident offshore, how long will it be before the wax portion to reach Baku Bay?

Response: SH explained that this would be a minimum of 8 days to reach the nearest shoreline in worst case conditions (which occur in winter). Typically it is predicted wax (up to 20,00 tonnes) will arrive at the shoreline around 20 days after the most significant spill scenario assessed i.e. a well blowout in the ES location.

Question: Could you please provide the mathematical calculations i.e. formulas that are used within the software used for the spill modelling?

Response: SH explained that there are several steps or algorithms within the model and documentation can be provided for the main steps. Overall, the model has been refined over 20 years and has been calibrated and updated by comparison with measurements during real spill events.

6. Atmospheric Dispersion Modelling - Garry Gray

Question: Have the modelling assessment been completed based on Russian modelling approaches?

Response: No. A commercial software package called ADMS has been used. The equations on which the software is based are of Russian origin. The model allows concentration of pollutants to be calculated at specified locations and across a grid; the output of which is a pollutant map. The model also calculates concentration for various averaging periods such as annual average and short term (e.g. 1 hour peak).

Question: What meteorological data does the program use?

Response: The program uses an annual met file which includes 1 hour sequential met data i.e 8760 hours of data. This includes wind, humidity, rainfall data etc.

Question: Are you aware that a number of complaints particularly in Sangachal have been made regarding health and poor air quality? Specifically complaints have been made about a yellowish cloud affecting Sangachal town.

Response: Nijat Hasanov provided an overview of the air quality monitoring that has been completed around the terminal over the past 15 years. This has generally shown that air quality is good, however the prevailing wind direction is strongly southerly and therefore Sangachal town is immediately downwind of the terminal and of the dusty area to the north of the terminal. The terminal maintains a complaints register and concerns around air quality have been noted in this register.

7. Close

The meeting closed at 5.30pm following the conclusions of the workshops.

Shah Deniz 2 ESIA Public Meeting

13th August 2013, Hyatt Shusha Room, Baku

Attendees:

No.	Name		Position
1	Phil Murgatroyd	PM	BP- SD2 Process Engineer
2	Shapur Sotoudeh	SS	Statoil - SSU Leader
3	Ilgar Mammadov	IM	BP - SD2 Program PM
4	Farrukh Aliyev	FA	C&EA BP - EA officer
5	Emil M Hasanov	EH	C&EA BP - EA Advisor
6	Islam Mustafayev	IM	Chairmen ES Repsol
7	Elmira Rahimova	ER	C&EA
8	Shanaz Ferejzadeh	SF	B.C.S. mmc
9	Mirzayev Anar	MA	3M
10	Shamil Movsumov	SM	Independent Expert
11	Ayten Duruhan	AD	TPAO Country Manager
12	Elshad Damirchiyev	ED	BP- Drilling Engineer
13	Nijat Hassanov	NH	BP - Environmental Specialist
14	Tatyana Javanshir	TJ	MENR
15	Mammadov Rasad	MR	New Baku Post
16	Nigar Maharramova	NM	Environmental Advisor Challenger
17	Emil Ismayilov	EI	TREM
18	Chingiz Kishiyev	CK	ANS press
19	Aida Sultanova	AS	Associated Press, Azeri Press
20	Orkhan Ahmadli	OA	BP – SD2 Project Coordinator
21	Roman Isayev	RI	SOCAR, Ecology Department's Engineer
22	Lada Yevgzashiva	LY	Reuters
23	Nigaz Abbasova	NA	Interfax Azerbaijan
24	Kama Mustafayeva	KM	Upstream – BP
25	Tamam Bayatli	TB	BP –C&EA
26	Bill Boulton	BB	BP - SD2 Environmental and Social Manager
27	Frank Farquharson	FF	WRA - Hydrology specialist
28	Sean Hayes	SH	Genesis - Discharge and spill modelling specialist
29	Alun Lewis	AL	Spill specialist
30	Garry Gray	GG	URS - Air quality specialist
31	Anna Rouse	AR	URS - SD2 ESIA Project Manager
32	Hikmat Abdullayev	HA	URS - SD2 ESIA Consultant
33	Kamran Akhmadov	KA	Translator

1. Introduction and Presentation

Tamam Bayatli welcomed all participants to the meeting, provided a general overview and outlined the meeting agenda.

Bill Boulton provided a detailed overview of the project and how the Environmental and Socio-Economic Impact Assessment (ESIA) has been completed.

Elshad Damirchiyev presented a number of slides, which described how the drilling conditions within the SD2 Contract Area have informed the selection of a subsea development approach to the SD2 Project.

Phil Murgatroyd provided an overview of the proposed SD2 offshore and onshore facilities as well as providing a summary of anticipated onshore and offshore flaring scenarios.

Following the introductory presentation, there was a question and answer session.

2. Question and Answer Session

Question:
Emin Ismayilov (TREND Agency): According to the presentation slides, there will be 2 MODU used to drill the SD2 wells. The MODU proposed are the same as those used for the previous BP drilling activities in Azerbaijan sector of the Caspian Sea. Do you think there will be a requirement for additional new MODU during further stages of SD Project?

Response:
Elshad Damirchiyev: The current scope of SD2 Project drilling has been planned and scheduled to be completed by 2 existing MODU i.e. the Heydar Aliyev and Istiglal drilling rigs.

Ilgar Mammadov: If, in future, it is agreed with the Azerbaijan government to carry out additional SD drilling activities there may be a requirement for additional MODU, however for the current scope the 2 existing MODU are sufficient.

Question:
Emin Ismayilov (TREND Agency): Has the SD2 Project schedule been agreed with and approved by SOCAR and other stakeholders?

Response:
Ilgar Mammadov: Yes, the schedule has been communicated to and confirmed by SOCAR and other relevant stakeholders.

Question:
Shamil Movsumov (Independent Environmental Specialist): What is the methodology that BP plans to use for checking the status of the hydrate formation in the flowlines?

Response:
Elshad Damirchiyev: There are 2 main factors which affect the formation of hydrates which are temperature and pressure. Both are automatically monitored within the flowlines. In the event the temperature changes significantly and reaches the level where hydrates form the DEH system will be turned on to keep the flowlines warm.

Bill Boulton: At the SDA platform the production fluids travel from the wells directly to the platform processing facilities; a distance of around 60metres. There is therefore an extremely low risk of hydrates forming between the wellhead and the platform. At SD2, however, the flowlines between the manifolds and the SDB platform complex are up to 15 km. This is why Direct Electrical Heating (DEH) is required. Temperature, pressure and flow are monitored at the wellheads, the manifolds, within the flowlines and at the platform complex. Based on this information the potential for hydrate formation in the flowlines can be monitored.

Question:
Shamil Movsumov (Independent Environmental Specialist): Why do you need two platforms i.e. SDB PR and SDB QU? Why not just one large platform?

Response:
Ilgar Mammadov: The design of SDB platform complex has taken into account a number of aspects; the highest priority was safety. The two platform design allows the accommodation area, where the workers will be based, to be separate from the processing facilities.

Question:
Shamil Movsumov (Independent Environmental Specialist): Have you assessed potential SD2 spill scenarios?

Response:
Bill Boulton: Yes, a number of spill scenarios have been considered using modelling.

BB provided an overview of the scenarios assessed (i.e. flowline rupture, condensate pipeline rupture and well blowout) and the results obtained. These are presented in full within the

ESIA

Question:
Islam Mustafayev (NGO): How will waste be managed during the SD2 Project's operational phase?

Response:
Nijat Hasanov: All waste generated by SD2 activities will be managed in accordance with the existing AGT Region Waste Management plans and procedures.

Question:
Roman Isayev (SOCAR): Is it planned to use gas from the SD reservoir on the SDB platform for fuel?

Response:
Bill Boulton: Yes, a portion of gas from the reservoir will be used to fuel the platform generators. Under routine conditions 2 generators will be used to provide offshore power. Up to 4 generators will be used during DEH operations.

Question:
Chingiz Kishiyev (ANS): When is the peak production period is expected?

Response:
Ilgar Mammadov: Production will commence in 2018 and will rise to peak in 2022. Peak production will continue for approximately 8 years before the rate decreases.

Question:
Chingiz Kishiyev (ANS): Could you explain how the peak production rate lasts for 8 years.

Response:
Ilgar Mammadov: Not all 26 wells will be drilled and start production at the same time. Production from wells which start producing earlier will decrease by the time the latter wells start producing. The proposed period of time between first and last drilled well will be more than 10 years.

Question:
Tatyana Javanshir (MENR): What are the most significant flaring events expected at the SD2 onshore and offshore facilities? How many days a year is flaring at offshore and onshore SD2 facilities expected?

Response:
Phil Murgatroyd: The number of days that flaring will occur will be small and will occur due to equipment trips, maintenance and emergency events. As part of the SD2 Project, analysis of historical data and lessons learned from previous BP projects has been undertaken to identify where flaring can be reduced. To reduce flaring associated with maintenance, highly reliable equipment has been selected, giving a total availability for the onshore facilities of 99% i.e. the onshore facilities can be available for approximately 361 days per year.

Question Tatyana Javanshir (MENR): Is there any way of preventing discharges of WBM and cuttings to the Caspian Sea? Is it possible to collect the WBM and cuttings and ship to shore for disposal?

Response:
Bill Boulton: WBM and cuttings will only be discharged from the top hole sections. Non WBM and cuttings from the lower sections will be recovered and shipped to shore.

There are a number of issues around collecting WBM and cuttings. Firstly it is not technically feasible to collect cuttings from the top hole sections. The diameter of the holes is too large. In addition the volume of mud and cuttings is also very large and there are technical issues accommodating this volume on the drilling rig. The focus is therefore on selection of the appropriate "environmentally friendly" chemicals and assessing the potential impacts associated with WBM and cuttings. Discharge of WBM and cuttings to sea is consistent with the same practice elsewhere in the world including the North Sea, where these discharges are shown to result in insignificant environmental impacts

Shah Deniz 2 ESIA Public Meeting - Sangachal

15th August 2013, Community Centre, Sangachal Settlement

Attendees:

In addition to approximately 20 members of the local community (all male and varying in age between early 20s to retired) the meeting was attended by the following:

Name		Position
Guivami Rahimli	GR	C&EA - BP
Sabina Huseynova	SH	SD2 - BP
Ismayil Jabiyev	IJ	BP Challenger
Bill Boulton	BB	BP - SD2 Environmental and Social Manager
Tahir Jafarov	TJ	URS – Environmental Technician
Anna Rouse	AR	URS - SD2 ESIA Project Manager
Hikmat Abdullayev	HA	URS - SD2 ESIA Consultant

1. Introduction and Presentation

Guivami Rahimli (GR) welcomed all participants to the meeting and provided a general overview to the project, including the anticipated location and schedule of the construction works and the likely employment requirements. Questions were then taken from the meeting attendees.

2. Question and Answer Session

Question: I am one of the fishermen that uses the shoreline in front of the terminal. There has recently been a vessel in the area from which equipment has been deployed. Is this BP activity? Have construction works already started? Previously construction work was complete before compensation was agreed with the fishermen in the area. It would be preferable to agree compensation prior to the works.

Response: Bill Boulton (BB) confirmed that from the description of the activities it is likely that the vessel has been involved in survey activities. No SD2 construction work at the shoreline has started. It is planned to hold specific discussions with the fishermen in October. By this time the method and extent of the works required in Sangachal Bay and on the shoreline will be defined and the potential impacts can be discussed along with initial discussions on potential compensation.

Question: It is our understanding that there will be some negative impacts to the nearby communities during construction however the project will be a major benefit for Azerbaijan.

Response: GR confirmed that the project will be looking for range of people to help build the facilities both general construction workers and skilled and semi-skilled workers. There will be a commitment to recruit as many of these from the local area as possible. In the past those recruited have been provided with training and many of these people have gone on to find work abroad and on other projects in Azerbaijan.

GR provided an overview of the proposed Petrochemical Complex to be constructed by SOCAR to the north of Sangachal and pointed out that there is therefore potential for a great deal of employment in the local area.

GR outlined a new BP initiative to sponsor up to 100 people from the communities around the Sangachal Terminal to attend a vocational school in Gobustan. The school has recently been taken over by SOCAR. Students who study there will obtain an internationally recognised qualification. Students who graduate from the school will have the potential to get a good job and will not be required to work for BP. Fees will be more than 4,000 Manat per person and the courses will last up to one year.
Question: How can individuals pay these costs? They seem very high.

Response: GR stated that the fees pay for the tuition and are generally paid by sponsoring companies rather than individuals and this specific project will be funded by BP and co-ventureres.

Question: I have applied to Azfen at the terminal for a job but I haven't heard anything. Can you explain why?

Response: GR confirmed that Azfen were awarded the SD2 Infrastructure works. These works are almost complete and Azfen are therefore not looking to recruit.

Question: In the presentation you stated that that employment within the communities will be targeted however, as with previous works, there are still people who arrive from other regions, who are given work ahead of locals. We understand it is because they know people who are involved with the employment or who are already employed. How do you intend to recruit from the communities specifically?

Response: GR stated that previously forms were provided by the contractors to the applicants asking for their details including place of registration. This approach will be adopted again.

Question: There were a number of people who moved to the area and then registered specifically to gain employment. Can this be stopped?

Response: GR confirmed that this compliant was raised with the contractors, who need to address it. In addition he pointed out that the community at Azim Kend needs to be taken into account. They are not registered but live in the area and are entitled to work.

Question: Why are only people that are known to BP employed? I have full driving license and could be a BP driver.

Response: GR stated that previously BP employed a number of drivers directly. However a number of companies are now used to provide BP with drivers e.g. Orient. You would need to apply to them.

Question: Following the completion of the works why did BP not continue to provide financial support to the communities such as loans to continue development of skills and education.

Response: GR confirmed that BP did provide a number of loans for this purpose

Question: When new project starts, is it planned to employ experienced people rather than young people?

Response: GR stated that those people who have experience and training would have more opportunity of employment.

Question: How long is training at SOCAR School?

Response: Up to 1 year depending on the subject studied.

Question: We are aware that there are a number of monitoring stations around the terminal and a number of people have been paid compensation as a result. Can you explain? Is this because they have an adverse impact?

Response: Tahir Jafarov (TJ) confirmed that he is an environmental technician for URS and undertakes noise and dust monitoring within Azim Kend, Masiv 3, Umid and Sangachal. Compensation is provided to the individuals within the community who look after the monitoring equipment to prevent it being taken or damaged.

GR confirmed that there have been a number of monitoring stations around the terminal for many years. The purpose of these is to establish current environmental conditions e.g. air quality and noise. As has been discussed previously the results have shown that air quality is well below international standards.

Question: What about flaring? We believe there is a need to monitor at the top of the accommodation blocks in Sangachal. Also we believe there is a noise issue. Sometimes the flare is extremely noisy and sometimes this happens in the night.

Response: GR confirmed that the noise issues to date have mainly been due to the SD1 ground flare at the terminal. This is currently being replaced with a flare which is quieter.

TJ also confirmed that during the noise surveys, which are completed at each location 4 times a day during the survey period, the majority of the noise comes from the railway or the road and to a lesser extent from the power station.

GR confirmed that BP is committed to looking after their neighbours and try to do whatever is possible to minimise noise from the terminal.

Question: We are very concerned about the safety of our children. There have been a number of traffic accidents and accidents involving the railway. Could BP support constructing a bridge across the road and railway?

Response: GR stated that BP can provide support for this suggestion but cannot build the bridge. The funds would need to come from the government, who would need to approve and construct the bridge.

Question: There are an insufficient number of places at the kindergarten for the number of children

Answer: GR confirmed that this will be taken as a comment and followed up to see how BP can support it. It is understood that there is a plan to build a new school at Azim Kend.

The meeting concluded with a reminder of the deadline to provide comments (23rd August 2013) on the SD2 ESIA documents. These can be provided by letter, phone or e-mail.

Shah Deniz 2 ESIA Public Meeting - Umid

15th August 2013, Community Centre, Umid Settlement

In addition to approximately 15 members of the local community (3 female and the rest male, all young and middle aged) the meeting was attended by the following:

Attendees:

Name		Position
Guivami Rahimli	GR	C&EA - BP
Sabina Huseynova	SH	SD2 - BP
Ismayil Jabiyev	IJ	BP Challenger
Bill Boulton	BB	BP - SD2 Environmental and Social Manager
Tahir Jafarov	TJ	URS – Environmental Technician
Anna Rouse	AR	URS - SD2 ESIA Project Manager
Hikmat Abdullayev	HA	URS - SD2 ESIA Consultant

1. Introduction and Presentation

Guivami Rahimli (GR) welcomed all participants to the meeting and provided a general overview to the project, including the anticipated location and schedule of the construction works and the likely employment requirements. Questions were then taken from the meeting attendees.

2. Question and Answer Session

GR confirmed that the project will be looking for a range of people to help build the facilities both general construction workers and skilled and semi-skilled workers. There will be a commitment to recruit as many of these from the local area as possible. In the past those recruited have been provided with training and many of these people have gone on to find work abroad and on other projects in Azerbaijan.

GR outlined a new BP initiative to sponsor up to 100 people from the communities around the Sangachal Terminal to attend a vocational school in Gobustan. The school has recently been taken over by SOCAR. Students who study there will obtain an internationally recognised qualification. Students who graduate from the school will have the potential to get a good job and will not be required to work for BP. Fees will be more than 4,000 Manat per person and the courses will last up to one year.

Question: What is the environmental commitment for the project?

Response: Bill Boulton (BB) confirmed that there are numerous environmental commitments. These include commitments around treated sewage discharges and air quality, which are required to meet relevant standards.

Question: Please explain what standards have been adopted.

Response: BB confirmed that the air quality standards are based on those defined by the World Health Organisation for the protection of health. Standards associated with treated sewage discharge and noise are those already adopted by the terminal.

Question: Have you considered the potential for odour?

Answer: BB stated that under routine conditions SD2 produced water would be sent to the ACG produced water facilities and from there to the reinjection facilities offshore. There is, however, potential for storage of SD2 produced water at the terminal when these facilities are not available. A study is in progress to assess potential odour issues associated with the produced water temporary storage. Based on the characteristics of the produced water, odour impacts are not expected.

Question: Does BP have a license for produced water offsite disposal elsewhere in the world. Currently produced water is retained at the Terminal and sent offshore for reinjection.

Is it correct that there is a future plan, which may include the option to send to a 3rd party who has a license from the MENR?

Response: GR stated that previously produced water at the terminal was transported offsite to the cement plant and to other companies. These companies all had a relevant license from the MENR. Produced water is no longer sent to the cement plant as the technology has changed.

Question: When will employment begin? Will I get a job?

Response: GR confirmed that construction works are planned to commence in Q1 2014. Numerous people from Umid have been employed for the SD2 Infrastructure Works. Those who have received training will have greater opportunities for employment.

Question: Will people be employed and then provided with training?

Answer: GR stated that previously there was a Human Development Centre that was run by a well-known professor Urkhan Alekperov, who is currently the Rector of one of the universities. A number of training courses were run by the centre. Given that numerous people went through this training and have worked on previous projects there is not the same requirement for the SD2 project. Instead it is planned to send up to 100 people to the vocational school in Gobustan, where international qualifications will be awarded. This will be more valuable than the previous training offered by the development centre as it is more widely recognised.

Question: What about those people who have recently completed training? Will they have an opportunity?

Answer: GR confirmed there would be opportunities, the preference will be to use those with training and experience. The names of those who have been employed for the Infrastructure project along with their training and skills records have been maintained in a database. This will be passed onto the contractor for the main SD2 works.

Question: For the previous projects there has been a commitment for the construction contractors to employ people from the local communities including Umid. We are grateful for the contribution that this had made to reducing unemployment and want this to continue. For the new SD2 project will there be a similar commitment to employ local people? It is worth noting that it is an advantage to employ local people as it is in our interest to carry out our work responsibly and safely to avoid potential incidents that could affect the local area.

Answer: GR confirmed the contractor that is awarded the main SD2 project works will have an obligation to maximise employment from the local communities. As you will remember, for the SD2 Infrastructure works Azfen brought a team to Umid to meet with you and gather CVs. This was part of their commitment to prioritise local employment. The same commitments will be discussed with the main SD2 project contractor as part of contract negotiations. Personnel records and training records will be shared with the contractor when they have been selected. Where there are issues BP will work with the contractor to try and address these.

It is evident from looking around Umid, where there are three new buildings under construction, that there has been a financial benefit from the works in the area. GR confirmed that there are plans to construct a new school at Azim Kend. This is government funded, where a great deal of funds are as a result of oil and gas revenues. The new SOCAR petrochemical complex planned for construction to the north of Sangachal will also result in significant employment opportunities.

Question: Will there be any social investment projects as a result of the SD2 Project?

Answer: GR stated that there will be a contribution associated with the SD2 Project to the social investment programme.

Question: We understand this is a large project and there will be significant revenue for Azerbaijan as a result. Please can you confirm when it will commence.

Answer: GR confirmed that construction will commence in Q1 2014.

Question: Can you confirm the daily production rate for SD1 and SD2?

Answer: GR confirmed that currently the SD1 production rate is 8 million standard cubic feet per day (mmscfd). The anticipated SD2 production rate is 16 mmscfd. Therefore the total production rate from the SD Contract Area will be 24 mmscfd.

Question: A number of non-governmental organisations (NGOs) were formed with BP's assistance as a result of the previous works at the terminal. Will support to NGOs also be provided as a result of the SD2 works? Will BP continue to support the people within Umid?

Answer: GR stated that community funds will be made available and announcements will be made. NGOs will be entitled to apply for funds for community projects. This was the previous approach adopted. One of the NGOs in Umid was previously successful and obtained funds for a local project. Workers required for the successful project would contact the NGO regarding employment – BP would not be involved. BP will continue to provide support in this way as well as the previously discussed scheme to sponsor local people to attend the school in Gobustan.

Question: How will we be made aware of the Gobustan school scheme beginning?

Answer: GR confirmed that an announcement will be made.

Question: How long will the training last?

Answer: GR confirmed it will last from 3 months to a year depending on the selected specialities..

Question: Who will be selected for sponsorship? Will it mainly be young people?

Answer: It is likely that a pilot scheme will be run initially and the brightest students will be selected. The people selected will likely be under 30 years.

The meeting concluded with a reminder of the deadline to provide comments (23rd August 2013) on the SD2 ESIA documents. These can be provided by letter, phone or e-mail.

SD2 Project ESIA

Public Disclosure August 2013

SD2 ESIA Meeting

Start	**Finish**	**Presentation**
2.00	2.10	Chair - welcome and agenda
2.10	2.45	SD2 project and ESIA overview
2.45	3.45	Break-out Session 1 Table 1: Surface Water modelling and Flood assessment Table 2: Discharge modelling Table 3: Condensate characterisation
3.45	4.00	Tea Coffee
4.00	4.45	Break-out Session 2 Table 1: Spill assessment Table 2: Atmospheric dispersion modelling Table 3: No drill zone
4.45	5.20	Question and Answers
5.20	5.30	Close

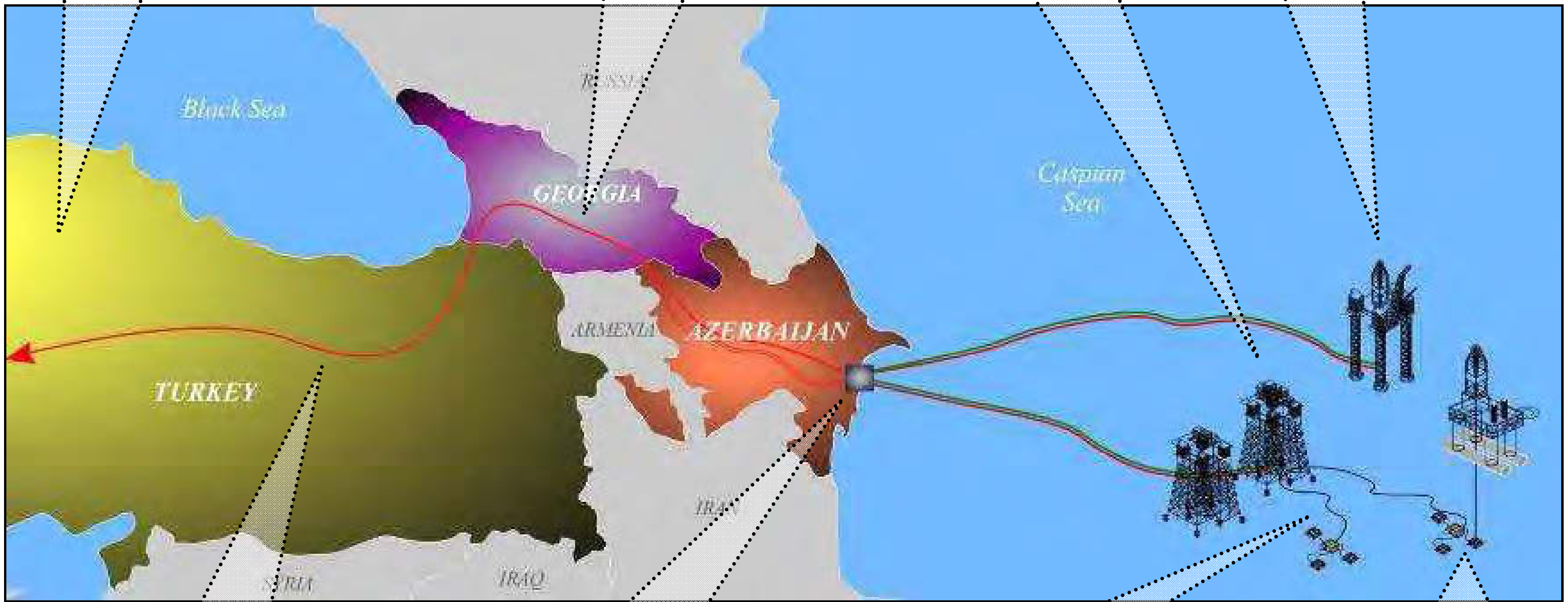
Scope of SD2, SCPx and TANAP

Contracts to sell gas to Turkey and Europe

Expansion of South Caucasus Pipeline to Georgian border with new 56" pipeline

Two new bridge linked platforms provide 16 bcma offshore processing

Existing Stage 1 Platform



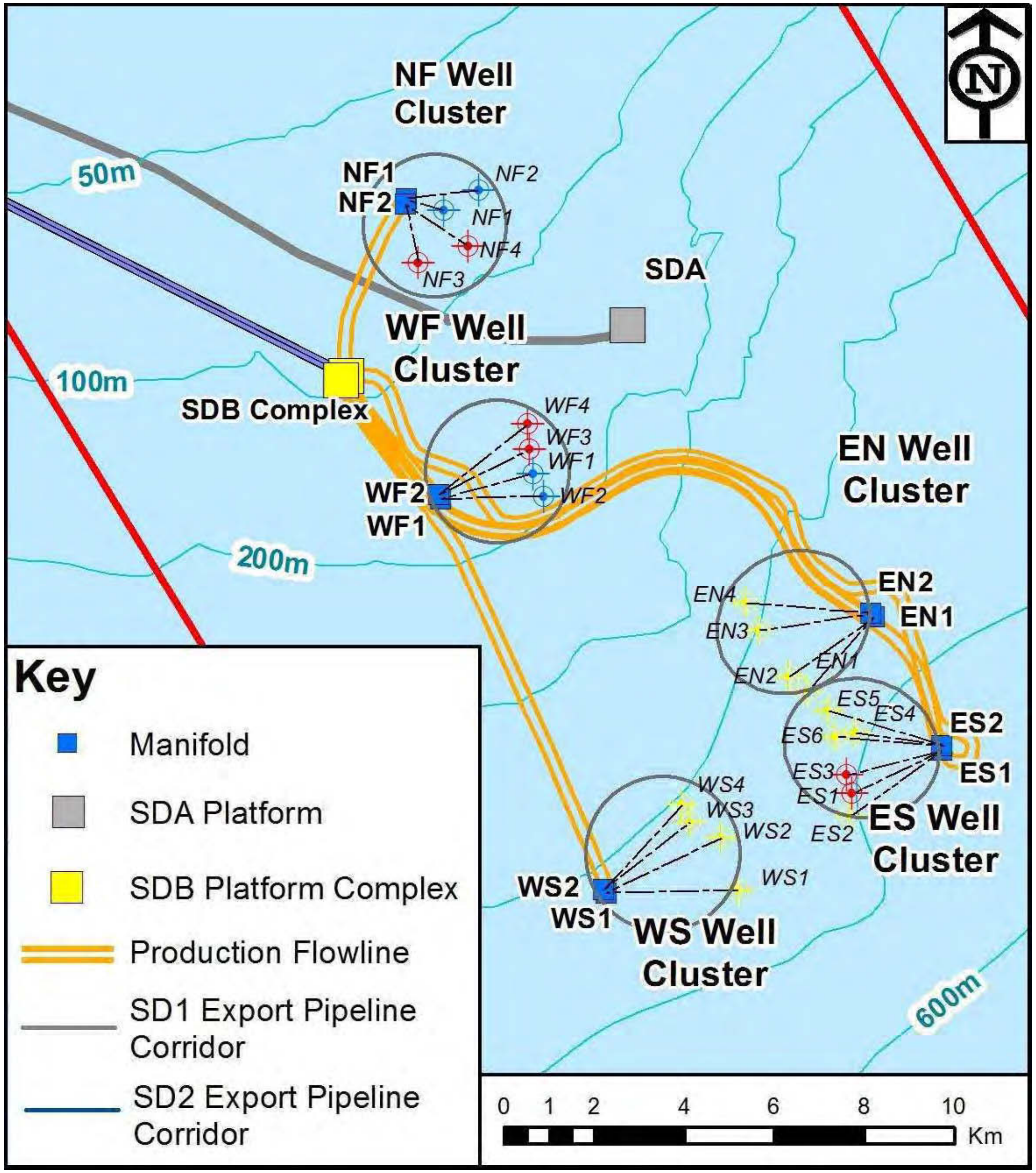
2000km Trans-Anatolian Pipeline across Turkey

New terminal at Sangachal with compressors for Shah Deniz and SCP

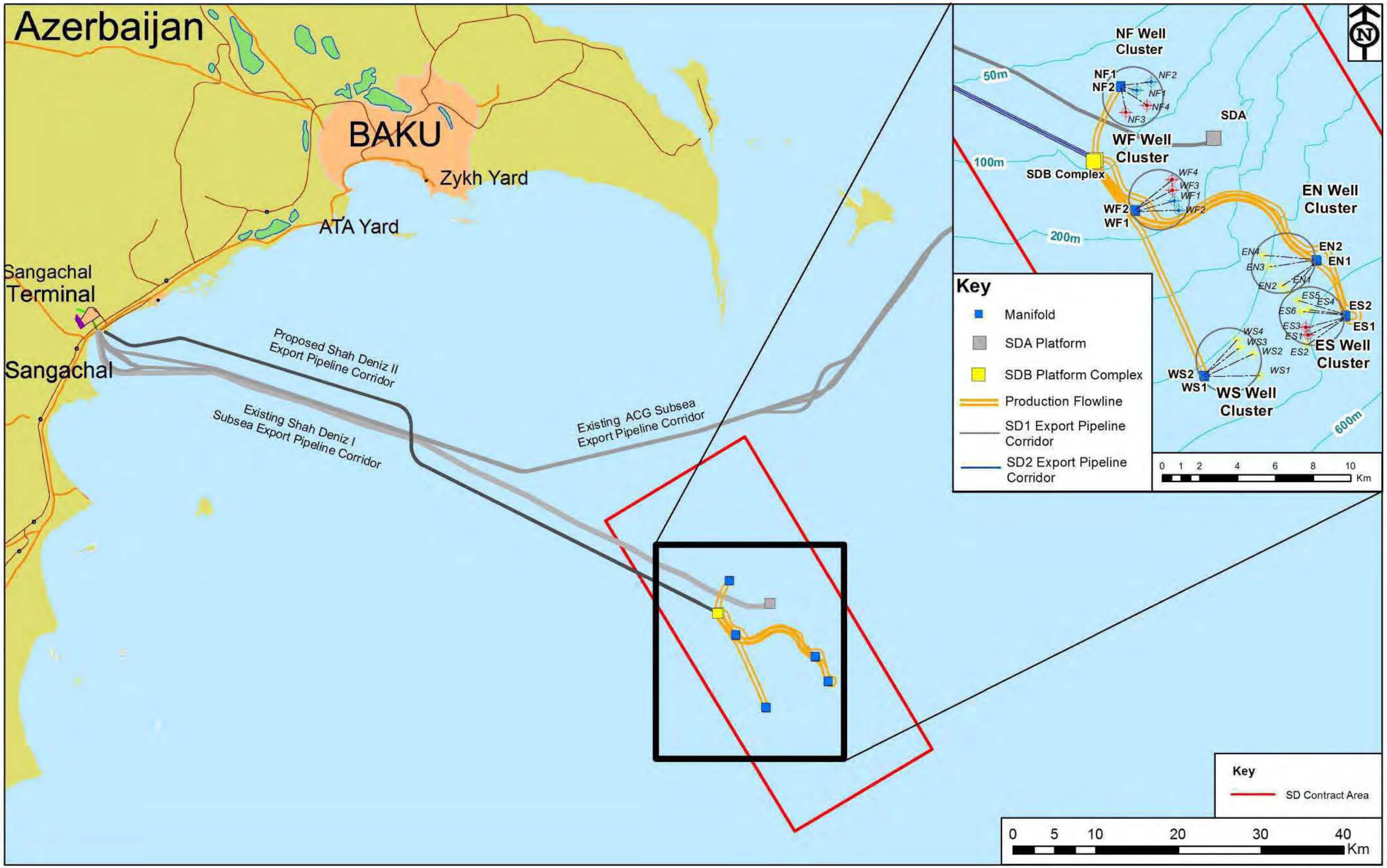
500 km of subsea pipelines and flowlines in up to 550m water depth

26 subsea wells drilled with 2 semi-submersible rigs

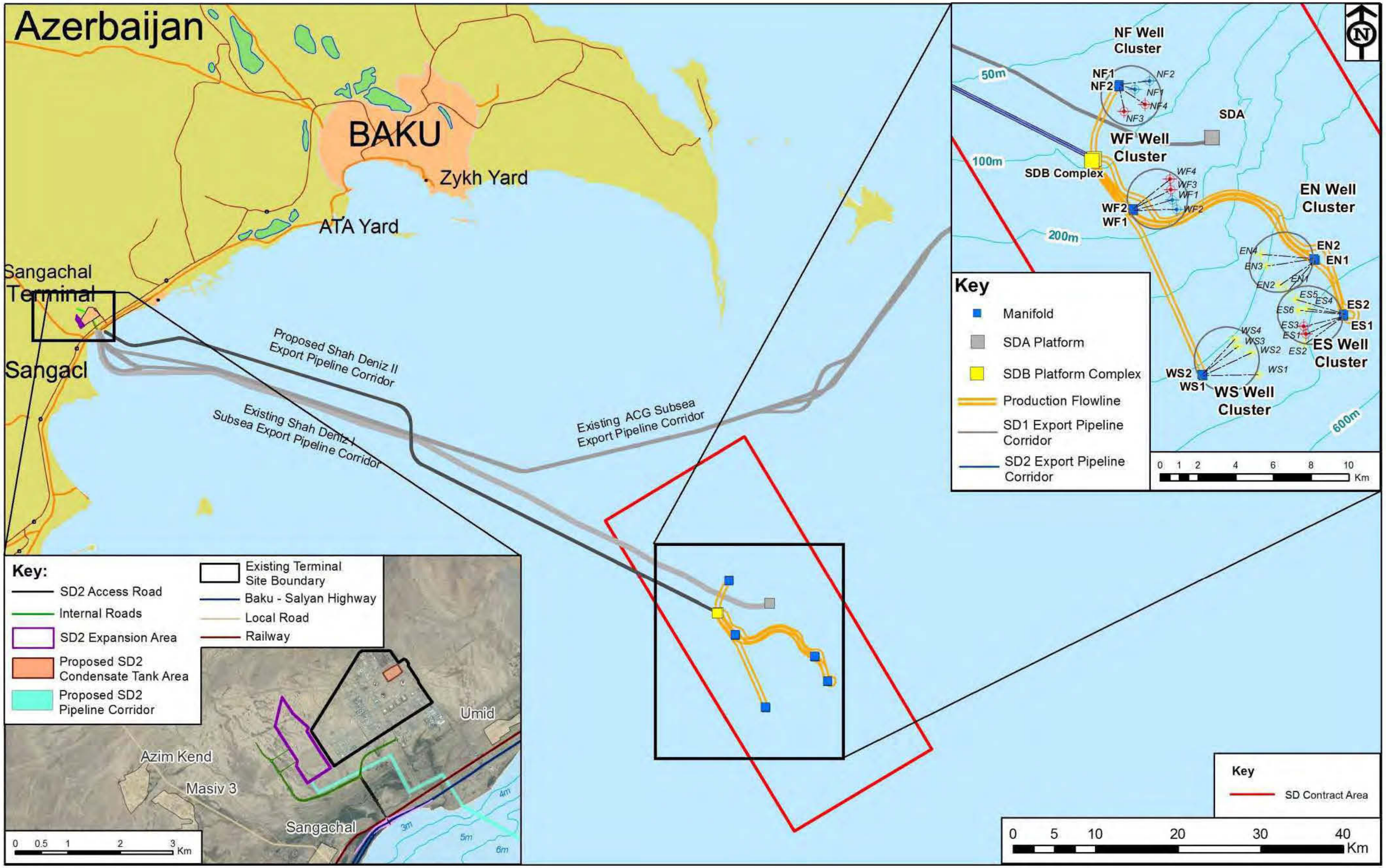
Location of SD2 Project Activities



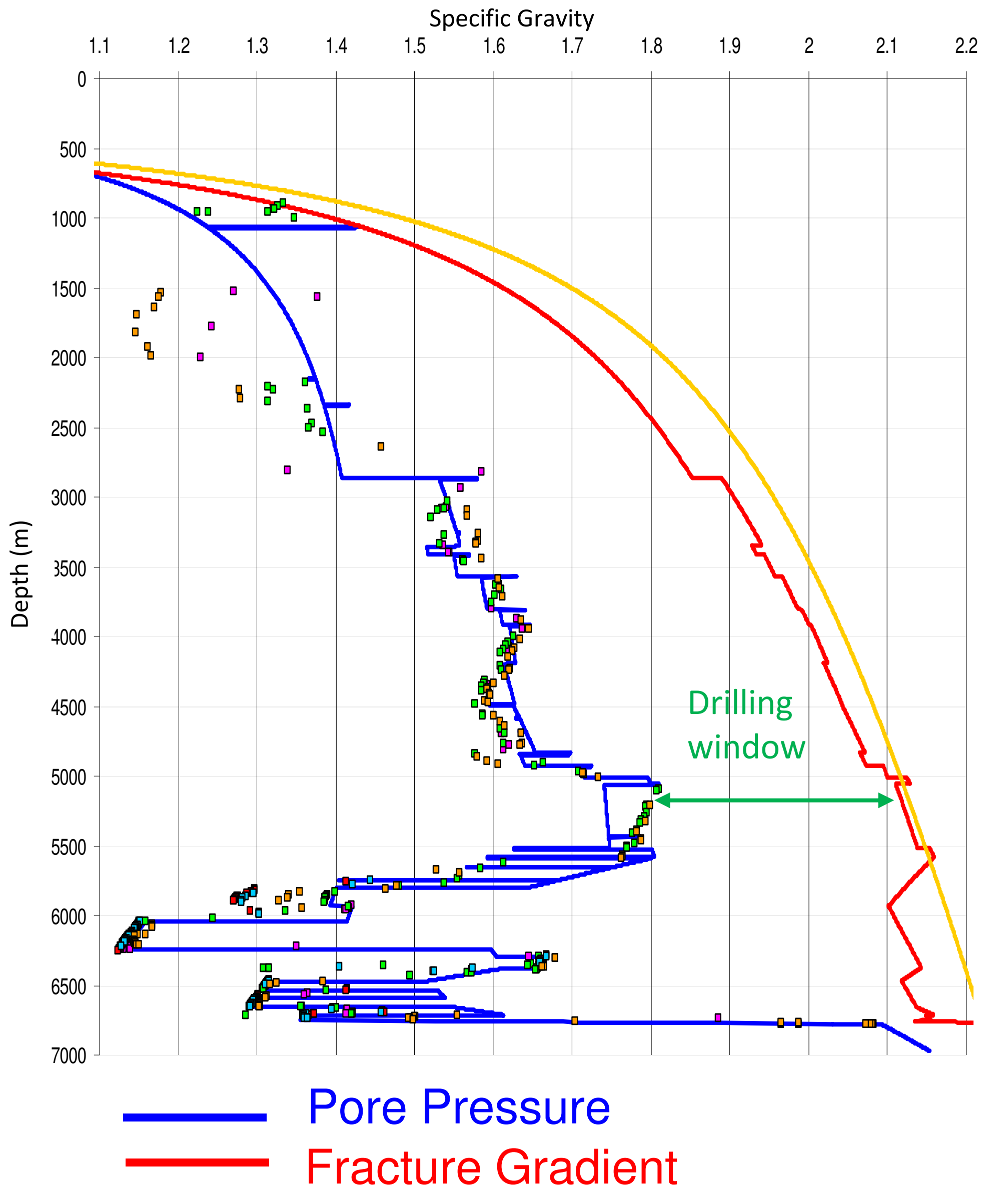
Location of SD2 Project Activities



Location of SD2 Project Activities



SD2 Project Drilling



Pore pressure = the density of the drilling fluids required to hold back the pressure exerted from the reservoir formations

Fracture gradient = the pressure required to induce fractures in the rock at a given depth

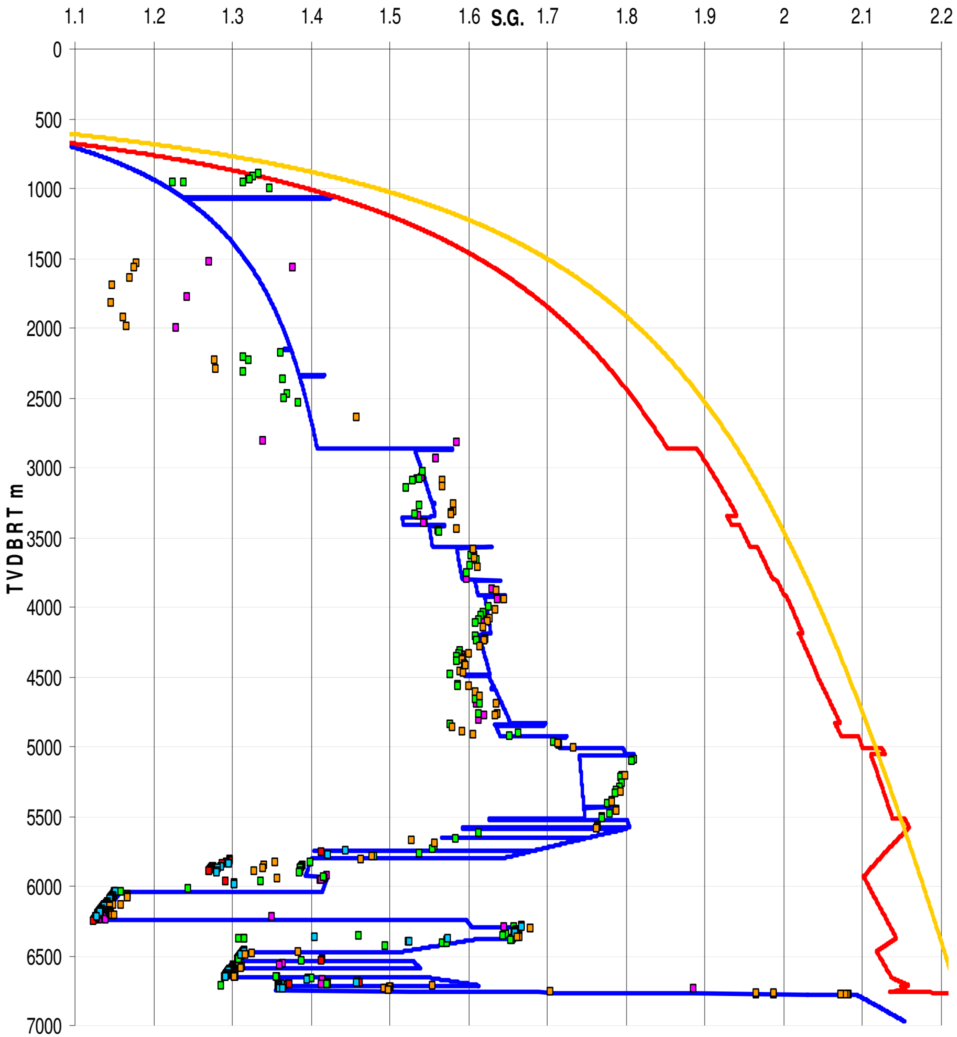
The difference between pore pressure and fracture gradient is the "drilling window".

If the drilling window is too small there is a risk of total loss of well control.

Minimum acceptable drilling window for SD2 Project is 0.1 s.g

SD2 Project Drilling

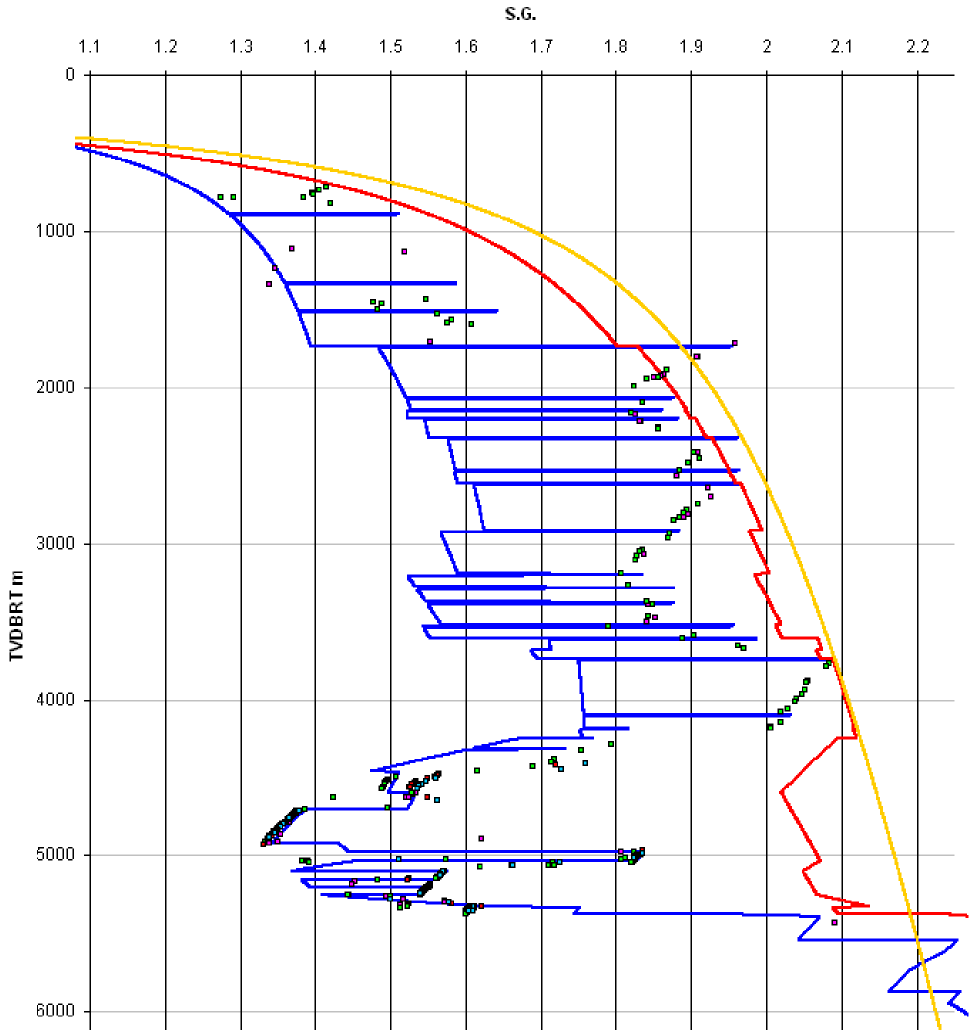
Shah Deniz Flank Well



Pore Pressure

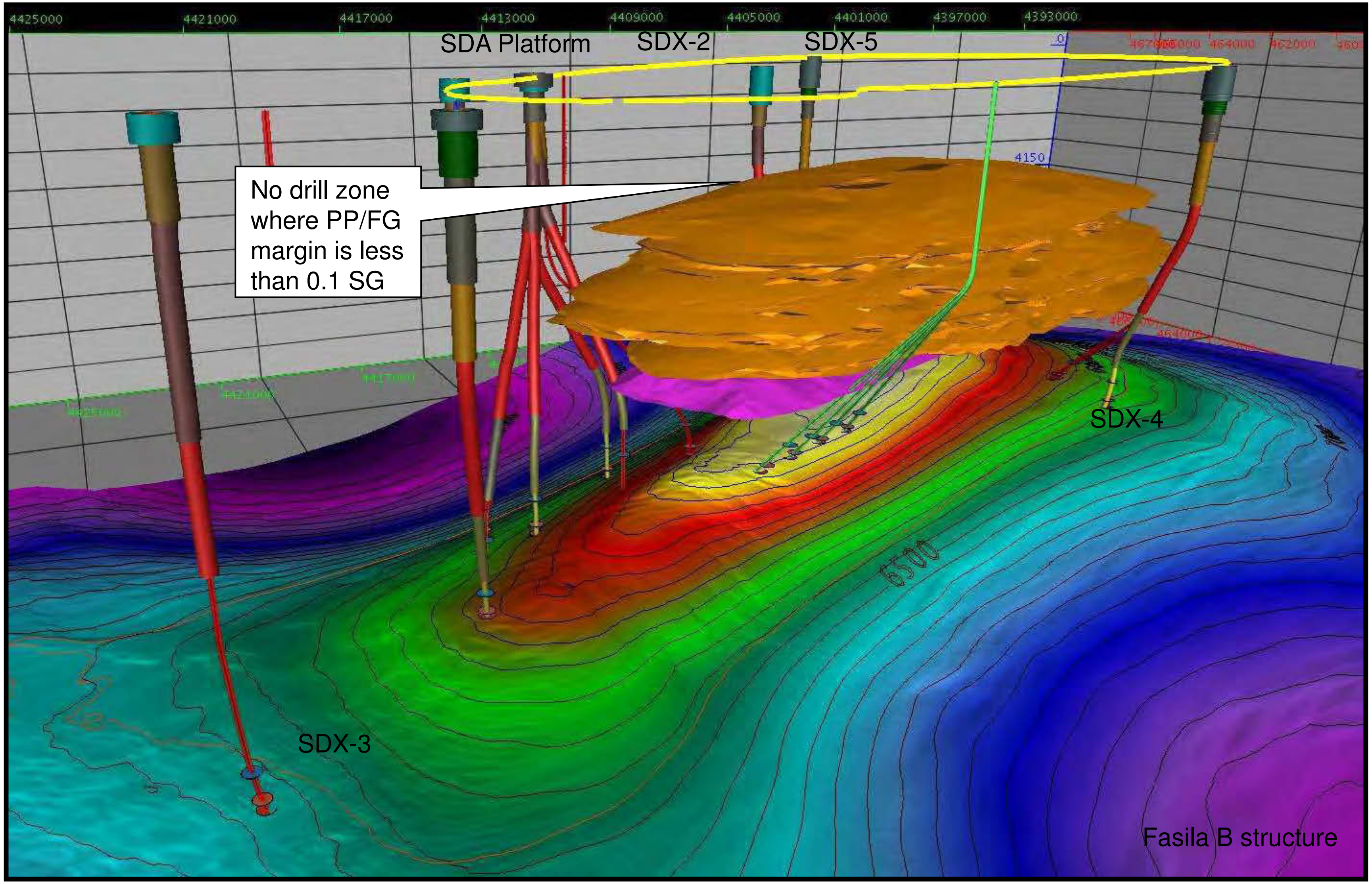
Fracture Gradient

Shah Deniz Crestal Well



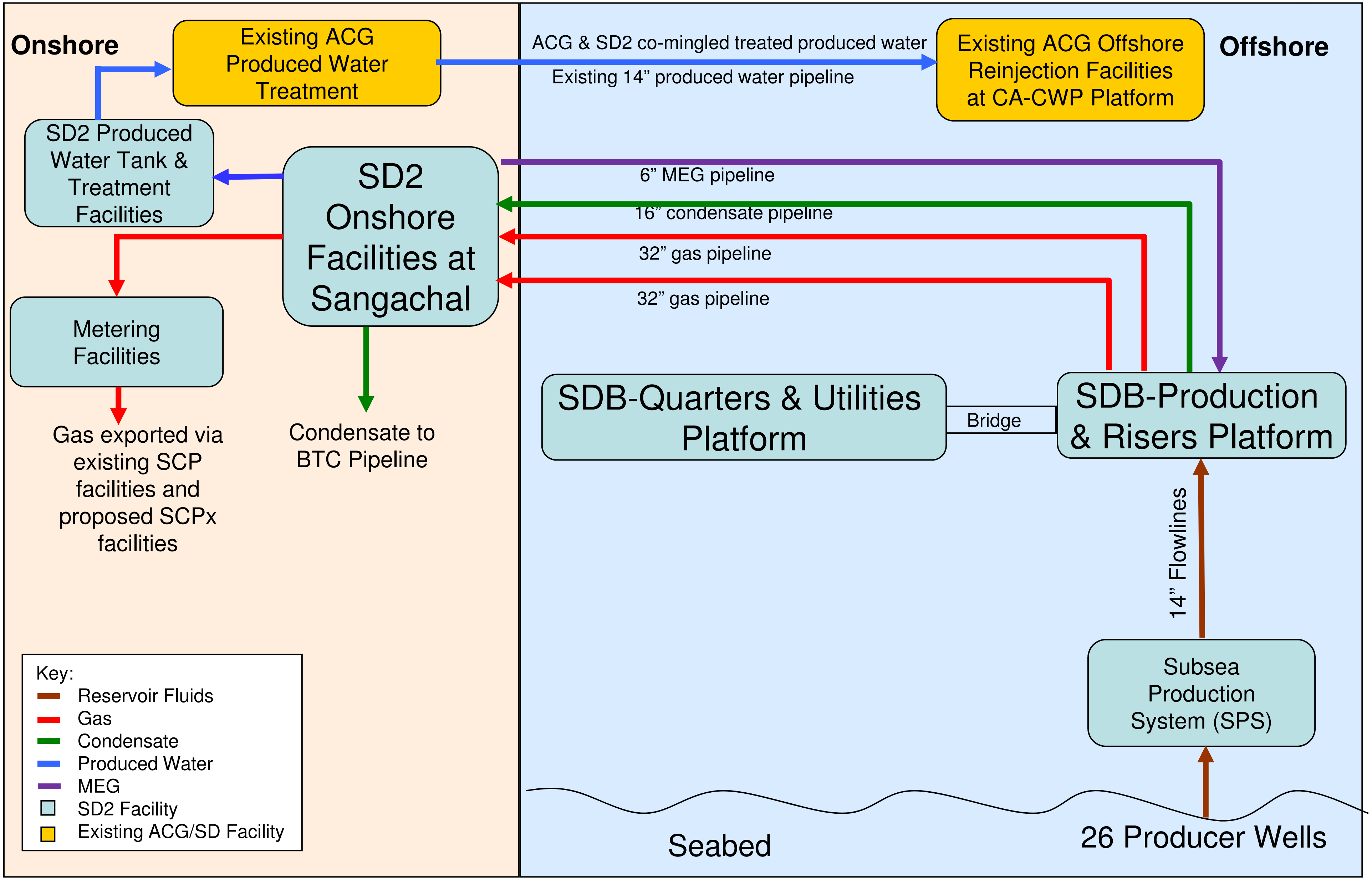
Drilling window within the centre (i.e. the crest) of the Contract Area is not sufficient

SD2 Project Drilling

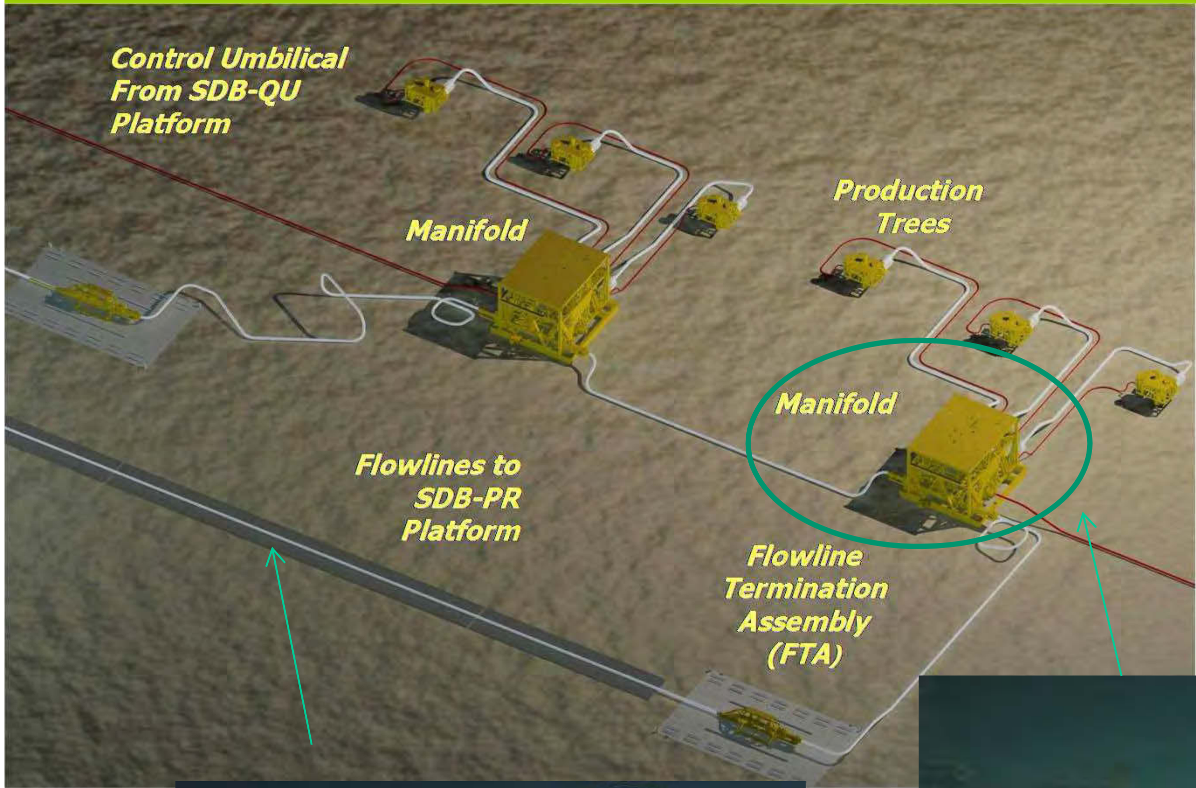


No drill zone across the crest of the structure has driven the option to position wells centred at manifold locations around the periphery.

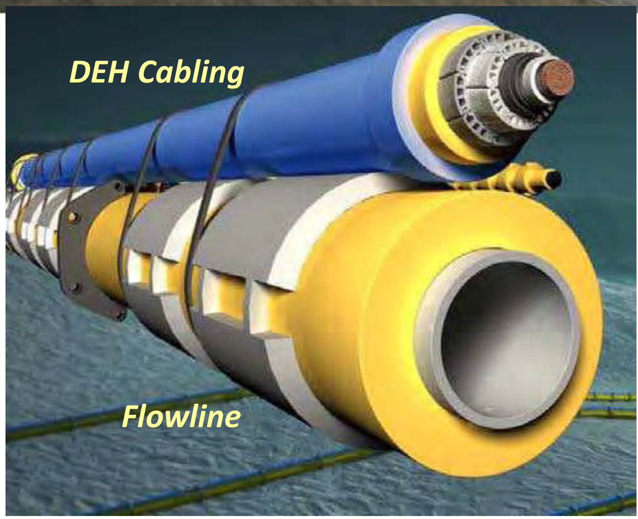
Scope of SD2 Project



SD2 Project Subsea

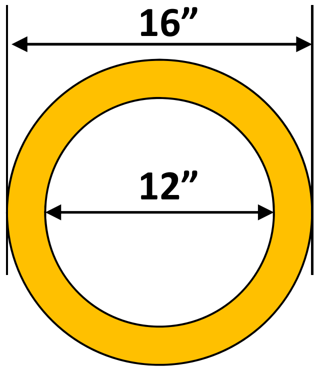


- 5 Subsea clusters
- At each cluster 2 manifolds and between 4-5 trees (wells)
- High integrity pressure protection system within each manifold
- DEH system maintains flow line temperature to control hydrate formation



SD2 Project Subsea

Fully Rated Flowlines



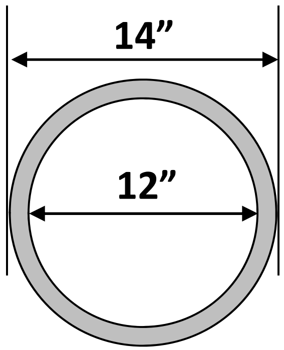
900 bar rated

16” Outer Diameter
60mm (2.4”) wall thickness

Outside line-pipe manufacturing industry capabilities

Outside regional pipelay vessel capabilities

HIPPS Protected Flowlines

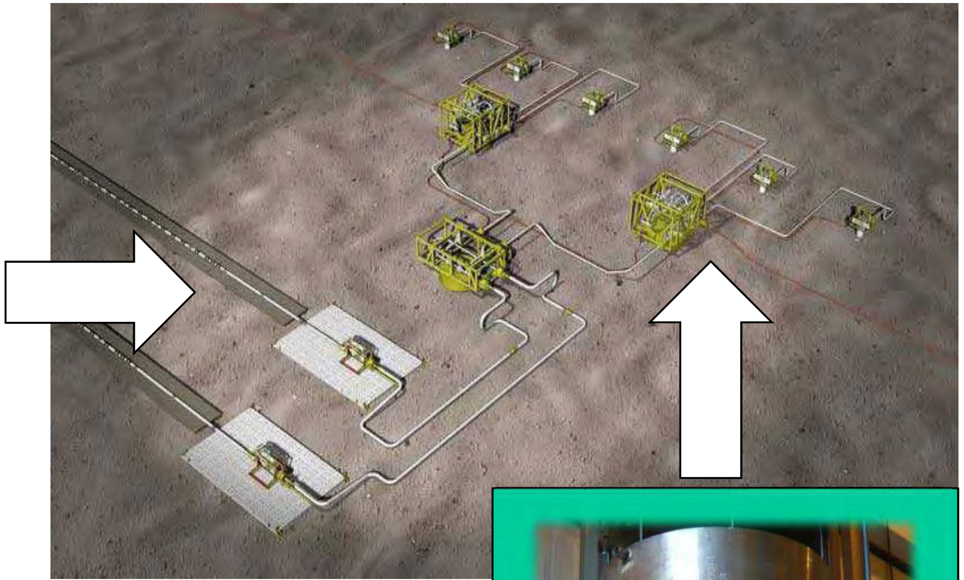


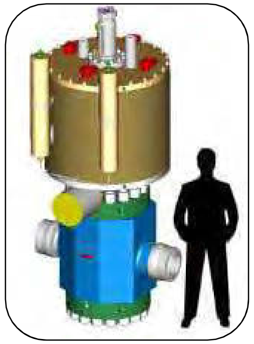
270 bar rated

14” Outer Diameter
29mm (1.1”) wall thickness

Within line-pipe manufacturing industry capabilities

Within regional pipelay vessel capabilities



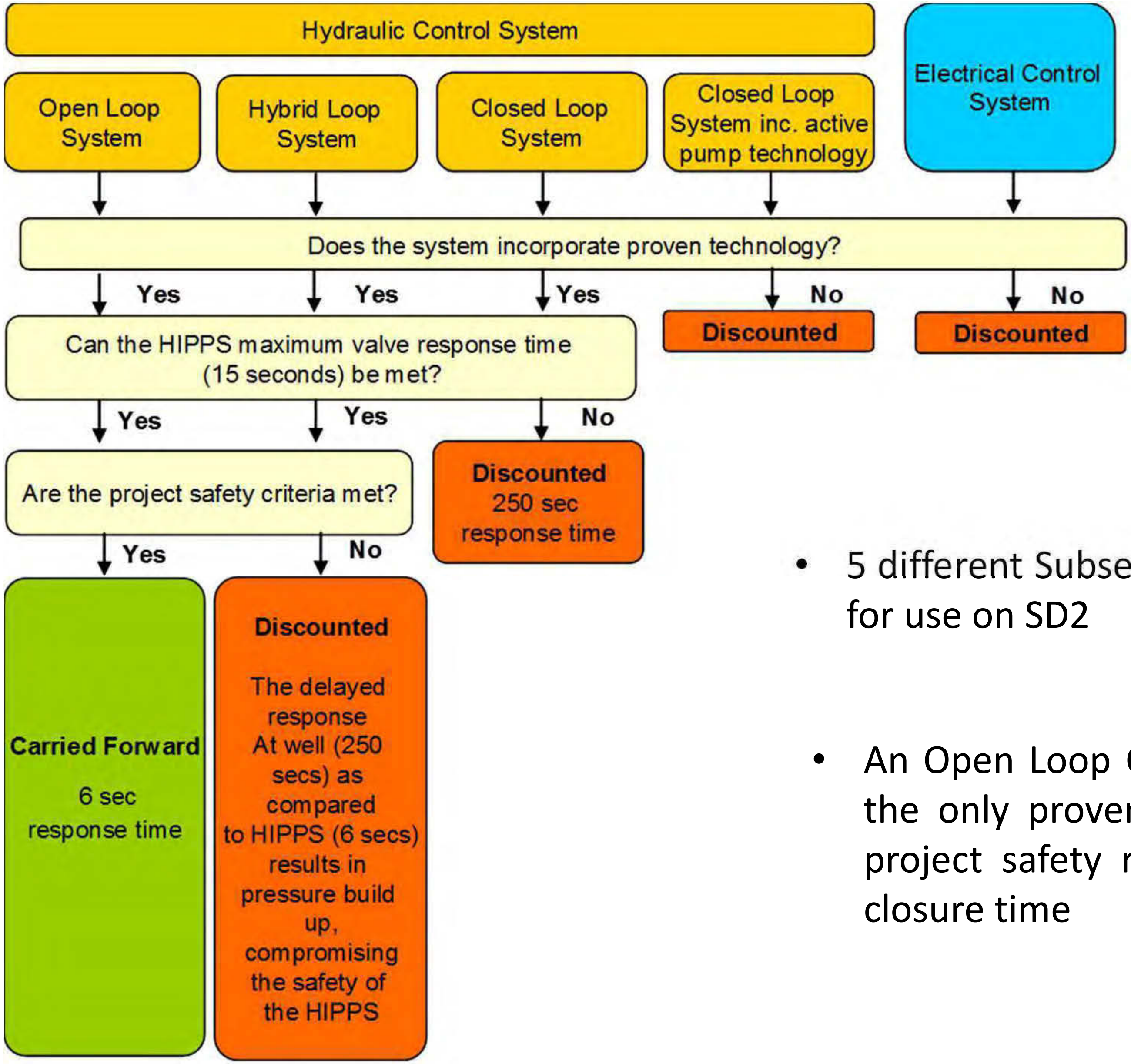


10” bore

900 bar rated

17,500 Kg

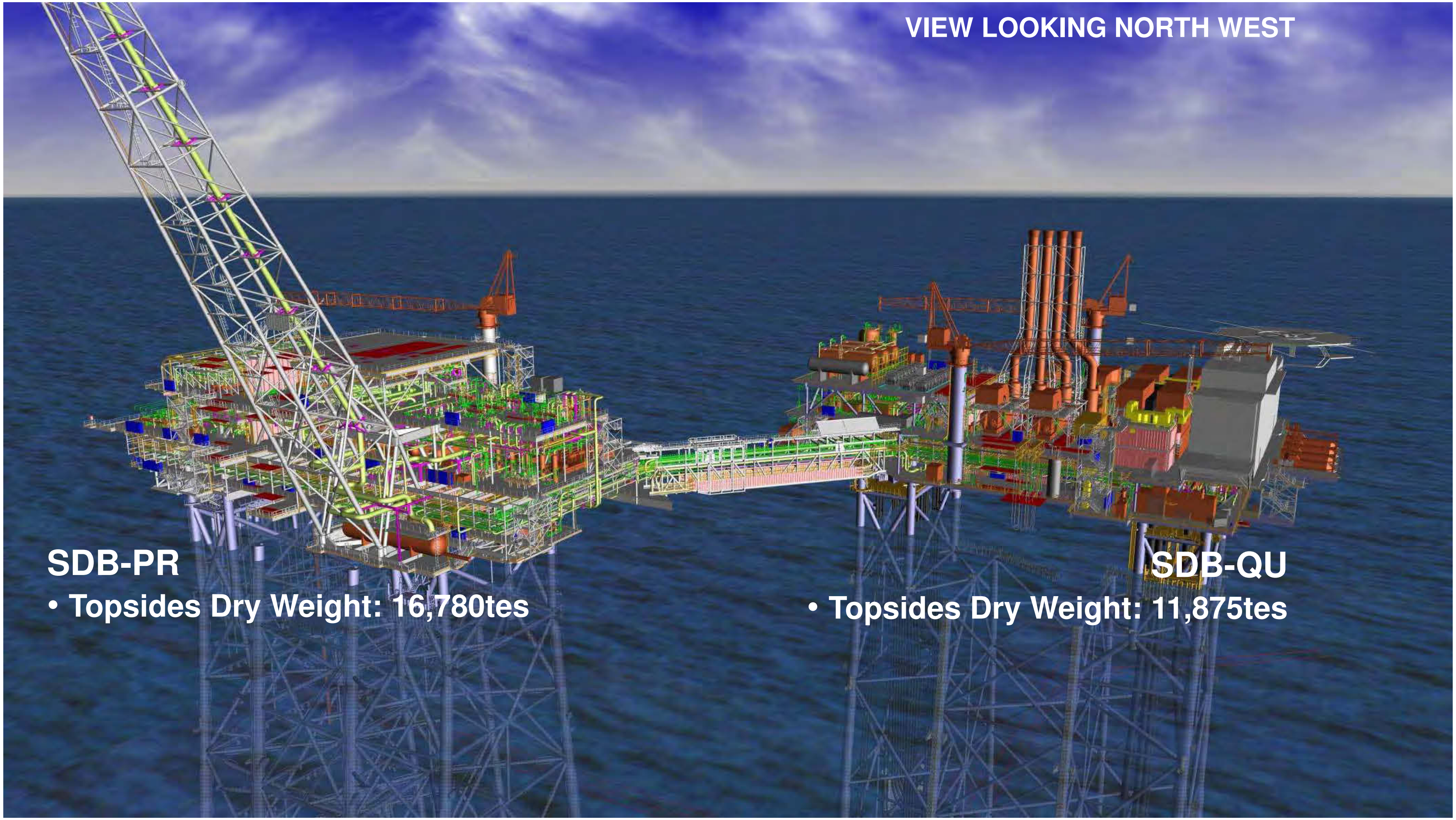
SD2 Project Subsea



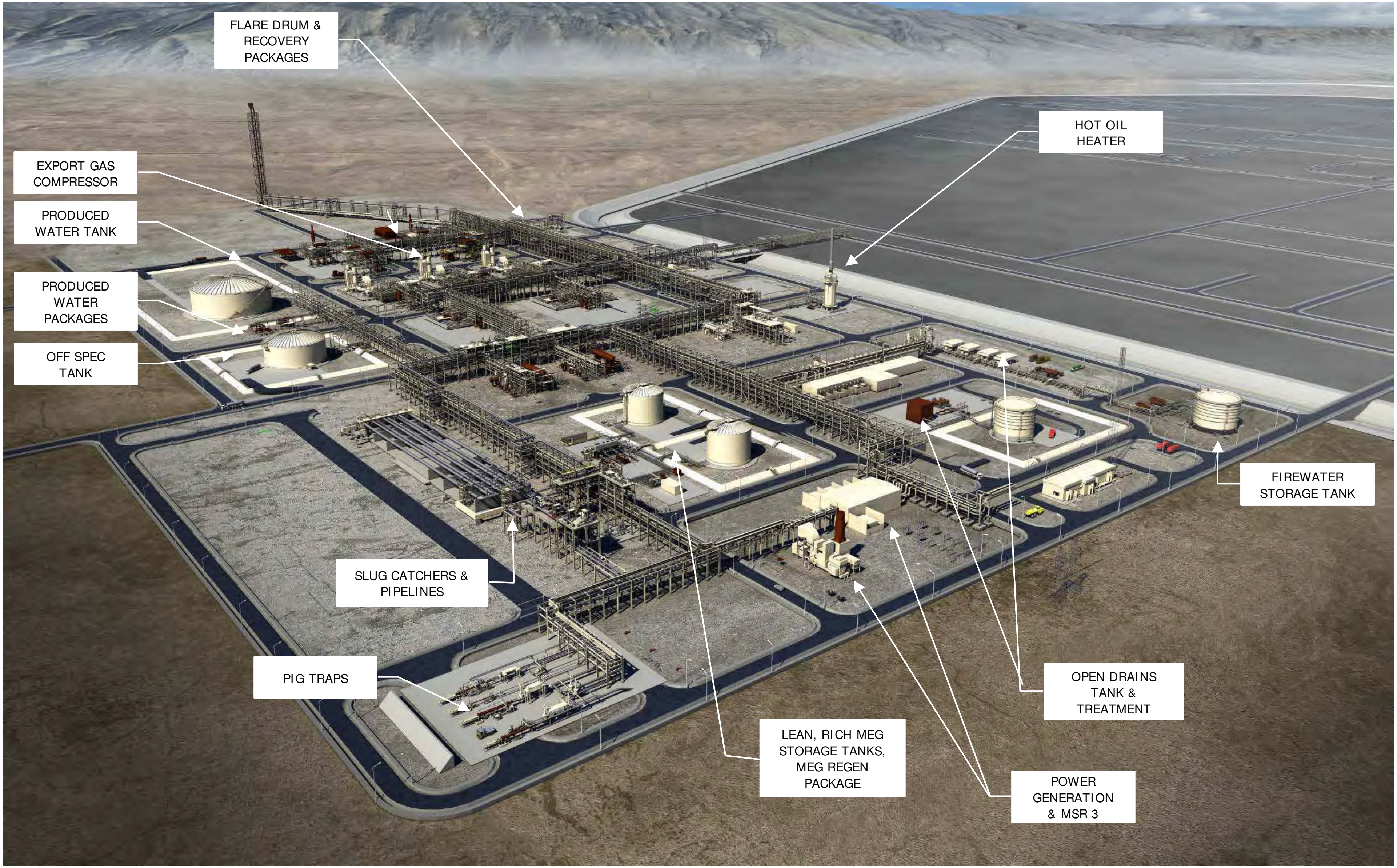
- 5 different Subsea Control Systems were considered for use on SD2

- An Open Loop Control System was selected as it is the only proven technology that meets all of the project safety requirements with respect to valve closure time

SD2 Project Bravo Platform Complex

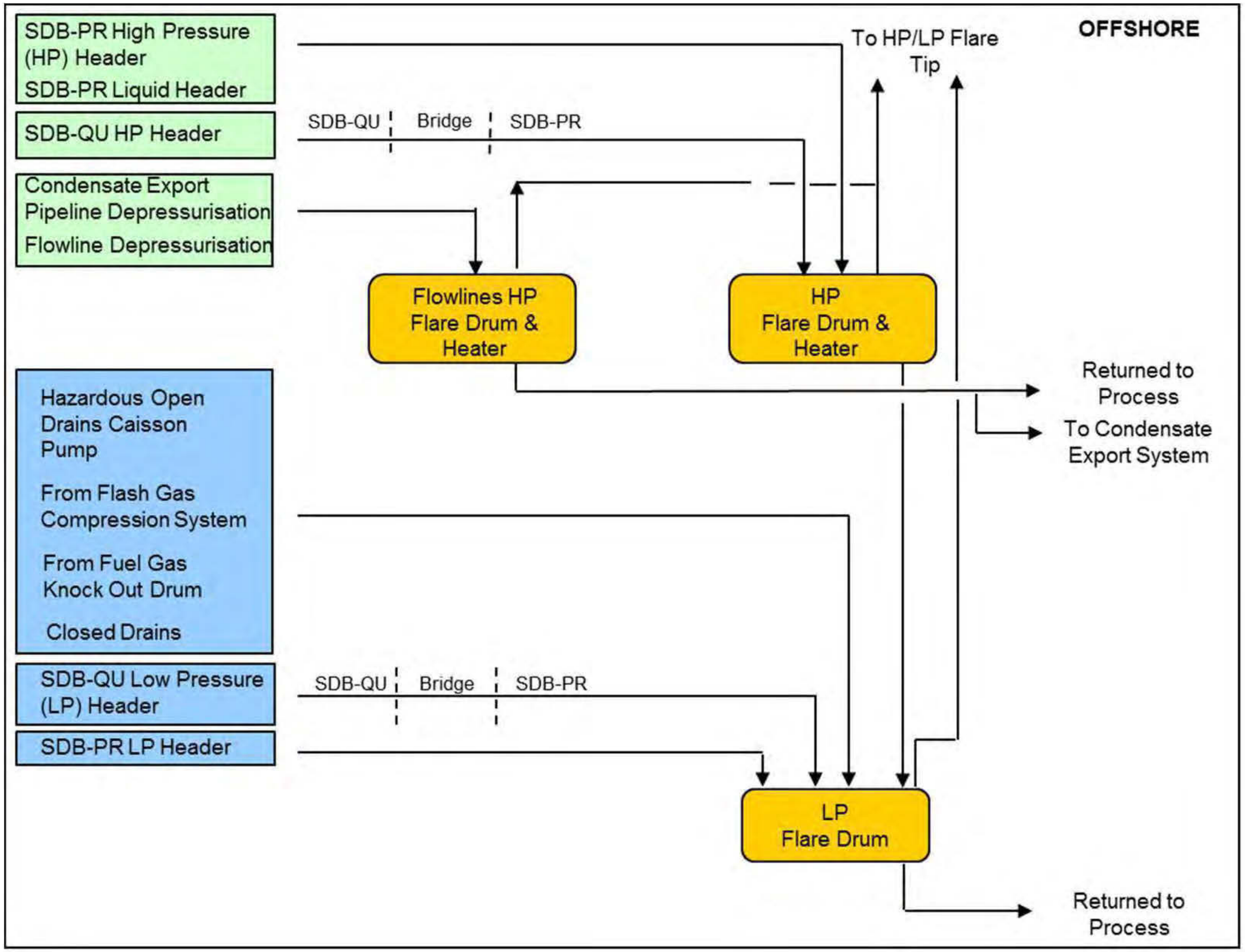


SD2 Project Sangachal Terminal

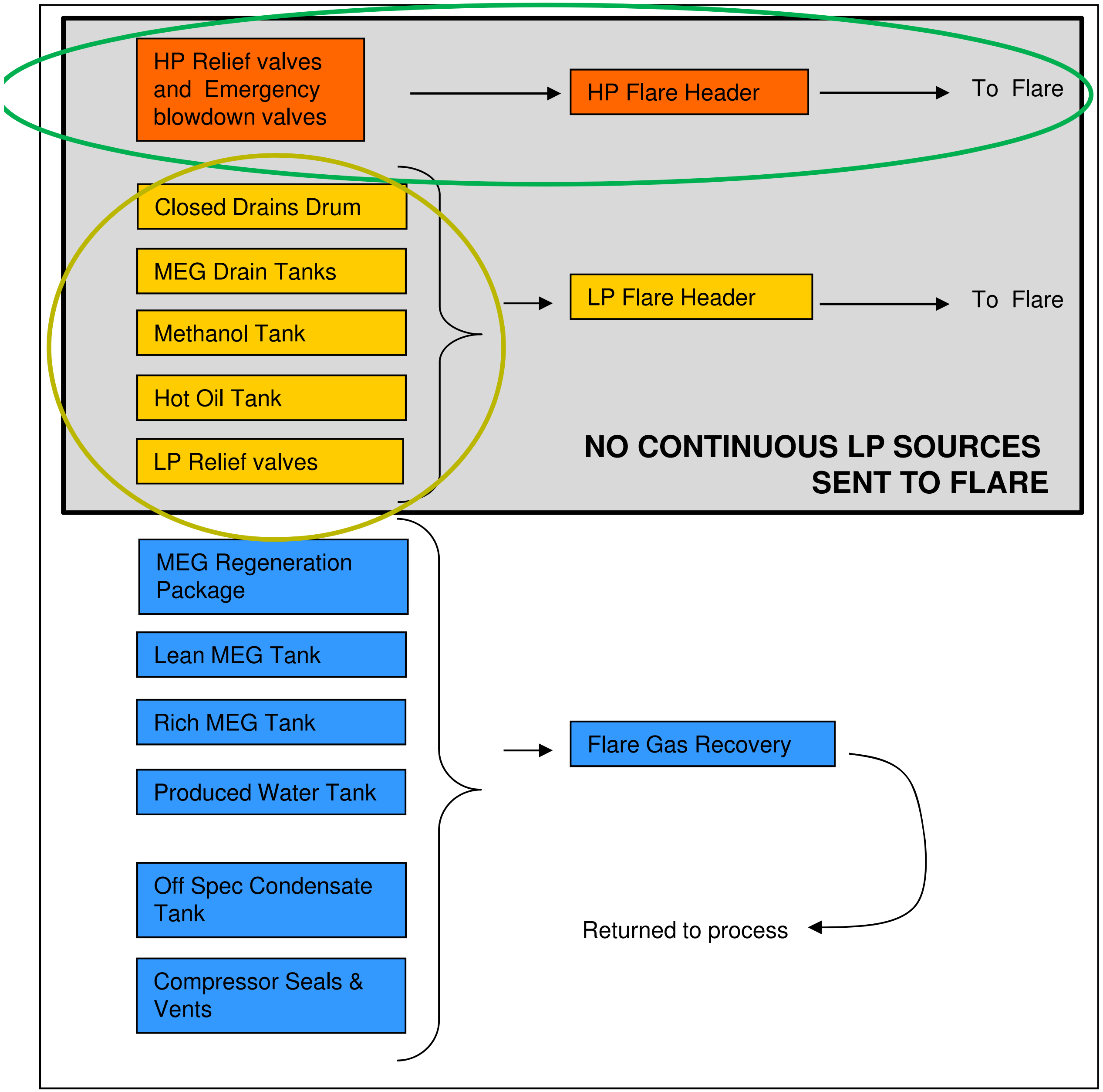


SD2 Project Flaring Offshore

- Primary aim is to send gas to the terminal for export and minimise flaring
- Tanks and vessels provided with headers to route gas to flare (located on the SDB-PR platform)
- Offshore non routine flaring scenarios:
    - Flowline pigging
    - Subsea Condensate Pipeline pigging
    - Flash Gas Compressor trips
    - Spill off from separators & heaters following shutdown
    - Planned and Emergency Depressurisation

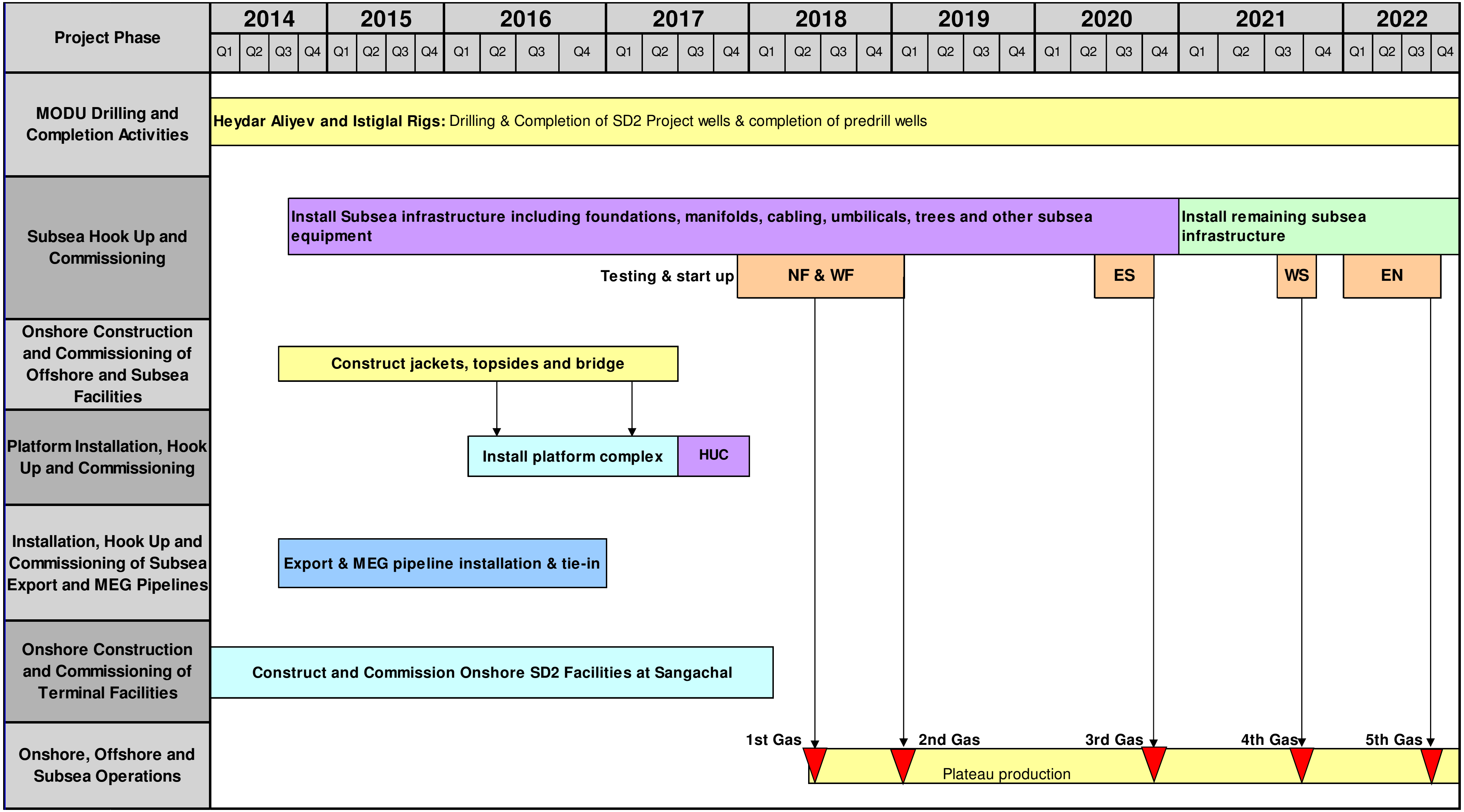


SD2 Project Flaring Onshore

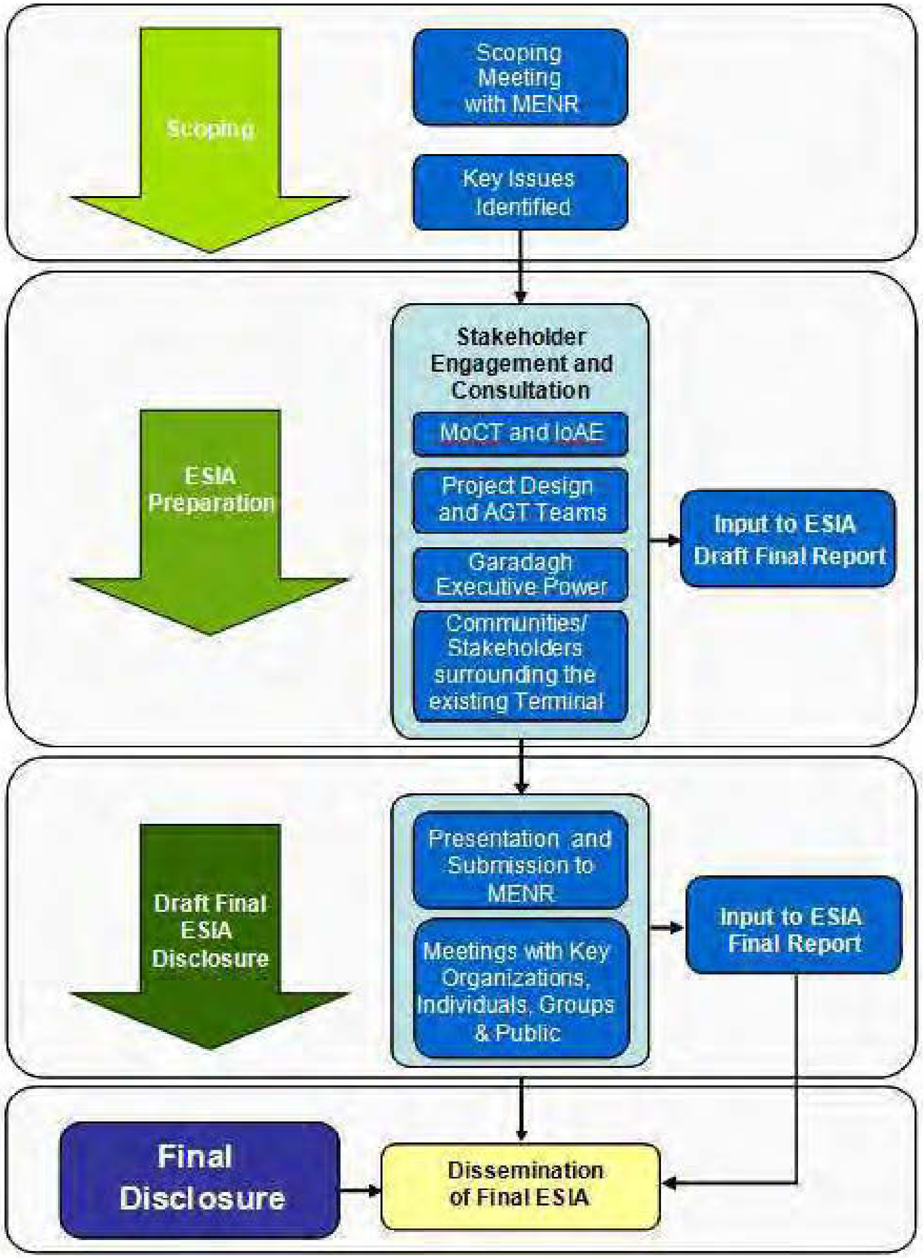


- Flare system onshore designed to avoid continuous flaring.
  Note: HP and LP flares have continuous pilots at flare tips.
- HP system designed to allow maintenance of valves to occur without flaring
- Vents from some tanks includes nitrogen – not suitable to send to flare gas recovery
- Nitrogen purge onshore.
- Onshore non routine flaring scenarios:
  - Export compressor trips
  - Loss of flash gas compression
  - Loss of 1 or 2 gas conditioning trains
  - Loss of 1 or 2 condensate trains
  - Inability to export gas
  - Planned and Emergency Depressurisation

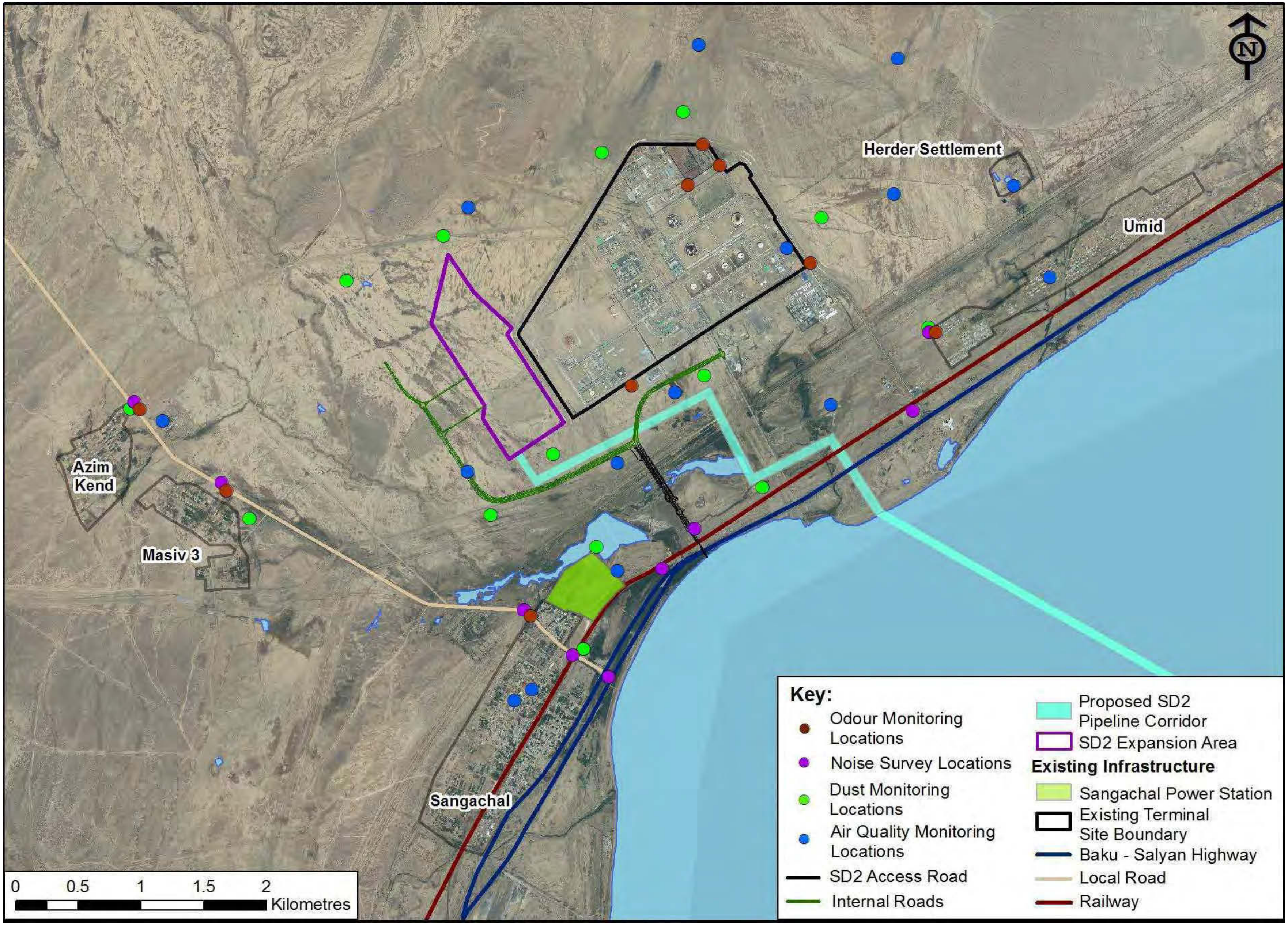
SD2 Project Indicative Schedule



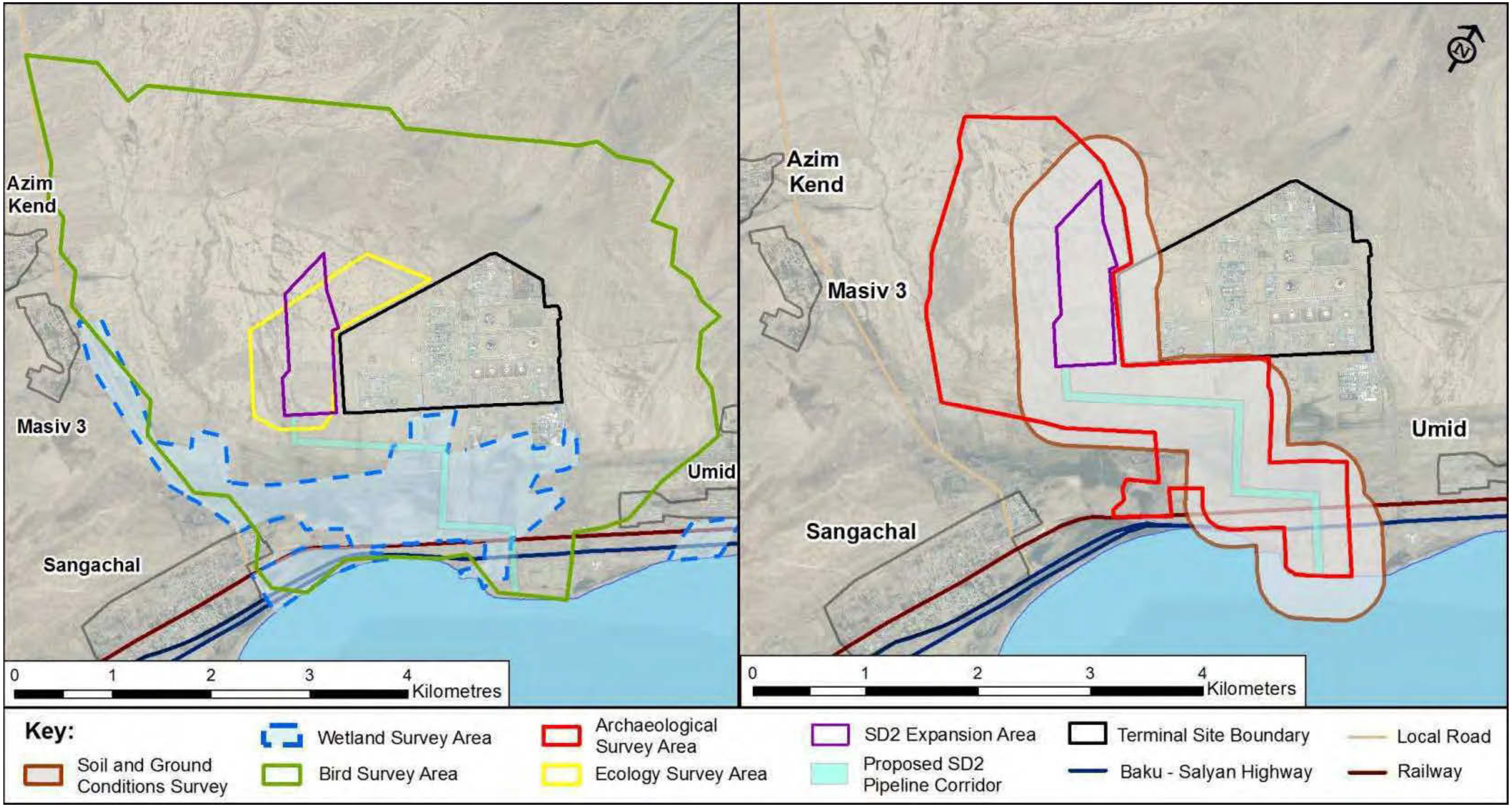
SD2 Project ESIA Consultation



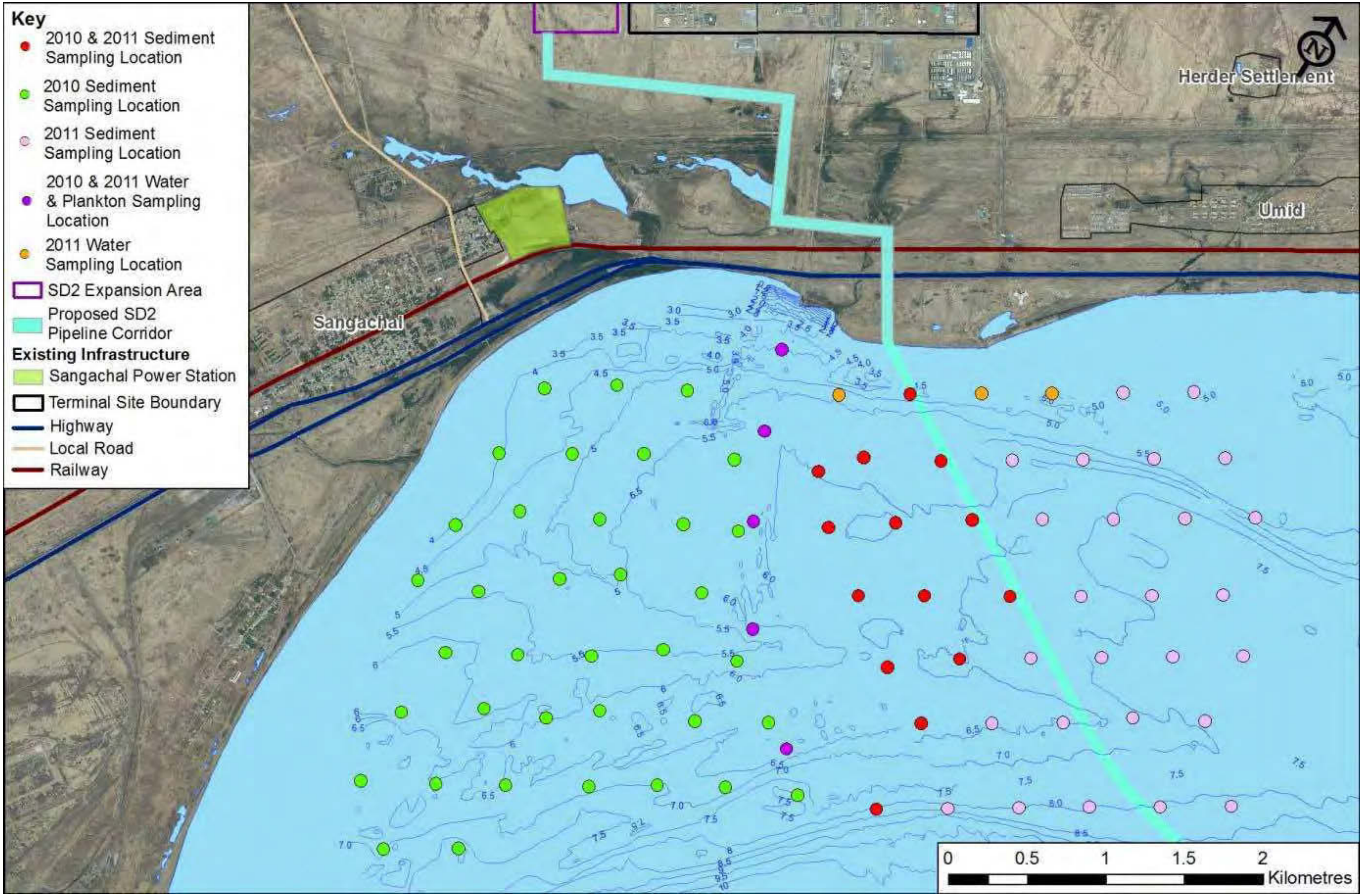
SD2 ESIA Process Onshore Baseline Air Quality, Dust, Odour and Noise



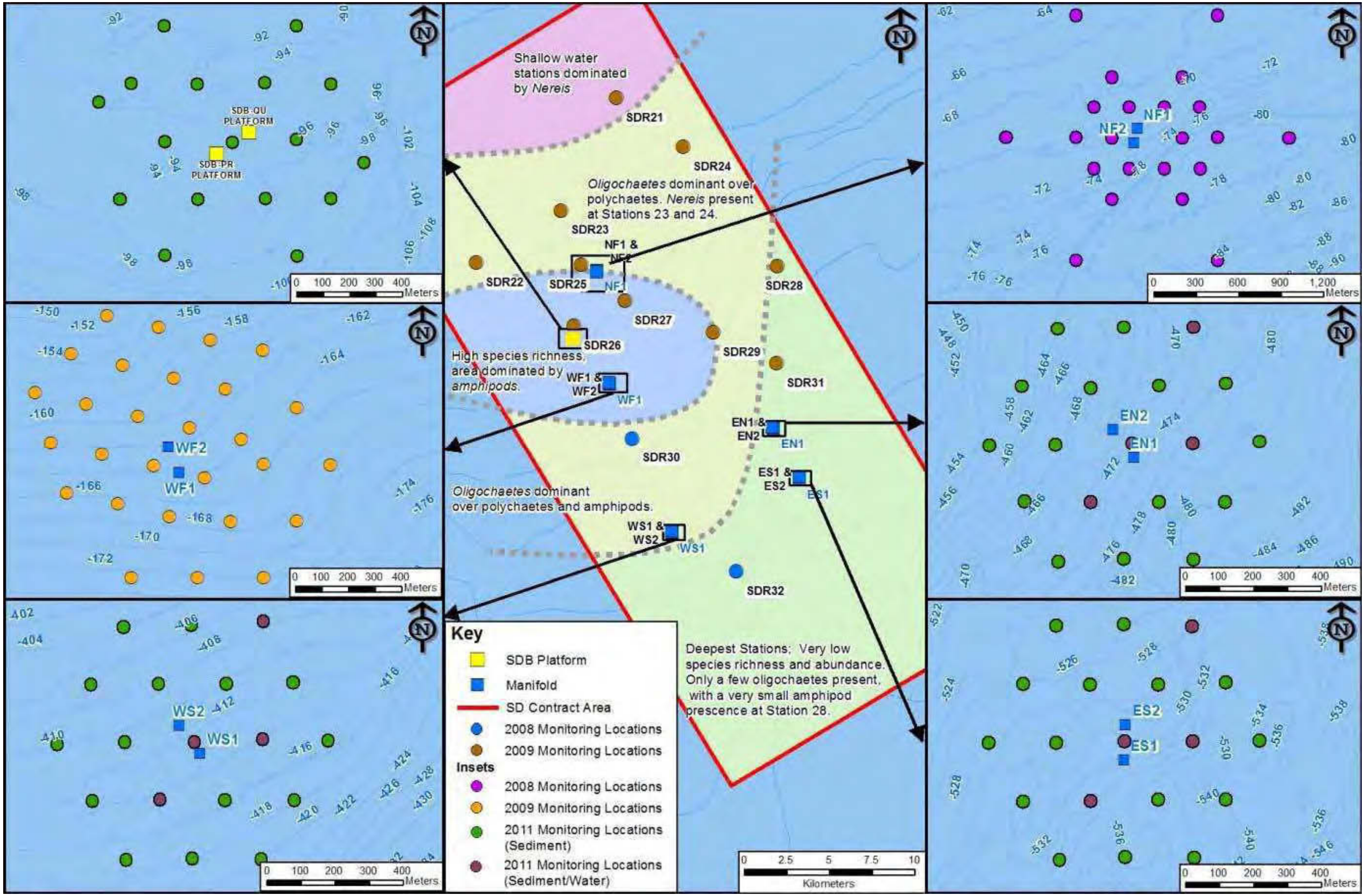
SD2 ESIA Process Onshore Baseline Survey Areas



SD2 ESIA Process Nearshore Baseline



SD2 ESIA Process Offshore Baseline



SD2 ESIA Breakout sessions

Break-out Session 1

- Table 1: Surface Water modelling and Flood assessment
- Table 2: Discharge modelling
- Table 3: Condensate characterisation

Break-out Session 2

- Table 1: Spill assessment
- Table 2: Atmospheric dispersion modelling
- Table 3: No drill zone

SD2 ESIA – Feedback

- Feedback and grievances should be raised with BP
- BP will address any outstanding issues raised through feedback in the final ESIA
- All comments must be submitted by the 23 August, 2013
- Feedback to be sent to:

  BP Azerbaijan
  1033 Izmir st.
  Hyatt Tower II
  AZ1065 Baku
  Azerbaijan

- esiafeedback@bp.com
- Telephone number: +994124979000

SD2 Project ESIA

Public Disclosure August 2013

SD2 ESIA Meeting

Start	Finish	Presentation
10:00	10:15	Chair - welcome and agenda
10:15	11:15	SD2 project and ESIA overview
11:15	11:30	Break
11:30	12:30	Question and Answers
12:30	12:45	Close

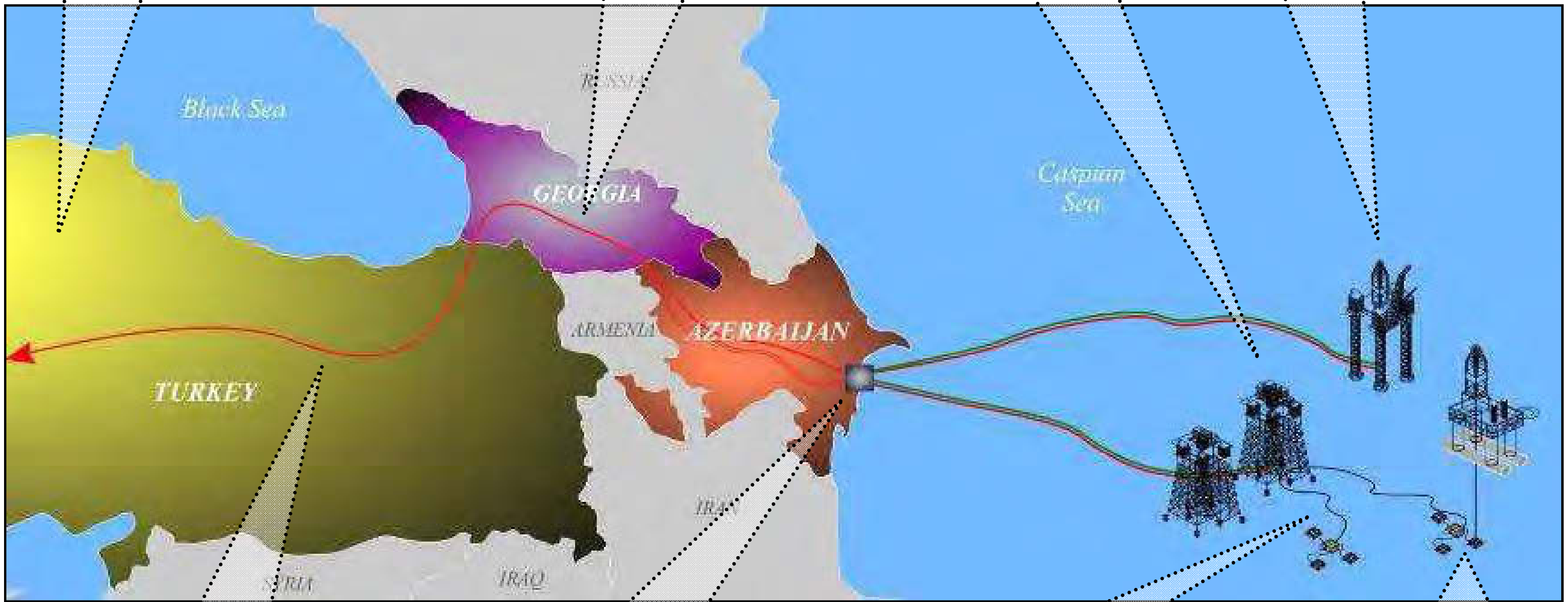
Scope of SD2, SCPx and TANAP

Contracts to sell gas to Turkey and Europe

Expansion of South Caucasus Pipeline to Georgian border with new 56" pipeline

Two new bridge linked platforms provide 16 bcma offshore processing

Existing Stage 1 Platform



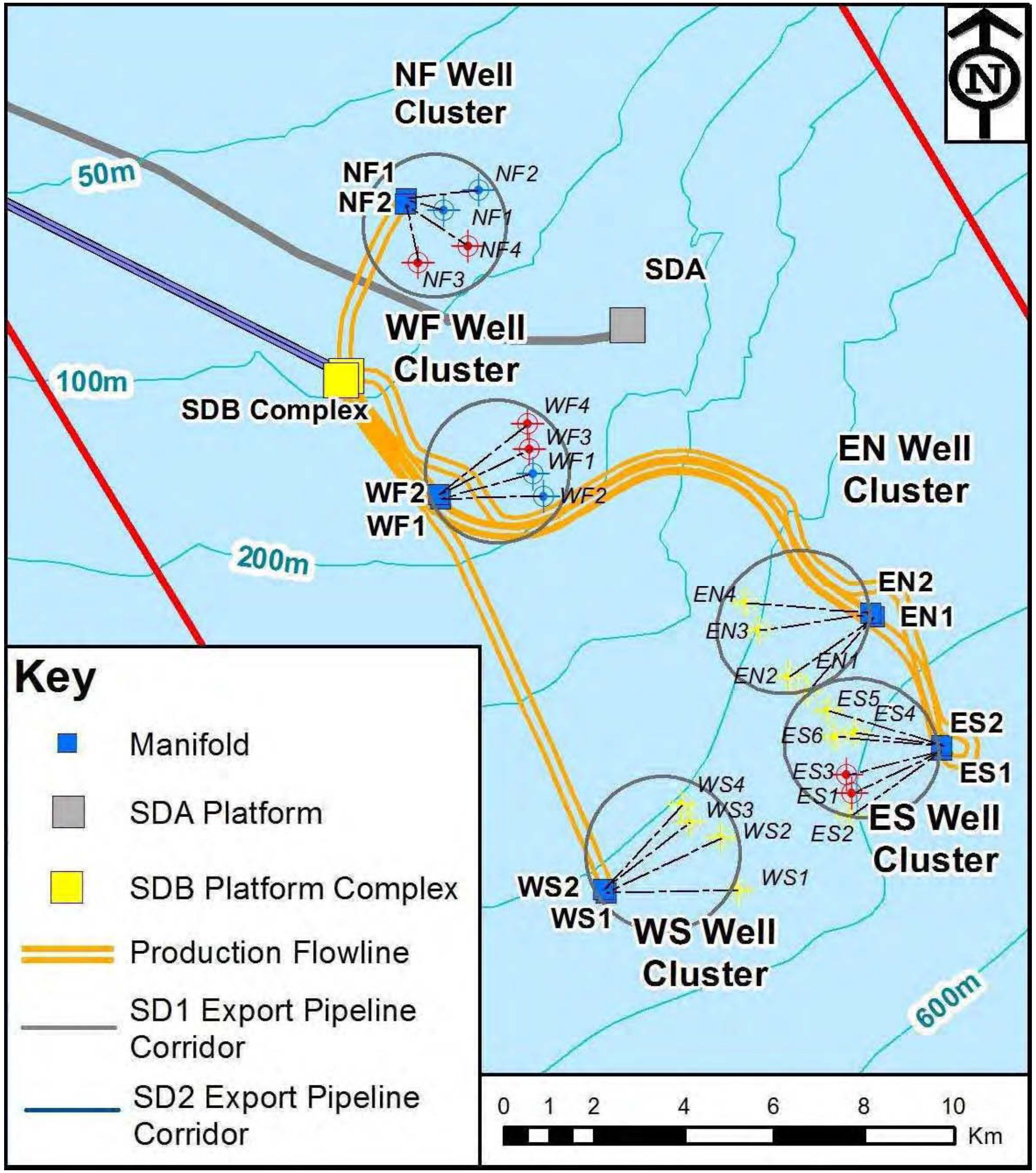
2000km Trans-Anatolian Pipeline across Turkey

New terminal at Sangachal with compressors for Shah Deniz and SCP

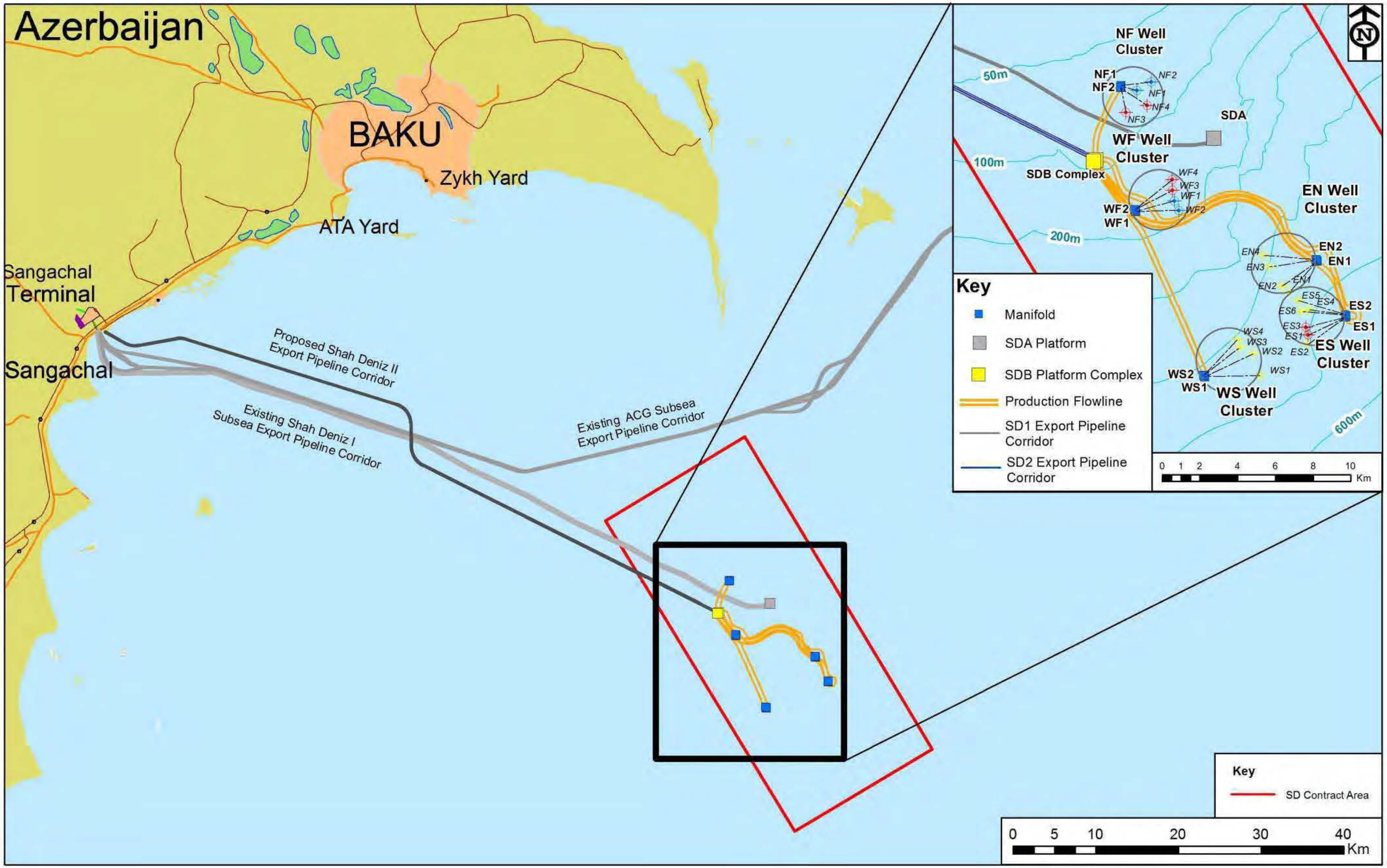
500 km of subsea pipelines and flowlines in up to 550m water depth

26 subsea wells drilled with 2 semi-submersible rigs

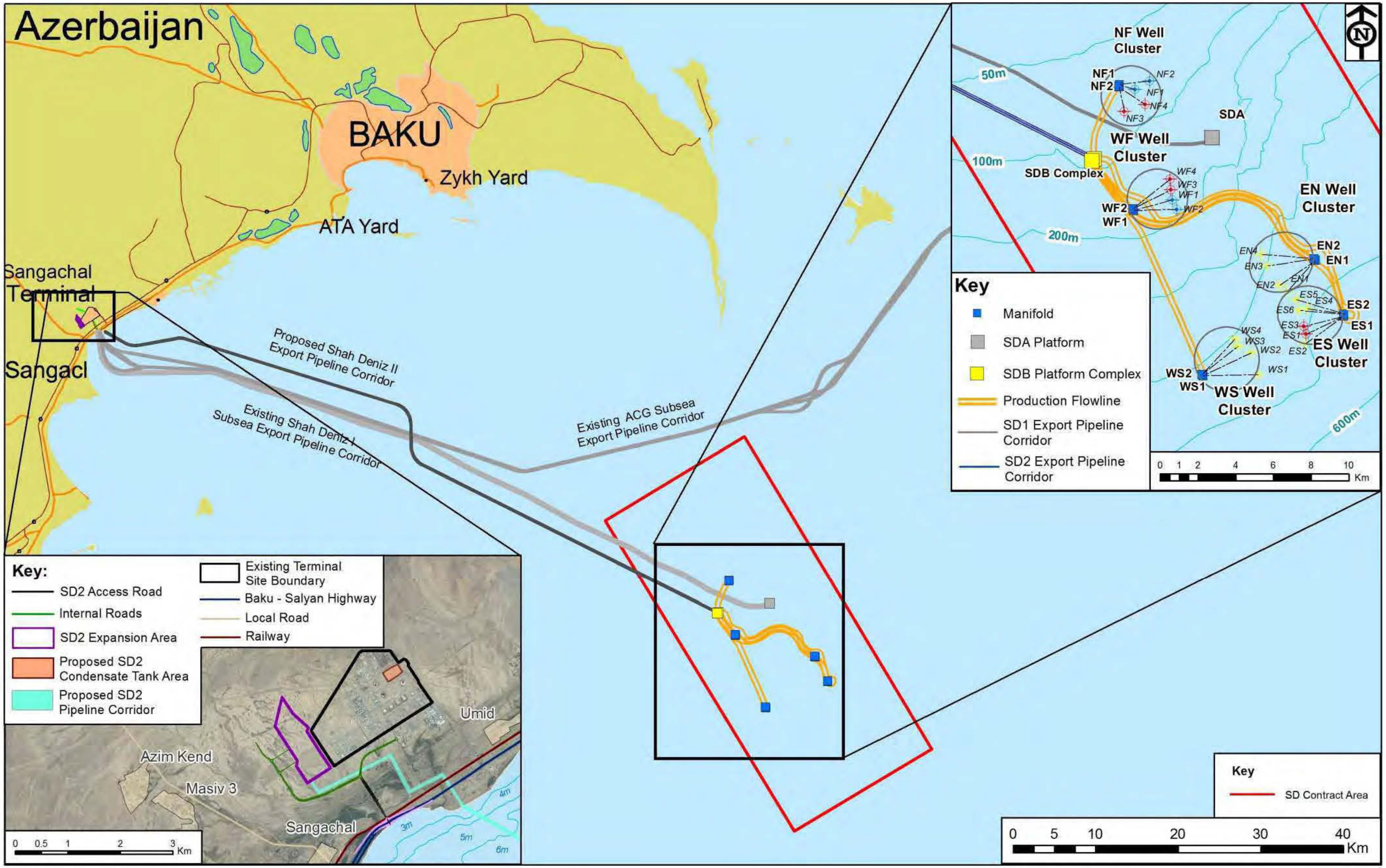
Location of SD2 Project Activities



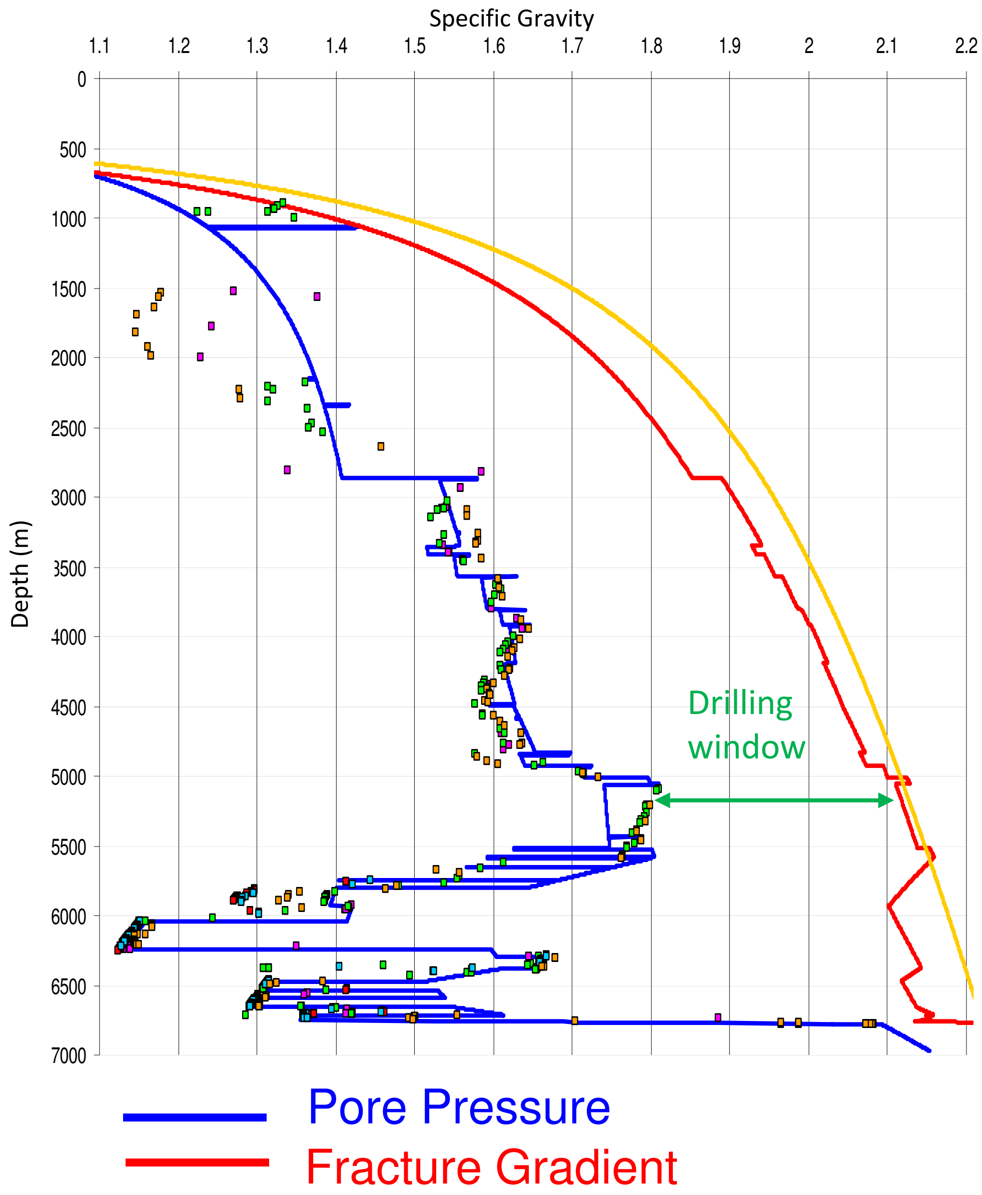
Location of SD2 Project Activities



Location of SD2 Project Activities



SD2 Project Drilling



Pore pressure = the density of the drilling fluids required to hold back the pressure exerted from the reservoir formations

Fracture gradient = the pressure required to induce fractures in the rock at a given depth

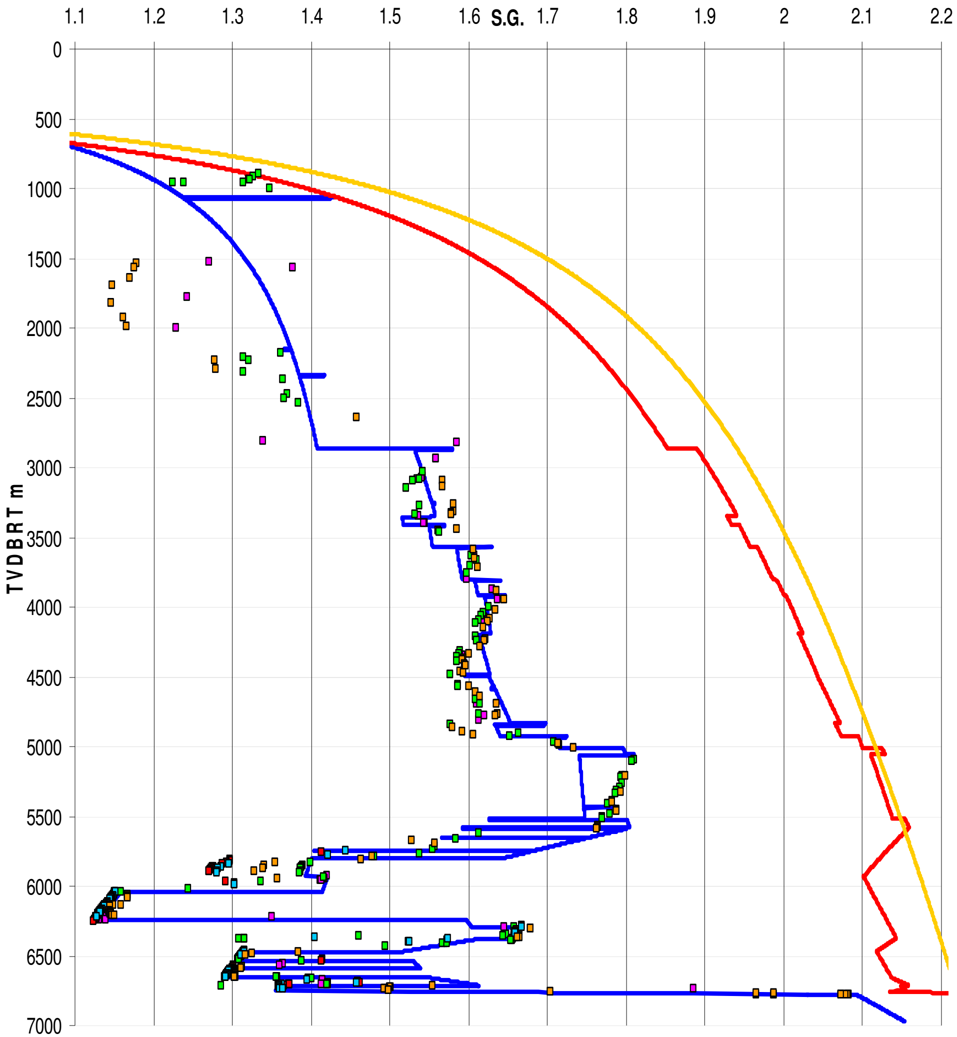
The difference between pore pressure and fracture gradient is the "drilling window".

If the drilling window is too small there is a risk of total loss of well control.

Minimum acceptable drilling window for SD2 Project is 0.1 s.g

SD2 Project Drilling

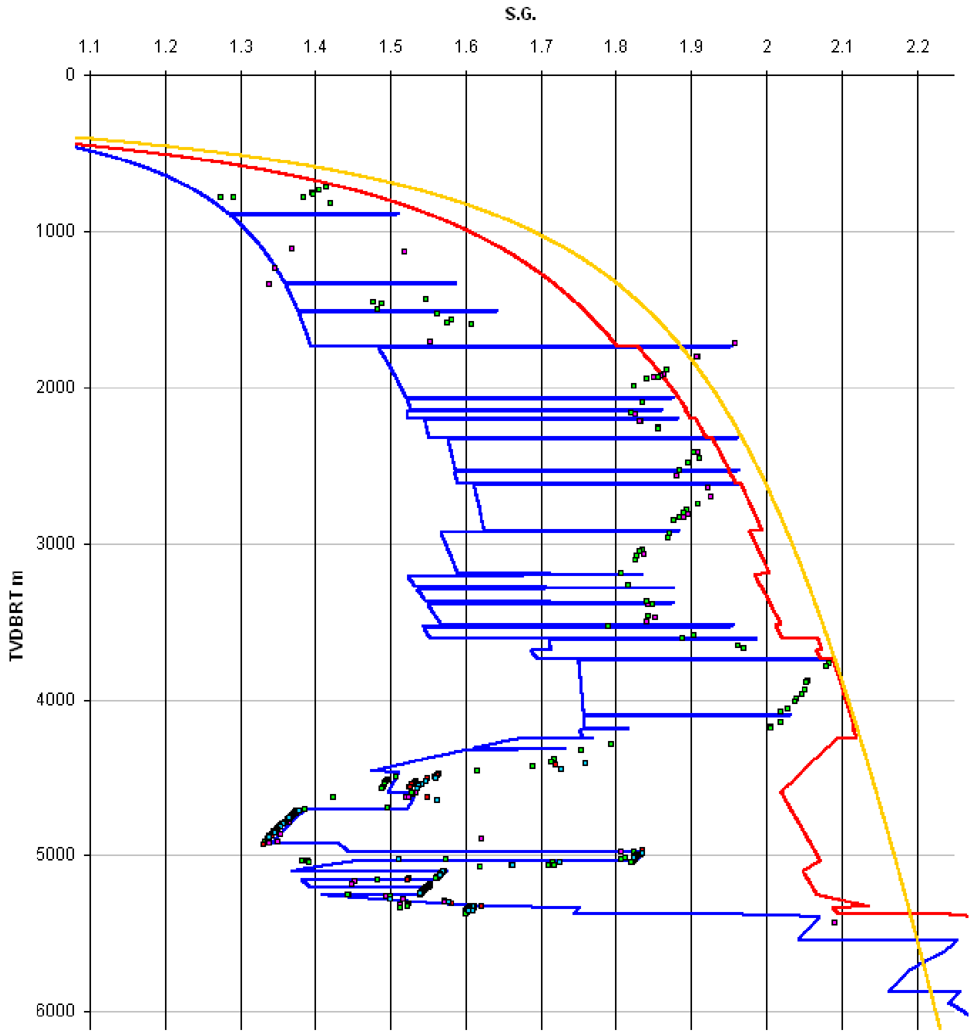
Shah Deniz Flank Well



Pore Pressure

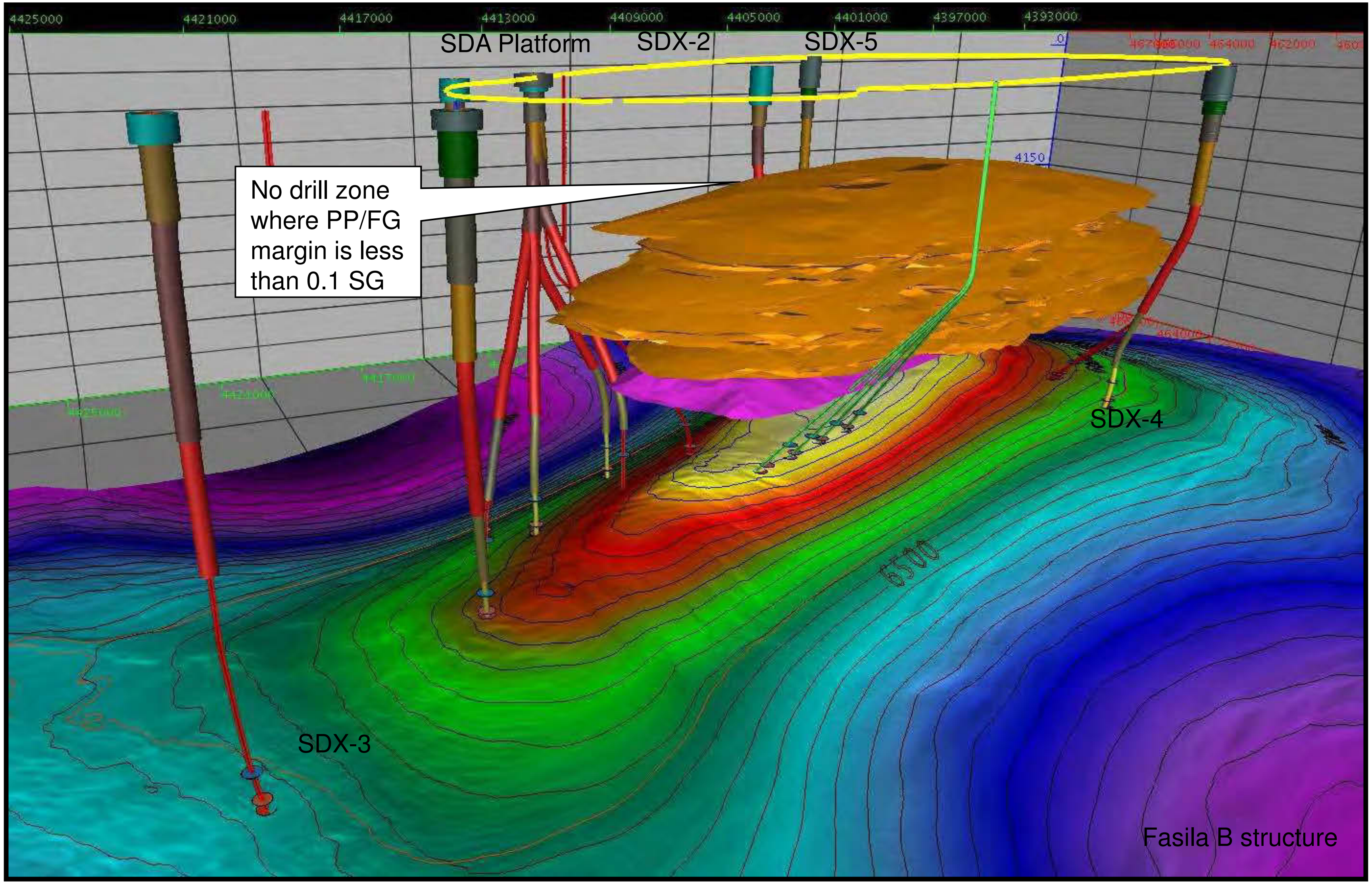
Fracture Gradient

Shah Deniz Crestal Well



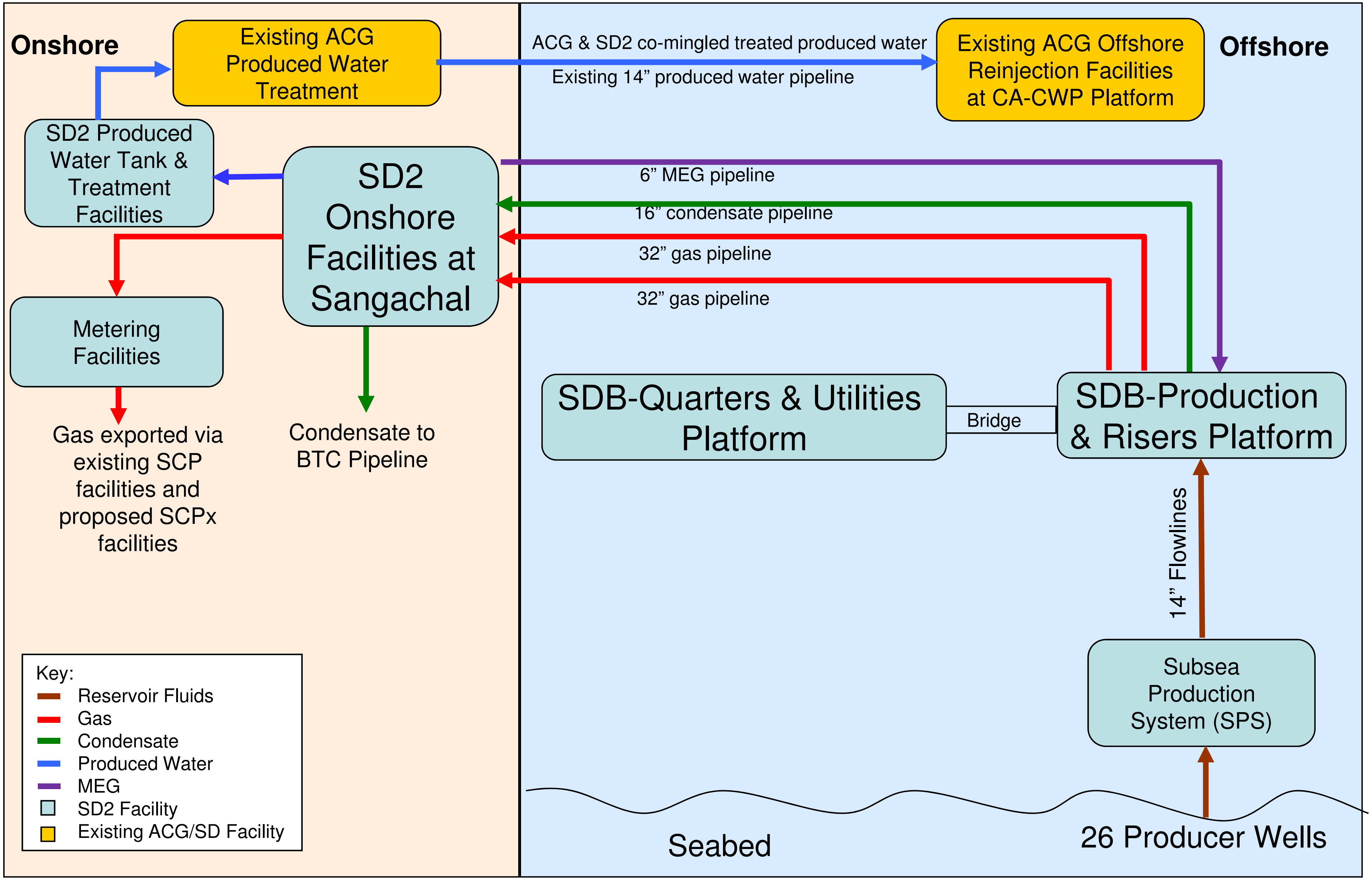
Drilling window within the centre (i.e. the crest) of the Contract Area is not sufficient

SD2 Project Drilling

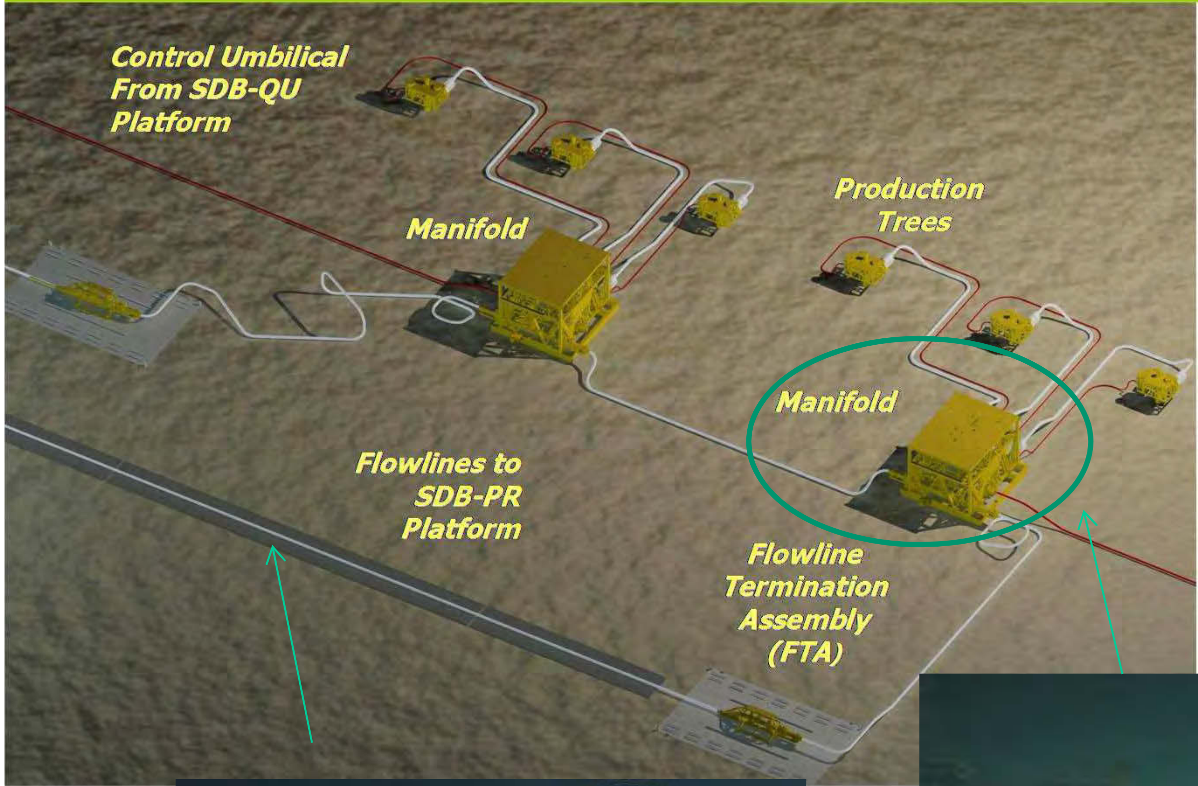


No drill zone across the crest of the structure has driven the option to position wells centred at manifold locations around the periphery.

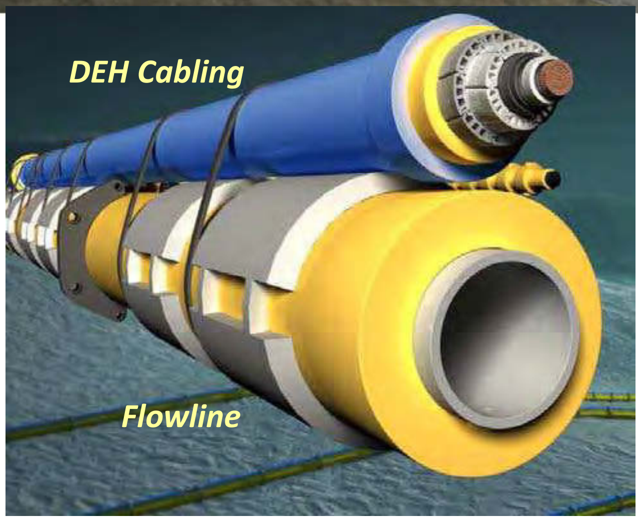
Scope of SD2 Project



SD2 Project Subsea

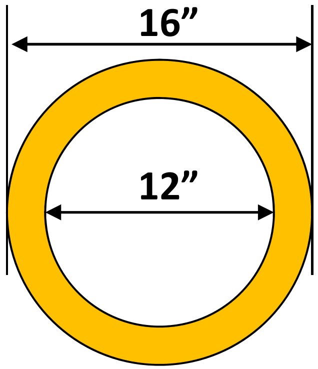


- 5 Subsea clusters
- At each cluster 2 manifolds and between 4-5 trees (wells)
- High integrity pressure protection system within each manifold
- DEH system maintains flow line temperature to control hydrate formation



SD2 Project Subsea

Fully Rated Flowlines



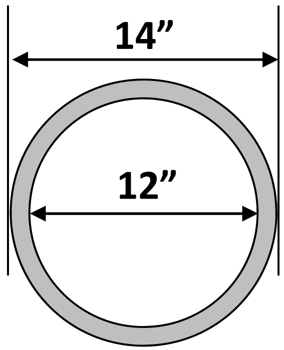
900 bar rated

**16” Outer Diameter
60mm (2.4”) wall thickness**

Outside line-pipe manufacturing industry capabilities

Outside regional pipelay vessel capabilities

HIPPS Protected Flowlines

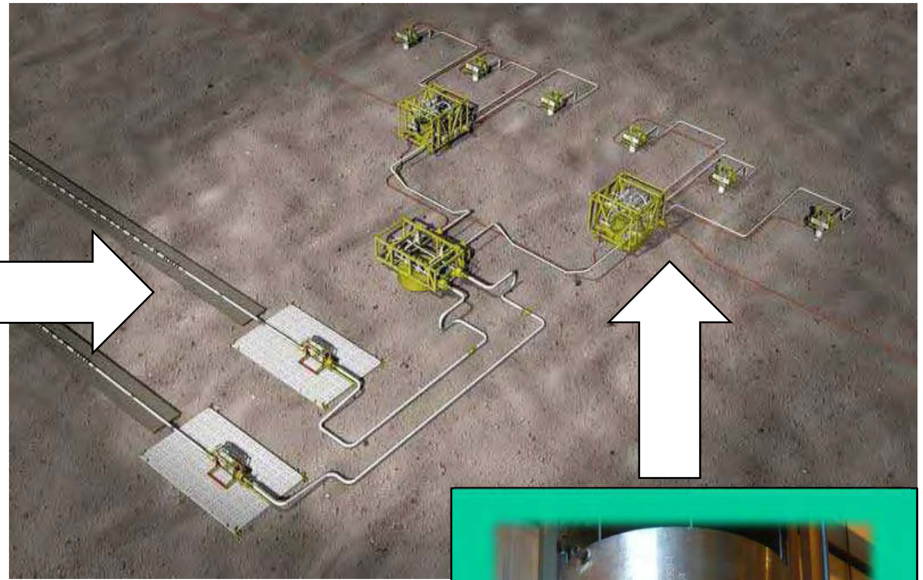


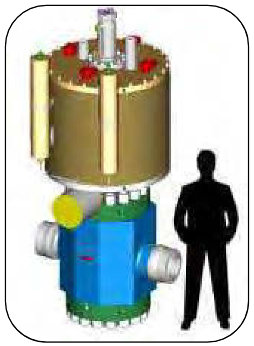
270 bar rated

**14” Outer Diameter
29mm (1.1”) wall thickness**

Within line-pipe manufacturing industry capabilities

Within regional pipelay vessel capabilities



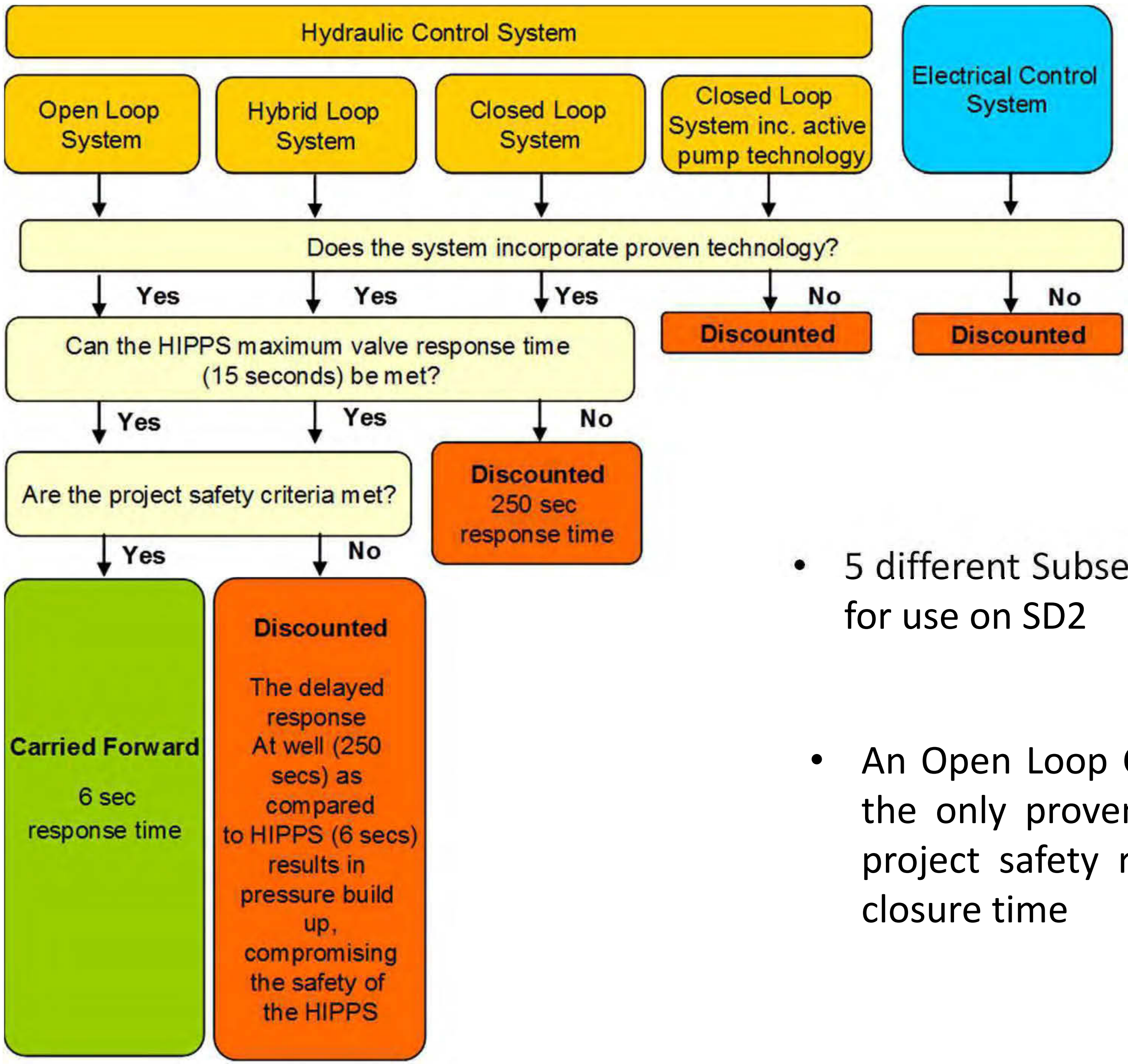


10” bore

900 bar rated

17,500 Kg

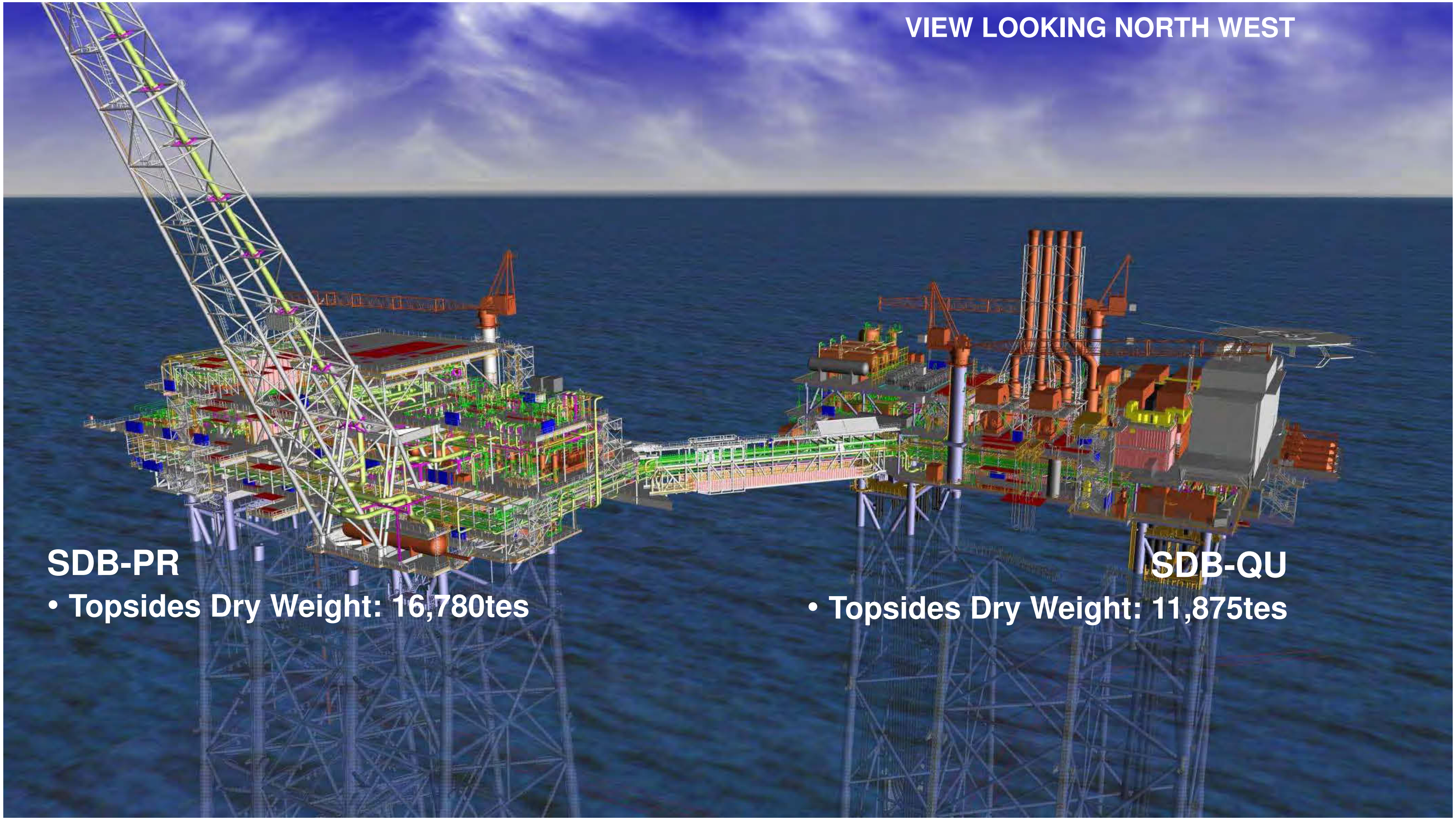
SD2 Project Subsea



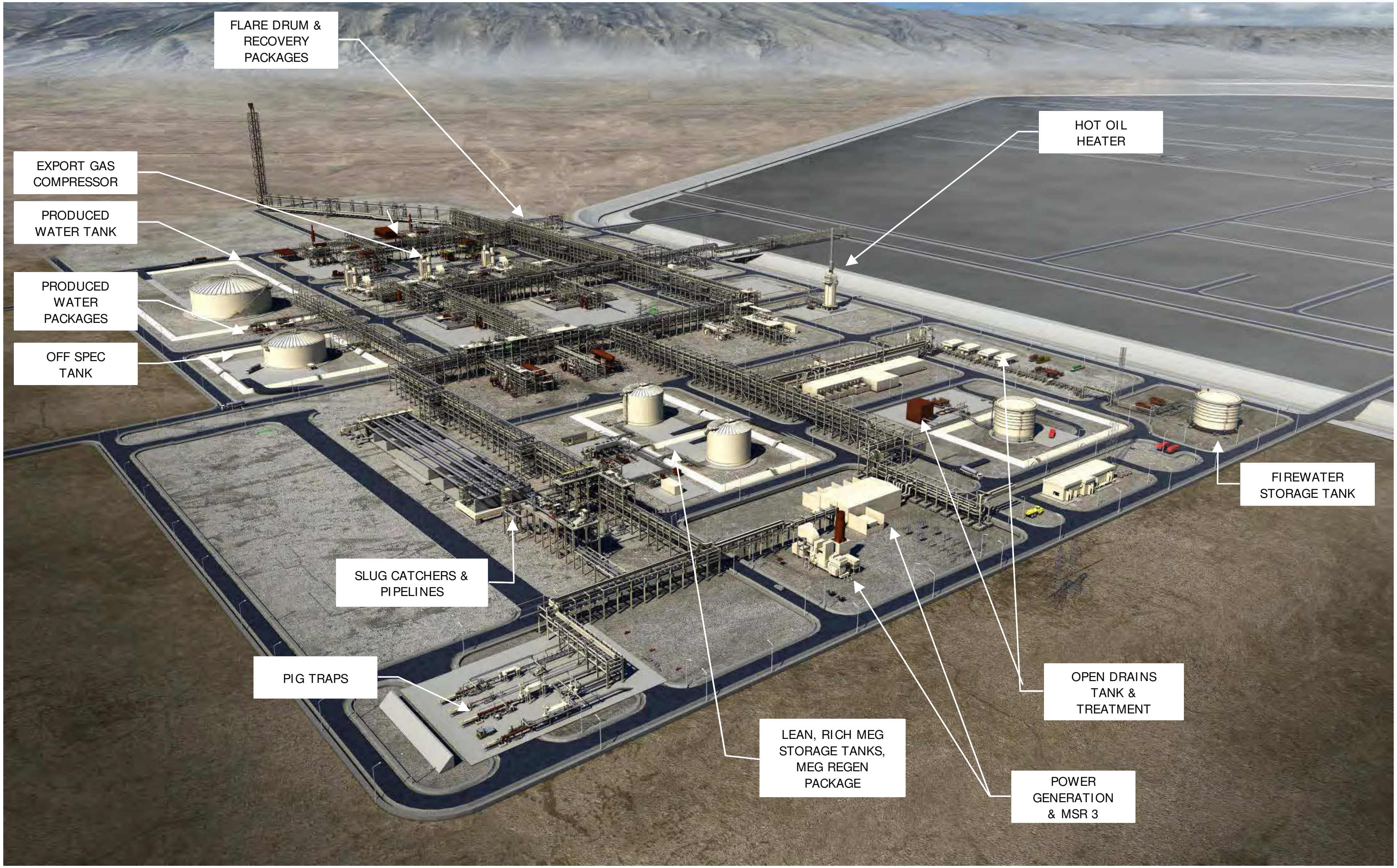
- 5 different Subsea Control Systems were considered for use on SD2

- An Open Loop Control System was selected as it is the only proven technology that meets all of the project safety requirements with respect to valve closure time

SD2 Project Bravo Platform Complex



SD2 Project Sangachal Terminal



SD2 Project Flaring Offshore

- Primary aim is to send gas to the terminal for export and minimise flaring

- Tanks and vessels provided with headers to route gas to flare (located on the SDB-PR platform)

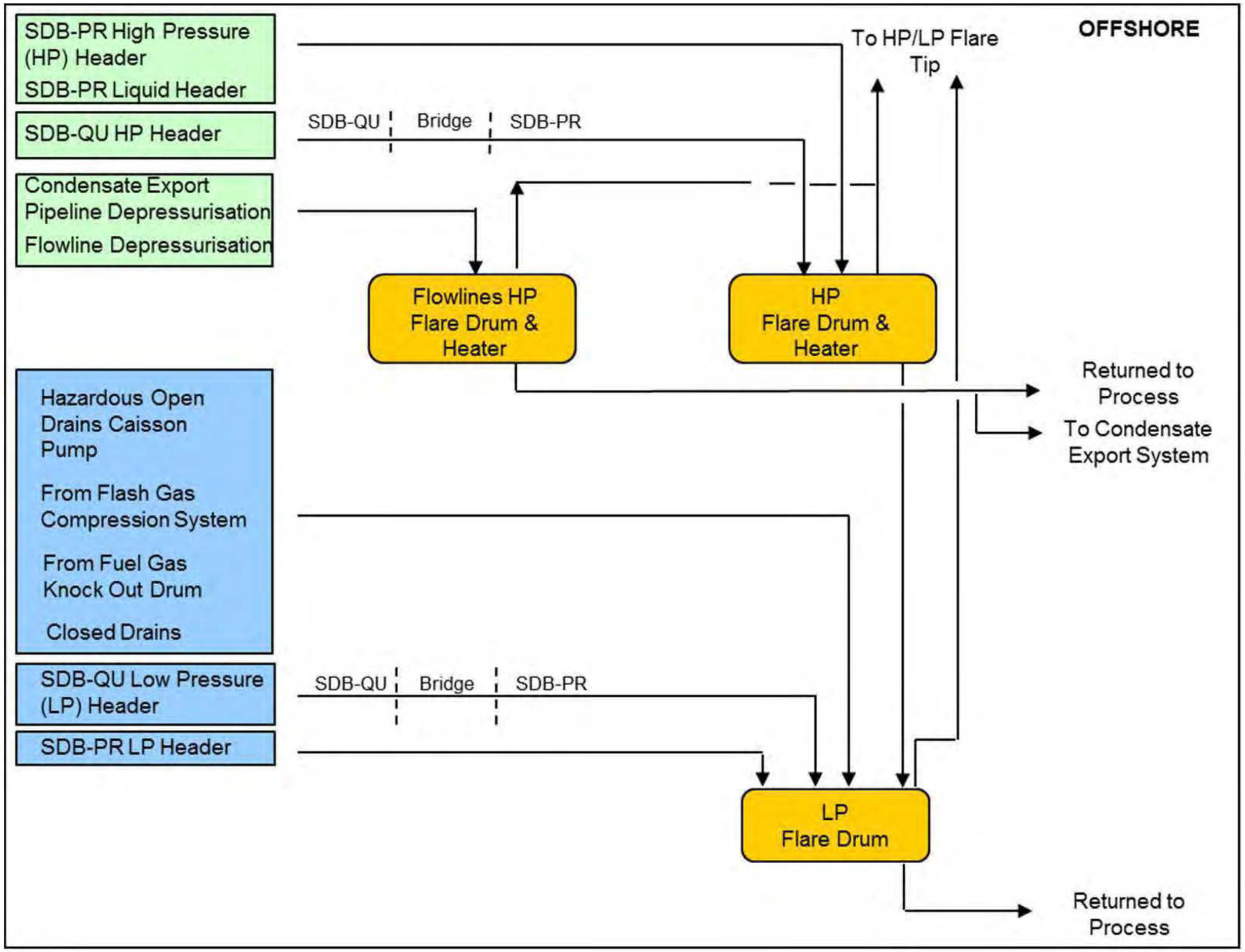
- Offshore non routine flaring scenarios:

    - Flowline pigging

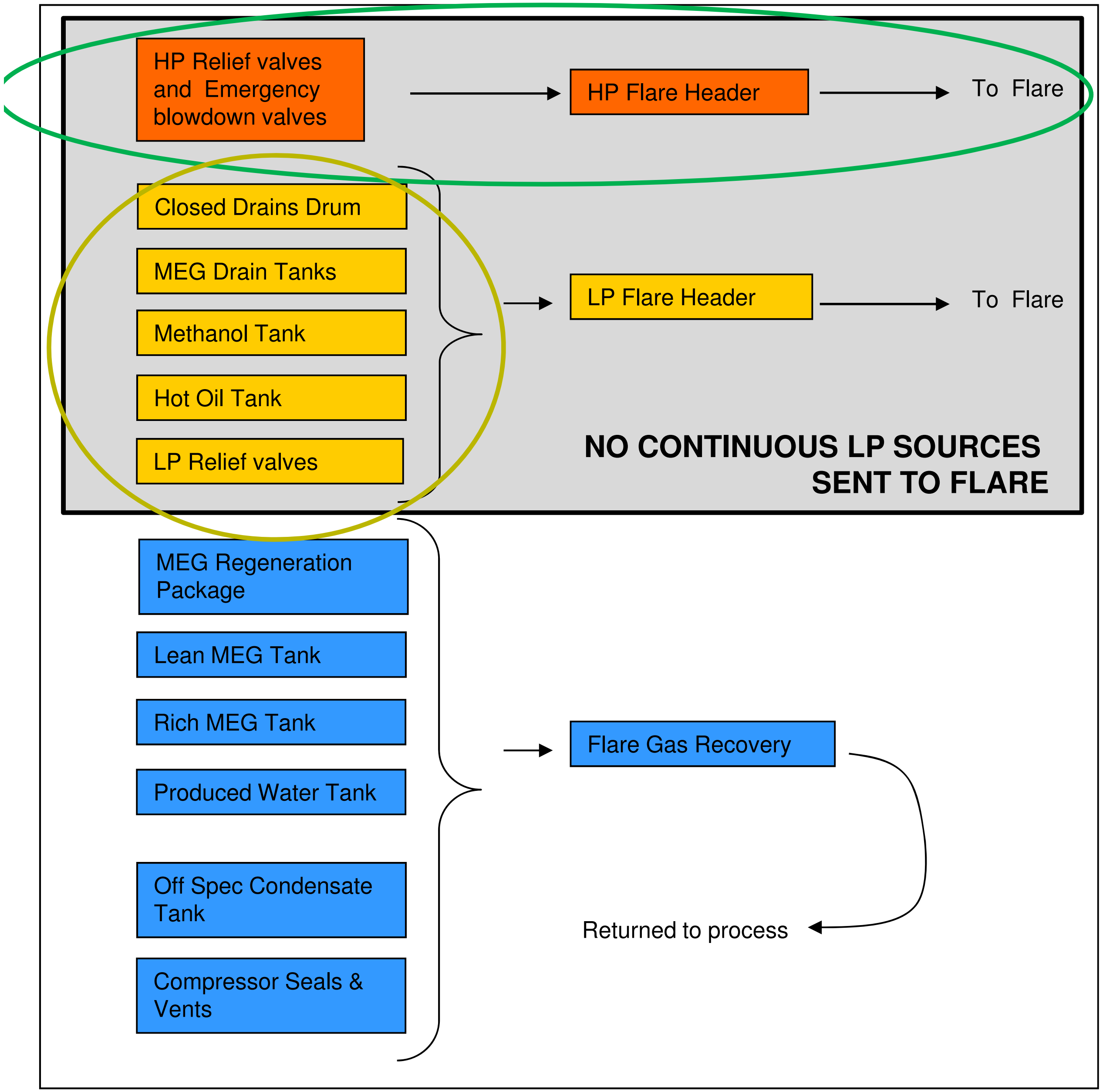
    - Subsea Condensate Pipeline pigging

    - Flash Gas Compressor trips
    - Spill off from separators & heaters following shutdown

    - Planned and Emergency Depressurisation

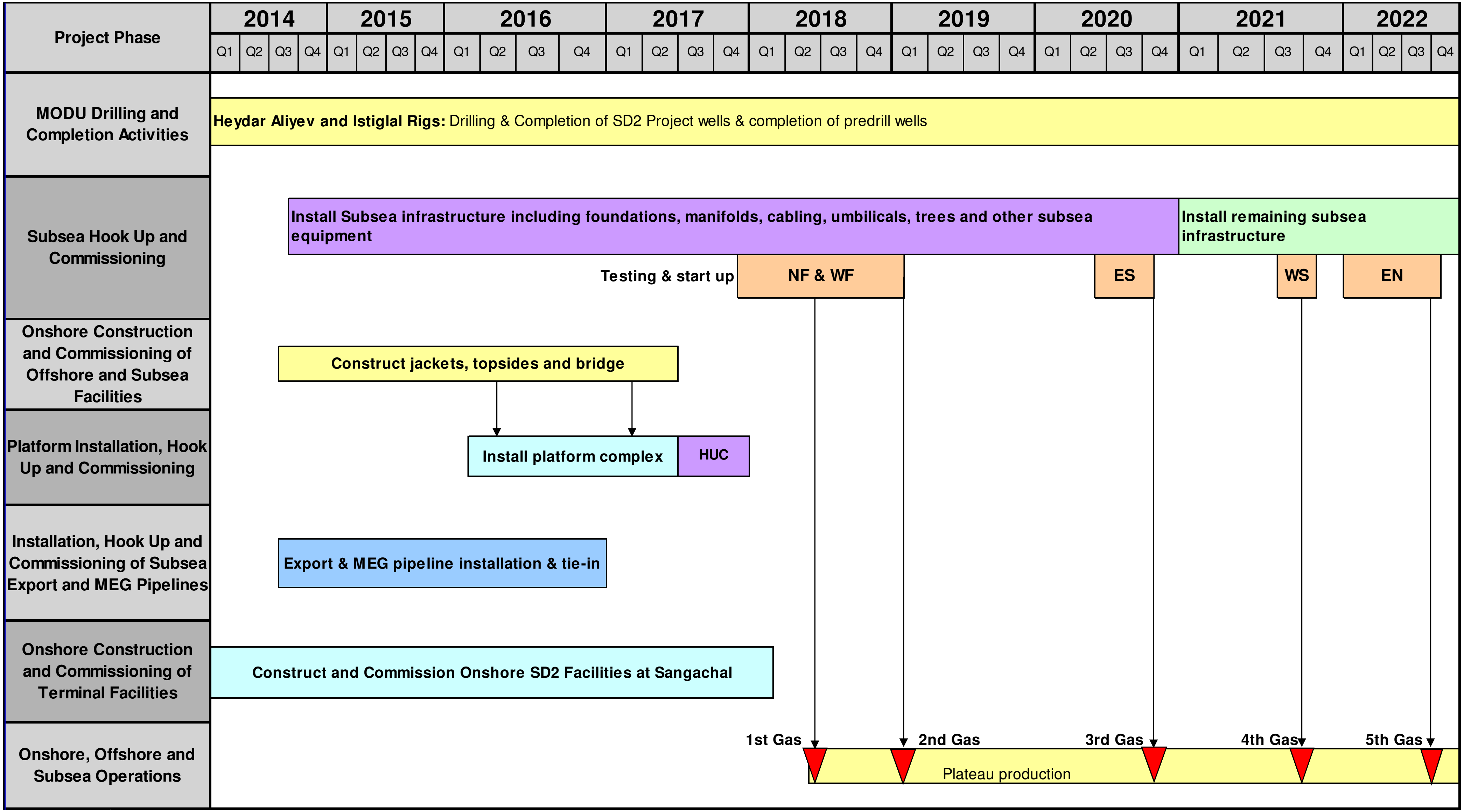


SD2 Project Flaring Onshore

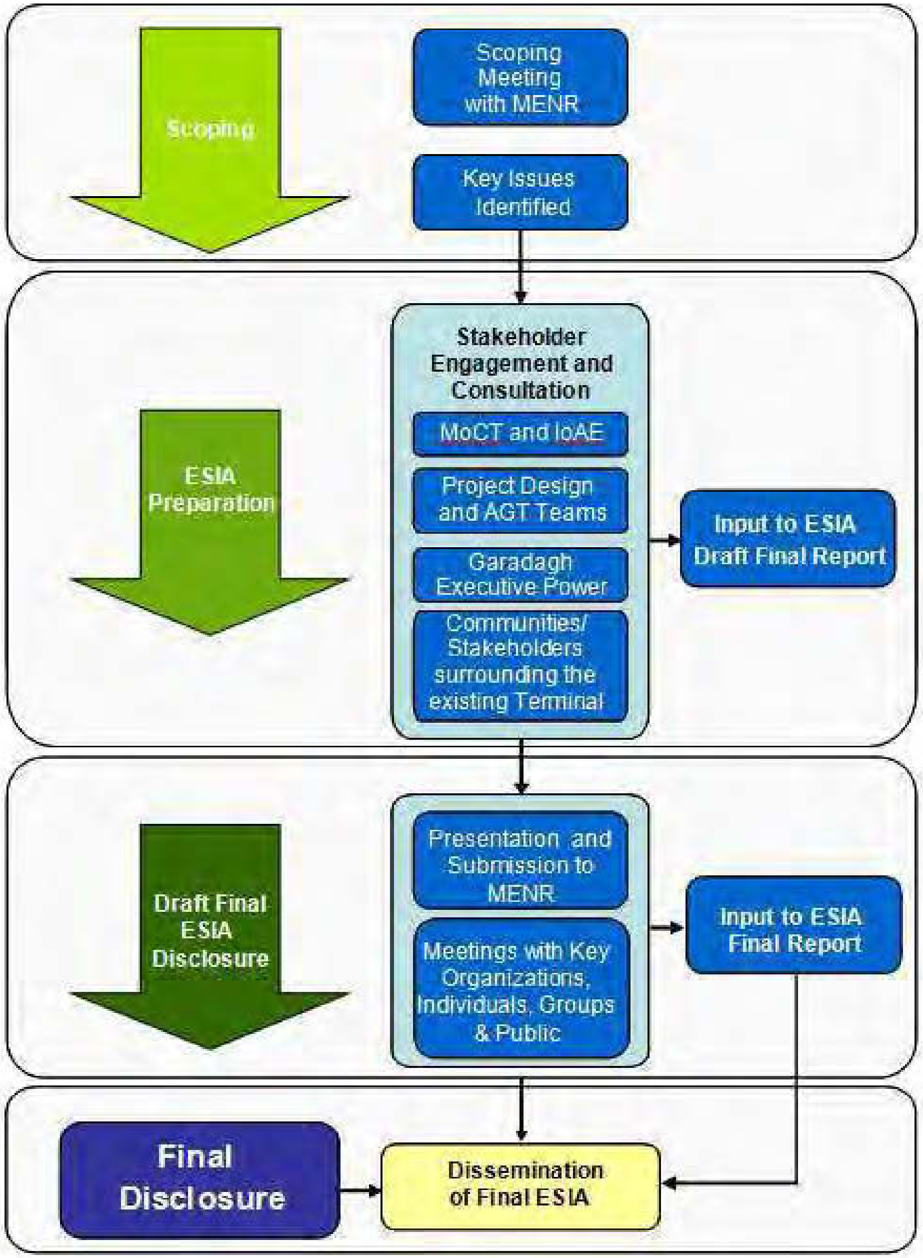


- Flare system onshore designed to avoid continuous flaring.
  Note: HP and LP flares have continuous pilots at flare tips.
- HP system designed to allow maintenance of valves to occur without flaring
- Vents from some tanks includes nitrogen – not suitable to send to flare gas recovery
- Nitrogen purge onshore.
- Onshore non routine flaring scenarios:
  - Export compressor trips
  - Loss of flash gas compression
  - Loss of 1 or 2 gas conditioning trains
  - Loss of 1 or 2 condensate trains
  - Inability to export gas
  - Planned and Emergency Depressurisation

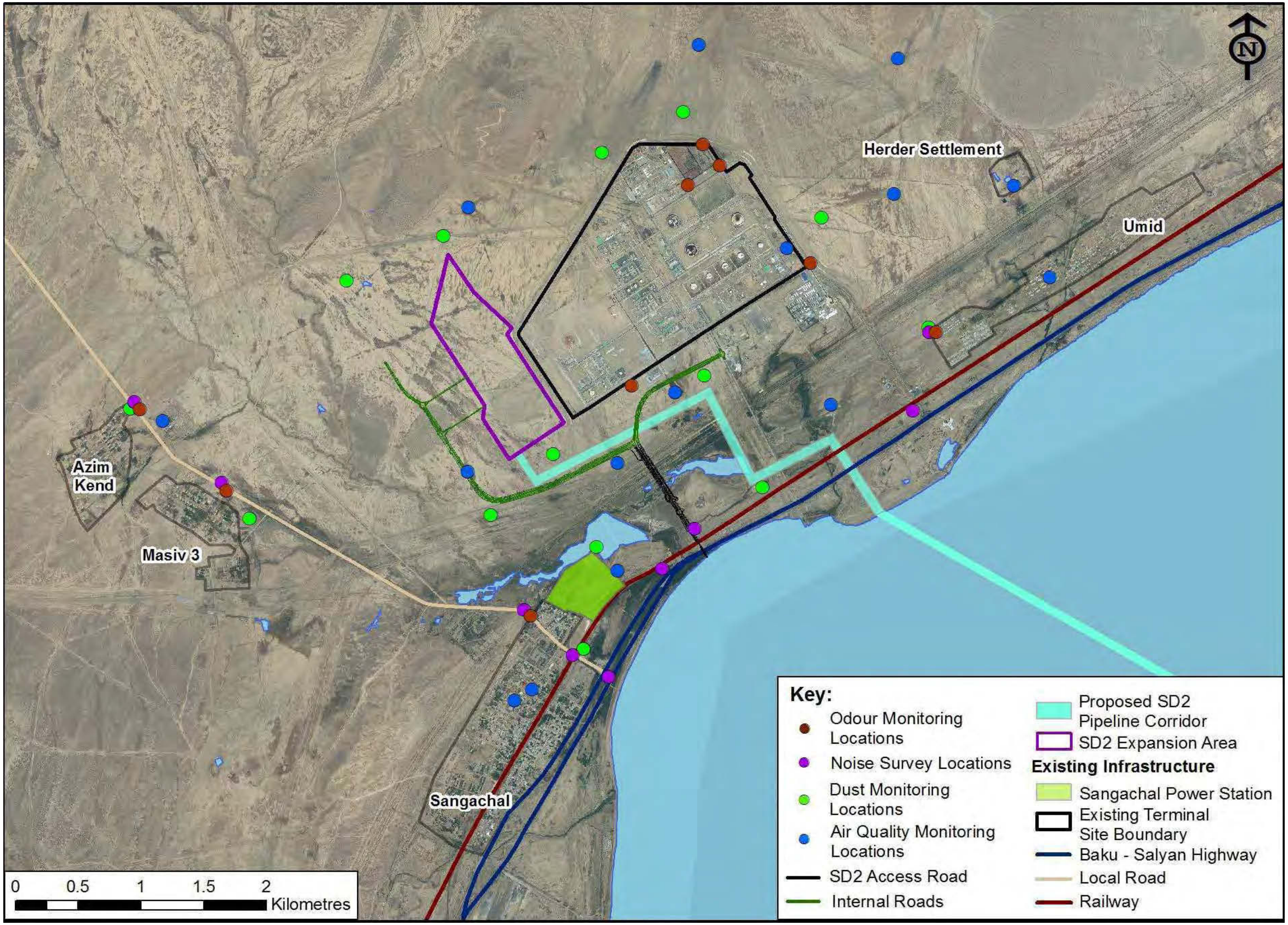
SD2 Project Indicative Schedule



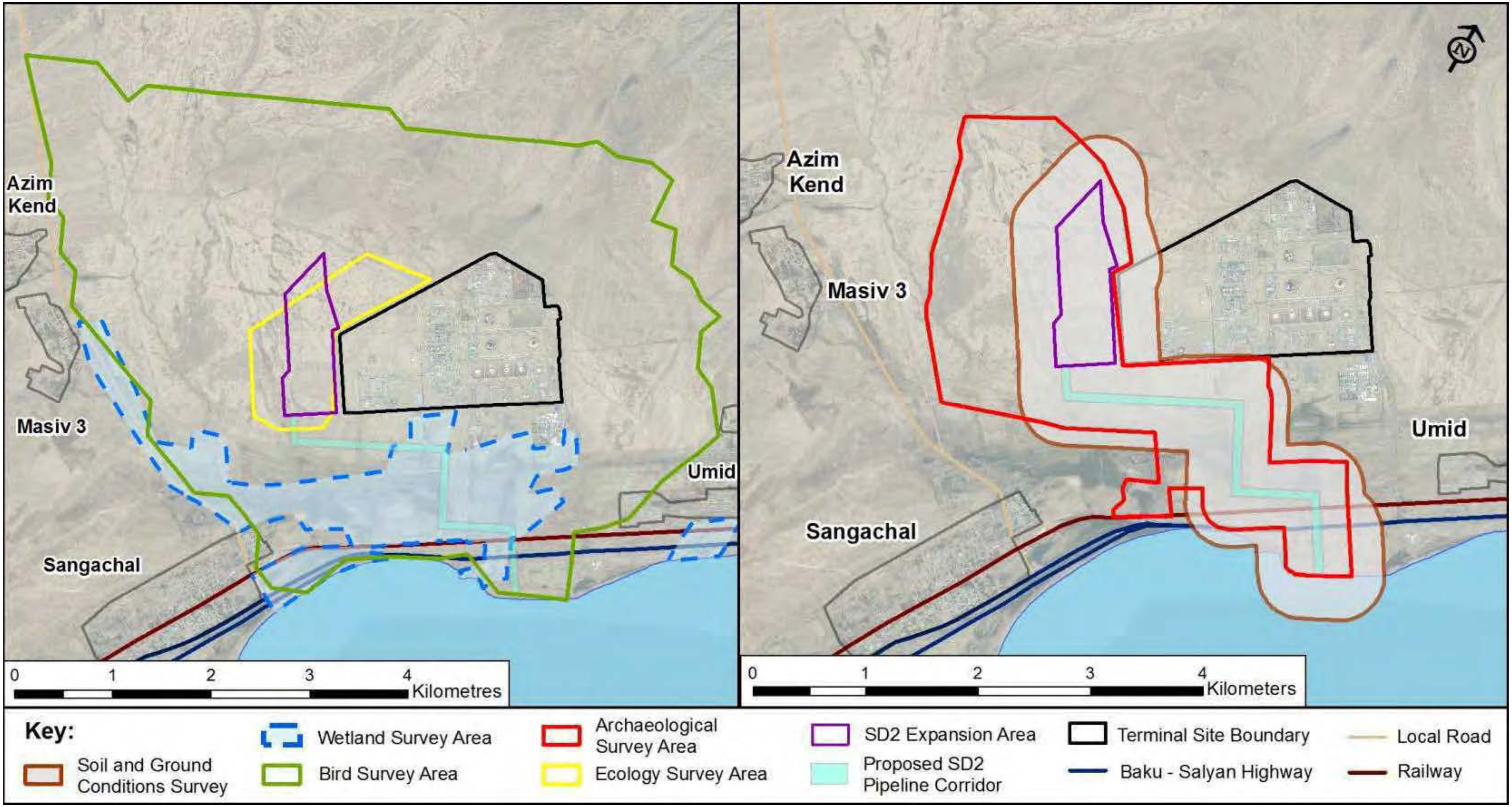
SD2 Project ESIA Consultation



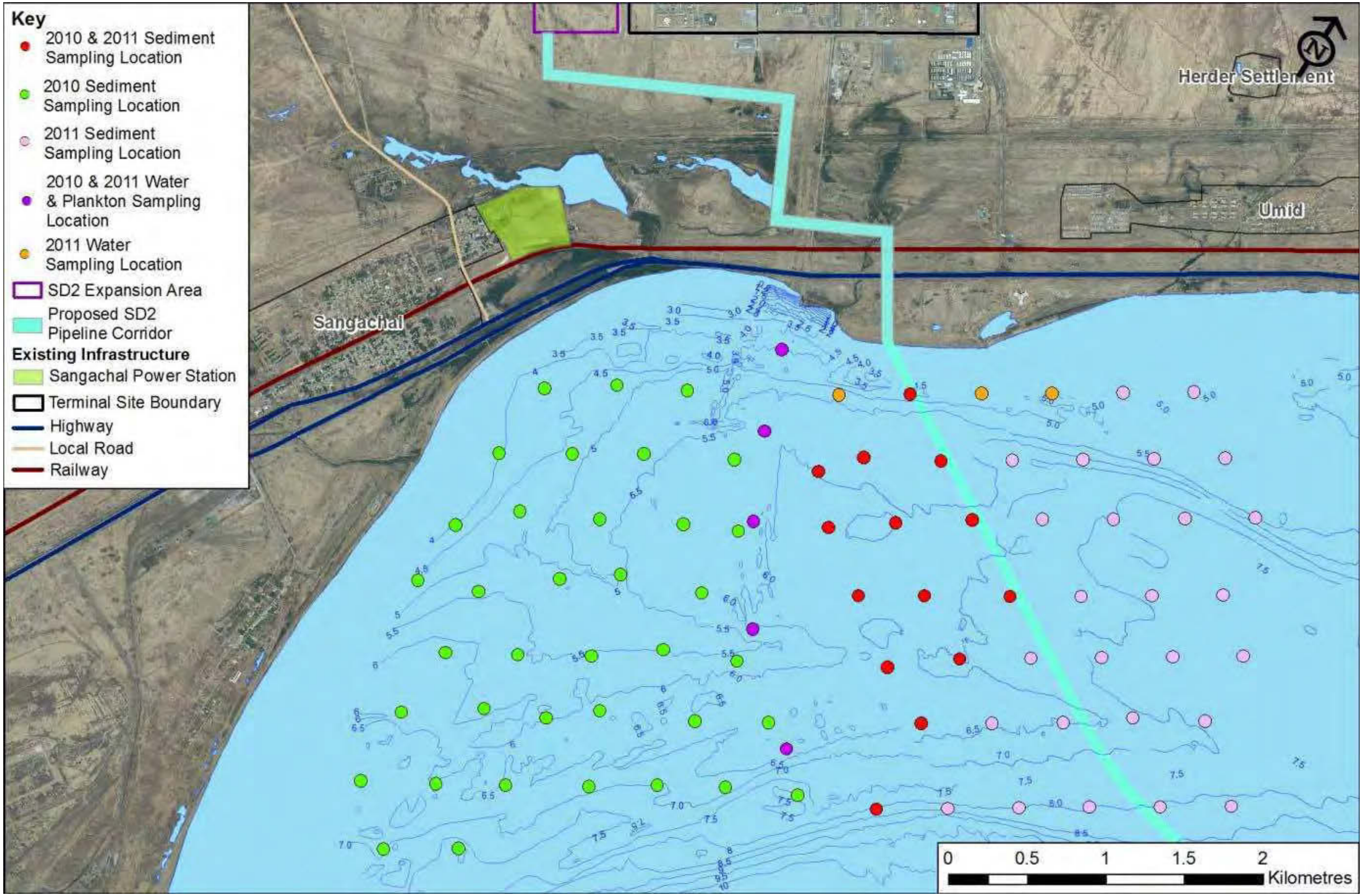
SD2 ESIA Process Onshore Baseline
Air Quality, Dust, Odour and Noise



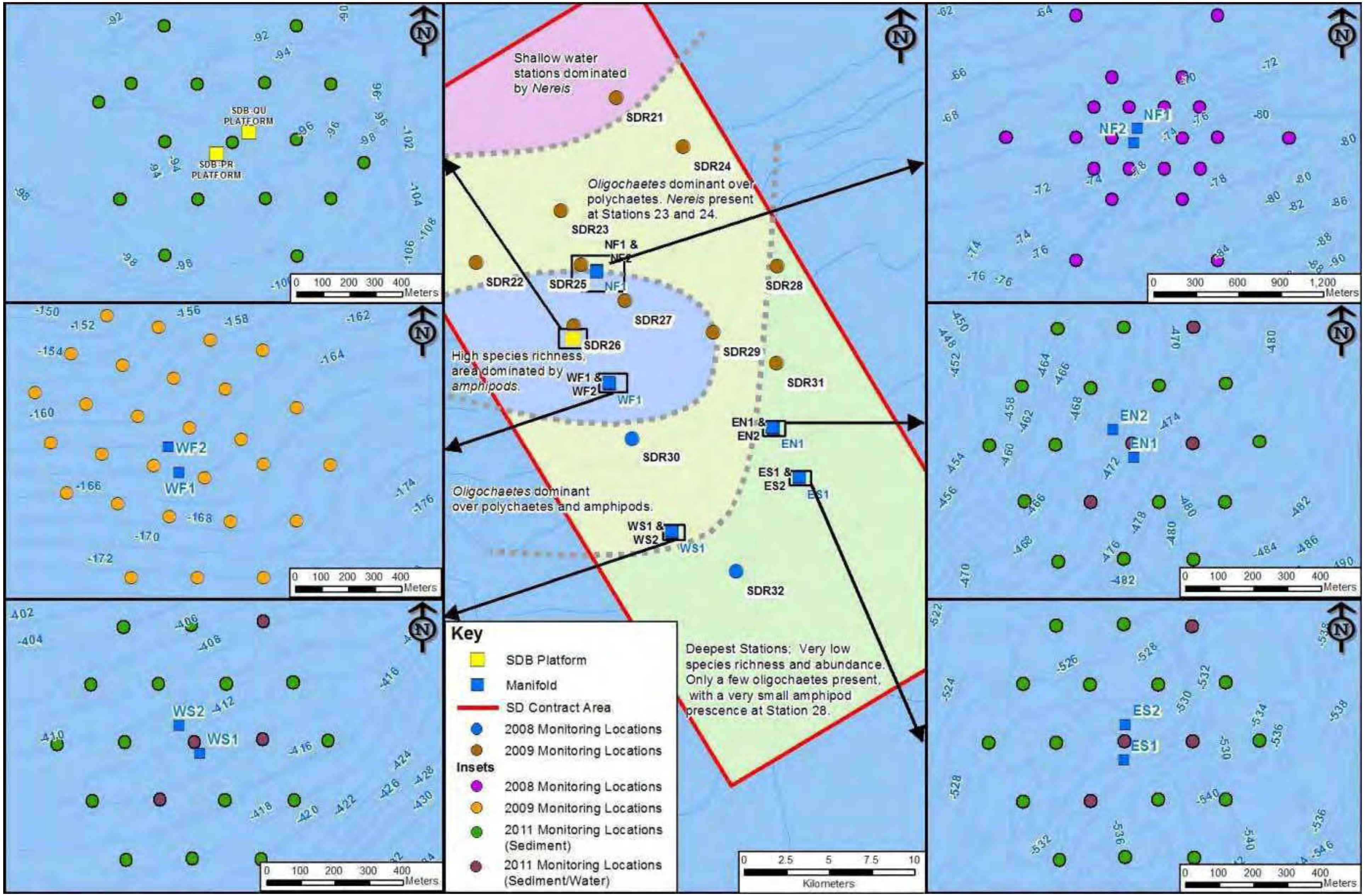
SD2 ESIA Process Onshore Baseline Survey Areas



SD2 ESIA Process Nearshore Baseline



SD2 ESIA Process Offshore Baseline



SD2 ESIA Assessment Process

- Consideration and assessment of potential environmental and social aspects and impacts has supported the Shah Deniz 2 Project design and decision making process

- Reviews of design options and construction plans have been undertaken to identify and assess environmental and social issues and have involved:

  - Modelling work
  - Laboratory studies
  - Monitoring and historic data collection and analysis:
    - Provided from BP arranged surveys and on-going monitoring work
    - Surveys/data provided by national institutes

Onshore decisions

- New road route to the terminal
- Tank containment design
- GHG reduction initiatives
- Onshore flare selection
- Surface water management at the terminal
- Drainage layout and treatment process
- Onshore terminal design/layout to reduce plant noise

Offshore & cross project decisions

- Flare selection offshore
- Power generator selection
- Offshore sewage plant selection
- Recruitment and employment relationship management
- Waste management

SD2 Project ESIA GHG Reductions

Project	Options Adopted	GHG Emissions Reduction	
		(tonnes/LoF)[1,2]	(average tonnes/year)
SD2 Offshore	Onshore Compression vs Offshore Compression[3] Options Selected: Onshore Compression	67,000	2,913
	Flare vs vent Option Selected: Flare	1,267,985	55,130
	Solar Titan 130 Type Generators vs RB211 Type Generators Option Selected: Solar Titan 130 Type Generators	100,475	4,368
	Offshore Power Generation vs Power from Shore[4] Option Selected: Offshore Power Generation	-67,727	-2,944
SD2 Onshore	Direct Drive Gas Turbines (GTs) for compression vs electric drives Option Selected: Direct Drive GTs	173,939	7,563
	Waste Heat Recovery Units (WHRU) on compression GTs vs hot oil heaters Option Selected: WHRU on compression GTs	1,584,729	68,901
	Flare Gas Recovery (FGR) vs no FGR Option Selected: FGR	130,729	5,683
	Total GHG Emissions Reduction:	**3,257,130**	**141,614**

- Annual GHG saving is approximately equivalent to **0.13%** of the forecast Azerbaijani GHG emissions for the year 2020*.
- LoF GHG savings equate to project saving of 21% over LoF.

* 2020 emissions estimated within First National Communication of Azerbaijan on Climate Change, May 23, 2000

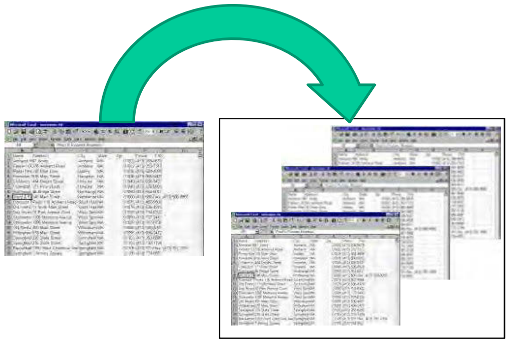
Environmental and Social Management and Monitoring Process

SD2 ESIA Commitments

Construction and commissioning

Operations Phase

Incorporated Into Existing Environmental Management System



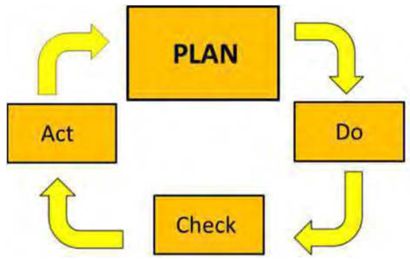
Detailed Design and Procurement

Equipment Specifications and Operational Procedures

Construction and Commissioning

Environmental and Social Management Systems / Plans, Registers and Procedures

Contract Clauses



SD2 ESIA – Feedback

- Feedback and grievances should be raised with BP
- BP will address any outstanding issues raised through feedback in the final ESIA
- All comments must be submitted by the 23 August, 2013
- Feedback to be sent to:

BP Azerbaijan
1033 Izmir st.
Hyatt Tower II
AZ1065 Baku
Azerbaijan

- esiafeedback@bp.com
- Telephone number: +994124979000

SD2 Project ESIA

Community meeting August 2013

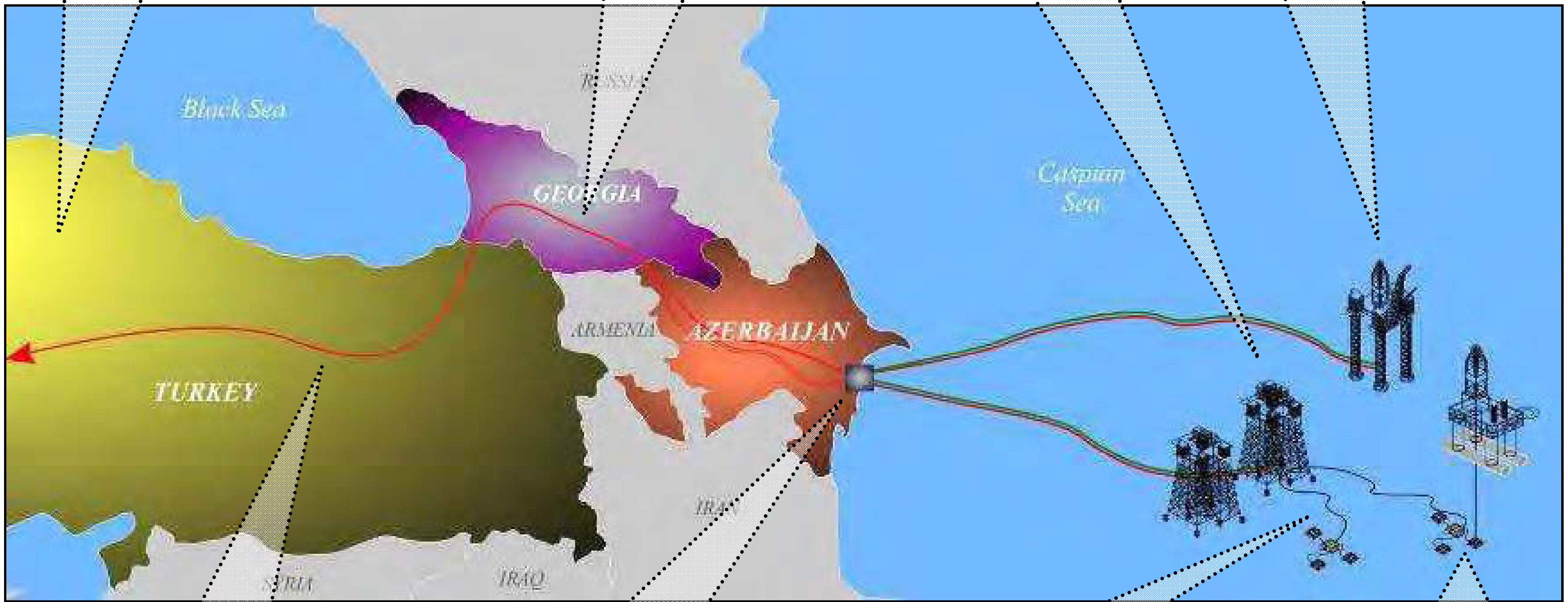
Scope of SD2, SCPx and TANAP

Contracts to sell gas to Turkey and Europe

Expansion of South Caucasus Pipeline to Georgian border with new 56" pipeline

Two new bridge linked platforms provide 16 bcma offshore processing

Existing Stage 1 Platform



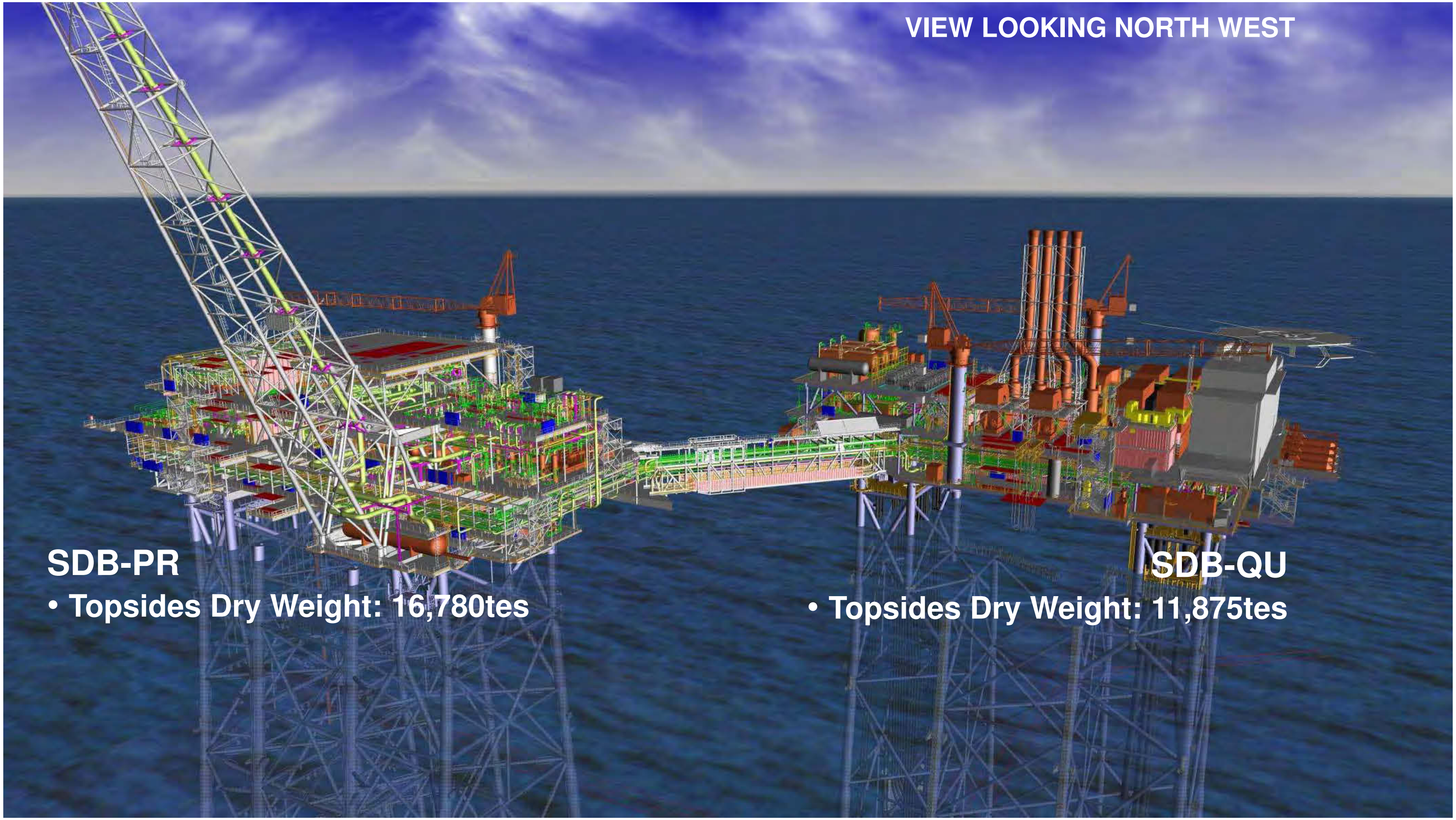
2000km Trans-Anatolian Pipeline across Turkey

New terminal at Sangachal with compressors for Shah Deniz and SCP

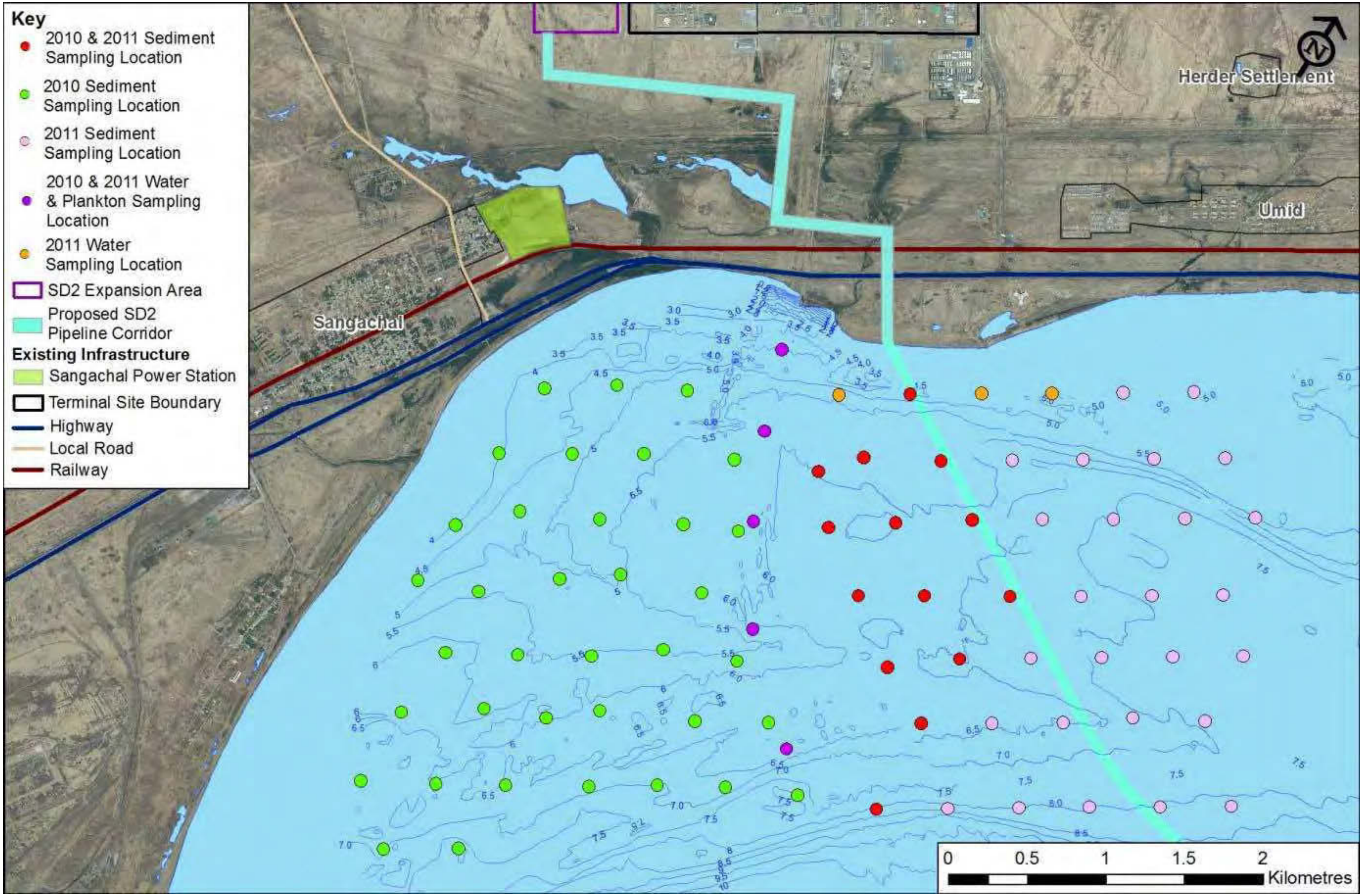
500 km of subsea pipelines and flowlines in up to 550m water depth

26 subsea wells drilled with 2 semi-submersible rigs

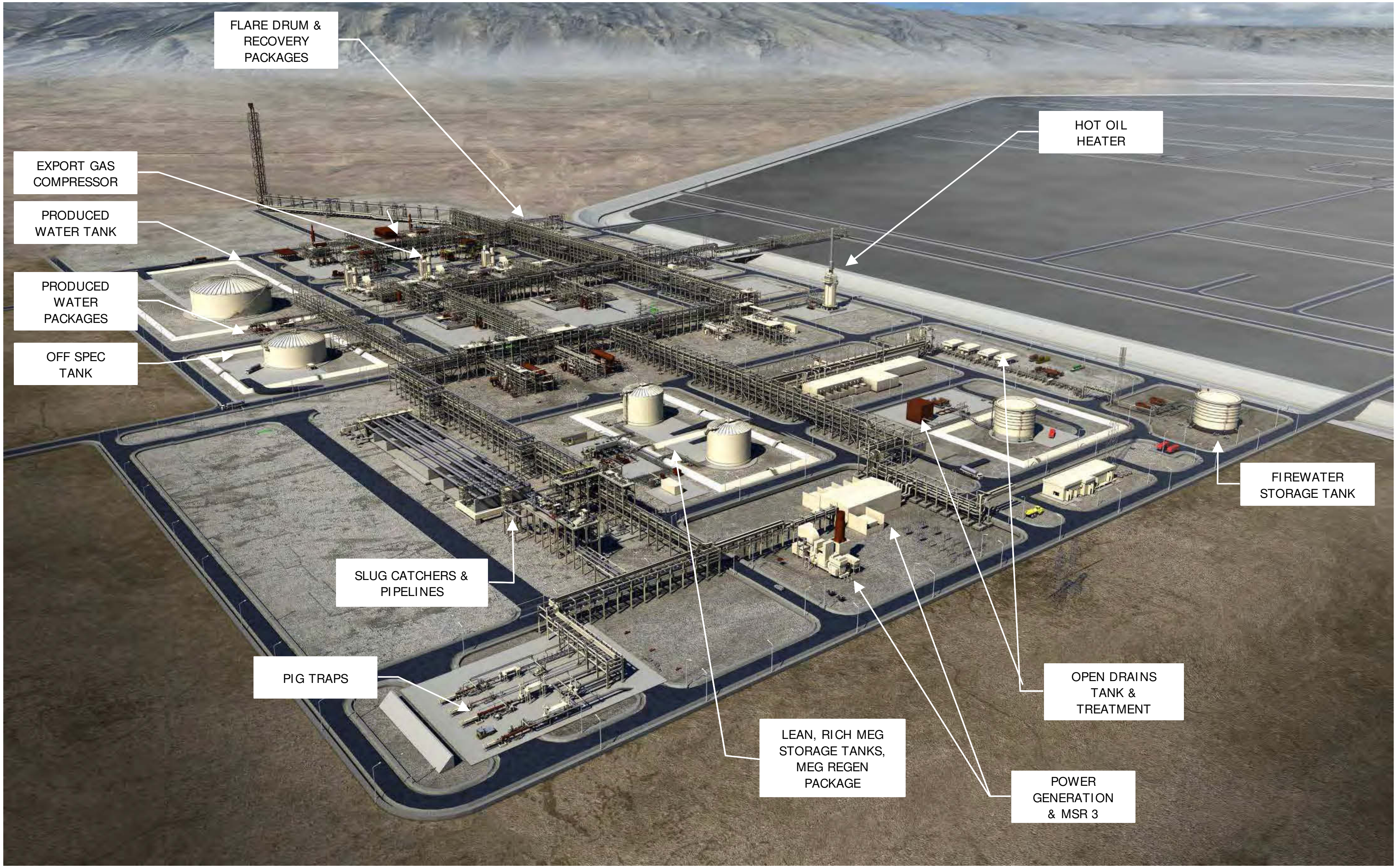
SD2 Project Bravo Platform Complex



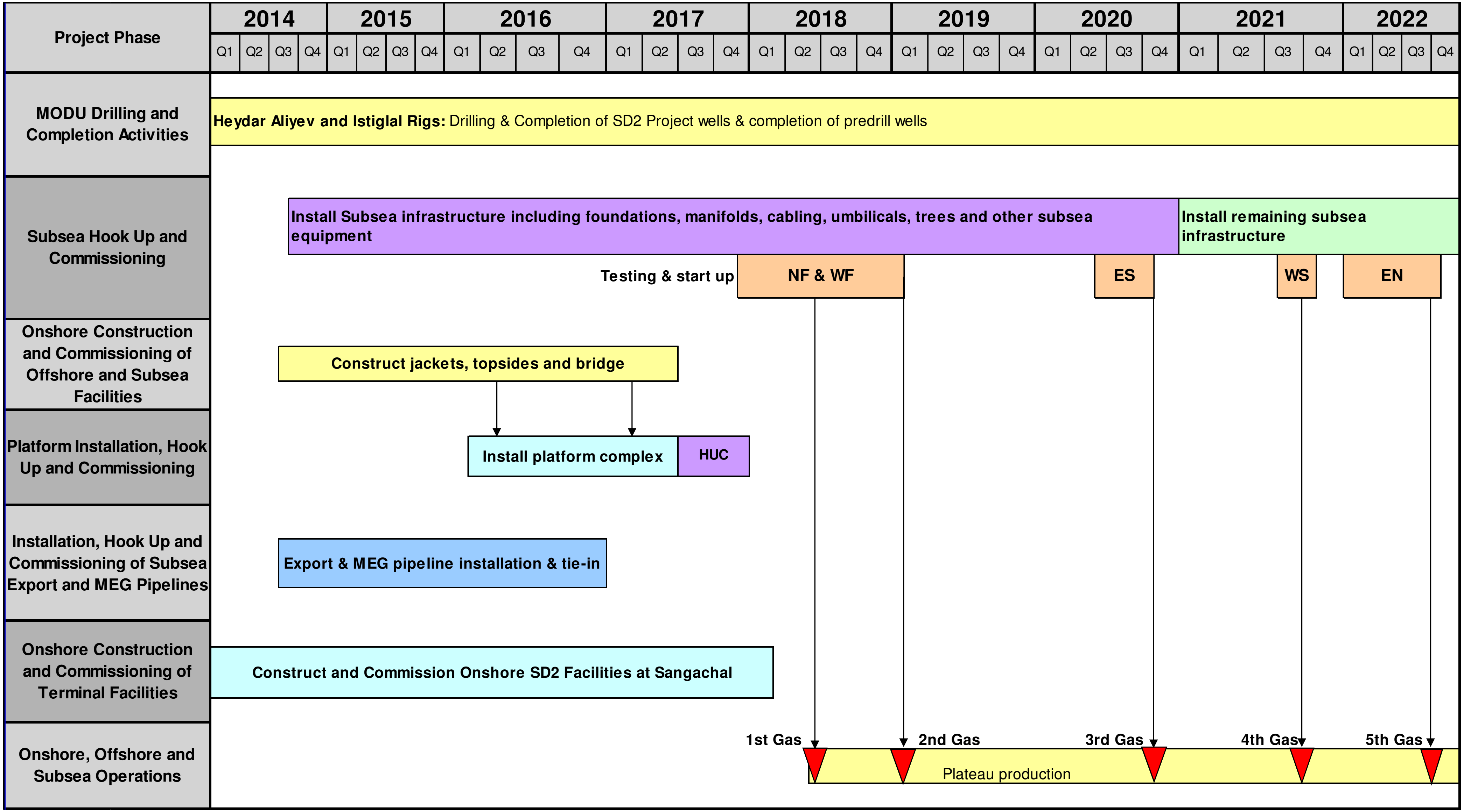
SD2 ESIA Process Nearshore Baseline



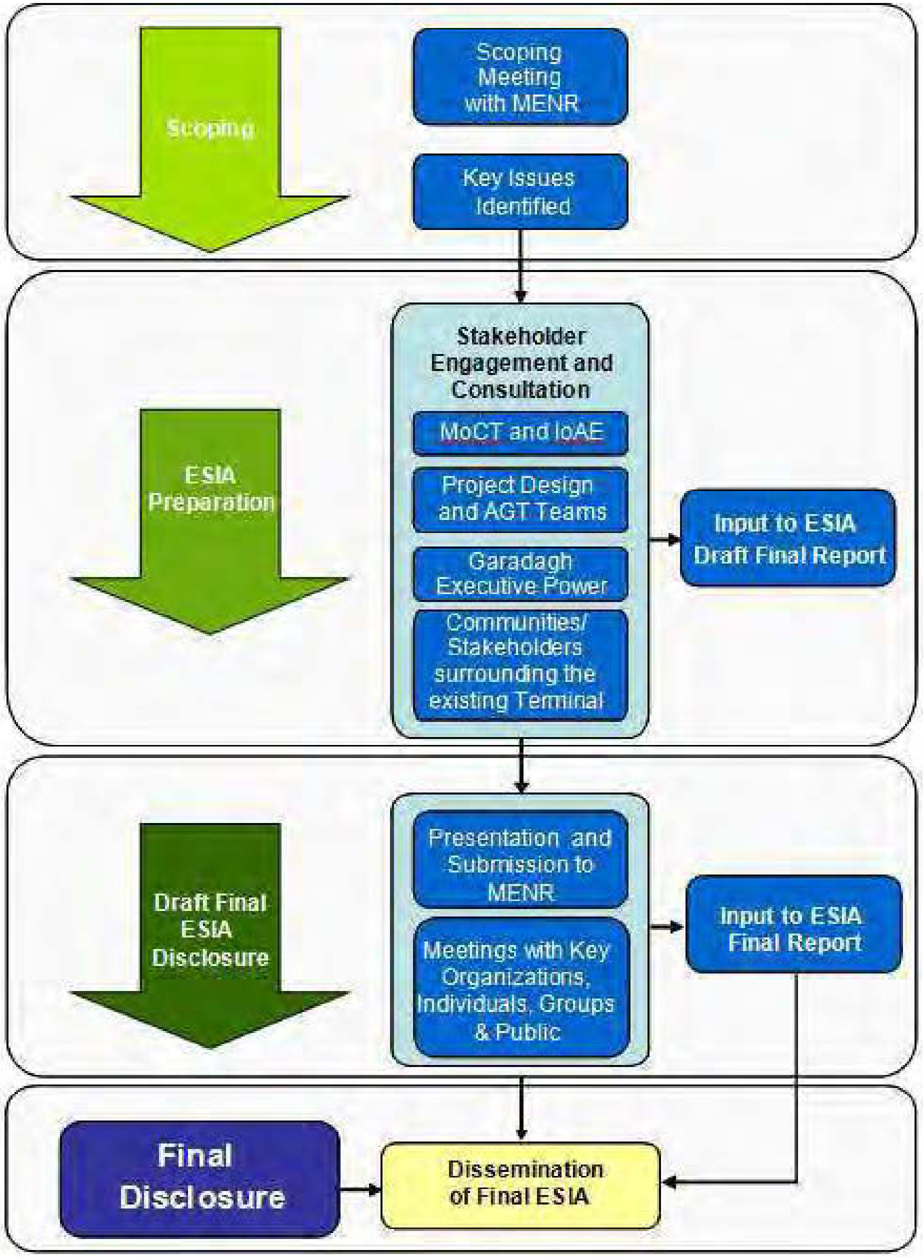
SD2 Project Sangachal Terminal



SD2 Project Indicative Schedule



SD2 Project ESIA Consultation



SD2 ESIA – Feedback

- Feedback and grievances should be raised with BP
- BP will address any outstanding issues raised through feedback in the final ESIA
- All comments must be submitted by the 23 August, 2013
- Feedback to be sent to:

  BP Azerbaijan
  1033 Izmir st.
  Hyatt Tower II
  AZ1065 Baku
  Azerbaijan

- esiafeedback@bp.com
- Telephone number: +994124979000